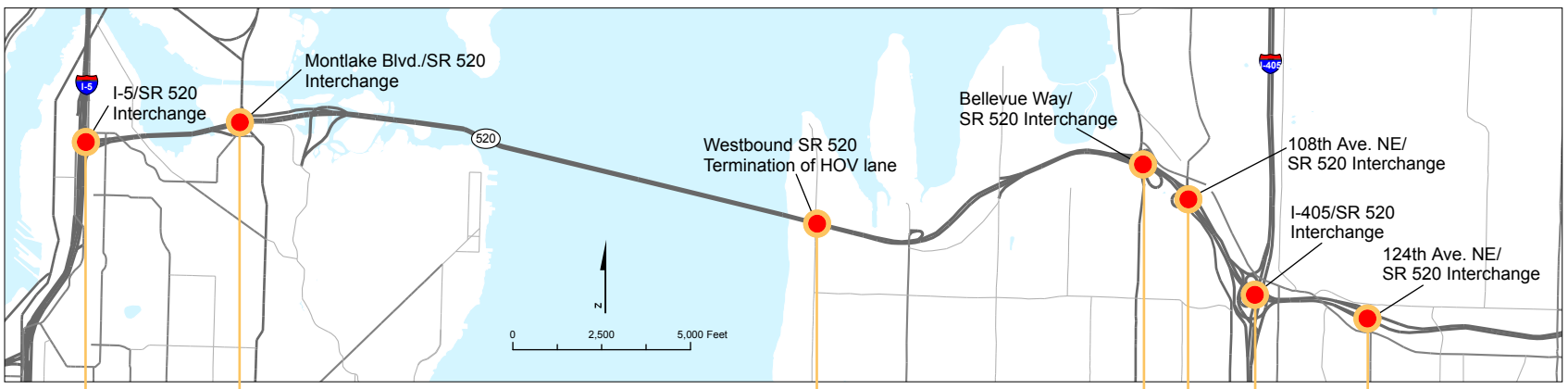


Between I-5 and 124th Ave. NE

General Purpose Travel Speed

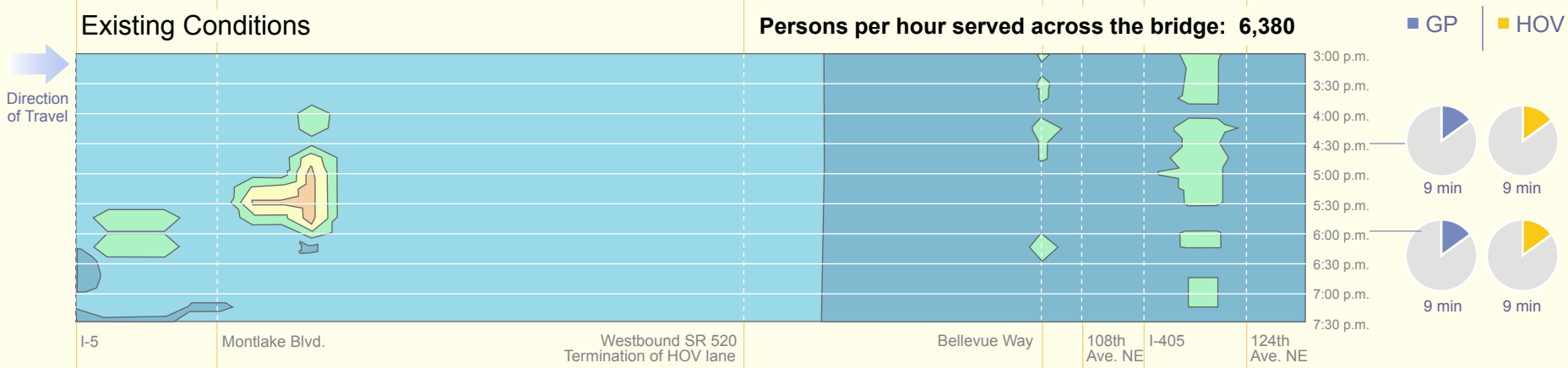
50+ mph | 40-50 mph | 30-40 mph | 20-30 mph | 10-20 mph | 0-10 mph

Travel Time

From 124th Ave. NE to I-5

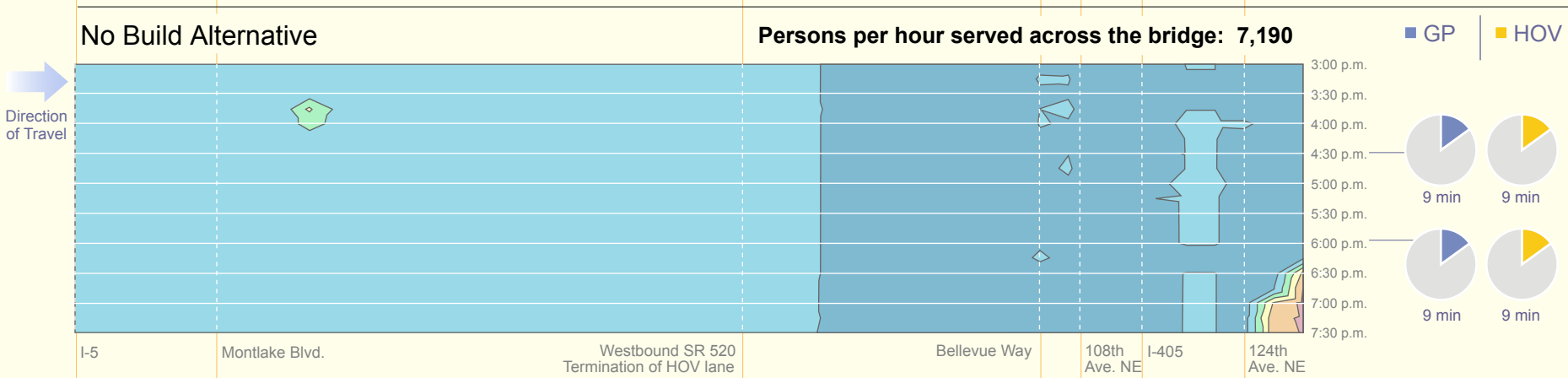
Existing Conditions

Persons per hour served across the bridge: 6,380



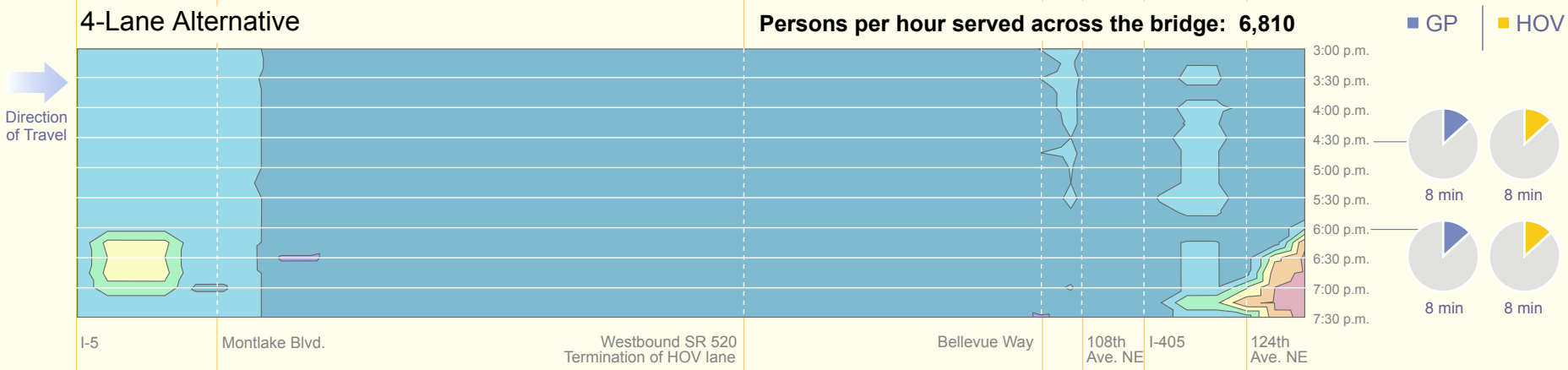
No Build Alternative

Persons per hour served across the bridge: 7,190



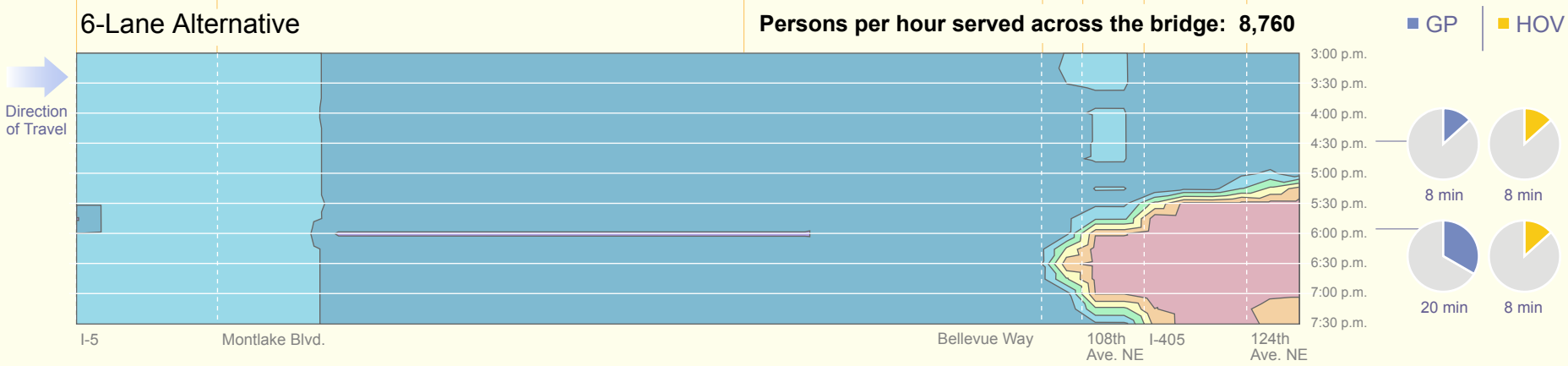
4-Lane Alternative

Persons per hour served across the bridge: 6,810



6-Lane Alternative

Persons per hour served across the bridge: 8,760



Note: Persons served across the bridge refers to the average number of persons served during the specified peak period.

Exhibit 4-30. **Eastbound P.M. Peak Period Freeway Operations**

SR 520 Bridge Replacement and HOV Project

Where are there safety concerns along the SR 520 corridor?

In order to identify where there are safety concerns along the SR 520 corridor, the transportation discipline team evaluated historical accident data for the SR 520 mainline between the I-5 and 108th Avenue Northeast interchanges, as well as at all freeway ramps, overcrossings, and ramp termini intersections along this segment of the freeway. The team used historical accident data obtained from WSDOT and Seattle, Hunts Point, Yarrow Point, Medina, Clyde Hill, and Bellevue for the years 2000 through 2002 to identify locations where accidents have occurred at a higher than average rate.

In general, SR 520 accidents are attributed to congestion and deficiencies in roadway design. In most cases, safety could be improved by improving traffic flow and designing the freeway to meet current standards.

What are the accident trends?

Using WSDOT's accident history reports for the SR 520 mainline, ramps, and overcrossings, the team identified historical trends and determined where the highest concentration of accidents occurred between January 1, 2000, and December 31, 2002. Results are provided separately below for each type of facility.

SR 520 Mainline

Exhibit 4-31 shows the number and severity of all mainline accidents that occurred from 2000 through 2002 on SR 520 between I-5 and the 108th Avenue Northeast interchange. In the years surveyed, most of the

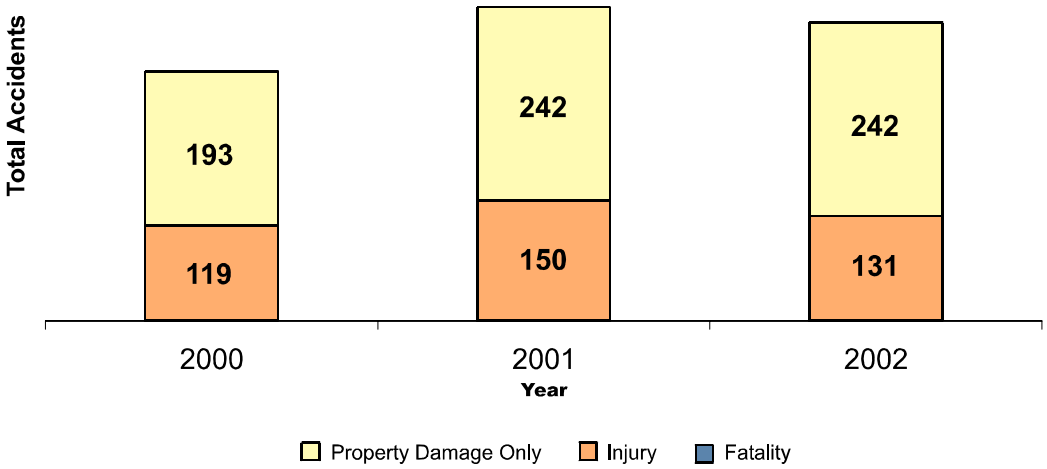


Exhibit 4-31. SR 520 Mainline Accidents by Year and Severity

accidents that occurred resulted in property damage only, and no fatalities were recorded.

Mainline accident rates (expressed as accidents per million vehicle miles) were calculated for different sections of the SR 520 study area to provide weighted average values that could be used to compare safety across sections with differing traffic volume and physical characteristics. The accident rates were calculated using the equation provided in the *Washington State Highway Annual Collision Summary Report* (WSDOT 1996). Exhibit 4-32 shows average accident rates for 2000 through 2002, by direction, for specific sections of SR 520 in the project area. As shown in this exhibit, the highest accident rates were between I-5 and the Lake Washington Boulevard ramps in both directions. Accident rates during the 3-year period were also relatively high on westbound SR 520 between the 84th Avenue Northeast on-ramp and the 108th Avenue Northeast interchange.

Exhibit 4-32. SR 520 Mainline Average Accident Rates by Milepost Range (2000 through 2002)

SR 520 Mainline Location	Milepost Range	Length (miles)	3-Year Average Accident Rate (mvm)
Eastbound			
I-5 to Lake Washington Boulevard On-Ramp	0.00 to 1.63	1.63	2.85
Lake Washington Boulevard On-Ramp to 84th Avenue Northeast Off-Ramp	1.64 to 4.34	2.70	1.25
84th Ave NE Off-Ramp to 108th Avenue Northeast On-Ramp	4.35 to 6.31	1.96	0.53
Westbound			
I-5 to Lake Washington Boulevard Off-Ramp	0.00 to 1.63	1.63	2.82
Lake Washington Boulevard Off-Ramp to 84th Avenue Northeast On-Ramp	1.64 to 4.66	3.02	1.24
84th Avenue Northeast On-Ramp to 108th Avenue Northeast	4.67 to 6.47	1.80	2.20

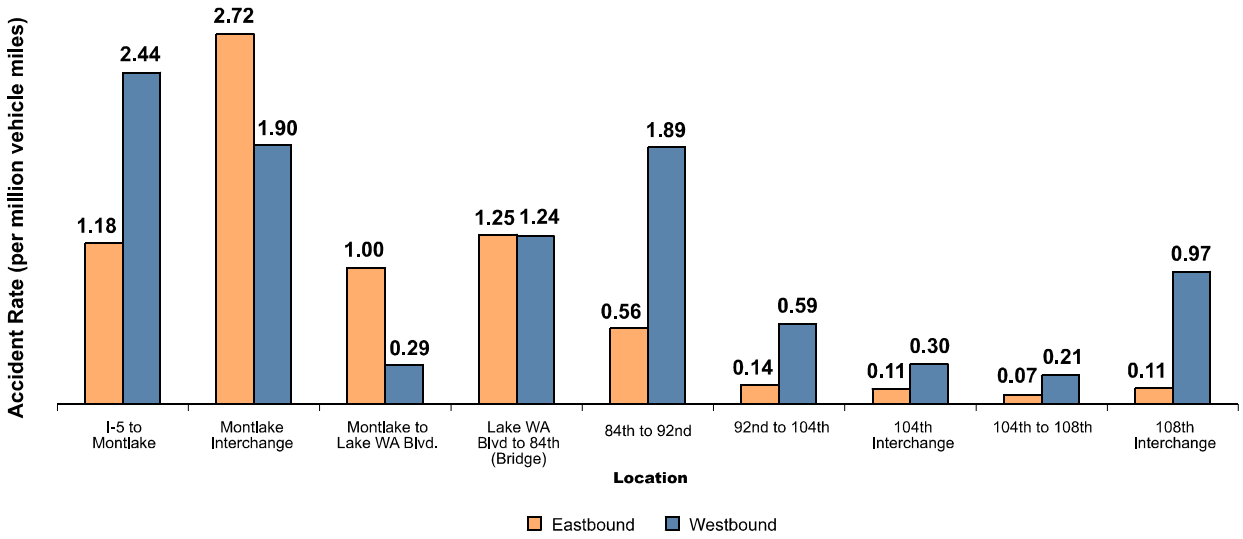
Source: SR 520 Accident Data (January 2000 through December 2002) (WSDOT 2004b).

Notes: mvm = million vehicle miles

Accident rates (per mvm) were calculated using the following equation (per WSDOT's *Washington State Highway Annual Collision Summary Report*): Accident Rate = [(Number of Accidents) x (1 Million)] / [(Section Length) x (AADT) x (365 Days)]. The accident rates shown above differ from rates shown in Exhibit 4-33, because sections of the SR 520 mainline less than 1 mile long were combined to calculate accident rates for longer sections of the SR 520 mainline.

The transportation discipline team took a closer look at accident rates in each SR 520 section to determine which interchange areas experienced the highest concentration of accidents. The results of this evaluation, as shown in Exhibit 4-33, indicate that the highest concentration of

accidents in the years surveyed was between I-5 and the Montlake Boulevard interchange. A relatively high rate of accidents was also recorded on westbound SR 520 between the 84th and 92nd interchanges.



Note: Accident rates were calculated using the following equation (per WSDOT's Washington State Highway Annual Collision Summary Report): Accident Rate = [(Number of Accidents) x (1 Million)] / [(Section Length) x (AADT) x (365 Days)]. Section lengths less than 1 mile long were excluded from the formula.

Exhibit 4-33. SR 520 Mainline Accidents Rates by Roadway Section (2000 through 2003)

Based on the *Washington State Highway Annual Collisions Summary Report,* the average accident rate on King County highways in 1996 was 2.27 accidents per million vehicle miles. This county-wide average was exceeded in 2000 through 2002 along the following sections of the SR 520 mainline:

- SR 520 eastbound between the Montlake Boulevard interchange ramps
- SR 520 westbound from the Montlake Boulevard interchange to I-5

SR 520 Ramps and Overcrossings

The team also reviewed accident data for interchange ramps and overcrossings along the SR 520 corridor. Exhibit 4-34 shows the total number and severity of all accidents that occurred from 2000 through 2002 at each SR 520 interchange between I-5 and 108th Avenue Northeast. As shown in Exhibit 4-34, of the 3 years evaluated, the highest number of accidents occurred at the Montlake Boulevard interchange, and the majority of accidents that occurred resulted in

property damage only. One fatality was recorded at the Montlake Boulevard interchange.

What types of accidents happen in the project area?

The team also reviewed WSDOT's accident records to determine what types of accidents were most prevalent along the SR 520 corridor between 2000 and 2002. Exhibit 4-35 summarizes the findings of this review.

Exhibit 4-34. SR 520 Interchange Ramps and Overcrossings—3-Year Accident History (2000 through 2002)

Interchange	Property Damage	Injury	Fatality
Montlake Boulevard	59	36	1
Lake Washington Boulevard	13	5	0
84th Avenue Northeast	12	1	0
92nd Avenue Northeast	3	3	0
104th Avenue Northeast	10	2	0
108th Avenue Northeast	12	4	0

Exhibit 4-35. Summary of SR 520 Accidents by Type

	Fixed Object	Rear End	Enter at Angle	Side Swipe	Overturn	Other	Total Accidents
Eastbound Mainline	16%	70%	6%	4%	1%	3%	436
Eastbound Ramps	22%	53%	13%	3%	2%	7%	57
Westbound Mainline	23%	62%	7%	5%	1%	2%	641
Westbound Ramps	23%	60%	10%	1%	3%	3%	82

Source: WSDOT (2004b).

As shown in Exhibit 4-35, the majority of the accidents were rear-end accidents, with 70 percent and 62 percent for the eastbound and westbound mainline, respectively, and 53 percent and 60 percent for the eastbound and westbound ramps, respectively. Rear-end accidents are primarily caused by congestion and/or poor sight distance. Along the SR 520 corridor, the following substandard design conditions contribute to the high occurrence of rear end accidents:

- Mainline
  - Substandard ramp merge/diverge areas

  - Congested roadway conditions
  - Minimal shoulder widths
  - Limited horizontal sight distance

- Ramps
  - Substandard ramp merge/diverge areas
  - Ramp grades exceed minimum design standards
  - Ramp connection between mainline and city streets do not meet guidelines for acceleration/deceleration lengths and tapers

Accidents involving vehicles hitting fixed objects also made up a relatively high percentage of the total accidents, with 16 percent and 23 percent for the eastbound and westbound mainline, respectively, and 22 percent and 23 percent for the eastbound and westbound ramps, respectively. Fixed-object accidents result from the proximity of moving traffic to bridge piers, jersey barriers, guardrails, and other barriers to moving traffic. The following conditions contribute to the occurrence of fixed-object accidents along the SR 520 corridor:

- Mainline—Lack of adequate shoulders in Seattle and Lake Washington sections
- Ramps—Ramp connections between mainline and city streets do not meet guidelines for acceleration/deceleration lengths and tapers

What are the High Accident Locations (HALs)?

WSDOT provided the team with a list of High Accident Corridors, High Accident Locations, and Pedestrian Accident Locations in the study area. WSDOT defines each of these as follows:

- High Accident Corridor (HAC)—a 1-mile or longer section of highway that has experienced a higher than average number of severe accidents over a period of time.
- Pedestrian Accident Location (PAL)—a section of highway where four or more vehicle-pedestrian collisions have occurred in a 6-year period.
- High Accident Location (HAL)—a section of highway less than a mile long that experienced a higher than average number of severe accidents over a period of time.

No HACs or PALs have been identified along the SR 520 corridor in recent years. The following four locations within the study area were identified as HALs between 2001 and 2002:

- SR 520 mainline near I-5 interchange—milepost 0.00 to 0.31
- SR 520 westbound on-ramp from Montlake Boulevard—milepost 0.00 to 0.22
- SR 520 eastbound on-ramp from Montlake Boulevard—milepost 0.00 to 0.42
- SR 520 westbound off-ramp to Lake Washington Boulevard—milepost 0.07 to 0.27

These HALs are shown in Exhibit 4-36, which also shows the total number of accidents in each of these locations between 2000 and 2002. The following accident patterns were observed for these HALs:

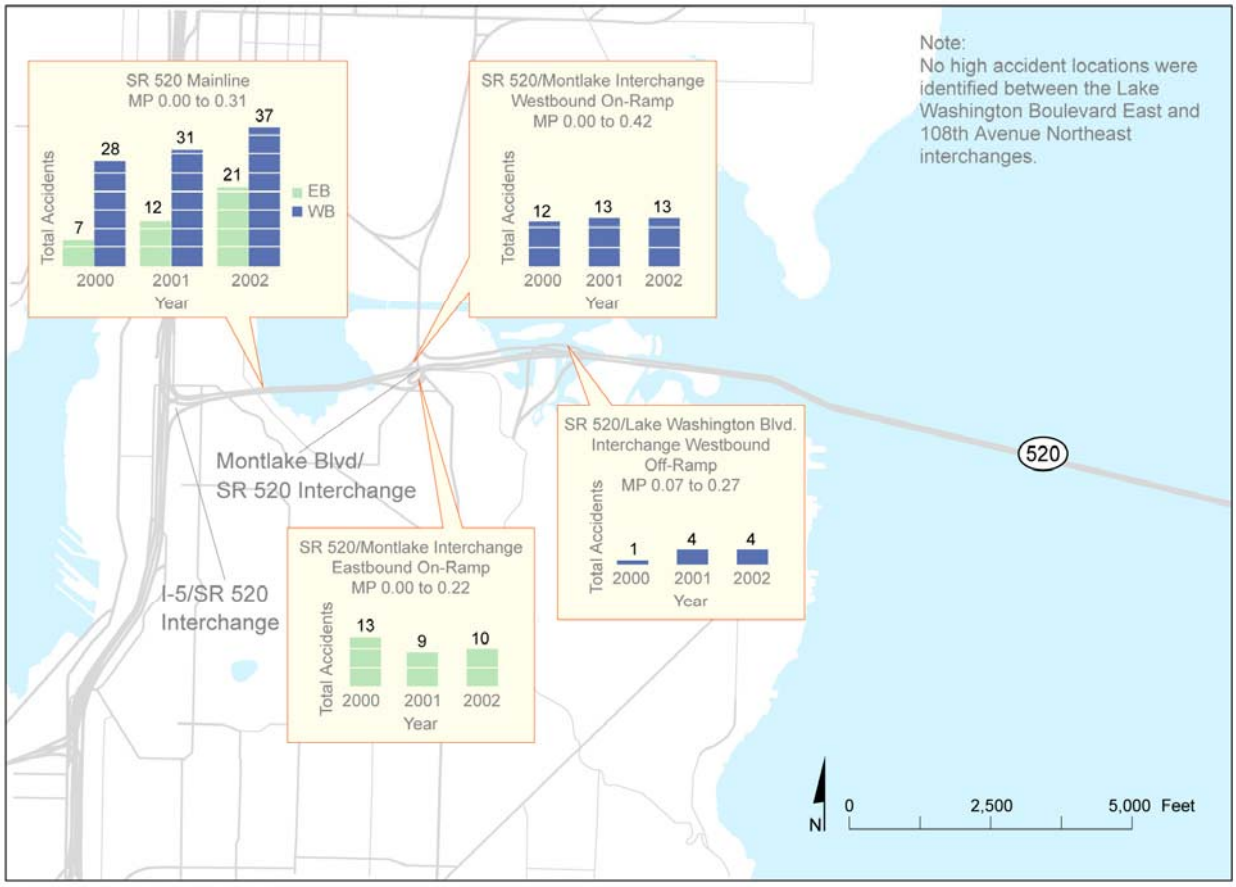


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Exhibit 4-36. Summary of SR 520 High Accident Locations

- SR 520 Mainline near I-5 Interchange (MP 0.00 to 0.31)—The majority of accidents recorded in this segment of the SR 520 mainline involved vehicles traveling westbound. Many of these accidents involved vehicles striking fixed objects (such as bridge rails, concrete barrier, or guardrail) on wet pavement during daylight hours. Several rear-end accidents were also reported in this mainline segment. The lack of adequate shoulders in this area, the transition to lower design speeds at the I-5 interchange ramps (35 mph), and high congestion levels during peak periods of the day are all contributing factors.
- SR 520 Westbound On-Ramp from Montlake Boulevard (MP 0.00 to 0.22)—The majority of accidents recorded at this HAL were rear-end accidents. Accidents primarily occurred during daylight hours under both wet and dry pavement conditions. The short merge/taper lengths at this on-ramp are a probable cause for many of these accidents.
- SR 520 Eastbound On-Ramp from Montlake Boulevard (MP 0.00 to 0.42)—The majority of accidents recorded at this HAL were rear-end accidents. One fatality, recorded in 2000, resulted from a head-on collision at on-ramp milepost 0.11. Most accidents at this location occurred during daylight hours, with either wet or dry pavement conditions. This on-ramp is currently metered and has short merge/taper lengths. These factors likely contribute to the high occurrence of rear-end accidents.
- SR 520 Westbound Off-Ramp to Lake Washington Boulevard (MP 0.07 to 0.27)—The majority of accidents recorded at this HAL involved vehicles striking fixed objects. Most accidents at this location occurred during daylight hours, with either wet or dry pavement conditions. The high occurrence of fixed-object accidents can be attributed to the short taper length from the mainline and the sharp horizontal curve that currently exists on the off-ramp.

What effect will the project alternatives have on freeway safety?

How can the facility design features improve safety?

In many cases, the proposed build alternatives could reduce the potential for accidents along the SR 520 mainline and ramps. This is especially true in areas where design deficiencies currently exist and/or where congestion occurs. Exhibit 4-37 highlights some of the design

features associated with each of the alternatives. These features are described in the following sections. Potential changes that could affect HALs in the SR 520 corridor are identified in Exhibit 4-38 and are also described below.

4-Lane Alternative

Mainline and ramp shoulder widths would be improved along the SR 520 corridor with the 4-Lane Alternative. Inside shoulder widths would be 4 feet and outside shoulder widths would be 10 feet along the SR 520 mainline. Ramp shoulder widths would be 8 feet. On- and off-ramp tapers would be lengthened at all project merge/diverge areas. Although the 4-Lane Alternative would not include any major capacity improvements to SR 520, the number of fixed-object and rear-end accidents may be reduced by the proposed design improvements.

In addition to shoulder widening, the SR 520 mainline near I-5 would be improved by increased deceleration and taper lengths and a new westbound auxiliary lane. These changes would likely improve safety in this HAL.

The westbound on-ramp from Montlake Boulevard would be reconstructed with wider shoulders and a longer acceleration and merge area, which should reduce the occurrence of rear-end accidents in this area.

Wider shoulders and an increased acceleration and merge area would also be provided at the eastbound on-ramp from Montlake Boulevard. These improvements would likely have a positive effect on safety in this area.

The westbound off-ramp to Lake Washington Boulevard would be reconstructed with wider shoulders, a longer deceleration and taper area, and an increased ramp radius. These design changes should reduce the occurrence of fixed-object accidents on this off-ramp.

6-Lane Alternative

The 6-Lane Alternative would add an eastbound and westbound HOV lane and also would increase mainline and ramp shoulder widths along the SR 520 corridor. Ten-foot shoulders would be provided along both sides of the SR 520 mainline, and ramp shoulders would be widened to 8 feet. On- and off-ramp tapers would be lengthened at all project merge/diverge areas. The number of fixed-object and rear-end accidents may be reduced by these design improvements.

Exhibit 4-37. SR 520 Mainline Design Features by Alternative

		Existing Facility	4-Lane Alternative	6-Lane Alternative
Mainline Design				
Access Control	Seattle	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access
	Lake Washington	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access
	Eastside	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access
Lane Width	Seattle	12 feet	12 feet	12 feet
	Lake Washington	12 feet	12 feet	12 feet
	Eastside	12 feet	12 feet	12 feet
Median Type/Width (e.g., barrier, median, multilevel)	Seattle	Jersey barrier	Jersey barrier	Jersey barrier
	Lake Washington	Jersey barrier	Jersey barrier	Jersey barrier
	Eastside	Jersey barrier	Jersey barrier	Jersey barrier
Inside Shoulder Width	Seattle	1 foot	4 feet	10 feet
	Lake Washington	1 foot	4 feet	10 feet
	Eastside	1 foot	4 feet	10 feet
Outside Shoulder Width	Seattle	Curb (1-2 feet)	10 feet	10 feet
	Lake Washington	Curb (1-2 feet)	10 feet	10 feet
	Eastside	Westbound—1 foot Eastbound 6-10 feet	10 feet	10 feet
HOV Lanes	Seattle	None	None	Both Directions
	Lake Washington	None	None	Both Directions
	Eastside	Westbound	Westbound	Both Directions

Exhibit 4-37. SR 520 Mainline Design Features by Alternative

		Existing Facility	4-Lane Alternative	6-Lane Alternative
Pedestrian Accommodation	Seattle	Pedestrians prohibited	14-foot bike/pedestrian lane on north side from Montlake Boulevard Interchange to east	14-foot bike/pedestrian lane on north side from Montlake Boulevard Interchange to east
	Lake Washington	Pedestrians prohibited	14-foot bike/pedestrian lane on north side	14-foot bike/pedestrian lane on north side
	Eastside	Pedestrians prohibited	14-foot bike/pedestrian lane on south side to 96th Avenue Northeast	14-foot bike/pedestrian lane on south side to 96th Avenue Northeast
Ramp Design				
Maximum Grade (up or down)	Seattle	7%	7%	7%
	Lake Washington	Not applicable	Not applicable	Not applicable
	Eastside	6%	6%	6%
Location of Merged On-Ramps	Seattle	I-5 eastbound on-ramp, Montlake Boulevard eastbound on-ramp, Montlake Boulevard westbound on-ramp, Lake Washington eastbound on-ramp	I-5 eastbound on-ramp, Montlake Boulevard eastbound on-ramp, Montlake Boulevard westbound on-ramp, Lake Washington eastbound on-ramp	I-5 eastbound on-ramp, Montlake Boulevard eastbound on-ramp, Montlake Boulevard westbound on-ramp, Lake Washington eastbound on-ramp
	Lake Washington	Not applicable	Not applicable	Not applicable
	Eastside	84th westbound on-ramp, 92nd eastbound on-ramp, 104th westbound on-ramp, 108th eastbound on-ramp, 108th westbound on-ramp	84th westbound on-ramp, 92nd eastbound on-ramp, 104th westbound on-ramp, 108th eastbound on-ramp, 108th westbound on-ramp	84th westbound on-ramp, 92nd eastbound on-ramp, 104th westbound on-ramp, 108th eastbound on-ramp, 108th westbound on-ramp
Ramp Taper Designs	Seattle	On-ramps—20:1 Off-ramps—10:1	On-ramps—50:1 Off-ramps—20:1	On-ramps—50:1 Off-ramps—20:1
	Lake Washington	Not applicable	Not applicable	Not applicable
	Eastside	On-ramps—20:1 Off-ramps—10:1	On-ramps—50:1 Off-ramps—20:1	On-ramps—50:1 Off-ramps—20:1

Exhibit 4-38. Potential to Improve or Degrade Safety at High Accident Locations

	Year 2030 4-Lane Alternative	Year 2030 6-Lane Alternative
Existing HAL Locations—SR 520 Mainline		
East of I-5 Ramps (MP 0.00 to 0.31)	Potentially improved due to increased shoulder widths, increased deceleration and taper lengths, and a new westbound auxiliary lane	Potentially improved due to increased shoulder widths, increased deceleration and taper lengths, and new westbound and eastbound auxiliary lanes
Existing HAL Locations—SR 520 Interchange Ramps		
Westbound On-Ramp from Montlake Boulevard	Potentially improved due to increased shoulder widths, increased acceleration and merge length, and a new westbound auxiliary lane	Potentially improved due to increased shoulder widths, increased acceleration and merge length, and a new westbound auxiliary lane
Eastbound On-Ramp from Montlake Boulevard	Potentially improved due to increased shoulder widths and increased acceleration and merge length	Potentially improved due to increased shoulder widths and increased acceleration and merge length
Westbound Off-Ramp to Lake Washington Boulevard	Potentially improved due to increased shoulder widths, increased deceleration and taper length, and increased ramp radius	Potentially improved due to increased shoulder widths, increased deceleration and taper length, and increased ramp radius

Note: Wider inside shoulder widths in the 6-Lane Alternative may provide greater accident reduction benefits than the 4-Lane Alternative.

With the 6-Lane Alternative, the SR 520 mainline near I-5 would be widened to include 10-foot shoulders, increased deceleration and taper lengths, and new westbound and eastbound auxiliary lanes. These changes would likely improve safety in this HAL. Safety benefits with the 6-Lane Alternative would likely be greater than under the 4-Lane Alternative, because of wider inside shoulder widths and increased mainline capacity.

Similar to the 4-Lane Alternative, the westbound on-ramp from Montlake Boulevard would be reconstructed with wider shoulders and a longer acceleration and merge area, which should reduce the occurrence of rear-end accidents in this area.

Similar to the 4-Lane Alternative, wider shoulders and an increased acceleration and merge area would also be provided at the eastbound on-ramp from Montlake Boulevard with the 6-Lane Alternative. These improvements would likely have a positive effect on safety in this location.

Improvements at the westbound off-ramp to Lake Washington Boulevard would also be similar under both the 4- and 6-Lane Alternatives. Improvements would include widened shoulders, a longer deceleration and taper area, and an increased ramp radius. These design changes should reduce the occurrence of fixed-object accidents on this off-ramp.

What conclusions can be drawn?

- The increase in vehicles under the No Build Alternative will increase congestion on northbound and southbound I-5. I-5 congestion affects SR 520 in two ways: (1) I-5 traffic destined to eastbound SR 520 is not served (during either the a.m. or p.m. peak periods) because it is stuck in I-5 congestion, and (2) congestion from I-5 extends onto SR 520 as far back as I-405 during the a.m. peak period.
- I-5 congestion affects operations on SR 520 and results in nearly double the average travel time between I-5 and 124th Avenue Northeast compared to today.
- Under the 4-Lane Alternative, even with the reduction in vehicle demand crossing SR 520, I-5 is still forecast to operate over capacity and cause severe congestion on SR 520 in the westbound direction

during the a.m. peak period. This severe congestion results in travel time impacts on all traffic. Carpools and buses have a slightly better travel time than GP because of the existing length of HOV lane between 124th Avenue Northeast and 76th Avenue Northeast.

- The primary issue with the 4-Lane Alternative is that, even if more buses were provided to serve the high transit demand, they would not be served any faster than is shown in the current analysis because the HOV lane does not provide a congestion bypass across the SR 520 bridge.
- The 6-Lane Alternative would have the capacity to move more people in less time than both the No Build and 4-Lane Alternatives. With the completed HOV lanes across SR 520, more people would be served per hour (compared to the No Build Alternative), increasing the AVO to 2.26 occupants per vehicle. Compared with the No Build Alternative, GP travel times would decrease from 27 to 21 minutes between I-5 and 124th Avenue Northeast and HOV lane travel times would decrease from 23 to 10 minutes. Carpools and bus traffic would benefit greatly from this alternative with this substantially faster travel time.
- The 6 Lane alternative would also remove the conflict points between the HOV lane and the on-ramps by moving the HOV lane to the center. GP vehicles entering and exiting the freeway would no longer have to cross through the HOV lane in order to get to the GP lanes. With the 6 Lane Alternative, transit agencies could provide more frequent and more reliable bus service because buses would be able to bypass the congestion in the GP lanes.

Chapter 5: Local Traffic Operations

What is in this chapter?

This chapter describes how the project alternatives would affect the way traffic operates on local streets near the SR 520 Interchange.

Why is it important to study traffic operations on local streets adjacent to the SR 520 interchanges?

SR 520's interchanges have an effect on the local streets that connect with them. Changes in traffic volumes and patterns on the freeway will change traffic operations on these streets. The transportation discipline team studied traffic operations on local streets adjacent to the SR 520 interchanges to determine the effects of each alternative on traffic volumes and congestion, nonmotorized vehicle operations, and safety. An operational analysis was completed for each of the 2030 alternatives to determine what effect the changes in traffic freeway volumes would have on the local intersections.

What aspects of the local street system were studied and why?

The transportation project team studied the following aspects of the local street system:

- **Traffic Operations and Congestion**—Traffic volumes were forecast for the local arterials adjacent to the SR 520 interchanges for the No Build, 4-Lane, and 6-Lane Alternatives. The change in traffic demand and travel patterns and how they would affect operations on the local street system is different for each alternative. These differences will ultimately be important decision factors in identifying a preferred alternative. In addition, local jurisdictions have established standards for traffic operations; the analysis results will let them know whether and to what degree each alternative would meet their established standards.

- **Interface Between Nonmotorized (Pedestrian and Bicycle) Amenities and Local Streets**—Pedestrian and bicycle travel are important components of any travel corridor; they often link together to form an entire commute trip. For example, a commuter may walk or bike to a bus stop or park-and-ride, catch a bus across the lake, and then walk or bike the rest of the way to work. Therefore, it is important to study the effects of each alternative on nonmotorized travel. "Amenities" refers to intersection modifications needed to serve pedestrians and bicyclists. Regional pedestrian and bicycle improvements are discussed in *Chapter 6: Nonmotorized Facilities*.

- **Accident History**—The history of accidents at intersections and along streets often reveals problems in a transportation network. Project engineers can identify geometric (design) or congestion issues using information from a study of accident frequencies and types (rear-end, head-on, side angle). They can then propose design modifications to improve safety within the transportation network.

How were local street traffic operations analyzed?

The transportation discipline team analyzed local street traffic operations using a traffic modeling software package called Synchro. The team evaluated intersection operations because intersections control the capacity of the local street network. The evaluation used the forecast traffic volumes for travel during commuter peak hour periods, specifically the morning and late afternoon peak periods for conditions in the base year (2000) and the design year (2030). Peak hour traffic volumes were collected from the cities of Seattle, Bellevue, Kirkland, Medina, Clyde Hill, Hunts Point, and Yarrow Point. Traffic data collection companies conducted traffic counts at locations where data were not available from the cities. Future (2030) freeway mainline and ramp traffic volumes were developed using the methodology described in *Chapter 3: Freeway and Local Traffic Forecasts*.

Traffic conditions for street systems are typically measured for a single peak hour during the longer a.m. and p.m. weekday commuter peak periods. During the a.m. commute period, existing freeway volumes in the study area generally peak from 7:45 a.m. to 8:45 a.m.; during the p.m. commute period, they peak from 5:00 p.m. to 6:00 p.m. However, due to the dynamic nature of the SR 520 corridor, peak hour volumes for the local traffic analysis are based on the highest 15-minute freeway flows during the 6:00 a.m. to 9:00 a.m. morning peak period and the

3:00 p.m. to 6:00 p.m. late afternoon peak period, overlain upon the local street a.m. and p.m. peak hour volumes.

The analysis of existing intersection operations used existing signal timing and phasing information obtained from each jurisdiction. All operational analyses for future conditions used optimized signal and network settings (except phasing) to provide a similar comparison of operations for the alternatives. Please see Exhibit 5-1 for an explanation of how signal and network optimization can affect traffic operations.

Signal phasing was also revised and optimized at a few freeway ramp intersections to improve operations. The project team used intersection level of service (LOS) to compare traffic operations between project alternatives. At some locations where the LOS was below E, maximum volume-to-capacity (V/C) ratios and queue spillback locations were also used to compare traffic operations across the alternatives. LOS, V/C ratio, and queue spillback are defined and described below. For a more detailed description of the traffic forecasting methodology, see *Chapter 3: Freeway and Local Traffic Forecasts.*

Did you know?

The Year 2030 No Build Alternative conditions are *sometimes* better than existing conditions. This happens because the existing system may not be optimized for the interchange area. The No Build Alternative analysis includes an optimized signal system as part of its definition. So, conditions can improve despite traffic volume changes because of signal optimization improvements.

Exhibit 5-1. **Existing and Year 2030 No Build Alternative Conditions**

What is a maximum volume-to-capacity (V/C) ratio, and what does it mean?

Measuring intersection V/C ratios helps traffic engineers to highlight operational constraints at intersections and identify the most effective improvements. The V/C ratio compares the amount of traffic on a roadway (the 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 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, etc.). For instance, given the same lane layout, the longer the signal is green, the more vehicles that can move through the intersection in that lane. At an intersection, V/C ratios are calculated for the groups of lanes approaching the intersection. The maximum V/C ratio for the intersection as a whole represents the most constrained group of lanes at that intersection—

that is, the lanes through which the least amount of traffic is able to move.

Generally, intersections with V/C ratios greater than 1 but less than 1.10 (i.e., those up to 10 percent over capacity) are good candidates for improvement using signal optimization. Intersections with V/C ratios approaching 2.0, or nearly 100 percent over capacity, generally require reconstruction in order for operations to improve. For conditions in between these extremes, a combination of physical improvements and signal optimizations may provide adequate capacity. For instance, lane markings can be changed to create turning lanes or additional lanes, and signal operations can be optimized for this new arrangement.

What is a queue spillback location?

A queue spillback occurs where a queue from a downstream intersection fills up all of the space on a segment of roadway and prevents vehicles from entering the upstream intersection when the light is green. In other words, vehicles cannot proceed through an intersection because vehicles are backed up from the next intersection. As shown in Exhibit 5-2, the location at which a vehicle is blocked from moving through an intersection is referred to as the queue spillback location. This chapter discusses queue spillbacks on local streets; spillbacks from freeway on-ramps onto the local street system are discussed in Chapter 4.

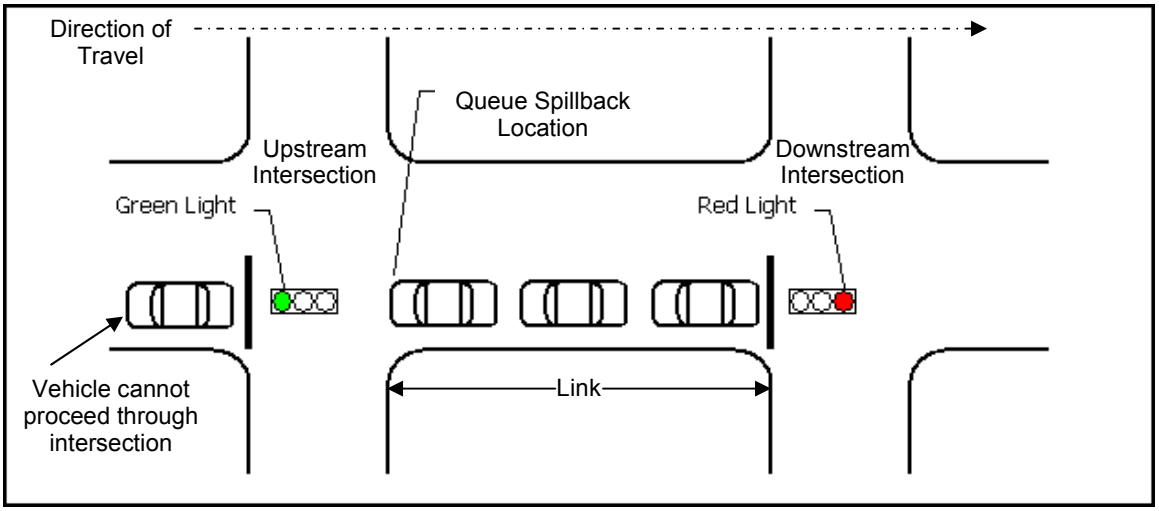


Exhibit 5-2. **Queue Spillback Location**

Source: Synchro User Guide, Version 610, Trafficware Company, Albany, CA

What is level of service and how is it applied?

Level of service (LOS) rates the quality of traffic operations on a given transportation facility. The rating scale uses the letters A through F, similar to grading scales used in the education system, where A is the best grade and F the worst. The letter grades are assigned based on the levels of delay that drivers experience at an intersection. The letter A represents the least-delayed conditions, while the letter F represents the most-delayed conditions. For intersections controlled by signals and all-way stops, LOS represents an average delay for the entire intersection. For two-way-stop controlled intersections, LOS represents the most-delayed leg of the intersection. Delays are calculated using various factors, including V/C ratios (see *What is a maximum volume-to-capacity (V/C) ratio and what does it mean?*).

For this report, the overall intersection LOS is reported for all unsignalized intersections, regardless of the type of intersection (four-way, two-way, uncontrolled ramp termini where left turns yield to oncoming traffic). Because Synchro only provides a "letter" LOS for four-way, stop-controlled intersections, it is necessary to develop a methodology for determining "letter" LOS for the other unsignalized intersections. 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 movement that must either stop or yield. For this project, this average intersection delay is used to estimate a "letter" LOS for the overall intersection using the *Highway Capacity Manual* (HCM), (Transportation Research Board 2000) ranges of reported delay, as shown in Exhibit 5-3. For example, if Synchro reports an average delay of 5.9 seconds per vehicle at a 2-way stop intersection, project engineers report an LOS A, using the HCM standard of an average delay of 10 seconds or less per vehicle. If the LOS for the stop or yield movement is LOS D or worse, traffic operations for this movement are discussed in text.

Which intersections were studied?

Project team engineers studied traffic operations at each ramp terminal intersection in the project. In some of the interchange areas, they also studied intersections adjacent to the ramp terminal intersections that

would be affected by the project alternatives. Exhibit 5-4 shows the interchange areas and their associated study intersections.

Exhibit 5-3. **Delay Ranges Associated with LOS Ratings**

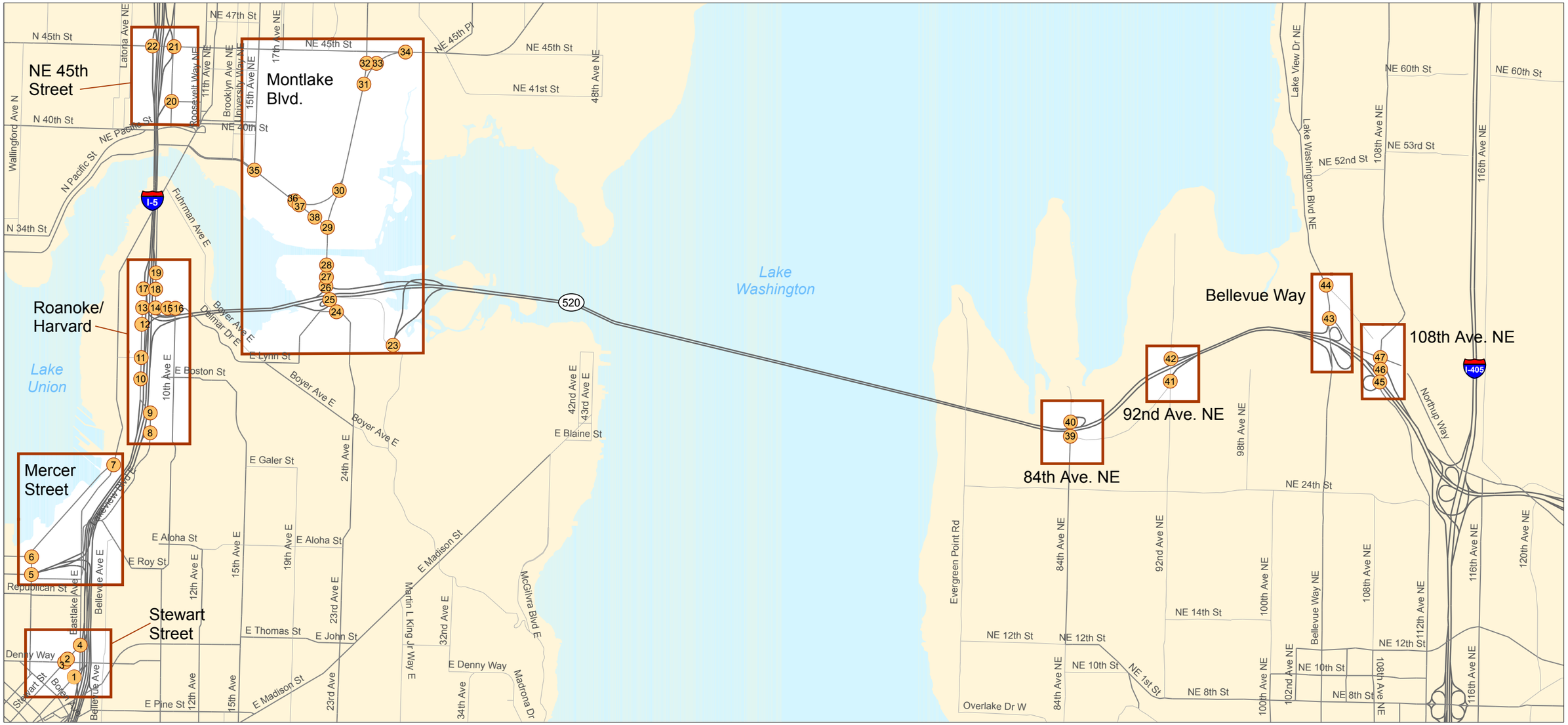
		Ranges of Reported Delay	
LOS	**Conditions**	**Signalized Intersections (seconds/vehicle)**	**Stop-Controlled Intersections (seconds/vehicle)**
A	Best (Short Delay)	≤10	≤10
B	↓	>10 and ≤20	> 10 and ≤15
C		>20 and ≤35	> 15 and ≤25
D		>35 and ≤55	> 25 and ≤35
E		>55 and ≤80	> 35 and ≤50
F	Worst (Long Delay)	>80	> 50

Source: HCM (Transportation Research Board 2000).

What is the accident and safety history record in the study area?

Accident data were reviewed for all interchange ramp terminus intersections between I-5 and the 108th Avenue Northeast interchange to identify locations where accidents between 2000 and 2002 occurred at a higher than average rate. Seattle, Hunts Point, Yarrow Point, Medina, Clyde Hill, and Bellevue provided the transportation discipline team with accident data for interchange ramp terminus intersections for this time period. In reviewing the data, the team decided that signalized intersections with 10 or more collisions in 12 consecutive months and unsignalized intersections with 5 or more collisions in 12 consecutive months would be defined as having higher than average accident rates.

Exhibit 5-5 shows the average annual number of accidents that have occurred at each intersection studied during the 3-year period between January 1, 2000, and December 31, 2002. None of the interchange ramp terminus intersections experienced higher than average accident rates during this time. The highest occurrence of accidents was recorded at the Montlake Boulevard East/East Hamlin Street intersection, with an average of 7 accidents per year in the 3-year period. Most of these accidents were rear-end or sideswipe types. This intersection is located close to the SR 520 westbound on- and off-ramps and the Montlake Boulevard East/East Shelby Street intersection. In addition, many vehicles traveling between the SR 520 ramps and Northeast Pacific Street weave from one lane to another in this area. The area is typically



LEGEND

1 Intersection

Interchange Area

Stewart Street
1 Yale Ave./Howell St./I-5 SB On-Ramp
2 Yale Ave./Stewart St.
3 Denny Way/Stewart St.
4 John/Stewart/Eastlake

Mercer Street
5 Mercer St./I-5 Ramps
6 Fairview Ave./Valley St.
7 Fairview Ave./Eastlake Ave.

Roanoke/Harvard
8 Lakeview Blvd./I-5 NB Off-Ramp
9 Lakeview Blvd./Harvard Ave.
10 Boylston Ave./E Boston St.
11 Boylston Ave./E Lynn St.
12 Boylston Ave./E Louisa St.
13 Boylston Ave./E Roanoke St.
14 E Roanoke St./Harvard Ave./SR 520 WB Off-Ramp
15 E Roanoke St./Broadway Ave.
16 E Roanoke St./10th Ave.
17 Boylston Ave./E Edgar St.
18 E Edgar St./Harvard Ave.
19 E Hamlin St./Harvard Ave./I-5 NB On-Ramp

NE 45th Street
20 NE 42nd St./7th Ave. NE
21 NE 45th St./7th Ave. NE
22 NE 45th St./5th Ave. NE

Montlake Boulevard
23 SR 520 Arboretum Ramps
24 Montlake Blvd./E Roanoke St.
25 Montlake Blvd./SR 520 EB Ramps/ Lake Washington Blvd.
26 Montlake Blvd./SR 520 WB Ramps
27 Montlake Blvd./E Hamlin St.
28 Montlake Blvd./E Shelby St.
29 Montalke Blvd./Pacific St.
30 Montlake Blvd./Pacific Pl.
31 Montlake Blvd./25th Ave. NE
32 25th Ave. NE/Pend Orielle Rd.
33 Montlake Blvd./NE 44th St.
34 Montlake Blvd./NE 45th St.
35 15th Ave. NE/Pacific St.
36 Pacific St./Pacific Pl.
37 Pacific St./Hospital Exit
38 Pacific St./Hospital Emergency Entrance

84th Ave
39 84th Ave. NE/SR 520 EB Off-Ramp
40 84th Ave. NE/SR 520 WB On-Ramp

92nd Ave
41 92nd Ave. NE/SR 520 EB On-Ramp
42 92nd Ave. NE/SR 520 WB Off-Ramp

Bellevue Way
43 Lake Washington Blvd. NE/Northup Way
44 Lake Washington Blvd. NE/NE 38th Pl.

108th Ave
45 108th Ave. NE/SR 520 EB On-Ramp
46 108th Ave. NE/SR 520 WB Ramps
47 108th Ave. NE/Northup Way

N 0 2,500 5,000 Feet

Exhibit 5-4. **Interchange Areas and Analysis Intersections**
SR 520 Bridge Replacement and HOV Project

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congested during peak commute hours, which further increases the potential for accidents at the intersection.

Exhibit 5-5. **Local Street Intersections—Average Annual Accidents between January 1, 2000, and December 31, 2002**

With both build alternatives, the Montlake Boulevard/SR 520 westbound ramps intersection would be signalized, and the existing u-turn movement at the Montlake Boulevard East/East Hamlin Street intersection would be removed. These design changes would reduce some of the weaving activity in this area, which in turn could reduce rear-end and sideswipe accidents. Coordinating the signals in this area would also improve traffic flow, which could reduce congestion and improve traffic safety.

What are the local traffic operations analysis results?

This section presents the results of the Synchro traffic model results by interchange area. The interchange areas were defined using the influence areas shown in Exhibit 1-5 as a base. The influence areas were further subdivided into individual interchange areas so as to focus the local traffic analysis results. The interchange areas, shown in Exhibit 5-4, are as follows:

- Stewart Street Interchange Area
- Mercer Street Interchange Area
- East Roanoke Avenue Interchange Area

- Northeast 45th Street Interchange Area
- Montlake Boulevard Interchange Area
- 84th Avenue Northeast Interchange Area
- 92nd Avenue Northeast Interchange Area
- Bellevue Way Interchange Area
- 108th Avenue Northeast Interchange Area

The LOS operational results are presented in a summary exhibit for each interchange area. Mini-graphics are also provided for each intersection experiencing changes in LOS.

Seattle

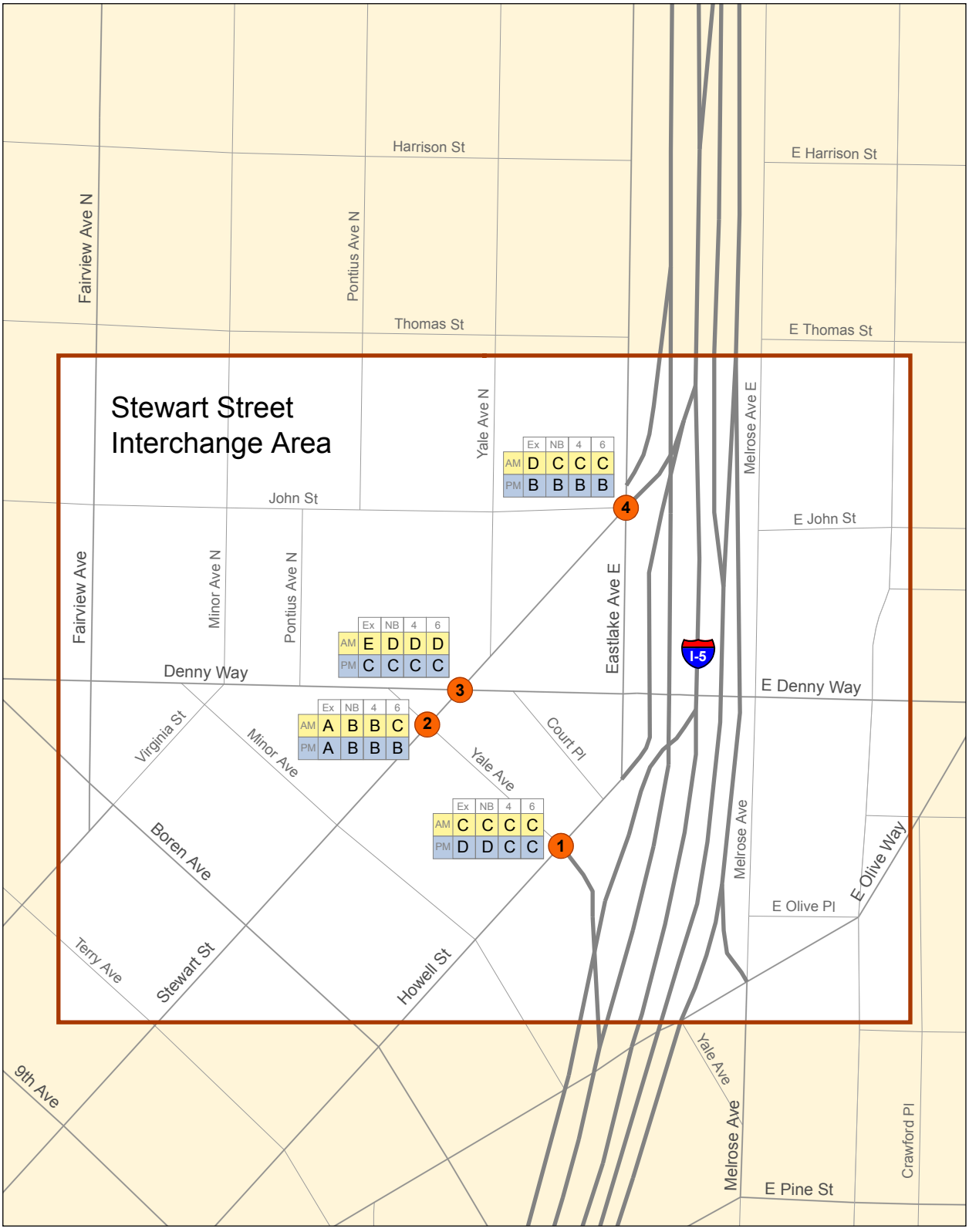
Stewart Street Interchange Area

The Stewart Street interchange area is shown in Exhibit 5-6. The exhibit highlights which intersections were analyzed within the Stewart Street interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses the change in traffic volumes from today and for all future alternatives. The LOS results shown in Exhibit 5-6 and traffic operations at each intersection are also discussed in detail.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-7 shows Stewart Street interchange area traffic volumes today and for the 2030 alternatives during the a.m. peak hour. The traffic volumes shown represent the total traffic at that location on both sides of the street. For instance, volumes listed for a location north of an intersection are the sum of the northbound traffic leaving the intersection and southbound traffic approaching the intersection. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts*.



LEGEND

1 Study signalized intersection

5 Study unsignalized intersection

No Build — 4-Lane
Existing — 6-Lane

	Ex	NB	4	6
A.M. Peak Hour AM	D	C	C	C
P.M. Peak Hour PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 250 500 Feet

Exhibit 5-6. **Stewart Street Interchange Area**

SR 520 Bridge Replacement and HOV Project

Exhibit 5-7. A.M. Peak Hour Traffic Volumes for Local Streets at the Stewart Street Interchange Area

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
Eastlake Avenue north of Stewart Street	640	620	590	630	-20	-3%	-30	-5%	10	2%
Denny Way west of Stewart Street	1250	1170	1150	1220	-80	-6%	-20	-2%	50	4%
Denny Way east of Stewart Street	1880	1800	1770	1850	-80	-4%	-30	-2%	50	3%
Yale Avenue northwest of Stewart Street	250	260	260	250	10	4%	0	0%	-10	-4%
Stewart Street southwest of Yale Avenue	2040	1890	1960	2000	-150	-7%	70	4%	110	6%
Howell Street southwest of Yale Avenue	1050	1100	1110	1110	50	5%	10	1%	10	1%
Total of Locations	7110	6840	6840	7060	-270	-4%	0	0%	220	3%

No Build Alternative

Overall, No Build Alternative traffic volumes would decrease by 4 percent compared with existing traffic volumes during the a.m. peak hour in 2030. Traffic volumes would decrease as a result of higher use of transit and HOV for trips to and from downtown Seattle because of increased congestion on I-5 and SR 520.

4-Lane Alternative

The 4-Lane Alternative traffic volumes would be the same as No Build Alternative traffic volumes during the a.m. peak hour in 2030. This is the result of the toll on the Evergreen Point Bridge, which would cause traffic patterns to shift.

6-Lane Alternative

Overall, 6-Lane Alternative traffic volumes would increase by 3 percent compared with No Build traffic volumes during the a.m. peak hour in 2030. Diversion of traffic to other routes due to tolling would be offset by the increase in HOV capacity and improved freeway operations with the 6-Lane Alternative improvements.

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-8 shows existing and future Stewart Street interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts*.

Exhibit 5-8. **P.M. Peak Hour Traffic Volumes for Local Streets at the Stewart Street Interchange Area**

Location	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
	Existing	No Build	4-Lane	6-Lane	(vph)	(%)	(vph)	(%)	(vph)	(%)
Eastlake Avenue north of Stewart Street	780	970	940	950	190	24%	-30	-3%	-20	-2%
Denny Way west of Stewart Street	1350	1410	1430	1460	60	4%	20	1%	50	4%
Denny Way east of Stewart Street	1880	1940	1950	2000	60	3%	10	1%	60	3%
Yale Avenue northwest of Stewart Street	420	410	390	400	-10	-2%	-20	-5%	-10	-2%
Stewart Street southwest of Yale Avenue	960	960	950	1000	0	0%	-10	-1%	40	4%
Howell Street southwest of Yale Avenue	1680	1850	1850	1910	170	10%	0	0%	60	3%
Total of Locations	7070	7540	7510	7720	470	7%	-30	0%	180	2%

No Build Alternative

Overall, No Build Alternative traffic volumes would increase by 7 percent on local streets in the Stewart Street interchange area during the p.m. peak hour in 2030. This reflects growth that is forecast to occur between now and 2030.

4-Lane Alternative

Overall, 4-Lane Alternative traffic volumes would decrease slightly (30 vph less), yet in terms of percent change, they would be the same as No Build Alternative traffic volumes during the p.m. peak hour in 2030.

Year 2030 6-Lane Alternative

Traffic volumes for the 6-Lane Alternative would increase by 2 percent over the No Build Alternative in 2030. As with the a.m. peak hour, diversion of traffic to other routes due to tolling would be offset by the increase in HOV capacity and improved freeway operations with the 6-Lane Alternative improvements.

How would the project affect traffic operations?

This section describes how the project alternatives would affect traffic operations at the interchange area by comparing operations under the 4-Lane and 6-Lane Alternatives to operations under the No Build Alternative. The results are presented by intersection for those intersections that would experience a change in LOS with the build alternatives.

At this interchange area, intersection operations would generally be worse in the a.m. peak hour than the p.m. peak hour because of express lane traffic exiting at the Stewart Street/Eastlake Avenue intersection. Exhibit 5-6 provides a full summary of traffic operations in the Stewart Street interchange area.

One intersection (Stewart Street/Eastlake Avenue East—Location 4) would operate at the same LOS for all future alternatives during the a.m. and p.m. peak hours without any capacity and queuing issues, and therefore is not discussed.

Howell Street/Yale Avenue/I-5 Southbound On-Ramp Intersection (Exhibit 5-6, Location 1)

Existing Conditions

This signalized intersection currently provides access to I-5 southbound for the north part of downtown Seattle.

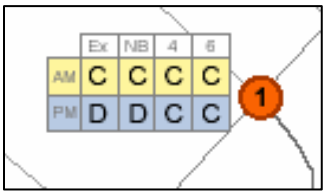


Exhibit 5-6a. **Howell Street/I-5 Southbound On-Ramp LOS**

Under existing conditions, this intersection operates at LOS C during the a.m. peak hour. Capacity is sufficient for all movements; however, the southeastbound through/right queue on Yale Avenue extends back through the Stewart Street/Yale Avenue intersection because the two intersections are so close together.

During the p.m. peak hour, this intersection operates at LOS D. The southeastbound through/right lane is over capacity (all other lanes have capacity remaining) and the queue extends back through the Stewart Street/Yale Avenue intersection, as it does during the a.m. peak hour.

No Build Alternative

Under No Build Alternative conditions, operations at this intersection in 2030 would be at LOS C during the a.m. peak hour and LOS D during the p.m. peak hour.

4-Lane Alternative

During the a.m. peak hour, this intersection would continue to operate at LOS C in 2030, as it would under No Build Alternative conditions.

During the p.m. peak hour, intersection operations would improve from LOS D under the No Build Alternative to C under the 4-Lane Alternative because of a slight decrease in traffic volumes for northbound right turns (10 vehicles per hour) and eastbound through movements (20 vph less). These slight changes in traffic volumes would improve the LOS because the No Build Alternative operates near the threshold where LOS D changes to LOS C.

6-Lane Alternative

This intersection would operate at the same level as the 4-Lane Alternative (LOS C) during both the a.m. and p.m. peak hours in 2030.

Yale Avenue/Stewart Street Intersection (Exhibit 5-6, Location 2)

Existing Conditions

This signalized intersection currently operates on the same traffic signal controller as the Denny Way/Stewart Street intersection. Yale Avenue connects Denny Way to southbound I-5.

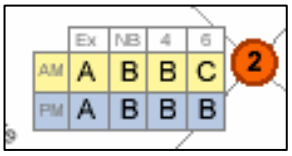


Exhibit 5-6b. **Yale Avenue/ Stewart Street LOS**

Under existing conditions, this intersection operates at LOS A during the a.m. peak hour. Capacity is available for all movements; however, since Denny Way is so close, southeast-bound traffic queues onto it.

During the p.m. peak hour, this intersection operates at LOS A. As during the a.m. peak hour, again, capacity is available for all movements and southeast-bound traffic queues onto Denny Way.

No Build Alternative

This intersection would operate at an LOS of B during both the a.m. and p.m. peak hours in 2030.

4-Lane Alternative

This intersection would continue to operate at LOS B in 2030 (same as under No Build Alternative) during both the a.m. and p.m. peak hours.

6-Lane Alternative

During the a.m. peak hour in 2030, intersection operations would shift from LOS B under No Build to C under the 6-Lane Alternative because southbound through volumes on Stewart Street would increase by 110 vehicles per hour (vph) over No Build Alternative conditions.

During the p.m. peak hour, intersection operations would be the same as under No Build Alternative conditions (LOS B).

Denny Way/Stewart Street (Exhibit 5-6, Location 3)

Existing Conditions

This signalized intersection currently operates on the same traffic signal controller as the Yale Avenue/Stewart Street intersection. Denny Way crosses I-5 and routes traffic between Capitol Hill and Seattle. Stewart Street routes traffic between I-5 and downtown Seattle.

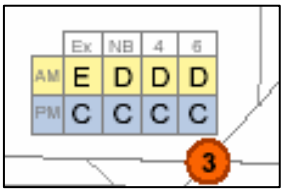


Exhibit 5-6c. **Denny Way/ Stewart Street LOS**

Under existing conditions, this intersection operates at LOS E during the a.m. peak hour because the westbound left-turn and southwest-bound approach are over capacity (all other lane groups have capacity remaining). The over-capacity southwest-bound approach also queues back through the Stewart Street/Eastlake Avenue East intersection.

During the p.m. peak hour, this intersection operates at LOS C. Capacity is available for all movements, and queues do not extend into adjacent intersections.

No Build Alternative

While this intersection would operate at LOS D during the a.m. and peak hour in 2030, southbound queues on Stewart Street would spill back to the Stewart Street/Eastlake Avenue East intersection because this approach is slightly over capacity, with a V/C ratio of 1.02. The queue lengths would not vary significantly between alternatives and would not affect intersection operations at the Stewart Street/Eastlake Avenue East intersection.

During the p.m. peak hour, this intersection would operate at LOS C, with very little queuing.

4-Lane Alternative

During the a.m. peak hour in 2030, this intersection would operate at LOS D, like the No Build Alternative. The V/C ratio would increase slightly from 1.02 to 1.04 for the Stewart Street southbound approach.

During the p.m. peak hour, this intersection would continue to operate at LOS C, as under No Build Alternative conditions.

6-Lane Alternative

Operation at this intersection during the a.m. peak hour would be similar to the 4-Lane Alternative in 2030, with a V/C ratio of 1.05. During the p.m. peak hour, this intersection would continue to operate at LOS C, as under No Build Alternative conditions.

How would the project affect traffic circulation in the Stewart Street interchange area?

Although freeway traffic volumes would change as a result of the project, they are expected to maintain a distribution similar to today's traffic. The project would not change local traffic circulation in this interchange area. The total on-street traffic would change between existing conditions and the future alternatives; the changes would result in slightly less traffic through the area in the a.m. peak hour, and slightly more traffic during the p.m. peak hour.

How would the project affect the pedestrian and bicycle amenities in the Stewart Street interchange area?

Pedestrian and bicycle amenities would not change from existing conditions at this interchange because the project design does not include changes to the local street system.

What are the findings for the Stewart Street interchange area?

- Generally, traffic would operate well at the Stewart Street interchange area across all of the future build alternatives, with an LOS of D or better.
- The future build alternatives would not greatly affect traffic operations at the Stewart Street interchange area. The 4-Lane and 6-Lane Alternatives would have virtually the same effect on traffic operations within this area.
- Under the project alternatives, traffic operations would be slightly better during the p.m. peak hour for the Yale Avenue/Stewart Street, Denny Way/Stewart Street, and Eastlake Avenue East/Stewart Street intersections because the I-5 express lane off-ramp to Stewart Street would not operate during the p.m. peak hour.

- Conversely, traffic operations at the Howell Street/Yale Avenue/I-5 Southbound on-ramp would be better during the a.m. peak hour than the p.m. peak hour because the I-5 express lane on-ramp from Howell Street would not operate during the a.m. peak hour.

Mercer Street Interchange Area

The Mercer Street interchange area is shown in Exhibit 5-9. The exhibit highlights which intersections were analyzed within the interchange area and shows the LOS results from the Synchro traffic analysis.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-10 shows the existing and future Mercer Street interchange area traffic volumes during the a.m. peak hour. The volumes shown represent the total traffic at that location on both sides of the street. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

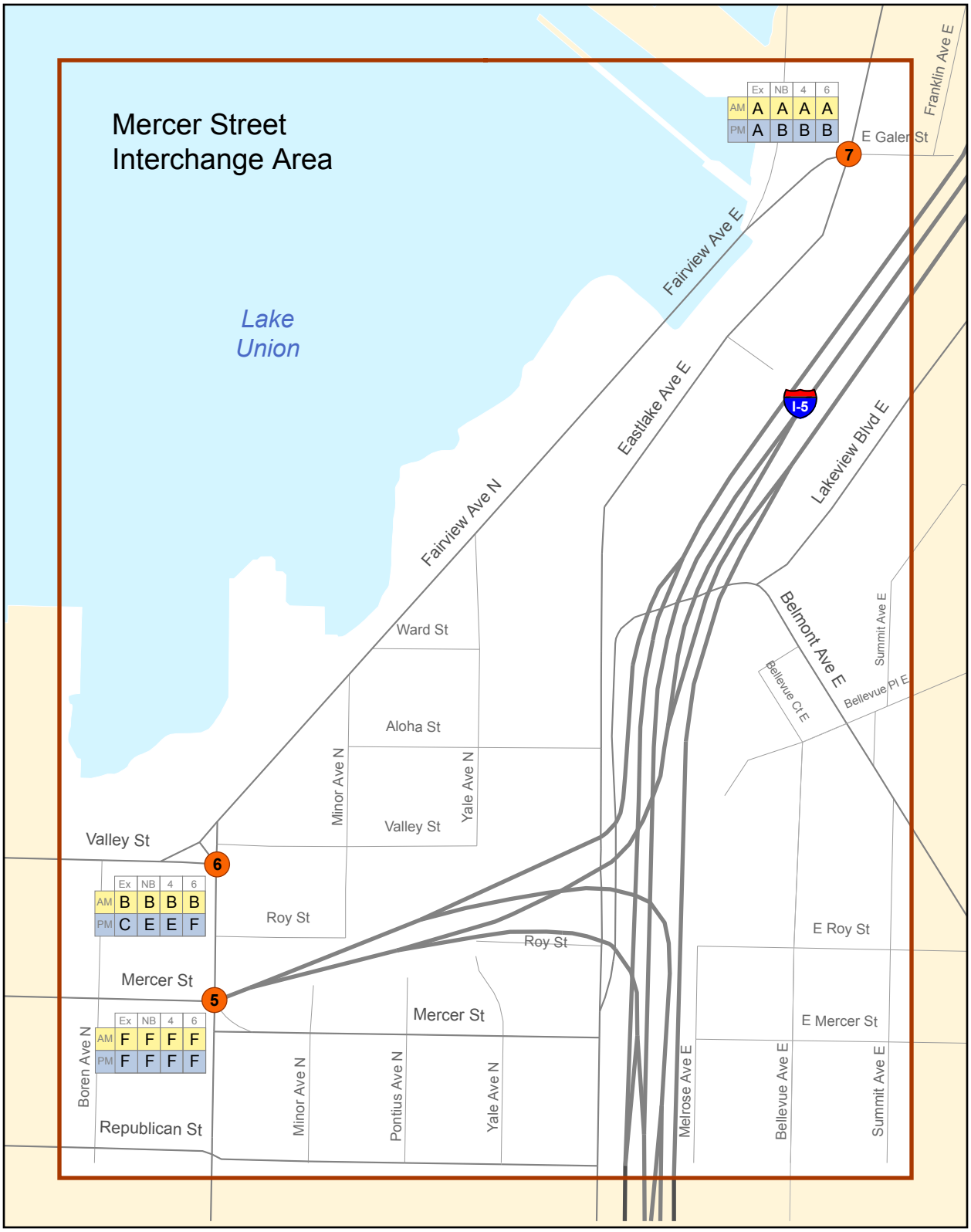
Overall, No Build Alternative traffic volumes would decrease by 4 percent from existing traffic volumes during the a.m. peak hour in 2030. This would result from higher use of transit and HOV for trips to and from downtown Seattle because of increased congestion on I-5 and SR 520.

4-Lane Alternative

During the a.m. peak hour, 4-Lane Alternative traffic volumes would increase slightly (10 vph), yet in terms of percent change, they would be the same as under the No Build Alternative in 2030. This slight shift in traffic volumes could be due to changing traffic patterns resulting from the toll on the Evergreen Point Bridge.

6-Lane Alternative

Overall, 6-Lane Alternative traffic volumes would increase by 3 percent over No Build volumes during the a.m. peak hour in 2030. Diversion of traffic due to tolling would be offset by increased HOV capacity and improved freeway operations with the 6-Lane Alternative improvements.



LEGEND

1 Study signalized intersection

5 Study unsignalized intersection

No Build — Existing — 4-Lane — 6-Lane

		Ex	NB	4	6
A.M. Peak Hour	AM	D	C	C	C
P.M. Peak Hour	PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 250 500 Feet

Exhibit 5-9. **Mercer Street Interchange Area**

SR 520 Bridge Replacement and HOV Project

Exhibit 5-10. **A.M. Peak Hour Traffic Volumes for Local Streets at the Mercer Street Interchange Area**

					Change Between					
	Total 2-Way Peak Hour Volume				No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	Existing	No Build	4-Lane	6-Lane	(vph)	(%)	(vph)	(%)	(vph)	(%)
Mercer Street west of Fairview Avenue	2200	2350	2270	2350	150	7%	-80	-3%	0	0%
Fairview Avenue north of Mercer Street	2970	2640	2710	2770	-330	-11%	70	3%	130	5%
Fairview Avenue south of Mercer Street	1870	1790	1810	1870	-80	-4%	20	1%	80	4%
Total of Locations	7060	6780	6790	6990	-280	-4%	10	0%	210	3%

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-11 shows the existing and 2030 Mercer Street interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

Exhibit 5-11. **P.M. Peak Hour Traffic Volumes for Local Streets at the Mercer Street Interchange Area**

					Change Between					
	Total 2-Way Peak Hour Volume				No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	Existing	No Build	4-Lane	6-Lane	(vph)	(%)	(vph)	(%)	(vph)	(%)
Mercer Street west of Fairview Avenue	4070	4410	4360	4510	340	8%	-50	-1%	100	2%
Fairview Avenue north of Mercer Street	2440	2420	2450	2530	-20	-1%	30	1%	110	5%
Fairview Avenue south of Mercer Street	2240	2470	2480	2570	230	10%	10	0%	100	4%
Total of Locations	8750	9300	9290	9610	550	6%	-10	0%	310	3%

No Build Alternative

Overall, No Build Alternative traffic volumes would increase by 6 percent over existing traffic volumes during the p.m. peak hour in 2030. This reflects growth that is forecast to occur between now and 2030.

4-Lane Alternative

During the p.m. peak hour in 2030, traffic volumes for the 4-Lane Alternative traffic volumes would decrease slightly (by 10 vph), yet in terms of percent change, they would be the same as under the No Build Alternative. This slight shift could be due to the toll on the Evergreen Point Bridge.

6-Lane Alternative

The 6-Lane Alternative would increase traffic volumes by 3 percent over the No Build Alternative in 2030. Diversion of traffic due to tolling would be offset by increased HOV capacity and improved freeway operations with the 6-Lane Alternative improvements.

How would the project affect traffic operations?

This section describes how the 2030 alternatives would affect traffic operations at the interchange area and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection.

As shown in Exhibit 5-9, the Eastlake Avenue East/Fairview Avenue North intersection (Location 7) would operate at the same LOS for all of the future alternatives during the a.m. and p.m. peak hours without any capacity and queuing issues, and therefore is not discussed. The intersection of Mercer Street with the I-5 ramps also operates at the same LOS under all of the project alternatives; however, operations at this intersection are discussed to address queuing issues.

Mercer Street/Fairview Avenue/I-5 Ramps Intersection (Exhibit 5-9 Location 5)

Existing Conditions

This signalized intersection currently provides northbound and southbound access to I-5. Mercer Street connects the Seattle Center area, Queen Anne, South Lake Union, and Elliott Avenue with I-5.

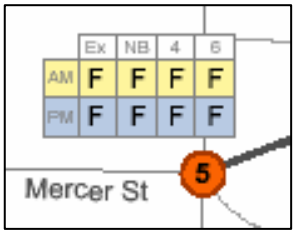


Exhibit 5-9a. **Mercer Street/ I-5 Ramps LOS**

Under existing conditions, this intersection operates at LOS F during the a.m. peak hour because of the over-capacity westbound approach and northbound through movement. All other lane groups have capacity remaining during this time. During the p.m. peak hour, this intersection operates at LOS F because of the over-capacity westbound approach, eastbound through, and northbound right-turn movements. All other lane groups have capacity remaining.

No Build Alternative

This ramp terminus intersection operates at LOS F today during the a.m. peak hour because westbound right (V/C=1.40), westbound left (V/C=1.33), and northbound through (V/C=1.17) traffic volumes exceed capacity. Without modification, it would continue to operate at LOS F under No Build Alternative conditions for the a.m. and p.m. peak hours in 2030.

As shown in Exhibit 5-12, under No Build Alternative conditions, the eastbound through (EBT) traffic volumes also would exceed capacity (V/C=1.29) during the a.m. peak hour. However, the northbound through (NBT) traffic volumes would be served through signal optimization and network coordination, reducing the V/C ratio to 0.79. Overall, operations at this intersection would fail because the eastbound and westbound movements would be over capacity.

	No Build	4-Lane	6-Lane
EBT	1.29	1.22	1.26
EBR	0.95	1.00	1.06
WBL	1.21	1.23	1.27
WBR	1.35	1.39	1.43
NBT	0.79	0.79	0.83
NBR	0.27	0.26	0.27
SBT	0.19	0.19	0.19

Exhibit 5-12. **A.M. Peak Hour V/C Ratios by Movement for the Mercer/I-5 Ramps Intersection**

Queues during the a.m. peak hour would be greatest for westbound traffic, which would accumulate on the southbound I-5 Mercer Street off-ramp. The ramp provides approximately 2,500 feet of storage capacity; the queues would not exceed this distance. Therefore, the queues would not affect traffic operations on I-5.

This intersection also currently operates at LOS F today during the p.m. peak hour. Eastbound through (V/C=1.75), westbound left (V/C=1.22), westbound right (V/C=1.16), and northbound right (V/C=1.78) traffic volumes exceed capacity (see Exhibit 5-13). Without modification, it would continue to operate at LOS F under No Build conditions, while the eastbound right (V/C=1.48) and northbound through (V/C=1.13) traffic volumes would also exceed capacity. All traffic volumes for all movements would exceed capacity during the p.m. peak hour, except for the westbound left and southbound through movements.

	No Build	4-Lane	6-Lane
EBT	1.87	1.83	1.90
EBR	1.48	1.52	1.56
WBL	0.78	0.79	0.81
WBR	1.13	1.15	1.19
NBT	1.13	1.15	1.21
NBR	1.36	1.34	1.39
SBT	0.37	0.37	0.37

Exhibit 5-13. **P.M. Peak Hour V/C Ratios by Movement for the Mercer/I-5 Ramps Intersection**

Queues during the p.m. peak hour would be greatest for all eastbound traffic and for northbound right-turning traffic because of the demand to access I-5. However, these queues would not affect traffic at adjacent intersections.

4-Lane Alternative

As shown in Exhibits 5-12 and 5-13, most of the V/C ratios would change only slightly between the No Build and 4-Lane Alternatives for

both the a.m. and p.m. peak hours by 2030. The 4-Lane Alternative would add capacity to SR 520, but not to this intersection.

During the a.m. peak hour, the largest V/C ratio increase would be for the westbound right-turn traffic volumes because of a 70 vph increase in traffic volumes. The largest decrease in V/C ratio would be for the eastbound through movement because of a 100 vph decrease in traffic volumes.

During the p.m. peak hour, the largest V/C ratio increase would be for the eastbound right-turn movement because of a 20 vph increase in traffic volumes. The largest decrease in V/C ratio would be for the eastbound through movement because of an 80 vph decrease in traffic volumes.

6-Lane Alternative

As shown in Exhibits 5-12 and 5-13, most of the V/C ratios would change only slightly between the No Build and 6-Lane Alternatives for both the a.m. and p.m. peak hours by 2030. The 6-Lane Alternative would add capacity to SR 520, but not to this intersection.

During the a.m. peak hour, the biggest V/C ratio increase (from 0.95 to 1.06) would be for the eastbound right-turn movement because of a 30 vph increase in traffic volumes. The biggest decrease in V/C ratio decrease would be for the eastbound through movement because of a 50 vph decrease in traffic volumes. Queues would be similar to No Build Alternative conditions.

Under the 6-Lane Alternative, V/C ratios in the p.m. peak hour would increase for all movements. The biggest V/C ratio increase would be for the eastbound right-turn and northbound through movements, which would increase from 1.48 to 1.56 and 1.13 to 1.21, respectively. The eastbound right-turn and northbound through movements would both increase by 30 vph. Queues would be similar to No Build Alternative conditions.

Fairview Avenue/Valley Street Intersection (Exhibit 5-9, Location 6)

Existing Conditions

This signalized intersection currently provides westbound movement toward the Seattle Center area and Queen Anne for traffic exiting from I-5 at the Mercer Street/Fairview Avenue/I-5 ramps intersection because Mercer Street is one-way eastbound. Valley Street connects the east Lake Union area to Seattle Center and Queen Anne.

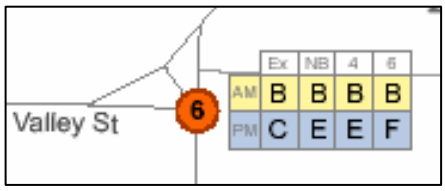


Exhibit 5-9b. **Fairview Avenue/ Valley Street LOS**

Under existing conditions, this intersection operates at LOS B during the a.m. peak hour. Capacity is available for all lane groups; however, the northbound left-turn movement is near capacity, and the northbound left-turn queue does back up through the intersection.

During the p.m. peak hour, this intersection operates at LOS C. As during the a.m. peak hour, capacity is available for all lane groups, but the northbound left-turn movement is near capacity and backs up through the intersection.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS B during both the a.m. peak hour and at LOS E during the p.m. peak hours in 2030. During the p.m. peak hour, the southwest-bound through (Fairview Avenue to Valley Street) and northbound left turn movements are over capacity, with maximum V/C ratios of 1.11 and 1.15 respectively.

4-Lane Alternative

This intersection would operate at the same LOS as under the No Build Alternative in 2030. The maximum V/C ratios would increase slightly from 1.11 to 1.13 for the southwest-bound through movement and from 1.15 to 1.16 for the northbound left-turn movement.

6-Lane Alternative

During the a.m. peak hour, this intersection would operate at the same LOS as under No Build conditions in 2030.

During the p.m. peak hour, intersection operations would drop by one level of service, from LOS E to LOS F, because of a slight increase in congestion that would increase the delay per vehicle at the intersection. The increased congestion is caused by an additional 60 vph for the

Valley Street eastbound through movement, an additional 110 vph for the Fairview Avenue northbound left-turn movement, and an additional 50 vph for the Fairview Avenue southwest-bound through movement onto Valley Street. Combined, this is an increase of 210 vph through an intersection that was already operating above capacity under No Build conditions. With this increase in traffic, the Valley Street eastbound through movement would just exceed capacity with a maximum V/C ratio of 1.01. The southwest-bound through movement V/C ratio would increase from 1.13 to 1.16, and the northbound left-turn movement V/C ratio would increase from 1.16 to 1.17. Even with the increase in traffic, northbound left-turning traffic would not queue back to the Mercer/I-5 ramps intersection because it would be metered by the congested traffic conditions at that intersection. Metered traffic is defined in Exhibit 5-14.

Did you know?

What is metered traffic?

Metered traffic occurs when congestion at an intersection prevents cars from reaching the next intersection. Therefore, the congested intersection controls or *meters* the amount of traffic getting to the next or "downstream" intersection. Because traffic cannot get to the downstream intersection, it can operate with a good LOS.

Exhibit 5-14. **Definition of Metered Traffic**

How would the project affect traffic circulation in the Mercer Street interchange area?

Some small increases in traffic would occur; however, local traffic circulation patterns would not change because of the project. Total on-street traffic would change between existing conditions and the project alternative. During the a.m. peak hour, there would be less traffic than exists today. During the p.m. peak hour, there would be more traffic.

The additional traffic volume at the Eastlake/Fairview intersection that would occur under the 6-Lane Alternative could represent traffic that has diverted from I-5 to the local street system to access downtown Seattle. Drivers could choose the local street system because of increased congestion at the I-5/ SR 520 Interchange. As mentioned above, this diversion would not change neighborhood traffic circulation patterns, but would result in slightly more traffic through the area.

How would the project affect the pedestrian and bicycle amenities in the Mercer Street interchange area?

Pedestrian and bicycle amenities would not change at this interchange because the project design does not include changes to the local street system.

What are the findings for the Mercer Street interchange area?

- Generally, the future build alternatives would not negatively affect traffic operations at intersections in the Mercer Street interchange area, except for the Valley Street/Fairview Avenue North intersection under the 6-Lane Alternative, where LOS would shift from E to F.
- The 4-Lane and 6-Lane Alternatives would have a similar effect on traffic operations within the Mercer Street interchange area.
- The Mercer Street/Fairview Avenue North intersection is over capacity now and would continue to be under all future alternatives.
- Queues at the Mercer Street/Fairview Avenue North intersection would not affect operations on I-5.
- The 6-Lane Alternative would increase traffic through this area, particularly the Eastlake Avenue East/Fairview Avenue East intersection. This is because drivers would choose the local street system rather than I-5 to access downtown Seattle, due to increased congestion at the I-5/SR 520 Interchange.

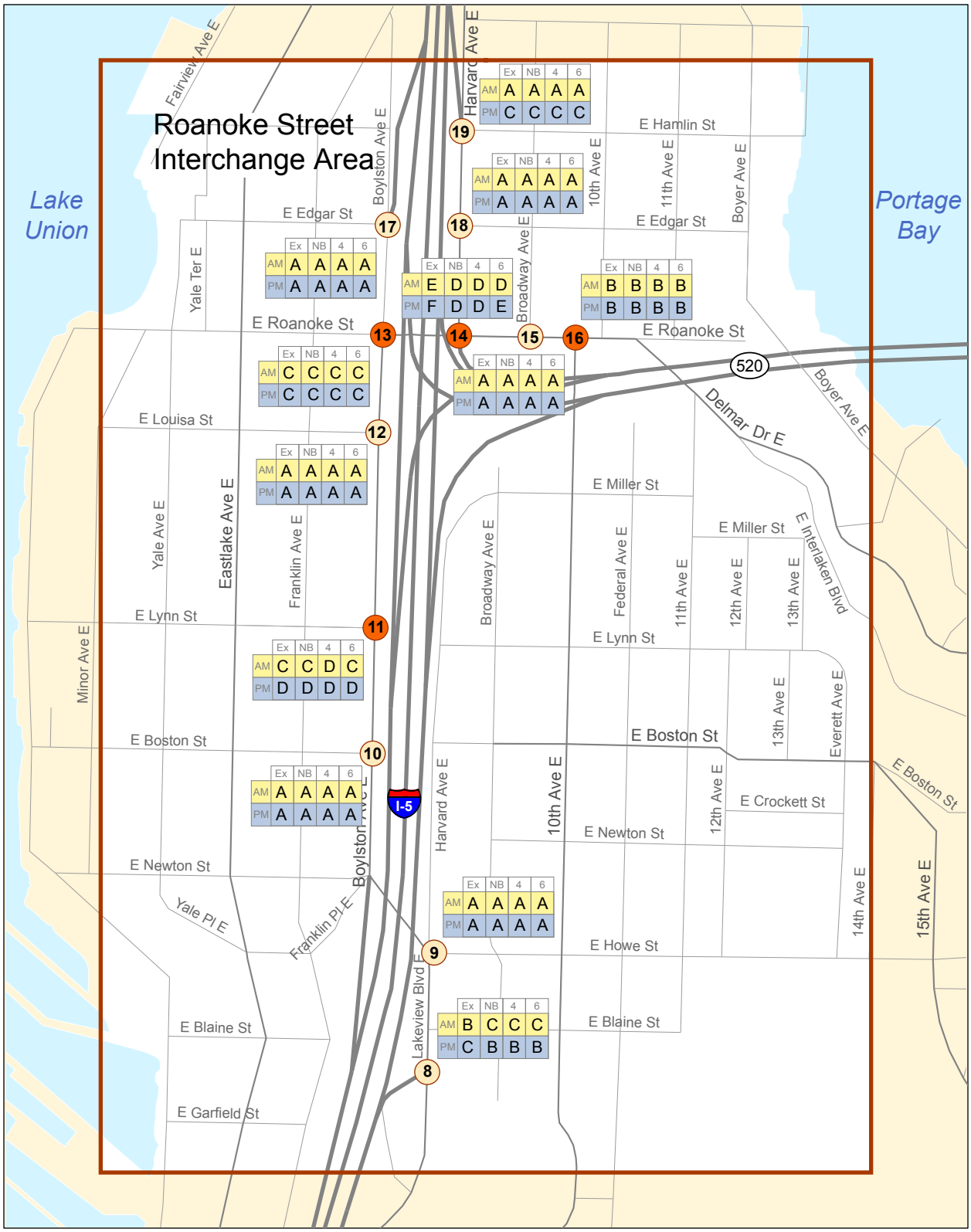
Roanoke Street Interchange Area

The Roanoke Street interchange area is shown in Exhibit 5-15. The exhibit highlights which intersections were analyzed within the interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses traffic volumes for existing conditions and all 2030 alternatives. The LOS results shown in Exhibit 5-15 and traffic operations at the intersections are also discussed in detail by intersection.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-16 shows existing and 2030 Roanoke Street interchange area traffic volumes during the a.m. peak hour. The volumes shown include traffic on both sides of the street; for instance, volumes listed for a location north of an intersection are the sum of the northbound traffic leaving the intersection and the southbound traffic approaching the intersection. The changes in traffic volumes are briefly described below.



LEGEND

- (1) Study signalized intersection
- (5) Study unsignalized intersection

No Build — Existing — 4-Lane — 6-Lane

	Ex	NB	4	6
A.M. Peak Hour AM	D	C	C	C
P.M. Peak Hour PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 500 1,000 Feet

Exhibit 5-15. **Roanoke Street Interchange Area**

SR 520 Bridge Replacement and HOV Project

Exhibit 5-16. **A.M. Peak Hour Traffic Volumes for Local Streets at the Roanoke Street Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
Harvard Avenue north of East Hamlin Street	840	930	960	960	90	11%	30	3%	30	3%
East Roanoke Street east of Harvard Avenue	1930	2120	2140	2140	190	10%	20	1%	20	1%
East Roanoke Street west of Boylston Avenue	400	440	440	440	40	10%	0	0%	0	0%
East Lynn Street west of Boylston Avenue	800	870	860	860	70	9%	-10	-1%	-10	-1%
Lakeview Boulevard south of I-5 northbound ramp	430	500	510	510	70	16%	10	2%	10	2%
Total of Locations	4400	4860	4910	4910	460	10%	50	1%	50	1%

For more information regarding traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

Overall, No Build Alternative traffic volumes would increase by 10 percent over existing traffic volumes during the a.m. peak hour by 2030.

4-Lane Alternative

The 4-Lane Alternative traffic volumes would be only slightly greater (1 percent) than No Build Alternative traffic volumes during the a.m. peak hour by 2030. Traffic patterns would shift as a result of the toll on the Evergreen Point Bridge.

6-Lane Alternative

Similar to the 4-Lane Alternative, traffic volumes would be only slightly greater (1 percent) than No Build traffic volumes during the a.m. peak hour by 2030.

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-17 shows existing and 2030 Roanoke Street interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below.

Exhibit 5-17. **P.M. Peak Hour Traffic Volumes for Local Streets at the Roanoke Street Interchange Area**

					Change Between					
	Total 2-Way Peak Hour Volume				No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	Existing	No Build	4-Lane	6-Lane	(vph)	(%)	(vph)	(%)	(vph)	(%)
Harvard Avenue north of East Hamlin Street	1130	1250	1250	1280	120	11%	0	0%	30	2%
East Roanoke Street east of Harvard Avenue	2040	2180	2190	2290	140	7%	10	0%	110	5%
East Roanoke Street west of Boylston Avenue	390	410	430	430	20	5%	20	5%	20	5%
East Lynn Street west of Boylston Avenue	790	840	850	880	50	6%	10	1%	40	5%
Lakeview Boulevard south of I-5 northbound ramp	630	680	680	710	50	8%	0	0%	30	4%
Total of Locations	4980	5360	5400	5590	380	8%	40	1%	230	4%

For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts*.

No Build Alternative

No Build Alternative traffic volumes would increase by 8 percent on the local streets at the Roanoke Street interchange area during the p.m. peak hour in 2030. This reflects growth that is forecast to occur between now and 2030.

4-Lane Alternative

Overall, 4-Lane Alternative traffic volumes would increase slightly (by 40 vph or 1 percent) compared with the No Build Alternative traffic volumes during the p.m. peak hour in 2030.

6-Lane Alternative

Overall, 6-Lane Alternative traffic volumes would increase by 4 percent over No Build Alternative traffic volumes in 2030. Diversion of traffic due to tolling would be offset by increased HOV capacity and improved freeway operations with 6-Lane Alternative improvements.

How would the project affect traffic operations?

This section describes how the 2030 alternatives would affect traffic operations at the interchange area and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection.

As shown in Exhibit 5-15, the project would only have negative effects on the operation of the East Roanoke Street/Harvard Avenue East/SR 520 westbound off-ramp intersection. The remaining eleven intersections would operate at LOS D or better for all future alternatives.

The following intersections would operate at the same LOS for all of the future alternatives during the a.m. and p.m. peak hours without any capacity and queuing issues, and therefore are not discussed:

- Harvard Avenue East/Lakeview Boulevard (Location 9)
- Boylston Avenue East/East Boston Street (Location 10)
- Boylston Avenue East/East Louisa Street (Location 12)
- Boylston Avenue East/East Roanoke Street (Location 13)
- Broadway Avenue East/East Roanoke Street (Location 15)
- 10th Avenue East/East Roanoke Street (Location 16)
- Boylston Avenue East/East Edgar Street (Location 17)
- Harvard Avenue East/East Edgar Street (Location 18)

The following intersections also would operate at the same LOS for all of the future alternatives; however, operations at these intersections are discussed to address capacity and queuing issues:

- I-5 northbound off-ramp/Lakeview Boulevard (Location 8)
- I-5 northbound on-ramp/Harvard Avenue East (Location 19)

The following intersections would experience a change in LOS for one of the future alternatives as compared with the No Build Alternative, and therefore are discussed below:

- Boylston Avenue East/East Lynn Street (Location 11)

- East Roanoke Street/Harvard Avenue East/SR 520 westbound off-ramp (Location 14)

I-5 Northbound Off-Ramp/Lakeview Boulevard Intersection (Exhibit 5-15, Location 8)

Existing Conditions

This unsignalized intersection currently provides local neighborhood access from northbound I-5. Lakeview Boulevard passes under I-5 and connects the east Lake Union area with the west side of Capitol Hill. The I-5 northbound off-ramp is stop-controlled, and Lakeview Boulevard has the right-of-way.

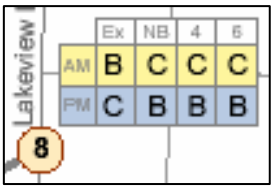


Exhibit 5-15a. **I-5 Northbound Off-Ramp/Lakeview Boulevard LOS**

Under existing conditions, this intersection operates at LOS B during the a.m. peak hour. Traffic exiting from northbound I-5 operates at LOS D because it stops for traffic on Lakeview Boulevard. Capacity is available for all lane groups, and the off-ramp traffic does not queue onto I-5.

During the p.m. peak hour, this intersection operates at LOS C. Traffic exiting from northbound I-5 operates at LOS E because it stops for traffic on Lakeview Boulevard. As during the a.m. peak hour, capacity is available for all lane groups and the off-ramp traffic does not queue back onto I-5.

No Build Alternative

During the a.m. peak hour, this intersection would operate at LOS C in 2030. While the intersection would operate overall at LOS B during the p.m. peak hour, traffic exiting from northbound I-5 would operate at LOS D because it is required to stop at the end of the ramp, creating delay. Each vehicle would experience an average of 29 seconds of delay at this intersection. However, this ramp is not over capacity, and queues would not affect operations on I-5.

4-Lane Alternative

This intersection would continue to operate at LOS C during the a.m. peak hour in 2030, as under No Build Alternative conditions.

During the p.m. peak hour, intersection operations would remain the same as under No Build Alternative conditions, with LOS B for the overall intersection and LOS D for traffic exiting from northbound I-5. Available capacity and queues would not change from No Build Alternative conditions.

6-Lane Alternative

This intersection would continue to operate at LOS C during the a.m. peak hour in 2030, as under No Build Alternative conditions. During the p.m. peak hour, intersection operations would also remain the same as under No Build Alternative conditions, with LOS B for the overall intersection and LOS E for traffic exiting from northbound I-5. Available capacity and queues would not change from No Build Alternative conditions.

Boylston Avenue East/East Lynn Street (Exhibit 5-15, Location 11)

Existing Conditions

This signalized intersection provides access to East Lynn Street, which connects Boylston Avenue East to Eastlake Avenue East and the east side of Lake Union.

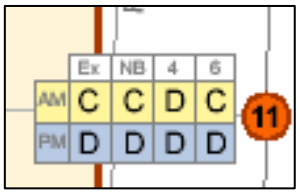


Exhibit 5-15b. **Boylston Avenue East/East Lynn Street LOS**

Under existing conditions, this intersection operates at LOS C during the a.m. peak hour. Capacity is available for all lane groups, and traffic does not queue into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS D. Traffic exiting from northbound I-5 operates at LOS E because it stops for traffic on Lakeview Boulevard. As during the a.m. peak hour, capacity is available for all lane groups, and traffic does not queue into adjacent intersections.

No Build Alternative

In 2030, this intersection would operate at LOS C during the a.m. peak hour and LOS D during the p.m. peak hour. There would be no capacity or queuing issues during either peak hour.

4-Lane Alternative

During the a.m. peak hour in 2030, the LOS would shift from C to D because of an increase in cycle length over the No Build Alternative. The longer cycle length would increase the average delay at the intersection from 34.1 to 35.3 seconds per vehicle. The threshold for LOS D is 35 seconds, so this intersection would operate just barely at LOS D. The longer cycle length is used because it matches the optimized network cycle length. There are no capacity or queuing issues at this intersection.

During the p.m. hour, this intersection would continue to operate at LOS D, as under No Build Alternative conditions.

6-Lane Alternative

This intersection would continue to operate at the same LOS as under the No Build Alternative for both the a.m. and p.m. peak hours in 2030.

East Roanoke Street/Harvard Avenue East/SR 520 Westbound Off-Ramp Intersection (Exhibit 5-15, Location 14)

Existing Conditions

This signalized intersection provides access from westbound SR 520 to nearby neighborhoods. East Roanoke Street connects Eastlake Avenue East and the east side of Lake Union to Delmar Drive East and the residential area south of Portage Bay. Harvard Avenue East connects local neighborhood streets and Roanoke Street to the northbound I-5 on-ramp and Eastlake Avenue East to the north.

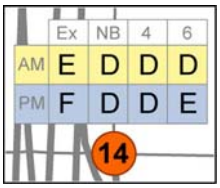


Exhibit 5-15c. **East Roanoke Street/Harvard Avenue East/SR 520 Westbound Off-Ramp LOS**

Under existing conditions, this intersection operates at LOS E during the a.m. peak hour because the eastbound and southbound approaches are over capacity. The eastbound approach queue extends back through the East Roanoke Street/Boylston Avenue East intersection. The off-ramp queue does not block access to the westbound SR 520 ramp to northbound I-5.

During the p.m. peak hour, this intersection operates at LOS F because the eastbound, northbound, and southbound approaches are over capacity. As during the a.m. peak hour, the eastbound approach queue extends back through the East Roanoke Street/Boylston Avenue East intersection, and the off-ramp queue does not block access to the westbound SR 520 ramp to northbound I-5.

No Build Alternative

During the a.m. peak hour in 2030, this intersection would operate at LOS D with an average of 48.1 seconds of delay per vehicle. Eastbound through traffic volumes would exceed roadway capacity with a V/C ratio of 1.07. Because of this, eastbound traffic would queue back to the Boylston Avenue East/East Roanoke Street intersection. Southbound left/right shared and left-only lane volumes would approach capacity with V/C ratios of 0.93 and 0.99, respectively.

During the p.m. peak hour, intersection operations would be similar to a.m. peak hour operations, with an LOS of D and an average of 48.4 seconds of delay per vehicle. In the p.m. peak hour, both the eastbound and southbound traffic volumes would exceed capacity, with V/C ratios of 1.07 and 1.01, respectively. Southbound volumes in

the left/right shared lane would approach capacity with a V/C ratio of 0.96. As during the a.m. peak hour, eastbound traffic would queue back to the Boylston Avenue East/East Roanoke Street intersection. Southbound traffic queues would not affect the adjacent intersection.

4-Lane Alternative

During the a.m. peak hour in 2030, the intersection would continue to operate at LOS D, but with an increase in average delay from 48.1 to 53.3 seconds per vehicle. The additional delay would result from an increase in eastbound through traffic volumes of 40 vph. Eastbound traffic would continue to queue back to the Boylston Avenue East/East Roanoke Street intersection. Additionally, southbound left-turn movements would increase by 20 vehicles, which is just enough to exceed capacity, shift the V/C ratio from 0.99 to 1.03, and increase delay.

During the p.m. peak hour, this intersection would continue to operate at LOS D, as it would under No Build Alternative conditions, but with a slight increase in average delay from 48.4 to 49.8 seconds per vehicle. Queues and capacities are similar to No Build Alternative conditions.

6-Lane Alternative

During the a.m. peak hour in 2030, the intersection would continue to operate at LOS D because eastbound through traffic volumes would be the same as under the No Build Alternative. The average delay per vehicle would increase slightly over No Build conditions, from 48.1 to 50.0 seconds per vehicle. Queues and capacities would be similar to No Build Alternative conditions.

During the p.m. peak hour, the LOS would shift from D to E because the average delay per vehicle would increase from 48.4 seconds under the No Build Alternative to 59.5 seconds under the 6-Lane Alternative. The average delay per vehicle would increase because total traffic volume through the intersection would increase by 140 vph. Because the eastbound through traffic volumes would already exceed capacity under No Build conditions, this increase in traffic is enough to shift the LOS from D to E.

I-5 Northbound On-Ramp/Harvard Avenue East (Exhibit 5-15, Location 19)

Existing Conditions

This unsignalized intersection currently provides access to northbound I-5 from the nearby neighborhoods. Southbound right turns onto the on-ramp are prohibited. The northbound left turn is the only movement that provides freeway access, and it must yield to oncoming southbound traffic.

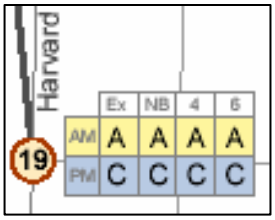


Exhibit 5-15d. **I-5 Northbound On-Ramp/Harvard Avenue East LOS**

Under existing conditions, this intersection operates at LOS A during the a.m. peak hour. Traffic destined for northbound I-5 operates at LOS B because it yields to southbound traffic. Capacity is available for all lane groups, and traffic does not queue into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS C. Traffic destined for northbound I-5 operates at LOS E because it yields to southbound traffic. As during the a.m. peak hour, capacity is available for all lane groups, and traffic does not queue into adjacent study intersections.

No Build Alternative

During the a.m. peak hour in 2030, this intersection would operate at LOS A without any capacity or queuing issues. During the p.m. peak hour, however, it would operate at LOS C overall. Northbound traffic turning left onto northbound I-5 would experience LOS D with an average delay of 32.5 seconds per vehicle. This delay would occur because there is a high volume of left turns (770 vph) at this intersection, and drivers would have a difficult time finding a gap in southbound traffic (670 vph).

4-Lane Alternative

During the a.m. peak hour in 2030, intersection operations would be the same as under No Build Alternative conditions. During the p.m. peak hour, the intersection would continue to operate at LOS C overall and LOS D for northbound traffic turning left onto northbound I-5. The average delay per vehicle would increase slightly, from 32.5 to 34.2 seconds per vehicle, because the northbound left-turn volumes would increase by 10 vph.

6-Lane Alternative

During the a.m. peak hour in 2030, intersection operations would be the same as under No Build conditions. During the p.m. peak hour, this intersection would continue to operate at LOS C overall, but the LOS for northbound traffic turning left onto northbound I-5 would degrade to LOS F. The average delay per vehicle would increase from 32.5 to 50.2 seconds per vehicle because northbound left-turn volumes would increase by 70 vph.

How would the project affect traffic circulation in the Roanoke Street interchange area?

The project would not change local traffic circulation patterns in this interchange area. The total volume of on-street traffic would change between existing conditions and the future alternatives; during both peak hours there would be more traffic. More detail can be found about the change in traffic in *Chapter 3: Freeway and Local Traffic Forecasts.*

How would the project affect the pedestrian and bicycle amenities at this interchange?

Under the 4-Lane Alternative, pedestrian and bicycle amenities would not change in this location because the project design would not include changes to the local street system. Under the 6-Lane Alternative, pedestrian and bicycle amenities would be improved with the addition of a lid between Delmar Drive and 10th Avenue East. See *Chapter 6: Nonmotorized Facilities* for project area bicycle and pedestrian amenities.

What are the findings at the Roanoke Street interchange area?

- Generally, the build alternatives would not have much effect on traffic operations at the Roanoke Street interchange area.
- Only two of the 12 analyzed intersections would experience any kind of degradation in LOS under the build alternatives; even with this degradation in LOS, traffic would operate at LOS E or above.
- Traffic to and from SR 520 would cause capacity and queuing issues at two intersections: Harvard Avenue East/East Roanoke Street/SR 520 westbound off-ramp and Boylston Avenue East/East Roanoke Street.
- Queues at the Harvard Avenue East/East Roanoke Street/SR 520 westbound off-ramp would not affect operations on SR 520.

Northeast 45th Street Interchange Area

The Northeast 45th Street interchange area is shown in Exhibit 5-18. The exhibit highlights which intersections were analyzed within the interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses existing traffic volumes and the changes in traffic volumes that would occur as a result of the project. The LOS results shown in Exhibit 5-18 and traffic operations in the interchange area are also discussed in detail by intersection.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-19 shows existing and 2030 Northeast 45th Street interchange area traffic volumes during the a.m. peak hour. The traffic volumes shown include traffic on both sides of the street. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

Overall, No Build Alternative traffic volumes would increase by 2 percent over existing traffic volumes during the a.m. peak hour by 2030.

4-Lane Alternative

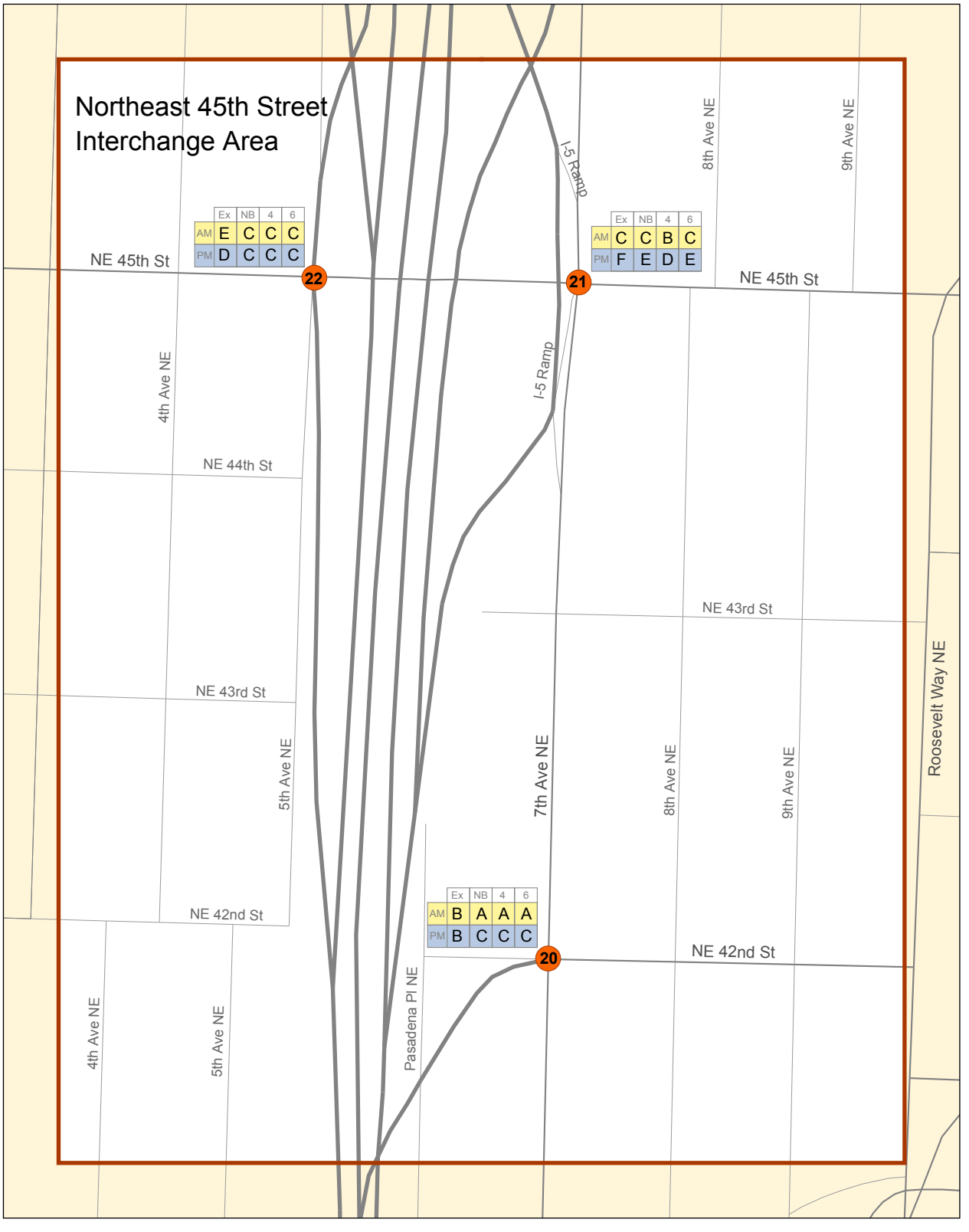
Traffic volumes under the 4-Lane Alternative traffic volumes would decrease by 2 percent overall during the a.m. peak hour by 2030 as compared with the No Build Alternative. Traffic would shift away from the Evergreen Point Bridge as a result of the toll.

6-Lane Alternative

The 6-Lane Alternative traffic volumes would increase slightly (by 1 percent) over No Build traffic volumes during the a.m. peak hour by 2030.

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-20 shows existing and 2030 Northeast 45th Street interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below.



LEGEND

1 Study signalized intersection

5 Study unsignalized intersection

No Build — Existing — 4-Lane — 6-Lane

		Ex	NB	4	6
A.M. Peak Hour	AM	D	C	C	C
P.M. Peak Hour	PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 250 500 Feet

Exhibit 5-18. **Northeast 45th Street Interchange Area**

SR 520 Bridge Replacement and HOV Project

Exhibit 5-19. **A.M. Peak Hour Traffic Volumes for Local Streets at the Northeast 45th Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
5th Avenue Northeast north of Northeast 45th Street	880	900	880	910	20	2%	-20	-2%	10	1%
7th Avenue Northeast north of Northeast 45th Street	550	560	550	580	10	2%	-10	-2%	20	4%
Northeast 45th Street west of 5th Avenue Northeast	1370	1390	1370	1410	20	1%	-20	-1%	20	1%
Northeast 45th Street east of Northeast 7th Avenue	2160	2190	2160	2230	30	1%	-30	-1%	40	2%
5th Avenue Northeast south of I-5 southbound on-ramp	190	200	190	190	10	5%	-10	-5%	-10	-5%
7th Avenue Northeast south of Northeast 42nd Street	420	420	420	410	0	0%	0	0%	-10	-2%
Northeast 42nd Street east of 7th Avenue Northeast	340	340	340	320	0	0%	0	0%	-20	-6%
Total of Locations	5910	6000	5910	6050	90	2%	-90	-2%	50	1%

For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

No Build Alternative traffic volumes would increase by 9 percent on the local streets in the Northeast 45th Street interchange area during the p.m. peak hour. This reflects growth that is forecast to occur between now and 2030.

Exhibit 5-20. **P.M. Peak Hour Traffic Volumes for Local Streets at the Northeast 45th Street Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
5th Avenue Northeast north of Northeast 45th Street	710	780	780	780	70	10%	0	0%	0	0%
7th Avenue Northeast north of Northeast 45th Street	940	1020	1020	1030	80	9%	0	0%	10	1%
Northeast 45th Street west of 5th Avenue Northeast	1730	1880	1860	1900	150	9%	-20	-1%	20	1%
Northeast 45th Street east of Northeast 7th Avenue	2530	2730	2710	2810	200	8%	-20	-1%	80	3%
5th Avenue Northeast south of I-5 southbound on-ramp	210	220	220	230	10	5%	0	0%	10	5%
7th Avenue Northeast south of Northeast 42nd Street	530	580	590	590	50	9%	10	2%	10	2%
Northeast 42nd Street east of 7th Avenue Northeast	390	430	450	440	40	10%	20	5%	10	2%
Total of Locations	7040	7640	7630	7780	600	9%	-10	0%	140	2%

4-Lane Alternative

Overall, 4-Lane Alternative traffic volumes would decrease slightly (by 10 vph), yet in terms of percent change, they would be the same as No Build Alternative traffic volumes during the p.m. peak hour in 2030.

6-Lane Alternative

Traffic volumes for the 6-Lane Alternative would show an overall increase of 2 percent as compared to No Build traffic volumes in 2030. The diversion of traffic due to tolling would be offset by the increase in HOV capacity and improved freeway operations.

How would the project affect traffic operations?

This next section describes how the future alternatives would affect traffic operations in the interchange area and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection.

As shown in Exhibit 5-18, intersection operations at the Northeast 45th Street interchange area would be better in the a.m. than the p.m. peak hour. The following intersections would operate at the same LOS for all future alternatives and therefore are not discussed:

- 7th Avenue Northeast/Northeast 42nd Street (Location 20)
- 5th Avenue Northeast/Northeast 45th Street (Location 22)

LOS would improve between existing conditions and the No Build Alternative at the 5th Avenue Northeast/Northeast 45th Street intersection (listed above) and the 7th Avenue Northeast/Northeast 45th Street intersection (discussed below) because the increases in traffic volumes would be counteracted by optimized signal settings. The optimized signal settings assumed for the No Build Alternative would use shorter cycle lengths (90 seconds vs. 150 seconds for the a.m. peak hour and 90 seconds vs. 180 seconds for the p.m. peak hour), which would cause less delay. The shorter cycle lengths would better match the natural cycle lengths of the intersections. Natural cycle lengths typically represent the cycle length that creates the least delay while providing enough time to clear all of the waiting vehicles.

Northeast 45th Street/7th Avenue Northeast (Exhibit 5-18 Location 21)

Existing Conditions

This signalized intersection connects northbound I-5 to Northeast 45th Street. 7th Avenue Northeast parallels I-5 and joins with the northbound I-5 ramps in the vicinity of Northeast 42nd Street (with the I-5 express lanes), Northeast 45th Street, and Northeast 50th Street. Northeast 45th Street connects Ballard, Fremont, and Wallingford on the west with the University of Washington, University Village, and Sand Point on the east.

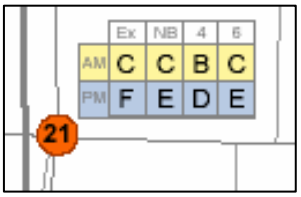


Exhibit 5-18a. **Northeast 45th Street/7th Avenue Northeast LOS**

Under existing conditions, this intersection operates at LOS C during the a.m. peak hour. Capacity is available for all lane groups at the intersection, and queues do not back into adjacent study intersections or onto northbound I-5.

During the p.m. peak hour, this intersection operates at LOS F because the westbound approach is over capacity. All of the other lane groups have capacity remaining. As during the a.m. peak hour, queues do not back into adjacent study intersections or onto northbound I-5.

No Build Alternative

In 2030 under No Build Alternative conditions, intersection operations would be the same as under existing conditions at LOS C during the a.m. peak hour. During the p.m. peak hour, the LOS would improve from F to E as a result of signal network optimization. However, as under existing conditions, the intersection would continue to operate over capacity on the westbound approach. With the increase in traffic volumes over existing conditions, the eastbound left and northbound through approaches would also be over capacity under No Build Alternative conditions.

4-Lane Alternative

LOS would improve from C to B during the a.m. peak hour and from E to D during the p.m. peak hour by 2030. LOS would improve during the a.m. peak hour because overall traffic would decrease slightly (40 vph total for all approaches). LOS would improve during the p.m. peak hour because traffic volumes exiting from I-5 would decrease by 70 vph.

6-Lane Alternative

Under 6-Lane Alternative conditions, this intersection would operate in 2030 at the same LOS as the No Build Alternative during the both the a.m. and p.m. peak hours.

How would the project affect traffic circulation in the Northeast 45th Street interchange area?

The project would not change local traffic circulation patterns in this interchange area. There would be little change to local streets. More detail on changes in traffic volume can be found in *Chapter 3: Freeway and Local Traffic Forecasts.*

How would the project affect the pedestrian and bicycle amenities in the Northeast 45th Street interchange area?

Pedestrian and bicycle amenities would not change at this interchange because the project design does not include changes to the local street system.

What are the findings at the Northeast 45th Street interchange area?

- Generally, the build alternatives would not negatively affect traffic operations in this interchange area.
- The Northeast 45th Street/7th Avenue Northeast intersection operates above capacity under existing conditions and would continue to do so under all future alternatives.

Montlake Boulevard Interchange Area

The Montlake Boulevard interchange area is shown in Exhibit 5-21. The exhibit highlights which intersections were analyzed within the interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses the changes from existing traffic volumes for all project alternatives. The LOS results shown in Exhibit 5-21 and effects on traffic operations are also discussed in detail by intersection.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-22 shows existing and 2030 Montlake Boulevard interchange area traffic volumes during the a.m. peak hour. The volumes shown include traffic on both sides of the street. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

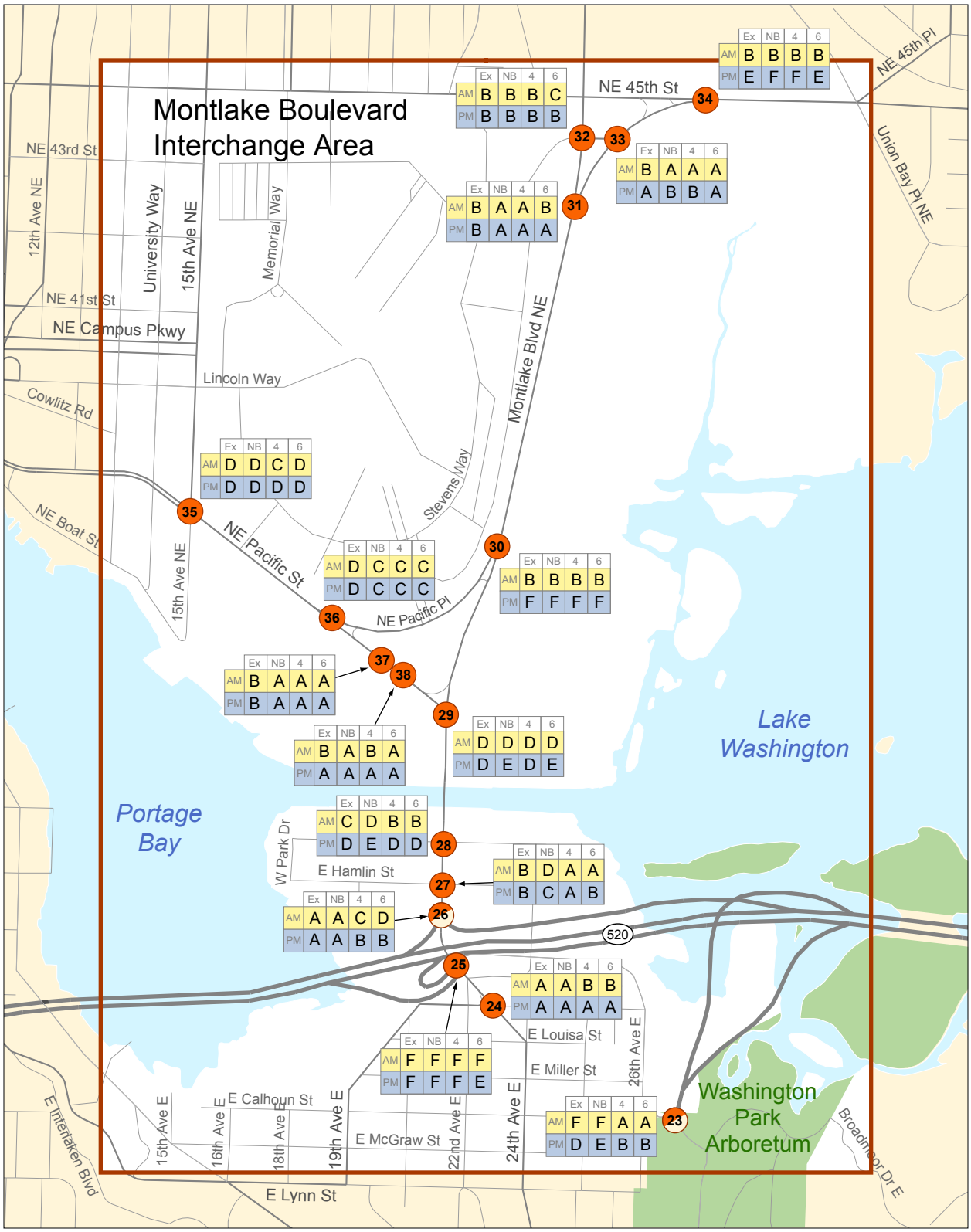
Overall, No Build Alternative traffic volumes would increase by 3 percent over existing traffic volumes during the a.m. peak hour by 2030.

4-Lane Alternative

Traffic volumes under the 4-Lane Alternative would decrease by 4 percent during the a.m. peak hour by 2030 compared with No Build Alternative traffic volumes. Traffic patterns would shift as a result of the toll on the Evergreen Point Bridge.

6-Lane Alternative

The 6-Lane Alternative traffic volumes would increase by 2 percent compared with No Build traffic volumes during the a.m. peak hour in 2030.



LEGEND

- 1 Study signalized intersection
- 5 Study unsignalized intersection
- 26 These intersections would be signalized under the 4-Lane and 6-Lane Alternatives

No Build — Existing — 4-Lane — 6-Lane

	Ex	NB	4	6
A.M. Peak Hour AM	D	C	C	C
P.M. Peak Hour PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

N 0 500 1,000 Feet

LEVEL OF SERVICE

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

Exhibit 5-21. **Montlake Boulevard Interchange Area**

SR 520 Bridge Replacement and HOV Project

Exhibit 5-22. **A.M. Peak Hour Traffic Volumes for Local Streets at the Montlake Boulevard Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
Montlake Boulevard north of SR 520 westbound ramps	5290	5380	5310	5550	90	2%	-70	-1%	170	3%
Montlake Boulevard south of SR 520 eastbound ramps	2530	2600	2540	2670	70	3%	-60	-2%	70	3%
Lake Washington Boulevard east of SR 520 ramps	2370	2520	2250	2480	150	6%	-270	-11%	-40	-2%
Total of Locations	10190	10500	10100	10700	310	3%	-400	-4%	200	2%

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-23 shows existing and 2030 Montlake Boulevard interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

Exhibit 5-23. **P.M. Peak Hour Traffic Volumes for Local Streets at the Montlake Boulevard Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
Montlake Boulevard north of SR 520 westbound ramps	5300	5660	5570	5760	360	7%	-90	-2%	100	2%
Montlake Boulevard south of SR 520 eastbound ramps	2320	2360	2310	2230	40	2%	-50	-2%	-130	-6%
Lake Washington Boulevard east of SR 520 ramps	1600	1770	1640	1780	170	11%	-130	-7%	10	1%
Total of Locations	9220	9790	9520	9770	570	6%	-270	-3%	-20	0%

No Build Alternative

Overall, No Build Alternative traffic volumes would increase by 6 percent on local streets in the Montlake Boulevard interchange area during the p.m. peak hour. This reflects growth that is forecast to occur between now and 2030.

4-Lane Alternative

Traffic volumes for the 4-Lane Alternative during the p.m. peak hour would decrease by 3 percent as compared with the No Build Alternative because the toll on the Evergreen Point Bridge would divert traffic from SR 520 onto other routes in 2030.

6-Lane Alternative

Overall, 6-Lane Alternative traffic volumes would be slightly less (-20 vehicles) than No Build Alternative traffic volumes in 2030, but in terms of percent change, the volumes would remain the same.

How would the project affect traffic operations?

This section describes how the project alternatives would affect traffic operations at the interchange area and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection.

As shown in Exhibit 5-21, the following intersections would operate at the same LOS for all project alternatives during the a.m. and p.m. peak hours without any capacity and queuing issues, and therefore are not discussed:

- Montlake Boulevard/25th Avenue Northeast (Location 31)
- 25th Avenue Northeast/Pend Orielle Street (Location 32)
- Montlake Boulevard/Northeast 44th Street (Location 33)
- Northeast Pacific Street/Northeast Pacific Place (Location 36)
- Northeast Pacific Street/Hospital Exit (Location 37)
- Northeast Pacific Street/Emergency Entrance (Location 38)

What limits the ability to alleviate traffic congestion in the Montlake Boulevard interchange area?

The opportunities for road improvements in the Montlake Boulevard interchange area to improve system operations are constrained by the presence of significant neighborhood amenities. These include:

- The Montlake Bridge, which is assumed to remain in its current configuration as a four-lane facility to preserve its historic character.
- Lake Washington Boulevard, a historic Olmstead boulevard, is a Seattle park.
- Montlake Boulevard, also a historic Olmstead boulevard, is a Seattle park.

Notwithstanding these limitations, the project does include some improvements at the interchange area to make the most of the local street system.

Lake Washington Boulevard/SR 520 Arboretum Ramps (Exhibit 5-21, Location 23)

Existing Conditions

This unsignalized intersection currently provides access to and from the east on SR 520. Traffic movements operate under stop control except for the right turn from northbound Lake Washington Boulevard onto the eastbound SR 520 on-ramp, which is not controlled. Lake Washington Boulevard routes traffic between Montlake Boulevard to the west and Madrona Park and Madison Park to the south.

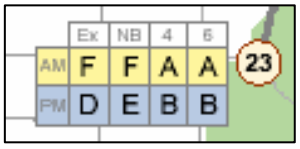


Exhibit 5-21a. **Lake Washington Boulevard/ SR 520 Arboretum Ramps LOS**

Under existing conditions, this intersection operates at LOS F during the a.m. peak hour because of inadequate capacity on the northwest-bound approach, which includes the heavily used right turn onto the eastbound SR 520 on-ramp. The southeast-bound through movement is near capacity. The westbound SR 520 off-ramp does not back onto westbound SR 520, and queues do not back into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS D, and no movements are over capacity. As during the a.m. peak hour, the off-ramp queue does not back onto westbound SR 520, and queues do not back into adjacent study intersections.

No Build Alternative

Under No Build Alternative conditions in 2030, this intersection would operate at LOS F during the a.m. peak hour, with about 6 minutes of

delay per vehicle. Vehicles destined for the SR 520 eastbound on-ramp would experience long delays because of ramp metering and insufficient storage capacity. During the p.m. peak hour, this intersection would operate at LOS E.

4-Lane Alternative

Under the 4-Lane Alternative, this intersection is assumed to be signalized, which would improve intersection operations to LOS A during the a.m. peak hour and LOS B during the p.m. peak hour in 2030. The heavy traffic entering eastbound SR 520 in the a.m. would experience less delays when accessing the on-ramp with the signal because the queue from traffic traveling through the intersection toward Montlake Boulevard would be shorter than with all-way stop control. Signalizing this intersection would also prevent additional queuing on Lake Washington Boulevard beyond this intersection.

6-Lane Alternative

As under the 4-Lane Alternative, this intersection would be signalized. With signalization, intersection operations would improve from LOS F to LOS A during the a.m. peak hour and from LOS E to LOS B during the p.m. peak hour in 2030.

Montlake Boulevard/East Roanoke Street (Exhibit 5-21, Location 24)

Existing Conditions

This signalized intersection connects East Roanoke Street and neighborhoods south of Portage Bay with Montlake Boulevard. Within the project limits, Montlake Boulevard routes traffic between the east side of Capitol Hill and University Village.

Exhibit 5-21b. **Montlake Boulevard/East Roanoke Street LOS**

Under existing conditions, this intersection operates at LOS A during the a.m. peak hour. Capacity is available for all lane groups at the intersection, and queues do not back into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS A. As in the a.m. peak hour, capacity is available for all lane groups at the intersection, and queues do not back into adjacent study intersections.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS A during both the a.m. and p.m. peak hours in 2030.

4-Lane Alternative

Under the 4-Lane Alternative, this intersection would drop from LOS A to LOS B during the a.m. peak hour by 2030 as average delay per vehicle increased from 9.6 seconds to 10.2 seconds. Both the northbound and southbound through traffic volumes would increase by 30 vehicles per hour. During the p.m. peak hour, this intersection would continue to operate at LOS A.

6-Lane Alternative

Intersection operations would be the same as the 4-Lane Alternative in 2030.

Montlake Boulevard/Lake Washington Boulevard/SR 520 Eastbound Ramps (Exhibit 5-21, Location 25)

Existing Conditions

This signalized intersection connects eastbound SR 520 with Montlake Boulevard, Lake Washington Boulevard, and the surrounding neighborhoods.

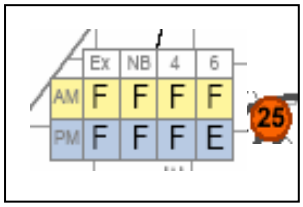


Exhibit 5-21c. **Montlake Boulevard/Lake Washington Boulevard/SR 520 Eastbound Ramps LOS**

Under existing conditions, this intersection operates at LOS F during the a.m. peak hour because the eastbound approach, northbound through, and southbound left-turn movements are well over capacity. The westbound right is just over capacity but still operates at LOS D. The eastbound SR 520 off-ramp does not queue onto eastbound SR 520 under normal operations. The northbound approach queues through the Montlake Boulevard/Roanoke Street intersection, and the southbound approach queues through the westbound SR 520 on-ramp intersection.

During the p.m. peak hour, this intersection operates at LOS F because the eastbound and northbound approaches are over capacity. The westbound right is at capacity but still operates at LOS D. The eastbound SR 520 off-ramp queues onto eastbound SR 520 by a few vehicles at peak conditions within the hour. As during the a.m. peak hour, the northbound approach queues through the Montlake Boulevard/Roanoke Street intersection, and the southbound approach queues through the westbound SR 520 on-ramp intersection.

No Build Alternative

In 2030, this intersection would operate at LOS F under No Build Alternative conditions during both peak hours. With future signal optimization and the change in volumes, the northbound and southbound queues would be shorter during both peak hours, but still

would continue to back through the adjacent intersections. Intersection operations would fail primarily because of the following conditions:

- Traffic in both peak hours traveling northbound on Montlake Boulevard north of the intersection would exceed the signal capacity, even when optimized.
- Traffic turning left from the eastbound SR 520 off-ramp also would operate over capacity. This movement would compete with the northbound through movement for signal time.
- Westbound right-turn traffic would operate over capacity. This movement would compete for signal time because it is the heaviest westbound movement, and a free right turn is not allowed at the intersection.

The eastbound lanes would be over capacity during the p.m. peak hour, but not during the a.m. peak hour. Some capacity would remain during the a.m. peak hour because the eastbound vehicle volumes would not fully use the available green time. The green time cannot be reduced to serve other vehicle movements, since it is at the minimum allowable length necessary to allow pedestrians to cross. In both peak hours, the northbound through movement and westbound right-turn movement would exceed capacity.

Northbound traffic on Montlake Boulevard leaving the intersection would also be affected periodically by p.m. peak hour queues extending back from the Montlake Boulevard/Hamlin Street intersection. These queues at Hamlin Street would result primarily from the following conditions:

- The Montlake Bridge would create a merge condition for heavy traffic northbound around Hamlin Street when vehicles exiting the freeway via the westbound off-ramp take a free right turn and merge onto Montlake Boulevard before reaching East Shelby Street. Other than optimizing signal coordination, not much can be done about this queue backing up from Hamlin Street because the Montlake Bridge's northbound capacity constrains arterial operations.
- The weaving and merging activity south of East Hamlin Street would cause congestion when vehicles exiting the freeway via the westbound off-ramp take a free right turn and merge across traffic into the northbound left/u-turn lane at the Montlake

Boulevard/East Hamlin Street intersection. This is a very short distance, and the multiple lane changes would cause friction for the northbound movements at Hamlin Street.

In addition to the above, the southbound left turn from Montlake Boulevard to Lake Washington Boulevard would be over capacity during the a.m. peak hour.

The eastbound SR 520 off-ramp would queue periodically onto eastbound SR 520 during the p.m. peak hour, but not the a.m. peak hour (because of future signal optimization).

4-Lane Alternative

Under the 4-Lane Alternative, this intersection would be reconstructed and signal phasing and timing would be optimized. The design includes an additional lane for eastbound left-turning traffic, and the third lane would be converted to a shared through/right-turn lane. The additional lanes would allow more sharing of the signal green time with other movements (see Exhibits 5-24 and 5-25 for existing and proposed lane geometry for this and adjacent intersections). Also, a signal phase would be added for the westbound right turn during the southbound left-turn phase. With this new intersection design, the Montlake Boulevard/SR 520 eastbound ramps intersection would still operate at LOS F during both peak hours.

During the a.m. peak hour in 2030, average vehicle delays would increase under the 4-Lane Alternative compared with the No Build Alternative because traffic volumes would increase for the eastbound off-ramp, and northbound through movements would exceed the additional signal capacity. However, the additional northbound left turn lane would slightly improve traffic operations for the northbound left turn movement.

During the p.m. peak hour, the average delay per vehicle would decrease under the 4-Lane Alternative compared with No Build Alternative because the intersection volumes would be better distributed across the available capacity. For example, the eastbound off-ramp approach would operate better than under No Build Alternative conditions.

During both a.m. and p.m. peak hours, the northbound and southbound queues would be similar to the No Build Alternative, and would still back through the adjacent intersections. The eastbound

SR 520 off-ramp would queue onto eastbound SR 520 during peak times within both peak hours.

6-Lane Alternative

Under the 6-Lane Alternative, this intersection would be reconstructed to provide the same approach lanes and signal phase addition as discussed under the 4-Lane Alternative.

In the a.m. peak hour, the intersection would operate at LOS F in 2030, as under both the 4-Lane Alternative and the No Build Alternative. Average delays would increase compared with No Build conditions; however, the maximum V/C ratio (which coincides with the southbound left-turn movement) would decrease, so the delay would shift to other movements.

The new intersection design would result in a better LOS in the p.m. peak hour than under the No Build Alternative. The average delay would be 99 seconds per vehicle under No Build, compared to 79 seconds per vehicle under the 6-Lane Alternative. Traffic operations under the 6-Lane Alternative would be better than the 4-Lane Alternative because of the lower traffic volumes.

During both a.m. and p.m. peak hours, the northbound and southbound queues would be similar to the No Build Alternative, and would back through the adjacent intersections. The eastbound SR 520 off-ramp would queue onto eastbound SR 520 during peak times within both peak hours.

Montlake Boulevard/SR 520 Westbound Ramps (Exhibit 5-21, Location 26)

Existing Conditions

This unsignalized intersection connects westbound SR 520 to Montlake Boulevard. The east and west legs are currently separated by a median down the center of Montlake Boulevard (see Exhibit 5-24 for the existing layout).

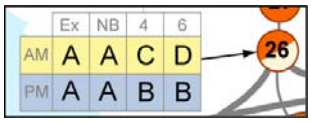
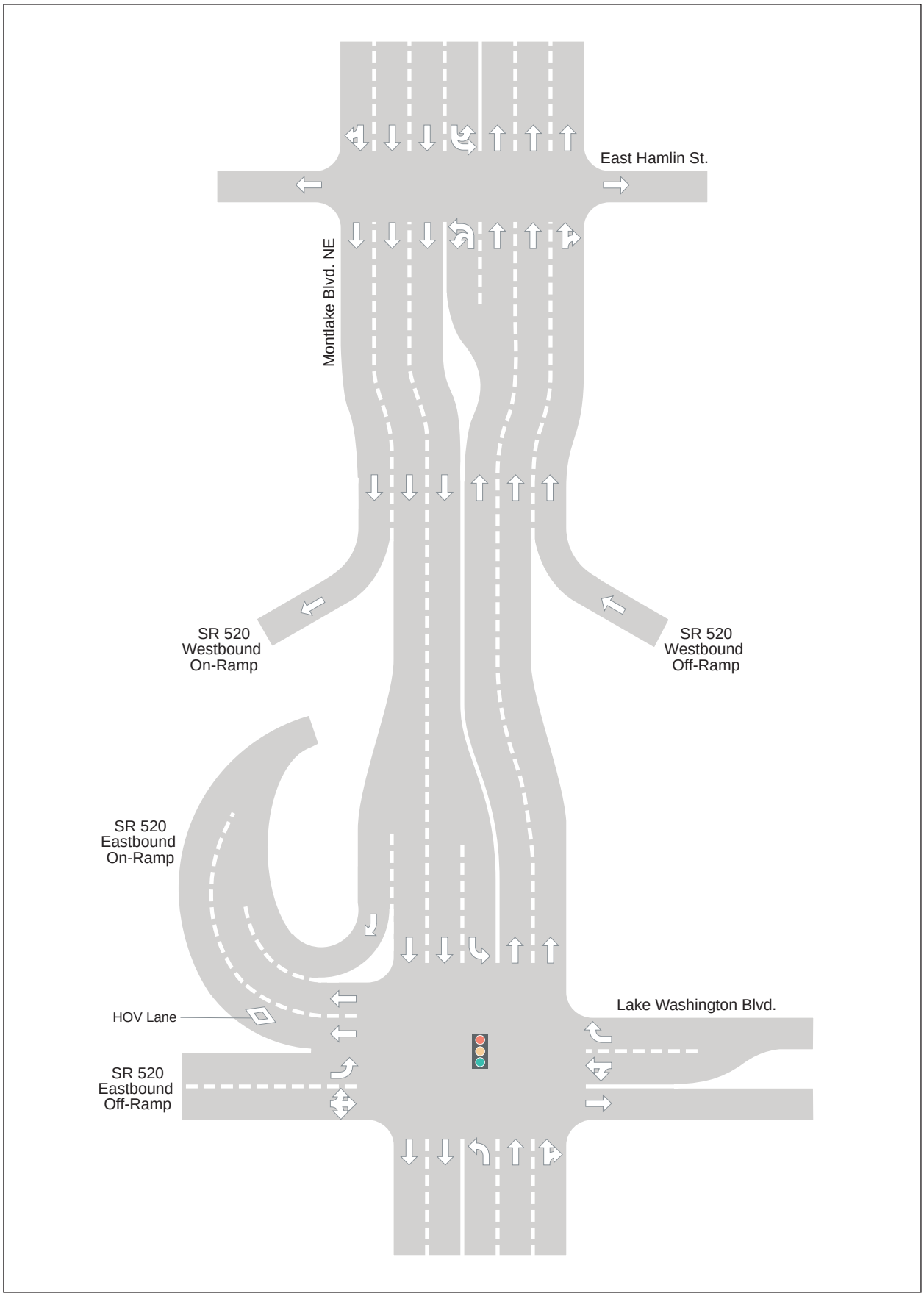


Exhibit 5-21d. **Montlake Boulevard/SR 520 Westbound Ramps LOS**

The on-ramp can only be accessed from southbound Montlake Boulevard. The inability to make northbound left turns from Montlake Boulevard forces northbound traffic destined for the SR 520 westbound on-ramp to make a u-turn at the Montlake Boulevard/Hamlin Street intersection.

The SR 520 westbound off-ramp terminates along the right side of the northbound travel lanes on Montlake Boulevard before East Hamlin



N Not To Scale

Exhibit 5-24. **SR 520 Eastbound and Westbound Ramps at Montlake—Existing Lane Geometry**

SR 520 Bridge Replacement and HOV Project

180171.AF.14 TDR_05-24_520 ramps existing lanes.ai 1jun05

Street, and all of the traffic exiting SR 520 is forced north to the Montlake Boulevard/East Hamlin Street intersection. The inability to make a left turn from the westbound off-ramp forces traffic destined south on Montlake Boulevard to make a northbound u-turn at Hamlin Street.

Under existing conditions, this intersection operates at LOS A during the a.m. peak hour. Traffic exiting from westbound SR 520 operates at LOS B rather than LOS A because it needs to merge before reaching East Shelby Street (between East Hamlin Street and East Shelby Street, Montlake Boulevard narrows down from three northbound through lanes to two). Capacity is available for all lane groups, and the off-ramp traffic does not queue onto westbound SR 520.

During the p.m. peak hour, conditions are very similar to the a.m. peak hour. This intersection operates at LOS A, and traffic exiting from westbound SR 520 operates at LOS B because of the merge before reaching East Shelby Street. Capacity is available for all lane groups, and the off-ramp traffic does not queue onto westbound SR 520.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS A during both the a.m. and p.m. peak hours in 2030. The off-ramp merge movement would operate at LOS B during the a.m. peak hour and at LOS C during the p.m. peak hour. The off-ramp would not queue onto westbound SR 520 under regular operations during either peak hour.

4-Lane Alternative

Under the 4-Lane Alternative, the Montlake Boulevard/SR 520 westbound ramps intersection would be reconstructed and signalized, and phasing would be optimized. Exhibit 5-25 shows the proposed layout. This improvement would remove the northbound u-turn volume from the Montlake Boulevard/East Hamlin Street intersection, which would benefit the Shelby/East Hamlin neighborhood because traffic would be rerouted away from homes. This new design would also improve operations at the Montlake Boulevard/East Hamlin Street intersection (see discussions under Montlake Boulevard/East Hamlin Street for why this occurs). This design change would also reduce the vehicle-trip lengths because vehicles would not have to double back in a u-turn maneuver.

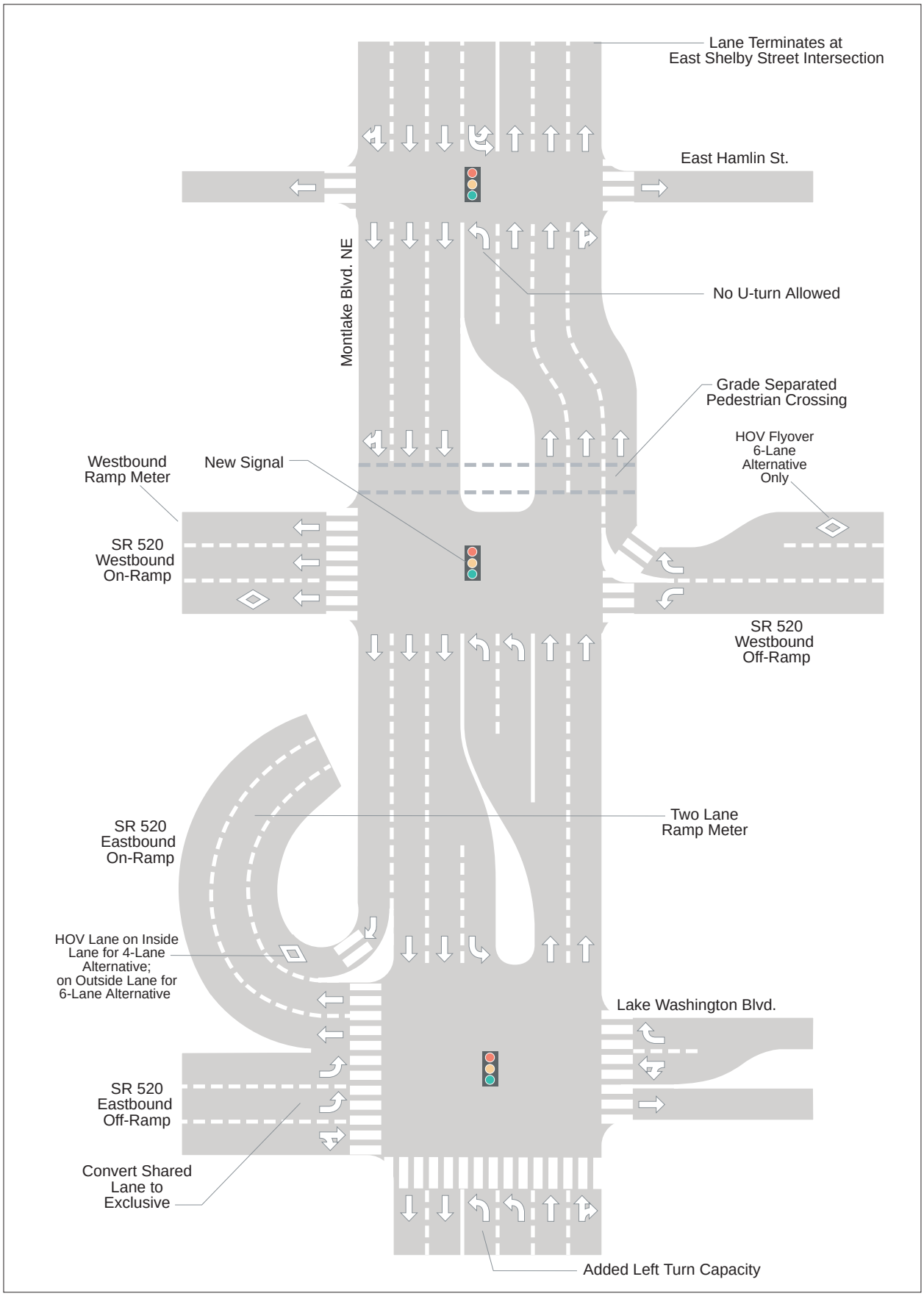


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Exhibit 5-25. **SR 520 Eastbound and Westbound Ramps at Montlake—Future Lane Geometry**

SR 520 Bridge Replacement and HOV Project

The new design would improve westbound SR 520 access for trips to and from the area south of the interchange. A westbound left turn lane would be added at the end of the off-ramp to improve access to Montlake Boulevard south of the SR 520 interchange. Two northbound left-turn lanes would be added on the Montlake Boulevard bridge over SR 520 for improved access to the SR 520 westbound on-ramp for northbound traffic on Montlake.

The existing free westbound right turn would be changed to protected-permitted phasing to improve control of the pedestrian crossing at the intersection. The signal control would stop the right-turn movement for pedestrians to cross in a crosswalk. Right-turning traffic would still turn into its own lane and then merge left, comparable to No Build, except that in No Build there would be no signal control to stop right-turning vehicles for pedestrians wanting to use the crosswalk. Maintaining the ability for all of the traffic turning right on Montlake Boulevard to merge is very important in maintaining traffic operations and creating a condition in which the ramp would not back onto the freeway.

The southbound through traffic movement would also improve at this intersection. The outside (westernmost) southbound lane at the Montlake Boulevard/SR 520 westbound ramps intersection would be converted from the existing right-turn only lane to a shared through/right-turn only lane. This would allow southbound through vehicles needing to get to the SR 520 eastbound on-ramp to use this outermost lane to bypass queues in the inside through lanes.

With these intersection improvements, the Montlake Boulevard/SR 520 westbound ramps intersection would operate at LOS C during the a.m. peak hour and LOS B during the p.m. peak hour in 2030. This intersection would operate worse than No Build (LOS A) with signalization because the northbound through movement would no longer be a free movement as it would be under No Build Alternative conditions.

During both the a.m. and p.m. peak hours, southbound traffic queues would spill back into the Montlake Boulevard/Hamlin Street intersection. However, the westbound SR 520 off-ramp would not queue onto westbound SR 520 under regular operations during either peak hour.

6-Lane Alternative

Under the 6-Lane Alternative in 2030, intersection operations would be worse (LOS D in the a.m. peak hour) than 4-Lane Alternative conditions, but the LOS would improve to B in the p.m. peak hour (see Exhibit 5-25 for the proposed layout). In the a.m. peak hour, the westbound left turns would experience a very long queue delay because of a longer cycle length of 120 seconds and a smaller allotted green time under the 6-Lane Alternative. This would not affect the overall performance of the intersection, nor would it cause traffic to back onto the westbound SR 520 mainline. The p.m. peak hour operations would be about the same under the 6-Lane Alternative as the 4-Lane Alternative because the signal would have the capacity to serve the volumes similarly despite the differences.

The westbound right-turning traffic would queue a length of about 1,200 feet on the westbound off-ramp. This queue would remain contained on the off-ramp without affecting freeway operations. This queue delay is the primary reason for the intersection LOS D during the a.m. peak hour.

Montlake Boulevard/East Hamlin Street (Exhibit 5-21, Location 27)

Existing Conditions

This signalized intersection provides access to East Hamlin Street. East Hamlin Street is one-way only with traffic routed away from Montlake Boulevard on the east and west legs, allowing vehicles to turn onto East Hamlin Street but not from it onto Montlake Boulevard.

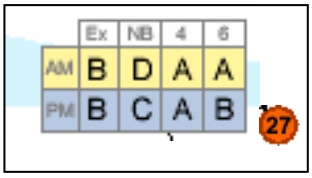


Exhibit 5-21e. **Montlake Boulevard/East Hamlin Street LOS**

Under existing conditions, this intersection operates at LOS B during the a.m. peak hour. Capacity is available for all lane groups at the intersection. The northbound approach periodically queues back through the SR 520 westbound ramps intersection. The southbound through movement queues back through the East Shelby Street intersection.

During the p.m. peak hour, this intersection operates at LOS B. As during the a.m. peak hour, capacity is available for all lane groups at the intersection. Northbound left-turn/u-turn bay queues overflow into the northbound through lanes. The northbound approach periodically queues back through the SR 520 westbound ramps intersection. The southbound through movement queues back through the East Shelby Street intersection.

No Build Alternative

Under the No Build Alternative, this intersection would operate at LOS D during the a.m. peak hour and LOS C during the p.m. peak hour in 2030. As described for existing conditions, queues would exceed the northbound left-turn lane storage capacity and overflow into the northbound through lanes.

4-Lane Alternative

Because of improvements at the Montlake Boulevard/SR 520 westbound ramps intersection, operations at the Montlake Boulevard/East Hamlin Street intersection would improve from LOS D to LOS A during the a.m. peak hour and from LOS C to LOS A during the p.m. peak hour by 2030.

The Montlake Boulevard/SR 520 westbound ramps intersection improvements would remove the northbound u-turn volume from the Montlake Boulevard/East Hamlin Street intersection, which would help traffic flow at this intersection by making more green time available for southbound traffic on Montlake Boulevard. Also, the signal at the westbound ramps would act as a meter for traffic entering Montlake Boulevard from SR 520 and help coordinate the arrival of vehicles at the East Hamlin Street and East Shelby Street intersections on Montlake Boulevard.

6-Lane Alternative

Similar to the 4-Lane Alternative, reconfiguration of the Montlake Boulevard/SR 520 westbound ramps intersection would improve operations at the Montlake Boulevard/East Hamlin Street intersection. With the 6-Lane Alternative, this intersection would operate at LOS A during the a.m. peak hour and LOS B during the p.m. peak hour in 2030. The LOS would shift to B during the p.m. peak hour because Montlake Boulevard through traffic volumes would increase.

Montlake Boulevard/East Shelby Street (Exhibit 5-21, Location 28)

Existing Conditions

This signalized intersection provides access to Montlake Boulevard from East Shelby Street. East Shelby Street is one-way only, with traffic routed toward Montlake Boulevard on the east and west legs. This allows vehicles to turn onto Montlake Boulevard, but not from it. Northbound buses can bypass northbound queues stopped at East

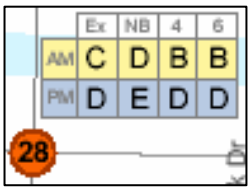


Exhibit 5-21f. **Montlake Boulevard/East Shelby Street LOS**

Shelby Street by using the bus pull-out area and the bus-only phase at the signal.

Under existing conditions, this intersection operates at LOS C during the a.m. peak hour. Capacity is available for all lane groups at the intersection; however, the northbound through lanes are very close to capacity (V/C = 0.99). The northbound approach queues back through the Montlake Boulevard/East Hamlin Street intersection. The southbound through movement queues back through the Montlake Boulevard/Northeast Pacific Street intersection.

During the p.m. peak hour, this intersection operates at LOS D because the northbound through lanes are over capacity. As during the a.m. peak hour, the northbound approach queues back through the Montlake Boulevard/East Hamlin Street intersection and the southbound through movement queues back through the Montlake Boulevard/Northeast Pacific Street intersection.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS D during the a.m. peak hour in 2030. During the p.m. peak hour, the intersection would operate at LOS E. The northbound through movement would be over capacity with a V/C ratio of 1.22, and the southbound through movement would be close to capacity with a V/C ratio of 0.94.

Northbound traffic would queue back through the Montlake Boulevard/East Hamlin Street intersection in both the a.m. and p.m. peak hours. Southbound traffic would queue back to the Montlake Boulevard/Northeast Pacific Street intersection in the a.m. peak hour. In both the a.m. and p.m. peak hours, the southbound queue would be metered by the Montlake Boulevard/Northeast Pacific Street intersection, which is true for all alternatives.

4-Lane Alternative

Under 4-Lane Alternative conditions, intersection operations would improve during the a.m. peak hour from LOS D to LOS B by 2030 because northbound and southbound traffic volumes would decrease on Montlake Boulevard. Northbound volumes would decrease by 40 vph and southbound volumes by 30 vph. Also, both northbound and southbound approaches would receive longer green times because of a longer cycle length that has more overall green time to distribute to the most constrained travel lanes.

During the p.m. peak hour, intersection operations would improve from LOS E to LOS D. The northbound through volume would be 130 vph less than the No Build Alternative, and the related V/C ratio for the northbound through movement would improve to 1.15.

In the a.m. peak hour, northbound and southbound queues would be similar to the No Build Alternative. The southbound queue would be longer, backing into the Montlake Boulevard/Northeast Pacific Street intersection. In the p.m. peak hour, queues would be similar to the No Build Alternative.

6-Lane Alternative

Under 6-Lane Alternative conditions, this intersection would operate with the same LOS as under the 4-Lane Alternative for both the a.m. and p.m. peak hours in 2030 because the incremental change in volumes would not alter the delays sufficiently to affect the LOS.

In the a.m. peak hour, northbound and southbound queues would be similar to the No Build Alternative. The southbound queue would be longer, backing into the Montlake Boulevard/Northeast Pacific Street intersection. In the p.m. peak hour, queues would be similar to the No Build Alternative.

Montlake Boulevard/Northeast Pacific Street (Exhibit 5-21, Location 29)

Existing Conditions

Northeast Pacific Street begins in the University District on the west and ends at the signalized Montlake Boulevard/Northeast Pacific Street intersection. One notable feature at this intersection is the queue jump for the southeast-bound HOV lane, which gives a green light to the HOV lane before the other right-turn lanes on Northeast Pacific Street.

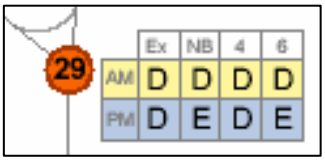


Exhibit 5-21g. **Montlake Boulevard/ Northeast Pacific Street LOS**

Under existing conditions, this intersection operates at LOS D during the a.m. peak hour. The southeast-bound right-turn and southbound through movements are over capacity. The northbound approach queue backs up to the East Shelby Street intersection. The southeast-bound right queues through the Northeast Pacific Street/University Hospital Emergency Entrance intersection. The southbound through movement queues back through the Montlake Boulevard/Pacific Place intersection.

During the p.m. peak hour, this intersection operates at LOS D. The southeast-bound right is over capacity, and the northbound through

lanes nearly at capacity (V/C = 0.99). As during the a.m. peak hour, the northbound through movement queues back through the Montlake Boulevard/East Shelby Street intersection, the southeast-bound right queues through the Northeast Pacific Street/University Hospital Emergency Entrance intersection, and the southbound through movement queues back through the Montlake Boulevard/Pacific Place intersection.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS D during the a.m. peak hour in 2030. The southbound through and southeast-bound right-turn movements would exceed capacity, and the queues would back through the adjacent intersections of Montlake Boulevard/Pacific Place and Montlake Boulevard/University Hospital Emergency Entrance.

During the p.m. peak hour, this intersection would operate at LOS E. Like the a.m. peak hour, the southbound through and southeast-bound right-turn would be over capacity; however, the northbound through would also be over capacity. The southbound through queue would not back through the Montlake Boulevard/Pacific Place intersection as it would under the a.m. peak hour conditions. The southeast-bound queue would back through the adjacent intersection (Montlake Boulevard/University Hospital Emergency Entrance), and the northbound through queue would back through the Montlake Boulevard/East Shelby Street intersection.

4-Lane Alternative

The 4-Lane Alternative would operate at the same LOS as the No Build Alternative in the a.m. peak in 2030. The southbound through and southeast-bound right-turn movements would be over capacity, and the resulting queues would back through the adjacent intersections of Montlake Boulevard/Northeast Pacific Place and Montlake Boulevard/University Hospital Emergency Entrance, as they would under the No Build Alternative.

In the p.m. peak hour, the LOS would improve from E to D with the 4-Lane Alternative because the northbound volumes would decrease more than the southbound and southeastbound volumes would increase. As in the No Build Alternative, the southbound through, southeastbound right-turn, and the northbound through movements would be over capacity. The southeast-bound right-turn and northbound through queues would back through the adjacent

intersections, as under the No Build Alternative. Unlike the No Build Alternative, however, the southbound through queue would back through the Montlake Boulevard/Northeast Pacific Place intersection because there is a greater southbound volume. As under the No Build Alternative, the northbound queue would extend back through the Montlake Boulevard/East Shelby Street intersection.

6-Lane Alternative

Under the 6-Lane Alternative, the intersection would continue to operate at LOS D during the a.m. peak hour in 2030, although the delay would increase slightly compared to the No Build Alternative. The southbound through and southeast-bound right-turn movements would exceed capacity and queue back through the adjacent intersections of Montlake Boulevard/Northeast Pacific Place and Montlake Boulevard/University Hospital Emergency Entrance, as under the No-Build Alternative.

During the p.m. peak hour, intersection LOS would be the same as under No Build Alternative conditions (LOS E). The LOS would deteriorate compared to the 4-Lane Alternative because the southbound volume on Montlake Boulevard and southeast-bound volume on Northeast Pacific Street would both increase, and these movements would compete for the green time at the signal. Like the No Build Alternative, the southbound through, southeast-bound right-turn, and the northbound through movements would exceed capacity. The southeast-bound right-turn and northbound through queues would back through the adjacent intersections, as they would under the No Build Alternative. Unlike the No Build Alternative, the southbound through queue would back through the Montlake Boulevard/Northeast Pacific Place intersection because of greater southbound volumes.

Montlake Boulevard/Northeast Pacific Place (Exhibit 5-21, Location 30)

Existing Conditions

Northeast Pacific Place provides access to the Triangle Parking Garage and connects Northeast Pacific Street to Montlake Boulevard with this signalized intersection. It is the only way for southeastbound vehicles on Northeast Pacific Street to access northbound Montlake Boulevard because left turns are not allowed at the Montlake Boulevard/Northeast Pacific Street intersection.

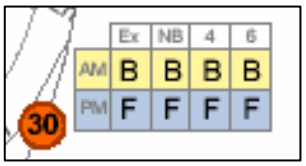


Exhibit 5-21h. **Montlake Boulevard/Northeast Pacific Place LOS**

Under existing conditions, this intersection operates at LOS B during the a.m. peak hour. Capacity remains for all movements, and traffic does not queue into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS F because the northbound through and eastbound left are over capacity. Additionally, the northbound through queues back through the Montlake Boulevard/Northeast Pacific Street intersection.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS B during the a.m. peak hour in 2030. Capacity is available for all movements, and queues would not spill back into adjacent intersections.

During the p.m. peak hour, this intersection would operate at LOS F because northbound traffic volumes on Montlake Boulevard and eastbound left turn traffic volumes from Northeast Pacific Place onto Montlake Boulevard would exceed capacity, causing congestion at the intersection. The northbound queue would spill back through the Montlake Boulevard/Northeast Pacific Street intersection. The eastbound queue is metered by the Northeast Pacific Street/Northeast Pacific Place intersection and does not extend back to that intersection under the metered conditions.

4-Lane Alternative

Under the 4-Lane Alternative in 2030, this intersection would operate at the same LOS during the a.m. peak hour as under No Build Alternative conditions. Capacity would be available, and queuing would not spill back into adjacent intersections, as under the No Build Alternative.

During the p.m. peak hour, intersection operations would continue to be LOS F. However, average p.m. peak hour delays would drop from 131 seconds of delay per vehicle under No Build Alternative conditions to 109 seconds of delay per vehicle under 4-Lane Alternative conditions. Also, the V/C ratio would drop for the northbound through movement and minimally increase (by 0.01) for the eastbound left-turn movement. These operational improvements would occur because traffic volumes decrease for the eastbound left-turn, northbound through, and southbound through movements. Also, signal timing optimizations would increase the signal cycle length by 20 seconds over No Build Alternative conditions, which would reduce some of the stopping and starting of vehicles and allow more usable green time in an hour. Like

the No Build Alternative, the northbound queue would spill back through the Montlake Boulevard/Northeast Pacific Street intersection. Also, the eastbound queue is metered by the Northeast Pacific Street/Northeast Pacific Place intersection and would not extend back to that intersection under the metered conditions.

6-Lane Alternative

Under 6-Lane Alternative conditions in 2030, this intersection would operate at the same LOS during the a.m. peak hour as under No Build Alternative conditions. Capacity would be available and queuing would not spill back into adjacent intersections, as under the No Build Alternative and the 4-Lane Alternative.

During the p.m. peak hour, this intersection would continue to operate at LOS F. However, average p.m. peak hour delays would decrease from 131 seconds of delay per vehicle under No Build Alternative conditions to 108 seconds of delay per vehicle under 6-Lane Alternative conditions. Also, the V/C ratios for the northbound through and eastbound left-turn movements would decrease. These operational improvements would occur because traffic volumes would decrease for the eastbound left-turn, northbound through, and southbound through movements. The network cycle length would be closer to the intersection's optimal cycle (at which delays are typically minimized) than under No Build conditions. Like the No Build Alternative, the northbound queue would spill back through the Montlake Boulevard/Northeast Pacific Street intersection; the difference is that only the eastbound through/right queue would be metered by the Northeast Pacific Street/Northeast Pacific Place intersection. Still, the queue would not extend back to that intersection under the partially metered conditions.

Montlake Boulevard/Northeast 45th Street (Exhibit 5-21, Location 34)

Existing Conditions

This signalized intersection provides access to the Northeast 45th Street viaduct. Using the viaduct to get to Northeast 45th Street, vehicles can access the University of Washington campus at 17th Avenue Northeast or the residential area immediately north of campus. To the east, Northeast 45th Street connects the Laurelhurst and Sand Point neighborhoods to Montlake Boulevard.

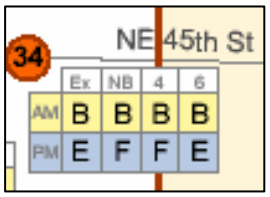


Exhibit 5-21i. **Montlake Boulevard/Northeast 45th Street LOS**

Under existing conditions, this intersection operates at LOS B during the a.m. peak hour. Capacity remains for all movements, and traffic does not queue into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS E because the northeast-bound through movement on Montlake Boulevard and the southeast-bound left from the viaduct are over capacity. The northeastbound through queue backs through the Montlake Boulevard/Northeast 44th Street intersection.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS B during the a.m. peak hour in 2030. Capacity would be available, and queues would not extend into adjacent intersections.

During the p.m. peak hour, this intersection would operate at LOS F. The left-turn movement from the Northeast 45th Street viaduct and the northeast-bound through movement on Montlake Boulevard (traffic traveling north on Montlake Boulevard toward Sand Point Way) would exceed capacity and compete for green time at the signal. Northeast-bound queues would back up through the adjacent Montlake Boulevard/Northeast 44th Street intersection.

4-Lane Alternative

Under 4-Lane Alternative conditions in 2030, this intersection would operate at LOS B during the a.m. peak hour as under the No Build Alternative. Capacity would be available, and queues would not extend into adjacent intersections.

During the p.m. peak hour, this intersection would operate at LOS F. However, average p.m. peak hour delays would decrease from 106 seconds per vehicle under the No Build Alternative to 82 seconds per vehicle under 4-Lane Alternative. The northeastbound through movement would exceed capacity but the V/C ratio would decrease. For the left turn from the Northeast 45th Street viaduct, the V/C ratio would be about the same as under the No Build Alternative. Overall, intersection operations would improve, primarily because traffic volumes would decrease through the intersection for all approaches rather than only for one approach or for one specific movement. Northeast-bound queues would continue to extend back through the adjacent Montlake Boulevard/Northeast 44th Street intersection, as under the No Build Alternative.

6-Lane Alternative

Under the 6-Lane Alternative, this intersection would operate at LOS B during the a.m. peak hour in 2030, as it would under the No Build Alternative. Capacity would be available, and queues would not extend into adjacent intersections.

During the p.m. peak hour, intersection operations would improve to LOS E. Average p.m. peak hour delays would drop from 106 seconds per vehicle under the No Build Alternative to 77 seconds per vehicle under the 6-Lane Alternative. Also, although still over capacity, the V/C ratio would decrease for both the left turn from the Northeast 45th Street viaduct and the northeast-bound through movement on Montlake Boulevard. Intersection operations would improve for the same reasons as under the 4-Lane Alternative conditions, but traffic volumes would be slightly lower because more traffic turns onto Pacific Street instead of continuing north on Montlake Boulevard. Northeast-bound queues would continue to extend back through the adjacent Montlake Boulevard/Northeast 44th Street intersection, as under the No Build and 4-Lane Alternatives.

Northeast Pacific Street/15th Avenue Northeast (Exhibit 5-21, Location 35)

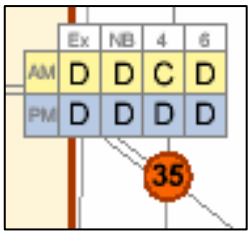


Exhibit 5-21j. **Northeast Pacific Street/15th Avenue Northeast LOS**

Existing Conditions

This signalized intersection provides access to 15th Avenue Northeast along the west side of the University of Washington main campus.

Under existing conditions, this intersection operates at LOS D during the a.m. peak hour. Capacity is sufficient for all movements, and traffic does not queue into adjacent study intersections. The northwest-bound left-turn movement does overflow its storage bay, but not enough to affect the Northeast Pacific Street/Northeast Pacific Place intersection.

During the p.m. peak hour, this intersection operates at LOS D. As during the a.m. peak hour, capacity remains for all movements, and traffic does not queue into adjacent study intersections.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at LOS D during the a.m. peak hour in 2030. Capacity would be available for all movements, and queues would not back up into any adjacent study intersections.

During the p.m. peak hour, the same LOS, capacity, and queuing conclusions apply as during the a.m. peak hour.

4-Lane Alternative

Under the 4-Lane Alternative, intersection operations during the a.m. peak hour would improve from LOS D to C by 2030 because of signal optimization and subtle shifts in traffic volumes. Capacity would be available for all movements, and queues would not back up into any adjacent study intersections.

During the p.m. peak hour, this intersection would operate at LOS D, as under the No Build Alternative. Capacity would be available for all movements, and queues would not back up into any adjacent study intersections.

6-Lane Alternative

During the a.m. peak hour, this intersection would operate at LOS D in 2030, as under the No Build Alternative. Like the 4-Lane Alternative, the 6-Lane Alternative would include small changes in traffic volumes entering the intersection and network signal optimization, but the effects of these changes would not be sufficient to improve the LOS. Capacity would be available for all movements, and queues would not back up into any adjacent study intersections.

During the p.m. peak hour, this intersection would operate at LOS D, as under the No Build Alternative. There would be traffic volume decreases at the intersection that would normally improve LOS; however, a longer cycle length than under the No Build Alternative would counteract this effect. (Longer cycle lengths tend to increase delays but provide more capacity.) Capacity would be available for all movements, and queues would not back up into any adjacent study intersections.

How would the project affect traffic circulation in the Montlake Boulevard interchange area?

Traffic volumes would grow between existing conditions and the project alternatives, and this growth would be consistent with the functioning of streets today. In other words, local streets would not become arterial bypass routes. Some local rerouting would occur because of the new traffic signal at the Montlake Boulevard/SR 520 westbound ramps intersection, but that change would occur on the arterial rather than on neighborhood streets. No other changes to local traffic circulation have been identified in this interchange area. Traffic

volume changes are discussed in *Chapter 3: Freeway and Local Traffic Forecasts* of this report.

What are the pedestrian and bicycle amenity changes in the Montlake Boulevard interchange area?

Under the 4-Lane and 6-Lane Alternatives, the Montlake Boulevard interchange would be designed to include various nonmotorized enhancements. At the Montlake Boulevard/SR 520 westbound off-ramp intersection, pedestrians would cross the east leg of the intersection via a pedestrian signal that would stop vehicles from turning right from the off-ramp onto Montlake Boulevard. Additionally, a nonmotorized path aligned along the SR 520 mainline is proposed that would allow pedestrians to cross under Montlake Boulevard. These improvements offer more controlled and therefore safer crossing opportunities than under existing conditions and the No Build Alternative. Exhibit 5-26 is a conceptual sketch of the nonmotorized path undercrossing.

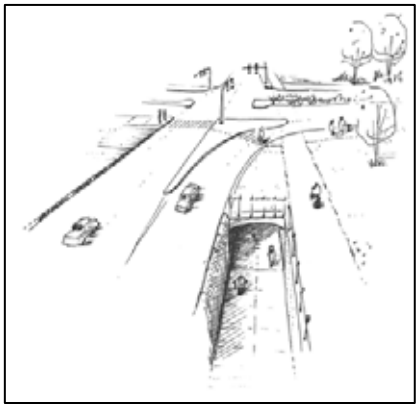


Exhibit 5-26. **Conceptual Sketch of the SR 520 Path Undercrossing**

Under the 6-Lane Alternative, pedestrian and bicycle amenities would be further improved with the addition of a lid over SR 520 at Montlake Boulevard. See *Chapter 6: Nonmotorized Facilities* for further discussion about bicycle and pedestrian amenities.

What are the findings at the Montlake Boulevard interchange area?

- Generally, the build alternatives would not negatively traffic operations at the intersections within the Montlake Boulevard interchange area. In fact, LOS would improve to D or better at five intersections under both the 4-Lane and 6-Lane Alternatives. Additionally, LOS would not degrade to D or worse at any of the study area intersections, except at the Montlake Boulevard/SR 520 westbound ramps intersection. This degradation would be due to a change in intersection control from a yield for the exiting SR 520 westbound traffic to a signal. With a signal, vehicles would experience more delay but traffic operations and flow would improve.

- Traffic operations in the Montlake Boulevard interchange area are affected by the number of vehicles traveling through this area, with traffic volumes today exceeding capacity at most intersections. Traffic operations are also constrained by the historic Montlake

Bridge and Montlake and Lake Washington Boulevards, whose geometrics cannot accommodate existing traffic volumes. Given these constraints, traffic queues form and extend back to adjacent intersections, creating systemwide congestion through the Montlake Boulevard interchange area that would persist to a large degree under future conditions.

- At the SR 520 Lake Washington Boulevard ramps intersection, traffic operations would benefit greatly from a change in traffic control from all-way stop control to signalization.
- The Montlake Boulevard/SR 520 eastbound ramps intersection operates at LOS F today and would continue to do so under all future alternatives. Traffic volumes would exceed capacity on all approaches and queue into adjacent intersections (except on Lake Washington Boulevard, where there is no adjacent intersection).
- Traffic operations at the Montlake Boulevard/East Hamlin Street intersection would improve with signalization of the downstream intersection at Montlake Boulevard/SR 520 westbound ramps.
- Northbound traffic operations at the Montlake Boulevard/East Shelby Street intersection are and would continue to be affected by queues from the Montlake Boulevard/Northeast Pacific Street intersection.
- During the p.m. peak hour, traffic operations at the Montlake Boulevard/Northeast Pacific Place intersection are affected by congestion at the Montlake Boulevard/Northeast Pacific Street intersection. The Montlake Boulevard/Northeast Pacific Place intersection operates at LOS F today and would remain at this level under all project alternatives.
- During the p.m. peak hour, the Montlake Boulevard/Northeast 45th Street intersection would operate at LOS F under both the No Build and 4-Lane Alternatives and at LOS E under the 6-Lane Alternative. Traffic operations are constrained by geometrics on the Northeast 45th Street viaduct, causing traffic volumes to exceed capacity.

Eastside

84th Avenue Northeast Interchange Area

The 84th Avenue Northeast interchange area is shown in Exhibit 5-27. The exhibit highlights which intersections were analyzed within the interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses the change in traffic volumes from today and for all future alternatives. The LOS results shown in Exhibit 5-27 and project effects on traffic operations are also discussed in detail by intersection.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-28 shows the existing and forecasted 2030 84th Avenue Northeast interchange area traffic volumes during the a.m. peak hour. The traffic volumes shown include traffic on both sides of the street. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

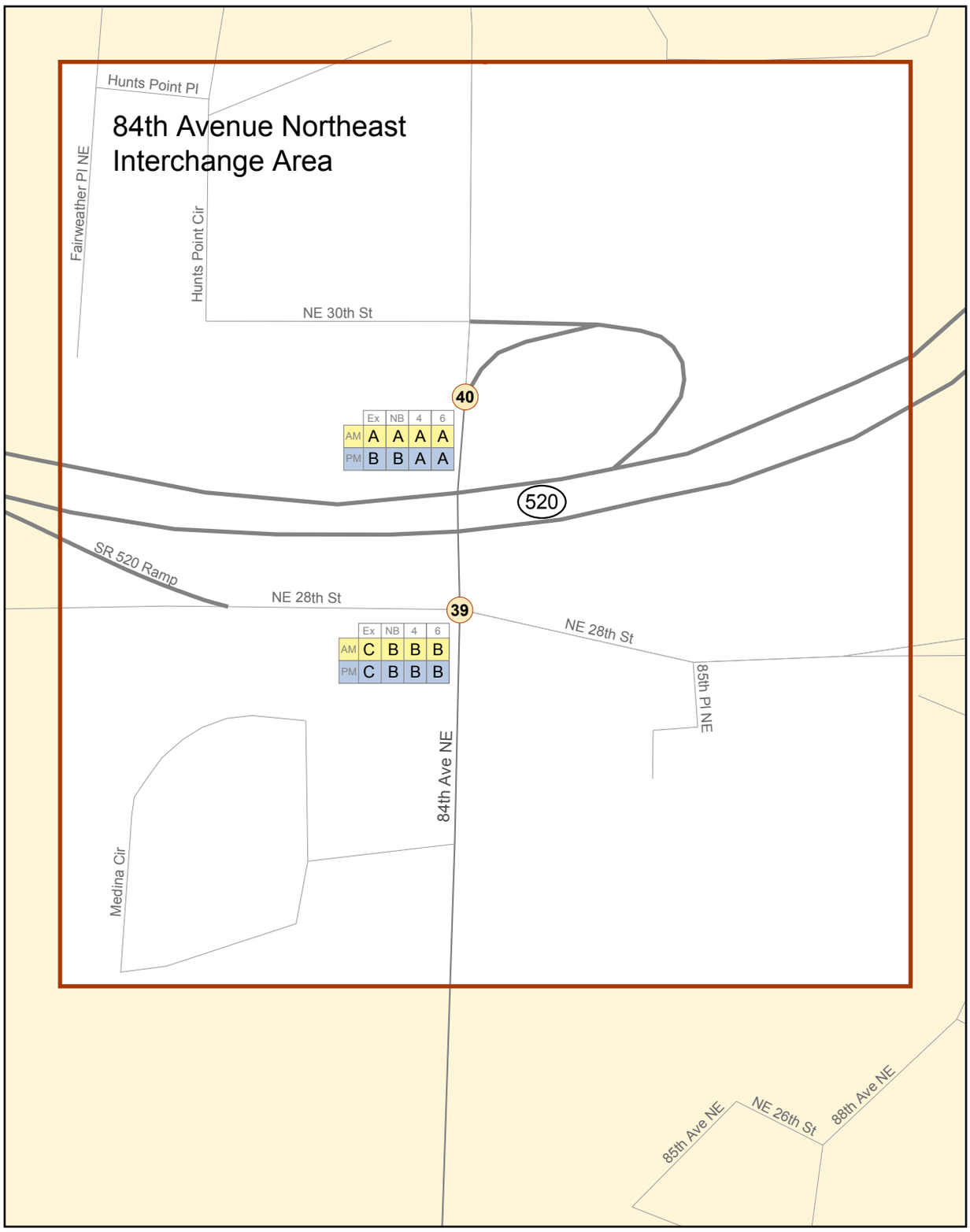
Overall, No Build Alternative traffic volumes in 2030 would increase by 15 percent compared with existing traffic volumes during the a.m. peak hour.

4-Lane Alternative

Traffic volumes for the 4-Lane Alternative would decrease in 2030 by 16 percent as compared with No Build Alternative traffic volumes during the a.m. peak hour. Traffic patterns would shift as a result of the toll on the Evergreen Point Bridge.

6-Lane Alternative

6-Lane Alternative traffic volumes in 2030 would decrease 9 percent compared with No Build traffic volumes during the a.m. peak hour.



LEGEND

1 Study signalized intersection

5 Study unsignalized intersection

No Build — Existing — 4-Lane — 6-Lane

		Ex	NB	4	6
A.M. Peak Hour	AM	D	C	C	C
P.M. Peak Hour	PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 125 250 Feet

Exhibit 5-27. **84th Avenue Northeast Interchange Area**

SR 520 Bridge Replacement and HOV Project

Exhibit 5-28. **A.M. Peak Hour Traffic Volumes for Local Streets at the 84th Avenue Northeast Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
84th Avenue Northeast north of westbound on-ramp	170	180	160	190	10	6%	-20	-11%	10	6%
Northeast 28th Street east of 84th Avenue Northeast	630	740	630	680	110	17%	-110	-15%	-60	-8%
84th Avenue Northeast south of eastbound off-ramp	1120	1290	1070	1150	170	15%	-220	-17%	-140	-11%
Total of Locations	1920	2210	1860	2020	290	15%	-350	-16%	-190	-9%

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-29 shows the existing and forecasted 2030 84th Avenue Northeast interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

Exhibit 5-29. **P.M. Peak Hour Traffic Volumes for Local Streets at the 84th Avenue Northeast Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
84th Avenue Northeast north of westbound on-ramp	160	240	230	250	80	50%	-10	-4%	10	4%
Northeast 28th Street east of 84th Avenue Northeast	650	530	480	530	-120	-18%	-50	-9%	0	0%
84th Avenue Northeast south of eastbound off-ramp	1210	1210	1000	1160	0	0%	-210	-17%	-50	-4%
Total of Locations	2020	1980	1710	1940	-40	-2%	-270	-14%	-40	-2%

No Build Alternative

Overall, No Build Alternative traffic volumes in 2030 would decrease by 2 percent from existing traffic volumes during the p.m. peak hour.

4-Lane Alternative

Traffic volumes for the 4-Lane Alternative in 2030 would decrease 14 percent compared to No Build Alternative traffic volumes during the p.m. peak hour because of the toll on the Evergreen Point Bridge.

6-Lane Alternative

Overall, 6-Lane Alternative traffic volumes in 2030 would decrease by 2 percent compared to the No Build Alternative. The decrease in traffic volumes would be less than under the 4-Lane Alternative because of the completion of the HOV lane across the Evergreen Point Bridge to I-5.

How would the project affect traffic operations?

This section describes how the 2030 alternatives would affect traffic operations at the interchange area and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection. As shown in Exhibit 5-27, the 84th Avenue Northeast/SR 520 eastbound off-ramp intersection (Location 39) would operate at the same LOS for all future alternatives and therefore is not discussed.

84th Avenue Northeast/SR 520 Westbound On-Ramp (Exhibit 5-27, Location 40)

Existing Conditions

This unsignalized intersection connects 84th Avenue Northeast to westbound SR 520. 84th Avenue Northeast connects Hunts Point to Medina and Clyde Hill as well as to SR 520 to and from the west.

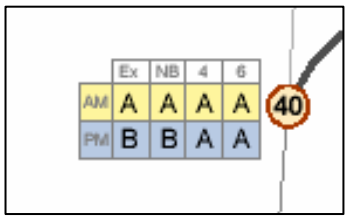


Exhibit 5-27a. **84th Avenue Northeast/SR 520 Westbound On-Ramp LOS**

Under existing conditions, this intersection operates at LOS A during the a.m. peak hour. Capacity is available for all lane groups, and queues do not extend into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS B. Capacity is available for all lane groups, and queues do not extend into adjacent study intersections.

No Build Alternative

Under No Build Alternative conditions, this intersection would operate at the same LOS as under existing conditions during both the a.m. and p.m. peak hours in 2030.

4-Lane Alternative

During the a.m. peak hour, this intersection would operate at the same LOS as under the No Build Alternative in 2030. During the p.m. peak hour, intersection operations would improve from LOS B to LOS A because northbound through volumes would decrease by 10 vph and northbound right-turn volumes would decrease by 20 vph. This reduction in demand would be because of the toll on the Evergreen Point Bridge.

6-Lane Alternative

Intersection operations in 2030 would be the same as under the 4-Lane Alternative for the both the a.m. and p.m. peak hours.

How would the project affect traffic circulation in the 84th Avenue Northeast interchange area?

Both of the build alternatives would reduce freeway traffic volumes in this neighborhood. Under the 4-Lane Alternative, bridge tolling would have a similar effect to ramp metering and would reduce traffic volumes on the westbound SR 520 on-ramp. Under the 6-Lane Alternative, the added capacity and reduced travel times would somewhat outweigh the effects of bridge tolling; traffic volumes would increase slightly over 4-Lane Alternative condition, but would still be lower than under No Build Alternative conditions.

How would the project affect the pedestrian and bicycle amenities in the 84th Avenue Northeast interchange area?

Under the 4-Lane Alternative, pedestrian and bicycle amenities would not change at this interchange because the project design does not include changes to the local street system. Under the 6-Lane Alternative, pedestrian and bicycle amenities would be improved with the addition of a lid at 84th Avenue Northeast. See *Chapter 6: Nonmotorized Facilities* for project area bicycle and pedestrian amenities.

What are the findings at the 84th Avenue Northeast interchange area?

The key finding at the 84th Avenue Northeast Interchange Area is that the build alternatives would improve p.m. peak hour traffic operations at the two ramp terminus intersections.

92nd Avenue Northeast Interchange Area

The 92nd Avenue Northeast interchange area is shown in Exhibit 5-30. The exhibit highlights which intersections were analyzed within the interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses the change in traffic volumes from today and for all project alternatives. The LOS results shown in Exhibit 5-30 and traffic operations in the area are also discussed in detail by intersection.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-31 shows the existing and forecasted 2030 92nd Avenue Northeast interchange area traffic volumes during the a.m. peak hour. Traffic volumes shown represent the total traffic on both sides of the street. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts*.

No Build Alternative

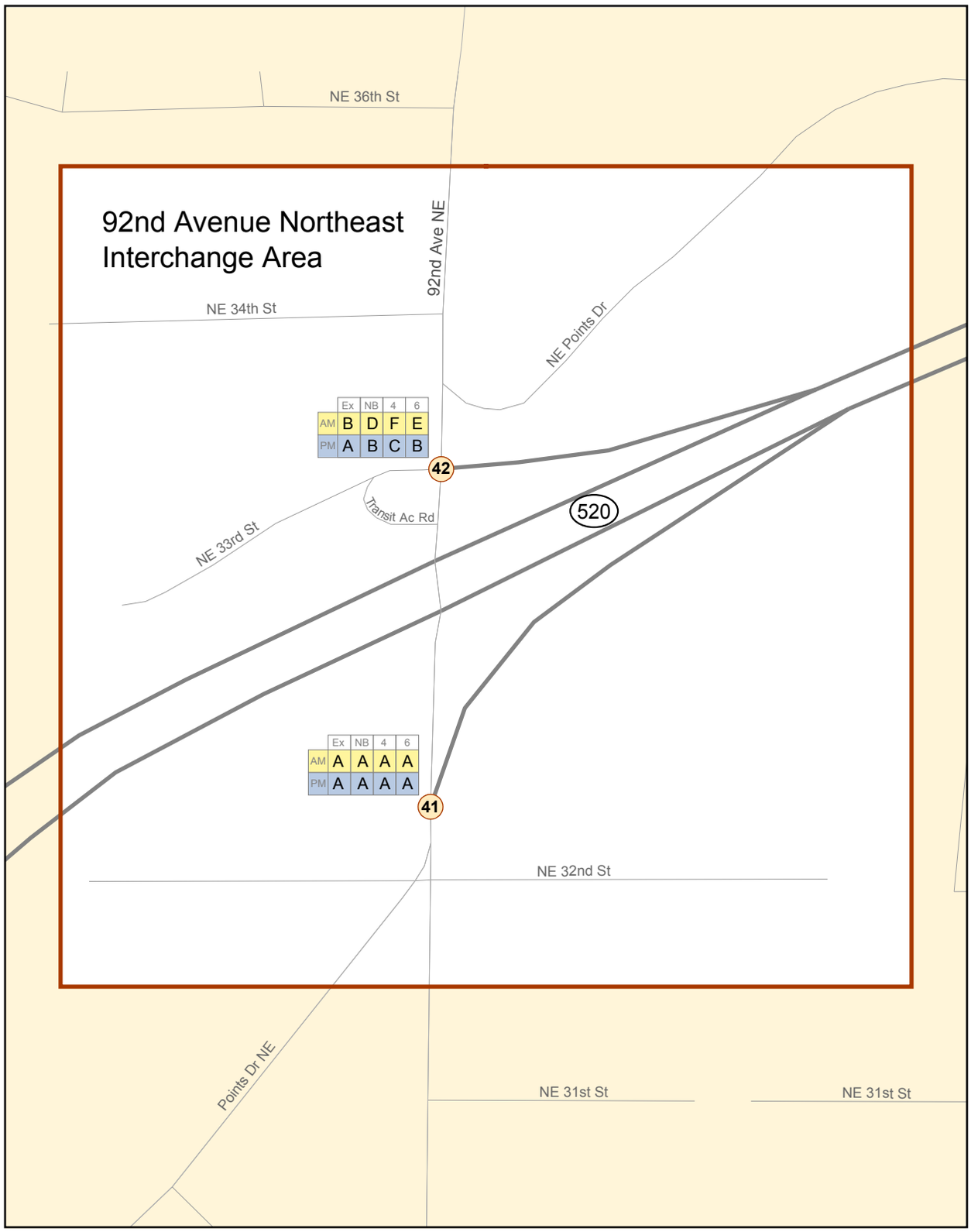
Overall, No Build Alternative traffic volumes would increase by 18 percent over existing traffic volumes during the a.m. peak hour in 2030.

4-Lane Alternative

Traffic volumes under the 4-Lane Alternative in 2030 would increase 11 percent over the No Build Alternative traffic volumes during the a.m. peak hour. Traffic patterns would shift as a result of the toll on the Evergreen Point Bridge.

6-Lane Alternative

6-Lane Alternative traffic volumes in 2030 would increase 6 percent over the No Build traffic volumes during the a.m. peak hour.



LEGEND

1 Study signalized intersection

5 Study unsignalized intersection

No Build — Existing — 4-Lane — 6-Lane

	Ex	NB	4	6
A.M. Peak Hour AM	D	C	C	C
P.M. Peak Hour PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 125 250 Feet

Exhibit 5-30. **92nd Avenue Northeast Interchange Area**

SR 520 Bridge Replacement and HOV Project

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Exhibit 5-31. **A.M. Peak Hour Traffic Volumes for Local Streets at the 92nd Avenue Northeast Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
92nd Avenue Northeast north of westbound off-ramp	340	380	370	400	40	12%	-10	-3%	20	5%
92nd Avenue Northeast south of eastbound on-ramp	940	1130	1300	1200	190	20%	170	15%	70	6%
Total of Locations	1280	1510	1670	1600	230	18%	160	11%	90	6%

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-32 shows the existing and 2030 92nd Avenue Northeast interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts*. Overall, a.m. and p.m. peak hour volumes at this interchange area are almost the same.

Exhibit 5-32. **P.M. Peak Hour Traffic Volumes for Local Streets at the 92nd Avenue Northeast Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
92nd Avenue Northeast north of westbound off-ramp	320	410	460	440	90	28%	50	12%	30	7%
92nd Avenue Northeast south of eastbound on-ramp	760	840	940	890	80	11%	100	12%	50	6%
Total of Locations	1080	1250	1400	1330	170	16%	150	12%	80	6%

No Build Alternative

No Build Alternative traffic volumes in 2030 would increase by 16 percent during the p.m. peak hour on the local streets at the 92nd

Avenue Northeast interchange area. This reflects growth that is forecast to occur between now and 2030.

4-Lane Alternative

Overall, 4-Lane Alternative traffic volumes in 2030 would increase by 12 percent over No Build Alternative traffic volumes during the p.m. peak hour because of the toll on the Evergreen Point Bridge.

6-Lane Alternative

Traffic volumes under the 6-Lane Alternative in 2030 would increase by 6 percent compared to the No Build Alternative volumes because of the additional lanes.

How would the project affect traffic operations?

This section describes how the project alternatives would affect traffic operations at the interchange area in 2030 and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection. As shown in Exhibit 5-30, the 92nd Avenue Northeast/SR 520 eastbound on-ramp intersection (Location 41) would operate at the same LOS for all of the future alternatives and is therefore not discussed.

92nd Avenue Northeast/SR 520 Westbound Off-Ramp (Exhibit 5-30, Location 42)

Existing Conditions

This unsignalized intersection currently provides local neighborhood access to and from the east on SR 520 and connects Yarrow Point with Clyde Hill. The SR 520 westbound off-ramp is stop-controlled, and 92nd Avenue Northeast has the right-of-way.

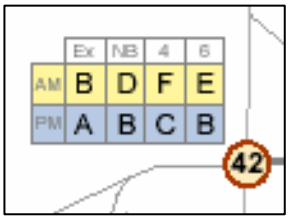


Exhibit 5-30a. **92nd Avenue Northeast/SR 520 Westbound Off-Ramp LOS**

Under existing conditions, this intersection operates at LOS B during the a.m. peak hour. Traffic exiting from westbound SR 520 operates at LOS C because it stops for traffic on 92nd Avenue Northeast. Capacity is available for all lane groups, and the off-ramp traffic does not queue onto SR 520.

During the p.m. peak hour, this intersection operates at LOS A. Traffic exiting from westbound SR 520 operates at LOS C because it stops for traffic on 92nd Avenue Northeast. As during the a.m. peak hour, capacity is available for all lane groups, and the off-ramp traffic does not queue back onto SR 520.

No Build Alternative

Under No Build Alternative conditions, operations at this intersection would drop from LOS B to D in the a.m. peak hour and from LOS A to B in the p.m. peak hour by 2030, compared to existing conditions.

4-Lane Alternative

During the a.m. peak hour, overall intersection operations would degrade to LOS F by 2030 because SR 520 westbound off-ramp traffic would increase (by 50 vph) as people alter their travel choices in response to the toll on Evergreen Point Bridge. The westbound approach would operate at LOS F under the No Build Alternative, but this would not be sufficient to bring the overall intersection to LOS F. With the 4-Lane Alternative, there would be enough delay at the westbound approach to bring the overall intersection to LOS F, even though the northbound and southbound through movements would still travel freely.

During the p.m. peak hour, intersection operations would shift from LOS B for the No Build Alternative to LOS C because southbound volumes on 92nd Avenue Northeast would increase by 60 vph. However, northbound volumes would decrease by 10 vph. Local traffic volumes would change as a result of people altering their travel behavior in response to the toll on Evergreen Point Bridge.

6-Lane Alternative

During the a.m. peak hour, this intersection would operate at LOS E under the 6-Lane Alternative in 2030, which would be worse than under the No Build Alternative but better than under the 4-Lane Alternative. Intersection operations would improve to LOS E because the SR 520 westbound off-ramp volume would be the same as under No Build Alternative conditions. However, because traffic volumes would increase slightly for the southbound through movement (10 vph), the northbound through movement (10 vph), and the transit stop access (10 vph) as compared to the No Build Alternative, the intersection would operate at LOS E, which is worse than under No Build conditions.

During the p.m. peak hour, this intersection would operate the same as under the No Build Alternative. Intersection operations would improve compared to the 4-Lane Alternative because the southbound through traffic volumes on 92nd Avenue Northeast would decrease by 30 vph, and the transit stop access traffic volumes would decrease by 10 vph. While the local traffic volumes would be more with the 6-Lane

Alternative than under the No Build Alternative, the increase in volumes would be less than under the 4-Lane Alternative and would not change the LOS relative to No Build Alternative conditions.

How would the project affect traffic circulation in the 92nd Avenue Northeast interchange area?

The project would not change local traffic circulation in this interchange area, although there would be more traffic during both the a.m. and p.m. peak hours. More detail about changes in traffic volumes can be found in *Chapter 3: Freeway and Local Traffic Forecasts.*

How would the project affect the pedestrian and bicycle amenities in the 92nd Avenue Northeast interchange area?

Under the 4-Lane Alternative, pedestrian and bicycle amenities would not change in the 92nd Avenue Northeast interchange area because the project design does not include changes to the local street system. Under the 6-Lane Alternative, pedestrian and bicycle amenities would be improved with the addition of a lid at 92nd Avenue Northeast. See *Chapter 6: Nonmotorized Facilities* for project area bicycle and pedestrian amenities.

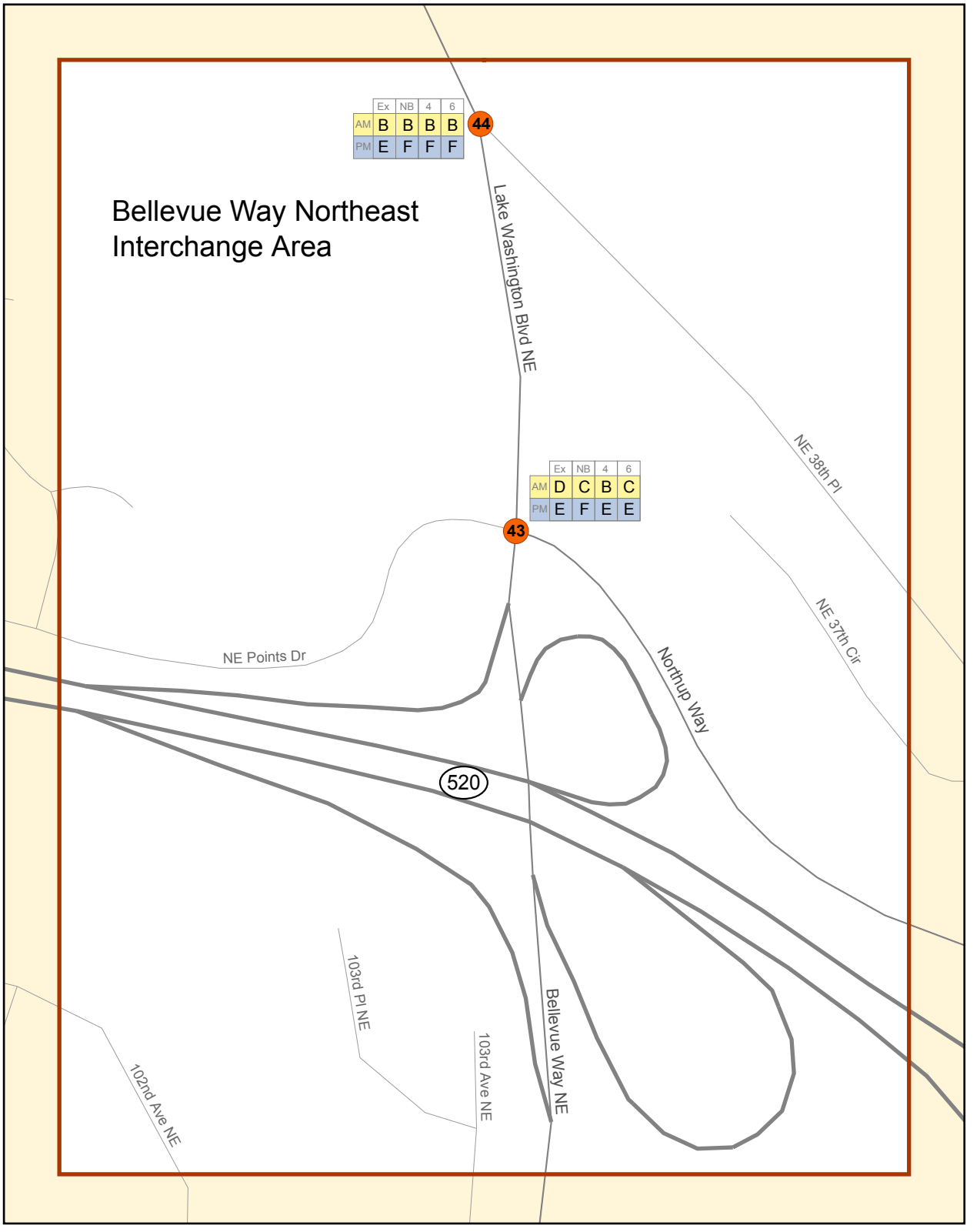
What are the findings at the 92nd Avenue Northeast interchange area?

- The 4-Lane Alternative would affect a.m. peak hour traffic volumes at the SR 520 westbound off-ramp at 92nd Avenue Northeast. Exiting traffic volumes would increase by 50 vph as compared to the No Build Alternative, and LOS would shift from D to F.
- Under the 6-Lane Alternative, traffic volumes would increase at 92nd Avenue Northeast less than the 4-Lane Alternative. Both a.m. and p.m. peak hour LOS would be better than under the 4-Lane Alternative.

Bellevue Way Interchange Area

The Bellevue Way interchange area is shown in Exhibit 5-33. The exhibit highlights which intersections were analyzed within the interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses the change in traffic volumes from today and for all future alternatives. The LOS results shown in Exhibit 5-33 and traffic operations in the area are also discussed in detail by intersection.



LEGEND

1 Study signalized intersection

5 Study unsignalized intersection

No Build — Existing — 4-Lane — 6-Lane

		Ex	NB	4	6
A.M. Peak Hour	AM	D	C	C	C
P.M. Peak Hour	PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 250 500 Feet

Exhibit 5-33. **Bellevue Way Northeast Interchange Area**

SR 520 Bridge Replacement and HOV Project

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How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-34 shows existing and 2030 Bellevue Way Northeast interchange area traffic volumes during the a.m. peak hour. The traffic volumes shown represent the total traffic on both sides of the street. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts*.

Exhibit 5-34. **A.M. Peak Hour Traffic Volumes for Local Streets at the Bellevue Way Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
Bellevue Way north of SR 520 west-bound ramps	2580	2930	2370	2680	350	14%	-560	-19%	-250	-9%
Bellevue Way south of SR 520 eastbound ramps	1890	2110	1840	2000	220	12%	-270	-13%	-110	-5%
Total of Locations	4470	5040	4210	4680	570	13%	-830	-16%	-360	-7%

No Build Alternative

Overall, in 2030 No Build Alternative traffic volumes would increase 13 percent over existing traffic volumes during the a.m. peak hour.

4-Lane Alternative

In 2030, traffic volumes for the 4-Lane Alternative would decrease 16 percent compared with the No Build Alternative traffic volumes during the a.m. peak hour. Traffic patterns would shift as a result of the toll on the Evergreen Point Bridge.

6-Lane Alternative

In 2030, 6-Lane Alternative traffic volumes would decrease by 7 percent compared with No Build traffic volumes during the a.m. peak hour.

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-35 shows the existing and forecasted 2030 Bellevue Way interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below. For more

information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

Overall, No Build Alternative traffic volumes in 2030 would increase by 32 percent on the local streets at the Bellevue Way interchange area during the p.m. peak hour. This reflects growth that is forecast to occur between now and the year 2030.

Exhibit 5-35. **P.M. Peak Hour Traffic Volumes for Local Streets at the Bellevue Way Interchange Area**

					Change Between					
	Total 2-Way Peak Hour Volume				No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	Existing	No Build	4-Lane	6-Lane	(vph)	(%)	(vph)	(%)	(vph)	(%)
Bellevue Way north of SR 520 west-bound ramps	3220	4340	3660	4120	1120	35%	-680	-16%	-220	-5%
Bellevue Way south of SR 520 eastbound ramps	2360	3010	2800	2960	650	28%	-210	-7%	-50	-2%
Total of Locations	5580	7350	6460	7080	1770	32%	-890	-12%	-270	-4%

4-Lane Alternative

Overall, 4-Lane Alternative traffic volumes in 2030 during the p.m. peak hour would decrease by 12 percent from the No Build Alternative because of the toll on the Evergreen Point Bridge.

6-Lane Alternative

Traffic volumes for the 6-Lane Alternative in 2030 would decrease by 4 percent over No Build Alternative traffic volumes.

How would the project affect traffic operations?

This section describes how the project alternatives would affect traffic operations at the Bellevue Way interchange area and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection. Exhibit 5-33 also provides a graphical summary of the LOS results by intersection.

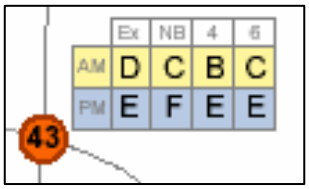


Exhibit 5-33a. **Bellevue Way/ Northup Way LOS**

Bellevue Way/Northup Way (Exhibit 5-33, Location 43)

Existing Conditions

This signalized intersection provides access to Kirkland via Lake Washington Boulevard and downtown Bellevue via Bellevue Way

from Northup Way.

Under existing conditions, this intersection operates at LOS D during the a.m. peak hour because the southbound left-turn movement is over capacity. The southbound approach queues back through the Lake Washington Boulevard/Northeast 38th Place intersection.

During the p.m. peak hour, this intersection operates at LOS E. The southbound left-turn movement is over capacity, and the northbound through movement is at capacity. The southbound approach queues back through the Lake Washington Boulevard/Northeast 38th Place intersection.

No Build Alternative

This intersection would operate at LOS C during the a.m. peak hour in 2030. Traffic queuing from the Lake Washington Boulevard Northeast/Northeast 38th Place intersection to the north would extend back to this intersection and affect traffic operations for the northbound through lane. Intersection operations would improve slightly because of the signal timing optimizations assumed for the future build alternatives.

During the p.m. peak hour, this intersection would operate at LOS F. The northbound through, southbound through, southbound left, and westbound left-turn movements would be at or in excess of their lane capacities, with V/C ratios of 1.11, 0.96, 1.17, and 1.22, respectively. The northbound and southbound through traffic queues would be longer in the p.m. than in the a.m. peak hour. The westbound approach traffic volumes would all be metered by the congested conditions at the 108th Avenue Northeast/Northup Way intersection to the east. Also, eastbound approach volumes would increase from 40 vph in the a.m. peak hour to 500 vph in the p.m. peak hour because of traffic exiting adjacent residential and office areas, as well as people trying to avoid the westbound and southbound left lane queues.

4-Lane Alternative

During the a.m. peak hour in 2030, the LOS would improve at the Bellevue Way/Northup Way Northeast intersection from C to B compared to No Build because traffic volumes would decrease overall as people adjusted their travel choices in response to the toll on Evergreen Point Bridge. Therefore, the northbound and southbound traffic queues would be shorter than under No Build Alternative conditions.

Similarly, the LOS would improve from LOS F to E during the p.m. peak hour. The northbound through, southbound left-turn, and westbound left-turn traffic volumes would continue to exceed their lane capacities with V/C ratios of 1.09, 1.10, and 1.07, respectively. The southbound left lane would operate well within capacity with a V/C ratio of 0.79. Queue conditions would be similar to No Build Alternative queue conditions, but slightly shorter.

6-Lane Alternative

During the a.m. peak hour in 2030, the LOS would be at C, the same as under No Build Alternative conditions. Overall, traffic volumes would be higher than under the 4-Lane Alternative but lower than under the No Build Alternative. The increase in traffic volumes between the 4-Lane and 6-Lane Alternatives is enough that the LOS would not improve as it would for the 4-Lane Alternative. Because 6-Lane Alternative traffic volumes would be slightly lower than No Build Alternative traffic volumes, the northbound and southbound traffic queues would remain but be slightly shorter than under No Build Alternative conditions.

During the p.m. peak hour, this intersection would continue to operate at LOS E as under the 4-Lane Alternative. This is an improvement over No Build Alternative conditions of LOS F because traffic volumes would be lower under the 6-Lane Alternative. Queues and V/C ratios would also decrease compared with No Build Alternative conditions.

Lake Washington Boulevard/Northeast 38th Place (Exhibit 5-33, Location 44)

Existing Conditions

This signalized intersection provides access to and from the South Kirkland park-and-ride via Northeast 38th Place. Northbound Lake Washington Boulevard transitions from two lanes to one at this intersection.

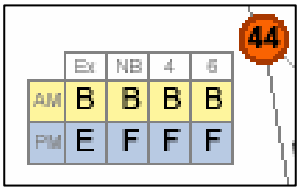


Exhibit 5-33b. **Lake Washington Boulevard/ Northeast 38th Place LOS**

Under existing conditions, the intersection operates at LOS B during the a.m. peak hour. Capacity remains for all movements. The northbound through queue extends back through the Bellevue Way/Northup Way intersection. The southbound approach can queue back through the Lake Washington Boulevard/Lakeview Drive Northeast intersection.

During the p.m. peak hour, this intersection operates at LOS E. The southbound left-turn movement is over capacity, and the northbound through movement is at capacity. The southbound approach queues

back through the Lake Washington Boulevard/Northeast 38th Place intersection.

No Build Alternative

In 2030, this intersection would operate at LOS B during the a.m. peak hour. However, northbound and southbound traffic volumes would continue to queue, with northbound traffic queuing back to the Bellevue Way/Northup Way intersection because of the reduction in the number of through lanes.

During the p.m. peak hour, this intersection would operate at LOS F and would also have northbound traffic queues. Northbound through traffic volumes would exceed capacity with a V/C ratio of 1.45, and queues would be more than twice as long as the a.m. peak hour queues. This queue would affect traffic operations at the Bellevue Way/Northup Way intersection to the south, as well as traffic flow on Bellevue Way.

4-Lane Alternative

In 2030, this intersection would continue to operate at LOS B during the a.m. peak hour. The northbound and southbound through lane queues would be slightly shorter than under No Build Alternative conditions because northbound through traffic volumes would decrease by 170 vph and southbound through traffic volumes by 180 vph. This would result from drivers shifting their travel patterns in response to the toll on Evergreen Point Bridge.

During the p.m. peak hour, this intersection would continue to operate at LOS F. As in the a.m. peak hour, the northbound and southbound through lane queues would be slightly shorter than under No Build Alternative conditions because northbound through traffic volumes would decrease by 140 vph and southbound through traffic volumes by 160 vph. The northbound through V/C ratio would decrease from 1.45 to 1.33.

6-Lane Alternative

This intersection would continue to operate at LOS B during the a.m. peak hour and to fail at LOS F during the p.m. peak hour in 2030. Both a.m. and p.m. peak hour volumes would be higher than under the 4-Lane Alternative, but lower than under the No Build Alternative. Therefore, intersection operations and queue lengths would improve slightly over the No Build Alternative and be slightly worse than under the 4-Lane Alternative. The northbound through V/C ratio would be

1.38, which is between the No Build Alternative V/C ratio of 1.45 and the 4-Lane Alternative V/C ratio of 1.33.

How would the project affect traffic circulation in the Bellevue Way interchange area?

No street system changes are proposed in this interchange area that would affect local traffic circulation or change the functionality of the streets. Growth between existing conditions and the future alternatives would result in slightly more traffic through the area; however, traffic entering and leaving SR 520 is forecast to use the same corridors as it does today, and no new local routes would be established. More detail on the changes can be found in *Chapter 3: Freeway and Local Traffic Forecasts.*

How would the project affect the pedestrian and bicycle amenities at the Bellevue Way interchange area?

Pedestrian and bicycle amenities in this interchange area would not change with the project alternatives because the project design does not include changes to the local street system.

What are the findings at the Bellevue Way interchange area?

- Generally, the build alternatives would not negatively affect traffic operations at the intersections within the Bellevue Way interchange area.
- At the Bellevue Way/Northup Way Northeast intersection, LOS during the a.m. peak hour would improve from C to B under the 4-Lane Alternative and would be at C under the No Build and 6-Lane Alternatives. During the p.m. peak hour, LOS would improve from F to E under both the 4-Lane and 6-Lane Alternatives as compared to No Build.
- At the Lake Washington Boulevard Northeast/Northeast 38th Place intersection, LOS would remain the same for all future alternatives during both the a.m. and p.m. peak hours.
- Traffic volumes would exceed capacity at both intersections during the p.m. peak hour under all 2030 alternatives as vehicles access westbound SR 520.

108th Avenue Northeast Interchange Area

The 108th Avenue Northeast interchange area is shown in Exhibit 5-36. The exhibit highlights which intersections were analyzed within the 108th Avenue Northeast interchange area and shows the LOS results from the Synchro traffic analysis.

This section discusses the change in traffic volumes from today and for all future alternatives. The LOS results shown in Exhibit 5-36, along with traffic operations in the area, are also discussed in detail by intersection.

How do traffic volumes change across the alternatives during the a.m. peak hour?

Exhibit 5-37 shows the existing and 2030 108th Avenue Northeast interchange area traffic volumes during the a.m. peak hour. The traffic volumes shown represent the total traffic on both sides of the street.

The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

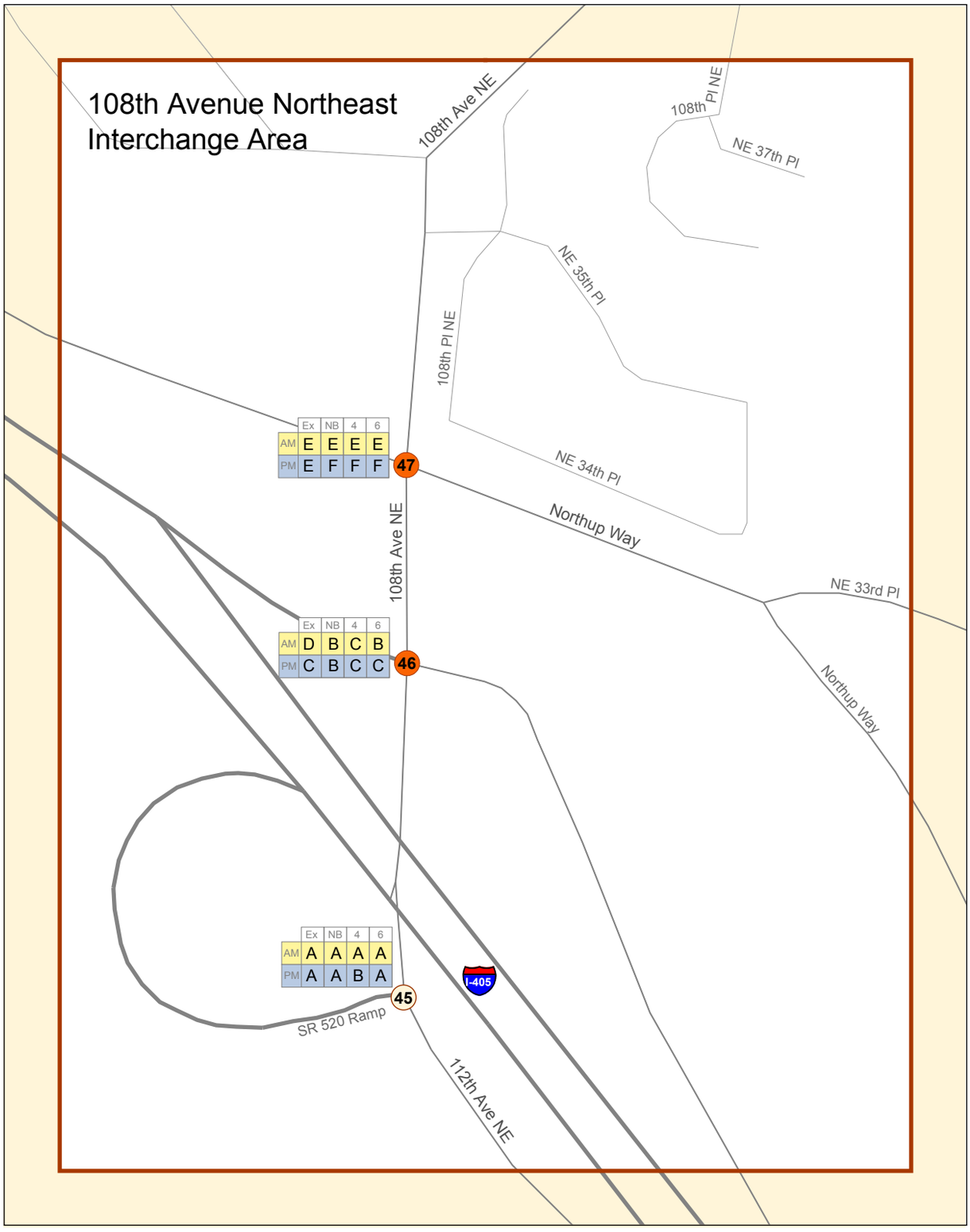
Overall, No Build Alternative traffic volumes in 2030 would increase by 22 percent compared with existing traffic volumes during the a.m. peak hour. This reflects growth that is forecasted to occur between now and 2030.

4-Lane Alternative

Traffic volumes for the 4-Lane Alternative traffic volumes would be 9 percent higher than No Build Alternative traffic volumes during the a.m. peak hour in 2030. This increase reflects anticipated changes in travel patterns as a result of tolling on the Evergreen Point Bridge.

6-Lane Alternative

In 2030, 6-Lane Alternative traffic volumes would be 3 percent higher than No Build traffic volumes during the a.m. peak hour.



LEGEND

1 Study signalized intersection

5 Study unsignalized intersection

No Build — Existing — 4-Lane — 6-Lane

		Ex	NB	4	6
A.M. Peak Hour	AM	D	C	C	C
P.M. Peak Hour	PM	B	B	B	B

Existing Conditions Year 2000 — Alternatives Year 2030

LEVEL OF SERVICE

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

N 0 125 250 Feet

Exhibit 5-36. **108th Avenue Northeast Interchange Area**

SR 520 Bridge Replacement and HOV Project

Exhibit 5-37. **A.M. Peak Hour Traffic Volumes for Local Streets at the 108th Avenue Northeast Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
108th Avenue Northeast north of SR 520 westbound ramps	2350	2870	3160	2950	520	22%	290	10%	80	3%
108th Avenue Northeast south of SR 520 eastbound on-ramp	1110	1350	1450	1410	240	22%	100	7%	60	4%
Total of Locations	3460	4220	4610	4360	760	22%	390	9%	140	3%

How do traffic volumes change across the alternatives during the p.m. peak hour?

Exhibit 5-38 shows the existing and 2030 108th Avenue Northeast interchange area traffic volumes during the p.m. peak hour. The changes in traffic volumes are briefly described below. For more information regarding the traffic volume forecasts for the local street network, see *Chapter 3: Freeway and Local Traffic Forecasts.*

No Build Alternative

Overall, No Build Alternative traffic volumes in 2030 would increase by 24 percent on the local streets at the 108th Avenue Northeast Street interchange area during the p.m. peak hour. This reflects growth that is forecast to occur between now and 2030.

Exhibit 5-38. **P.M. Peak Hour Traffic Volumes for Local Streets at the 108th Avenue Northeast Interchange Area**

	Total 2-Way Peak Hour Volume				Change Between					
					No Build and Existing		4-Lane and No Build		6-Lane and No Build	
Location	**Existing**	**No Build**	**4-Lane**	**6-Lane**	**(vph)**	**(%)**	**(vph)**	**(%)**	**(vph)**	**(%)**
108th Avenue Northeast north of SR 520 westbound ramps	2460	3030	3200	3200	570	23%	170	6%	170	6%
108th Avenue Northeast south of SR 520 eastbound on-ramp	1470	1850	1920	1940	380	26%	70	4%	90	5%
Total of Locations	3930	4880	5120	5140	950	24%	240	5%	260	5%

4-Lane Alternative

During the p.m. peak hour in 2030, traffic volumes for the 4-Lane Alternative would be 5 percent higher than No Build Alternative traffic volumes. This increase reflects anticipated changes in travel patterns as a result of tolling on the Evergreen Point Bridge.

6-Lane Alternative

Growth at this interchange area would be similar to the 4-Lane Alternative. Overall, 6-Lane Alternative traffic volumes in 2030 would increase by 5 percent over No Build Alternative traffic volumes.

How would the project affect traffic operations?

This next section describes how the project alternatives would affect traffic operations at the interchange area and compares 4-Lane and 6-Lane Alternative traffic operations to the No Build Alternative. The results are presented by intersection. Exhibit 5-36 also provides a graphical summary of the LOS results by intersection.

108th Avenue Northeast/SR 520 Eastbound On-Ramp (Exhibit 5-36, Location 45)

This intersection is currently uncontrolled; therefore, traffic turning left on the SR 520 eastbound on-ramp must yield to through traffic on 108th Avenue Northeast. Project engineers assumed that traffic control would remain the same for the build alternatives.

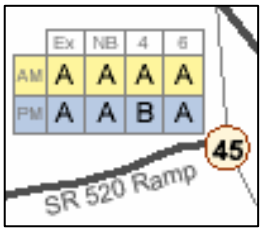


Exhibit 5-36a. **108th Avenue Northeast/SR 520 Eastbound On-Ramp LOS**

Existing Conditions

108th Avenue Northeast is a north-south street that connects downtown Bellevue with downtown Kirkland. This unsignalized intersection currently provides access to eastbound SR 520 from the nearby neighborhoods and commercial areas. The northbound left-turn must yield to oncoming southbound traffic.

Under existing conditions, this intersection operates at LOS A during the a.m. peak hour. The northbound left operates at LOS C because it yields to southbound traffic. Capacity is available for all lane groups, and traffic does not queue into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS A. The northbound left operates at LOS B because it yields to southbound traffic. As during the a.m. peak hour, capacity is available for all lane groups, and traffic does not queue into adjacent study intersections.

No Build Alternative

This intersection would operate at LOS A during both the a.m. and p.m. peak hours in 2030.

4-Lane Alternative

This intersection would continue to operate at LOS A during the a.m. peak hour and would shift from LOS A to B during the p.m. peak hour in 2030. The LOS B threshold is crossed when there is greater than a 10 second average delay per vehicle, and this intersection would have a 10.4-second average delay. The delay would result from a 220-vph increase in traffic volumes turning left onto the SR 520 eastbound on-ramp. The LOS for this movement would be LOS F, and the lane would be at capacity with a V/C ratio of 0.97.

6-Lane Alternative

In 2030, this intersection would operate at LOS A during both the a.m. and p.m. peak hour, similar to No Build conditions and an improvement over the 4-Lane Alternative's p.m. peak hour LOS. This improvement is because the left turn traffic volumes onto the SR 520 eastbound on-ramp would decrease by 60 vph compared with 4-Lane Alternative conditions. Because this intersection would be at the threshold at 10.4 seconds of delay per vehicle under the 4-Lane Alternative, this slight decrease in traffic volumes would be enough to shift the LOS to A with 7.2 seconds of delay per vehicle. The LOS for vehicles turning left onto SR 520 would be E, and the lane would operate below capacity with a V/C ratio of 0.89.

108th Avenue Northeast/SR 520 Westbound Ramps (Exhibit 5-36, Location 46)

Existing Conditions

This signalized intersection provides access to and from westbound SR 520 for nearby streets.

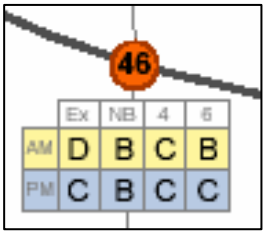


Exhibit 5-36b. **108th Avenue Northeast/SR 520 Westbound Ramps LOS**

Under existing conditions, this intersection operates at LOS D during the a.m. peak hour. The westbound left/through/right and right-turn only lanes are over capacity. The westbound off-ramp queue does not back onto westbound SR 520, and other queues do not back into adjacent study intersections.

During the p.m. peak hour, this intersection operates at LOS C. The westbound left/through/right lane is over capacity. As during the a.m. peak hour, the westbound off-ramp queue does not back onto

westbound SR 520, and other queues do not back into adjacent study intersections.

No Build Alternative

This intersection would operate at LOS B during both the a.m. and p.m. peak hours in 2030. Intersection operations would improve over existing conditions because the signal optimization improvements assumed under the No Build Alternative would offset the increase in traffic volumes. However, because the 108th Avenue Northeast/ Northup Way northbound through and left traffic volumes would queue back to this intersection, SR 520 traffic exiting at this intersection would queue on the ramp during both the a.m. and p.m. peak hours. These queues would not affect operations on westbound SR 520.

4-Lane Alternative

Intersection operations would degrade from LOS B to C during both the a.m. and p.m. peak hours under the 4-Lane Alternative in 2030 at the 108th Avenue Northeast/SR 520 westbound ramps intersection. The LOS would degrade during the a.m. peak hour because of a 280-vph increase in traffic volumes exiting from SR 520. During the p.m. peak hour, southbound traffic volumes on 108th Avenue Northeast would increase by 380 vph compared with No Build Alternative conditions. SR 520 off-ramp traffic would have similar queues to those described for the No Build Alternative.

6-Lane Alternative

During the a.m. peak hour, the 6-Lane Alternative would operate at LOS B in 2030, the same as under the No Build Alternative and better than the 4-Lane Alternative. The only difference in traffic volumes between No Build and 6-Lane Alternative conditions is a 110-vph increase for the southbound through lane and a 30-vph decrease for the southbound right lane.

During the p.m. peak hour, this intersection would operate at LOS C, as under the 4-Lane Alternative. The LOS would be lower than for No Build because of a 280-vph increase in southbound traffic volumes on 108th Avenue Northeast.

SR 520 exiting traffic would have similar queues to those described for No Build Alternative conditions.

108th Avenue Northeast/Northup Way (Exhibit 5-36, Location 47)

Existing Conditions

This signalized intersection provides access from Northup Way to and from the South Kirkland park-and-ride via 108th Avenue Northeast.

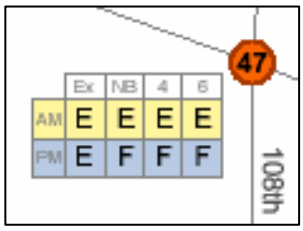


Exhibit 5-36c. **108th Avenue Northeast/ Northup Way LOS**

Under existing conditions, this intersection operates at LOS E during the a.m. peak hour because the eastbound through lane is over capacity. The northbound through queue extends back through the 108th Avenue Northeast/SR 520 westbound ramps intersection.

During the p.m. peak hour, this intersection operates at LOS E because the westbound approach is over capacity. The northbound through queue extends back through the 108th Avenue Northeast/SR 520 westbound ramps intersection.

No Build Alternative

During the a.m. peak hour, this intersection would operate at LOS E in 2030. Traffic volumes for the northbound left and through lanes would exceed capacity, and queues would extend back to the 108th Avenue Northeast/SR 520 westbound ramps. Traffic volumes for the eastbound and southbound through lanes would also exceed capacity.

During the p.m. peak hour, this intersection would operate at LOS F. As during the a.m. peak hour, traffic volumes for the northbound left and left/through lanes would exceed capacity, and queues would extend back to the 108th Avenue Northeast/SR 520 westbound ramps intersection.

4-Lane Alternative

The 108th Avenue Northeast/Northup Way intersection would also operate at LOS E during the a.m. peak hour and LOS F during the p.m. peak hour in 2030, with similar capacity and queuing issues as under No Build Alternative conditions. Overall, total intersection traffic volumes would increase by 140 vph during the a.m. peak hour and by 50 vph during the p.m. peak hour.

6-Lane Alternative

Like the No-Build and 4-Lane Alternatives, this intersection would operate at LOS E during the a.m. peak and LOS F during the p.m. peak hour in 2030, with similar capacity and queuing issues as under No Build Alternative conditions. Overall, total intersection traffic volumes

would increase by 30 vph during the a.m. peak hour as compared with No Build.

How would the project affect traffic circulation in the 108th Avenue Northeast interchange area?

The build alternatives do not propose any modifications to the local street system that would result in changes to local traffic circulation in the 108th Avenue Northeast interchange area. Therefore, future traffic would circulate through the interchange area similarly to existing conditions.

Local traffic distribution would be very similar for each of the project alternatives at the intersections adjacent to the 108th Avenue Northeast interchange. There are variations in the on- and off-ramp traffic volumes at the interchange between each of the alternatives. These increases and decreases in ramp volumes would be accompanied by decreases and increases in local traffic. Under the 4-Lane Alternative, local traffic volumes approaching the 108th Avenue Northeast/ Northup Way interchange would increase 2 percent in the a.m. peak hour and 3 percent in the p.m. peak hour compared with the No Build Alternative local traffic volumes. For the 6-Lane Alternative at the same location, local traffic volumes would increase 1 percent in the a.m. peak hour and 5 percent in the p.m. peak hour. These changes in local traffic volumes would result in a small net change in overall local traffic at the 108th Avenue Northeast interchange area between the No Build, 4-Lane, and 6-Lane Alternatives.

How would the project affect the pedestrian and bicycle amenities in the 108th Avenue Northeast interchange area?

Pedestrian and bicycle amenities would not change at this interchange area because the project design does not include changes to the local street system.

What are the findings at the 108th Avenue Northeast interchange area?

- Generally, the build alternatives would not negatively affect traffic operations at the intersections within the 108th Avenue Northeast interchange area.
- The 108th Avenue Northeast/SR 520 eastbound on-ramp intersection would operate at LOS B or above under all project

alternatives. Northbound vehicles on 108th Avenue Northeast would experience LOS E and F under the 4-Lane and 6-Lane Alternatives.

- The 108th Avenue Northeast/SR 520 westbound ramps intersection would operate at LOS C or above for all project alternatives. Traffic volumes would exceed capacity for the westbound off-ramp during both the a.m. and p.m. peak hours under all project alternatives. Traffic volumes would queue on the exit ramp but would not affect operations on SR 520.
- The 108th Avenue Northeast/Northup Way Northeast intersection would operate at LOS E during the a.m. peak hour and LOS F during the p.m. peak hour under all future alternatives. Traffic volumes would exceed capacity on the eastbound, southbound, and northbound approaches during both peak hours, and queues would affect operations at the 108th Avenue Northeast/SR 520 ramps intersection.

What conclusions can be drawn?

- The project build alternatives would not greatly affect traffic operations on the local street network. Instead, the project benefits would be realized in substantial improvements in freeway operations (see *Chapter 4: Freeway Traffic Operations*).
- Local traffic volumes would not be substantially different between the project alternatives. Therefore, the alternatives would not greatly affect traffic operations or LOS at the local intersections within each interchange area.
- Under the 4-Lane Alternative, LOS would improve to D or better at eight study intersections and would drop to D or worse at two intersections. Under the 6-Lane Alternative, LOS would improve to D or better at seven study intersections and drop to D or worse at four study intersections.

Chapter 6: Nonmotorized Facilities

What is in this chapter?

This chapter discusses existing and proposed pedestrian and bicycle facilities, also known as nonmotorized facilities, within the project corridor. Proposed project improvements are intended to increase mobility options throughout the corridor and across Lake Washington. The improvement of nonmotorized facilities would simultaneously increase mobility, provide a viable alternative to driving, and enhance the livability of communities. During community design workshops held in November 2000, communities along the SR 520 corridor declared that "the ability to walk and ride bicycles around the neighborhood to parks, community facilities, and commercial areas is important. Safety should be addressed and walkways and trails enhanced"(SR 520 Project Team 2000b).

Major design elements of the nonmotorized facilities under consideration for the proposed project are:

- A continuous bicycle/pedestrian path that would cross Lake Washington from Montlake to Yarrow Bay
- A new tunnel under Montlake Boulevard connecting to the Bill Dawson Trail (Montlake interchange area)
- Effective cross-corridor routes and connections between neighborhoods and regional facilities
- Connections to transit facilities and transit stops
- Under the 6-Lane Alternative, two lids in Seattle (at 10th Avenue East and Delmar Drive East, and at Montlake Boulevard) and three lids on the Eastside (at Evergreen Point Road, and 84th and 92nd Avenues Northeast). These lids over the highway could provide additional opportunities for bicycle and pedestrian path connections, and could improve bicycle/pedestrian connectivity among many of the Seattle neighborhoods and among communities on the Eastside.

These proposed project improvements constitute the largest differences in nonmotorized transportation between the No Build Alternative and the 4-Lane and 6-Lane Alternatives. The main differences between the 4-Lane Alternative and the 6-Lane Alternative in terms of bicycle/ pedestrian improvements is that the 4-Lane Alternative would not have lids, while the 6-Lane Alternative would include five lids.

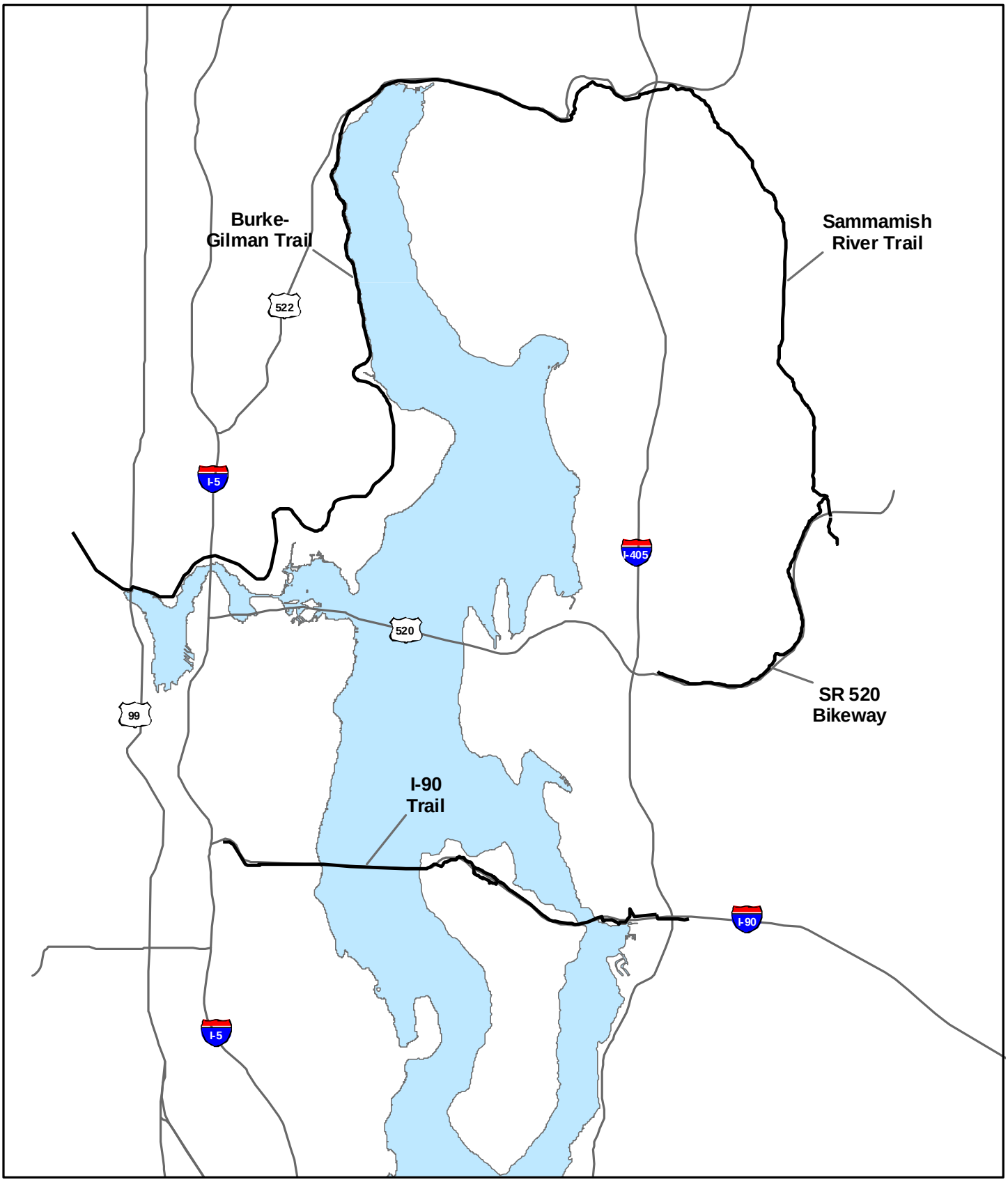
The following sections describe the existing nonmotorized facilities and the proposed improvements along the study corridor. To clearly illustrate the existing facilities and the proposed improvements, the project area is divided into several subareas. Additional detailed information about existing and proposed bicycle/pedestrian facilities can be found in the *SR 520 Bridge Replacement and HOV Project: Nonmotorized Planning and Design Report* (SR 520 Project Team 2004e).

What nonmotorized facilities exist today?

The Evergreen Point Bridge poses a substantial challenge for cyclists and pedestrians traveling between Seattle and the Eastside communities. Because of the limited shoulder widths, no pedestrian or bicycle traffic is allowed on the bridge. Bicyclists wishing to cross the lake via SR 520 must board a bus equipped with a bicycle-carrying rack. In Seattle and on the Eastside, there are many bicycle/pedestrian trails along the SR 520 corridor, but these trails are not directly connected to one another. In Seattle, bicyclists and pedestrians can reach the SR 520 corridor via several trails and surface streets, but there is no dedicated off-street network. On the Eastside, bicyclists and pedestrians can travel for longer stretches on paved off-road trails within the corridor, but these trails are not continuous.

What regional trails exist near the SR 520 corridor?

There are many Class I, II, and III bicycle trails within the project area. Class I trails are shown in Exhibit 6-1. For more detailed information on regional trails, readers can refer to the King County Department of Transportation's recently published King County Bicycling Guide Map, which provides a comprehensive presentation of the region's bicycle system. The Seattle Bicycle and Pedestrian Program publishes a counterpart to this map, the Seattle Bicycling Guide Map (City of Seattle 2003a).



Class I Bicycle Trails

0 1 2 4 Miles

Exhibit 6-1. **Class I Bicycle Trails**

SR 520 Bridge Replacement and HOV Project

Class I bicycle facilities are paved and have exclusive rights-of-way for the principal use of bicycles, pedestrians, and other nonmotorized means of travel. Class I trails are required to be at least 10 feet wide. Class II bicycle facilities are established within the paved area of arterials for the preferential use of bicycles. These paved bicycle areas, or bike lanes, are striped in widths varying between 4 and 12 feet and are signed as designated bikeways. Class III bicycle facilities are located along existing arterials (without striping) and are intended to provide continuity within the bikeway system. They may be supported with signs indicating their status as components of the regional bicycle system.

There are four Class I regional bicycle facilities near the project area:

- Burke-Gilman Trail
- Elliott Bay Trail (not shown on Exhibit 6-1)
- Sammamish River Trail
- I-90 Trail

The Burke-Gilman Trail and the Sammamish River Trail are connected and therefore function as one. This trail extends for 27 miles from west of Gasworks Park in Seattle, around the north end of Lake Washington, to Marymoor Park in Redmond. The I-90 Trail extends more than 4 miles from the Dearborn Street/Rainier Avenue area in Seattle to Mercer Slough in Bellevue. Future improvements to the regional bicycle trail system include a Class I trail along East Lake Sammamish Parkway Northeast and SR 520 to just east of the I-405/SR 520 interchange. The SR 520 portion of the trail has recently been opened between West Lake Sammamish Parkway Northeast and Northeast 24th Street, just east of 120th Avenue Northeast.

According to a 1995 user count, the Burke-Gilman Trail had 2,239 daily bicyclists in the vicinity of the University of Washington. In the last 10 years, this area has experienced a 41 percent increase in users.

What nonmotorized facilities exist in communities near the SR 520 corridor?

The transportation discipline team determined the existing conditions of nonmotorized facilities for each neighborhood and community by conducting field investigations, reviewing local bicycle and pedestrian

plans, and meeting with bicycle/pedestrian program coordinators and trail planners from the communities along the corridor.

Seattle

In the Seattle portion of the project area, numerous on-street and informal bicycle/pedestrian connections form a network that is convoluted and occasionally unsafe—for the bicyclist in particular. The Seattle project area comprises steep terrain, a large water body (Portage Bay), and a dense urban grid of streets of all types. Residential communities abut the highway, along with schools, parks, and commercial areas. Both the I-5/SR 520 interchange and the bridges over the Montlake Cut are busy, important crossroads that link the Roanoke/Portage Bay, Capitol Hill, Eastlake, Montlake, and University District neighborhoods. Exhibit 6-2 shows the existing trails in the Seattle project area neighborhoods.

North Capitol Hill and Roanoke/Portage Bay Neighborhoods

East Roanoke Street is the primary cross-corridor connection that links Eastlake and North Capitol Hill. Bicyclists use the main arterials of Eastlake Avenue East and Harvard Avenue East, which parallel I-5, for north-south travel.

The intersections of East Roanoke Street with Boylston Avenue East, Harvard Avenue East, and 10th Avenue East are undesirable for bicyclists and pedestrians. High traffic density, lengthy signal phasing, and poor visibility contribute to the difficulty of using East Roanoke Street to make east-west connections in this neighborhood.

Montlake Neighborhood

The Montlake Boulevard bridge is one of three north-south connections across SR 520 in the Montlake neighborhood. The other north-south connections are the Bill Dawson Trail, which runs under SR 520 along the west side of Montlake Boulevard and connects the Montlake Playfield (south of SR 520 on Portage Bay) and the NOAA Northwest Fisheries Science Center Building (north of SR 520), and the 24th Avenue East bridge, which connects Lake Washington Boulevard to East Montlake Park. Bicyclists and pedestrians can access the Montlake interchange area from the Lake Washington Loop Trail, the Arboretum Trail, and the Burke-Gilman Trail. The eastbound Montlake bus stop, located under the Montlake Boulevard overpass in the eastbound lanes

of the highway, is a major hub for transit riders traveling between downtown Seattle, the University of Washington, and Eastside destinations. The primary flaw of the eastbound bus stop is that it is not accessible to disabled riders because the only access is by stairs. Westbound bus riders use a different bus stop, located north of the highway and adjacent to the Montlake off-ramp.

Lake Washington

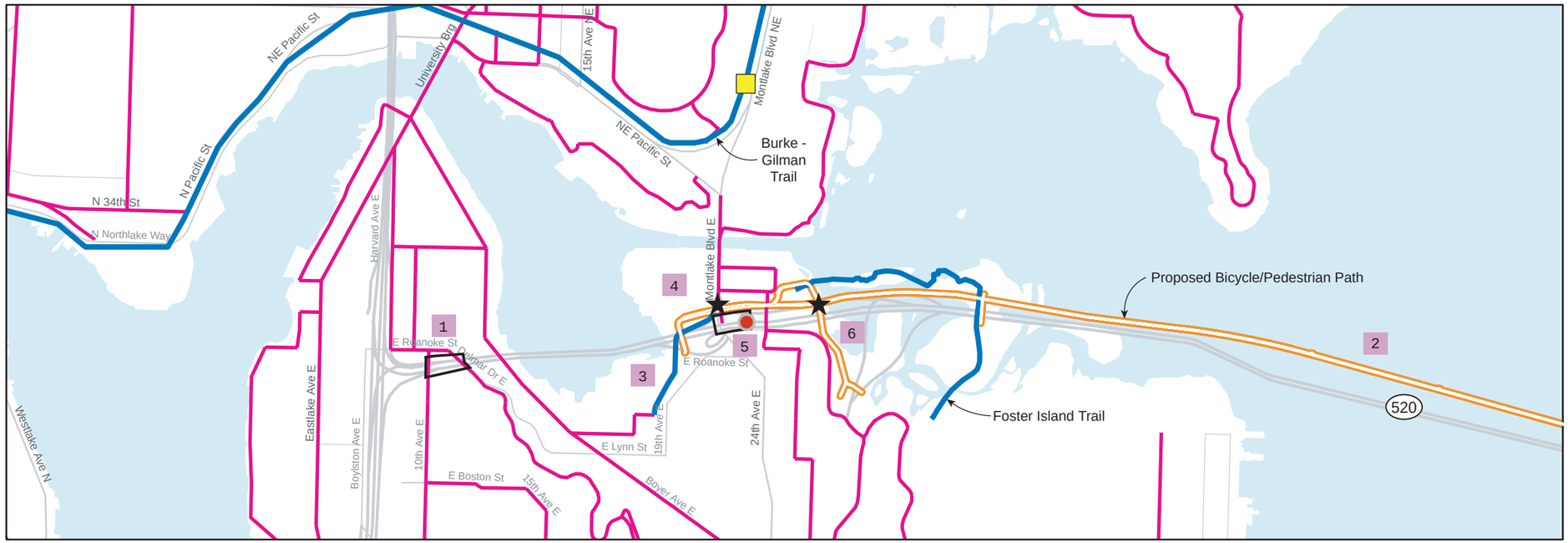
Currently, there is no pedestrian and bicycle access to the Evergreen Point Bridge. Bicyclists must mount their bicycles on Metro buses to cross the Evergreen Point Bridge, or park and lock their bicycles at the bicycle racks at the Montlake interchange.

The King County Metro Bikes-on-Buses program, which outfitted Metro's entire bus fleet with bicycle racks that can each carry two bicycles, was implemented in November 1994. This program has also led to an increase in bicycle use throughout the region. Metro estimates that the Bikes-on-Buses program transported a total of 10,633 bicyclists per week within their service area between August and September 2002.

King County Metro publishes a quarterly report entitled *Highway 520 Bicycle Commuter Count* that reports quarterly bicycle demand on SR 520. During the summer, an average of 189 bicycle commuters cross the Evergreen Point Bridge per day. King County Metro reported the following statistics about bicycle demand across the Evergreen Point Bridge:

- 15 percent of the buses had one bicycle on the rack.
- 3 percent of the time, the bicycle racks were fully occupied.
- 1 percent of bicycle commuters could not take their bicycle on a bus because the rack was full.

In both the summer and winter bicycle surveys, Sound Transit route 545 and King County Metro routes 271, 255, and 540 were the highest demand routes for bicycle commuters. Demand was greatest during the morning peak hours between 6:00 a.m. and 9:30 a.m. The Redmond/Overlake employment area is the major destination for bicycle commuters.



Seattle

Proposed Improvements - Roanoke/Portage Bay Neighborhood

1 Improve east-west bicycle/pedestrian connectivity and provide bicycle/pedestrian amenities.
Lid over SR 520 from 10th to Delmar

Opportunities
Improve bicycle/pedestrian crossing safety at intersections
Roanoke at Boylston & Harvard

Proposed Improvements - Montlake Neighborhood

2 Build continuous shared-use path from Montlake Blvd. across Lake Washington to vicinity of 96th Ave. NE and NE Points Drive

3 Maintain and upgrade Bill Dawson Trail and connection to Montlake Blvd.
Montlake Playfield to NOAA at Montlake Blvd.

4 Improve bicycle/pedestrian crossing of Montlake Blvd.
Tunnel under Montlake Blvd. to connect Bill Dawson Trail and proposed shared-use path

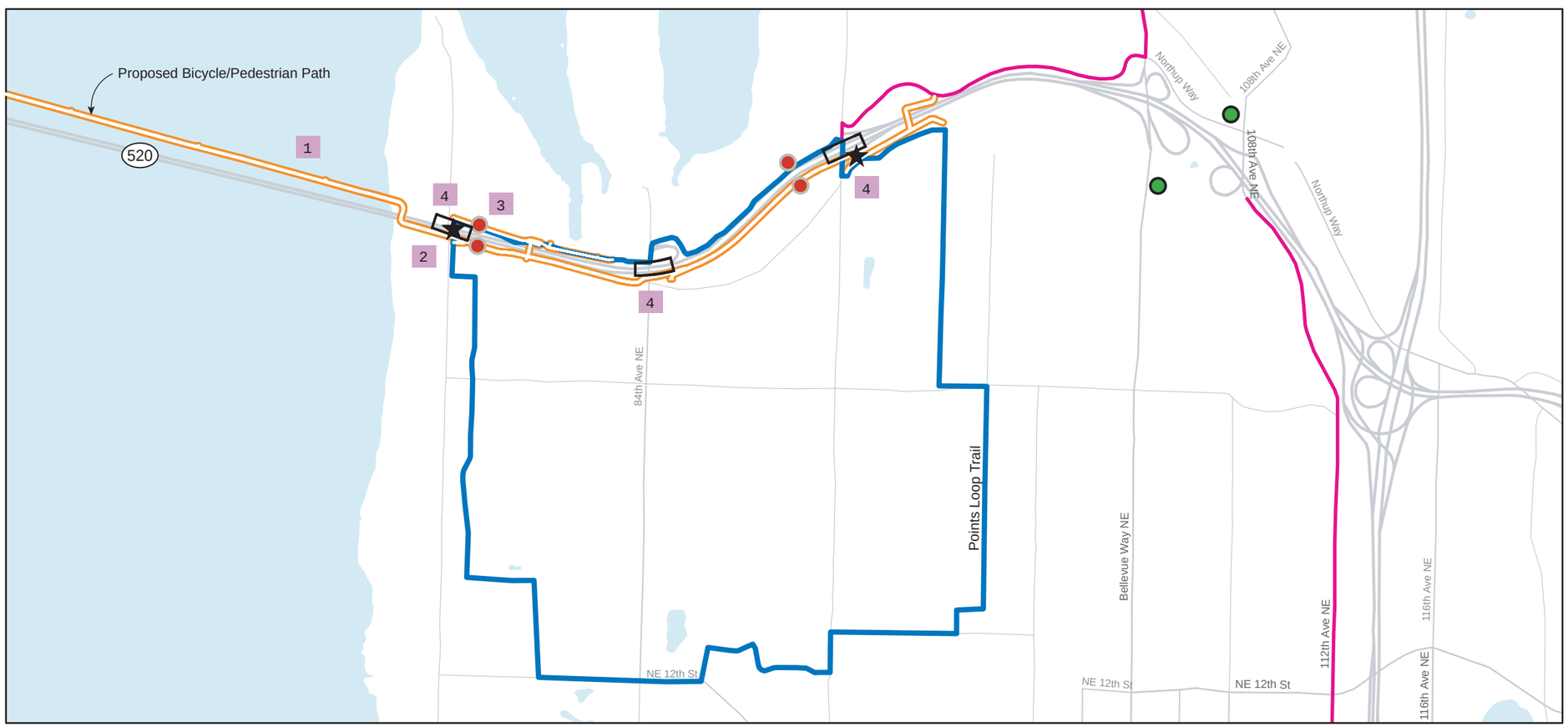
5 Provide accessible bus stop and additional bicycle/pedestrian amenities. *Bus stop and lid over SR 520 at Montlake Blvd.*

6 Provide bicycle/pedestrian connections to existing trails and MOHAI site. *Direct connections to Arboretum and Foster Island Trails, Lake Washington Blvd. E.*

Opportunities
Provide additional bicycle parking and site for bicycle station.
Enhance connection to University of Washington and Burke-Gilman Trail.

N

0 1000 2000 Feet



Eastside

Proposed Improvements

Evergreen Point to 96th Ave. NE

1 Build continuous shared-use path from Montlake Blvd. across Lake Washington to vicinity of 96th Ave. NE and NE Points Drive

2 Maintain Points Loop Trail separate but parallel to SR 520 with connection to proposed shared-use path

3 Provide connections between proposed shared-use path and in-line bus stops
Evergreen Point Road (76th Ave. NE) and 92nd Ave. NE

4 Build lids at 76th, 84th, and 92nd Avenues NE

Opportunities
Upgrade Points Loop Trail
Improve bicycle/pedestrian safety at trail/road crossings
Points Loop Trail at 84th Ave. NE and 92nd Ave. NE

- Proposed lids (6-Lane Alternative only)
- Existing transit facility or Park-and-Ride
- Existing bus stop
- Existing grade-separated crossing
- Proposed connection to other trail
- Existing on-street bicycle route
- Existing regional or local trail
- Proposed bicycle path (6-Lane Alternative version shown; 4-Lane Alternative concept the same)

Note:
Please refer to conceptual plans for more detailed drawings of improvements.

Exhibit 6-2. **Nonmotorized Improvement Concepts**
SR 520 Bridge Replacement and HOV Project

Eastside

The area immediately east of the Evergreen Point Bridge is rolling terrain with a semi-rural quality to the neighborhoods. Houses are on spacious lots, which for the most part are separated from the freeway by wide, wooded buffers. Two large park/open space areas are connected by a continuous, though indirect, bicycle/pedestrian path that extends from the Evergreen Point Road transit stop to Bellevue Way. It is possible to travel eastward along surface roads, but for long stretches there is no designated bicycle lane. Exhibit 6-2 shows the existing trails on the Eastside.

Medina, Hunts Point, Yarrow Point, Clyde Hill, Bellevue, Kirkland, and Redmond

The Points Loop Trail is a grade-separated, off-road trail that runs through Medina, Hunts Point, and Yarrow Point, with both on-street and off-street portions. The north end of the Points Loop Trail runs parallel to the north side of SR 520, from Evergreen Point Road to 96th Avenue Northeast. At 92nd Avenue Northeast, the Points Loop Trail crosses SR 520 and runs parallel to the highway on the south side. The trail crosses the 84th Avenue Northeast and Hunts Point Road intersection at grade and Medina Creek on a covered bridge. North-south connections can be made via a footbridge that spans the highway from Bellevue Christian School/Three Points Elementary School to the Fairweather Nature Preserve, and overpasses at 84th and 92nd Avenues Northeast. The footbridge does not comply with the Americans with Disabilities Act (ADA) and is not accessible to wheelchairs.

There are no bicycle facilities between Bellevue Way (which is referred to as Lake Washington Boulevard Northeast on the north side of SR 520) and 108th Avenue Northeast. At 108th Avenue Northeast, just south of SR 520, the on-street bicycle route picks up again, running south along 112th Avenue Northeast.

At 92nd Avenue Northeast, just north of SR 520, an on-street bicycle route meets the Points Loop Trail and continues on Northeast Points Drive before turning north at Lake Washington Boulevard Northeast. This part of the route serves as a bicycle connection between Lake Washington Boulevard Northeast/Bellevue Way Northeast and the Points Loop Trail. At the Yarrow Point town limit (near 96th Avenue Northeast) the street is closed to auto traffic by a brick and bollard structure that leaves a very narrow passage open for bicyclists.

Today, there are four transit stops (two eastbound and two westbound) in the study area; buses must be in the outside lane to access the transit stop. The transit stops are accessible from the outside SR 520 mainline lane, requiring separate transit stops for eastbound and westbound travel. One set of transit stops (eastbound and westbound) is near Evergreen Point. The other set of transit stops (also eastbound and westbound) is located at 92nd Avenue Northeast. Nonmotorized access to the westbound transit stops at Evergreen Point and 92nd Avenue Northeast is available via the Points Loop Trail. Connections to the eastbound transit stops can be made by way of the footbridge, or via the overpasses at 84th and 92nd Avenues Northeast.

The existing SR 520 Bikeway, which is outside the project boundary, begins at Northeast 24th Street at approximately 124th Avenue Northeast in Bellevue and ends at the SR 520/West Lake Sammamish Parkway interchange in Redmond.

How is a path designed?

Two of the primary considerations when designing a bicycle/pedestrian path are personal safety and comfort on the path. A few of the bicycle/pedestrian path attributes that determine safety and comfort are visibility, paving, grade or slope, signage, and protective barriers. WSDOT's *Bicycle Facilities Design Guidance* (2001) provides standards and specifications for all aspects of path design that address safety and comfort, and the proposed project adheres to those standards. Indeed, most regional trails throughout the Puget Sound conform to these design standards or similar ones, such as the AASHTO *Guide for Development of Bicycle Facilities* (1999). Exhibit 6-3 defines the differences between paths, trails, and bike routes. Exhibit 6-4 shows a typical path cross-section.

Bicycle/pedestrian path—Also called a shared-use path. According to AASHTO's *Guide for the Development of Bicycle Facilities* (1999), a shared-use path is a "bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers and other nonmotorized users." Shared use paths are generally paved to accommodate nonmotorized wheels.

Trail—Trails are often distinguished from shared use paths by being unpaved, like the Foster Island Trail. However, many paved shared use paths in the Puget Sound region are called trails, such as the Burke-Gilman Trail.

Bike route—Used here to denote an on-street route that bicycles commonly use, whether or not the street has a designated bike lane.

Exhibit 6-3. **What is the Difference Between a Path, a Trail, and a Bicycle Route?**

Standards that specify sight distance, drainage, traffic signals, bollards, and structures (overpasses, underpasses, bridges, etc.) are established in the *Design Manual* section on Bicycle Facilities (WSDOT 2004a) and the AASHTO *Guide for the Development of Bicycle Facilities*. These detail elements will be addressed in the design phase, along with signage and lighting.

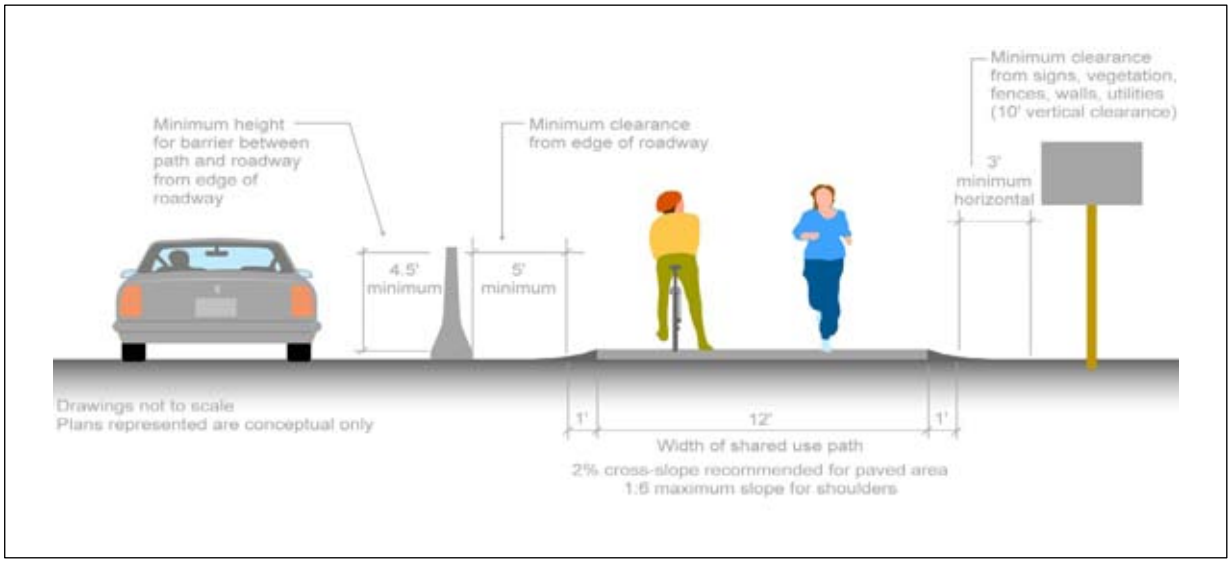


Exhibit 6-4. **Typical Path Cross Section**

What are the proposed improvements?

The existing nonmotorized facilities lack continuity and limit the ability of bicyclists and pedestrians to access the east and west sides of the study area. The intent of the proposed improvements is to improve nonmotorized facilities and enhance their continuity. The following sections describe the proposed improvements.

Seattle

The goal for nonmotorized travel in Seattle is to improve bicycle/pedestrian connections between the neighborhoods of North Capitol Hill, Roanoke/Portage Bay, and Montlake. Exhibit 6-2 shows the proposed improvements in Seattle.

North Capitol Hill and Roanoke/Portage Bay Neighborhoods

Bicycle/Pedestrian Path

The complexity of the I-5/SR 520 interchange, along with dense urban development, hilly terrain, and the Portage Bay Bridge, pose constraints that make the design of a bicycle/pedestrian path in this area challenging. The grade of the proposed Portage Bay Bridge would exceed the recommended standards for safe bicycle travel; therefore, a bicycle/pedestrian path on the Portage Bay bridge is not recommended.

The portion of the Bill Dawson Trail in the Montlake Playfield was recently repaved. Both the 4-Lane and 6-Lane Alternatives would upgrade the remaining stretch of trail between the playfield and the Northwest Fisheries Science Center, which would enhance the link between the west Montlake neighborhood, North Capitol Hill, and the University of Washington.

The 6-Lane Alternative would build a lid over SR 520 between 10th Avenue East and Delmar Drive East. The lid would provide opportunities for open space, landscaping, and bicycle/pedestrian paths, and would better connect the surrounding neighborhoods.

Montlake Neighborhood

Proposed improvements in the Montlake neighborhood would extend the existing paths and trails and upgrade the Montlake bus stop.

Bicycle/Pedestrian Path

A proposed new bicycle/pedestrian path would begin in the Montlake interchange area before crossing Lake Washington along the north side of the Evergreen Point Bridge. The proposed path would allow on-street connections to the University of Washington and the Burke-Gilman Trail on the west side of the study area, and would connect to the Foster Island Trail system via a spur path under SR 520 at Foster Island. The path would also connect to McCurdy Park and East Montlake Park, the current site of the Museum of History and Industry (MOHAI). South of SR 520, the path would connect to a new "multi-use trail" on the east side of Lake Washington Boulevard (as proposed in the *Washington Park Arboretum Proposed Master Plan* [City of Seattle 2001]).

The 6-Lane Alternative would build a lid over SR 520 at Montlake Boulevard. The lid would provide opportunities for open space, landscaping, and bicycle/pedestrian paths, and would better connect the surrounding neighborhoods.

Cross-Corridor Connections

The connection between Montlake, the University of Washington area, and the Burke-Gilman Trail would continue to be made via the Shelby/Hamlin neighborhood and the Montlake Bridge. The current 24th Avenue East bridge would be replaced and continue to offer an alternative to Montlake Boulevard for crossing SR 520. The bicycle/pedestrian path would extend under Montlake Boulevard via a tunnel to connect with the Bill Dawson Trail.

Transit Connections

The Montlake transit stops, which provide connections between Seattle and the Eastside, would be redesigned to better accommodate pedestrians, bicyclists, and disabled transit users. Additional informational signage, lighting, secure bicycle storage, ADA-compliant access, and protection from traffic noise would be part of the redesign of these transit stops.

Lake Washington

Adding a bicycle/pedestrian path to the new Evergreen Point Bridge across Lake Washington would be the most substantial nonmotorized improvement proposed for the SR 520 corridor. The ability to cross the bridge by bicycle or on foot would likely encourage more nonmotorized traffic on SR 520 for both commuting and recreational purposes.

The weather patterns on Lake Washington are an important consideration in design of the path because bicyclists would be exposed to wind and wave action. During the winter, prevailing winds come from the south and southwest, creating a great deal of chop and spray on the south side of the bridge. During the summer, prevailing winds come from the north and northwest but are far less severe. Placing the bicycle path on the north side of the bridge (as on I-90) offers some protection to bicyclists and pedestrians.

Five vantage points along the bridge would provide scenic views, as well as places to rest. Possible locations for these vantage points include Foster Island, Madison Park, and other spots along the bridge where there are special views.

Eastside

Nonmotorized facilities improvements proposed on the Eastside would improve and extend accessibility and upgrade transit stops. Exhibit 6-2 shows the proposed improvements in the Eastside portion of the study area.

Bicycle/Pedestrian Path

The proposed SR 520 bicycle/pedestrian path would add another nonmotorized path through the Eastside study area. After crossing Lake Washington, the proposed path would drop under the bridge just east of the lake, emerging at or near grade on the south side of SR 520. The path would continue east until 96th Avenue Northeast. From this

point, bicyclists and pedestrians would use streets to continue eastward. The existing pedestrian bridge just east of Evergreen Point Road would be replaced. The gap in nonmotorized routes (described earlier) would remain between Bellevue Way and 108th Avenue Northeast.

Cross-Corridor Connections

Three lids are proposed on the Eastside at Evergreen Point Road, 84th Avenue Northeast, and 92nd Avenue Northeast for the 6-Lane Alternative. These lids would provide cross-corridor connections and access to the Points Loop Trail. The lids would also connect and extend the proposed bicycle/pedestrian path described in the previous section.

Transit Connections

Both of the alternatives would include transit stops near Evergreen Point Road and 92nd Avenue Northeast. Under the 6-Lane Alternative, the transit stops would be moved to the inside lanes of SR 520. Accessible connections would be provided between the inside transit stops and the proposed bicycle/pedestrian path.

What conclusions can be drawn?

The proposed improvements to nonmotorized facilities surrounding the SR 520 corridor focus primarily on providing improved connections between Seattle and Eastside communities. The most notable of these improvements would be a pedestrian/bicycle path on the Evergreen Point Bridge across Lake Washington. Other major nonmotorized improvements would be increased north-south connections across SR 520.

The transportation and livability benefits of providing nonmotorized facilities add value to the affected neighborhoods and to the region as a whole. Nonmotorized systems can offer links and enhancements to communities that cannot come from other sources—specifically, from highway systems. Nonmotorized systems can, if carefully designed, alleviate the load on the highway system and reconnect communities that were severed by construction of the highway.

Chapter 7: Transit Operations

What is in this chapter?

This chapter describes and quantifies the benefits of transit service for moving more people along the SR 520 corridor. It provides information on transit characteristics and identifies the results of the travel forecasting model for the No Build, 4-Lane, and 6-Lane Alternatives.

What bus services are available in the study area today, and what services were assumed for the future?

For this report, the transportation discipline team assumed that bus service on the Eastside and across Lake Washington would have the same general pattern of service as today, but with improved service frequencies during peak and off-peak periods and with selected additional bus routes. The level of service (measured in annual bus hours) would be about 70 percent greater than today, reflecting an annual growth of about 2 percent per year from now to 2030 (SR 520 Project Team 2004a). This estimate is consistent with past trends in bus service growth, as calculated by transit providers. Service is assumed to grow at a greater rate during off-peak hours. Peak period service is expected to grow at the rate of about 1 percent per year.

We assumed that bus service on the Eastside using SR 520 would run all day. Sound Transit Regional Express and King County Metro routes between the Eastside and downtown Seattle and between the Eastside and the University District would provide this all-day service. Service providers for peak period-only routes include Community Transit, King County Metro, and Sound Transit Regional Express.

Consistent with the current routes, transit operators would provide service to and from major activity centers in the morning and afternoon, with most routes providing morning service to Seattle and afternoon service from Seattle. Although transit demand may shift due to the rebalancing of jobs and households in the region, the transportation discipline team assumed that these commute patterns would be similar

in 2030 to what they are today. The transit network and operating plans for the 2030 alternatives are consistent with those identified for other corridor projects in the region.

As the project proceeds, further definition of potential transit changes would address both the extent and orientation of service along the SR 520 corridor. The process to identify potential service changes beyond what has been identified in the operator transit plans will include transit agencies and others as appropriate. Funding outside of WSDOT will be identified for any transit service changes as well as supporting facilities. The project's Flexible Transportation Plan follow-up actions by WSDOT and other agencies can serve as a guide for this process.

Compared to existing service levels in Seattle, across Lake Washington, and on the Eastside, we assumed that bus service in 2030 would operate more frequently and with one additional service route. Exhibit 7-1 lists bus routes that currently cross the Evergreen Point Bridge, as well as those routes assumed to be in service in 2030.

Exhibit 7-1. Bus Routes Using SR 520

		2003 Headway (min)		Assumed 2030 Headway (min)	
Route	Description	Peak	Off-Peak	Peak	Off-Peak
242	Aurora Village-SR 520-Overlake	24		20	
250	Redmond-SR 520-Seattle	33		33	
252	Totem Lake-SR 520-Seattle	24		18	
255	Totem Lake-South Kirkland-SR 520-Seattle	20	30	15	30
256	Overlake-South Kirkland-SR 520-Seattle	36		36	
257	Totem Lake-SR 520-Seattle	30		30	
260	Kenmore-Juanita-SR 520-Seattle	60		60	
261	Overlake-Bellevue-SR 520-Seattle	30		30	
265	Redmond-Houghton-SR 520-Seattle	23		23	
266	Bear Creek-Redmond-SR 520-Seattle	24		20	
268	Bear Creek-Redmond-SR 520-Seattle	40		23	
271	Issaquah-Bellevue-SR 520-UW	30	30	30	20
271	Eastgate-Bellevue-SR 520-UW	30		30	
272	Eastgate-Crossroads-SR 520-UW	36	60	30	30
277	Totem Lake-SR 520-UW	30		30	

Exhibit 7-1. Bus Routes Using SR 520

Route	Description	2003 Headway (min)		Assumed 2030 Headway (min)	
		Peak	Off-Peak	Peak	Off-Peak
310	Bothell-SR 520-Seattle			45	
311	Duvall-Woodinville-SR 520-Seattle	24		24	
CT424	Snohomish-Monroe-SR 520-Seattle	60		30	
ST540	Redmond-SR 520-UW	20	30	20	30
ST545	Redmond-SR 520-Seattle	15	30	15	30
ST555	Issaquah-Bellevue-SR 520-Northgate	30		30	

Source: SR 520 Project Team (2004).
UW = University of Washington
Note: Headway refers to the amount of time that elapses between bus arrivals for a given route.

Exhibit 7-2 shows bus routes listed in Exhibit 7-1 and provides an overview of those routes included in the transit operations assessment for this analysis. Although no existing routes are expected to have been eliminated by 2030, King County Metro's new Route 310 will be operating to provide additional bus service between Bothell and Seattle. Future service expansion will, for the most part, involve service frequency improvements rather than new routes.

The transit service characteristics documented in this chapter, including frequencies and service routes, do not vary by alternative. There are, however, differences in ridership demand among the project alternatives. This is because transit would become a more attractive option with the addition of HOV lanes, which would increase transit speeds for some alternatives. The increase in traffic congestion with the No Build Alternative and the tolls with the two build alternatives would also influence higher transit ridership.

Transit centers are an important component of the existing and future transit system. Transit centers are major transfer points, which are also timed transfer locations; they allow riders to plan their trips with minimum wait times between buses. Other types of transfer points serve virtually the same purpose but without some of the conveniences of transit centers. The Bellevue, Montlake, University, and Evergreen Point transit centers are major transfer points located within the project area. These transit facilities, shown in Exhibit 7-3, are described below.

Bellevue Transit Center

The Bellevue Transit Center is located in Bellevue's downtown business core on Northeast 6th Street. The transit center is the major timed transfer point for riders to reach most Eastside destinations in the King County Metro service area. This transit center is currently served by 24 individual bus routes.

South Kirkland Park-and-Ride Lot

The South Kirkland park-and-ride lot is located on the border of Bellevue and Kirkland. The lot, located primarily in a residential area, is a short distance from SR 520 and is currently served by seven King County Metro and Sound Transit routes. Some routes serve several areas of the Eastside, while other routes provide connections between the Eastside and downtown Seattle as well as the University District.

Montlake Transfer Point

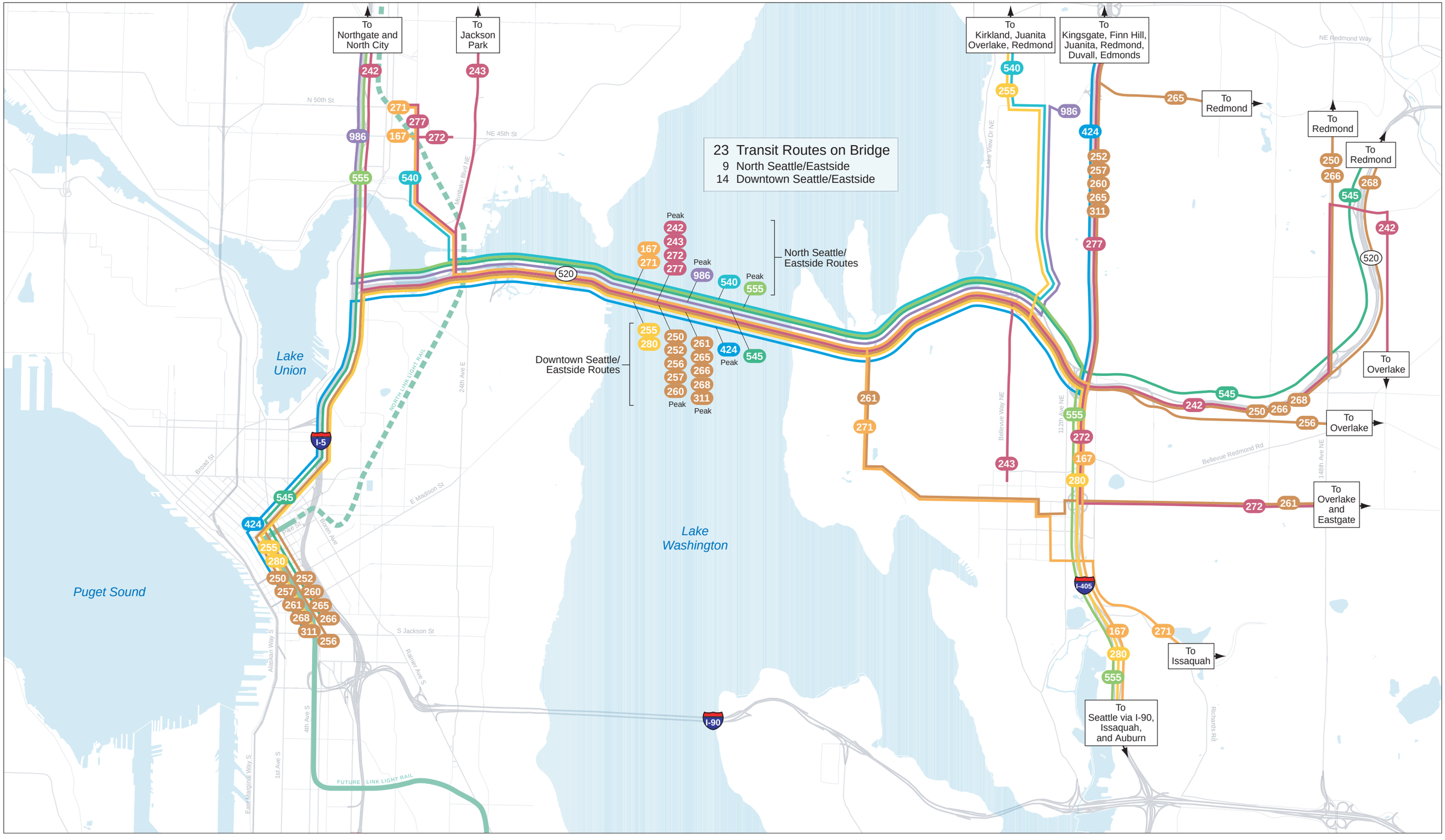
The Montlake major transfer point is located on the west end of the Evergreen Point Bridge at the Montlake Boulevard East bridge. This stop is within walking distance of the University of Washington and University Hospital. This stop is also one of the primary transfer points for routes serving Capitol Hill riders and a gateway for many Seattle-to-Eastside bicycle commuters. It is currently served by 30 individual routes.

Evergreen Point Transfer Point

The Evergreen Point major transfer point is located on the east end of the Evergreen Point Bridge and is served by almost all of the same routes (26 of the 29 routes) as the Montlake stop.

University Transfer Point at Northeast Pacific Place

The University major transfer point is located on Northeast Pacific Street, just northwest of the Montlake Boulevard/Northeast Pacific Street intersection, and is in front of the University Hospital. This transfer point provides access to the University Hospital, the main campus, and Husky Stadium. This stop is currently served by 44 individual routes.



METRO TRANSIT
- North Seattle/Eastside
- Peak Hour North Seattle/Eastside
- Limited Service North Seattle/Eastside
- Downtown Seattle/Eastside
- Peak Hour Downtown Seattle/Eastside

SOUND TRANSIT
- North Seattle/Eastside
- Peak Hour North Seattle/Eastside
- Downtown Seattle/Eastside

COMMUNITY TRANSIT
- Peak Hour Downtown Seattle/Snohomish County

LINK LIGHT RAIL
- Initial Segment (Approved)
- North LINK (Proposed)

N 0 2,500 5,000 Feet

Exhibit 7-2. **Year 2030 Transit Routes Using Evergreen Point Bridge**

SR 520 Bridge Replacement and HOV Project

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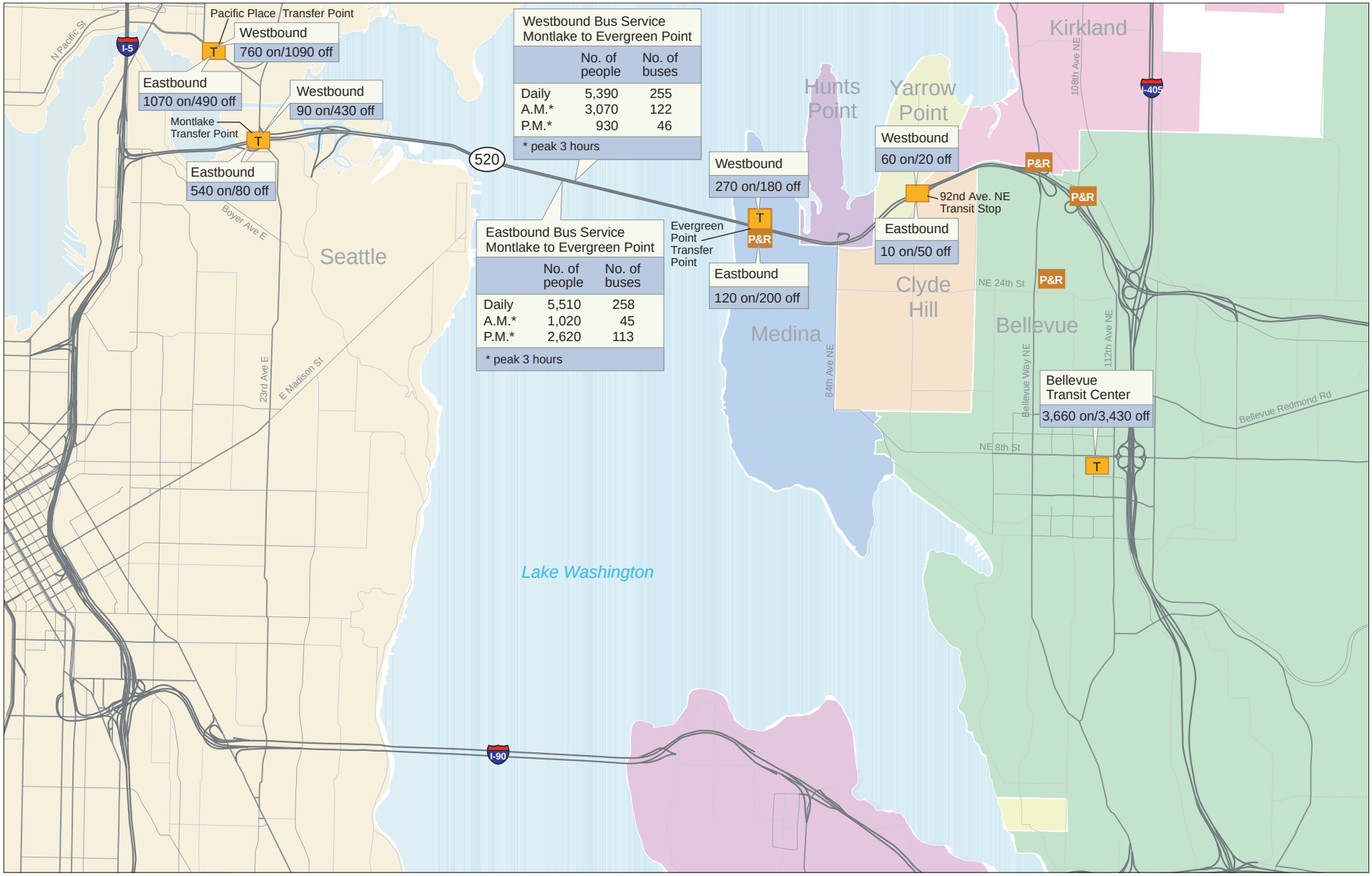

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0 2,500 5,000

Source: Metro Transit System Map (September 2002).

Note: The "on" and "off" numbers indicate the daily number of people boarding or alighting at that transit center location. Passenger volumes are averages based on aggregate counts from fall 2003 (September-January) survey.

Exhibit 7-3. **Existing Transit System Information**

SR 520 Bridge Replacement and HOV Project

Freeway Transit Stops at 92nd Avenue Northeast

The freeway transit stops at 92nd Avenue Northeast provide bus access for Hunts Point, Yarrow Point, Medina, and Clyde Hill to routes crossing the SR 520 bridge. The freeway stop is served by 20 routes.

How many people use transit during peak periods?

The travel forecasting analysis estimated average passenger bus loads during the a.m. peak period. These loads are the average number of passengers for each bus. These averages are compared to available bus capacity along the corridor. Bus capacity is determined by the expected schedules for each bus route operating along the corridor. The average bus capacity (based on King County Metro's current fleet mix) is assumed to be 65 passengers per bus, taking into account that bus fleets in 2030 will likely contain a mix of standard and articulated buses. Metro's most common articulated bus seats 64 and its most common standard coach seats 42 persons. Metro's current fleet is about half articulated and half standard size.

The relationship between a bus's capacity and the number of passengers actually riding on it can be used to calculate a "load factor," which yields a level of service (LOS). Like LOS measurements for roadways and intersections, this measure quantifies the quality of the bus passenger's experience of the transit trip. If Metro's existing fleet mix is provided along the SR 520 corridor in the future, the average seating capacity would be 53 seats per bus. At 65 passengers per bus, the result is a 1.23 load factor. Using the *Transit Capacity and Quality of Service Manual* developed under the Transit Cooperative Research Project yields a 1.23 load factor, resulting in an LOS of D. At this LOS, the average passenger load represents a manageable level of capacity.

Instances where the number of passengers per vehicle-trip exceeds 65 indicate that the frequency and/or capacity of transit service is either inadequate to meet demand or, at a minimum, will discourage riders. In some cases, the disparity between supply and demand is substantial. For example, westbound a.m. peak hour demand currently exceeds supply by over 300 percent for Metro Route 266 and Community Transit Route 424. For eastbound routes, demand exceeds supply by over 300 percent on Metro Route 271.

The following sections compare the projected 2030 a.m. peak hour transit demand to expected capacities by route for three corridors: Kirkland, Redmond, and I-90/I-405. Exhibits 7-4 through 7-9 illustrate this information.

Kirkland Corridor

For the purposes of this study, the Kirkland corridor includes bus routes using SR 520 to travel between downtown Seattle or the University of Washington and north Puget Sound east of Lake Washington.

Westbound

Exhibit 7-4 shows SR 520 transit loads traveling westbound via the Kirkland corridor during the 2030 a.m. peak hour. All buses, with the exception of Metro Route 310, are projected to operate at levels that exceed the route capacities. This would likely be the case for all alternatives, with demand generally growing as the roadway and HOV capacity expands.

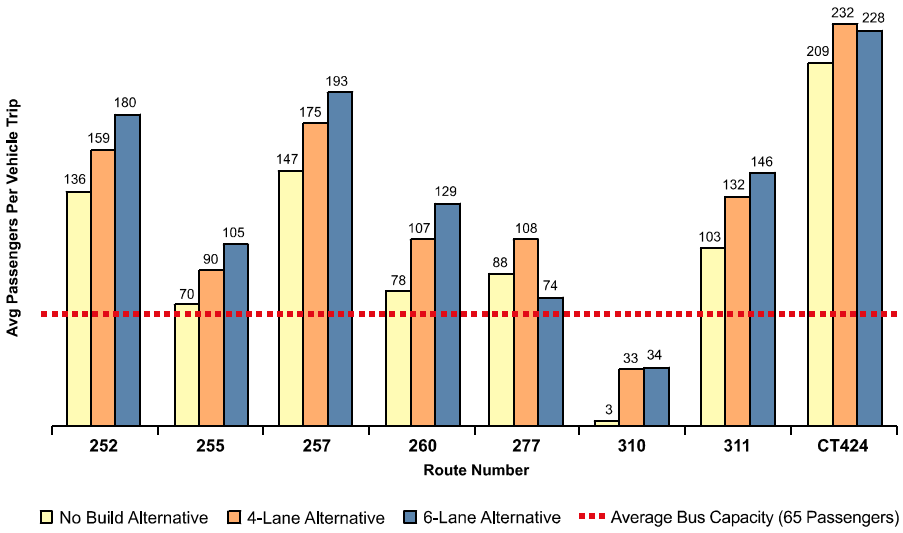


Exhibit 7-4. SR 520 Transit Loads—A.M. Peak Hour, Westbound Kirkland Corridor

Eastbound

Exhibit 7-5 shows SR 520 transit loads traveling eastbound via the Kirkland corridor during the a.m. peak hour. Metro Route 255 is the only bus route that operates eastbound in this corridor. For all 2030 alternatives, demand for transit service would be met by the proposed

bus frequencies on this route. This demand would be met in part due to the market characteristics of Eastside destinations versus those in Seattle. Land use densities and parking costs at employment centers in the Eastside would not be as high as those in Seattle; therefore, the transit service demand would be less for eastbound travel.

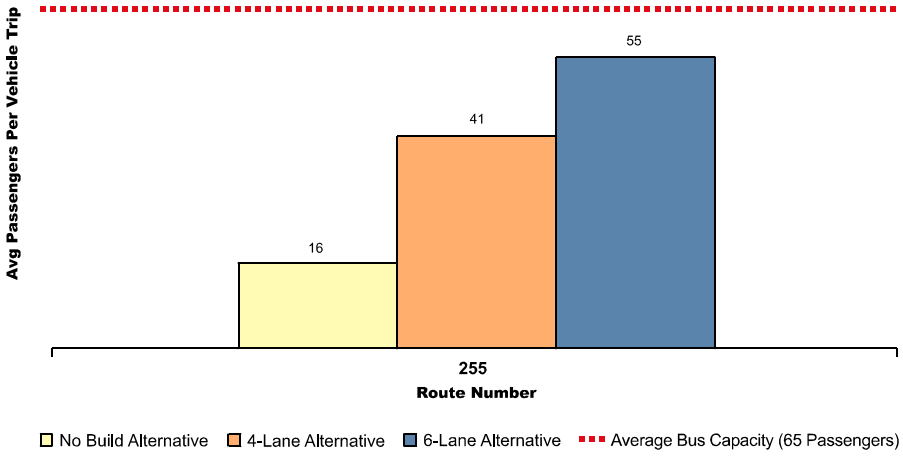


Exhibit 7-5. SR 520 Transit Loads—A.M. Peak Hour, Eastbound Kirkland Corridor

Redmond Corridor

For the purposes of this study, the Redmond corridor includes bus routes using SR 520 for all or part of their travel between downtown Seattle or the University of Washington and Redmond.

Westbound

Exhibit 7-6 shows SR 520 transit loads traveling westbound via the Redmond corridor during the 2030 a.m. peak hour. All Metro routes are projected to operate at levels that exceed the proposed capacities. The two Sound Transit routes that operate in this corridor, however, would be adequately served by the proposed bus frequencies.

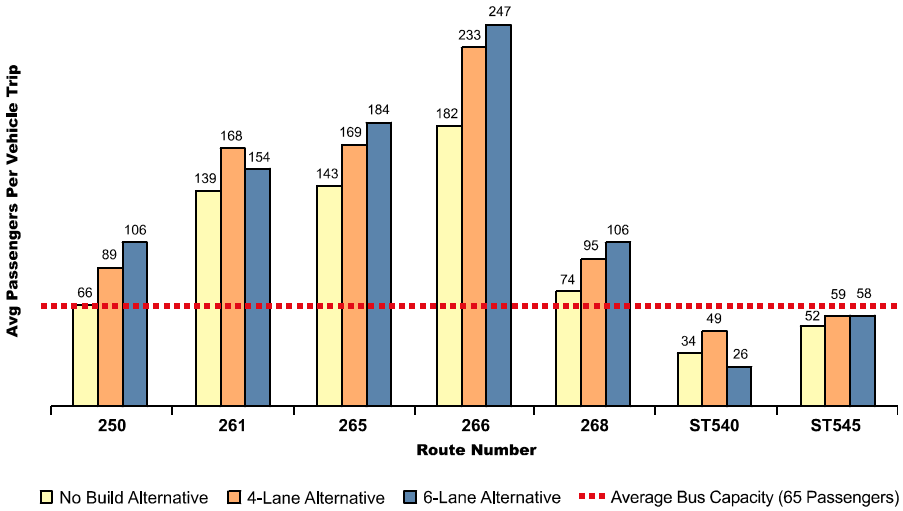


Exhibit 7-6. SR 520 Transit Loads—A.M. Peak Hour, Westbound Redmond Corridor

Eastbound

Exhibit 7-7 shows SR 520 transit loads traveling eastbound via the Redmond corridor during the 2030 a.m. peak hour. Under the No Build Alternative, transit demand for the four eastbound bus routes would be met by service capacities. Under the build alternatives, demand would be expected to exceed capacity for Metro Route 256.

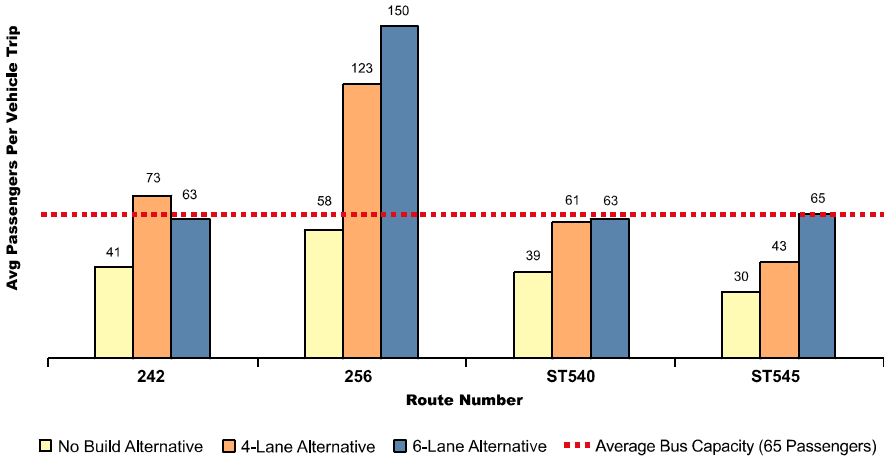


Exhibit 7-7. SR 520 Transit Loads—A.M. Peak Hour, Eastbound Redmond Corridor

I-90/I-405 Corridor

For this study, the I-90/I-405 corridor is defined as bus routes using SR 520 to travel between downtown Seattle or the University of Washington and areas east of Bellevue other than Redmond.

Westbound

Exhibit 7-8 shows SR 520 transit loads traveling westbound from the I-90/I-405 corridor during the 2030 a.m. peak hour. Transit demand for Metro Route 271 (originating in Issaquah and Eastgate) would be on average, 60 percent greater than proposed service capacity under all alternatives. The other two routes serving the corridor would provide adequate bus frequencies to meet transit demand, with the exception of Metro Route 272. Under the 4-Lane Alternative, transit demand would narrowly exceed proposed capacity. The relatively low ridership on Sound Transit Route 555 may be due in part to riders being attracted to routes that directly serve downtown Seattle from the Eastside. This level of attraction could result in demand being less than what is occurring today. Route 555 provides service to Northgate but does not serve downtown Seattle.

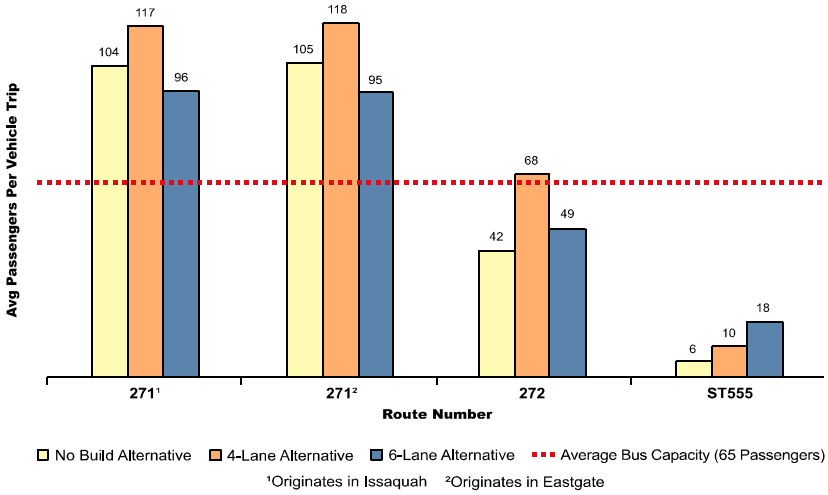


Exhibit 7-8. SR 520 Transit Loads—A.M. Peak Hour, Westbound I-90/I-405 Corridor

Eastbound

Exhibit 7-9 shows SR 520 transit loads for eastbound travel through the I-90/I-405 corridor during the 2030 a.m. peak hour. Metro Route 271 (terminating in Issaquah and Eastgate) would be substantially overloaded eastbound under all alternatives, with up to five times more transit demand than capacity. Sound Transit Route 555 is the only other

transit route serving this corridor; on this route, the demand for transit service would be met by the proposed bus frequencies.

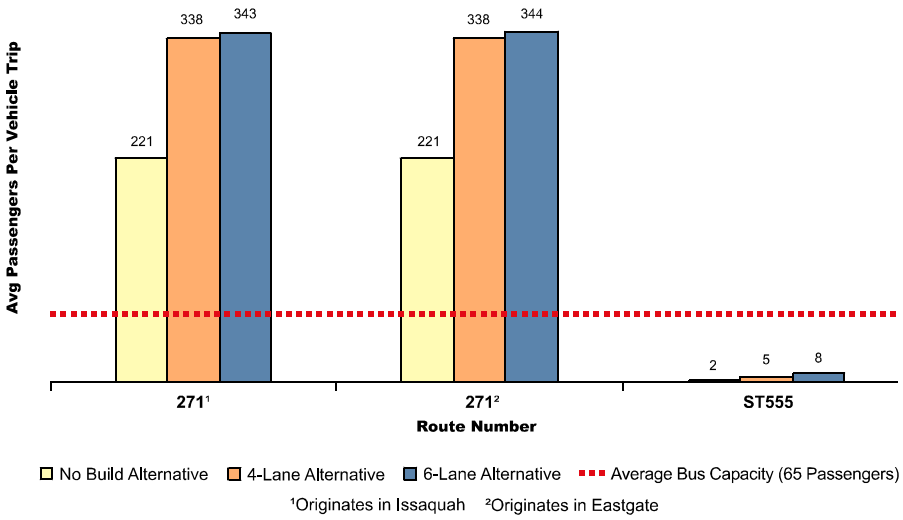


Exhibit 7-9. SR 520 Transit Loads—A.M. Peak Hour, Eastbound I-90/I-405 Corridor

What is the transit demand versus the supply?

As indicated in the previous section, we predict that demand would exceed the supply in 2030 for several bus routes operating on the Evergreen Point Bridge. Exhibit 7-10 quantifies the imbalance between supply and demand for bus service in the corridor, and also estimates the number of buses that would be necessary to provide sufficient capacity to meet the demand.

The transportation discipline team estimated the additional number of buses identified in Exhibit 7-10 using information from the transit demand forecasting process, combined with an overall estimate of peak period to peak hour ratio. The team then divided the number of peak hour passengers by an assumed load of 65 passengers per bus to obtain the number of buses needed.

Under the 4-Lane and 6-Lane Alternatives, passenger demand during the a.m. peak hour would increase by about 35 percent compared to the No Build Alternative. There is very little variation in transit passenger demand among the two build alternatives. Approximately 30 percent more buses would be needed to accommodate the projected growth in demand, again with little variation between the build alternatives.

Exhibit 7-10. A.M. Peak Passenger and Vehicle Demand for Buses Crossing Lake Washington

	Number of Passengers	Forecast Buses	Avg. Bus Occupancy	Number of Buses Needed	Adjusted Avg. Bus Occupancy[a]
Baseline Conditions (1998)					
Westbound	1,200	40	30	40	32
Eastbound	150	13	12	13	17
Total	1,350	53		47	
No Build Alternative					
Westbound	3,320	43	77	76	44
Eastbound	1,050	20	53	24	44
Total	4,370	63		100	
Growth over Existing	224%	19%		113%	
4-Lane Alternative					
Westbound	4,100	43	95	92	45
Eastbound	1,690	20	85	38	44
Total	5,790	63		130	
Growth over No Build	32%	0%		30%	
6-Lane Alternative					
Westbound	4,170	43	97	91	46
Eastbound	1,820	20	91	40	46
Total	5,990	63		131	
Growth over No Build	37%	0%		31%	

[a] Based on an average bus capacity of 65 passengers.

The addition of the HOV lane under the 6-Lane Alternative would improve travel time for buses crossing Lake Washington. While this would result in some time savings, travel time would not vary enough among the alternatives to result in changes to the required number of buses.

What is the person throughput for carpool and bus trips in the SR 520 corridor?

Person throughput is a measure of what percentage of actual person demand (as identified by travel forecasting estimates) can be accommodated in a corridor under a certain set of operating conditions.

In other words, it measures how many of the people who want to use the corridor can actually travel through it, given the corridor's capacity and the traffic volumes it is carrying at the time.

We used the CORSIM microsimulation model and estimates of vehicle occupancy to characterize person throughput for carpool and bus trips. This section summarizes information on the average person demand and throughput for carpool and bus trips at the mid-span of the Evergreen Point Bridge. Exhibit 7-11 shows the results for the No Build, 4-Lane, and 6-Lane Alternatives. The extent of person throughput is expressed in terms of the percentage of person throughput versus estimated person demand. A percentage of less than 100 indicates that not all estimated demand would be accommodated; a percentage of 100 indicates that the demand is served and that all potential carpool or bus trips would be accommodated for the time period and direction evaluated.

Exhibit 7-11. Percent of Estimated Carpool and Bus Person Demand Accommodated by the Alternatives (Average Levels)

Time Period and Direction	Carpool			Bus		
	No Build	4-Lane	6-Lane	No Build	4-Lane	6-Lane
A.M. Peak—Westbound	74%	77%	93%	63%	53%	67%
A.M. Peak—Eastbound	81%	85%	98%	100%	66%	71%
P.M. Peak—Westbound	81%	95%	100%	100%	73%	71%
P.M. Peak—Eastbound	88%	92%	100%	74%	62%	67%

For a.m. westbound person-trips, carpool person throughput would increase from 74 percent to 77 percent between the No Build Alternative and the 4-Lane Alternative. For bus trips, overall demand would grow but the extent of actual bus trips served versus demand would decline. Under the No Build Alternative, transit person throughput would be only 63 percent of total demand. This share would decline under the 4-Lane Alternative to 53 percent, but increase to 67 percent under the 6-Lane Alternative. For other time periods and travel directions, the same general patterns are evident, except that the percent served by the 6-Lane Alternative would be less than the No Build Alternative. This decline in transit person throughput for the build alternatives reflects the gap between potential transit demand (which increases with the build alternatives) and available service

capacity to meet this demand. The 6-Lane Alternative is the only alternative that would have the available roadway capacity to serve the transit service demand.

In general, both carpool and transit person throughput would be less than the estimated demand under the No Build and 4-Lane Alternatives. Under the 6-Lane Alternative, carpool person throughput during the p.m. peak period would fully meet demand. Under the No Build Alternative, transit person demand would be met in both directions during the a.m. and p.m. peak periods. The low share of transit throughput versus demand in the other alternatives indicates a gap between potential demand and service capacity.

How would the project affect transit travel time?

Exhibit 7-12 presents 2030 estimated general purpose (GP) and transit travel times between I-5 in Seattle and 124th Avenue Northeast on the Eastside. The table depicts the savings between transit travel times under the No Build, 4-Lane, and 6-Lane Alternatives.

No Build Alternative

During the a.m. peak period, the average travel time for westbound transit traffic between 124th Avenue Northeast and I-5 would be 39 minutes. This is a 10-minute savings compared to GP travel time. The average travel time for eastbound transit traffic would be 19 minutes, which is the same travel time as GP traffic. In the eastbound direction, no HOV lanes would be available in the SR 520 corridor.

During the p.m. peak period, the average westbound transit travel time would be 24 minutes, a 6-minute savings compared to GP traffic travel. The average eastbound transit travel time would be 9 minutes, which would also be the travel time for GP traffic operations.

Exhibit 7-12. Average Travel Times for General Purpose Traffic and Transit Vehicles (in minutes) between I-5 and 124th Avenue Northeast

Alternatives	General Purpose	Transit	Time Saved (Transit vs. General Purpose)	Transit Time Saved (No Build vs. Build)
A.M. Peak Westbound				
No Build	49	39	10	--
4-Lane	57	46	11	-7
6-Lane	55	14	41	25
A.M. Peak Eastbound				
No Build	19	19	0	--
4-Lane	8	8	0	11
6-Lane	8	8	0	11
P.M. Peak Westbound				
No Build	30	24	6	--
4-Lane	10	10	0	14
6-Lane	12	11	1	13
P.M. Peak Eastbound				
No Build	9	9	0	--
4-Lane	8	8	0	1
6-Lane	9	8	1	1

4-Lane Alternative

During the a.m. peak period, the average travel time for westbound transit traffic between 124th Avenue Northeast and I-5 would be 46 minutes under the 4-Lane Alternative. This is an 11-minute savings compared to GP travel time. There would be 7 minutes of additional transit travel time compared to transit under the No Build Alternative. The HOV lane travel time would increase compared to the No Build Alternative because congestion would increase on I-5 with the build alternatives. This is discussed in detail in *Chapter 4: Freeway Traffic Operations*.

During the a.m. peak period, the average travel time for eastbound transit traffic between 124th Avenue Northeast and I-5 would be

8 minutes, which is the same as GP travel time. No HOV lanes would be available in this section of SR 520. There is an 11-minute savings in travel time compared to transit in the No Build Alternative. The travel time would be shorter because wider shoulders and lanes on the Evergreen Point Bridge would allow speeds to increase as vehicles approach the bridge.

During the p.m. peak period, the average westbound transit travel time would be 10 minutes, the same as for GP traffic operations. There would be a 14-minute savings in travel time compared to transit in the No Build Alternative. The travel time would be shorter due to the improvements to the Evergreen Point Bridge (similar to the operations in the eastbound direction in the morning) and due to the decrease in vehicular demand.

During the p.m. peak period, the average eastbound transit travel time would be 8 minutes, which would also be the travel time for GP traffic operations. There is a 1-minute savings in travel time compared to transit under the No Build Alternative. Again, the travel time would be shorter with the improvements to the Evergreen Point Bridge.

6-Lane Alternative

During the a.m. peak period, the average westbound travel time for transit between 124th Avenue Northeast and I-5 would be 14 minutes under the 6-Lane Alternative (which indicates free-flow conditions). This is a 41-minute savings compared to GP traffic travel time. This is also a 25-minute savings in transit travel time over the No Build Alternative. The completion of the HOV lane would reduce the transit travel time compared to the No Build Alternative (which would end the HOV lane at 76th Avenue Northeast).

During the a.m. peak period, the average eastbound travel time for transit between 124th Avenue Northeast and I-5 would be 8 minutes, the same as GP travel time. When compared to transit travel time for the No Build Alternative, this is an 11-minute savings. The travel time would be shorter with the improvements to the Evergreen Point Bridge (completion of the HOV lane, and wider shoulders and lanes on the bridge increases speeds approaching the bridge).

During the p.m. peak period, the average westbound transit travel time would be 11 minutes, which is a 1-minute savings compared to GP travel time. This is a 13-minute savings in transit travel time compared to the No Build Alternative. Similar to the traffic operations in the

eastbound during the a.m. peak, the travel time would be shorter with the improvements to the Evergreen Point Bridge and completion of the HOV lane.

During the p.m. peak period, the average eastbound transit travel time would be 8 minutes, which is a 1-minute savings compared to travel time for GP traffic operations and a 1-minute savings in travel time compared to transit under the No Build Alternative. Again, the minor travel time reduction would be due to the improvements to the Evergreen Point Bridge.

How would carpool and transit trips change under each alternative?

Exhibit 7-13 shows carpool and transit ridership in terms of daily person-trips for each alternative. The most substantial change would be in carpool use, in which daily person-trips would increase from 11,220 (No Build Alternative) to as many as 55,950 (6-Lane Alternative). The increase in transit ridership would be smaller but still considerable, especially given the number of vehicles removed from streets and highways when more people use transit. Transit daily person-trips would increase from 34,070 (No Build Alternative) to as many as 47,580 (6-Lane Alternative). For both transit and carpool modes, the 6-Lane Alternative would accommodate more daily person-trips than the 4-Lane Alternative.

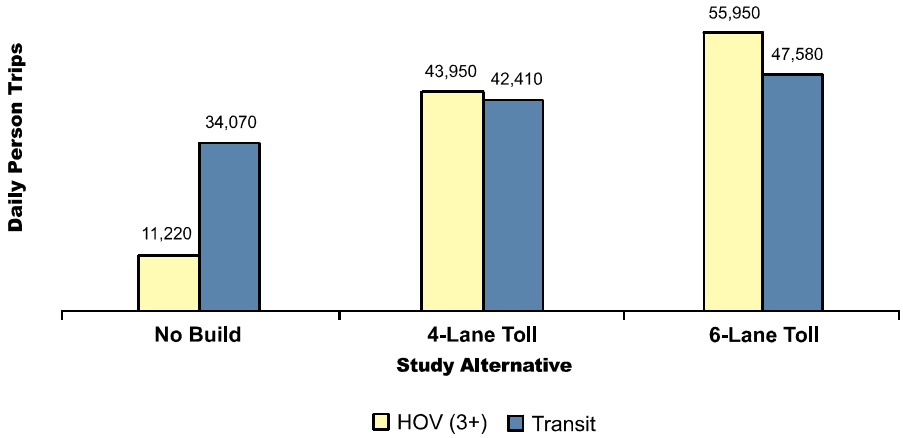


Exhibit 7-13. Carpool and Transit Ridership on SR 520

Chapter 8: Parking Supply

What is in this chapter?

This chapter describes the existing parking supply and the estimated future parking demand and use to determine how each project alternative could affect parking supply in the study area. For this analysis, we divided the study area into the following three areas:

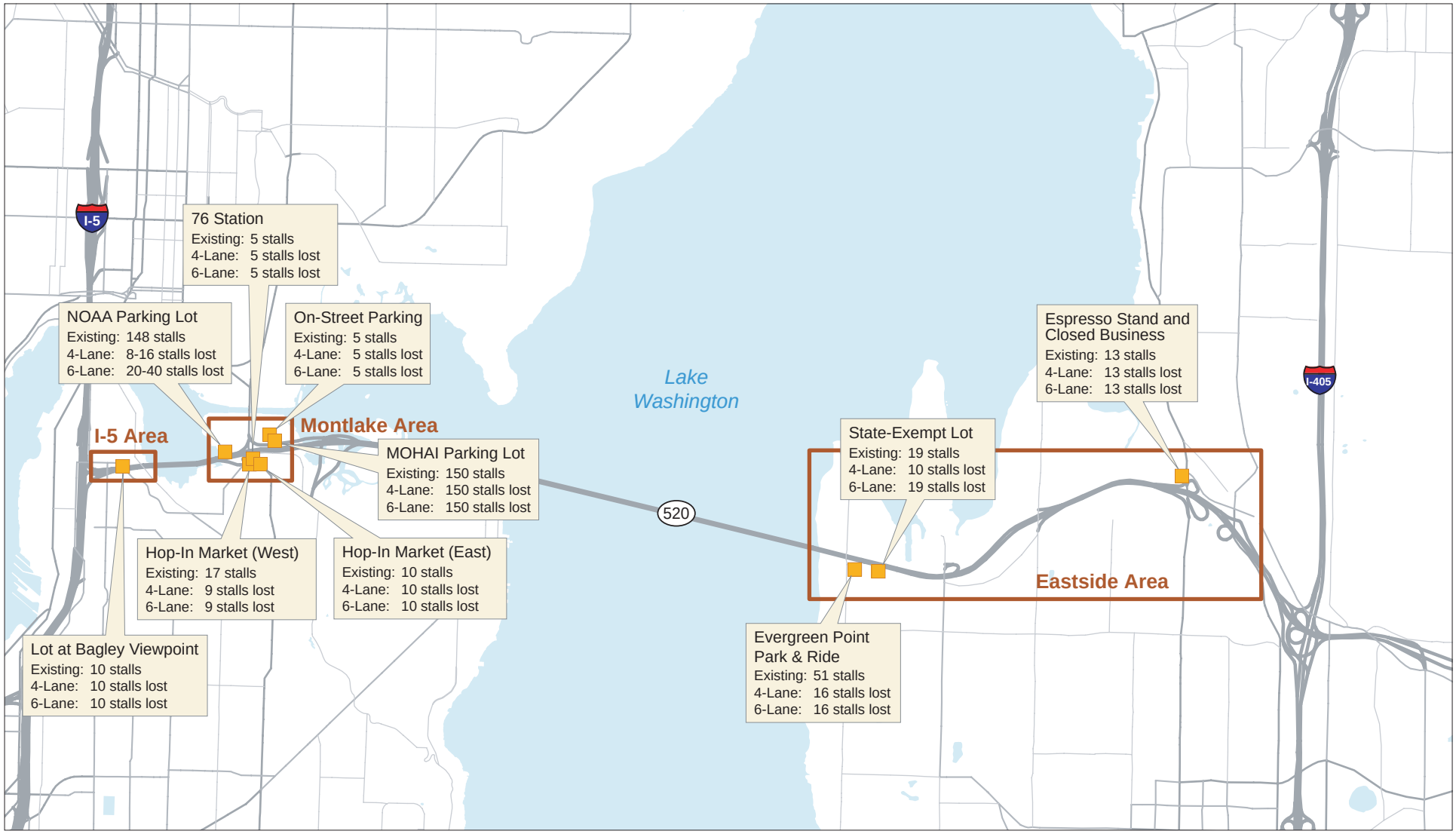
- I-5 area—the area east of I-5 and west of Portage Bay, from East Roanoke Street on the north to SR 520 to the south
- Montlake Boulevard area—the area east of Portage Bay and west of Lake Washington, from East Shelby Street on the north, to East Roanoke Street on the south
- Eastside area—the area east of Lake Washington, including Medina, Hunts Point, Clyde Hill, Yarrow Point, Kirkland, and Bellevue from Northeast Points Drive on the north, to Northeast 28th Street on the south

Exhibit 8-1 shows a map of these areas, the locations of parking lots, existing parking supply, and the potential effects of the 4-Lane and 6-Lane Alternatives. For each area, the text discusses affected parking lots, the changes to each lot, and the potential changes within communities based on changes in parking demand.

The analysis results represent the transportation discipline team's planning-level estimates, which are based on preliminary information that would be refined during final design. For example, the effect on parking supply at some lots was estimated by visually inspecting the planning-level designs. At Montlake's National Oceanic and Atmospheric Administration (NOAA) Northwest Fisheries Science Center parking facility, which is partially under the current Portage Bay Bridge, we have conservatively estimated the number of parking stalls that would be affected because bridge column locations are not yet known.

How was parking supply information collected?

The transportation discipline team estimated the effect on the parking supply for each alternative based on existing supply, planning-level designs, field observations, and discussions with the project designers.



N

0 2,500 5,000 Feet

Exhibit 8-1. **Potentially Affected Parking Areas**

SR 520 Bridge Replacement and HOV Project

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The analysis resulted in an approximation of the number of parking spaces that could be affected by each alternative. The team collected field data for each parking area expected to be affected by one or more of the build alternatives. These data included existing parking data (including supply) and estimated demand and use for the peak periods during one weekday in February 2004. The estimated parking demand and use data were collected and summarized at these identified parking facilities for each hour during the peak periods. This 1-day count approximates current typical weekday demand.

How would the project affect parking in the corridor?

This section describes the existing parking spaces that may be affected by the build alternatives and summarizes how each alternative would affect the parking supply. The photo exhibits are included to provide an overall sense of character at each parking area.

I-5 Area in Seattle

In the I-5 area, the 4-Lane and 6-Lane Alternatives would affect only the Bagley Viewpoint parking lot.

Lot at Bagley Viewpoint (Delmar Drive East and East Roanoke Street)

Existing Conditions

This lot, located in Bagley Viewpoint Park, is just east of the Delmar Drive overpass and north of the existing SR 520 structure. Currently, it has 10 parking stalls of which, on average, only one is used. Exhibits 8-2 and 8-3 show the existing parking area, looking north and south, respectively.

Exhibit 8-2. Bagley Viewpoint Parking Lot—Looking North

Exhibit 8-3. Bagley Viewpoint Parking Lot—Looking South

4-Lane and 6-Lane Alternatives

Exhibit 8-4 presents the supply, estimated demand for parking stalls, estimated percentage of stalls used, and number of stalls that could be affected at the Bagley Viewpoint parking lot under the 4-Lane and 6-Lane Alternatives. Both alternatives would completely eliminate this lot. The elimination of all 10 parking stalls at the viewpoint would not have a large effect on the community because this lot receives so little use.

Exhibit 8-4. Estimated Effects on Parking Supply in the I-5 Area Under the 4-Lane and 6-Lane Alternatives[a]

Location	Lot at Bagley Viewpoint
Supply	10
Average Demand	1
Average Percent Used	10%
Estimated Number Affected	10

[a]Other nearby parking areas may be affected if upgrades to meet limited access standards are required for facilities near the ramp termini. See *Additional Potential Effects on Parking Supply*.

Montlake Boulevard Area in Seattle

In the Montlake Boulevard area, approximately six parking facilities would be affected by both the 4-Lane and 6-Lane Alternatives. Exhibit 8-5 presents the supply, estimated demand for parking stalls, estimated percentage of stalls used, and number of stalls expected to be affected by the alternatives at each location.

Exhibit 8-5. Estimated Effects on Parking Supply in the Montlake Area Under the 4-Lane and 6-Lane Alternatives[a]

Location	MOHAI	East Hamlin Street On-Street	Hop-In Market (West)	Hop-In Market (East)	Texaco Station	NOAA NW Fisheries Science Center
Supply	150	5	17	10	5	148
Average Demand	59	1	9	4	4	116
Average Percent Used	39%	20%	53%	40%	80%	78%
Estimated Number Affected	150	5	9	10	5	8-16[b], 20-40[c]

[a] Other nearby parking may be affected if upgrades to meet limited access standards are required for facilities near the ramp termini. See *Additional Potential Effects on Parking Supply*.

[b] Estimated 4-Lane Alternative effect.

[c] Estimated 6-Lane Alternative effect.

The 4-Lane and 6-Lane Alternatives are expected to affect approximately 190 and 210 parking spaces in this area, respectively. The difference between the two alternatives would be at the NOAA Northwest Fisheries Science Center parking area, where the 4-Lane Alternative would eliminate fewer spaces because of its smaller footprint.

Museum of History and Industry (2700 24th Avenue East)

Existing Conditions

MOHAI's parking lot surrounds the museum on all but the south side. The museum is located in both McCurdy Park and East Montlake Park,

just east of 24th Avenue East. Currently, the lot has 150 parking stalls. Exhibit 8-6 shows the existing lower parking lot at MOHAI.

Exhibit 8-6. MOHAI Lower Parking Lot

4-Lane and 6-Lane Alternatives

The 4-Lane and 6-Lane Alternatives would eliminate all spaces in this lot to locate a stormwater treatment wetland. Because of the project limits and right-of-way needs, MOHAI and its parking lot would likely be moved to a different location. Access to East Montlake Park and the Washington Park Arboretum would be maintained, and parking would be provided for park users. The number of replaced spaces depends on negotiations with the Seattle Parks and Recreation Department.

24th Avenue East On-Street Parking (East Hamlin Street and 24th Avenue East)

Existing Conditions

There are five on-street parking stalls located just west of MOHAI on the west side of 24th Avenue East, just south of East Hamlin Street. Exhibit 8-7 shows a portion of the parking area.

Exhibit 8-7. 24th Avenue East On-Street Parking

4-Lane and 6-Lane Alternatives

The 4-Lane and 6-Lane Alternatives would eliminate all five stalls from this location. The removal of these parking spaces would have a small negative effect on the community because the average use is only 20 percent, or one parking space.

Hop-In Market (2605 22nd Avenue East)

East Side of the Market

Existing Conditions

Parking is available in the front lot of the Hop-In Market (on the east side of the market), which is situated southwest of East Lake Washington Boulevard, north of East Roanoke Street, and on both sides of 22nd Avenue East. Currently, there are 10 parking stalls. Exhibit 8-8 shows the existing parking area, looking west.

Exhibit 8-8. East Side of Hop-In Market—Looking West

4-Lane and 6-Lane Alternatives

Both alternatives would eliminate all 10 stalls from the front of the Hop-In Market. Because the Hop-In Market

would remain in place, demand for parking at the store is not expected to decrease. Between noon and 1 p.m., demand for parking in this lot can reach 89 percent. Therefore, the removal of all parking spaces in this lot would affect the business and the community. Some mitigation would be necessary because the remaining parking in the west lot would be insufficient to accommodate the displaced demand (see *West Side of the Market* below).

West Side of the Market

Existing Conditions

The back parking lot of the Hop-In Market (on the west side of the market) is situated southwest of East Lake Washington Boulevard, north of East Roanoke Street, and west of 22nd Avenue East. Currently, the lot has 17 parking stalls. Exhibit 8-9 shows the existing parking area, looking south.

Exhibit 8-9. West Side of Hop-In Market—Looking South

4-Lane and 6-Lane Alternatives

Although the grocery store would remain, both alternatives would eliminate 40 feet from the west side of the back lot of the Hop-In Market, resulting in a loss of nine spaces.

While, on average, nine parking stalls are in use at this location, this lot often experiences a demand of up to 15 stalls between 12 p.m. and 1 p.m. Additionally, demand is likely to be greater here if and when the 10 parking stalls in front of the grocery are eliminated. Thus, the loss of 9 out of 17 parking spaces would affect the grocery store and the community. The grocery store would remain in operation after the project was constructed; therefore, mitigation for the estimated parking loss should be considered.

76 Station (2645 East Montlake Place)

Existing Conditions

The 76 Station on 22nd Avenue East and East Lake Washington Boulevard currently contains five parking stalls.

4-Lane and 6-Lane Alternatives

Both alternatives would eliminate the gas station and its entire parking lot. Therefore, all five parking spaces at the gas station would be affected. However, because the gas station itself would be removed, associated demand to park in this lot would also be removed. Therefore, there would be no effect on the community of removing the lot itself.

NOAA Northwest Fisheries Science Center (2725 Montlake Boulevard East)

Existing Conditions

NOAA has a parking lot on the south side of the NOAA Northwest Fisheries Science Center building. Located south of East Hamlin Street and west of Montlake Boulevard East, some of the parking stalls in this lot lie beneath the existing SR 520 structure. The column sections of the bridge are too low to allow cars to park between the columns. The lot currently has approximately 148 parking stalls. Exhibit 8-10 shows existing parking located beneath the SR 520 structure, looking southeast.

Exhibit 8-10. NOAA Lot, Section Under SR 520—Looking Southeast

4-Lane Alternative

The 4-Lane Alternative would extend the SR 520 structure approximately 110 feet north of the existing structure (based on planning-level designs), eliminating four parking spaces near one row of columns and four spaces from the other row of columns, for a total loss of eight parking spaces. However, if column sections were to be shifted, it is possible that up to 16 parking stalls could be eliminated.

While the average demand for parking in this parking lot is 116 stalls out of 148, demand can reach up to 136 stalls between 1 p.m. and 3 p.m. The elimination of 8 stalls would still leave a sufficient number of spaces to meet demand (provided that current conditions continue), but if 10 or more stalls were eliminated, supply would no longer meet demand. If 16 stalls (the maximum estimate) were eliminated, then some patrons would likely be displaced.

6-Lane Alternative

The 6-Lane Alternative would extend the SR 520 structure approximately 170 feet north of the existing structure (based on planning-level designs), eliminating 7 parking stalls near one row of columns and 13 stalls from the other row of columns, for a total loss of 20 parking stalls. However, if column sections were to be shifted, it is possible that up to 40 stalls could be eliminated.

Based on the maximum current demand of 136 out of the 145 spaces, the elimination of 20 parking spaces could cause a displacement of up to 11 patrons, while the elimination of 40 spaces could displace up to 31 patrons. Thus, the community would be moderately affected by the removal of 20 to 40 parking spaces.

Eastside

In the Eastside area, three locations may be affected by the 4-Lane and 6-Lane Alternatives. They are the state-exempt parking lot, the Evergreen Point park-and-ride, and a lot associated with By-the-Way Espresso and a vacant building. These lots are depicted in Exhibit 8-1.

Exhibit 8-11 presents the supply, estimated demand for parking stalls, estimated percentage of stalls used, and number of stalls expected to be affected by the alternatives.

Exhibit 8-11. Estimated Effects on Parking Supply in the Eastside Area Under the 4-Lane and 6-Lane Alternatives[a]

Location	State-Exempt Lot	Evergreen Point Park-and-Ride	By-the-Way Espresso & Closed Business
Supply	19	51	13
Average Demand	1	45	3
Average Percent Used	5%	88%	23%
Estimated Number Affected	10[b], 19[c]	16	13

[a] Other nearby parking areas may be affected if upgrades to meet limited access standards are required for facilities near the ramp termini. See *Additional Potential Effects on Parking Supply*.

[b] Estimated 4-Lane Alternative Effect.

[c] Estimated 6-Lane Alternative Effect.

Evergreen Point Park-and-Ride (SR 520 and Evergreen Point Road, Medina)

Existing Conditions

This lot lies east of Evergreen Point Road and just south of SR 520 in Medina and currently contains 51 parking stalls. Sixteen of the parking stalls are on the north side of the lot and 35 are on the south side. The lot currently experiences an 88 percent use rate; during its peak months in 2003, this rate rose to 92 percent. Exhibit 8-12 shows a portion of the Evergreen Point park-and-ride.

4-Lane and 6-Lane Alternatives

Both the 4-Lane and 6-Lane Alternatives would eliminate all the parking stalls on the north side of the lot, or 16 stalls. This would reduce parking supply by 31 percent. Thus, during peak months, parking demand would exceed the remaining parking supply. This would constitute a parking effect to the community.

Exhibit 8-12. Evergreen Point Park-and-Ride

State-Exempt Lot (SR 520 near Evergreen Point Road, Medina)

Existing Conditions

This lot is on the east side of the Evergreen Point park-and-ride lot, just south of SR 520, in Medina. Half of the parking stalls are on the north side of the lot and half are on the south side. Currently, it contains 19 parking stalls. Exhibit 8-13 shows the existing parking area, located beyond the metal-gate barrier, looking east.

Exhibit 8-13. State-Exempt Lot—Looking East

4-Lane Alternative

The 4-Lane Alternative would affect approximately 10 parking stalls on the north side of this lot. Between 12 p.m. and 1 p.m., the state-exempt lot experiences an average demand for three stalls, which corresponds to an average use rate of less than 6 percent. This is the highest demand experienced over the course of a day. Therefore, even with the removal of 10 out of 19 parking stalls, the existing demand at this lot would still be met.

6-Lane Alternative

The 6-Lane Alternative would eliminate the entire lot (all spaces). Because the lot appears to be minimally used, the actual effect on parking supply would likely be minor.

By-the-Way Espresso and Closed Business (Northeast Points Drive and Lake Washington Boulevard Northeast, Kirkland)

Existing Conditions

This lot lies south of Northeast Points Drive on the west side of Lake Washington Boulevard Northeast in Kirkland. Currently, it contains 13 parking stalls. The By-the-Way Espresso stand is near the west end of the parking area, and a closed business sits near the east end. Exhibit 8-14 shows the western section of the existing parking area, looking west.

Exhibit 8-14. By-the-Way Espresso—Looking West

4-Lane and 6-Lane Alternatives

Both of the build alternatives would eliminate this entire lot (all spaces). Because of the project limits and right-of-way needs, we anticipate that the By-the-Way Espresso and the vacant building, along with the parking lot, would be removed completely. Thus, there would be no future demand for parking in this lot.

Additional Potential Effects on Parking Supply

Under the 4-Lane and 6-Lane Alternatives, several lots beyond those described above could potentially be affected if upgrades of facilities near the ramp termini were required to meet standards for limited access. These lots are as follows:

- I-5 Area
  - The fire station and the WSDOT incident parking lots on East Roanoke Street and Harvard Avenue East
- Montlake Boulevard Area
  - The on-street parking on East Roanoke Street and East Montlake Place (limited to within 130 feet of East Montlake Place)
- Eastside Area
  - The on-street parking on 84th Avenue Northeast, just north of Northeast 30th Street
  - The on-street parking on 92nd Avenue Northeast, just north of Northeast 34th Street
  - The on-street parking on Northeast Points Drive, just east of 92nd Avenue Northeast

What are the conclusions of the parking analysis?

The 4-Lane and 6-Lane Alternatives would affect the parking supply similarly at most locations. Because of its wider footprint, the 6-Lane Alternative would result in a greater loss of parking stalls at two locations: the NOAA Northwest Fisheries Science Center lot in the Montlake Boulevard area and the state-exempt lot in the Eastside area.

The No Build Alternative would result in no parking effects because the existing bridge structure would not be expanded. However, it is anticipated that the 4-Lane Alternative would result in an overall loss of 240 parking spaces, and the 6-Lane Alternative in an overall loss of 270 parking spaces. The slightly larger effect of the 6-Lane Alternative is due to its larger footprint. Exhibit 8-15 presents with the total estimated parking space losses by area for each alternative.

Exhibit 8-15. Summary of Estimated Parking Spaces Affected by Alternative and Area

Alternative	I-5	Montlake Boulevard	Eastside	Total
No Build	0	0	0	0
4-Lane	10	190	40	240
6-Lane	10	210	50	270

This analysis assumed that on-street parking currently existing on local streets near the SR 520 ramp termini would not be affected (i.e., these facilities would not have to meet the standards for limited access, which prohibit on-street parking within 300 feet of a limited access ramp terminal intersection).

Chapter 9: Construction Traffic

What is in this chapter?

This chapter provides a qualitative discussion of how construction of each build alternative would likely affect traffic. This preliminary analysis evaluates the potential effects of both the 4-Lane and 6-Lane Alternatives on traffic flow on adjacent local streets and freeways. The analysis includes the effect of construction-related truck traffic on overall traffic operations and a qualitative assessment of the effects of potential road closures. The estimated total construction period would be 7 to 8 years for the 4-Lane Alternative and 9 to 10 years for the 6-Lane Alternative. The No Build Alternative would not have construction effects and was therefore not evaluated.

The transportation discipline team made several assumptions when assessing the effects of construction on traffic operations and developing possible mitigation measures. An important assumption is that funding constraints were not considered in determining the construction effects. In order to develop the most conservative estimate of effects on truck traffic, it was assumed that funding would be available to allow both the Seattle and Eastside SR 520 corridor improvements to be constructed simultaneously. If, in fact, construction did not happen in these areas simultaneously, the effect of construction on traffic operations would be less than is estimated in this report.

Qualitative evaluation of the alternatives includes discussion of their potential effects on both regional and local roadway facilities. The local arterial discussion is divided into two regions: Seattle (I-5 Interchange, Portage Bay, and Montlake areas) and the Eastside (Medina, Hunts Point, Clyde Hill, Yarrow Point, Kirkland, and Bellevue). The following points are discussed for each alternative:

- Potential haul routes for construction traffic
- Estimates of the potential effect on both local street and regional highway traffic as a result of anticipated construction staging scenarios, potential haul routes, and associated construction vehicle volumes
- Identification of potential road closures and effects of those closures
- Estimates of construction duration

- Potential mitigation measures

The transportation discipline team assumed that the westbound HOV lane on SR 520 on the Eastside and the Lake Washington Boulevard ramps in Seattle would remain closed during most of the construction period and both areas would be used as construction staging area. It is estimated that these two closures would create the most substantial effects due to construction.

The local arterials would remain open for most of the construction period. We discuss those areas anticipated to be closed for a period of time during construction. During construction, partial closures of local arterial roadways may occur; however, this has not been addressed in this analysis and should be considered later in the project when design work has been more refined and construction phasing is known. The potential effects from construction are assessed for the critical travel periods—i.e., the typical work week, Monday through Friday, and the a.m. and p.m. peak periods of traffic. We anticipate that certain road closures would occur during the evening and on weekends; however, the effect of these closures on traffic are considered secondary and are not evaluated here.

What are the assumptions?

Given the available data, the transportation discipline team concluded that the most substantial effect on overall weekday peak period traffic operations from construction would be the proposed closure of the SR 520 westbound HOV lane and the Lake Washington Boulevard ramps. The largest effect would be to SR 520, which is anticipated to carry most of the construction trips. Exhibit 9-1 presents a summary of the estimated amount of truck traffic and a qualitative assessment of traffic effects related to truck haul trips. Although I-90 would not receive extra truck hauling traffic related to the SR 520 Bridge Replacement and HOV Project, small to moderate traffic effects (particularly to buses) would likely occur due to the closure of the SR 520 westbound HOV lane and some shift in bus service as well as passenger demand to I-90. With the closure of the Lake Washington Boulevard ramps, queuing and potential spillover to and from the Montlake Boulevard on- and off-ramps would occur.

Exhibit 9-1. Summary of Traffic Effects on Regional Facilities

	Estimated Number of Construction Truck Trips				
	Per day		Per hour		
Facility	4-Lane	6-Lane	4-Lane	6-Lane	Effect on Traffic
SR 520	289	309	36	39	Moderate/ Substantial
I-5	179	187	23	24	Moderate
I-405	105	115	13	15	Small/Moderate

Slightly larger traffic effects could occur with the 6-Lane Alternative than with the 4-Lane because of the higher number of trucks associated with the larger footprint and the construction of five lids that are not included in the 4-Lane Alternative. The construction period duration for the 6-Lane Alternative would also be longer than that estimated for the 4-lane Alternative. Potential mitigation strategies to address the effects on SR 520 include providing incentives for the contractor to re-open the westbound SR 520 HOV lane and Lake Washington Boulevard ramps as quickly as possible, requiring the contractor to minimize and/or prohibit construction truck trips during the peak periods, and developing strategies aimed at reducing overall peak period traffic levels on SR 520.

The transportation discipline team assumed that all adjacent local arterials would be open during construction except for the Lake Washington Boulevard ramps and Delmar Drive bridge over SR 520 in Seattle, which would be closed for the majority of the construction period. Detour routes have been developed and are discussed later in this chapter. Besides providing incentives to the contractor to reopen the closures more quickly, other potential mitigation could include detour signing and improvements to intersection channelization and/or signal operations along the detour routes. More specific improvements would be developed in conjunction with WSDOT and local jurisdictions at a later phase of project design. Overall, outside of the closures noted above, local arterials would experience little adverse effect due to construction.

How would construction vehicle volumes affect the transportation network?

The following sections present traffic information for the 4-Lane and 6-Lane Alternatives. The discussion begins with a qualitative analysis

regarding the Evergreen Point Bridge, possible construction staging areas, and roadway closures. Roadways are then evaluated by alternative, including a discussion of how construction of each alternative could potentially affect both regional and local traffic. In terms of safety, construction techniques would be similar for the 4-Lane and 6-Lane Alternatives. There would not be a measurable difference in construction safety between the two alternatives.

Evergreen Point Bridge

The floating portion of Evergreen Point Bridge across Lake Washington connects the west and east approach structures. While the new approach structures and pontoons are being constructed, we assume that the existing floating bridge would remain in place and operate with two lanes in each direction. The new floating bridge pontoons would be constructed offsite; therefore, there would be only a minor effect on traffic, because the haul truck traffic in this area related to the construction would be minimal.

Traffic on the existing floating portion of the bridge would be affected while the new bridge is being connected to its approach structures on either end. However, the tie-in of the new floating bridge with the approach structures could most likely be completed during a weekend closure; therefore, the effect on peak weekday traffic would be minimal.

Construction of the Evergreen Point Bridge west approach would require the use of a temporary detour bridge for both the 4-Lane and 6-Lane Alternatives. During the closure period, all traffic would be moved to a four-lane temporary detour bridge parallel to the existing bridge on the south side. The temporary detour bridge would have minimal shoulder widths but would be similar to the configuration of the existing structure. This configuration would expedite the construction of the temporary bridge. The Lake Washington Boulevard ramps would be closed to accommodate the temporary detour bridge.

The closure of the Lake Washington Boulevard ramps would require westbound traffic that normally uses the Lake Washington Boulevard off-ramp to exit at the Montlake Boulevard ramp. Moreover, the traffic currently using the eastbound SR 520 on-ramp at Lake Washington Boulevard would most likely use the eastbound on-ramp at Montlake Boulevard. Depending on the traffic demand, queue spillover from the Montlake ramps may affect westbound traffic operations on the bridge.

Proposed Construction Staging Areas

Given the limited right-of-way available in the project area, construction staging areas are somewhat constrained, and would be similar for both alternatives.

In Seattle, a potential area for construction staging is the MOHAI site, which is assumed to be acquired for the project. The unused R.H. Thompson Expressway Ramps, as well as the closed Lake Washington Boulevard ramps, could also be used as staging areas.

On the Eastside, we anticipate that the construction staging area(s) would lie within the project footprint. The westbound SR 520 HOV lane would also be used. The By-the-Way Espresso and adjacent buildings, located in Kirkland at Lake Washington Boulevard and Northup Way, are assumed to be acquired as new right-of-way and could also serve as a staging area.

Exhibit 9-2 shows the locations of potential construction staging areas.

Roadway Closures

There would be three long-term roadway closures within the project study area for both the 4-Lane and 6-Lane Alternatives during construction. Throughout the life of the project there would be intermittent short-term ramp and road closures. These closures would be further defined after the project design team develops additional design work and construction phasing.

The first long-term construction roadway closure that would substantially affect weekday peak period traffic operations would close the westbound SR 520 HOV lane for approximately 24 months for both the 4-Lane or 6-Lane Alternatives. This lane closure would also close the bus stop in Medina on the Eastside for relatively short durations throughout the construction period. The westbound HOV lane closure would likely contribute to HOV traffic shifting to other corridors such as I-90, where HOV lanes are in place.

The second long-term construction closure likely to cause a substantial effect on weekday peak period traffic operations is the Lake Washington Boulevard ramps in Seattle; the ramps would be closed for the majority of the construction period. The closure would be 37 months for the 4-Lane Alternative and 52 months for the 6-Lane Alternative (SR 520 Project Team 2004f). Detour routes developed for both ramps are shown in Exhibit 9-3. The Montlake area would likely

absorb most of the detour traffic from the ramp closure, increasing congestion in an already congested area.

The third location likely to be closed for a period of time during construction is the Delmar Drive bridge over SR 520 in Seattle. It is estimated that the Delmar Drive bridge may be closed for 9 to 12 months for both the 4-Lane and 6-Lane Alternatives. This closure is not anticipated to substantially affect the local arterial traffic stream, given that:

- This roadway primarily carries residential and recreational travelers, and demand along the roadway is moderate.
- Two alternate detour routes are available.

For bicycle and pedestrian traffic, the detour routes identified for the Delmar Drive bridge closure are feasible; however, the routes are steep and not ideal.

Exhibit 9-3 outlines the potential detour routes.

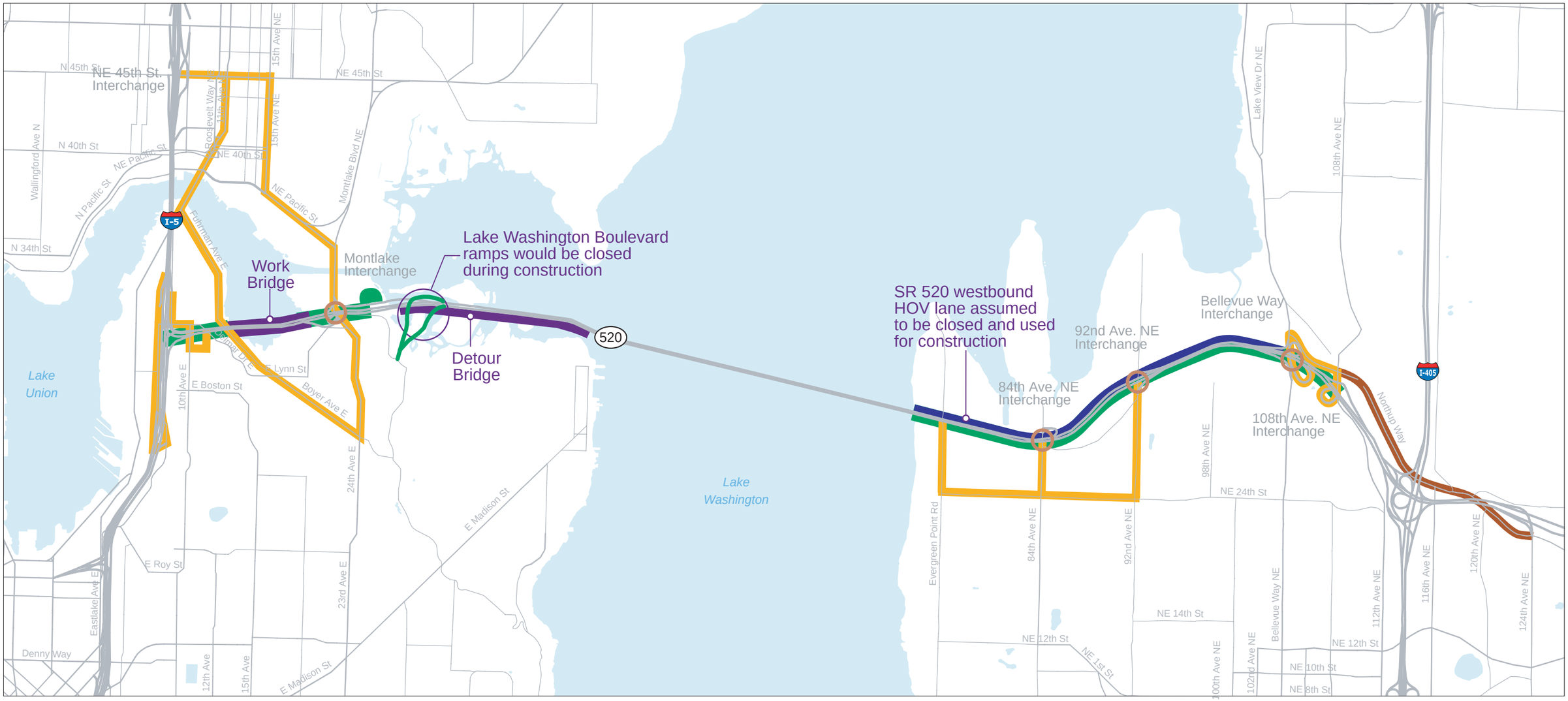
Potential Haul Routes, Traffic Effects, and Construction Duration

Potential haul routes would include both local arterial and regional roadways. This section presents information related to anticipated truck traffic volumes, a qualitative estimate of the effect of the projected truck traffic on general-purpose traffic during the peak period, and an estimate of the construction duration for the 4-Lane and 6-Lane Alternatives. The regional effects on SR 520, I-5, and I-405 are discussed first, followed by a discussion of the effect on local arterial traffic. Exhibits 9-4 and 9-5 present haul routes, anticipated construction duration, and number of trucks per day (average and peak) for Seattle and the Eastside, respectively.

The transportation discipline team assumed an average construction workday of 12 hours and a period of about 8 hours for actual hauling of construction materials.

How would the project affect regional freeway traffic?

The following section provides an overview of the potential effects of construction on regional freeway traffic. Exhibit 9-6 presents a summary of the potential effects on regional freeway traffic for the 4-Lane and 6-Lane Alternatives. Exhibit 9-2 shows the potential haul routes for both alternatives.



N

0 2,500 Feet

Construction staging area*

Carpool lane closed for construction staging

Temporary bridge

4- and 6-Lane Alternative haul route

6-Lane Alternative haul route

* Shaded areas are approximate. All construction staging areas are expected to be within WSDOT right-of-way or on WSDOT property except for the Montlake Boulevard Interchange area, where construction could be staged at McCurdy and East Montlake Parks.

Exhibit 9-2. **Potential Construction Staging Areas and Proposed Haul Routes**

SR 520 Bridge Replacement and HOV Project

N

0 2,500 Feet

Exhibit 9-3. **Potential Detour Routes**

SR 520 Bridge Replacement and HOV Project

Exhibit 9-4. Summary of Effects of Truck Traffic in Seattle

		Construction Duration (Months)			Truckloads/Day				
					Average		Peak		
Location	Description	4-Lane Alt.	6-Lane Alt.	Haul Routes	4-Lane Alt.	6-Lane Alt.	4-Lane Alt.	6-Lane Alt.	Notes
I-5	SR 520 Mainline	10	13	• SR 520 to I-5 southbound / northbound	23	40	92	92	Peak truck traffic assumed to be during 2 weeks of concrete paving period.
10th Avenue East	Bridge over SR 520	9	9	• West Roanoke to South Boylston to I-5 southbound • West Roanoke to North Harvard to I-5 northbound	15	15	20	20	Assume staged construction that allows continual access across 10th Avenue.
Delmar Drive	Bridge over SR 520	8	8	• West Roanoke to South Boylston to I-5 southbound • West Roanoke to North Harvard to I-5 northbound • South 11th Avenue to West Miller to South Harvard Avenue to East Newton to I-5 southbound • South 11th Avenue to West Miller to North 10th Avenue to West Roanoke to North Harvard to I-5 northbound	15	15	20	20	Assume staged construction that allows continual access across 10th Avenue.
10th and Delmar Lid (6-Lane Alternative only)	10th and Delmar Lid	N/A	11	• Westbound SR 520 to I-5 southbound/ northbound • Eastbound SR 520 to I-405 southbound / northbound	N/A	15	N/A	86	Assume Delmar Drive and 10th Avenue are completed before lid construction.
Portage Bay	SR 520 Mainline	20	28	• South Boyer to North 24th to East SR 520 • North Boyer to Furman to North Eastlake / 11th to West 45th to I-5 southbound / northbound	25	25	86	86	Could potentially use barges for construction.
Montlake Boulevard	SR 520 Mainline and Montlake Structure	20	26	• Eastbound SR 520 to I-405 southbound / northbound • Westbound SR 520 to I-5 southbound/ northbound • North Montlake to West Pacific to North 15th to West 45th to I-5 southbound / northbound	19	26	92	92	For the 6-Lane Alternative, Montlake Boulevard would be completed before Montlake lid construction.

Exhibit 9-4. Summary of Effects of Truck Traffic in Seattle

		Construction Duration (Months)			Truckloads/Day				
					Average		Peak		
Location	Description	4-Lane Alt.	6-Lane Alt.	Haul Routes	4-Lane Alt.	6-Lane Alt.	4-Lane Alt.	6-Lane Alt.	Notes
Montlake Lid (6-Lane Alternative only)	Montlake Lid	N/A	24	• Westbound SR 520 to I-5 southbound/ northbound • Eastbound SR 520 to I-405 southbound / northbound	N/A	15	N/A	86	
124th Avenue Northeast	Bridge over SR 520	8	8	• Westbound Park to South Montlake to westbound SR 520 to I-5 southbound/ northbound • Westbound Park to South Montlake to eastbound SR 520 to I-405 southbound / northbound • North Montlake to West Pacific to North 15th to West 45th to I-5 southbound / northbound • Westbound Park to North Montlake to eastbound SR 520 to I-405 southbound / northbound	15	15	20	20	
West Approach	Westbound SR 520 Mainline and Lake Washington Boulevard Structures	37	50	• Westbound SR 520 to I-5 southbound/ northbound • Eastbound SR 520 to I-405 southbound / northbound	46	42	86	86	Montlake Boulevard and Montlake Lid completed before construction of approaches; could potentially use barges.
Total number of peak truckloads per day							140	160	Assume that only one peak activity occurs simultaneously with two average activities.

Exhibit 9-5. Summary of Effects of Truck Traffic on Eastside

Location	Description	Construction Duration (Months)		Haul Routes	Truckloads/Day				Notes
					Average		Peak		
		4-Lane Alt.	6-Lane Alt.		4-Lane Alt.	6-Lane Alt.	4-Lane Alt.	6-Lane Alt.	
Evergreen Point Bridge		64	80	N/A					Number of trucks not determined; it is assumed that all material would be manufactured offsite, floated in and assembled.
East Highrise	Eastbound SR 520 Mainline	37	50	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound	46	42	86	86	
Evergreen Point Road (4- and 6-Lane Alternatives) and Lid (6-Lane only)	Bridge over SR 520 (4- and 6-Lane Alternatives) and Lid (6-Lane)	28.5	28.5	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound • Evergreen Point to East 24th Street to North 84th to westbound SR 520 to I-5 southbound / northbound • Evergreen Point to East 24th Street to North 92nd to eastbound SR 520 to I-405 southbound / northbound	15	15	20	20	Assume staged construction that allows continual access across Evergreen Point Bridge. For the 6-Lane Alternative, assume Evergreen Point Road Bridge completed before lid construction.
84th Avenue Northeast	Bridge over SR 520	7	7	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound • 84th to westbound SR 520 to I-5 southbound / northbound • 84th to East 24th Street to North 92nd Avenue to eastbound SR 520 to I-405 southbound/ northbound	15	15	20	20	Assume staged construction that allows continual access across 84th Avenue.

Exhibit 9-5. Summary of Effects of Truck Traffic on Eastside

Location	Description	Construction Duration (Months)		Haul Routes	Truckloads/Day				Notes
					Average		Peak		
		4-Lane Alt.	6-Lane Alt.		4-Lane Alt.	6-Lane Alt.	4-Lane Alt.	6-Lane Alt.	
84th Avenue Northeast Lid (6-Lane only)	84th Avenue Lid	N/A	9.5	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound	N/A	15	N/A	86	Assume that 84th Avenue Northeast completed before lid construction.
92nd Avenue Northeast	Bridge over SR 520	7	7	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound • 92nd to West 24th Street to North 84th to westbound SR 520 to I-5 southbound/ northbound • 92nd to West 24th Street to North 92nd to eastbound SR 520 to I-405 southbound/ northbound	15	15	20	20	Assume staged construction that allows continual access across 92nd Avenue Northeast.
92nd Avenue Northeast Lid (6-Lane only)	92nd Avenue Northeast Lid	N/A	9.5	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound	N/A	15	N/A	86	Assume that 92nd Avenue Northeast completed before lid construction.
Evergreen Point / Bellevue Way	SR 520 Mainline	24	32	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound	37	28	92	92	

Exhibit 9-5. Summary of Effects of Truck Traffic on Eastside

		Construction Duration (Months)			Truckloads/Day				
					Average		Peak		
Location	**Description**	**4-Lane Alt.**	**6-Lane Alt.**	**Haul Routes**	**4-Lane Alt.**	**6-Lane Alt.**	**4-Lane Alt.**	**6-Lane Alt.**	**Notes**
Bellevue Way (6-Lane Alternative only)	SR 520 Mainline and Bellevue Way Structure	N/A	8	• Westbound SR 520 to I-5 southbound / northbound • Eastbound SR 520 to I-405 southbound / northbound	N/A	21	N/A	86	Assume staged construction that allows continual access across Bellevue Way.
Total number of peak truckloads per day							149	160	Assume that only one peak activity occurs simultaneously with two average activities.