Chapter 5–Freeway Volumes and Operations

What is in this chapter?

This chapter presents the findings of the SR 520 transportation team's freeway volumes and operations analysis. The transportation team collected data for and analyzed current freeway traffic volumes and operations to understand the different factors that affect SR 520. Once current freeway traffic volumes and operations were characterized, effects of the year 2030 No Build Alternative were compared against existing conditions to determine what freeway traffic volumes and operations would be like in the year 2030 without the Medina to SR 202: Eastside Transit and HOV Project. The team then compared the year 2030 Build Alternative to the year 2030 No Build Alternative to determine its relative effects.

Although the Medina to SR 202: Eastside Transit and HOV Project includes improvements only on the SR 520 corridor between Medina and SR 202 near Redmond, the transportation study area extended beyond project construction boundaries onto I-5 and I-405 to account for traffic interactions between the freeways.

How does SR 520 operate today?

The existing configuration of SR 520 does not meet current WSDOT design guidelines and reduces 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 108th Avenue NE, Bellevue Way NE, and 84th Avenue NE on-ramps
- Poor sight distance at roadway curves resulting in slower speeds

The high traffic volumes on SR 520 affect traffic trying to access areas east of Lake Washington and result in regular congestion westbound approaching the SR 520 bridge (near the HOV lane termination in Medina) and eastbound approaching the bridge's west highrise. Several

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

Traffic operations on SR 520 east of Lake Washington are affected by the outside HOV lanes, especially westbound between 108th Avenue NE and Evergreen Point Road. Throughout this section, the HOV lane is on the outside with narrow shoulders and many "skip stripe" sections. Near the interchanges, "skip stripe" sections are where general-purpose drivers can travel in the HOV lane for short distances until they can merge in the general-purpose lanes. However, because the general-purpose lanes often operate under congested stop-and-go conditions, drivers are forced to stop in the HOV lane as they wait for a gap in the general-purpose lane traffic. This forces drivers in the HOV lane to travel at slower speeds and creates safety issues.

For eastbound travelers, there is no eastbound HOV lane between Evergreen Point Road and NE 124th Avenue NE. HOV traffic must travel in general-purpose lanes. The outside HOV lane operates well on SR 520 east of NE 124th Avenue because this section of roadway has wider lanes and shoulders and experiences little to moderate congestion. During the afternoon peak period, HOV lane operations near the Northeast 51st Street interchange can be affected by congestion extending back from the termination of SR 520 at Avondale Road.

Closely spaced on-ramps also affect SR 520 operations east of Lake Washington. Four interchanges (124th Avenue NE, SR 520/I-405, 108th Avenue NE, and Bellevue Way NE) all occur in a 1-1/2 mile stretch of roadway. WSDOT's current guideline specifies that interchanges be spaced 1 mile apart. The proximity of these on- and off- ramps results in a high amount of weaving activity in a short distance (especially west of I-405) as vehicles enter and exit the highway. With the outside HOV lane, this weaving degrades HOV lane operations.

Westbound, near the eastern shore of Lake Washington, traffic has difficulty merging onto SR 520 from 84th Avenue NE. The on-ramp at this interchange has a short acceleration distance to the SR 520 mainline. The stop bar for the ramp meter is only 150 feet away from the freeway, which does not allow vehicles enough time to reach

freeway speeds before merging. Because of the short acceleration length, drivers enter the SR 520 mainline at speeds below 50 mph.

During the peak periods, westbound general-purpose traffic on the mainline is generally moving at 30 mph, so general-purpose traffic merging from the 84th Avenue NE on-ramp may also travel at 30 mph through the skip stripe section, causing some congestion in the HOV lane.

Just after the 84th Avenue NE merge onto SR 520, the westbound HOV lane terminates near the merge from the Evergreen Point Freeway Station, which also has a short (460-foot) merge into the mainline. With this short merge lane, westbound buses cannot get up to speed and typically merge into the general-purpose lanes at speeds of approximately 35 mph, which affects general-purpose lane speeds.

The eastbound outside HOV lane, which begins near 124th Avenue NE, experiences similar issues as general-purpose drivers cross the HOV lane to reach the general-purpose lanes.

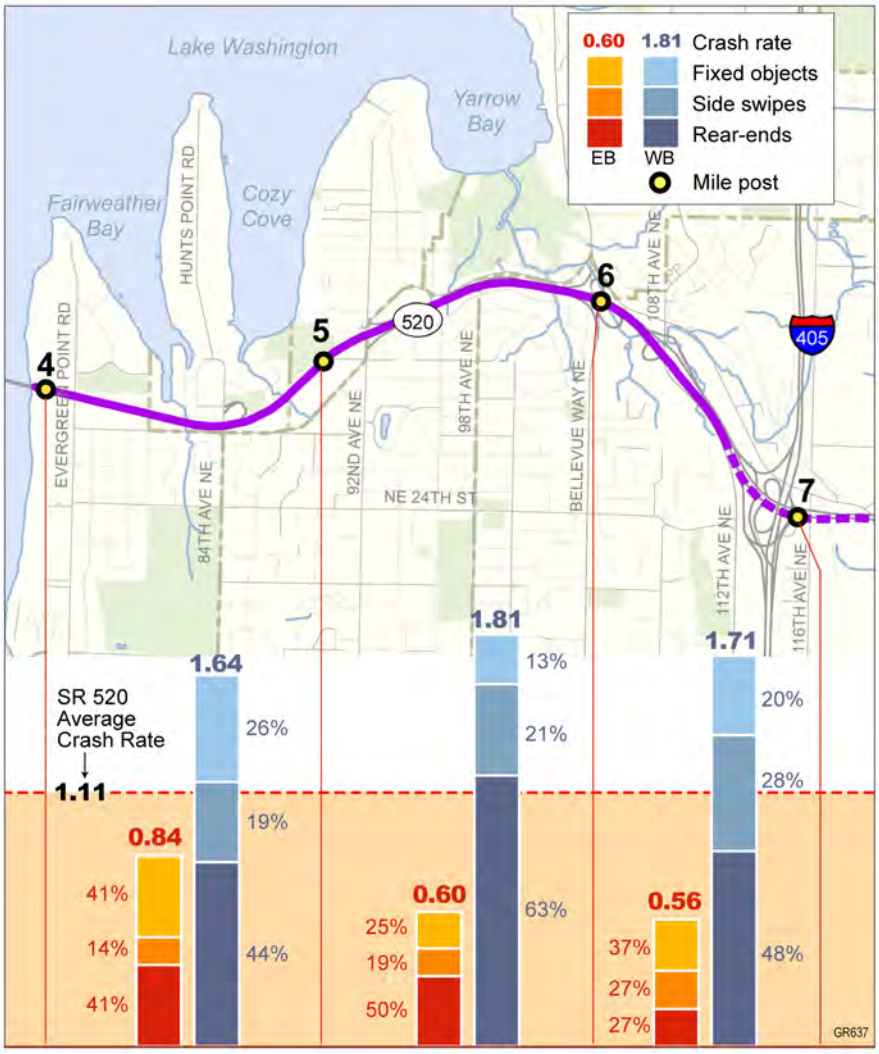
Eastbound traffic also experience congestion at the end of the corridor between the termination of SR 520 at Avondale and the West Lake Sammamish Parkway interchange. In the afternoon, SR 520 traffic volumes exceed what the signal at the SR 520 terminus/Avondale Road/Northeast Union Hill intersection can serve, causing traffic to back up onto the SR 520 mainline.

How has safety been addressed by the project?

Crash Rates in the Study Area

The transportation discipline team evaluated historical crash data for the SR 520 corridor to identify safety concerns along the mainline and ramps. Crash data were obtained from WSDOT for the most recent three full years of data collection (January 2006 through December 2008). These data provide the frequency, severity, and type of crashes along the SR 520 corridor between Medina and I-405 during that time. This study area was selected because it represents where construction will occur for the Medina to SR 202: Eastside Transit and HOV Project.

Exhibit 5-1 shows east and westbound crash rates along the SR 520 mainline between Medina and I-405. There is an average of 1.11 crashes per million vehicle miles traveled (mvmt) for the entire SR 520 corridor. All sections of westbound SR 520 have crash rates higher than the SR 520 corridor average crash rate. The highest crash rate occurs westbound between the 92nd Avenue NE and Bellevue Way NE interchanges (milepost 5.00 to 5.99). This is likely due to the horizontal curve that limits sight distance along this section, indicated by a higher-than-average number of rear-end collisions in the inside lane.



Source: SR 520 Crash Data (January 2006 through December 2008) (WSDOT)
Note: All crash rates are listed in crashes/mvmt.

Exhibit 5-1. Safety Crash Data

Types of Crashes in the Study Area

SR 520 Corridor

The majority of the mainline crashes were congestion-related, typically rear-end and sideswipe incidents. On the eastbound mainline, rear-end and sideswipe crashes represented 39 and 18 percent, respectively, of the total. On the westbound mainline, rear-end and sideswipe crashes represented 54 and 23 percent, respectively, of the total.

There are several design conditions that could have contributed to the high occurrence of congestion-related crashes during this period. These conditions, which do not meet current design guidelines, include:

- Mainline
  - Short ramp merge/diverge areas
  - Narrow shoulder widths
  - Short horizontal sight distance
- Ramps
  - Ramp merge/diverge areas
  - Ramp grades
  - Short acceleration/deceleration lengths and tapers

Vehicles hitting fixed objects also made up a relatively high percentage of the total crashes, especially in the eastbound direction and on the ramps. Fixed-object collisions represented 35 percent of the total eastbound mainline crashes and 60 percent of the eastbound ramp crashes.

Fixed-object crashes can result from drivers losing control because of roadway conditions or excessive speed, the close proximity of roadside barriers to moving traffic, and the avoidance of other traffic. Roadside barriers help to avert more serious crashes and injuries. The existing roadside barriers are very close to the travel lanes due to the limited cross-sectional width on the SR 520 corridor.

The following conditions could contribute to the occurrence of fixed-object crashes along the SR 520 corridor:

- Mainline
  - Narrow shoulders
  - Proximity of barriers to roadway

- Ramps
  - Roadway design
  - Pavement condition

SR 520 Ramps

The team also reviewed crash data for Eastside interchange ramps along the SR 520 corridor. Only two of the ramps had a substantial number of crashes over the 3-year reporting period to report. These are discussed below.

SR 520 EB On-Ramp from 108th Avenue NE

The majority of fixed-object crashes (80 percent) occurred in the curve at the merge end of the ramp. Possible contributing circumstances for these collisions are roadway design (i.e., superelevation, shoulder width, etc.), pavement condition, and/or driver inattention.

SR 520 WB off-ramp to 108th Avenue NE

A reported 90 percent of the collisions on this ramp occurred toward the intersection, indicating the crashes were intersection-related. Possible contributing circumstances include congestion, inadequate signing, and/or driver inattention.

How Facility Design Features Can Improve Safety

SR 520 crashes are attributed to traffic congestion and a roadway design that does not meet current design guidelines. This project will improve the roadway with wider shoulders, longer merge distances, and inside HOV lanes. The project will also improve ramps in the SR 520 project area, bringing the design up to current design guidelines and helping to alleviate current safety issues along the SR 520 mainline and ramps. The proposed design will allow smoother transitions for vehicles to change lanes, merge onto, and exit from the freeway.

Adding a direct-access high-occupancy vehicle (HOV) lane from 108th Avenue NE will reduce potential conflicts at this interchange because HOV traffic will no longer need to make multiple lane changes to exit and access the HOV lane.

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

Between today and the year 2030, the region's population will grow by 1.1. million people, add over 850,000 new jobs, and need to accommodate close to 50 percent more traffic (PSRC 2007). Projected

population and employment growth for select Seattle and Eastside areas are shown in Exhibit 5-2. 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 the lake. 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, and downtown Bellevue.

How would crosslake travel change?

Daily Travel

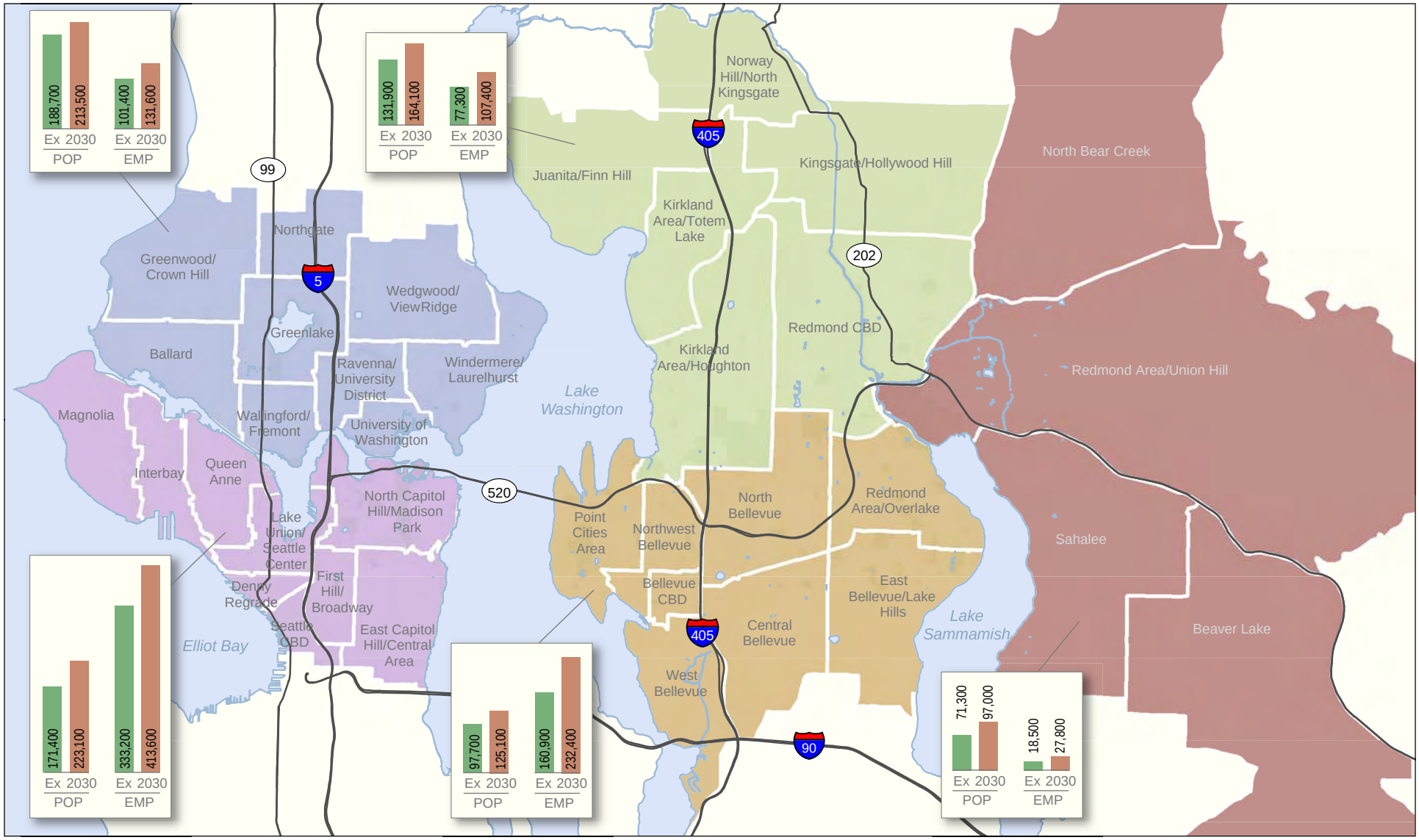
With the forecasted increases in population and employment, traffic volumes would also increase on major transportation facilities. Exhibit 5-3 shows the forecasted changes in daily vehicle demand volumes on SR 522, SR 520, and I-90 for the No Build and Build Alternatives. Person demand at all cross-lake roadways would increase substantially more than vehicle demand, indicating a growth in HOV travel (carpools and buses). With the Build Alternative, daily vehicle demand on SR 520, SR 522, and I-90 would be similar to the No Build Alternative.

Peak Period Travel

Similar to the daily volumes, peak period traffic volumes on SR 520 with the Build Alternative would be similar to the No Build Alternative. The Medina to SR 520: Eastside Transit and HOV Project would not substantially affect traffic volumes on SR 520, I-5, or I-405 because it would not add any general-purpose capacity. Exhibits 5-4 and 5-5 show the changes in traffic demand and throughput at key locations on SR 520, I-5, and I-405 during the morning and afternoon commute periods.

While more people would like to use the roadways in 2030 (represented by demand volumes), congestion would limit how much traffic could be served (throughput) during the peak periods. Year 2030 peak period throughput would not be substantially different than it is today.

I-405 is forecasted to experience the most growth in traffic volumes between now and the year 2030 because of increases in population and employment along the I-405 corridor. Congestion on the I-405 mainline would affect SR 520 traffic operations in the future.



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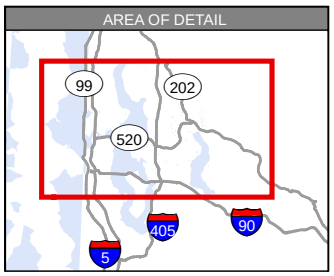
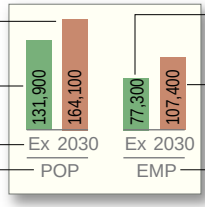


Forecasted Population by 2030
Existing Population
Existing (2006) / 2030 Population
Existing Employed Population
Forecasted Employed Population by 2030
Employment



N

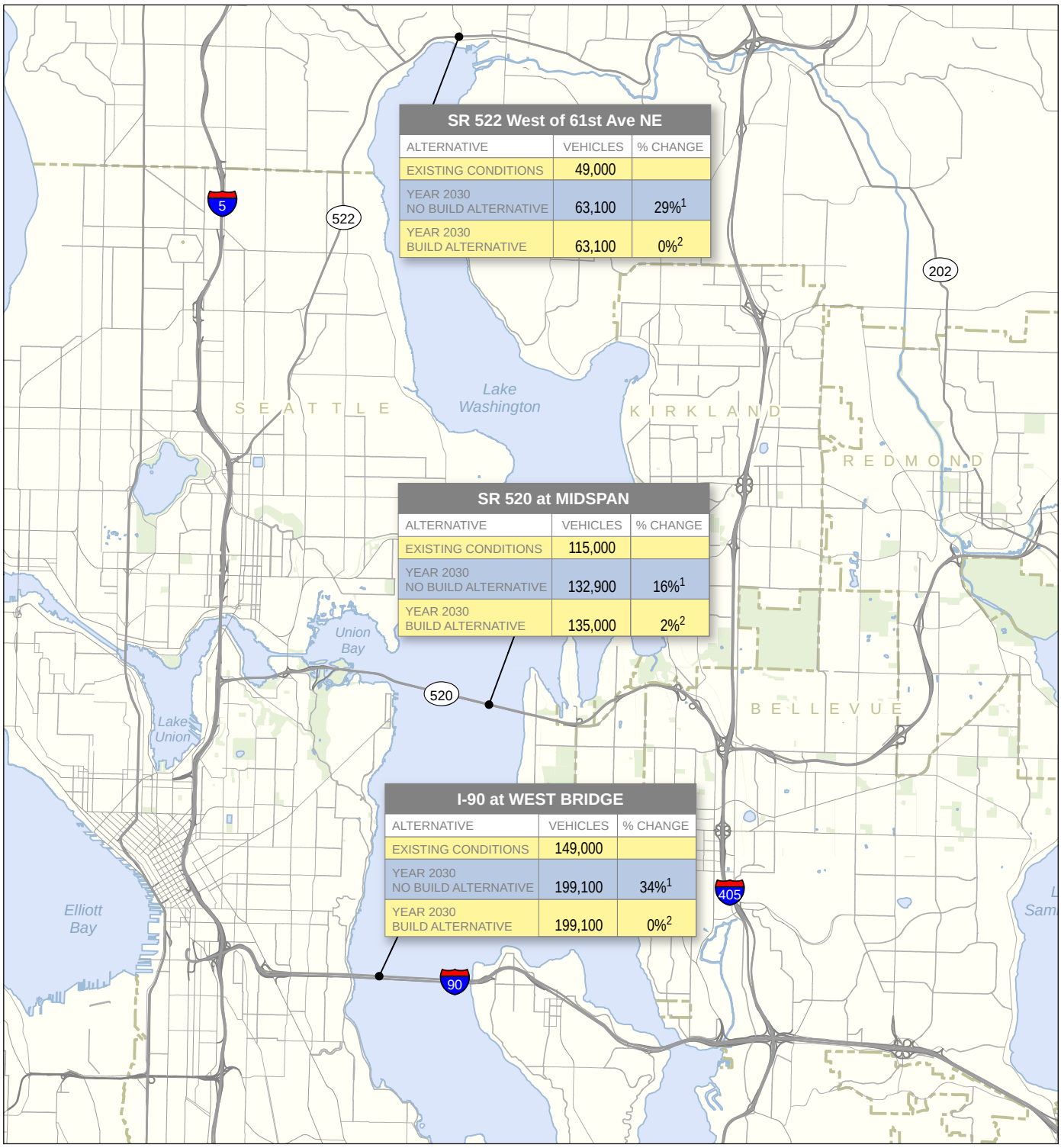
0 1 2 4 Miles

Source: WSDOT (2005, 2007, 2008d) 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**

Medina to SR 202: Eastside Transit and HOV Project



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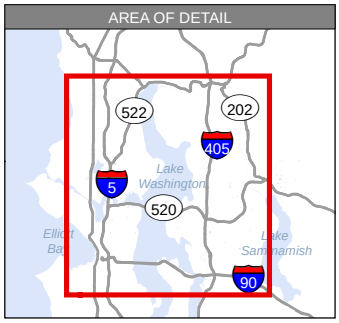

[1]Compared to Existing Conditions
[2]Compared to Year 2030 No Build Alternative

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

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0 1 2 Miles

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

Medina to SR 202: Eastside Transit and HOV Project

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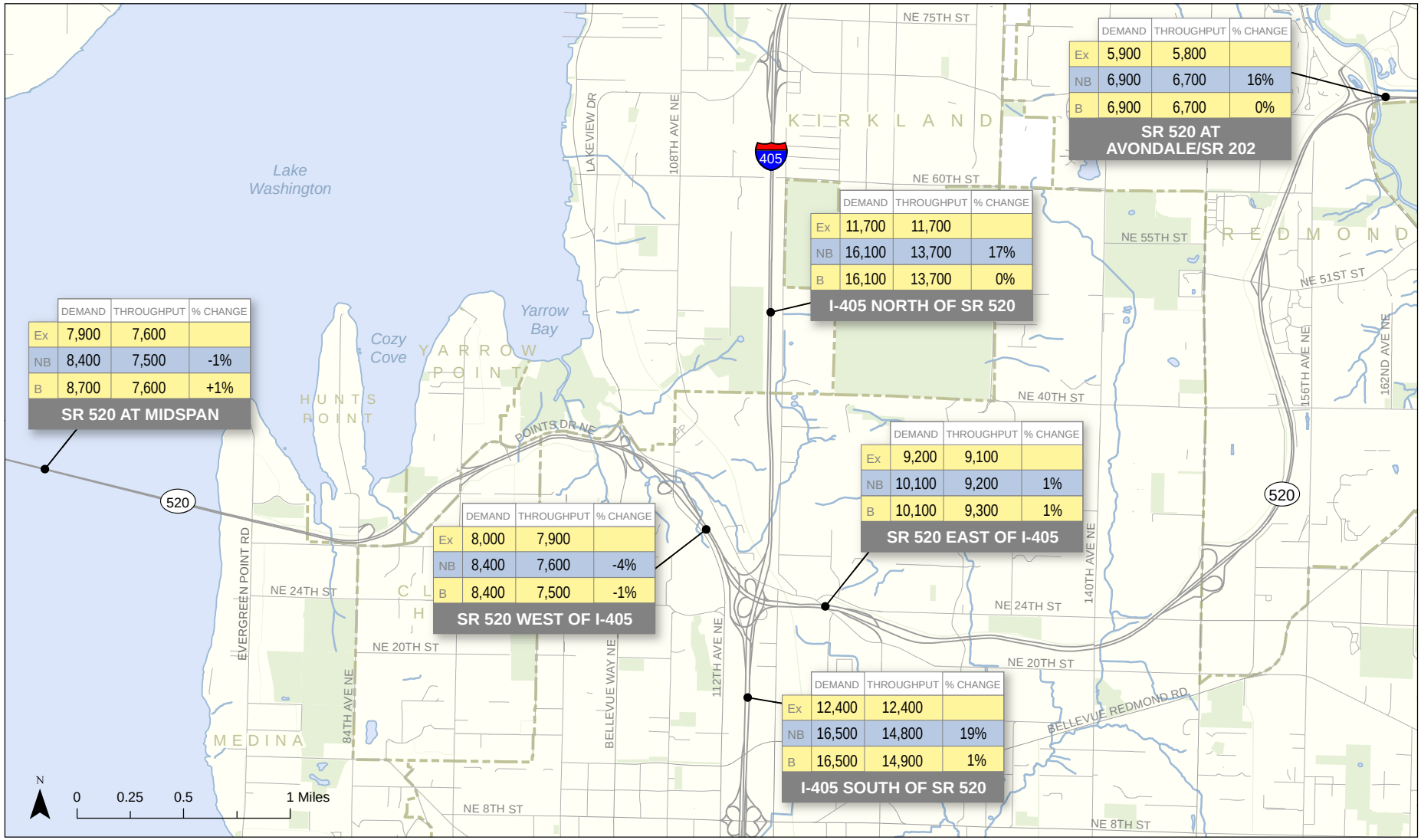


	DEMAND	THROUGHPUT	% CHANGE
Ex	7,900	7,600	
NB	8,400	7,500	-1%
B	8,700	7,600	+1%

SR 520 AT MIDSPAN

	DEMAND	THROUGHPUT	% CHANGE
Ex	5,900	5,800	
NB	6,900	6,700	16%
B	6,900	6,700	0%

SR 520 AT AVONDALE/SR 202

	DEMAND	THROUGHPUT	% CHANGE
Ex	11,700	11,700	
NB	16,100	13,700	17%
B	16,100	13,700	0%

I-405 NORTH OF SR 520

	DEMAND	THROUGHPUT	% CHANGE
Ex	9,200	9,100	
NB	10,100	9,200	1%
B	10,100	9,300	1%

SR 520 EAST OF I-405

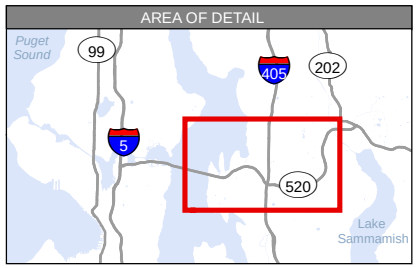
	DEMAND	THROUGHPUT	% CHANGE
Ex	8,000	7,900	
NB	8,400	7,600	-4%
B	8,400	7,500	-1%

SR 520 WEST OF I-405

	DEMAND	THROUGHPUT	% CHANGE
Ex	12,400	12,400	
NB	16,500	14,800	19%
B	16,500	14,900	1%

I-405 SOUTH OF SR 520

AREA OF DETAIL



Vehicles Per Hour

Alternative		DEMAND	THROUGHPUT	% CHANGE	
Existing	Ex	13,300	13,210		
No Build	NB	15,090	12,740	-4%	± Change % vs. Existing (Throughput)
Build	B	15,170	12,660	-1%	± Change % vs. No Build (Throughput)

LOCATION

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 5-4. **A.M. Peak Period Freeway Vehicle Volumes**

Medina to SR 202: Eastside Transit and HOV Project

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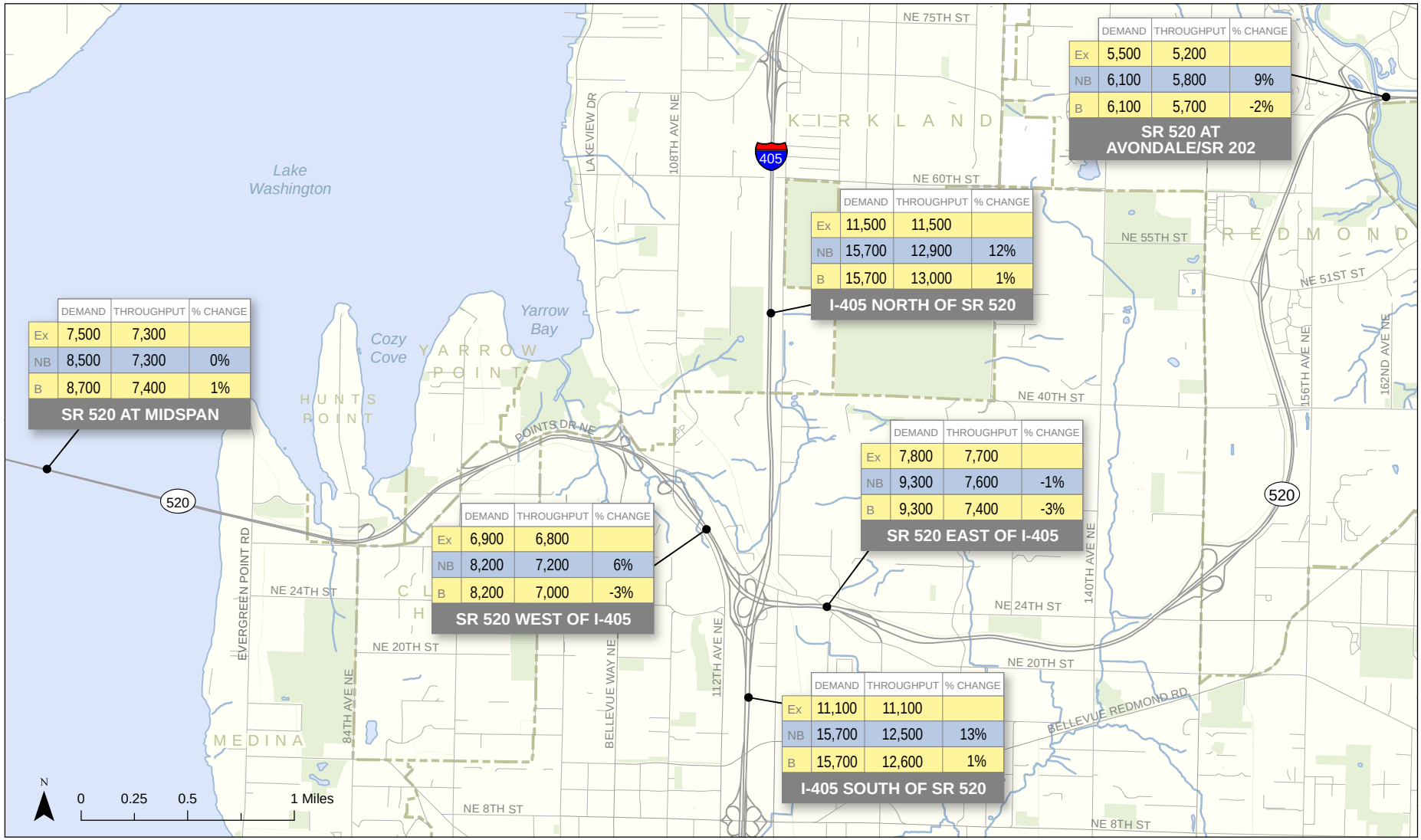


	DEMAND	THROUGHPUT	% CHANGE
Ex	7,500	7,300	
NB	8,500	7,300	0%
B	8,700	7,400	1%

SR 520 AT MIDSPAN

	DEMAND	THROUGHPUT	% CHANGE
Ex	5,500	5,200	
NB	6,100	5,800	9%
B	6,100	5,700	-2%

SR 520 AT AVONDALE/SR 202

	DEMAND	THROUGHPUT	% CHANGE
Ex	11,500	11,500	
NB	15,700	12,900	12%
B	15,700	13,000	1%

I-405 NORTH OF SR 520

	DEMAND	THROUGHPUT	% CHANGE
Ex	6,900	6,800	
NB	8,200	7,200	6%
B	8,200	7,000	-3%

SR 520 WEST OF I-405

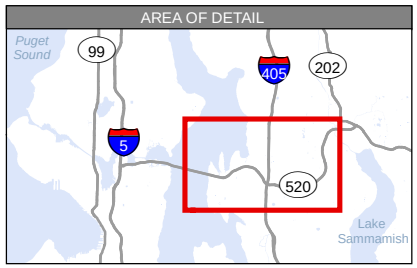
	DEMAND	THROUGHPUT	% CHANGE
Ex	7,800	7,700	
NB	9,300	7,600	-1%
B	9,300	7,400	-3%

SR 520 EAST OF I-405

	DEMAND	THROUGHPUT	% CHANGE
Ex	11,100	11,100	
NB	15,700	12,500	13%
B	15,700	12,600	1%

I-405 SOUTH OF SR 520

AREA OF DETAIL



Vehicles Per Hour

Alternative		DEMAND	THROUGHPUT	% CHANGE	
Existing	Ex	13,300	13,210		
No Build	NB	15,090	12,740	-4%	± Change % vs. Existing (Throughput)
Build	B	15,170	12,660	-1%	± Change % vs. No Build (Throughput)

LOCATION

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 5-5. **P.M. Peak Period Freeway Vehicle Volumes**

Medina to SR 202: Eastside Transit and HOV Project

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With the Build Alternative, the SR 520 corridor would have a continuous inside-lane HOV system and many of the existing design constraints along the corridor would be improved. These improvements would include:

- Improvement in SR 520 bus and carpool travel time reliability between SR 202 and Medina
- Improvements in general-purpose lane operations
- Improvements in safety along the SR 520 corridor

With these improvements, both west and eastbound HOV traffic would experience less congestion under the Build Alternative than under the No Build Alternative.

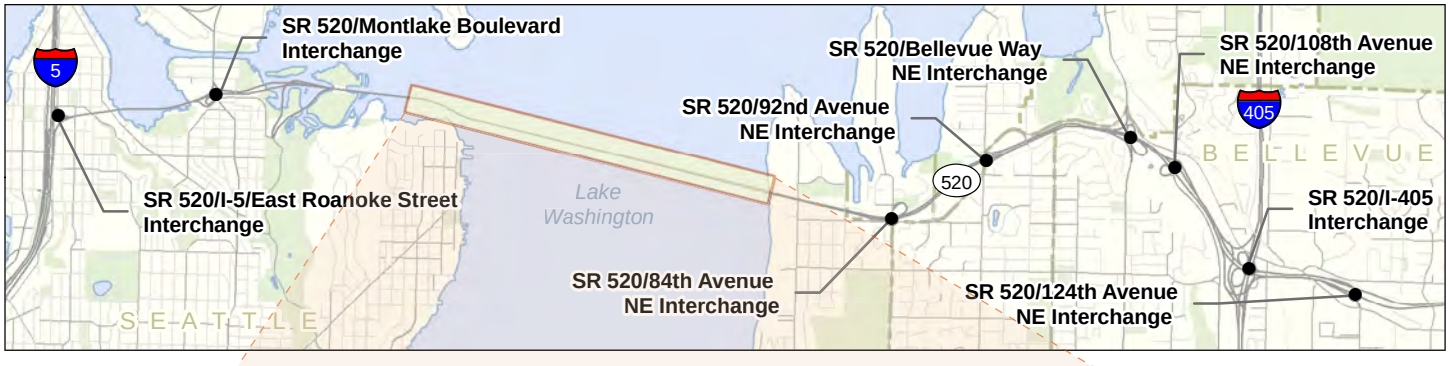
Exhibit 5-6 shows the volumes and mode share for each direction and peak period on SR 520. Freeway volumes and operations specifically for each direction of SR 520 and peak period are discussed below.

Vehicle and person mode share would be similar for the No Build and Build Alternatives and not substantively different than today. Mode share is expected to remain the same with the Medina to SR 202: Eastside Transit and HOV Project because a large part of the HOV facility already exists and the project would only improve those facilities, not add new HOV lanes. Additionally, by the year 2030, it was assumed that the HOV occupancy would increase to 3+ for the entire SR 520 corridor in order to maintain HOV lane operations.

The addition of a new HOV lane between Medina and 124th Avenue NE is critical for providing travel time reliability for carpools and buses, which influences people's decision to use transit or carpools. This section does not substantially increase the HOV capacity of the corridor.

How would westbound SR 520 operate during the morning commute?

As discussed earlier, westbound drivers typically experience congestion between the east bridge approach and Bellevue Way NE during the morning commute. This congestion would remain in the year 2030 under both the No Build and Build Alternatives, although it would be slightly less with the project. The greatest improvement from the project is the reliability provided for carpools and buses by relocating



Bridge Midspan: Volume Trips per Hour

Westbound Demand | Eastbound Demand | Westbound Throughput | Eastbound Throughput

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

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 5-6. **Peak Period SR 520 Cross Lake Volume Trips**

Medina to SR 202: Eastside Transit and HOV Project

the HOV lane to the inside and continuing it through the SR 520/I-405 interchange.

Volumes

As shown in Exhibit 5-7, person demand would increase more (from 7,100 to 7,900 persons per hour) than vehicle demand (from 4,000 to 4,300 vehicles per hour) between now and the year 2030. Because of congestion, throughput with the No Build Alternative would be similar to what it is today. With the project, vehicle and person demand would increase, but throughput would be similar to the No Build Alternative because the project is not adding westbound capacity to the corridor.

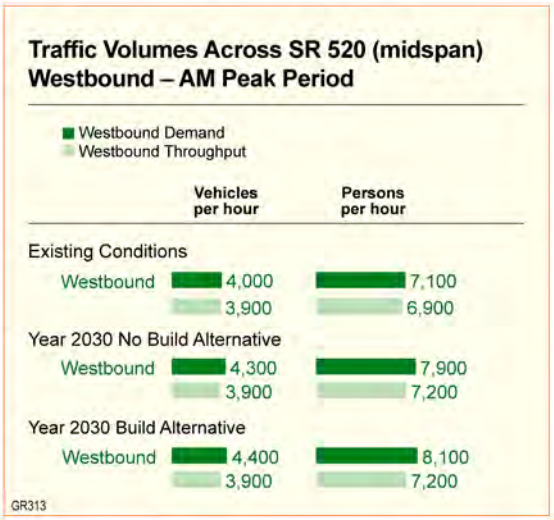
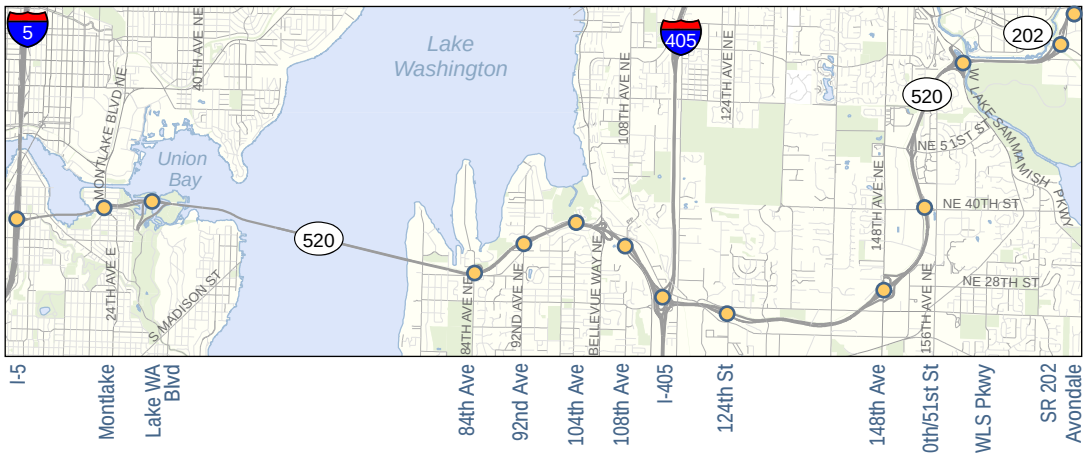


Exhibit 5-7. Westbound Morning Traffic Volumes (Demand and Throughput)

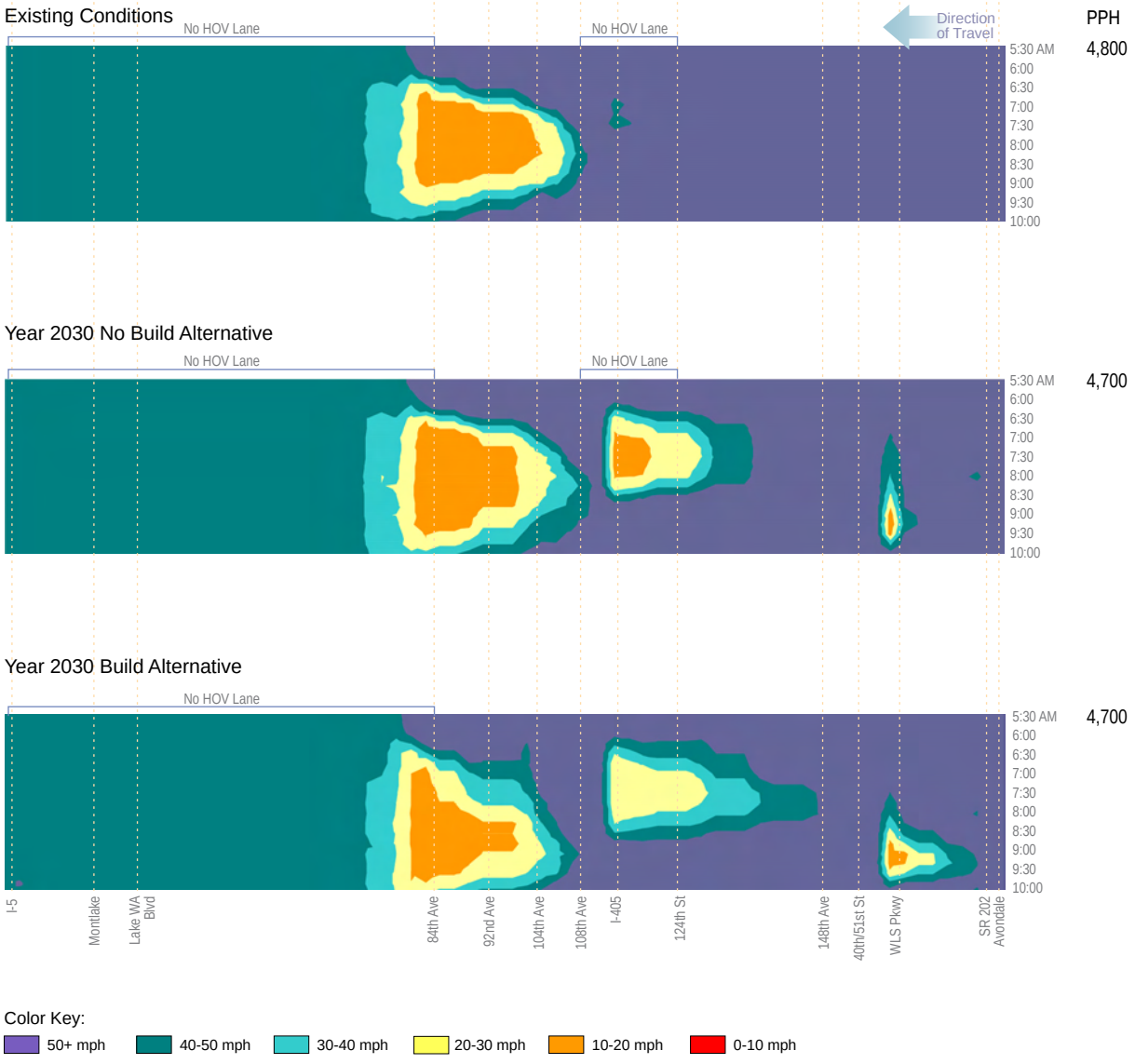
Congestion Points

Speed-flow diagrams (Exhibits 5-8 and 5-9) were developed using existing data and model output to provide a graphic representation of the congestion that occurs on SR 520 during the morning peak period. The worst of the congestion points, as shown in these diagrams, include:

- The east bridge approach and HOV lane termination point in Medina
- At the SR 520/I-405 interchange
- Near the Northeast 40th/51st Street interchange



SR 520 Westbound GP, AM Peak Period



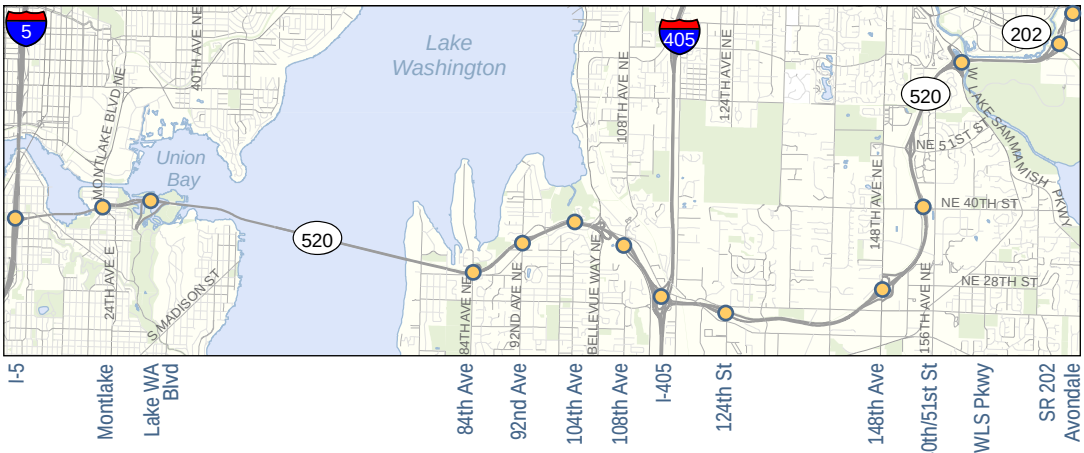
Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

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

Exhibit 5-8. **SR 520 Westbound Morning General-Purpose Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project



SR 520 Westbound HOV AM Peak Period

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. **SR 520 Westbound Morning HOV Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project

Each of these locations is discussed below, including a description of existing conditions and how the Build Alternative operates compared to the No Build Alternative.

East Bridge Approach and HOV Lane Termination Point

As shown in Exhibit 5-8, the worst of the congestion on westbound SR 520 begins west of the 84th Avenue on-ramp, which is where the westbound HOV lane terminates and HOV traffic and general-purpose traffic must merge. Congestion extends back to the Bellevue Way NE interchange area and lasts for approximately 3 hours. This congestion also limits the amount of traffic that can cross the floating bridge during this period.

HOV operations are affected here as well. The westbound HOV lane is discontinuous, with skip stripe sections through the interchange on- and off-ramps. General-purpose vehicles travel through these skip stripe sections to access off-ramps and use the sections to merge across to the general-purpose lanes from on-ramps.

By 2030, congestion with the No Build Alternative would begin at the east bridge approach as it currently does and extend back to the 108th Avenue NE interchange area. Congestion at this point would last for approximately 3-1/2 hours, slightly longer than the 3 hours experienced under existing conditions. Congestion would continue to affect both general-purpose and HOV trips as general-purpose vehicles attempt to merge across the HOV lane, affecting carpool and bus travel time and reliability. Speeds in the HOV lane would range from 50 mph to less than 10 mph.

The project would improve freeway operations east of the bridge approach. Both HOV and general-purpose traffic would both benefit from relocating the HOV lane to the inside of the corridor as well as other geometric improvements, such as wider shoulders, lanes, and longer on-ramp acceleration lanes. The Evergreen Point Freeway Station on-ramp merge would be improved, allowing buses to enter the freeway at higher speeds than they do today. HOV lane speeds would be a constant 50 mph or better.

At the SR 520/I-405 Interchange

Today, the off-ramp to I-405 southbound is over capacity and a queue spills back onto the SR 520 mainline, causing minor slowdowns.

With the No Build Alternative, congestion would worsen because traffic volumes will increase. Congestion through the SR 520/I-405 interchange lasts up to 2 hours. HOV vehicles would experience the same congestion as general-purpose trips because there would not be a dedicated HOV lane through this section of roadway.

With the project, the westbound HOV lane would be moved to the inside and extended through the SR 520/I-405 interchange. HOVs would be able to bypass the congestion, maintaining speeds of 50 mph or better.

NE 40th/51st Street Collector-Distributor

Today, there is no congestion between the West Lake Sammamish Parkway on-ramp and the Northeast 51st/40th Street collector-distributor.

By the year 2030, SR 520 would be congested between the West Lake Sammamish Parkway on-ramp and the Northeast 51st/40th Street collector-distributor because of the high volume (1,500 vehicles per hour) exiting to the collector-distributor, and the close proximity of the West Lake Sammamish on-ramp.

The congestion from the collector-distributor would spill back to the West Lake Sammamish Parkway on-ramp, causing congestion at the merge.

With the Build Alternative, congestion in this area would be the same as with the No Build Alternative because the project would not improve the ramps or interchanges through this section of SR 520. However, the Build Alternative would re-stripe the HOV lane to the inside, so HOV and transit would bypass this congestion.

Did you know?

A travel time under 15 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.

Travel Time and Speed

Exhibit 5-10 shows general-purpose and HOV "average" and "maximum" travel times between I-5 and SR 202. The average travel time represents a typical commute that would occur anytime throughout the peak period. The maximum travel time takes into account only the most congested time of the peak period, or "the peak of the peak."

Travel times for the entire SR 520 corridor are reported because some of the benefits of the Build Alternative would be realized outside of the

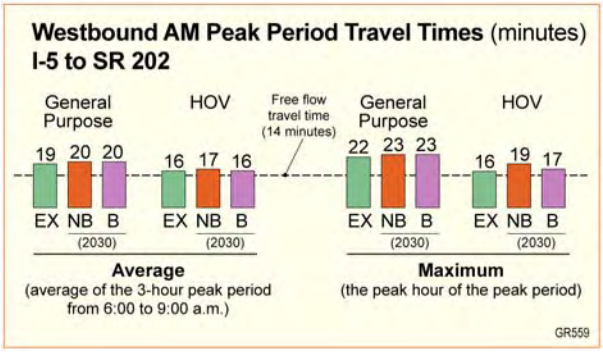


Exhibit 5-10. Westbound Morning Peak Period Travel Times Between I-5 and SR 202

project limits. Comparing the travel times between SR 202 and I-5 is an effective way to capture these benefits.

Today, the average travel time between SR 202 and I-5 is between 16 and 19 minutes (averaging 40 to 50 mph). HOV travel is 3 minutes faster than general-purpose travel. General-purpose vehicles experience congestion and delays approaching the east bridge approach.

Without the project, travel times for both general-purpose and HOV traffic would increase slightly (up to 1 minute) as a result of the increase in traffic volumes and congestion expected between now and the year 2030. HOV travel would be 3 to 4 minutes faster than general-purpose travel.

With the project, general-purpose and HOV travel times would be 1 to 2 minutes less compared to the No Build Alternative. This is due to relocation of the HOV lane to the inside and extension of the HOV lane through the SR 520/I-405 interchange. The travel time benefit of HOV travel would improve slightly to be 4 to 6 minutes faster than general-purpose travel.

How would eastbound SR 520 operate during the morning commute?

As discussed earlier in the chapter, the SR 520 corridor currently has little to no congestion between Medina and SR 202. Traffic is limited by congestion on the west side of the corridor between I-5 and the west bridge approach. These conditions are not expected to change substantially under either the No Build or Build Alternative. The greatest operational improvement from the project is the reliability provided for carpools and buses with the addition of an HOV lane

between Medina and 124th Avenue NE and the relocation of the HOV lane to inside to SR 202.

Volumes

As shown in Exhibit 5-11, person demand would increase more (from 6,900 to 7,600 persons per hour) than vehicle demand (from 3,900 to 4,100 vehicles per hour) between now and the year 2030. However, due to congestion on the corridor outside the project area, throughput would be similar for No Build and Build Alternatives. With the HOV system improvements, the Build Alternative would be able to serve slightly more people than the No Build Alternative.

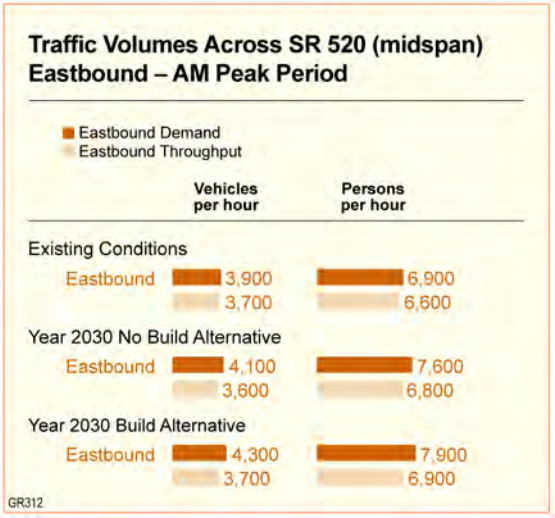
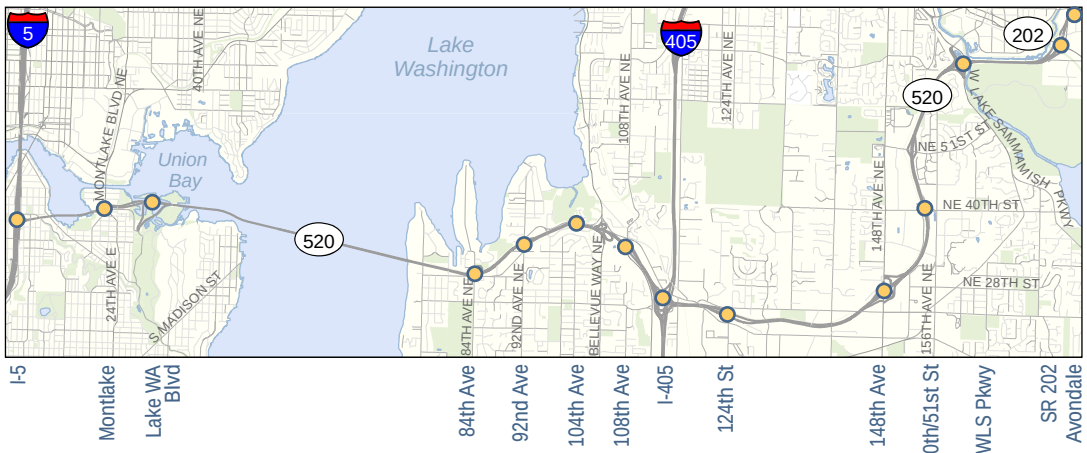


Exhibit 5-11. Eastbound Morning Traffic Volumes (Demand and Throughput)

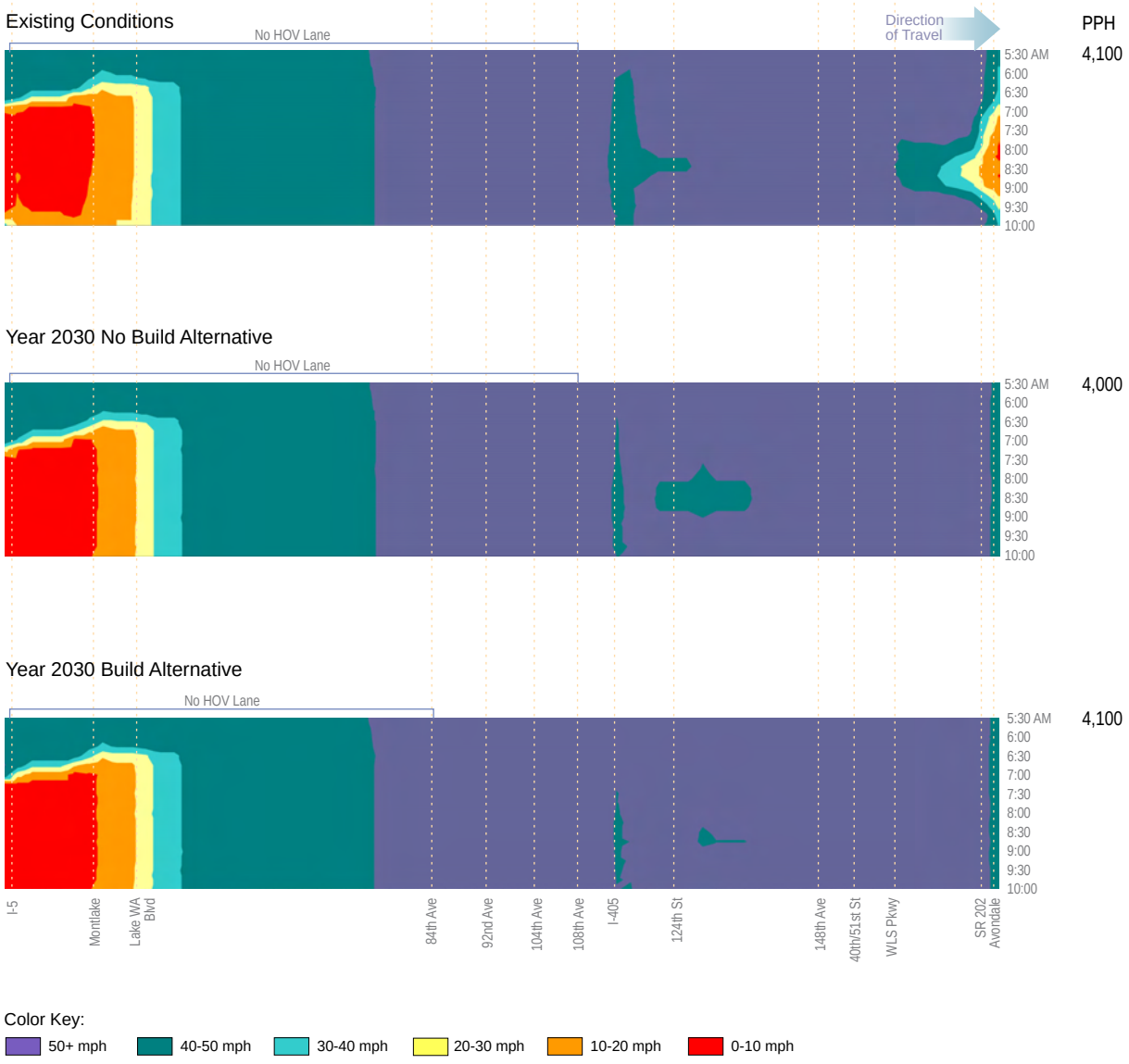
Congestion Points

The worst congestion points for the eastbound morning commute are shown in Exhibits 5-12 and 5-13. Some congestion occurs on SR 520 in the outside lanes through the SR 520/I-405 interchange, but the majority of the congestion occurs on the western half of the corridor between I-5 and the west bridge approach (near the Arboretum and just east of the Lake Washington Boulevard on-ramp).

This location is outside of the project limits, but is discussed here because congestion limits the amount of traffic that can cross the bridge, which serves to prevent traffic congestion on the east side of the lake. If there were no congestion at this location, existing congestion on the east side of the lake might be worse or occur at other locations that operate well today.



SR 520 Eastbound GP, AM Peak Period



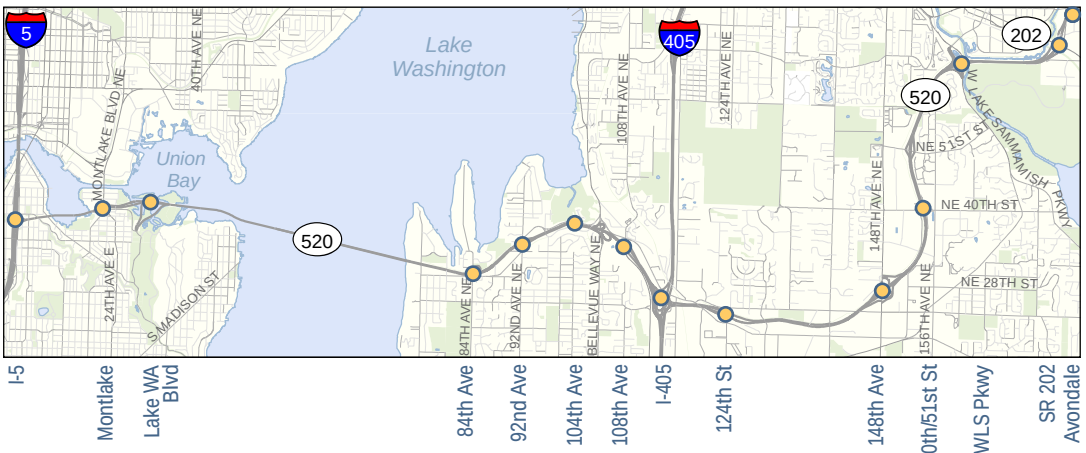
Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

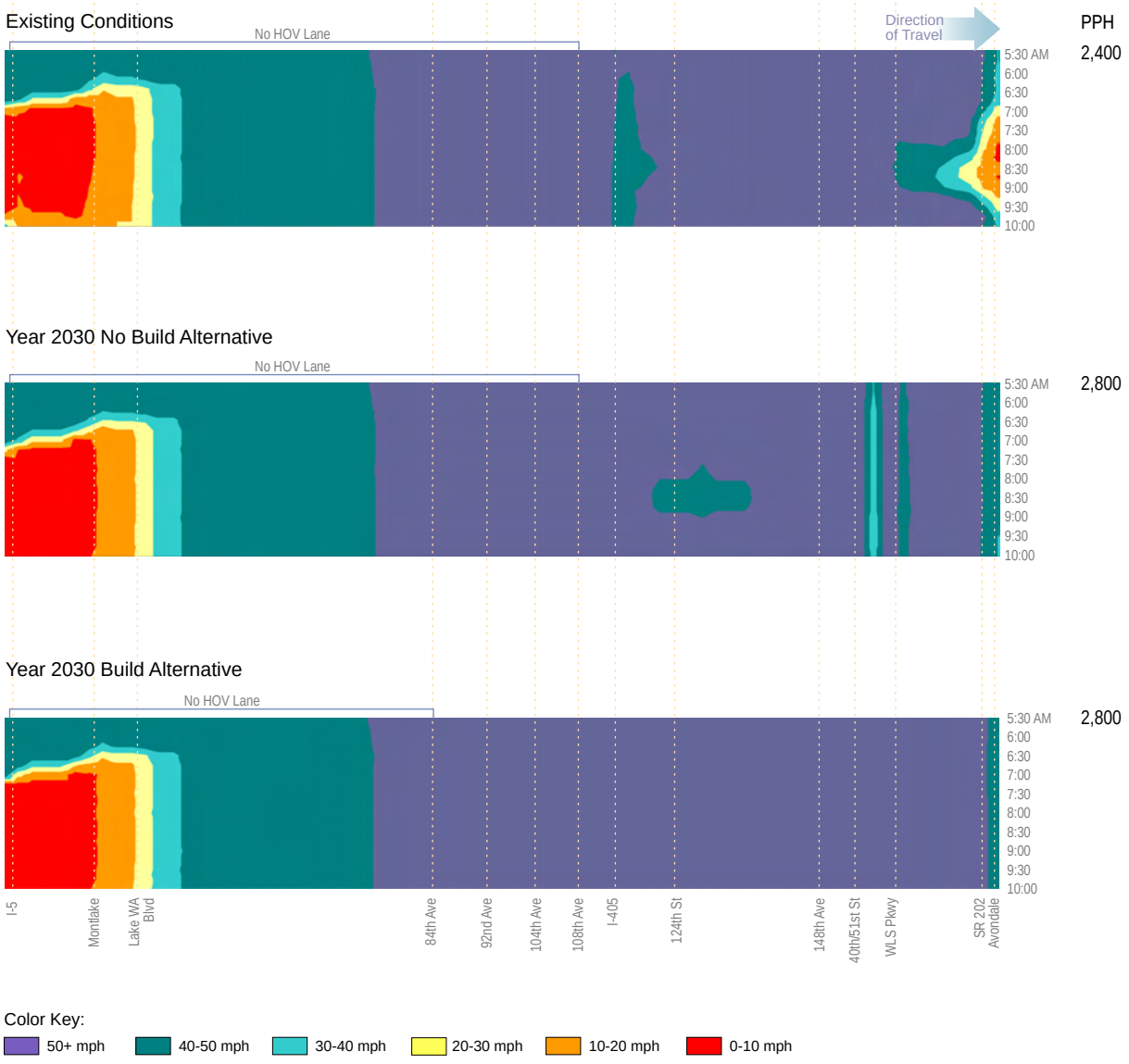
PPH = Persons per hour
(average during the peak period)

Exhibit 5-12. **SR 520 Eastbound Morning General-Purpose Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project



SR 520 Eastbound HOV AM Peak Period



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. **SR 520 Eastbound Morning HOV Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project

Congestion at this on-ramp results from merging traffic from Lake Washington Boulevard, the grade change between the ramp and the western high-rise of the Evergreen Point Bridge, visual distractions associated with the lake, and substandard shoulder widths. The queue at this location lasts for approximately 3 hours and can extend back to the I-5 interchange. Travel speeds through this congested area are reduced to below 10 mph.

In the year 2030 for both the No Build and Build Alternatives, congestion would be slightly worse because of the increase in traffic volumes forecasted between now and the year 2030. The Build Alternative would operate the same as the No Build Alternative.

Travel Time and Speed

Exhibit 5-14 shows general-purpose and HOV travel times between I-5 and SR 202 during the eastbound morning commute. These times are affected by the congestion shown in Exhibits 5-12 and 5-13 and discussed in the previous section.

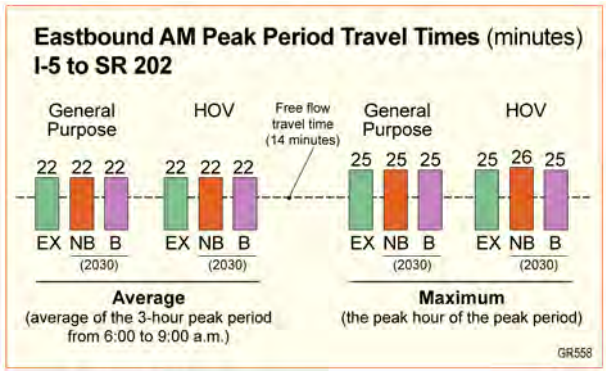


Exhibit 5-14. Eastbound Morning Peak Period Travel Times Between I-5 and SR 202

Travel times for general-purpose and HOV traffic are currently the same between I-5 and SR 202 (between 22 and 25 minutes) because of two reasons:

1) There is no HOV lane between I-5 and 124th Avenue NE so HOVs and general-purpose vehicles travel in the same lanes.

2) Where there is an HOV lane, the corridor is not currently congested.

With the No Build Alternative, general-purpose and HOV travel times would remain similar to what they are today because no changes would be made to the SR 520 corridor.

With the Build Alternative, general-purpose and HOV travel times would be similar to the No Build Alternative because there is little to no congestion within the project limits (Medina to SR 202).

How would westbound SR 520 operate during the afternoon commute?

As discussed earlier, westbound drivers typically experience the worse congestion between the east bridge approach and Bellevue Way NE as well as approaching and traveling through the SR 520/I-405 interchange. This congestion would worsen, especially at the SR 520/I-405 interchange, by the year 2030. With the project, HOV travel times would improve between approximately 15 and 40 minutes compared to the No Build Alternative because HOV travelers would be able to bypass general-purpose congestion in both of these locations.

Volumes

As shown in Exhibit 5-15, person trips would increase more (from 6,800 to 7,900 persons per hour) than vehicle trips (from 4,000 to 4,500 vehicles per hour) between now and the year 2030. Because the project is not adding westbound capacity to the corridor, vehicle and person trips would be similar between the No Build and Build Alternatives.

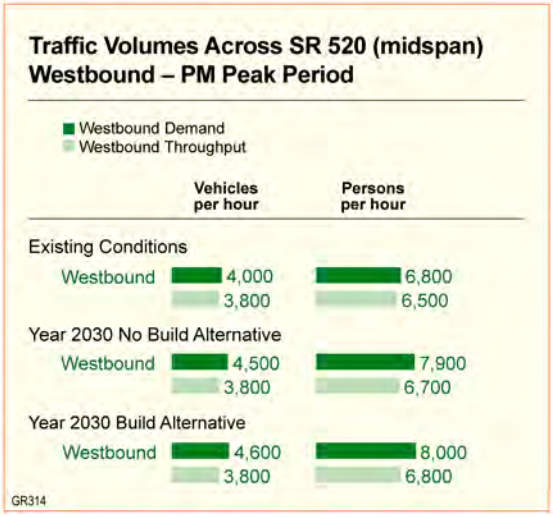


Exhibit 5-15. Westbound Afternoon Traffic Volumes (Demand and Throughput)

Congestion Points

The worst congestion points for the westbound afternoon commute are shown in Exhibits 5-16 and 5-17. Westbound, the worst congestion occurs at two locations:

- Between 124th Avenue NE and the SR 520/I-405 interchanges
- SR 520 bridge approach at the eastern lake shore

These two congestion points are discussed below, including a description of how the Build Alternative operates compared to the No Build Alternative.

Between 124th Avenue NE and SR 520/I-405 Interchanges

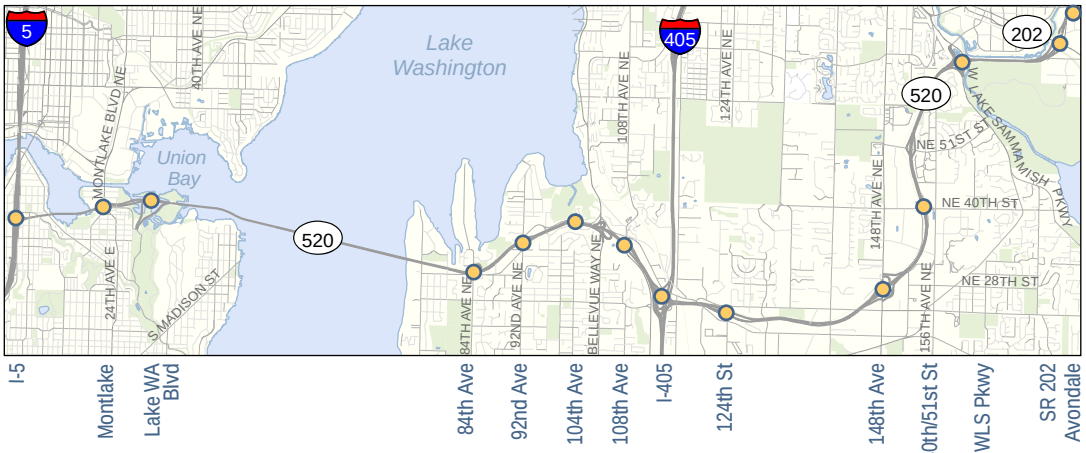
The SR 520/I-405 interchange ramps operate at capacity during the peak period and congestion extends back into the outside lane on the SR 520 mainline.

Congestion would worsen with the increase in traffic volumes expected between now and the year 2030. By the year 2030, congestion on the I-405 mainline would be substantially worse and would back up onto SR 520, affecting SR 520 mainline operations. On SR 520, congestion would extend back to the 40th/51st Street interchange, delaying both general-purpose and HOV trips.

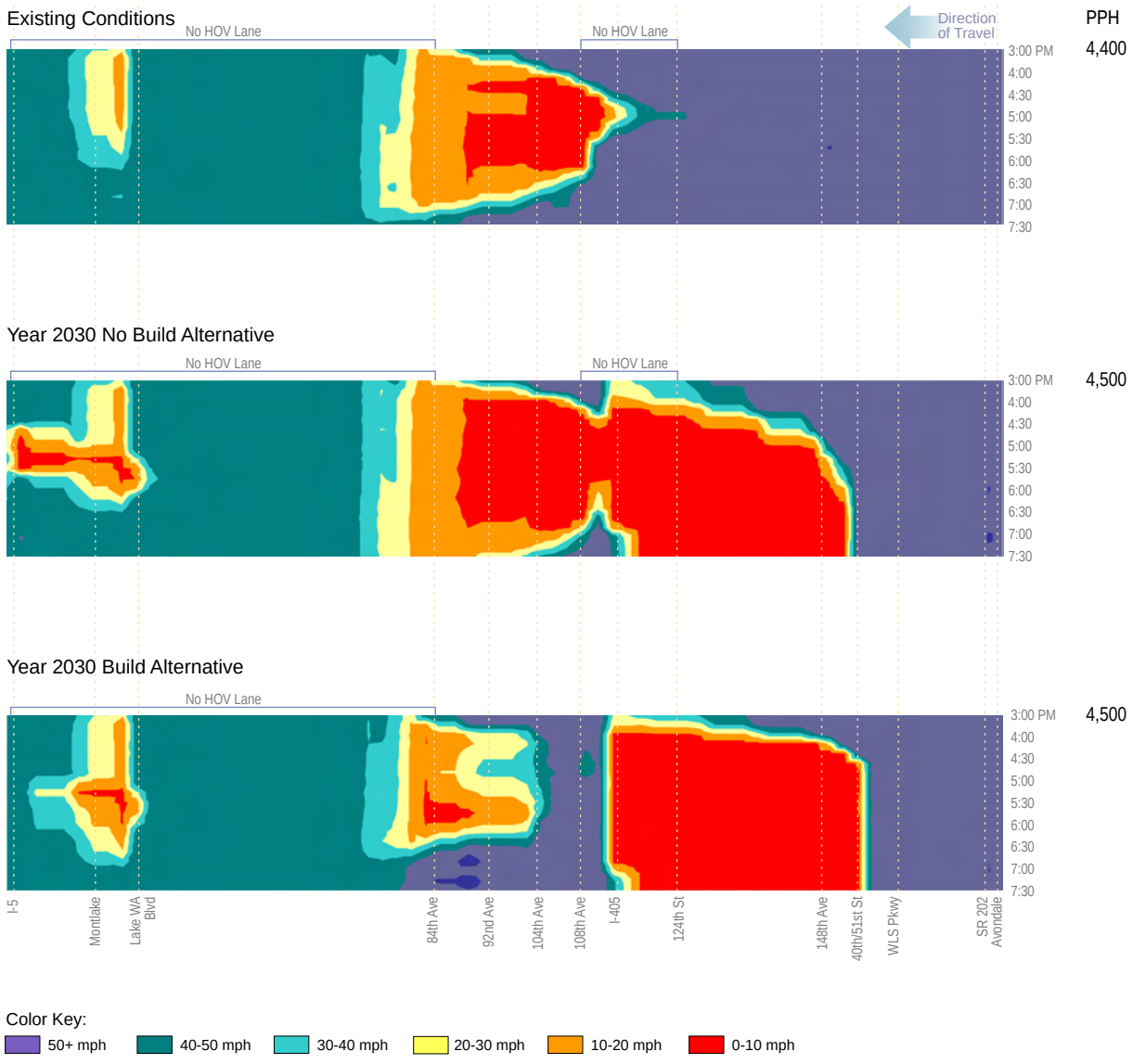
With the project, congestion on SR 520 would reach the 40th/51st Street interchange at the height of the peak. However, the project would relocate the HOV lane to the inside and extend it through the SR 520/I-405 interchange, allowing HOVs to bypass the congestion in the general-purpose lanes. As a result, HOV travel times and reliability would improve substantially by up to 45 minutes.

SR 520 Bridge Approach at the Eastern Lake Shore

Today, westbound congestion begins at the east floating bridge approach in the afternoon, similar to what occurs in the morning. The congestion begins as early as 3 p.m. and lasts until after 7 p.m. Congestion extends through the SR 520/I-405 interchange at its peak. This congestion limits the amount of traffic that can cross the bridge.



SR 520 Westbound GP, PM Peak Period



Color Key:

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

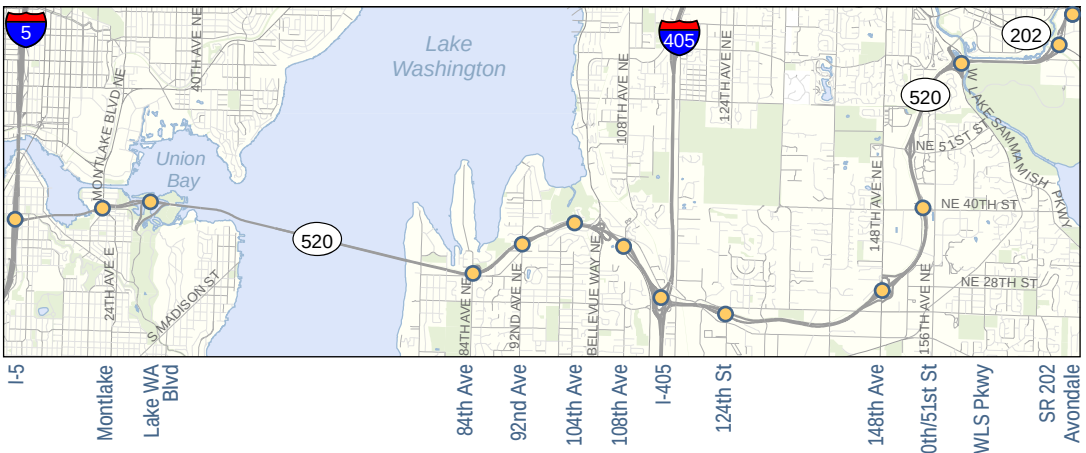
Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

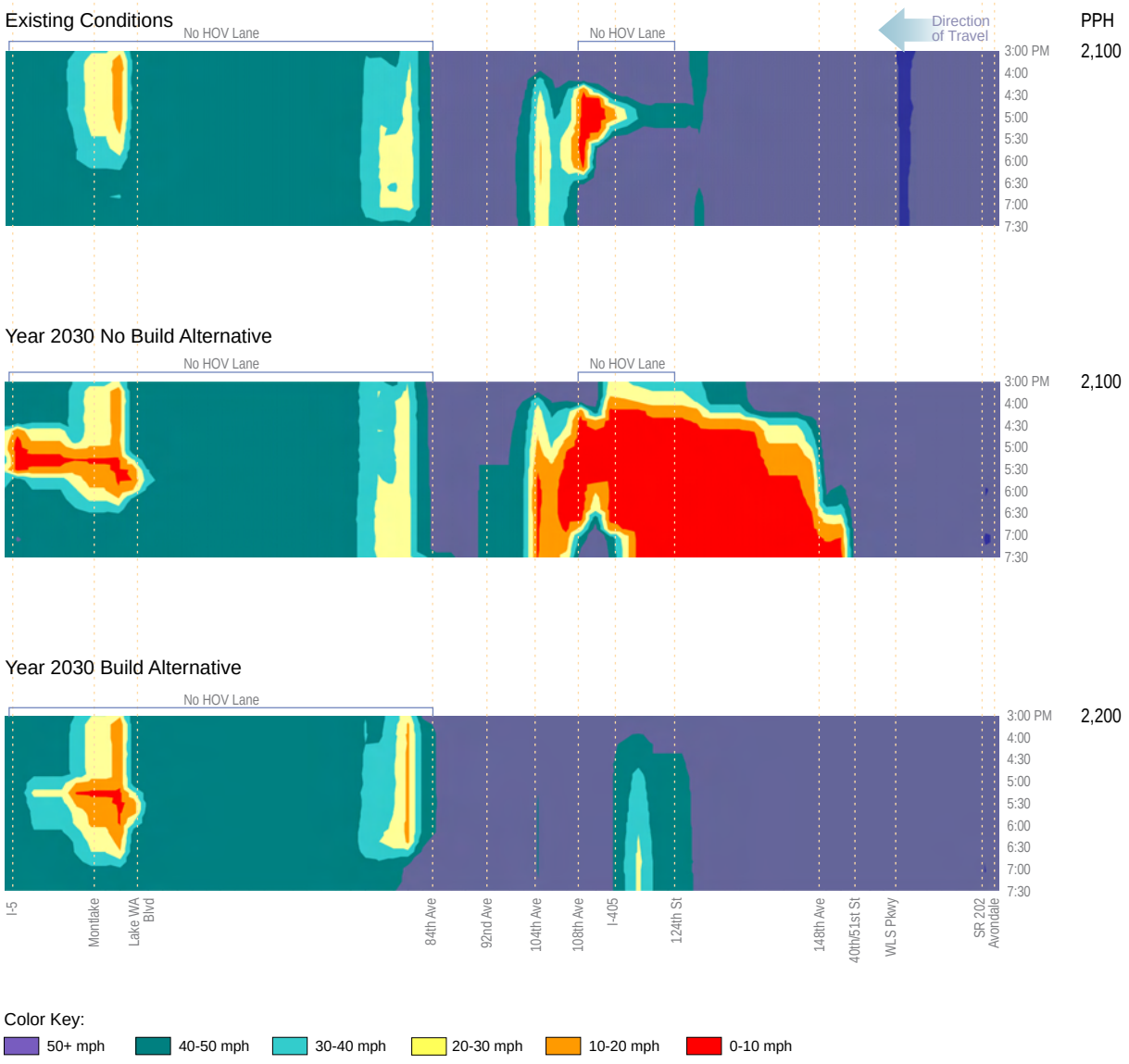
PPH = Persons per hour
(average during the peak period)

Exhibit 5-16. **SR 520 Westbound Afternoon General-Purpose Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project



SR 520 Westbound HOV PM 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 5-17. **SR 520 Westbound Afternoon HOV Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project

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By the year 2030, worsening westbound congestion would further limit the amount of traffic that could travel through this area. Congestion at the east bridge approach would increase and upstream congestion would be substantially worse. Much of the traffic destined for the westbound floating bridge would be delayed on I-405 or on SR 520, east of I-405.

The Build Alternative would improve freeway operations between the east bridge approach and I-405 by reducing conflicts between general-purpose and HOV traffic, and improving on-ramp merge points. In particular, freeway transit station on-ramp merge points would be improved, allowing buses to enter the freeway at higher speeds than they do today. The HOV and general-purpose lanes would both benefit from relocating the HOV lane to the inside of the corridor and from other geometric improvements, such as wider shoulders, wider lanes, and longer on-ramp acceleration lanes. HOV lane speeds would be a constant 50 mph or better.

The Build Alternative improvements would reduce congestion between the east bridge approach and I-405; however, some of the reduced congestion would be a result of decreased vehicle throughput at upstream locations on I-405 and on SR 520, east of I-405. Increased congestion in those areas would reduce the volume of vehicles arriving at the east bridge approach.

Travel Times and Speeds

Exhibit 5-18 shows general-purpose and HOV travel times between I-5 and SR 202 during the eastbound morning commute. These times are affected by the congestion shown in Exhibits 5-16 and 5-17 and discussed above.

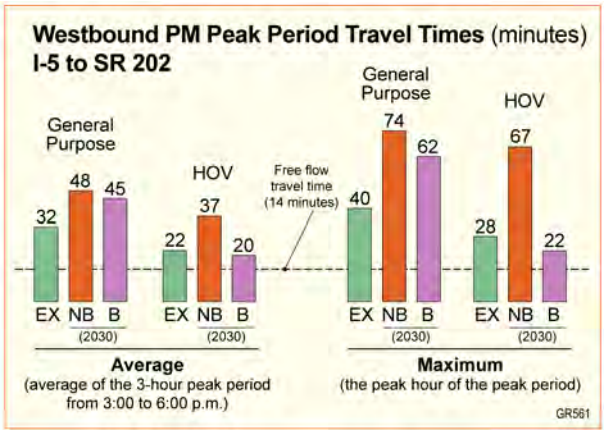


Exhibit 5-18. Westbound Afternoon Peak Period Travel Times between I-5 and SR 202

Today, travel times between SR 202 and I-5 are approximately 30 to 40 minutes for general-purpose vehicles and 20 to 30 minutes for HOVs. Although the HOV lane is interrupted by skip stripe sections and is affected by ramp traffic, HOV travel is still approximately 10 minutes faster than general-purpose travel.

By the year 2030, travel times between SR 202 and I-5 are expected to increase between 16 and 34 minutes for general-purpose traffic and 15 and 39 minutes for HOVs. These longer travel times are due to increases in population and employment (and, therefore, traffic volumes) between now and the year 2030. Congestion would worsen at the east floating bridge approach and on I-405, which would spill back onto SR 520 for most of the commute period.

With the project, westbound general-purpose travel times between SR 202 and I-5 would be approximately 3 to 12 minutes less than the No Build Alternative because of project improvements to the SR 520 corridor. Westbound HOV travel times would be 15 to 45 minutes less than the No Build Alternative because the uninterrupted inside HOV lane would allow carpool and bus traffic to bypass congestion in the general-purpose lanes. With the project, HOV travel would be approximately 25 to 40 minutes faster than general-purpose travel.

How would eastbound SR 520 operate during the afternoon commute?

As discussed earlier, congestion on eastbound SR 520 during the afternoon commute is currently limited to the east end of the corridor where it terminates at a signalized intersection with Avondale Road. By the year 2030, congestion at this location would be substantially reduced due to completion of the West Lake Sammamish Parkway to SR 202 Widening Project. That project would widen SR 520 from two to four lanes in each direction between West Lake Sammamish Parkway and SR 202. It would also provide additional storage capacity at the traffic signal, reducing the extent of the congestion compared to current conditions.

However, congestion on I-405 would be substantially worse and would back up onto the SR 520 mainline for much of the afternoon commute period. With the Medina to SR 520: Eastside Transit and HOV Project, congestion at this location would remain, but would be less than the No Build Alternative due to SR 520 corridor improvements.

Volumes

As shown in Exhibit 5-19, person demand (from 6,800 to 7,800 persons per hour) would increase more than vehicle demand (from 3,500 to 4,000 vehicles per hour) between now and the year 2030. The width of the floating bridge, west of the project area, limits the number of vehicles and people that can travel on SR 520. The Build Alternative would not serve substantially more vehicles and people across the lake than the No Build Alternative because the Medina to SR 202: Eastside Transit and HOV Project does not include improvements to the floating bridge.

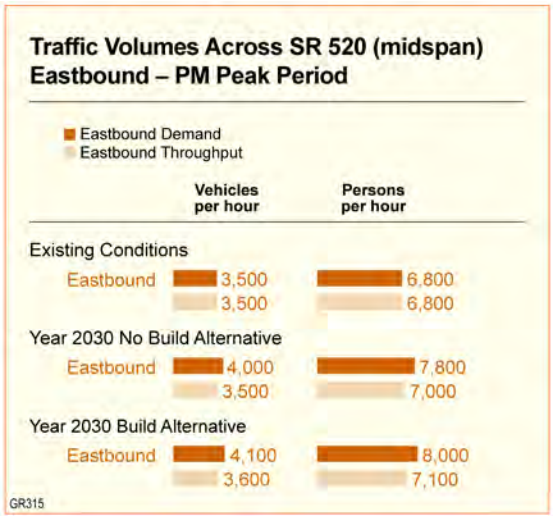


Exhibit 5-19. Eastbound Afternoon Traffic Volumes (Demand and Throughput)

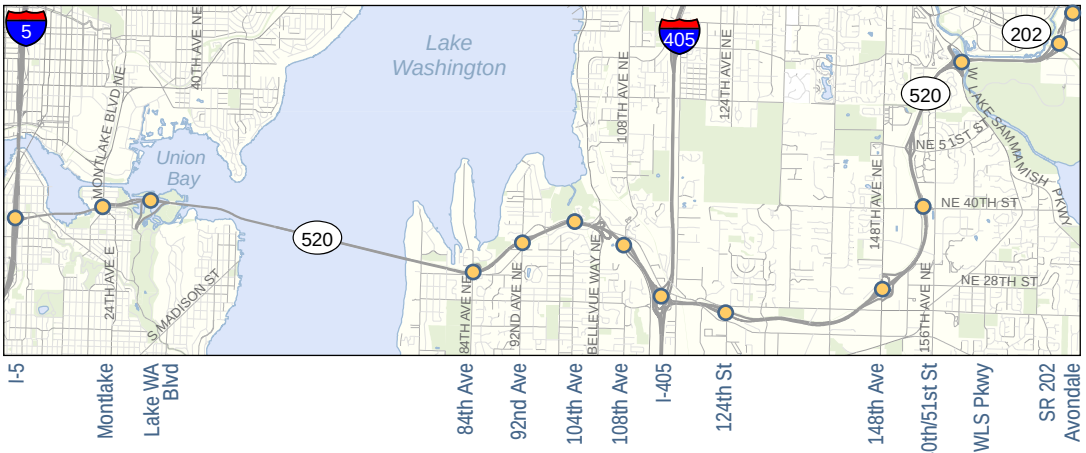
Congestion Points

The worst of the eastbound congestion points (shown in Exhibits 5-20 and 5-21) include the SR 520 freeway terminus at Avondale and the SR 520/I-405 interchange.

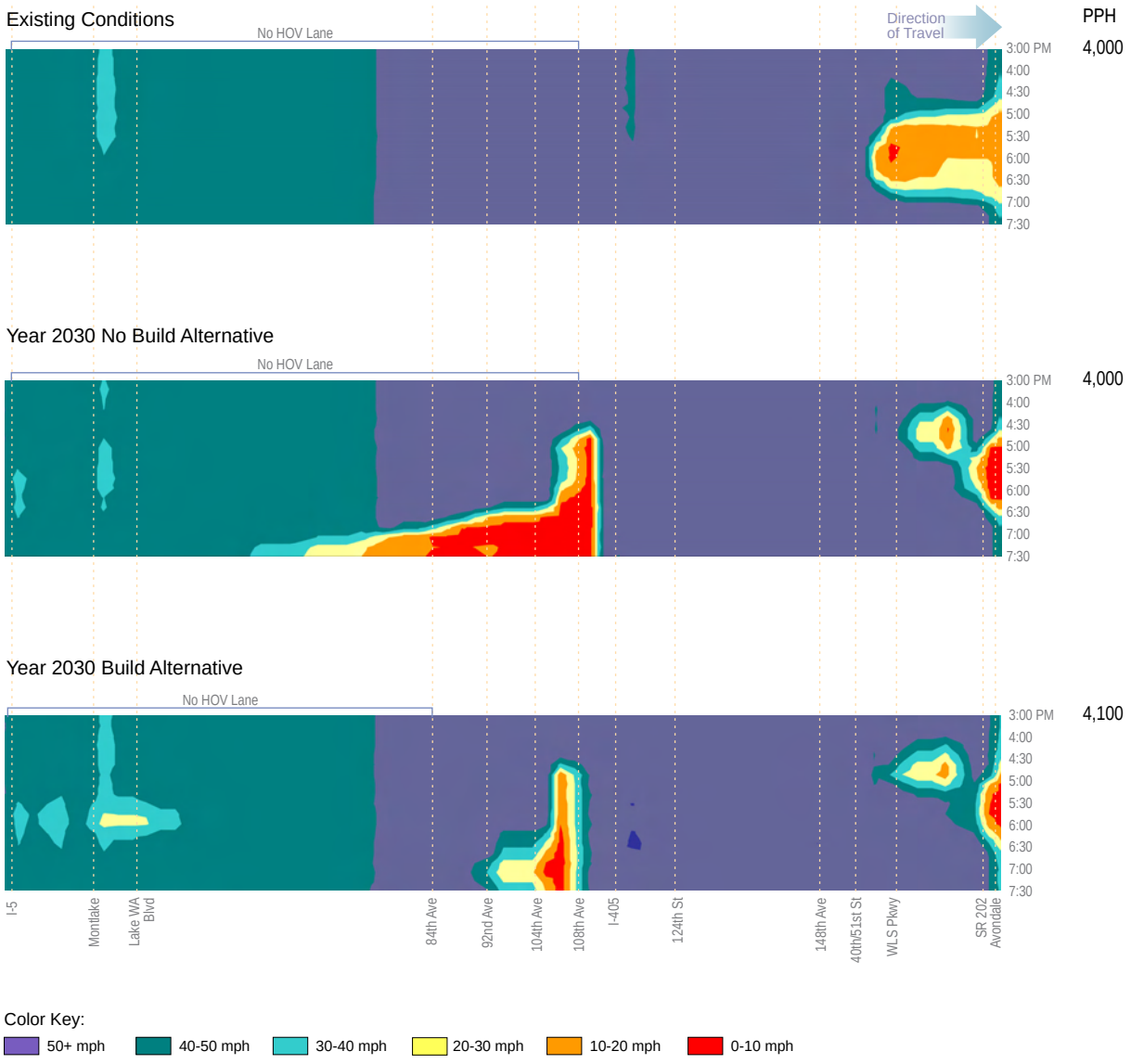
SR 520/I-405 Interchange

Today, afternoon commute congestion on I-405 spills back to the SR 520/I-405 interchange, but the effect on the SR 520 mainline is minimal.

By the year 2030 with the expected increases in traffic volumes, I-405 northbound and southbound would be severely congested during the afternoon/evening, which would limit the amount of traffic that could exit from eastbound SR 520 to I-405. The queue from the off-ramp to northbound I-405 would spill back onto eastbound SR 520 and extend



SR 520 Eastbound GP, PM Peak Period



Color Key:

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

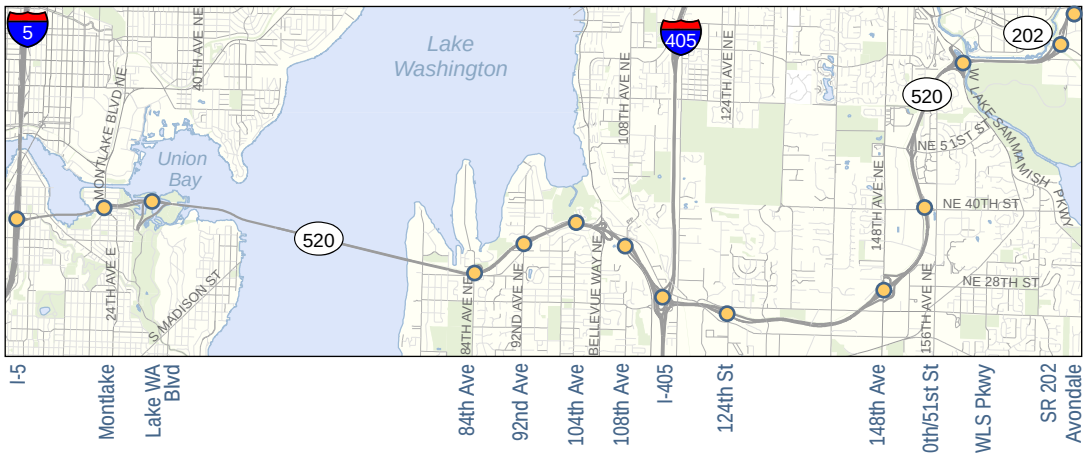
Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

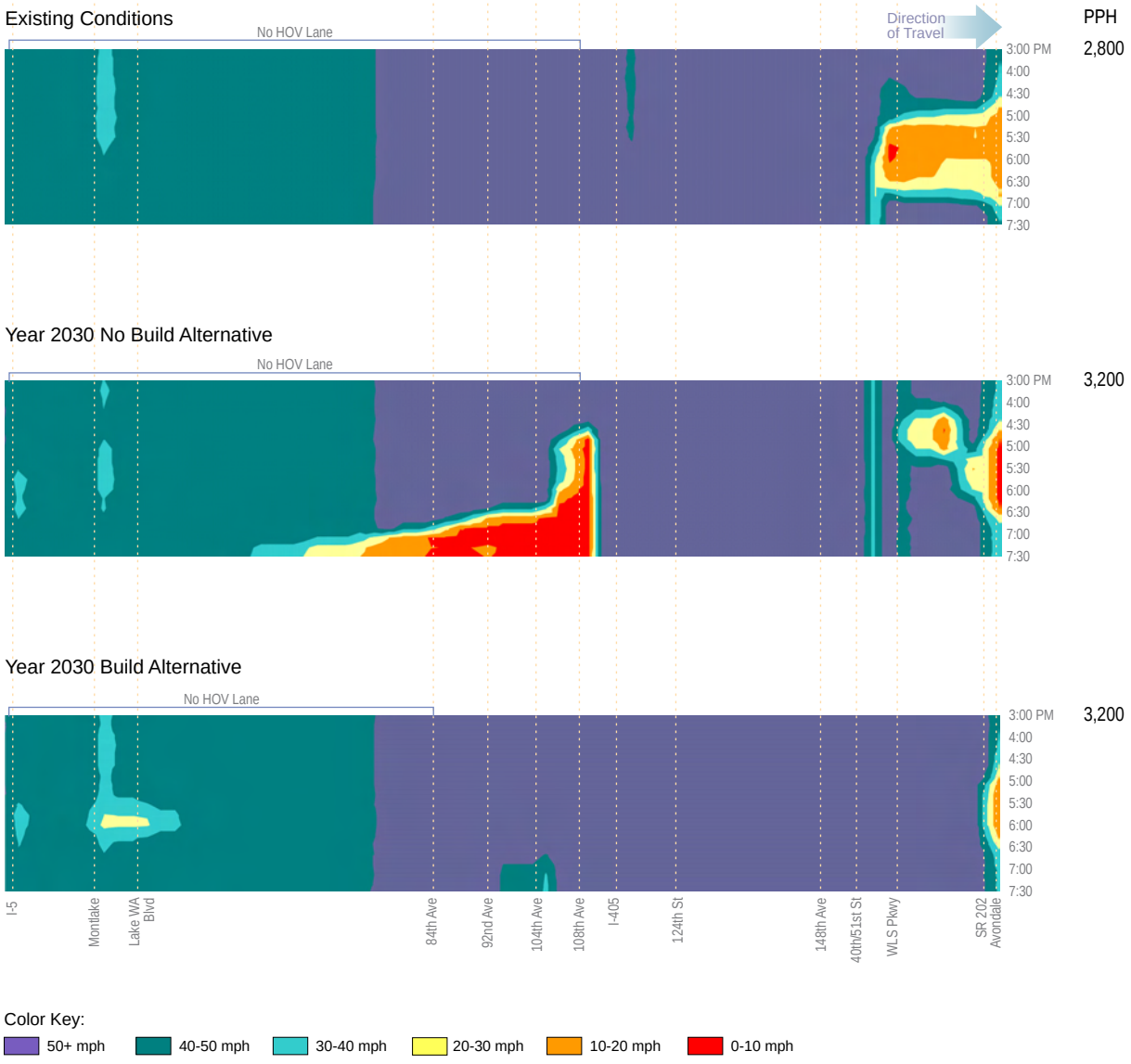
PPH = Persons per hour
(average during the peak period)

Exhibit 5-20. **SR 520 Eastbound Afternoon General-Purpose Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project



SR 520 Eastbound HOV PM Peak Period



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 5-21. **SR 520 Eastbound Afternoon HOV Freeway Operations**

Medina to SR 202: Eastside Transit and HOV Project

back onto the floating bridge. The queue would affect both general-purpose and HOV traffic because there is no HOV lane to allow HOV traffic to bypass the congestion.

With the Build Alternative, congestion in the general-purpose lanes would be reduced compared to the No Build Alternative, extending back only to the 92nd Ave NE interchange. The inside HOV lanes would provide a bypass to congestion in the general-purpose lanes, eliminating congestion for HOV traffic.

SR 520 Freeway Terminus at Avondale

Today congestion occurs at the SR 520 terminus/Avondale Road/Northeast Union Hill intersection where SR 520 traffic volumes exceed what the signal can serve, causing traffic to back up onto the SR 520 mainline. This congestion lasts for approximately 2-1/2 hours and typically extends back to the SR 520/NE 40th Street interchange area at the peak of congestion.

In the year 2030, eastbound congestion at the traffic signal at Northeast Union Hill Road and SR-520/Avondale Road would still occur, but would be reduced due to completion of the West Lake Sammamish Parkway to SR 202 Widening Project. That project would widen SR 520 from two to four lanes in each direction between West Lake Sammamish Parkway and SR 202. It would also provide additional storage capacity at the traffic signal, reducing the extent of the congestion compared to current conditions.

The same afternoon commute congestion that would occur under No Build conditions would also occur with the Build Alternative.

Travel Times and Speeds

Exhibit 5-22 shows general-purpose and HOV travel times between I-5 and SR 202 during the eastbound afternoon commute. These times are affected by the congestion discussed previously and shown in Exhibits 5-20 and 5-21.

Today, general-purpose and HOV travel times between I-5 and SR 202 (between 17 and 21 minutes) are similar for two reasons:

1) There is no HOV lane between I-5 and 124th Avenue NE, so HOVs and general-purpose traffic travel in the same lanes.

2) Where there is an HOV lane, the corridor is not currently congested.

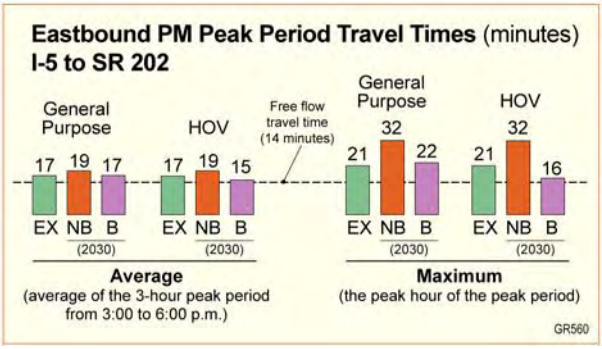


Exhibit 5-22. Eastbound Afternoon Peak Period Travel Times between I-5 and SR 202

Without the project, general-purpose and HOV traffic would experience longer travel times in the year 2030 than they do today, increasing by 2 to 11 minutes. While the West Lake Sammamish to SR 202 Widening Project (WSDOT) will reduce congestion at the east end of the corridor, the congestion spilling back from I-405 more than offsets these improvements.

With the Medina to SR 202: Eastside Transit and HOV Project, congestion near the SR 520/I-405 interchange would be reduced compared to the No Build Alternative. The project would provide capacity for HOV trips and some general-purpose trips to bypass the queue spillback from the I-405 mainline.

At the peak of congestion, the project would provide travel time savings of up to 16 minutes for carpool or transit compared to the No Build Alternative. On average during the afternoon commute, the project saves about 4 minutes of travel time for HOVtraffic.

As shown in Exhibit 5-22, the average general-purpose travel time would decrease slightly, by 2 minutes, between the No Build and Build Alternative, but maximum travel time would decrease by up to 10 minutes with the Build Alternative.