TRANSPORTATION

AFFECTED ENVIRONMENT

Travel Characteristics

Pertinent facts about existing Downtown travel characteristics include:

Average weekday trips with an origin or destination in Downtown:

- 815,000 person trips per day
- 519,400 vehicle trips per day

Percent of Downtown-oriented trips made by transit: 20%

Average automobile occupancy: 1.26 persons per vehicle.

EXISTING AM AND PM PEAK HOUR TRAFFIC CONDITIONS

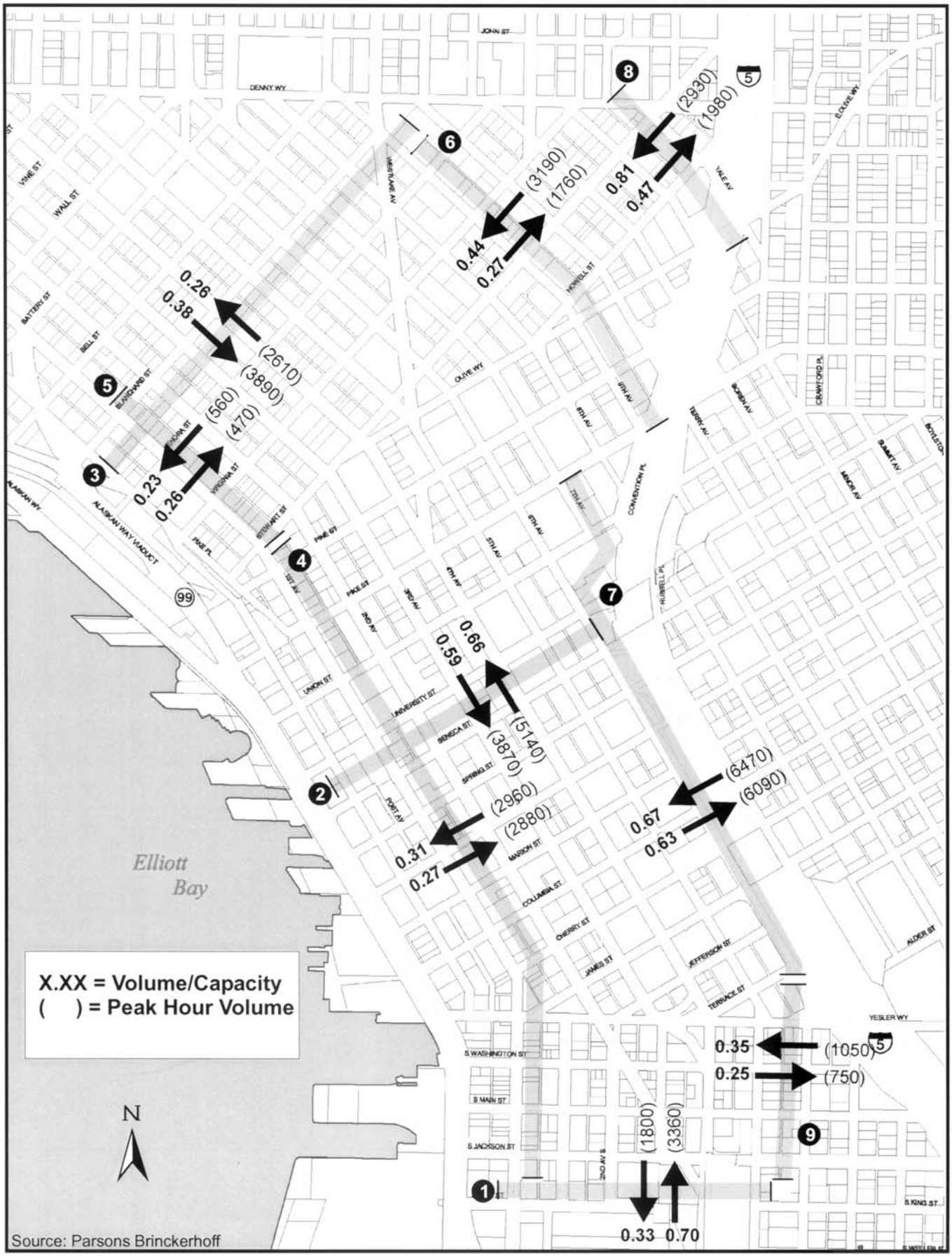
Travel patterns within and through Downtown can be interpreted using "screenlines" that measure traffic volumes and capacities on multiple streets carrying traffic in the same general direction. For this EIS, nine screenlines are defined to capture traffic entering and leaving Downtown from all directions, as well as locations within Downtown. This study examines traffic conditions during the AM and PM "peak hours," which represent the most congested conditions during the morning and evening commute periods. Typical AM and PM peak hours are 7-8 AM and 5:30-6:30 PM. Figures 31 and 32 illustrate existing AM and PM peak hour traffic volumes across the nine screenlines.

For each screenline, the existing traffic volumes are summed for travel in each direction, and a "volume-to-capacity ratio" (v/c ratio) is calculated. Typical street capacities are used for these calculations, but because the capacity of a roadway is not a hard-and-fast value, typical capacities can be exceeded.[1] In this study, a v/c ratio of 1.20 for a screenline indicates that streets crossing this screenline are at or near their ultimate capacity. A v/c ratio between 0.80 and 1.00 indicates moderately congested operating conditions, and a ratio between 1.00 and 1.20 indicates more-than-moderately congested conditions. The City's arterial level of service standard for these areas of Downtown is a screenline v/c ratio of 1.20 or less. Figures 31 and 32 show the peak hour traffic volumes and v/c ratios for each of the screenlines. Table 42 also summarizes that information.

Notable Findings

- As expected, inbound traffic volumes are greater during the AM peak hour, and outbound traffic volumes are greater during the PM peak hour.
- Traffic volumes across the studied screenlines during the PM peak hour are approximately 12% higher than screenline volumes during the AM peak hour.
- Outbound traffic during the PM peak hour represents 59% of traffic at screenlines (41% is inbound). During the AM peak hour, the inbound traffic represents 57% of traffic at screenlines (43% is outbound).
- Only two screenlines have v/c ratios of 0.80 or higher—Screenline 7 (east of Sixth Avenue, Pike St. to Yesler Way) eastbound during the PM peak hour; and Screenline 8 (east of Minor Avenue, Denny Way to Olive Way) westbound during the AM peak hour. These reflect the most heavily used commuting routes to/from Interstate 5 (via Stewart Street, Howell Street and Olive Way) as well as east-west traffic on Denny Way.

[1] For this study, the assumed street capacity is 600 vehicles per hour per lane.



Source: Parsons Brinckerhoff

Downtown Height & Density EIS

FIGURE 31
Existing Screenline Volumes and V/C Ratios
AM Peak Hour

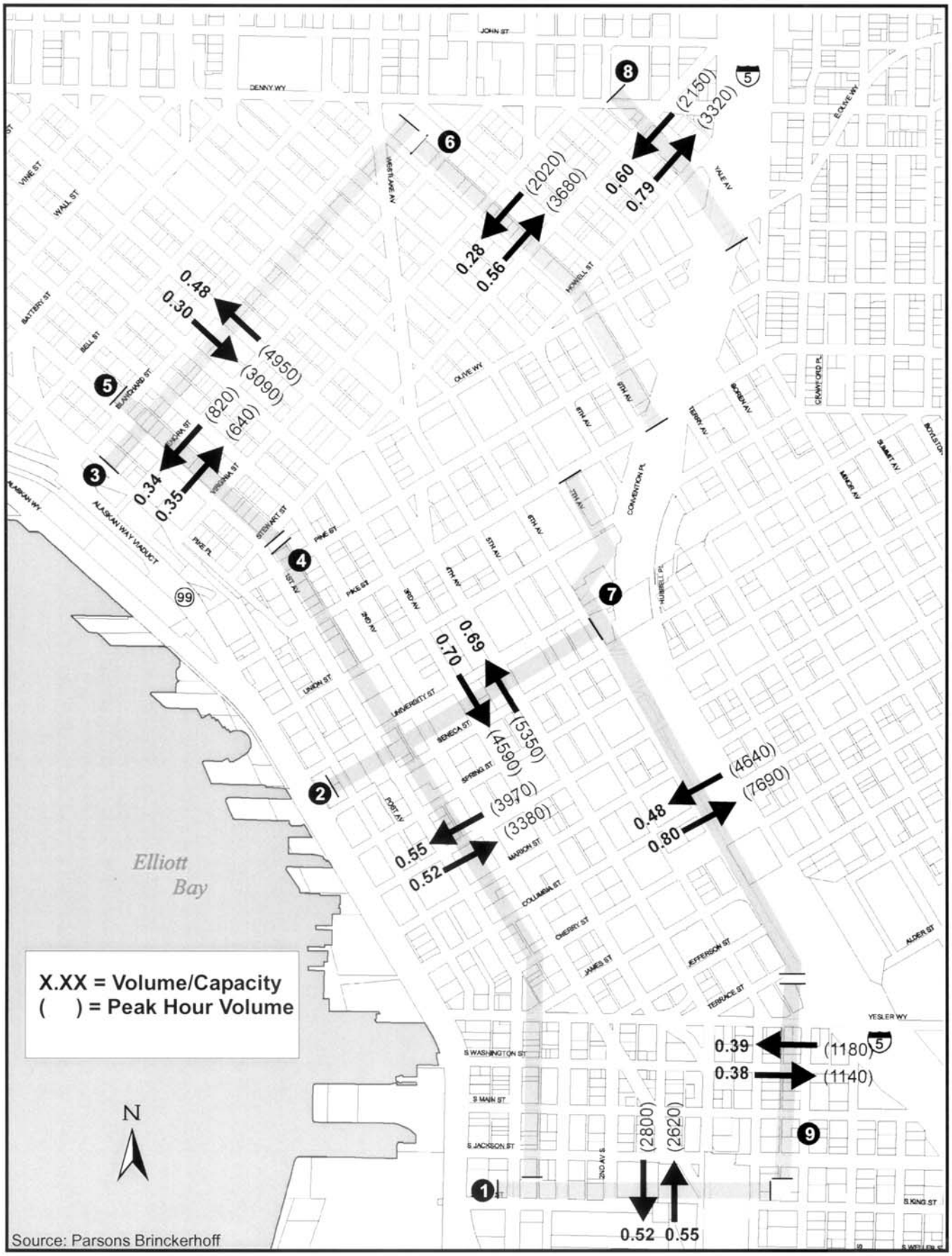


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FIGURE 32
Existing Screenline Volumes and V/C Ratios
PM Peak Hour

Table 42
Existing Peak Hour Traffic Volumes and V/C Ratios Across Screenlines

Screenline	Map Key	AM Peak Hour		PM Peak Hour	
		Volume	V/C Ratio	Volume	V/C Ratio
S. King St., First Ave. S. to Sixth Ave. S.	1				
Northbound Total		3,360	0.70	2,620	0.55
Southbound Total		1,800	0.33	2,800	0.52
North of Seneca St., Western Ave. to Sixth Ave.	2				
Northbound Total		5,140	0.66	5,350	0.69
Southbound Total		3,870	0.59	4,590	0.70
South of Blanchard St., Elliott Ave. to Ninth Ave.	3				
Northbound Total		2,610	0.26	4,950	0.48
Southbound Total		3,890	0.38	3,090	0.30
1st Ave/Office Core, East of First Ave., S. Jackson St. to Pine St.	4				
Westbound Total		2,960	0.31	3,970	0.55
Eastbound Total		2,880	0.27	3,380	0.52
1st Ave/Belltown, East of First Ave., Stewart St. to Blanchard St.	5				
Westbound Total		560	0.23	820	0.34
Eastbound Total		470	0.26	640	0.35
9th Ave/Denny Triangle, East of Ninth Ave., Lenora St. to Pike St.	6				
Westbound Total		3,190	0.44	2,020	0.28
Eastbound Total		1,760	0.27	3,680	0.56
6th Ave/Office Core, East of Sixth Ave., Union St. to S. Jackson St.	7				
Westbound Total		6,470	0.67	4,640	0.48
Eastbound Total		6,090	0.63	7,690	0.80
NE Denny Triangle, East of Minor Ave., Denny Way to Olive Way.	8				
Westbound Total		2,930	0.81	2,150	0.60
Eastbound Total		1,980	0.47	3,320	0.79
Yesler – Jackson, West of Sixth Ave.	9				
Westbound Total		1,050	0.35	1,180	0.39
Eastbound Total		750	0.25	1,140	0.38

Source: Parsons Brinckerhoff, 2002

- While Interstate 5 is the dominant origin and destination of commuting traffic, Aurora Avenue (SR 99) also is a frequent origin and destination. Screenline 3 captures traffic that arrives and departs Downtown via surface streets, to/from northern locations. Screenline 3 v/c ratios are approximately 0.38 for inbound traffic during the AM peak hour, and 0.48 for outbound traffic during the PM peak hour.
- Screenline 2 (north of Seneca Street) captures traffic moving north and south in the heart of Downtown. The v/c ratios ranging between 0.59 and 0.70 during the AM and PM peak hours reflect the moderately congested conditions observed in this area during peak commuting periods.

Traffic Circulation

The quality of traffic circulation on an arterial street system is generally the result of operating conditions at signalized intersections, since these are the locations where roadway capacity is shared by vehicles moving in conflicting directions. Operating conditions at key intersections along selected critical corridors serving the Downtown area were examined using a traffic model known as SYNCHRO. This tool simulates traffic operations at both a corridor and intersection level, and can indicate how operations at one intersection may affect those at nearby intersections. The results of the analysis are expressed in terms of "level of service"[2] and travel times through the corridors. Queuing conditions, referring to line-ups or back-ups of vehicles, are also evaluated, because back-ups may affect the operations of nearby intersections.

The studied corridors are the Denny Way corridor and the combined corridors of Stewart Street, Howell Street and Olive Way. Within these corridors, 38 intersections were analyzed—12 along Denny Way and 26 along the Stewart/Howell/Olive corridors. Table 43 and Figure 33 summarize current operating conditions for these corridors.

The analysis indicates that in the AM peak hour, only 2 intersections in the studied corridors operate at LOS F: Stewart St./Denny Way, and Stewart St./5th Avenue.

Operations in the PM peak hour are generally more congested than the morning peak hour, with 4 intersections experiencing operating conditions of LOS F: Stewart St./Yale Avenue, Howell St./Minor Avenue, Olive Way/Boren Avenue, and Stewart St./Denny Way. Denny Way/6th Avenue operates at LOS E. These findings are consistent with field observations.

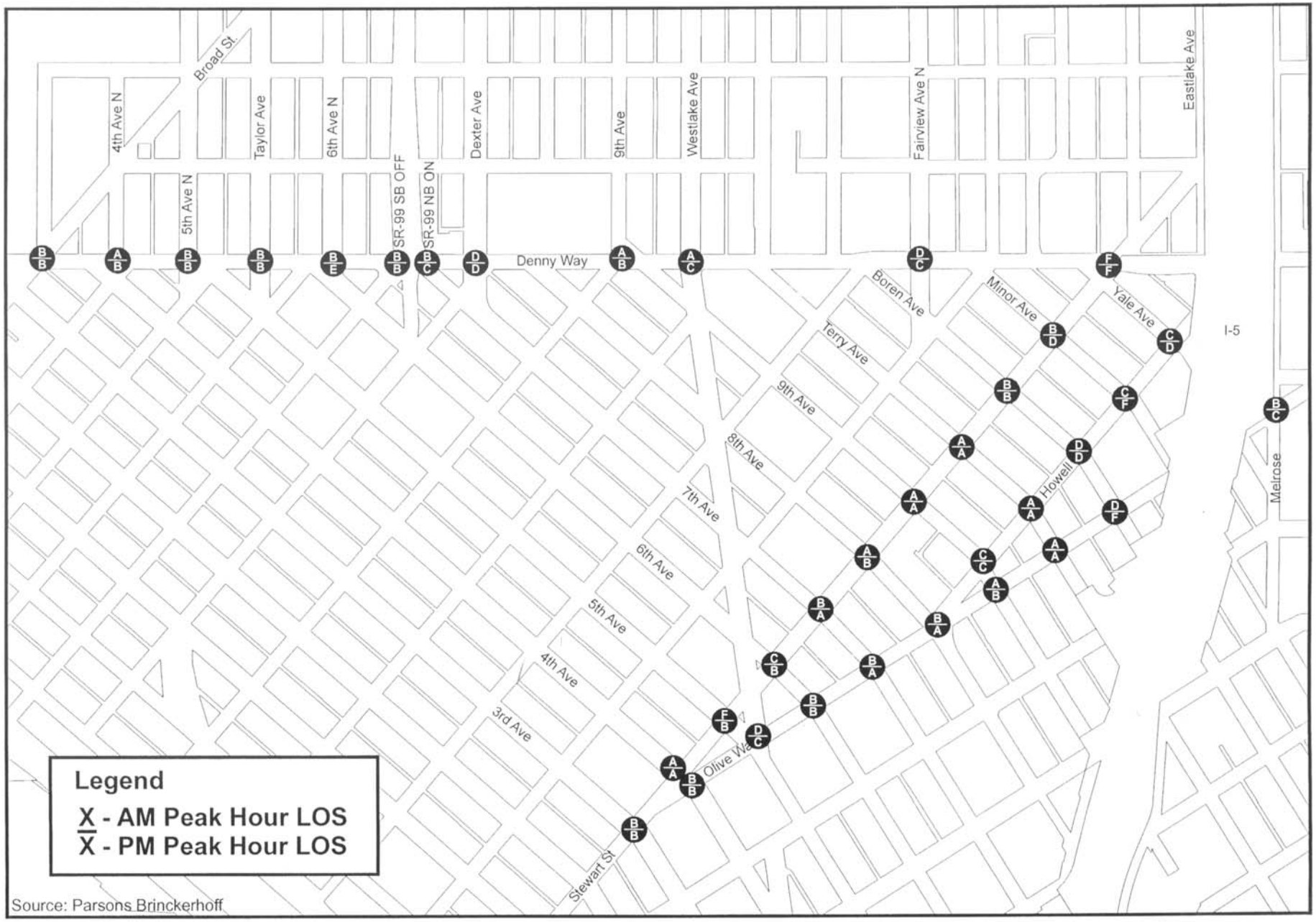
While other studied intersections operate at LOS D or better, several of them still experience queuing problems on one or more approaches, such that queue back-ups may affect operations at nearby intersections (see Table 43). This is evident along Stewart Street in the westbound direction and along Denny Way in both directions between Stewart Street and 6th Avenue, in the AM peak hour. During the PM peak hour, queuing problems are additionally noted along Howell Street between Boren and Yale Avenues.

[2] Level of service is a measure defined by the Highway Capacity Manual that ranges from excellent conditions (LOS A) to overloaded conditions (LOS F). Average vehicle delay for LOS A is 10 seconds or less, and for LOS F is greater than 80 seconds. These level of service measures are not directly related to the City's Arterial Level of Service Standard required by the Growth Management Act. The Arterial Level of Service Standard designated by the City is an areawide v/c ratio measured against all the arterials crossing certain specifically-defined screenlines.

Table 43
Current Peak Hour Intersection Levels of Service and Queuing Impacts

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Queuing Impacts*	LOS	Queuing Impacts*
Stewart & 3rd Ave	B	---	B	---
Stewart & 4th Ave	A	WB	A	---
Stewart & 5th Ave	F	SB/WB	B	---
Stewart & Westlake	B	WB	A	---
Stewart & 6th Ave	C	WB	B	---
Stewart & 7th Ave	B	---	A	---
Stewart & 8th Ave	A	---	B	---
Stewart & 9th Ave	A	---	A	---
Stewart & Terry	A	WB	A	---
Stewart & Boren	B	SB	B	SB
Stewart & Minor	B	---	D	SB/WB
Stewart & Yale	B	SB/WB	F	SB/WB
Howell & Yale	C	SB/EB/WB	D	SB/EB
Howell & Minor	C	WB	F	SB
Howell & Boren	D	NB/WB	D	NB/EB
Howell & Terry	A	---	A	---
Howell & 9th Ave	C	---	C	---
Howell & 8th/Olive	B	---	A	---
Olive & Melrose	B	EB	C	EB
Olive & Boren	D	NB	F	EB/NB/SB
Olive & Terry	A	---	A	---
Olive & 9th Ave	A	---	B	---
Olive & 7th Ave	B	---	A	---
Olive & 6th Ave	B	---	B	---
Olive & 5th/Westlake	D	SB	C	---
Olive & 4th Ave	B	---	B	---
Denny & Stewart	F	EB/WB/SW	F	EB/SW
Denny & Fairview	D	EB/WB/NB	C	EB/WB/NB
Denny & Westlake	A	---	C	EB/NB
Denny & 9th Ave	A	EB/SB	B	EB/SB
Denny & Dexter	D	EB/WB	D	EB/WB
Denny & Aurora NB	B	EB/WB	C	EB/WB/NB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	B	WB	E	EB/WB/NB
Denny & Taylor	B	WB	B	---
Denny & 5th Ave	B	---	B	---
Denny & 4th Ave	A	---	B	---
Denny & Broad	B	---	B	WB

* Direction(s) indicated are for approaches where queues from the specified intersection are calculated to back up and affect operations at adjacent intersections.



Source: Parsons Brinckerhoff

FIGURE 33
Existing AM & PM Peak Hour Intersection Levels of Service

Travel Times

Table 44 shows current average AM and PM peak hour travel time summaries for the studied corridors. Travel time is frequently used as a measure of effectiveness for comparing transportation alternatives. These findings were developed based on output from the SYNCHRO model. The longer travel times along Stewart Street in the PM peak hour may be due to less advantageous signal timings compared to the morning commute when signals are better set to facilitate inbound volumes.

Table 44
Current Average Peak Hour Corridor Travel Time Summaries

Corridor	AM Peak Hour (minutes)	PM Peak Hour (minutes)
Denny Way Eastbound	5.5	5.9
Denny Way Westbound	5.9	6.3
Olive Way Eastbound	3.8	3.4
Stewart Street Westbound	4.0	8.5

Source: Parsons Brinckerhoff, 2002
Assumptions:
* Stewart Street corridor evaluated from Yale Ave to 3rd Ave.
* Olive Way corridor evaluated from 3rd Ave to Boren Ave.
* Denny Corridor (both directions) evaluated from Broad St to Stewart St.
* Average travel speed of 20 mph is assumed for all arterial segments

Transit Service

Transit Operations

The transit analysis considers two corridors and two transit screenlines to measure bus service. The two corridors—Stewart Street from Yale to 3rd Avenue, and Olive Way from 3rd Avenue to Boren Avenue—were chosen because they each carry relatively high transit volumes, and because peak hour traffic modeling was conducted on them. For the two corridors, the analysis applies transit volumes to the respective travel times to develop a combined aggregate bus travel time value for the corridors. The two transit screenlines are: 1st to 5th Avenue north of Seneca Street, and Denny Way between Broad Street and Stewart Street. These screenlines capture north-south routes through the commercial core and to/from the north. See Appendix N for additional details, including tables documenting transit volumes.

Stewart St./Olive Way Corridors. This screenline helps measure the relationship to regional transit service providers. Stewart Street and Olive Way are the principal transit access routes to/from Interstate 5 in the study area. A total of 149 buses use the corridor in the AM peak hour and 115 buses in the PM peak hour. Stewart Street and Olive Way experience significant transit volumes entering Downtown in the AM peak hour; Stewart Street's volumes are partly attributable to the volumes of Community Transit buses. Service on Olive Way does not show a directional peak and has fairly balanced volumes in both the AM and PM peak hours due to a large number of Sound Transit buses returning to Interstate 5. The overall cumulative peak-hour travel times weighted by bus volumes for the combined Stewart/Olive corridors is 572 bus-minutes in the AM peak hour and 651 bus-minutes in the PM peak hour.

North of Seneca Transit Screenline. This screenline measures the major transit spine on surface streets through the Downtown core. Approximately 421 buses move through the corridor in the AM peak hour and 414 buses in the PM peak hour, representing approximately 5 percent of the traffic stream. These bus volumes do not include transit tunnel buses. The transit volumes are roughly equivalent northbound and

southbound during the peak hours. Fourth and Second Avenue carry the highest transit volumes. Community Transit and Sound Transit bus service is focused exclusively on Fourth and Second Avenue.

Denny Way Transit Screenline. This screenline captures more local-bound service than the Stewart/ Olive screenline, generally to/from northern and northwestern portions of the city. Approximately 169 buses cross Denny Way in both directions during the AM and PM peak hours. This includes 81 buses in the AM peak hour and 88 in the PM peak hour. The existing cumulative peak-hour sum of delay for buses crossing Denny Way is estimated at 29 minutes in the AM peak hour and 40 minutes in the PM peak hour. Dexter Avenue experiences the highest delays crossing Denny Way, due to large numbers of buses using the street coupled with high average traffic delay at the Denny/Dexter intersection. Aurora Avenue and Fifth Avenue (near Seattle Center) have a large number of buses using the street but fairly modest delays, resulting in moderate levels of overall delay. Fourth, Ninth and Westlake Avenues carry relatively few buses compared to the other streets crossing the Denny Way screenline, and have low levels of delay.

Transit Layover

A layover space is a designated stopover location for a transit vehicle at or near one end of a route, or at a turn-back point. Layover is a critical element in transit service planning and has direct implications on operating costs and levels of service provided. King County Metro has a total of 25 existing layover spaces in the study area, and 17 other identified potential layover spaces (see Figure 34). Community Transit has four layover spaces in the study area. These layover spaces are all within the northern portion of Downtown in the Belltown and Denny Triangle neighborhoods, and are concentrated mostly on Blanchard, Bell and Lenora Streets. They accommodate buses that originate in this area and move through Downtown heading to the Eastside and southern destinations.

Potential layover spaces are those that King County Metro considers feasible based on compatible adjacent land uses and proximity to route origins. The potential layover spaces are intended to provide alternative sites if development displaces existing spaces, and/or to accommodate projected growth in service that increases the need for layover spaces. Typically, layovers are located adjacent to vacant lots, parking lots or buildings with blank walls. It is considered undesirable to have layover buses parked next to residential or commercial uses, due to potential noise and diesel fume issues.

Green Street designations on Bell and Blanchard Streets and Ninth Avenue correspond with some existing layover spaces, and will likely reduce the number of potential layover sites in the study area. Though not explicitly stated in codes, the desired character of Green Streets may be incompatible with bus layover spaces.

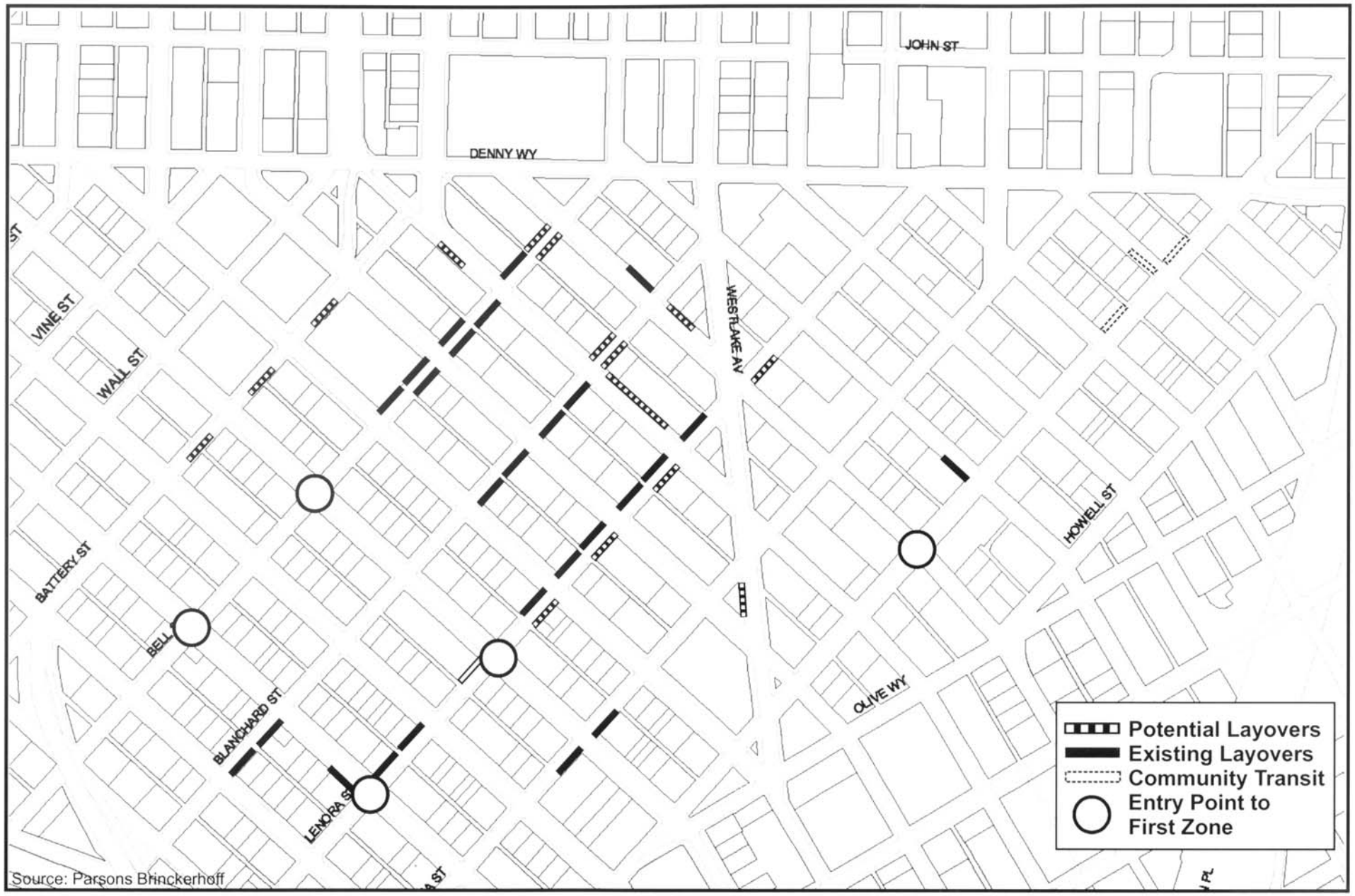


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FIGURE 34
Potential Future On-Street Layovers

IMPACTS

This impact section summarizes the findings of the transportation impact analysis (see Appendix N for additional detailed information). This section first presents the baseline condition for the year 2020, based on the future growth assumptions of this EIS. This baseline condition corresponds to the EIS Alternative 4 – No Action condition, because it shows what is projected to occur if none of the proposed zone changes occur. The 2020 baseline condition represents the impacts of Alternative 4, and also serves as a benchmark against which to compare the impacts of Alternatives 1, 2 and 3.

2020 Baseline Condition (Alternative 4 – No Action)

TRAVEL CHARACTERISTICS

The transportation impact modeling is based on: the high-end growth assumptions made for this EIS; forecasts from the City of Seattle's travel demand forecasting model; and travel "mode share" information from the Puget Sound Regional Council's travel demand model. Traffic growth rates were obtained from the City's model and applied to actual ground traffic counts to develop the future volumes used for analysis. Table 45 summarizes differences between existing conditions and 2020 travel assumptions. The highlights for 2020 include:

- a forecasted 58% increase in the number of person-trips to or from Downtown (including internal trips);
- an increase in the share of person-trips made by transit from 20% to 33%, translating to considerably more transit ridership;
- a 5.5% increase in average auto occupancy to 1.33 persons per vehicle; and
- an approximate 13% decrease in the share of person-trips made by automobiles.

Table 45
Comparison of Travel Characteristics

	Existing Condition	2020 Condition	% Change to Year 2020
Average person-trips/weekday to/from Downtown	815,000	1,285,000	58%
Average vehicle trips/weekday to/from Downtown	519,400	645,900	24%
Percent of person-trips made by transit	20%	33%	--
Daily person-trips made by transit	163,000	424,000	160%
Percent of person-trips made by automobile	80%	67%	--
Average auto occupancy	1.26 persons	1.33 persons	6%

The mode choice modeling assumed the presence of monorail, light rail from SeaTac to Northgate, and some growth in transit service. The transportation network for the traffic forecasting analysis assumed the existing capacity and function of SR 99, and no specific changes to the Mercer corridor. The Washington State Department of Transportation and the City of Seattle are analyzing replacement alternatives for the Alaskan Way Viaduct in an EIS. Some of the alternatives under consideration in that study would change how traffic accesses Downtown from SR 99, especially from the south. The City has also been studying alternatives for the Mercer Corridor, and will begin an EIS in the Fall of 2003. Options under consideration could have some impact on traffic volumes on Denny Way, but the extent of this impact has not yet been determined. Additionally, the following impact analysis does not analyze potential traffic operational impacts from monorail alignments because it is a programmatic study and sufficient detail

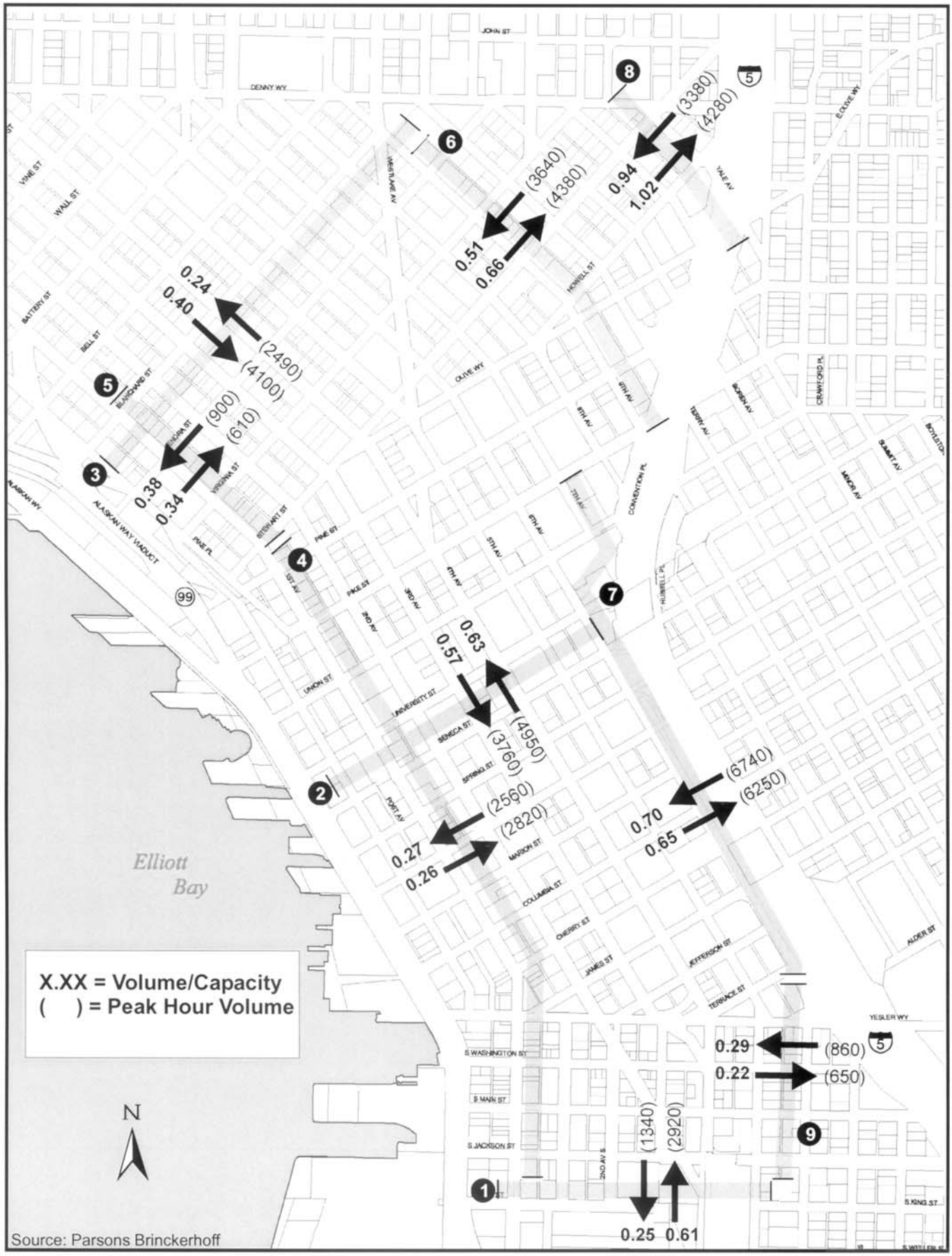
was not available at the time of study. However, the September 2003 Draft EIS for the monorail now identifies traffic impacts of the monorail alignment.

The 2020 analysis uses the same nine screenlines discussed for existing conditions. Table 46 shows 2020 peak hour traffic volumes and v/c (volume-to-capacity) ratios across the screenlines, for the AM and PM peak hour. The volumes shown are the summation of volumes on all individual streets crossing the screenline. Figures 35 and 36 portray these results graphically.

Table 46
Existing and 2020 No Action Peak Hour Traffic Volumes and Volume/Capacity Ratios

Screenline	Map Key	AM Peak Hour					PM Peak Hour				
		Existing		2020 No Action			Existing		2020 No Action		
		Volume	V/C Ratio	Volume	V/C Ratio	% Vol Chg.	Volume	V/C Ratio	Volume	V/C Ratio	% Vol Chg.
S. King St., 1st Ave. S. to 6th Ave. S.	1										
Northbound Total		3,360	0.70	2,920	0.61	-13.1	2,620	0.55	2,570	0.54	-1.9
Southbound Total		1,800	0.33	1,340	0.25	-25.6	2,800	0.52	2,720	0.50	-2.9
North of Seneca St., Western Ave. to 6th Ave.	2										
Northbound Total		5,140	0.66	4,950	0.63	-3.7	5,350	0.69	6,220	0.80	16.3
Southbound Total		3,870	0.59	3,760	0.57	-2.8	4,590	0.70	5,450	0.83	18.7
South of Blanchard St., Elliott Ave. to 9th Ave.	3										
Northbound Total		2,610	0.26	2,490	0.24	-4.6	4,950	0.48	5,320	0.52	7.5
Southbound Total		3,890	0.38	4,100	0.40	5.4	3,090	0.30	3,970	0.39	28.5
1st Ave/Office Core, East of 1st Ave., S. Jackson St. to Pine St.	4										
Westbound Total		2,960	0.31	2,560	0.27	-13.5	3,970	0.55	3,520	0.37	-11.3
Eastbound Total		2,880	0.27	2,820	0.26	-2.1	3,380	0.52	3,460	0.32	2.4
1st Ave/Belltown, East of 1st Ave., Stewart St. to Blanchard St.	5										
Westbound Total		560	0.23	900	0.38	60.7	820	0.34	1,020	0.42	24.4
Eastbound Total		470	0.26	610	0.34	29.8	640	0.35	910	0.51	42.2
9th Ave/Denny Triangle, East of 9th Ave., Lenora St. to Pike St.	6										
Westbound Total		3,190	0.44	3,640	0.51	14.1	2,020	0.28	3,780	0.53	87.1
Eastbound Total		1,760	0.27	4,380	0.66	148.9	3,680	0.56	5,830	0.88	58.4
6th Ave/Office Core, East of 6th Ave., Union St. to Jefferson St.	7										
Westbound Total		6,470	0.67	6,740	0.70	4.2	4,640	0.48	5,600	0.58	20.7
Eastbound Total		6,090	0.63	6,250	0.65	2.6	7,690	0.80	8,970	0.93	16.6
NE Denny Triangle: E. of Minor Ave., Denny Way to Olive Way	8										
Westbound Total		2,930	0.81	3,380	0.94	15.4	2,150	0.60	3,360	0.93	56.3
Eastbound Total		1,980	0.47	4,280	1.02	116.2	3,320	0.79	4,680	1.11	41.0
Yesler – Jackson, West of 6th Ave., Yesler Wy to S. Jackson St	9										
Westbound Total		1,050	0.35	860	0.29	-18.1	1,180	0.39	810	0.27	-31.4
Eastbound Total		750	0.25	650	0.22	-13.3	1,140	0.38	1,100	0.37	-3.5
Grand Totals		**57,700**		**65,470**		**13.5**	**63,370**		**76,580**		**20.8**

Source: Parsons Brinckerhoff, 2002



Source: Parsons Brinckerhoff

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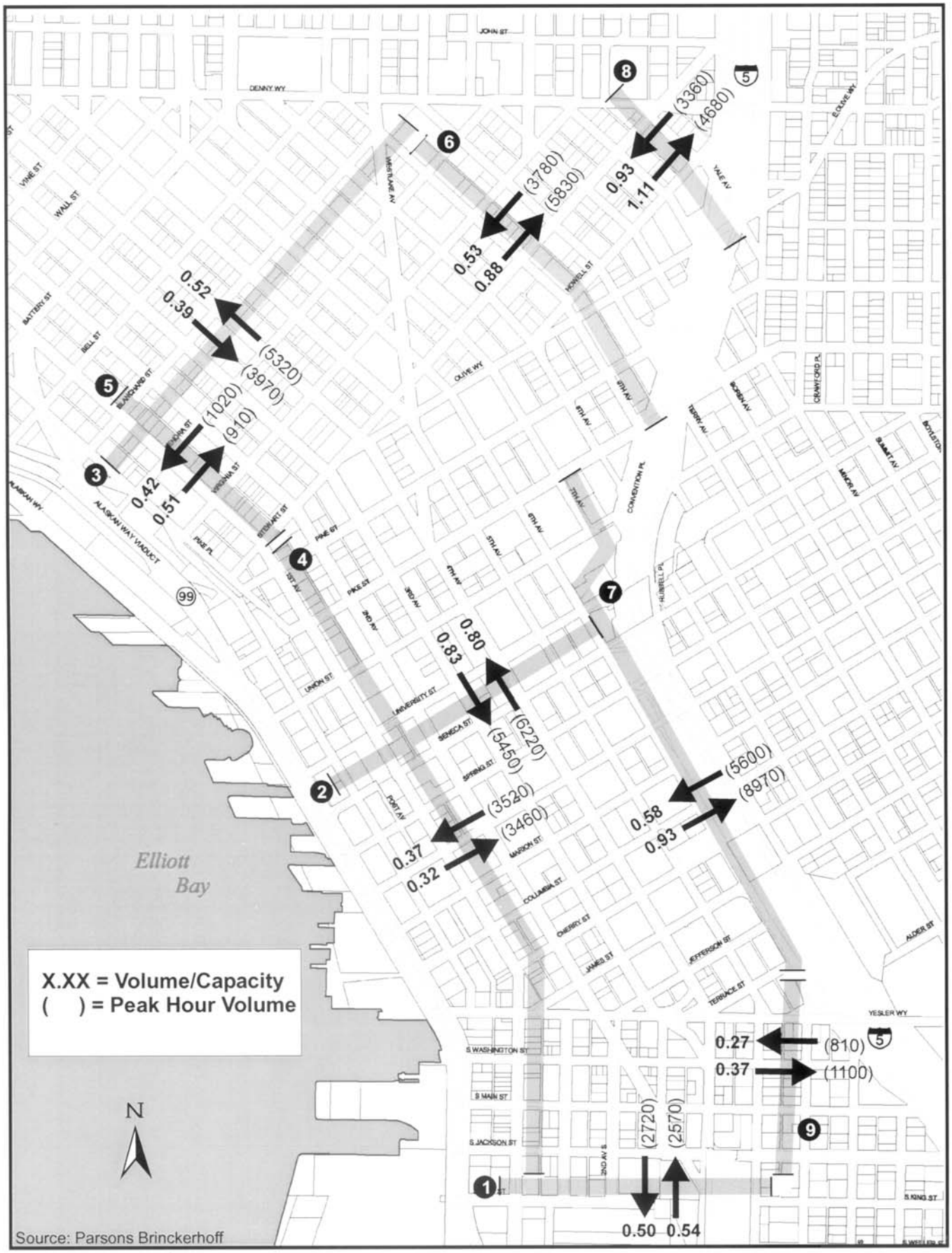
FIGURE 35
Year 2020 No Action Screenline Volumes and V/C Ratios - AM Peak Hour



Downtown Height & Density EIS

FIGURE 36
Year 2020 No Action Screenline Volumes and V/C Ratios
PM Peak Hour

Notable Findings

- On an aggregate basis, volumes across all screenlines are projected to increase by 9.4% in the AM peak hour, and by 19.4% in the PM peak hour. This level of increase would be generally consistent with overall regional growth.
- Some individual screenlines are predicted to experience more significant percentage traffic growth, including Screenlines 6 and 8 measuring east-west traffic and I-5 accessing traffic in the Denny Triangle, and Screenline 5 measuring east-west traffic near 1st Avenue in Belltown. For example, PM peak hour traffic volumes across Screenline 6 would increase almost 70 percent, across Screenline 8 would increase 47 percent, and across Screenline 5 would increase 33 percent by 2020.
- PM peak hour traffic volumes across Screenline 7 (including access to/from I-5 at the Commercial Core) would increase approximately 18 percent by 2020.
- Three screenlines are forecast to experience modest decreases in peak hour volumes by 2020, including Screenline 1 measuring north-south traffic near S. King Street, Screenline 4 measuring east-west traffic for Downtown areas near 1st Avenue between Pine Street and Pioneer Square, and Screenline 9 measuring east-west traffic near 6th Avenue between Yesler Way and Jackson Street. These decreases may be attributable to the addition of the SR 519 connection between I-5 and the Alaskan Way viaduct by 2020, which may alter traffic flow patterns measured by these screenlines.
- For the 2020 AM peak hour, probable increases in housing supply in the study area will likely result in more traffic departing Downtown. This outbound traffic will likely account for 48 percent of AM peak hour screenline volumes rather than the current 44 percent. This pattern will be most evident in the Denny Triangle area, where the two screenlines show large percentage increases in this AM peak hour outbound traffic.
- The directional split in the PM peak hour traffic will stay about the same, with outbound traffic representing 58 percent of the total screenline volumes, and inbound representing 42 percent.
- PM peak hour traffic is expected to grow at a faster rate than AM peak hour traffic. By 2020, PM peak hour traffic is projected to be over 22 percent greater than AM peak hour traffic, when summing up volumes across all screenlines.
- By 2020, four screenlines (two more than existing conditions) are anticipated to have v/c ratios of 0.80 or higher, indicating potentially congested operations:
  - Screenline 2, north of Seneca St., both directions in the PM peak hour
  - Screenline 6, east of 9th Avenue, eastbound in the PM peak hour
  - Screenline 7, east of 6th Avenue, eastbound in the PM peak hour
  - Screenline 8, north of Minor Avenue, both directions in the AM and PM peak hours.

  These results are consistent with expected traffic growth patterns and orientation of a large portion of traffic either to/from the east (e.g., Interstate 5) or to/from the north via surface streets.
- None of the screenlines are projected to exceed a v/c ratio of 1.20. At Screenline 8 east of Minor Avenue, eastbound volumes are expected to reach a v/c ratio of 1.01 in the AM peak hour and 1.11 in the PM peak hour. These ratios in excess of 1.0 indicate a relatively high level of congestion in both peak hours.

TRAFFIC CIRCULATION

As noted for Existing Conditions, traffic operating conditions were analyzed for two arterial corridors—the Denny Way corridor and the Stewart/Howell/Olive Way corridor. The SYNCHRO model assessed 38 intersections along these corridors for the 2020 AM and PM peak hours. For this analysis, the signal phasing and timing were held constant for both the existing conditions and 2020 period, to provide a consistent basis for comparing the impacts of the alternatives.

Table 48 shows projected 2020 peak hour levels of service as compared to existing levels for the identified corridors.[3] The table also identifies intersections with specific queuing problems. Figure 37 shows the results graphically for both the AM and PM peak hours.

2020 Baseline, AM Peak Hour

The analysis indicates that AM peak hour operations are expected to significantly worsen by 2020. Eleven of the 38 intersections analyzed are projected to operate at levels of service LOS E or worse, compared to only two intersections in Existing Conditions. These include two intersections each along Stewart and Howell Streets, three on Olive Way and four along Denny Way. Nine of these eleven intersection levels of service would be LOS F, and only two would be LOS E.

Although several intersections analyzed are expected to operate at LOS D or better in the AM peak hour, many of these are expected to experience queuing problems on one or more approaches such that queues will back up and affect operations at nearby intersections. Eight of the 12 intersections on Stewart Street would experience this for the westbound (inbound) direction during the AM peak hour. All 12 Denny Way intersections would experience queuing problems in the eastbound direction. These results indicate these travel directions for these two corridors in particular will experience significant congestion by 2020, even if no zoning changes occur.

Along Howell Street and Olive Way, nearly half of the intersections in the AM peak hour are also projected to experience queuing problems in the eastbound or outbound direction. This is a noticeable increase from existing conditions indicating that by 2020, outbound traffic from Downtown is expected to increase significantly in the AM peak hour.

2020 Baseline, PM Peak Hour

Similar to existing conditions, the 2020 PM peak hour traffic operating conditions are projected to be generally worse than AM peak hour conditions. The biggest change in operating conditions is projected to occur at the northeastern ends of Stewart Street, Howell Street, and Olive Way. Denny Way is expected to experience significant increases in congestion throughout the corridor, with a slightly higher predominance of congestion toward the western end. Between Dexter Avenue and Broad Street, all but two intersections are projected to operate at LOS E or F. Overall, 17 of the 38 intersections analyzed (45%), are projected to operate at LOS E or worse by the 2020 PM peak hour, up from 5 today, and 15 of those will operate at LOS F. A summarized comparison of performance is shown in Table 47.

Table 47
Performance Summary for 2020 Baseline PM Peak Hour

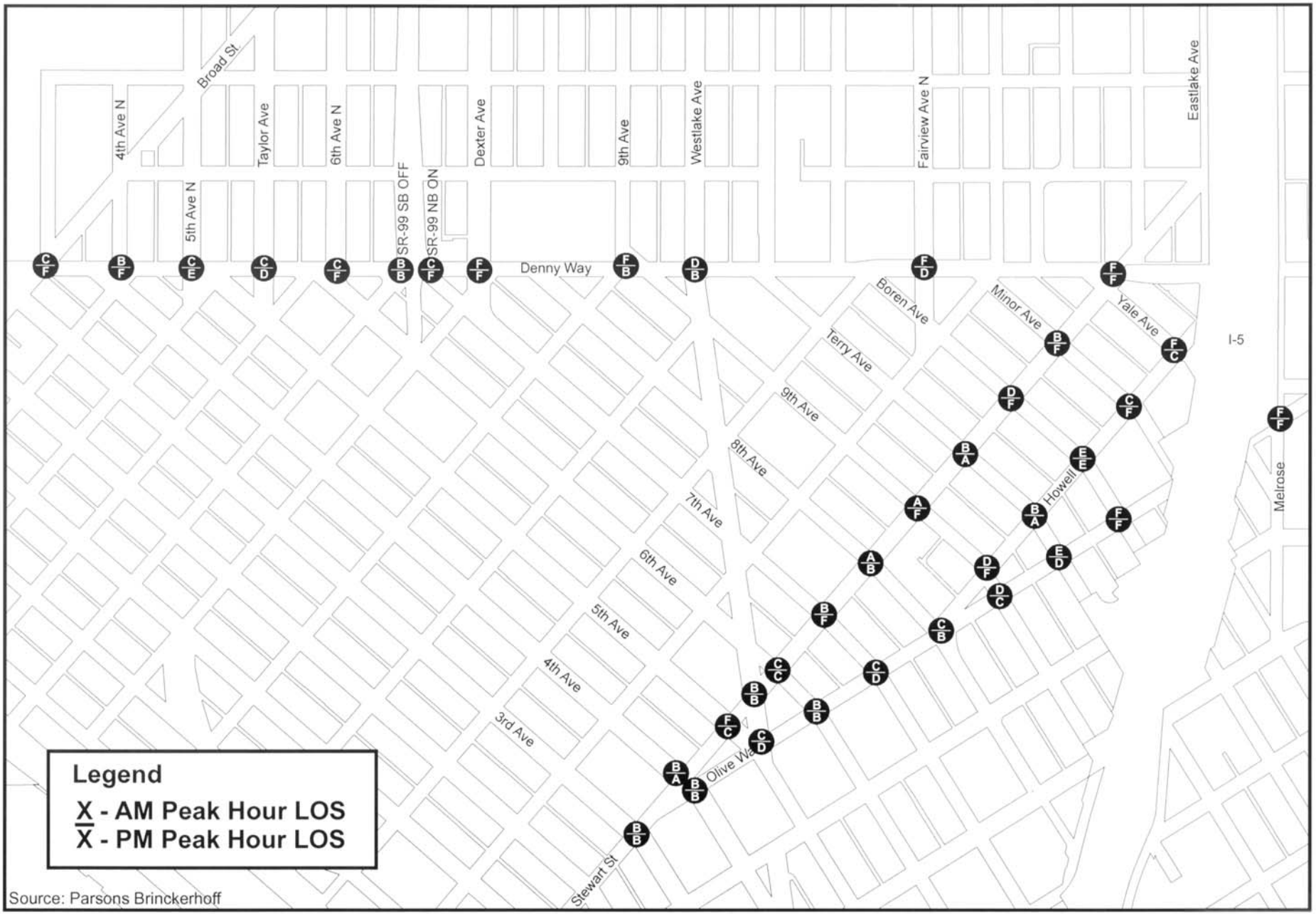
	Number of Intersections Operating at LOS E or F	
	Existing Conditions	**2020 Baseline**
Stewart Street	1 of 12	5 of 12
Olive/Howell	2 of 14	5 of 14
Denny Way	2 of 12	7 of 12

Source: SPO, Parsons Brinckerhoff, 2002

[3] Direction(s) indicated in Table 48 below are for those approaches where queues from the specified intersection are expected to back up and affect operations at adjacent intersections.

Table 48
Existing and 2020 No Action Peak Hour Intersection Levels of Service and Queuing Impacts

Intersection	AM Peak Hour				PM Peak Hour			
	Existing Conditions		2020 No-Action		Existing Conditions		2020 No-Action	
	LOS	*Queuing Impacts*	*LOS*	*Queuing Impacts*	*LOS*	*Queuing Impacts*	*LOS*	*Queuing Impacts*
Stewart & 3rd Ave	B	---	B	---	B	---	B	---
Stewart & 4th Ave	A	WB	B	NB/WB	A	---	A	NB/WB
Stewart & 5th Ave	F	SB/WB	F	SB/WB	B	---	C	SB/WB
Stewart & Westlake	B	WB	B	WB	A	---	B	---
Stewart & 6th Ave	C	WB	C	WB	B	---	C	WB
Stewart & 7th Ave	B	---	B	SB/WB	A	---	F	SB/WB
Stewart & 8th Ave	A	---	A	---	B	---	B	---
Stewart & 9th Ave	A	---	A	---	A	---	F	SB/WB
Stewart & Terry	A	WB	B	WB	A	---	A	---
Stewart & Boren	B	SB	D	SB/WB	B	SB	F	SB/WB
Stewart & Minor	B	---	B	---	D	SB/WB	F	SB/WB
Stewart & Yale	B	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Howell & Yale	C	SB/EB/WB	F	SB/EB/WB	D	SB/EB	C	SB/EB
Howell & Minor	C	WB	C	WB	F	SB	F	SB/WB
Howell & Boren	D	NB/WB	E	NB/EB/WB	D	NB/EB	E	---
Howell & Terry	A	---	B	---	A	---	A	---
Howell & 9th Ave	C	---	D	---	C	---	F	SB
Howell & 8th/Olive	B	---	C	EB	A	---	B	EB
Olive & Melrose	B	EB	F	EB/NB	C	EB	F	EB/NB
Olive & Boren	D	NB	F	EB/NB	F	EB/NB/SB	F	EB/NB/SB
Olive & Terry	A	---	E	EB	A	---	D	EB
Olive & 9th Ave	A	---	D	EB	B	---	C	EB/SB
Olive & 7th Ave	B	---	C	---	A	---	D	SB
Olive & 6th Ave	B	---	B	---	B	---	B	NB
Olive & 5th/Westlake	D	SB	C	SB	C	---	D	EB/SB
Olive & 4th Ave	B	---	B	---	B	---	B	---
Denny & Stewart	F	EB/WB/SW	F	EB/WB/SW	F	EB/SW	F	EB/WB/SW
Denny & Fairview	D	EB/WB/NB	F	EB/WB/NB	C	EB/WB/NB	D	EB/WB/NB
Denny & Westlake	A	---	D	EB	C	EB/NB	B	EB/NB
Denny & 9th Ave	A	EB/SB	F	EB/SB	B	EB/SB	B	EB/SB
Denny & Dexter	D	EB/WB	F	EB	D	EB/WB	F	EB/WB/NB
Denny & Aurora NB	B	EB/WB	C	EB/WB	C	EB/WB/NB	F	EB/WB/NB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	B	WB	C	EB/WB/NB	E	EB/WB/NB	F	EB/NB
Denny & Taylor	B	WB	C	EB	B	---	D	EB
Denny & 5th Ave	B	---	C	EB	B	---	E	EB/WB
Denny & 4th Ave	A	---	B	EB	B	---	F	EB
Denny & Broad	B	---	C	EB	B	WB	F	EB/WB/NE



Source: Parsons Brinckerhoff

Seattle Height & Density EIS

FIGURE 37
Year 2020 No Action
AM & PM Peak Hour Intersection Levels of Service

The queuing analysis for the PM peak hour indicates that by 2020, most of the corridors analyzed are expected to experience corridor-wide congestion. Eight of the 12 intersections along Stewart Street would likely experience queues in the westbound direction that would back up into adjacent intersections, compared to 2 in the existing condition. Along Denny Way, every intersection in the eastbound direction, and over half in the westbound direction, are expected to experience queuing problems. While not dramatically different from current conditions, this does indicate that congested conditions will be exacerbated in the future.

Travel Time

Table 49 shows projected 2020 average AM and PM peak hour travel time summaries for the studied corridors. The results indicate that all corridors are expected to experience significant increases in travel time by the 2020 baseline condition.

Table 49
Existing and 2020 No Action Peak Hour Corridor Travel Time Summaries

Corridor	AM Peak Hour (minutes)			PM Peak Hour (minutes)		
	Existing	2020	% Change	Existing	2020	% Change
Denny Way Eastbound	5.5	12.7	133%	5.9	19.7	232%
Denny Way Westbound	5.9	14.7	147%	6.3	10.6	68%
Olive Way Eastbound	3.8	6.6	75%	3.4	5.3	55%
Stewart Street Westbound	4.0	4.4	11%	8.5	11.9	40%

Source: Parsons Brinckerhoff, 2002
Assumptions:
* Stewart Street corridor evaluated from Yale Avenue to 3rd Avenue
* Olive Way corridor evaluated from 3rd Avenue to Boren Avenue
* Denny Corridor (both directions) evaluated from Broad Street to Stewart Street.
* Average travel speed of 20 mph is assumed from all arterial segments

TRANSIT SERVICE

Transit Operations

Assumed transit facilities in 2020 include Link Light Rail in its Locally Preferred Alternative alignment from Northgate to SeaTac. In addition, some joint bus/rail operations are projected to occur in the tunnel. Also, the presence of monorail is factored into the PSRC's mode share modeling.

North of Seneca Street Screenline. The 2020 AM peak hour conditions (baseline) would be nearly the same or slightly improved over existing conditions, meaning no adverse effects on transit operations in the Commercial Core. The PM peak hour traffic conditions are projected to worsen from a v/c ratio of 0.69 to 0.80 (northbound) and from 0.70 to 0.83 (southbound), which could mean a proportional increase in transit delay. Due to its southbound emphasis in the PM peak hour, transit service on 2nd Avenue will likely experience the greatest increase in delay. Transit traffic on 3rd and 4th Avenue will also experience increases in delay.

Stewart/Olive Corridors. By 2020, the cumulative amount of travel time spent by transit vehicles in the Stewart Street and Olive Way corridors is projected to increase by approximately 40% in the AM peak hour and 45% in the PM peak hour (see Table 50).

Table 50
Comparison of Existing and 2020 No Action
Cumulative Transit Travel Time – Olive/Stewart Corridors

Peak Hour	Total Bus-Minutes		% Change
	Existing	2020 No-Action	
AM	572	801	40%
PM	651	942	45%
Total, AM and PM	1223	1743	43%

Source: Parsons Brinckerhoff, 2002

Denny Way Screenline. Table 51 summarizes total minutes of delay incurred by buses crossing the Denny Way transit screenline in the 2020 baseline condition. Total minutes of delay are projected to increase from 29 minutes to 63 minutes in the AM peak hour, and from 40 minutes to 108 minutes in the PM peak hour. Denny Way's intersections with Dexter, Aurora, Fourth and Fifth Avenues (and Fairview Avenue in the AM peak hour) show the greatest predicted increase in transit delay.

Table 51
Comparison of Existing and 2020 No Action
Cumulative Bus Delay in Minutes Crossing Denny Way

	Bus-Minutes of Delay					
Crossing	Existing		2020 No-Action		% Change	
	AM	PM	AM	PM	AM	PM
Fourth Avenue	0.5	2.9	0.9	13.6	91%	368%
Fifth Avenue	6.0	6.1	8.8	27.4	46%	348%
Aurora Avenue	9.1	11.9	11.0	31.0	22%	161%
Dexter Avenue	6.4	11.7	15.0	26.7	134%	129%
Ninth Avenue	0.9	0.5	8.4	0.7	809%	24%
Westlake Avenue	0.6	2.1	3.5	1.6	496%	-25%
Fairview Avenue	5.7	5.2	15.0	7.4	165%	42%
Totals	29	40	63	108	115%	168%
AM and PM Totals	70 minutes		171 minutes		146%	

Source: Parsons Brinckerhoff, 2002

Transit Layover

The analysis conservatively assumes that redevelopment projects adjacent to layover locations would displace the layover spaces, as a worst-case impact. With this assumption, future development in the 2020 baseline condition may displace 10 existing and 7 potential Metro layover locations. No Community Transit layover locations would be affected. If these existing and potential layover locations are lost over time, it may be challenging to locate a sufficient number of additional replacement layover locations.

Alternative 1 – High End Height and Density Increase

Travel Characteristics

While substantial changes from existing conditions are projected for the 2020 Baseline Condition, there are relatively limited differences between Alternatives 1, 2 and 3 and the Baseline Condition (Alternative 4). Tables 52 and 53 summarize the differences between the Alternatives and the 2020 Baseline Condition for the PM peak hour at the nine screenlines, in terms of volumes, percent difference from the Baseline

Condition, and volume-to-capacity (v/c) ratio[4]. Table 52 illustrates that essentially all screenlines except Screenline 8 (East of Minor Avenue, Denny Way to Olive Way) would experience the same relative capacity conditions, as measured by v/c ratios. Given the nature of travel demand forecasting, differences of 5 percent or less are generally considered to be insignificant due to modeling accuracy limits.

Table 52
Comparison of 2020 PM Peak Hour Screenline Volumes to Baseline Condition

Screenline	2020 No Action	Alt. 1	Alt. 2	Alt. 3
	PM peak hr. total volume	Percent difference	Percent difference	Percent difference
1. S. King St.				
Northbound	2,570	0.8%	0.4%	0.0%
Southbound	2,720	1.5%	0.0%	1.5%
2. Seneca St.				
Northbound	6,220	1.1%	0.8%	0.2%
Southbound	5,450	1.3%	0.0%	0.4%
3. Blanchard St.				
Northbound	5,320	1.7%	1.1%	-0.2%
Southbound	3,970	1.0%	-0.3%	-0.5%
4. 1st Ave/Office Core				
Westbound	3,520	1.4%	0.9%	-0.3%
Eastbound	3,460	-3.2%	-2.3%	-2.3%
5. 1st Ave./Belltown				
Westbound	1,020	2.9%	4.9% (1,070)	8.8% (1,110)
Eastbound	910	0.0%	-2.2%	-3.3%
6. 9th Ave./Denny Triangle				
Westbound	3,780	4.2%	-0.5%	1.6%
Eastbound	5,830	2.4%	2.7%	2.2%
7. 6th Ave./Office Core				
Westbound	5,600	0.4%	0.2%	0.4%
Eastbound	8,970	-0.4%	-0.4%	0.0%
8. NE Denny Triangle				
Westbound	3,360	-3.6%	-3.3%	9.5% (3,680)
Eastbound	4,680	7.9% (5,050)	1.3%	0.0%
9. Yesler – Jackson				
Westbound	810	1.2%	1.2%	1.2%
Eastbound	1,100	0.0%	0.0%	-0.9%

Source: SPO, Parsons Brinckerhoff, 2002
Note: Numbers in parentheses are 2020 PM peak hour screenline traffic volumes under the alternatives.

At Screenline 8, eastbound PM peak hour traffic under Alternative 1 is projected to be approximately 8 percent greater than projected for the 2020 Baseline Condition (refer to Table 52). This additional traffic could be related to slightly greater concentration of future development in the Denny Triangle vicinity under Alternative 1 than for the No Action Alternative. With this additional traffic, the predicted v/c ratio at Screenline 8 for eastbound PM peak hour traffic would reach 1.20 by 2020, the highest v/c ratio for any alternative or screenline in this study (see Table 53). This would be right at the 1.20 threshold defined as the City's maximum arterial level of service standard[5]. This screenline covers a relatively small number of routes (Stewart Street, Howell Street, Denny Way, Olive Way) that are intensively used by commuters to enter and leave Downtown during peak hours. Other screenlines anticipated to experience v/c ratios of

[4] AM peak hour information is provided in the technical analysis prepared by Parsons Brinckerhoff (see Appendix N).
[5] Because Screenline 8 is not an official concurrency screenline, the 1.20 threshold is relevant only for general comparison purposes.

0.80 or higher for one or both travel directions include Screenlines 2, 6 and 7, in a manner similar to the Baseline Condition (see Table 53). Figures 38 and 39 illustrate the anticipated AM and PM peak hour volumes and v/c ratios across the studied screenlines.

Table 53
Comparison of 2020 Volume-to-Capacity Ratios to Baseline Condition

Screenline	2020 No Action	Alt. 1	Alt. 2	Alt. 3
	PM peak hr. v/c ratio	PM peak hr. v/c ratio	PM peak hr. v/c ratio	PM peak hr. v/c ratio
1. S. King St.				
Northbound	0.54	0.54	0.54	0.53
Southbound	0.50	0.51	0.50	0.51
2. Seneca St.				
Northbound	0.80	0.81	0.80	0.80
Southbound	0.83	0.84	0.83	0.83
3. Blanchard St.				
Northbound	0.59	0.60	0.60	0.59
Southbound	0.44	0.45	0.44	0.44
4. 1st Ave/Office Core				
Westbound	0.37	0.37	0.37	0.37
Eastbound	0.32	0.31	0.31	0.31
5. 1st Ave./Belltown				
Westbound	0.42	0.44	0.44	0.46
Eastbound	0.51	0.51	0.49	0.49
6. 9th Ave./D. Triangle				
Westbound	0.53	0.55	0.52	0.53
Eastbound	0.88	0.90	0.91	0.90
7. 6th Ave./Off. Core				
Westbound	0.58	0.59	0.58	0.59
Eastbound	0.93	0.93	0.93	0.93
8. NE Denny Triangle				
Westbound	0.93	0.90	0.90	1.02
Eastbound	1.11	1.20	1.13	1.12
9. Yesler – Jackson				
Westbound	0.27	0.27	0.27	0.27
Eastbound	0.37	0.37	0.36	0.37

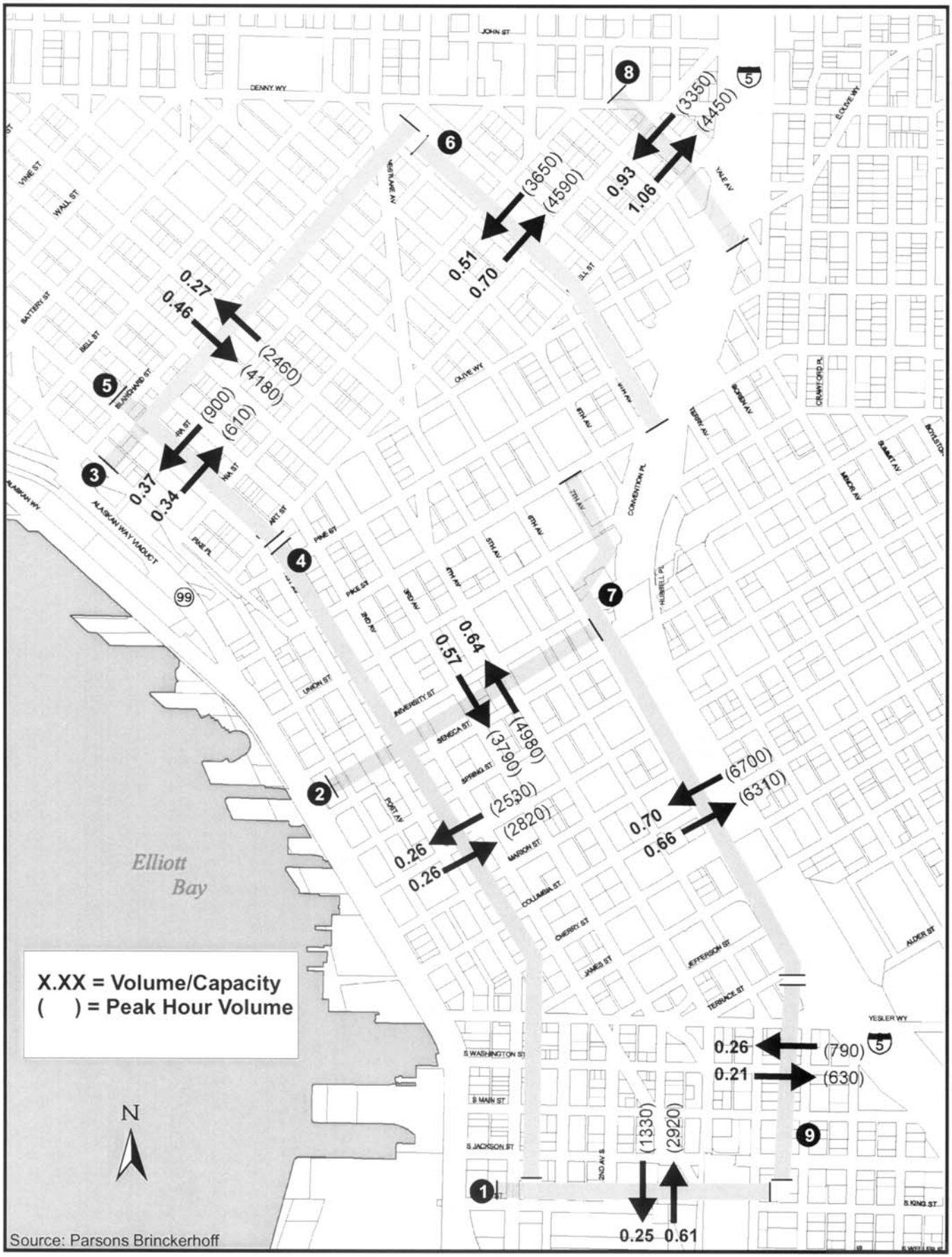
Source: SPO, Parsons Brinckerhoff, 2002

Traffic Circulation

Tables 54 and 55 show 2020 AM and PM peak hour intersection levels of service and queuing impacts for the alternatives, compared to the Baseline Condition. Figure 40 illustrates the AM and PM peak hour levels of service at intersections in the studied corridors.

AM Peak Hour

- In the studied corridors, 14 of 38 intersections are projected to experience operating conditions at LOS E or worse in 2020, 3 more than the Baseline Condition. Operational levels would decline along Stewart Street and Denny Way, but improve somewhat along Howell Street.
- Five intersections would decrease in level of service by two or more LOS levels compared to the Baseline Condition, and two would improve by that amount.
- **Queuing impacts:** generally similar to the Baseline Condition, with several noted problem areas.



Downtown Height & Density EIS

FIGURE 38
Screenline Volumes and V/C Ratios for Alternative 1
AM Peak Hour

Downtown Height & Density EIS

FIGURE 39
Screenline Volumes and V/C Ratios for Alternative 1
PM Peak Hour

Table 54
Comparison of Year 2020 AM Peak Hour Intersection LOS and Queuing Impacts

Intersection	2020 No-Action		2020 Alternative 1		2020 Alternative 2		2020 Alternative 3	
	LOS	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**
Stewart & 3rd Ave	B	---	A	---	A	---	B	---
Stewart & 4th Ave	B	NB/WB	B	NB/WB	B	NB	B	NB/WB
Stewart & 5th Ave	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Stewart & Westlake	B	WB	C	WB	B	WB	B	WB
Stewart & 6th Ave	C	WB	D	WB	D	WB	D	WB
Stewart & 7th Ave	B	SB/WB	E	SB/WB	C	WB	E	SB/WB
Stewart & 8th Ave	A	---	B	---	A	---	B	WB
Stewart & 9th Ave	A	---	A	---	A	---	B	---
Stewart & Terry	B	WB	B	WB	B	WB	B	WB
Stewart & Boren	D	SB/WB	F	SB/WB	D	SB/WB	E	SB/WB
Stewart & Minor	B	---	B	---	B	---	B	WB
Howell & Yale	F	SB/EB/WB	C	SB/WB	D	SB/WB	C	SB/WB
Howell & Minor	C	WB	C	WB	D	WB	B	WB
Howell & Boren	E	NB/EB/WB	D	NB/EB/WB	D	NB/EB/WB	F	NB/EB/WB
Howell & Terry	B	---	B	---	B	---	D	---
Howell & 9th Ave	D	---	C	---	D	---	C	---
Howell & 8th/Olive	C	EB	D	EB	B	---	A	---
Olive & Melrose	F	EB/NB	F	EB/NB	B	EB	F	EB/NB
Olive & Boren	F	EB/NB	E	EB/NB	C	EB	C	EB/NB
Olive & Terry	E	EB	E	EB	F	EB	C	EB
Olive & 9th Ave	D	EB	F	EB	C	EB	B	---
Olive & 7th Ave	C	---	C	---	B	---	B	---
Olive & 6th Ave	B	---	B	---	D	NB	B	---
Olive & 5th/Westlake	C	SB	C	SB	C	SB	D	SB
Olive & 4th Ave	B	---	B	---	B	---	B	---
Denny & Stewart	F	EB/WB/SW	F	EB/WB/SW	F	EB/WB/SW	F	EB/WB/SW
Denny & Fairview	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB
Denny & Westlake	D	EB	B	EB	B	---	B	EB
Denny & 9th Ave	F	EB/SB	F	EB/SB	B	SB	B	EB/SB
Denny & Dexter	F	EB	F	EB	F	EB/WB	F	EB
Denny & Aurora NB	C	EB/WB	C	EB/WB	E	EB/WB	C	EB/WB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	C	EB/WB/NB	D	EB/WB/NB	D	EB/WB/NB	B	EB/NB
Denny & Taylor	C	EB	F	EB	F	EB	B	---
Denny & 5th Ave	C	EB	C	EB	D	EB	A	EB
Denny & 4th Ave	B	EB	E	EB	D	EB	B	EB
Denny & Broad	C	EB	D	EB/WB	E	EB/WB	C	WB

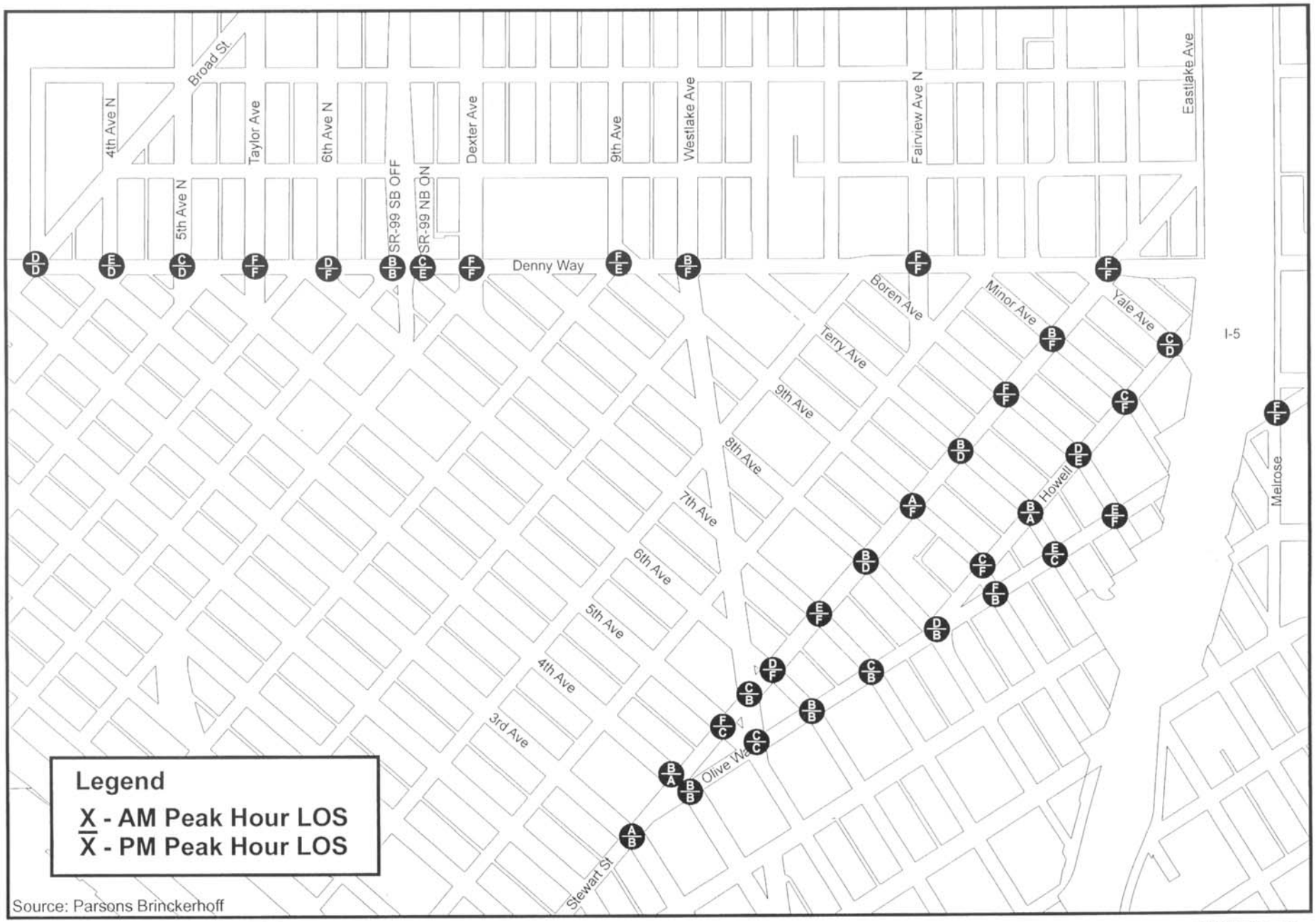
Source: Parsons Brinckerhoff, 2002
* Direction(s) indicated are for those approaches where queues from the specified intersection are expected to back up and affect operations at adjacent intersections.

Table 55
Comparison of Year 2020 PM Peak Hour Intersection LOS and Queuing Impacts

Intersection	2020 No-Action		2020 Alternative 1		2020 Alternative 2		2020 Alternative 3	
	LOS	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**
Stewart & 3rd Ave	B	---	B	---	B	---	B	---
Stewart & 4th Ave	A	NB/WB	A	NB	A	NB/WB	A	NB/WB
Stewart & 5th Ave	C	SB/WB	C	SB/WB	C	SB/WB	C	SB/WB
Stewart & Westlake	B	---	B	---	B	---	B	---
Stewart & 6th Ave	C	WB	F	WB	D	WB	C	WB
Stewart & 7th Ave	F	SB/WB	F	SB/WB	E	SB	F	SB/WB
Stewart & 8th Ave	B	---	D	WB	B	---	B	---
Stewart & 9th Ave	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Stewart & Terry	A	---	D	WB	B	---	B	---
Stewart & Boren	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Stewart & Minor	F	SB/WB	F	---	E	SB/WB	F	SB/WB
Stewart & Yale	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Howell & Yale	C	SB/EB	D	SB/EB	D	SB/EB	C	SB/EB
Howell & Minor	F	SB/WB	F	SB/WB	F	SB/WB	F	NB/SB/WB
Howell & Boren	E	---	E	NB/SB/EB	E	NB/SB/EB	E	NB/SB/EB
Howell & Terry	A	---	A	---	A	---	A	---
Howell & 9th Ave	F	SB	F	---	F	SB	F	SB
Howell & 8th/Olive	B	EB	B	---	B	---	D	EB/NB
Olive & Melrose	F	EB/NB	F	EB/NB	F	EB/NB	F	EB/NB
Olive & Boren	F	EB/NB/SB	F	EB/NB/SB	F	EB/NB/SB	F	EB/NB/SB
Olive & Terry	D	EB	C	EB	C	EB	E	EB
Olive & 9th Ave	C	EB/SB	B	EB	B	---	D	EB/SB
Olive & 7th Ave	D	SB	B	---	C	SB	F	EB/SB
Olive & 6th Ave	B	NB	B	NB	B	NB	F	EB/NB
Olive & 5th/Westlake	D	EB/SB	C	SB	C	SB	C	SB
Olive & 4th Ave	B	---	B	---	B	---	B	---
Denny & Stewart	F	EB/WB/SW	F	EB/WB/SW	F	EB/SW	F	EB/WB/SW
Denny & Fairview	D	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB
Denny & Westlake	B	EB/NB	F	EB/NB	F	EB/NB	F	EB/NB
Denny & 9th Ave	B	EB/SB	E	EB/SB	C	EB/SB	D	EB/SB
Denny & Dexter	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB	F	EB/NB
Denny & Aurora NB	F	EB/WB/NB	E	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	F	EB/NB	F	EB/NB	F	EB/NB	F	EB/NB
Denny & Taylor	D	EB	F	EB	D	EB	D	EB
Denny & 5th Ave	E	EB/WB	D	EB/NB	E	EB/NB	E	EB/WB/NB
Denny & 4th Ave	F	EB	D	EB	F	EB	F	EB
Denny & Broad	F	EB/WB/NE	D	EB/WB	F	EB/WB/NE	F	EB/WB/NE

Source: Parsons Brinckerhoff, 2002

* Direction(s) indicated are for those approaches where queues from the specified intersection are expected to back up and affect operations at adjacent intersections.



Source: Parsons Brinckerhoff

Seattle Height & Density EIS

FIGURE 40

Year 2020 Peak Hour Intersection LOS for Alternative 1

PM Peak Hour

- In the studied corridors, 19 of 38 intersections are projected to experience operating conditions at LOS E or worse in 2020, 2 more than the Baseline Condition. Operational levels would decline along Stewart Street and Denny Way.
- Seven intersections would decrease in level of service by two or more LOS levels compared to the Baseline Condition.
- **Queuing impacts:** generally similar to the Baseline Condition, with several noted problem areas. Additional queuing impacts predicted at two locations westbound on Stewart Street (at 8th and at Terry), and in multiple directions at Boren Avenue/Howell Street. Queuing impacts appear to lessen on Olive Way eastbound, compared to the Baseline Condition.

Table 56 further summarizes intersection performance of the alternatives in the PM peak hour.

Table 56
Intersection Performance Summary for 2020 PM Peak Hour (Without Mitigation)

	Number of Intersections Operating at LOS E or F				
	Existing Conditions	2020 Baseline	Alt. 1	Alt. 2	Alt. 3
Stewart St.	1 of 12	5 of 12	6 of 12	5 of 12	5 of 12
Olive/Howell	2 of 14	5 of 14	5 of 14	5 of 14	8 of 14
Denny Way	2 of 12	7 of 12	8 of 12	9 of 12	9 of 12
Totals	5 of 38	17 of 38	19 of 38	19 of 38	22 of 38

Source: SPO, 2002

Travel Time

Table 57 summarizes the PM peak hour corridor travel times by alternative (see Table 22 in Appendix N for AM peak hour travel times).

Table 57
Comparison of Corridor Travel Time Summaries by Alternative—PM Peak Hour

	No Action	Alternative 1		Alternative 2		Alternative 3	
	Time (minutes)	Time (minutes)	% Change from No Action	Time (minutes)	% Change from No Action	Time (minutes)	% Change from No Action
Denny Way Eastbound	19.7	16.6	-16%	14.4	-27%	24.5	24%
Denny Way Westbound	10.6	10.4	-2%	10.1	-5%	10.3	-3%
Olive Way Eastbound	5.3	4.0	-24%	3.5	-34%	6.4	23%
Stewart Street Westbound	11.9	17.8	50%	11.3	-5%	15.0	26%

Source: Parsons Brinckerhoff, 2002

Transit Service

North of Seneca Street Screenline. For the AM and PM peak hour, Alternative 1's v/c ratios are similar to the Baseline Condition, indicating no substantial differences in transit service impacts.

Olive/Stewart Corridors. Under Alternative 1, the cumulative amount of travel time spent by transit vehicles in the Olive and Stewart corridors would increase by approximately 10% in the AM peak hour and 24% in the PM peak hour, compared to the Baseline Condition. The sum of delay in both peak hours

(300 additional minutes) would represent an approximately 17% increase in transit travel time compared to the Baseline Condition.

Denny Way Screenline. Under Alternative 1, the cumulative additional delay for transit routes crossing the Denny Way screenline would be relatively similar to the Baseline Condition for both AM and PM peak hours, summing to an overall 2% improvement under Alternative 1. Aurora, Dexter, Fairview and 5th Avenues would experience relatively high amounts of delay.

Transit Layover

Alternative 1 would concentrate the projected future employment and housing growth into fewer overall properties than the other alternatives. Alternative 4, the Baseline Condition, would result in the greatest spread of future development across more properties than the other alternatives. Overall, with only 5 existing layover locations potentially displaced (compared to 10 in the 2020 Baseline), Alternative 1's impact on transit layover locations can be categorized as slightly less than the Baseline Condition.

Alternative 2 – Concentrated Office Core

Travel Characteristics

Table 53 earlier in this section shows the difference between Alternative 2 and the 2020 Baseline Condition for the PM peak hour at the nine screenlines. At Screenline 8, eastbound PM peak hour traffic under Alternative 2 is predicted to be approximately 1.3% greater than predicted for the Baseline Condition. This additional traffic could be related to slightly greater concentration of future development in the Denny Triangle vicinity under Alternative 2 than for the No Action Alternative. With this additional traffic, the predicted v/c ratio at Screenline 8 for eastbound traffic would reach 1.13, nearly the same as the Baseline Condition and less than Alternative 1 (refer to Table 53). This would be less than the 1.20 threshold defined as the City's maximum arterial level of service standard. Other screenlines anticipated to experience v/c ratios of 0.80 or higher for one or both travel directions include Screenlines 2, 6 and 7, in a manner similar to the Baseline Condition (refer to Table 53). Figures 41 and 42 illustrate the anticipated AM and PM peak hour volumes and v/c ratios across the studied screenlines.

Traffic Circulation

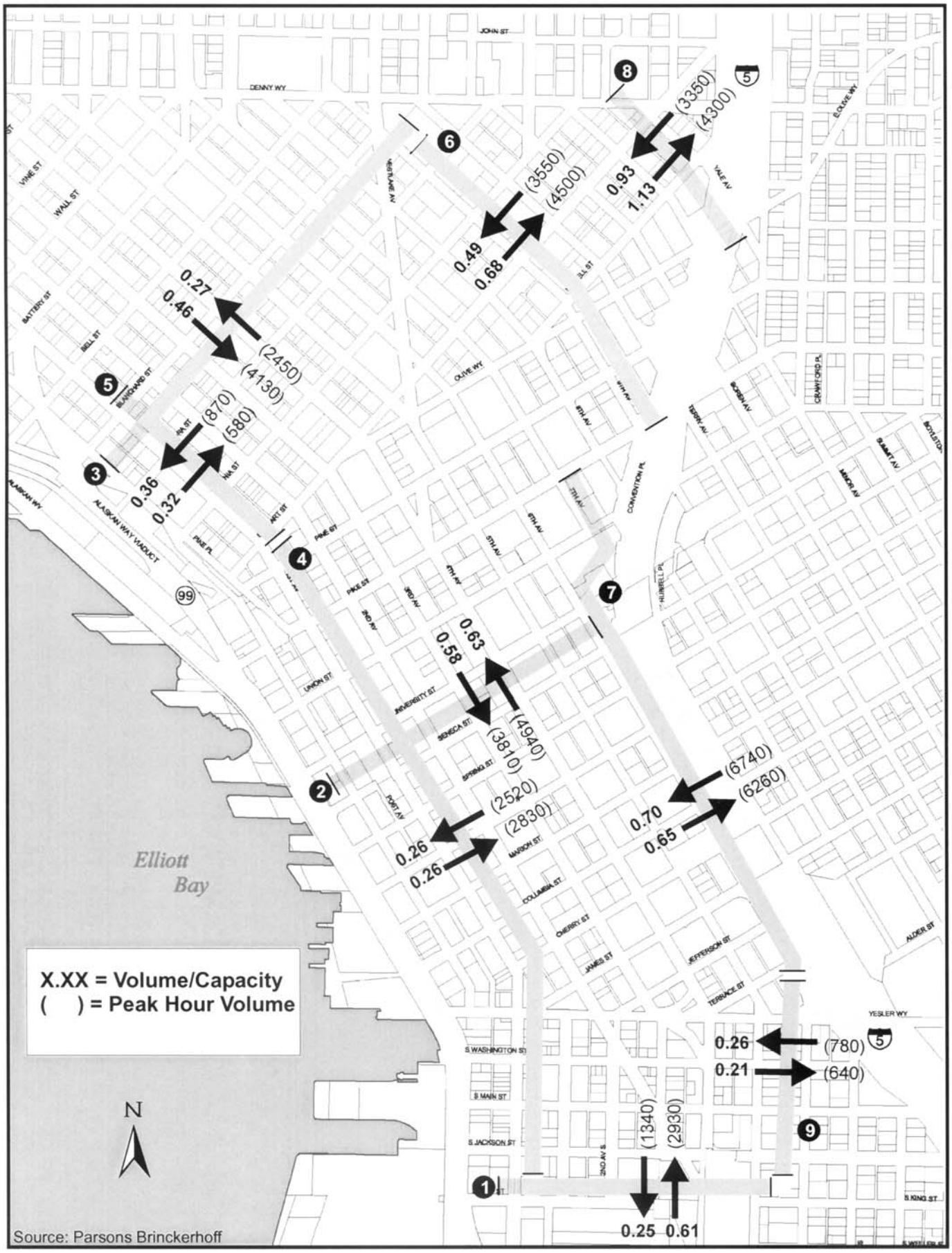
Tables 54 and 55 above show 2020 AM and PM peak hour intersection levels of service and queuing impacts for the alternatives, compared to the Baseline Condition. Figure 43 illustrates the AM and PM peak hour levels of service at intersections in the studied corridors for Alternative 2.

AM Peak Hour

- In the studied corridors, 9 of 38 intersections are projected to experience operating conditions at LOS E or worse in 2020, 2 less than the Baseline Condition. Operational levels would decline along Denny Way, but improve along Olive Way and Howell Street.
- Five intersections would decrease in level of service by two or more LOS levels compared to the Baseline Condition, and five would improve by that amount. Four of these declining intersections would be along Denny Way.
- **Queuing impacts:** Queuing impacts would be somewhat less than for the 2020 Baseline Condition, with some improvement along Stewart, Howell, Olive Way, and eastbound Denny Way (refer to Table 54). Some degradation would occur for westbound Denny Way.

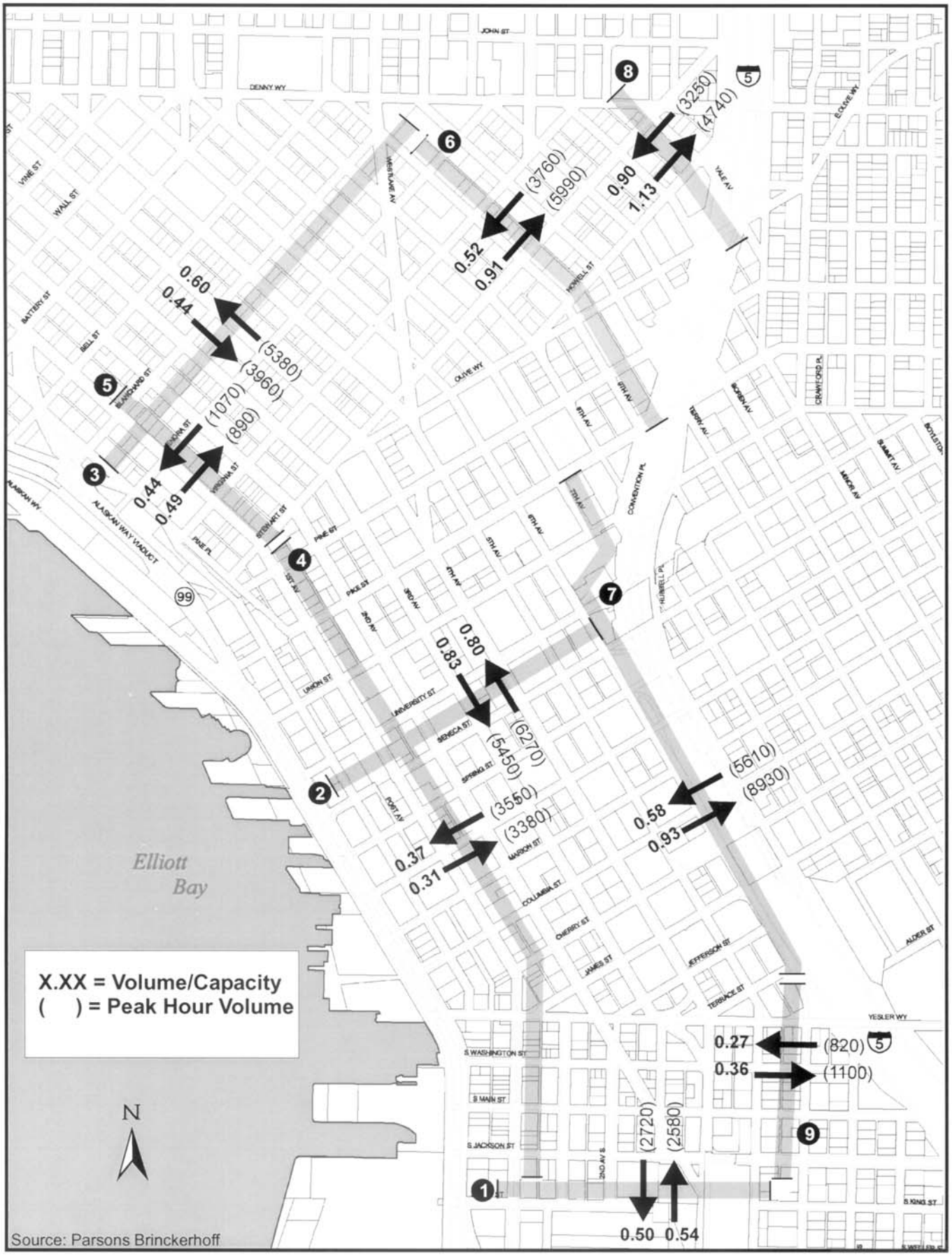
PM Peak Hour

- In the studied corridors, 19 of 38 intersections are projected to experience operating conditions at LOS E or worse in 2020, 2 more than the Baseline Condition. Operational levels would decline along Denny Way and Stewart Street.



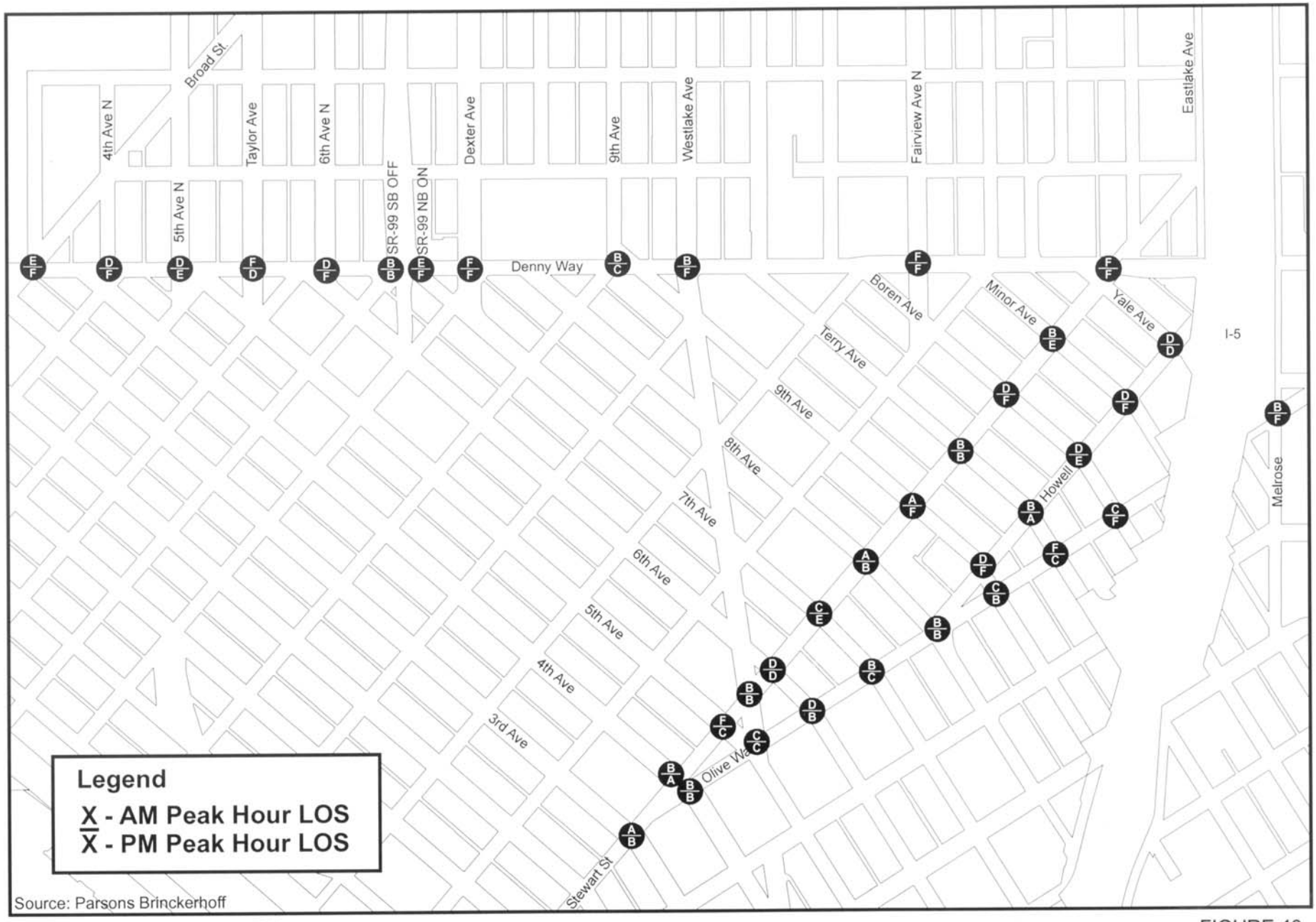
Downtown Height & Density EIS

FIGURE 41
Screenline Volumes and V/C Ratios for Alternative 2
AM Peak Hour



Downtown Height & Density EIS

FIGURE 42
Screenline Volumes and V/C Ratios for Alternative 2
PM Peak Hour



Source: Parsons Brinckerhoff

Seattle Height & Density EIS

FIGURE 43

Year 2020 Peak Hour Intersection LOS for Alternative 2

- Two intersections would worsen in level of service by two or more LOS levels compared to the Baseline Condition.
- **Queuing impacts:** generally similar to the Baseline Condition, with several noted problem areas (refer to Table 55). There would be fewer queuing impacts on Olive Way than the Baseline Condition or Alternative 1.

Travel Time

Refer to Table 57 earlier in this section for a comparison of corridor travel times.

Transit Service

North of Seneca Street Screenline. For the AM and PM peak hour, Alternative 2's v/c ratios are similar to the Baseline Condition, indicating no substantial differences in transit service impacts.

Olive/Stewart Corridors. Under Alternative 2, the cumulative amount of travel time spent by transit vehicles in the Olive and Stewart corridors would improve by approximately 1% in the AM peak hour and 15% in the PM peak hour, compared to the Baseline Condition. The sum of delay in both peak hours (149 fewer minutes) would represent an approximately 9% improvement in transit travel time compared to the Baseline Condition.

Denny Way Screenline. Transit delay for routes across the Denny Way Screenline would be notably greater than the Baseline Condition for both AM and PM peak hours, summing to an overall 21% greater level of delay under Alternative 2. Aurora, Dexter, Fairview and 5th Avenues would experience relatively high amounts of delay.

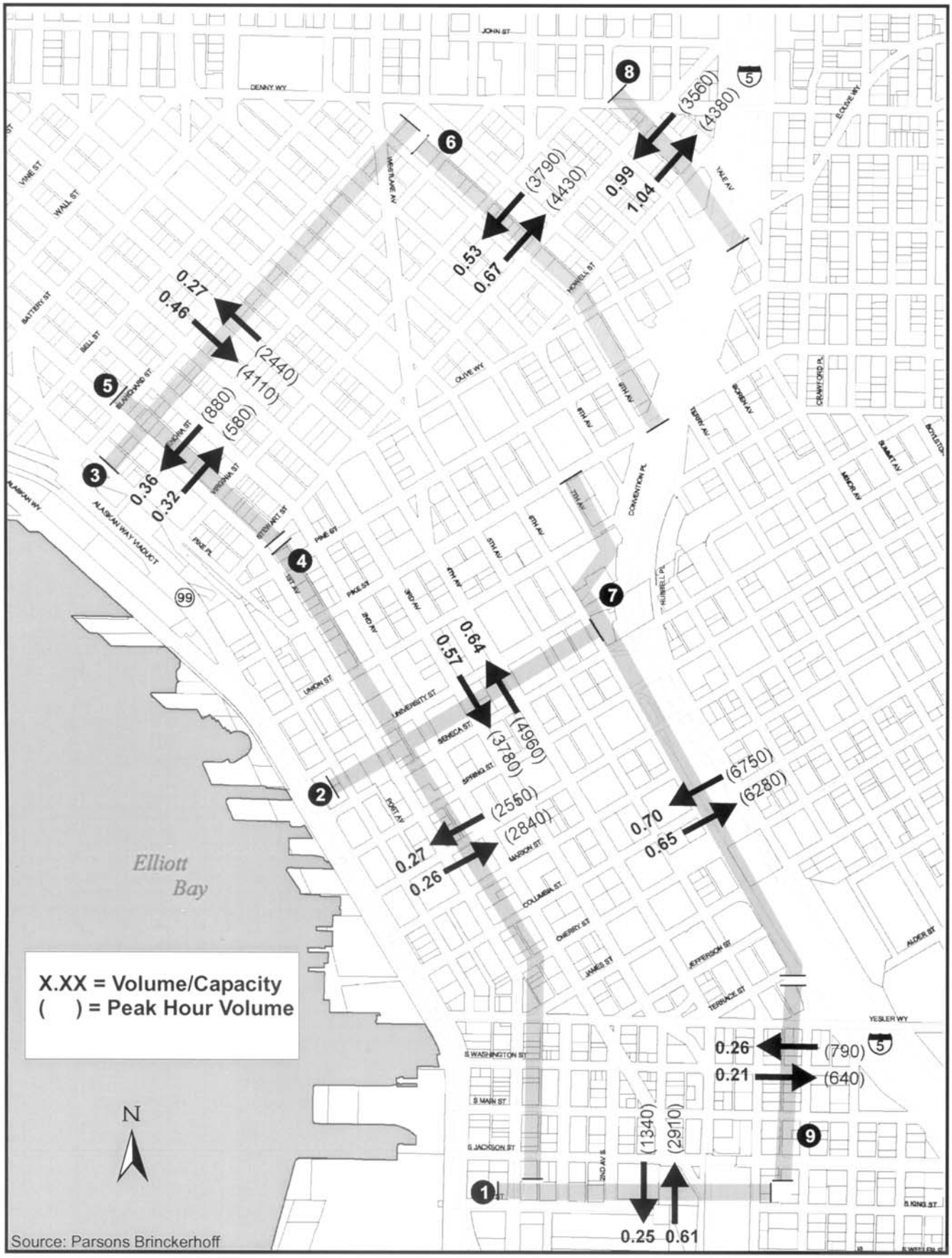
Transit Layover

Alternative 2 would concentrate the projected future employment and housing growth into fewer overall properties than Alternatives 3 or 4. Alternative 4, the Baseline Condition, would result in the greatest spread of future development across more properties than the other alternatives. Overall, Alternative 2's impact on transit layover locations can be categorized as slightly less than the Baseline Condition.

Alternative 3 – Residential Emphasis

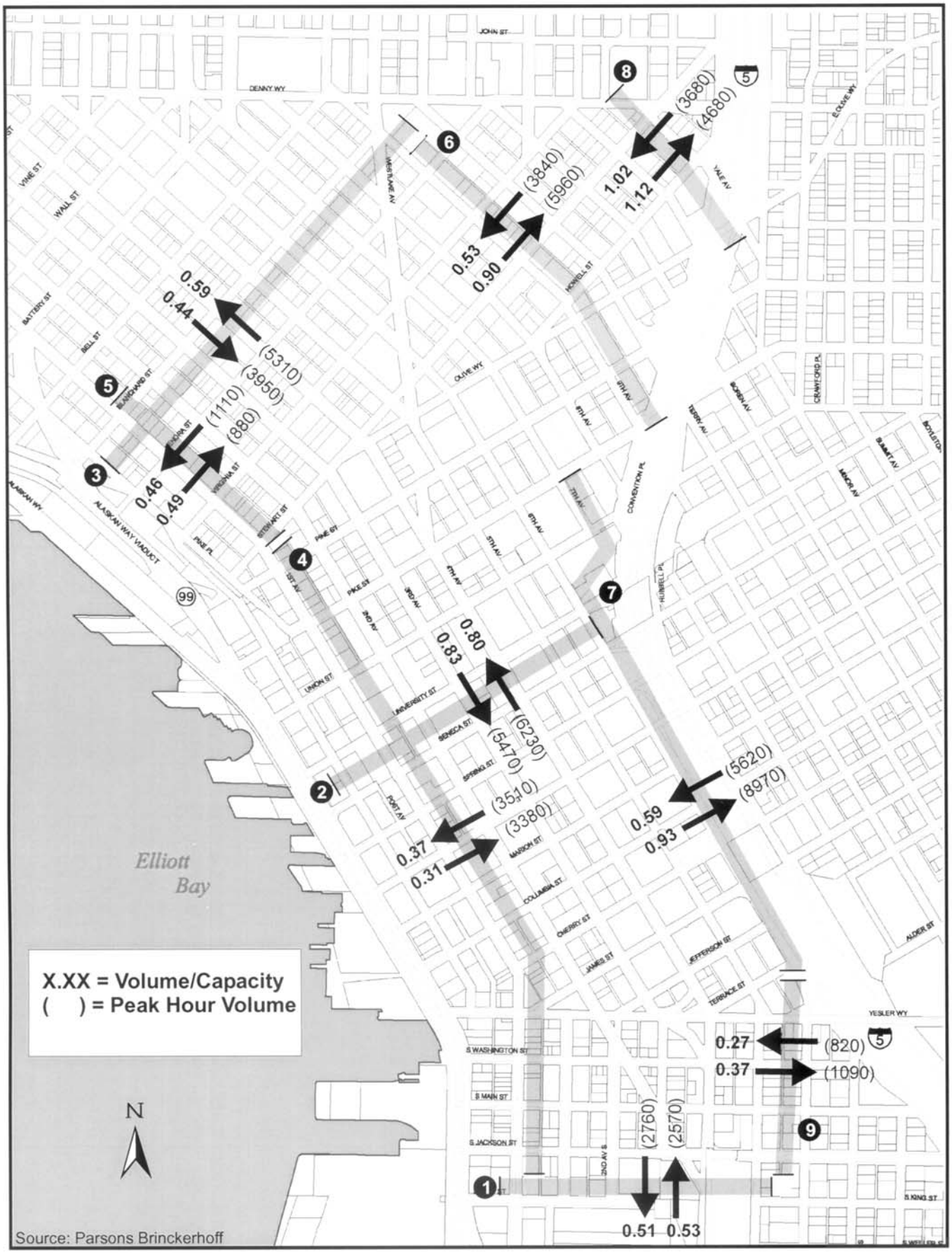
Travel Characteristics

Table 53 earlier in this section shows the difference between Alternative 3 and the 2020 Baseline Condition for the PM peak hour at the nine screenlines, in terms of volumes, percent difference from the Baseline Condition, and volume-to-capacity (v/c) ratio. At Screenline 8, westbound PM peak hour traffic under Alternative 3 is predicted to be approximately 9.5% greater than predicted for the Baseline Condition. This is probably due to the higher amount of residential use in the Denny Triangle vicinity under Alternative 3. With this additional traffic, the predicted v/c ratio at Screenline 8 for westbound traffic would reach 1.02 (refer to Table 53). This would be approximately 10% greater than the westbound v/c ratio for the other alternatives in this location. Other screenlines anticipated to experience v/c ratios of 0.80 or higher for one or both travel directions include Screenlines 2, 6 and 7, in a manner similar to the Baseline Condition (refer to Table 53). Another finding particular to Alternative 3 is a projected 8.8% increase over the Baseline Condition in westbound PM peak hour traffic at Screenline 5 (just east of 1st Avenue in Belltown). This might relate to traffic generated by projected employment and residential development in the 1st Avenue/Western Avenue and Belltown vicinities. Figures 44 and 45 illustrate the anticipated AM and PM peak hour volumes and v/c ratios across the studied screenlines.



Downtown Height & Density EIS

FIGURE 44
Screenline Volumes and V/C Ratios for Alternative 3
AM Peak Hour



Source: Parsons Brinckerhoff

Downtown Height & Density EIS

FIGURE 45
Screenline Volumes and V/C Ratios for Alternative 3
PM Peak Hour

Traffic Circulation

Tables 54 and 55 earlier in this section show 2020 AM and PM peak hour intersection levels of service and queuing impacts for the alternatives, compared to the Baseline Condition. Figure 46 illustrates the AM and PM peak hour levels of service at intersections in the studied corridors.

AM Peak Hour

- In the studied corridors, 9 of 38 intersections are projected to experience operating conditions at LOS E or worse in 2020, two fewer than the Baseline Condition. Operational levels would decline along Stewart Street, but improve somewhat along Denny Way, Olive Way and Howell Street compared to the Baseline Condition.
- Two intersections would decrease in level of service by two or more LOS levels compared to the Baseline Condition, and eight intersections would improve by that amount.
- **Queuing impacts:** generally similar to the Baseline Condition, with several noted problem areas (refer to Table 54). However, conditions would be slightly worse along Stewart Street and improve somewhat along Denny Way, Olive Way and Howell Street.

PM Peak Hour

- In the studied corridors, 22 of 38 intersections are projected to experience operating conditions at LOS E or worse in 2020, 5 more than the Baseline Condition. Operational levels would decline along Olive Way and Denny Way.
- Six intersections would decrease in level of service by two or more LOS levels compared to the Baseline Condition, and none would improve by that amount.
- **Queuing impacts:** generally similar to the Baseline Condition, with several noted problem areas (refer to Table 55). Queuing impacts appear to slightly increase along Stewart Street, and lessen on Olive Way, Howell Street and Denny Way compared to the Baseline Condition.

Travel Time

Refer to Table 57 earlier in this section for a comparison of corridor travel times.

Transit Service

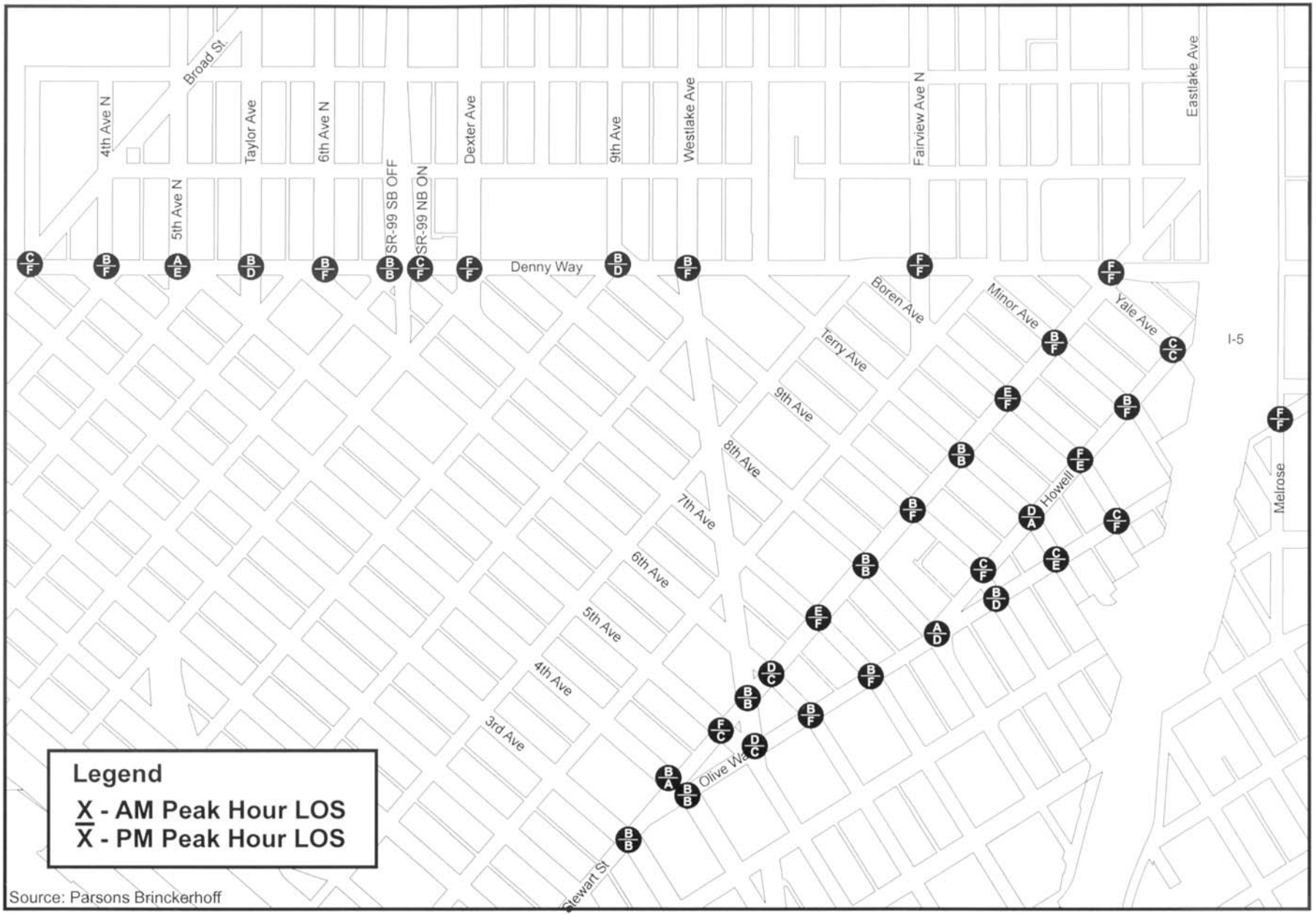
North of Seneca Street Screenline. For the AM and PM peak hour, Alternative 3's v/c ratios are similar to the Baseline Condition, indicating no substantial differences in transit service impacts.

Olive/Stewart Corridors. Under Alternative 3, the cumulative amount of travel time spent by transit vehicles in the Olive and Stewart corridors would decrease by approximately 4% in the AM peak hour but increase by 25% in the PM peak hour, compared to the Baseline Condition. The sum of delay in both peak hours (204 additional minutes) would represent an approximately 12% increase in transit travel time compared to the Baseline Condition.

Denny Way Screenline. Total cumulative transit delay for routes across the Denny Way Screenline would be nearly the same as the Baseline Condition for both AM and PM peak hours. An 18-minute (28%) improvement in transit delay for the AM peak hour would be offset by a 20-minute (18%) increase in transit delay during the PM peak hour. Aurora, Dexter, Fairview and 5th Avenues would experience relatively high amounts of delay.

Transit Layover

Alternative 3 would spread the projected future employment and housing growth over more properties than Alternatives 1 or 2. Alternative 4, the Baseline Condition, would result in the greatest spread of future development across more properties than the other alternatives. Given that Alternative 3 would potentially displace the same number of existing transit layover locations, it can be categorized as having impacts similar to the Baseline Condition.



Source: Parsons Brinckerhoff

Seattle Height & Density EIS

FIGURE 46
Year 2020 Peak Hour Intersection LOS for Alternative 3

Relationship to Transportation Plans and Policies

All of the alternatives studied in this EIS are generally consistent with the objectives of regional and local transportation-related plans and policies, although they are neutral with respect to certain topics such as pedestrian and bicycle travel modes. The concept of accommodating additional employment and residential growth within the Downtown Urban Center (the largest urban center in the region) is generally consistent with growth management objectives. Such a pattern should encourage greater transit use and more efficient investments in transportation improvements, compared to more typical suburbanized growth patterns. With future growth under any alternative, long-term transportation planning needs to promote improvements that will maintain the overall functionality of the system. See Appendix P for description of relevant plans and policies and additional discussion of the relationship of the alternatives.

MITIGATION STRATEGIES

Proposed Mitigation Strategies

With or without zone changes, the study area is likely to experience adverse impacts to travel conditions by 2020 with projected increases in levels of congestion and delay for all vehicles using Downtown streets, compared to today. For most studied locations, the projected traffic volumes for the three land use alternatives would be within 5% percent of the 2020 Baseline Condition. The biggest exception is in the northeast corner of the Denny Triangle (screenline #8) under Alternative 1, which would generate approximately 8% more traffic in the PM peak hour (peak direction) than the 2020 Baseline Condition. Data from other studied screenlines (#2, 6 and 7) indicate that PM peak hour traffic in 2020 will use a large portion of the available road capacity in the Downtown Commercial Core and Denny Triangle.

In order to alleviate future adverse impacts to traffic conditions as identified in this study, a combination of mitigation strategies should be implemented over time. The mix of mitigation strategies should be flexible and responsive to the magnitude and timing of significant adverse impacts experienced (or likely to be experienced) in the future. Because this is a programmatic EIS, the mitigation strategies are discussed at a somewhat generalized level of detail.

Demand Reduction Strategies

TRANSPORTATION DEMAND MANAGEMENT STRATEGIES

Over the past several years, transportation demand management (TDM) strategies have helped reduce the percentage of workers driving alone to Downtown. King County and other government agencies continue to enhance TDM strategies and programs over time. King County's Downtown Seattle Access Project is a federally funded demonstration project that seeks to reduce the single-occupant vehicle (SOV) parking supply and promote alternative transportation modes.

Continuing and strengthening the use of TDM strategies is proposed as a primary mitigation strategy to address projected significant adverse impacts.

- The current method of requiring transportation management plans (TMPs) for new development should be continued and improved as possible.
- The City should seek to include the most advanced and effective TDM strategies in TMPs for new developments.
- The City and other public agencies should continue to promote (and require as possible) greater implementation of TDM strategies, coordinated through worksites. The following TDM strategies should be promoted:
    - Discounted transit passes (e.g., Flex Pass)

- Promotion of other alternative modes (walking, biking)
- Increased telecommuting
- Business use of vans
- Carsharing
- Preferential parking for carpools/vanpools
- Guaranteed ride home
- Enhanced computerized ridematching database and mapping services
- Parking cashout (discontinuing parking subsidies and providing incentives for alternative modes)
- Enhanced real-time transit information via Internet and on-street kiosks.

- **Residential-oriented TDM programs.** The City should pursue the implementation of residential-oriented TDM programs Downtown to reduce vehicle trip generation by encouraging alternatives to automobile ownership. These programs should explore options such as FlexCar and bus pass incentives.
- **Transportation Management Association (TMA).** The City should promote formation of a TMA by Downtown stakeholders to aid in future TDM planning activities.

REDUCE TRIP GENERATION THROUGH AREA-SPECIFIC REZONES.

The City could pursue area-specific rezones that would govern the size and type of development, and its associated potential to generate trips in particularly congested areas. For example, future development of residential uses might generate fewer overall vehicle trips than office development on the same properties. Specific zoning could be targeted to certain locations where high traffic volumes might otherwise generate significant adverse impacts on traffic operations.

Mitigation Funding Strategies

CREATE A TRANSPORTATION MITIGATION PROGRAM FOR DOWNTOWN OR PORTIONS OF DOWNTOWN.

The City should develop a comprehensive approach to defining transportation mitigation requirements for projects in Downtown or portions of Downtown. The City is studying such an approach in analyses for the University District and South Lake Union neighborhoods. A transportation mitigation program could include defining a set of improvements to address significant adverse impacts, and a mechanism by which new development and redevelopment would contribute a fair share toward transportation system improvements. These improvements could address impacts to all mode choices, including roads, transit facilities, bicycle, pedestrian and ride-sharing programs. A transportation mitigation program could provide more certainty and clarity for Downtown property owners and developers, and greater certainty that significant transportation impacts would be remedied over the long term.

Mobility Strategies

A combination of strategies should be pursued to improve overall mobility of people and vehicles in the study area over the long term. The following discussion provides several possible options for mitigation strategies that could be pursued at the discretion of the decisionmakers.

DEFINE PHYSICAL IMPROVEMENT OPTIONS THAT SHOULD BE PLANNED AND IMPLEMENTED TO ENHANCE THE CAPACITY OF THE TRANSPORTATION NETWORK.

A comprehensive set of physical improvement options or specific improvement projects could be identified, and related to a transportation mitigation program. This could include previously-identified capital improvement projects, new capital improvements and/or changes (such as lane restriping or designation changes) that would make better use of existing rights-of-way. It could also include projects needing additional right-of-way, such as adding travel lanes or turn lanes to streets, and/or

pedestrian/bicycle-oriented improvements, transit facilities, and improvements such as grade-separation of selected intersections. Lane modifications could also include changes to better accommodate transit vehicles and reduce transit delay. The following improvement strategies are suggested as options by the transportation consultant:

Options for Stewart Street

- *Restripe Stewart Street between Yale and Sixth Avenue to allow for four 12-foot travel lanes, with no on-street parking during the AM or PM peak periods; or,*
- *Restripe Stewart Street between Yale and Sixth Avenue to allow for four ten-foot travel lanes and (along most segments) an eight-foot parking lane; and/or,*
- *Restripe Stewart Street to accommodate a right-side peak-period transit-only lane.*
- *Construct a grade-separated intersection of Stewart Street with Denny Way.*

  Grade-separating this intersection could provide significant relief to both the Denny Way and Stewart Street corridors. Before serious consideration is given to this measure, a more thorough analysis of its impacts, constructibility and costs would need to be undertaken.
- *Stewart Street configuration adjustments to discourage diversion of I-5 traffic.*

  It has been observed that a significant volume of traffic in the AM peak period exits the express lanes southbound onto Stewart Street and re-enters I-5 southbound at Yale Avenue in order to exit at later Downtown exits or continue south on the mainline. Modifications to the street system to discourage this movement could provide benefits to Stewart Street traffic operations in the AM peak hour. One possible reconfiguration would incorporate a left-turn only lane from Stewart Street onto Denny Way, to alter lane choices made by drivers seeking to turn left from Stewart Street to Yale Avenue.

Options for Olive Way and Howell Street

- *Restripe Olive Way between Fourth and Eighth Avenue to allow for four travel lanes during both the AM and PM peak periods.*
- *Restripe Olive Way to accommodate a right-side peak-period transit-only lane.*
- *Convert westbound contra-flow lane on Howell Street to eastbound direction.*

Options for Denny Way

- *Construct a grade-separated intersection of Stewart Street with Denny Way.*

  Same as discussed above.
- *Locate transit queue jumps at intersections with significant queues.*

  Under all of the alternatives, Fairview Avenue North would experience the longest queues and would likely benefit the most from a signal queue jump for transit vehicles. Other streets crossing Denny Way with significant delays and transit volumes that could also benefit from transit signal queue jumps include Fifth Avenue North, the Aurora Avenue North ramps, and Dexter Avenue North.
- *Potential benefit from restoring street grid over Aurora Avenue north of Denny Way.*

  This type of improvement is being considered as part of the Alaskan Way Viaduct Project. Reconnection of several east/west arterial streets currently severed by Aurora Avenue north of Denny Way would allow for more east/west traffic capacity, and potentially reduce the amount of traffic using Denny Way (particularly in the western portion of the corridor). Although assessment of these impacts to Denny Way is beyond the scope of this study, separate studies analyzing the overall impacts of these improvements are currently underway.

CURB LANE MANAGEMENT

- Truck loading and passenger loading in curb lanes can significantly affect capacity, as can driveway access points. Controls (development standards or conditions) could be placed on future development to require them to locate loading zones in alleys or on side streets, and locate access drives (preferably right-in and right-out only) on side streets rather than key arterials.
- Where loading zones and passenger pick-up/drop-off zones already exist, or are not possible to locate off-street or on a minor street, the City could consider time-of-day restrictions on use of loading zones and pick-up/drop-off zones to avoid peak hour conflicts.

RETIMING TRAFFIC SIGNALS TO OPTIMIZE CORRIDOR TRAFFIC FLOW

Retiming or re-synchronizing signals is a long-term operational strategy best implemented within the context of the entire Downtown street network, and on an ongoing periodic basis as actual changes in traffic volumes and patterns are experienced. More funding would allow more frequent updates to signal timing to better meet changing demands and travel patterns.

FUNDING FOR ADDITIONAL STAFFING OF CITY'S TRAFFIC MANAGEMENT CENTER

With additional funding for more staffing, the City's Traffic Management Center would be able to improve management of Downtown's traffic signal systems. More funding would allow the City to increase staffing and better utilize the capabilities of its traffic management center, including providing quicker signal timing responses to incidents, special events or other fluctuations in day-to-day traffic flows. More staffing would also allow more frequent updates of signal timing and coordination plans. This strategy would benefit traffic conditions throughout the Downtown street network.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Without mitigation, future development through the year 2020 would generate additional traffic volumes and increase congestion in portions of Downtown, most notably in the Denny Triangle area. Much of this impact would occur with or without zoning changes. However, if Alternative 1 or Alternative 3 is implemented, congestion in the northeastern Denny Triangle could be approximately 5-10 percent worse than under the other alternatives, including the 2020 baseline condition (Alternative 4 - No Action). Under all the alternatives considered, additional congestion will likely increase overall travel times on Denny Way, Stewart Street and Olive Way, including transit travel time. Implementation of mitigation strategies, at the City's discretion, would likely improve overall transportation conditions, so that a portion of the impacts of traffic congestion could be avoided.