Technical Report
South Lake Union Streetcar Project

Transportation

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City of Seattle Department of Transportation

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Chapter 1 Abstract/Summary

1.1 Background

The South Lake Union Streetcar traffic analysis builds on previous work conducted for the Seattle Streetcar Network and Feasibility Analysis (Parsons Brinckerhoff, 2003), and describes in further detail the various alignment elements and associated traffic impacts. The analysis tasks associated with this phase of the study mainly focus on short-term traffic impacts and operational conditions related to the streetcar line, and are intended to support the environmental review process and conceptual design efforts. Long-range traffic conditions related to the streetcar are also described in this document. However, due to the uncertainty of several large-scale infrastructure projects throughout the region that may affect traffic patterns in the South Lake Union area, the year-of-opening horizon timeline is emphasized.

The primary goal of this traffic analysis work is to address specific issues related to peak-hour traffic operations during the initial opening of the core streetcar segment. Year-of-opening conditions for the primary segment reflect a single preferred alignment, and assume several roadway improvements and major street reconfigurations in terms of directional operation, signal modifications, left-turn vehicle storage, and general arterial capacity. Peak-hour traffic volume shifts due to these roadway improvements were also incorporated to quantify the associated changes in local travel patterns.

For the purposes of the traffic analysis, Year 2007 defined the short-term year-of-opening reference horizon and long-range impacts were captured in the Year 2030 analysis. Two year-of-opening scenarios and two long-range scenarios were evaluated for the PM peak hour. This translated to a total of five evaluation scenarios, as follows:

1) 2001 Existing Conditions
2) 2007 No Build Scenario (no streetcar)
3) 2007 Build Scenario (with streetcar)
4) 2030 No Build Scenario (no streetcar)
5) 2030 Build Scenario (with streetcar)

As discussed more thoroughly in the *Project Description* section (Chapter 3), the future 2007 No Build and Build Streetcar scenarios assume that Westlake Avenue has been converted from a one-way arterial to a two-way arterial (two lanes in each direction) and that Terry Avenue has been converted from two-way to one-way operations from Thomas Street to Mercer Street (two lanes northbound). Left-turn lanes on Westlake Avenue at specific intersections were included in the two-way Westlake Avenue conversion. New traffic signals were also assumed at Terry Avenue/Valley Street, Terry Avenue/Mercer Street, and Fairview Avenue East/Ward Street.

For the long-range 2030 outlook, these improvements are combined with a proposed conversion of Mercer Street from a one-way primary arterial (eastbound) to a two-way (eastbound and westbound) spine through the South Lake Union area. Valley Street is also modified to reflect a more narrow profile with limited capacity and a greater emphasis on local circulation/access. Revisions to Fairview Avenue and various east-

west arterials south of Mercer Street are also included as part of the long-term improvement framework. These changes are identified in the comprehensive South Lake Union Transportation Study (Parsons Brinckerhoff, 2004).

The two north-south corridors of Westlake and Terry avenues primarily defined the study area. However, the complete streetcar line (initial operating segment) from Westlake Center station at Westlake Avenue/Olive Way to the north terminus along Fairview Avenue near Ward Street was captured in the analysis and consisted of approximately 20 intersection locations. The analysis tool selected for the technical evaluation was Synchro/SimTraffic (version 5.0), which provided the basic analysis output data and performance measures for summarizing the impacts of the streetcar system.

Construction of the streetcar line is expected to be within existing City of Seattle rights-of-way on Westlake Avenue, Thomas Street, Terry Avenue, and Fairview Avenue, and within the City of Seattle right-of-way railbank area just north of Valley Street. Implementation and phasing of the rail tracks and station improvements would be achieved while maintaining reasonable traffic capacity (e.g., keeping a minimum of two one-way lanes open along Westlake Avenue). Based on standard construction practices, signal modifications and installation of new signals would be made without major disruptions to intersecting cross streets.

This report documents existing (2002) and future (2007 and 2030) PM peak-hour traffic conditions along the primary streetcar alignment and provides an assessment of potential impacts related specifically to streetcar transit operations. The various background improvements reflecting directional street conversions, signal modifications, etc., are assumed to be in place at the time of opening.

1.2 Construction Impacts

General impacts that may result during the construction phase may include:

1) Slightly increased congestion and delays along Westlake Avenue (northbound direction), particularly at the intersection of Westlake Avenue/Mercer Street when final construction and re-striping efforts begin.
2) Terry Avenue southbound traffic redistribution to alternative streets such as Boren Avenue, Fairview Avenue, or 9th Avenue (due to one-way conversion).
3) Slightly increased travel times for King County Metro Bus Route 17 on Westlake Avenue due to reduced capacity (especially when two lanes are closed).
4) Increased delays on Fairview Avenue and Valley Street due to the construction-related capacity reduction on Fairview Avenue (particularly northbound from Valley Street to Ward Street).
5) Short-term traffic disruption on Thomas Street due to track construction and staging. The segment between Westlake Avenue and Terry Avenue would be closed to general-purpose traffic (both directions).

1.3 Short-Term (2007) Traffic Impacts

Traffic impacts related to the initial opening of the streetcar line (2007 year-of-opening) would be generally minor in terms of average vehicle delays, queuing, increases in travel time, etc. As discussed previously, several short-term roadway improvements are assumed to be in place by the year-of-opening that are likely to redistribute traffic patterns and volumes within the study area. The greatest change to the street network would consist of the Westlake Avenue conversion to a two-way arterial. Conversion of Terry Avenue to a one-way street (northbound) between Thomas and Mercer would have some affect on local circulation, but it is not a heavily traveled street. New signals and turning-movement revisions are also included as part of these changes.

Future PM peak-hour traffic volume forecasts for the 2007 No Build and Build scenarios were developed based on historical growth rates for several north-south and east-west arterials within the study area. An average growth estimate of 0.75 percent per year was directly applied to existing 2002 and 2003 turning-movement counts (supplied by SDOT) for 20 key intersections, in order to arrive at suitable 2007 volumes.

The operational analysis for 2007 traffic conditions (No Build and Build) was conducted using Synchro/SimTraffic and included the 20 intersections along Westlake Avenue, Terry Avenue, and Valley Street and various roadway modifications assumed to be in place prior to the opening of the streetcar line. The primary differences between the No Build and Build analysis networks consisted of: 1) exclusive streetcar movements (signal phases) at specific intersections, and 2) the incorporation of additional heavy-vehicle volumes and movements along Westlake Avenue and Terry Avenue to reflect in-lane streetcar operations.

Key findings of the 2007 year-of-opening technical analysis include the following:

1) No substantial delays or congestion issues along the primary corridors of Westlake and Terry avenues would result from in-lane streetcar operations.
2) Some queuing activity at the Westlake Avenue/Denny Way intersection is expected, particularly in the northbound direction.
3) Slightly higher intersection delays for "Build" conditions would result, specifically where exclusive streetcar movements are introduced.
4) Average streetcar operating/running speeds would generally be between 9 and 10 mph (this includes the time spent loading and unloading passengers).

1.4 Long-Term (2030) Traffic Impacts

Analysis results for long-range 2030 traffic conditions indicate modest impacts directly related to streetcar operations, despite noticeable increases in background average vehicle delays, queuing, and travel time/vehicle speeds. By the 2030 horizon, substantial changes in the roadway network are anticipated, particularly for key corridors such as Mercer Street, Valley Street, and 9th Avenue. In addition to the various short-term roadway improvements assumed to be in place (i.e. the Westlake and Terry avenue conversions), several additional improvements outlined in the South Lake Union (SLU) Transportation Study (Parsons Brinckerhoff, 2004) are also incorporated as background

modifications for the streetcar analysis. As recommended in the SLU study, the Mercer Street corridor is expected to be reconfigured and widened to accommodate two-way traffic from Fairview Avenue to 5th Avenue, and Valley Street would be narrowed to a minor two-lane local street. 9th Avenue would also be converted to two-way operations. A number of new signals and turning-movement revisions are also expected as part of the overall recommendation package.

Future PM peak-hour traffic volume forecasts for the 2030 No Build and Build scenarios were primarily taken from work conducted for the SLU Transportation Study. The traffic volume forecasts for that study were based on the City of Seattle's EMME/2 Travel Demand Forecasting model. To arrive at suitable future traffic volumes specifically for this study, some adjustments and post-processing of the SLU Transportation Study peak-hour volumes were required in order to adapt the previous forecasts to some of the unique arterial configurations assumed for the streetcar study (i.e. one-way Terry Avenue, Westlake Avenue lane geometry, etc). Aside from the proposed streetcar movements operating on ten-minute headways by 2030 (i.e. six additional vehicles during the peak hour), the 2030 No Build and Build scenario traffic volumes were assumed to be similar.

Operational analysis for 2030 traffic conditions (No Build and Build) was again conducted using Synchro/SimTraffic and included key intersections along Westlake Avenue, Terry Avenue, and Valley Street and the major roadway changes recommended from the SLU Transportation Study. Key findings of this long-range analysis include:

1) Overall added delays and congestion (compared to 2007 conditions) are expected on Westlake Avenue (northbound) and Mercer Street (eastbound) under both the Build and No Build scenarios, but with few areas greatly influenced by streetcar operations.
2) Increased queuing activity is expected at the Westlake Avenue/Denny Way intersection, in the northbound direction under both the Build and No Build scenarios.
3) Slightly higher intersection delays are expected for Build conditions (i.e., specifically related to streetcar operations), where exclusive streetcar movements are introduced.
4) Average streetcar operating/running speeds would generally be between 7 and 8 mph (again this includes the time spent loading and unloading passengers).

Chapter 2 Introduction

This technical report summarizes the potential future impacts of streetcar operations in the South Lake Union area, as they relate to general-purpose vehicular traffic circulation during the critical weekday PM peak-hour period. The streetcar route alignment reflected in this document specifically represents a preferred option selected from several South Lake Union alignments evaluated as a preliminary analysis/screening step. The primary north-south roadways that would be served by the streetcar system include Westlake Avenue, Terry Avenue, and Fairview Avenue (north of Valley Street).

The project limits of the streetcar line, shown in Figure 2-1, would extend from the intersection of Westlake Avenue/Olive Way (south terminus) to Fairview Avenue at Ward Street near the Fred Hutchinson Cancer Research Center (north terminus). Northbound travel for streetcar operations would be along Westlake Avenue (between Olive Way and Thomas Street), Thomas Street (between Westlake and Terry avenues), Terry Avenue (north of Thomas Street), within the railbank area just north of Valley Street, and in-street on Fairview Avenue (north of Valley Street near Ward Street). Southbound travel would be along Fairview Avenue (near Ward Street to Valley Street), within the railbank area just north of Valley Street, and along Westlake Avenue (Valley Street to the southern terminus).

To evaluate short-term and long-range traffic impacts associated with the streetcar line, two specific horizon years were targeted for the technical analysis: 2007 (year-of-opening) and 2030. For each of these timeline horizons, a No Build scenario (no streetcar) and a Build scenario (with streetcar) were investigated in terms of intersection delays, travel times, and average speeds. Combined with the existing conditions analysis, this translated to a total of five PM peak-hour analysis scenarios.

The structure of this technical report is intended to complement the environmental documentation process. As such, a formal project description and brief overview of the study methodology are given in Chapters 3 and 4 respectively, and the data items collected for this project phase and the evaluation of the affected environment are included in Chapter 5. Future traffic-related impacts and peak-hour operational conditions are described in Chapter 6 and potential short-term and long-term mitigation measures for the project are discussed in Chapter 7.

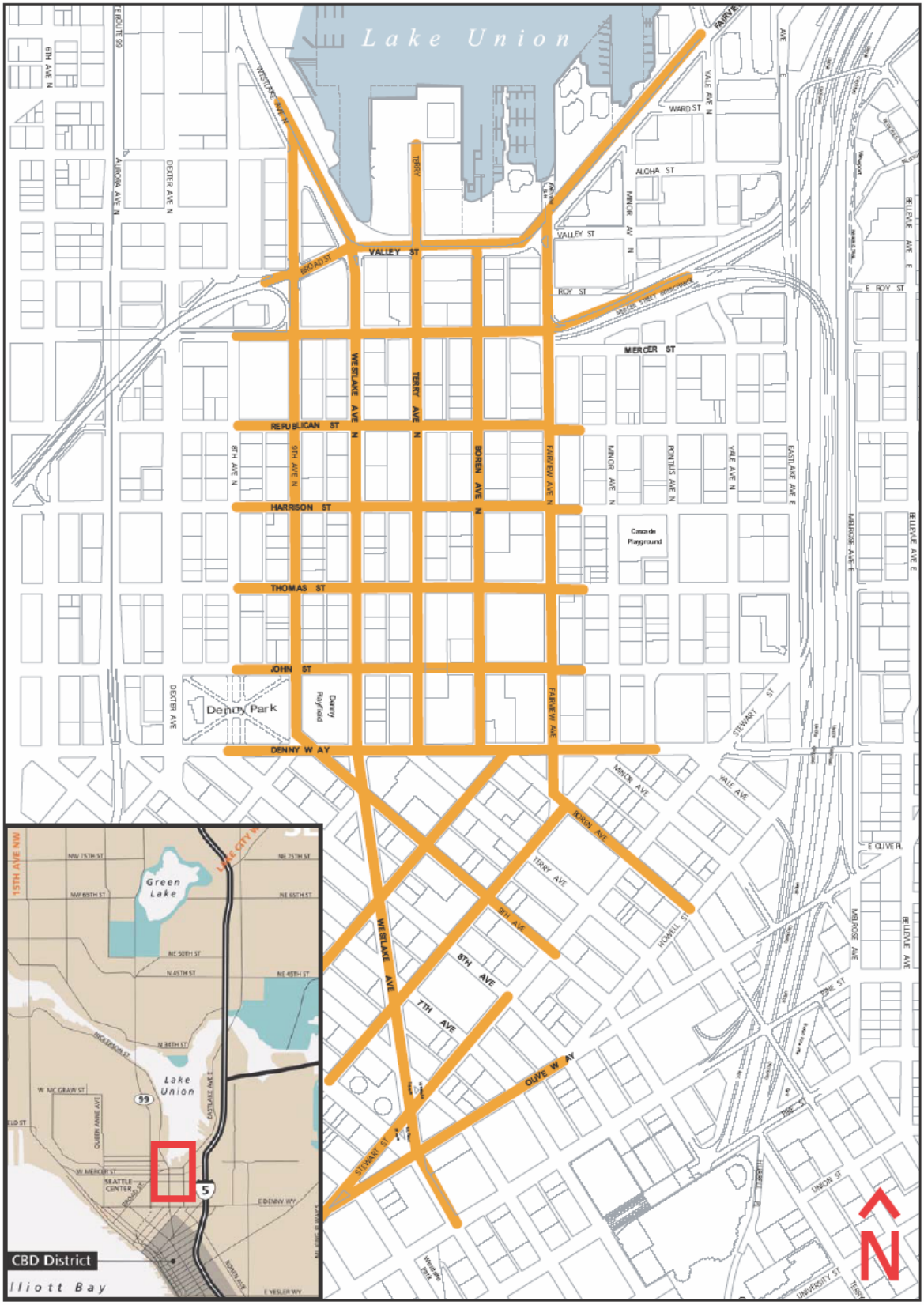

Figure 2-1: Vicinity Map and Study Area

Chapter 3 Project Description

The City of Seattle, in cooperation with the U.S. Department of Transportation Federal Transit Administration (FTA), proposes to construct a new streetcar line to serve the downtown, Denny Triangle and South Lake Union areas of Seattle. This line would provide local transit service, connect to the regional transit system, accommodate economic development, and contribute to neighborhood vitality. The project elements and construction are discussed in detail in the *South Lake Union Streetcar Project Description Memo* (Parsons Brinckerhoff, March 2005).

The proposed South Lake Union Streetcar would begin in the vicinity of the intersection of Westlake Avenue and Olive Way/5th Avenue in downtown Seattle (see Figure 3-1). It would extend north through the Denny Triangle and South Lake Union neighborhoods and terminate in the vicinity of Fairview Avenue N. and Ward Street near the Fred Hutchinson Cancer Research Center. The line would connect these neighborhoods and destinations with the regional transit hub at Westlake Center, which will be a major connection point for light rail, buses and monorail. The length of the proposed streetcar line is approximately 1.3 miles in each direction (2.6 track miles total) and the tracks and stops would be constructed entirely within existing right-of-way.

The streetcar would share the street with automobile traffic. Initially, the streetcar is expected to operate for 15 hours per day (roughly 6 AM to 9 PM), with fifteen minutes between cars. Ultimately, the system is expected to operate for 18 hours per day (roughly 5 AM to 11 PM), with ten minutes between cars.

As shown in Figure 3-1, streetcar stops would typically be side-platform corner-curb bulbs located within the parking lane at the far side of an intersection. Two stops would be center platform configurations: one within Fairview Avenue N. at the Fred Hutchinson campus and one in the railbank north of Valley Street adjacent to South Lake Union Park.

Bi-directional, low-floor, single-car, articulated streetcars are proposed. They are typically 66 feet long, 11.5 feet high, and 8 feet wide and run on standard gauge tracks. The streetcar would be powered by an overhead electrical system similar to those used by streetcars in cities such as Tacoma, Washington and Portland, Oregon.

A maintenance facility at the southwest corner of Fairview Avenue N. and Valley Street is also planned as part of this project. The maintenance facility building would be approximately 100 x 70 feet. Two additional yard storage tracks would also be provided. Daily vehicle maintenance and inspections and minor repairs would be completed at the facility.

In the typical construction method for the streetcar track system, the top 12 to 18 inches of pavement would be removed and replaced with rail-embedded reinforced concrete slabs within a trench approximately eight feet wide. This project would also involve upgrading the stormwater detention system, relocation of utilities, and installation of traction power substations.

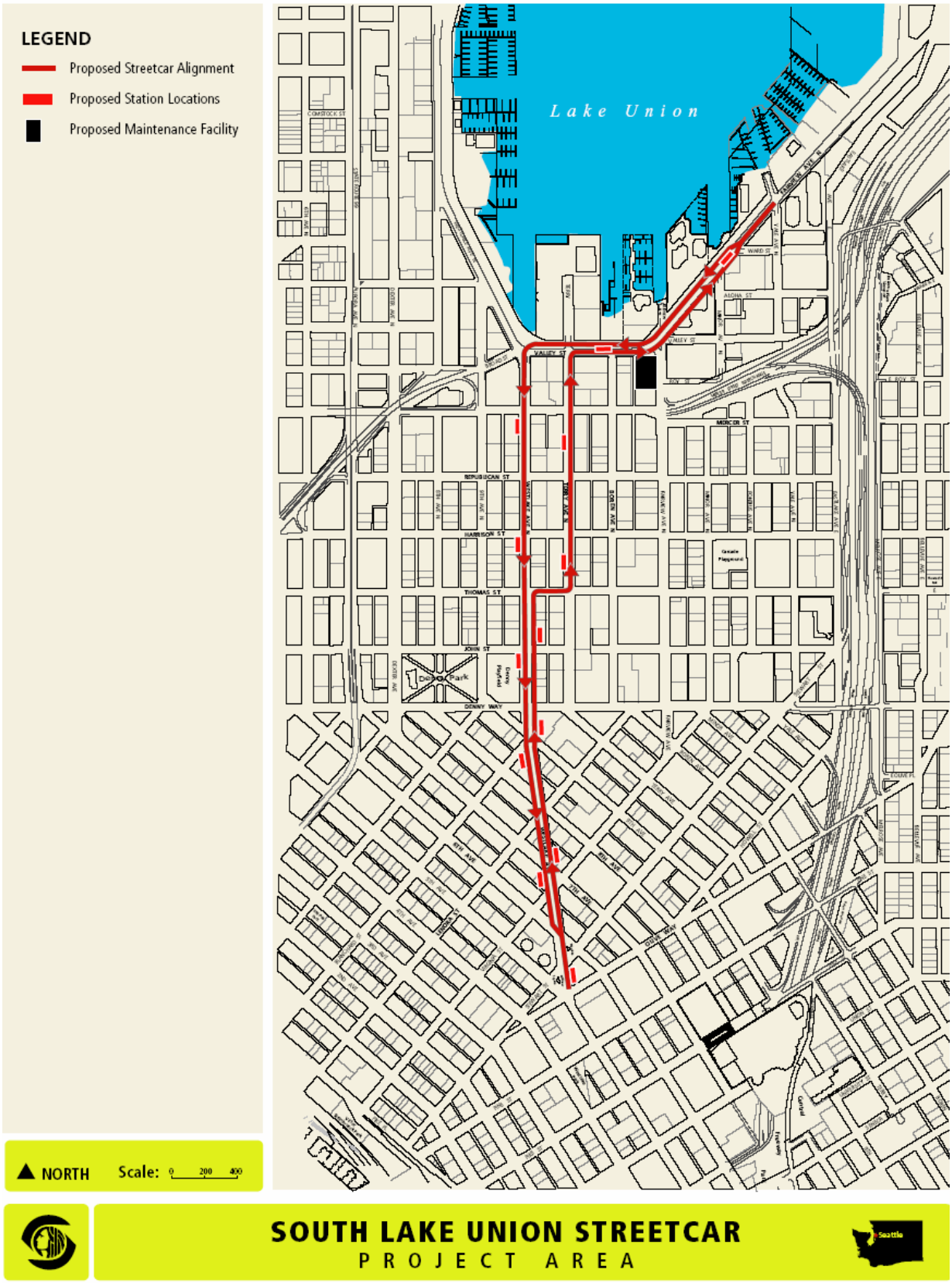

Figure 3-1: Project Area

Chapter 4 Methodology

This chapter summarizes the approach and tools used to develop traffic-volume forecasts and perform operational analysis of existing and future traffic conditions for the proposed streetcar line. The various types of data collected and refined and the methodologies used to gather this information are described at a summary level. The overall study approach and data collection procedures are discussed first, followed by an overview of the traffic forecasting process and operational analysis sequence.

4.1 Study Approach

This traffic analysis followed a conventional planning analysis approach that included a basic data collection/reconnaissance task, investigation of existing roadway and traffic conditions, forecasts of future trip generation and distribution patterns, and analysis of future operational impacts. As mentioned previously, most of the background data was taken from the South Lake Union (SLU) Transportation Study, which included existing traffic volumes, signal timing data, roadway geometry and lane configurations, and future long-range traffic forecasts. Although this data served as a sufficient foundation for conducting the analysis, refinements and/or further data collection were required in order to tailor the information to the specific context of the streetcar project. The additional data collected as part of the initial reconnaissance task was primarily related to lane geometry at or near proposed developments in the Denny Triangle area, confirmation or updates of existing traffic counts, and detailed transit service projections for Metro bus routes.

After making refinements to the available background data, existing traffic conditions were examined through the use of a simulation analysis tool. The same tool was used for the SLU Transportation Study; therefore, the approach and findings of both studies may be compared. Future short-term 2007 PM peak-hour traffic forecasts for key intersections within the study area were then developed using historical growth rates applied to existing counts. Long-range 2030 peak-hour forecasts were developed by using the data given in the SLU Transportation Study and adapting the volumes to the roadway configurations and geometric parameters specific to the streetcar project.

Using the refined forecasted volumes and distribution patterns for the 2007 and 2030 scenarios, future traffic conditions were investigated through further operational analysis and computer simulations. Traffic volumes were refined and updated and detailed network assumptions were made throughout the analysis process.

4.2 Data Collection and Refinement

As mentioned previously, most of the input data for the technical analysis was taken from the South Lake Union (SLU) Transportation Study, which evaluated future transportation scenarios within the South Lake Union area. From this prior work, a substantial amount of traffic data was available for approximately 70-80 intersections and 15-20 arterials included in that study area (for areas east and west of SR-99 and south of Lake Union).

For the purposes of the streetcar project, existing and long-range (2030) background from the SLU Study was needed only for the corridors of Westlake Avenue and Terry Avenue (and a portion of Fairview Avenue) and for the 20 intersections contained within the targeted streetcar study area.

Existing conditions data from the SLU Transportation Study was used in its native form for the existing conditions streetcar analysis in terms of peak-hour traffic volumes, signal timing data, lane geometry, bus route information, non-motorized trips, and heavy vehicle volumes. However, some the 2030 No Build data was refined due to specific differences between the SLU Study arterial network assumptions and those used for the streetcar project.

Signal timing data for the existing, 2007, and long-range 2030 No Build scenarios were taken directly from the SLU Study (2007 No Build data was assumed to remain the same as existing conditions). However, with the streetcar line in operation for the Build scenarios (2007 and 2030), modifications to specific signal timing data were developed independently to accommodate exclusive streetcar protected signal phases at intersections along Westlake and Terry avenues and at the intersection of Fairview Avenue with Valley Street.

4.3 Traffic Forecasts

Year-of-opening traffic forecasts for the 2007 No Build and Build scenarios were developed based primarily on historical traffic volumes (1998-2003) on selected arterials within the study area. Hourly counts (based on 24-hour periods) were obtained from the City of Seattle, which summarized arterial volumes at specific point locations along a given segment of roadway. These volumes were subsequently used to develop growth rates reflecting recent (five-year) arterial volume trends. A total of four screenlines were used to aggregate and average the hourly volume data provide provided by SDOT: two for the various north-south arterials and another two for the east-west arterials. Ultimately, the resulting historical growth rates were applied to the existing intersection traffic volumes in order to arrive at a set of 2007 “raw” No Build intersection volumes.

Refinements and adjustments were then made to these initial volumes to reflect the arterial configuration changes assumed by the 2007 horizon. Among these changes were the conversion of Westlake Avenue to two-way operations from Valley Street to south of Denny Way, and the conversion of Terry Avenue to a one-way street from Thomas to Mercer streets. Volume differences between the No Build (no streetcar) and Build (with streetcar) scenarios were negligible and reflected only the addition of streetcar movements along the Westlake Avenue, Terry Avenue, and Fairview Avenue corridors.

Year 2030 long-range forecasts for the No Build scenario were taken from the SLU Transportation Study and then adjusted to reflect the roadway configurations included in the 2007 scenarios, the conversion of Mercer Street to two-way operations, and modifications to the Valley Street cross-section between Westlake Avenue and Fairview Avenue. Also included in the list of long-range arterial changes was conversion of 9th Avenue to a two-way street from Westlake Avenue (at the north) to south of Denny Way (at the south). Traffic volumes were redistributed and balanced on the converted streets accordingly.

4.4 Operational Analysis

Analysis of roadway and intersection operational performance for the five evaluation scenarios was performed through use of the Synchro/SimTraffic simulation analysis package (version 5, Build series 321) developed by Trafficware, Inc. (Berkeley, California), which evaluates intersection delays and congestion based on procedures similar to those given in the Transportation Research Board (TRB) 2000 Highway Capacity Manual (Chapters 16 and 17). Basic inputs used for Synchro relate primarily to traffic data including traffic volumes, lane geometry (i.e., number of lanes, lane widths, turn-lane storage), signal timing data, pedestrian and bicycle volumes, bus and heavy vehicle traffic levels, and a variety of other data items.

The SimTraffic module serves as the microscopic tool that evaluates individual movements of vehicles and provides greater analysis detail with respect to traffic flow characteristics and vehicle-to-vehicle interactions. For the streetcar project, analysis results and performance measures were provided by SimTraffic. Although the SimTraffic module reports a number of output measures (i.e., the number of vehicles served at an intersection, average vehicle delays, fuel consumption, queues), only the average vehicle delay measure was used for this study to make comparisons between scenarios.

Background simulation models used for the streetcar project were taken from those previously developed for the SLU Transportation Study. To evaluate existing streetcar project conditions, the original SLU Study peak-hour (PM) existing conditions model was reduced in scope and size to reflect the smaller streetcar study area (20 vs. 80 intersections). Data inputs related to signal timings, peak-hour traffic volumes, etc. were then reviewed in detail, required adjustments were made to the input data (to update specific items), and the model was re-analyzed.

The short-term 2007 models for No Build and Build conditions were developed based on the existing conditions model, with a few critical network modifications made and background traffic growth incorporated. The long-range 2030 No Build and Build models for the streetcar project were based on the 2030 SLU Study models that had already included conversion of Westlake Avenue and 9th Avenue to two-way operations, widening of Mercer Street and conversion to two-way, and narrowing of Valley Street.

Chapter 5 Affected Environment

5.1 Existing Street Network

The existing roadway network that would be served by or affected by the streetcar line consists of a variety of street types. Roadways range from local two-lane streets to principal arterials. North-south traffic movements within the study area are primarily concentrated on the Westlake Avenue/9th Avenue one-way couplet and along Fairview Avenue north of Valley Street. East-west travel is generally made along Mercer Street, Valley Street, and Denny Way. A system of two-lane local and collector streets provide local circulation.

Characteristics of the primary roadway facilities vary with respect to lane number, width, grades, and posted speeds. These differences are based on specific functional needs within the roadway network and corridor capacity requirements. The key roadways are described below and shown in Figure 2-1 (Chapter 2). Figure 5-1 shows existing lane configurations at key intersection locations (selected for the critical-intersection or "hot spot" analysis).

- *Westlake Avenue* is a principal north-south arterial that is configured as a one-way street from 9th Avenue (just south of Denny Way) to north of Valley Street. Within the core study area, this arterial consists of four northbound lanes with parking on both sides of the street. The speed limit is posted at 30 mph and grades are generally modest (less than 5 percent). Lane widths are 10 to 12 feet and sidewalks are provided on both sides. Westlake Avenue is currently classified for transit use.
- *Terry Avenue* is a two-way minor north-south local street that lies east of Westlake Avenue and serves local/commercial loading trips within the South Lake Union area. The typical cross-section within the study area consists of a single travel lane in each direction and parking on both sides. Sidewalks are provided only for short segments and grades are minor. Speed limits are generally not posted. Terry Avenue is not currently classified for transit use but would be reclassified prior to project opening.
- *Denny Way* is a principal east-west arterial that provides access to/from I-5 and also serves Seattle Center and downtown waterfront traffic. This arterial consists of two lanes in each direction with no parking. Lane widths are generally 10 to 11 feet and sidewalks are typically provided. Grades within the study area are generally between 0 and 8 percent.
- *Mercer Street* is a principal east-west arterial configured one-way in the study area (eastbound only). This arterial serves as a critical spine within the South Lake Union area and provides direct access to/from the I-5 mainline and express lane corridors. Traffic volumes on Mercer Street are substantial, particularly during peak-hour periods. Speeds are posted at 30 mph and parking is only allowed along segments near Seattle Center. Grades are generally modest.

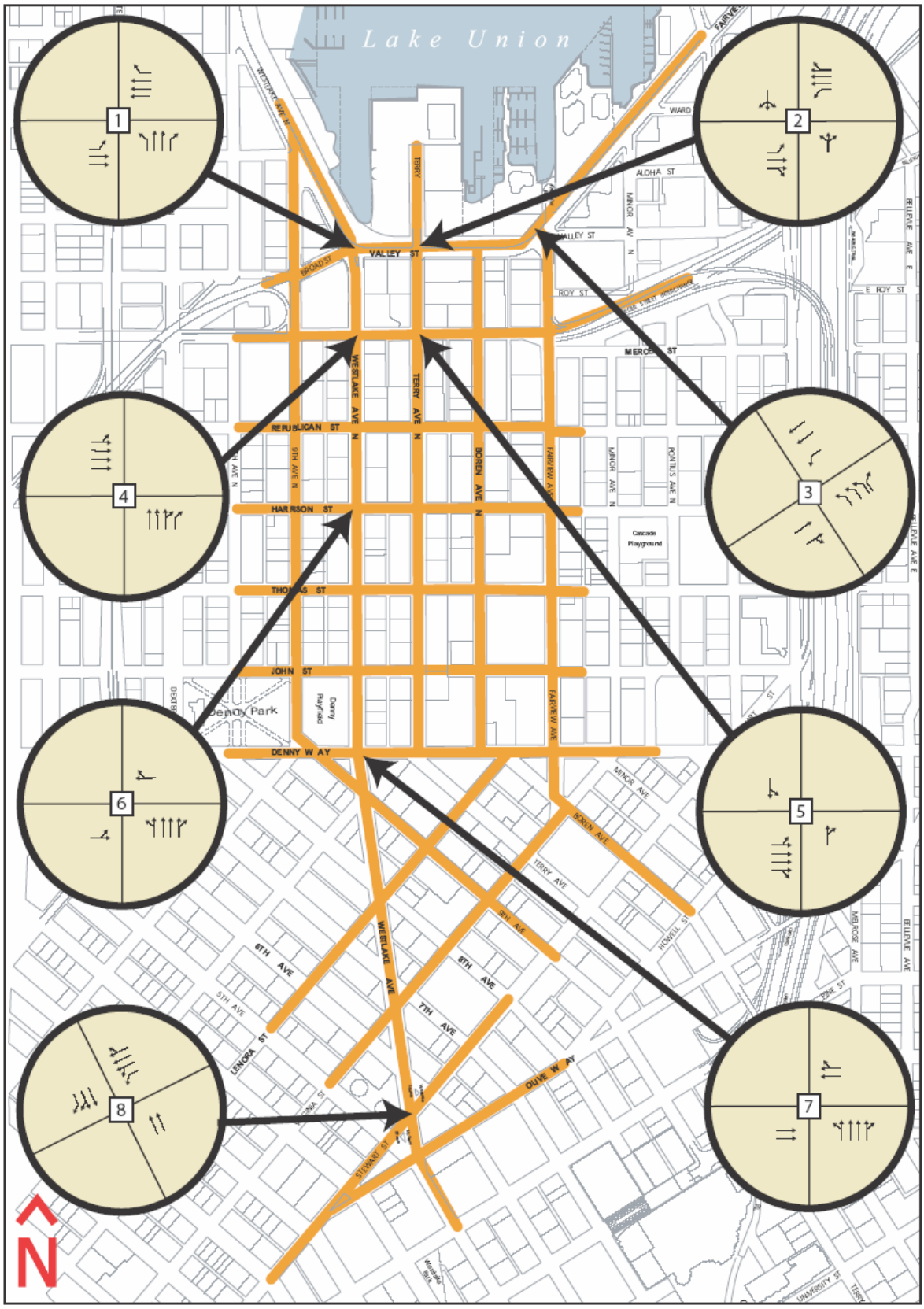

Figure 5-1: Existing Lane Geometry at Hot Spot Locations

- *Valley Street* is a two-way principal arterial that forms a one-way-style couplet with Mercer Street to the south. Like Mercer Street, this arterial carries a substantial amount of daily traffic and consists of five to six lanes. Valley Street serves as a major entry arterial into the city from the I-5 mainline and express lanes. Grades are modest and lane widths vary from 10 to 12 feet.
- *Fairview Avenue* is a north-south two-way arterial that generally consists of two travel lanes in each direction and a center left-turn lane. At Mercer Street, Fairview provides direct access to/from the I-5 ramps (northbound-to-eastbound and vice versa). Speeds are posted at 30 mph and grades are modest in the study area. Lane widths are 11 to 12 feet and sidewalks are provided on both sides. Fairview Avenue is currently classified for transit use.

5.2 PM Peak-Hour Volumes

PM peak-hour volumes for key intersections and arterials within the streetcar study area were taken from the SLU Transportation Study and reflect 2001/2002 traffic conditions for the PM peak period (4 to 6 PM). Background traffic data items for a total of 20 intersections were used from the SLU Transportation Study to build the existing streetcar analysis network. However, only the potential high volume/congestion "hot spot" locations (a total of eight intersections) within this network were targeted for analysis, due to the potential impacts of streetcar operations and/or intersection changes at these locations during the PM peak hour. As shown in Figure 5-1, several intersections outside the targeted "hot spot" locations were not included as part of the analysis, such as those along Westlake Avenue south of Denny Way or along Terry Avenue south of Mercer Street. These intersections are not expected to be impacted by streetcar operations due to the absence of any major street reconfigurations, so were omitted from the hot spot analysis. PM peak-hour existing turning-movement volumes are shown in Figure 5-2 (this figure also shows level of service analysis results).

5.3 Intersection Level of Service

Operational analysis of PM existing peak-hour conditions was performed for each of the eight hot spot locations using the Synchro/SimTraffic analysis package. This analysis was used to determine Level of Service (LOS), which is a general measure of congestion for transportation facilities such as intersections, freeways, and arterials. Table 5-1 shows standardized LOS criteria and thresholds for signalized intersections, as given in the updated Transportation Research Board (TRB) 2000 Highway Capacity Manual.

Analysis results in terms of average vehicle delays and LOS are shown in Figure 5-2. As shown in this figure, one intersection currently operates at LOS A during the PM peak hour, five operate at LOS B, and the remaining two operate at LOS C. Higher-congestion locations include Mercer Street/Terry Avenue and Mercer Street/Westlake Avenue. This congestion is expected, particularly at Westlake Avenue/Mercer Street, due to high overall traffic levels during the critical PM peak period. Key turning movements at the Denny Way/Westlake Avenue intersection, defined by critical vehicle conflicts, also show moderate to high levels of congestion.

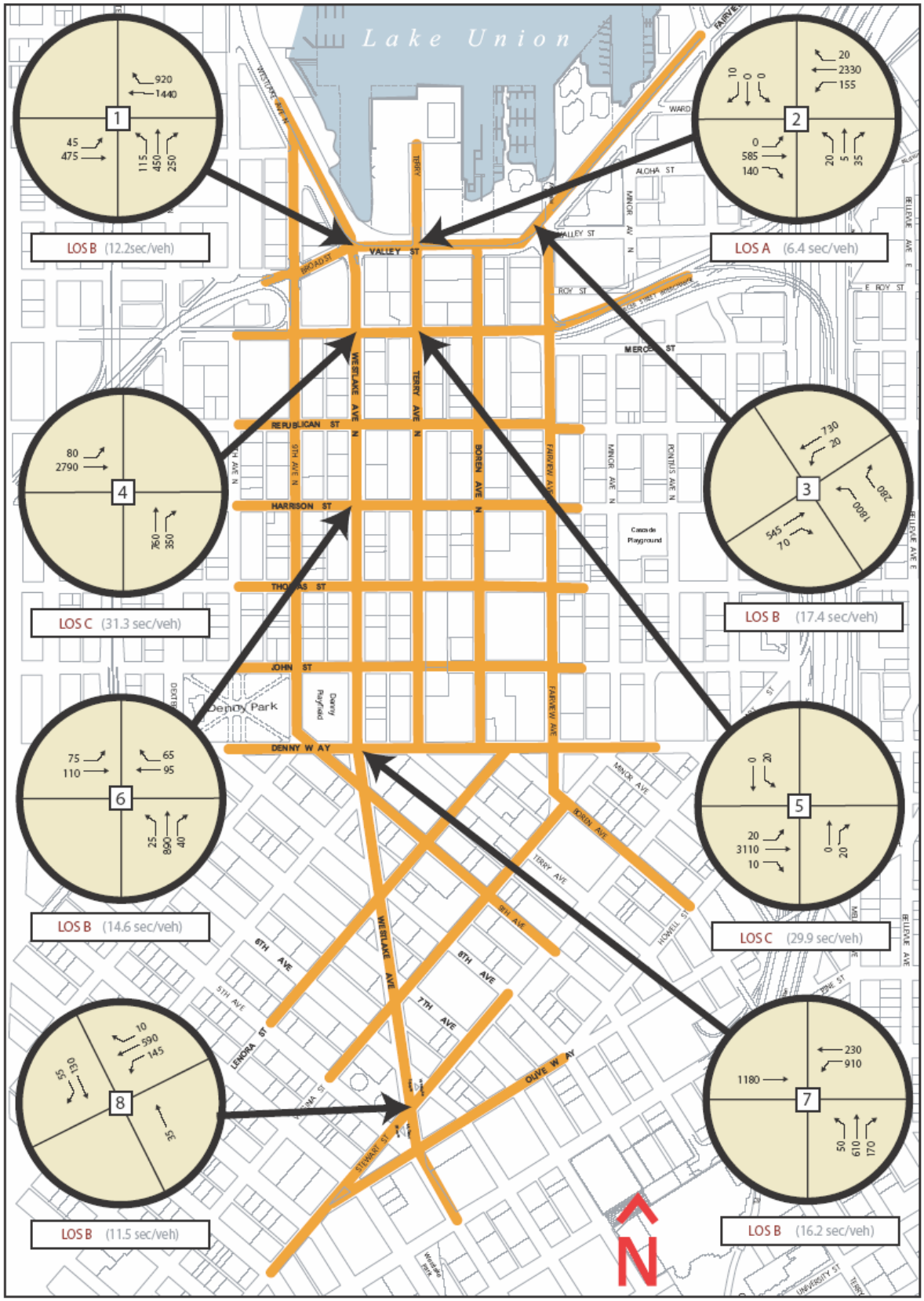

Figure 5-2: Existing Traffic Volumes and Hot Spot Level of Service (LOS)

Table 5-1: Level of Service Criteria

LOS	Signalized Delay (seconds/veh)	Description
A	≤ 10	Low delays, virtually free flow, unimpeded
B	> 10 and ≤ 20	Stable flow with minor delays, less freedom to maneuver through the intersection
C	> 20 and ≤ 35	Stable flow with some delays, less freedom to maneuver through the intersection
D	> 35 and ≤ 55	Long delays and high density, but stable flow and operations
E	> 55 and ≤ 80	Operating conditions at or near capacity
F	> 80	Forced operation, breakdown conditions

Source: 2000 Highway Capacity Manual (Chapter 16).

5.4 Transit Routes and Service

Metro Transit provides bus service throughout King County, including service to the project area. Based on King County Metro data only one bus route, Route 17, currently serves the Westlake Avenue corridor from Denny Way to Valley Street. This route provides service between the Loyal Heights/Ballard area and downtown Seattle and also transitions into the Route 23 to serves parts of south Seattle in the Rainier Valley area. Peak-hour headways on the Route 17 are approximately 15 minutes.

Other Metro transit service in the area is provided by Metro routes 8, 17, 26, 28, 66, and 70 (71, 72, and 73 at night and on Sundays). Route 8 is the Denny Way cross-town route that connects Capitol Hill and Queen Anne every 30 minutes during most time periods. Route 17 travels between downtown and Ballard via Westlake Avenue every 30 minutes. Routes 26 and 28 connect downtown with Fremont and other neighborhoods, and combined they operate every 15 minutes on Dexter. The Route 66 Express bus operates every 30 minutes between Roosevelt and downtown, with limited stops on Eastlake Avenue. Routes 70, 71, 72, and 73 combine to provide 15-minute frequency on Fairview Avenue N. All of these routes operate more frequently during peak hours (Parsons Brinckerhoff, 2004b).

5.5 Parking Inventory

Parking along Westlake Avenue is generally provided on both sides of the street from Stewart Street at the south end to Valley Street at the north end. As described previously, Westlake Avenue is a two-way arterial from Olive Way to 9th Avenue (just south of Denny Way) and is configured one-way northbound from 9th Avenue to north of Valley Street. Parking along Terry Avenue between Thomas and Valley Streets is relatively undefined and consists of approximately 70 to 80 spaces. Table 5-2 summarizes parking for the entire segment of Westlake Avenue from Stewart Street to Valley Street.

Table 5-2: Westlake Avenue Parking: Stewart Street to Valley Street

Type of Parking	Westside	Eastside	Total
General Purpose	104	78	182
Commercial (restricted)	5	4	9
Fire (restricted)	1	2	3
Total Inventory	110	84	194

A parking inventory assessment for the railbank area (the north side of Valley Street) between Terry Avenue and Fairview Avenue reveals an undetermined number of actual parking spaces due to the absence of consistent striping or markings. This area is not formally designated as a parking lot, but is nonetheless used for general parking throughout the day. Field notes indicate that approximately 40 to 45 parking spaces could be provided in this area, based on on-site vehicle counts.

The existing parking inventory on Thomas Street between Westlake Avenue and Terry Avenue is comprised of roughly eight (8) parking spaces on the north side and a similar number of spaces on the south side. There is no on-street parking on Fairview Avenue in the project area.

Chapter 6 Environmental Consequences

6.1 Roadway Network Changes

The transportation analysis included changes to the roadway network both that would be required for the streetcar project and that are expected to occur in the future independent of the project.

2007 Network Changes

The roadway system assumed for the 2007 opening-year scenarios (No Build and Build) includes two street modifications for the key corridors within the study area. These include conversion of Westlake Avenue to two-way operations from north of Valley Street to 9th Avenue (just south of Denny Way), and conversion of Terry Avenue to a one-way street from Thomas to Mercer streets. The two-way Westlake Avenue design would consist of two travel lanes in each direction, with left-turn pockets at the intersections of Valley Street, Mercer Street, Republican Street, and Denny Way. Parking would generally be provided on both sides. The one-way Terry Avenue design would consist of two northbound-only lanes with parallel parking on the west side and back-in angle parking on the eastside. Existing signals along Westlake Avenue would be modified to accommodate two-way traffic and new signals would be installed at the intersections of Terry Avenue/Valley Street, Terry Avenue/Mercer Street and Fairview Avenue /Ward Street (pedestrian signal).

For the 2007 Build scenario, the streetcar tracks are assumed to be in place along Westlake and Terry avenues (and also on Thomas Street and Fairview Avenue). The specific alignment for the streetcar is shown in Figure 6-1. Signal timing strategies that introduce exclusive streetcar signal phases are also included as part of the network modifications. These exclusive signal phases would be added at the following intersections:

1) Fairview Avenue/Valley Street – Fairview Avenue (in-street) to/from railbank
2) Terry Avenue/Mercer Street – Northbound westside to eastside crossover movement (from south side of Mercer Street to north side)
3) Westlake Avenue/Valley Street – Eastbound to southbound movement
4) Westlake Avenue near 6th Avenue – Double-track to single-track movement

For streetcar movements identified at Fairview Avenue/Valley Street (i.e. between Fairview Avenue and the railbank), enhanced vehicle detection would be implemented as part of the overall project improvement package. This would help identify streetcar vehicles exclusively and differentiate streetcars from buses (specifically for the southbound direction). This would be critical for determining when all traffic streams need to be stopped, to allow streetcars through the intersection unimpeded. For example, when a streetcar vehicle travels southbound to westbound into the railbank from Fairview Avenue, the vehicle is assumed to first wait in the bus-only left turn lane, then travel

through the intersection (in a southbound to westbound sweep). It crosses the two adjacent southbound traffic lanes and finally enters the railbank area on the north side of Valley Street. For the traffic signal to identify when the southbound general-purpose traffic movements should be stopped to allow this streetcar movement, the vehicle detection system will be required to distinguish between a bus at the signal and a streetcar (with or without a bus) at the signal. This movement would occur every 15 minutes in 2007 and every 10 minutes in 2030.

A new pedestrian signal is also anticipated on Fairview Avenue at Ward Street as part of the streetcar improvements, to facilitate safer pedestrian movements to/from the streetcar platform at the north terminus station. Access to/from the maintenance facility located at the southwest quadrant of Fairview Avenue/Valley Street would require a new clearance signal on Valley Street between Fairview Avenue and Boren Avenue, which would be intended for eastbound traffic on Valley Street. This maintenance facility signal would operate only in the early-morning (before 6:30 AM) and late evening (after 9:00 PM), with the exception of major vehicle breakdowns and/or critical safety precautions (i.e. vehicles needing immediate maintenance attention).

As part of the streetcar track construction within the railbank area that would extend through the intersection of Fairview Avenue/Valley Street, consolidation of the various driveways along Valley Street and Fairview Avenue (near the intersection) would likely occur. The result of this consolidation effort would be fewer points of entry/exit for local businesses in the northwest quadrant of the intersection (e.g. the former Burger King site) and a greater concentration of traffic volume at the remaining driveways. However, the reduced number of driveways may benefit overall traffic circulation in the area by decreasing the number of conflict points along Valley Street and Fairview Avenue and improving visibility and safety for drivers and pedestrians/bicyclists.

Cross-sections of Westlake and Terry avenues, which show the proposed lane configuration changes for the 2007 scenarios (applies to No Build and Build conditions) are shown in Figure 6-2 and Figure 6-3. Proposed track-related changes to Fairview Avenue near the Fairview Avenue/Valley Street intersection (including the use of the southbound transit-only left-turn pocket by the streetcar line) are shown in Figure 6-4. For reference, Figures 6-2 through 6-4 include comparisons to existing conditions. Specific 2007 intersection-level lane configurations are shown in Figure 6-5.

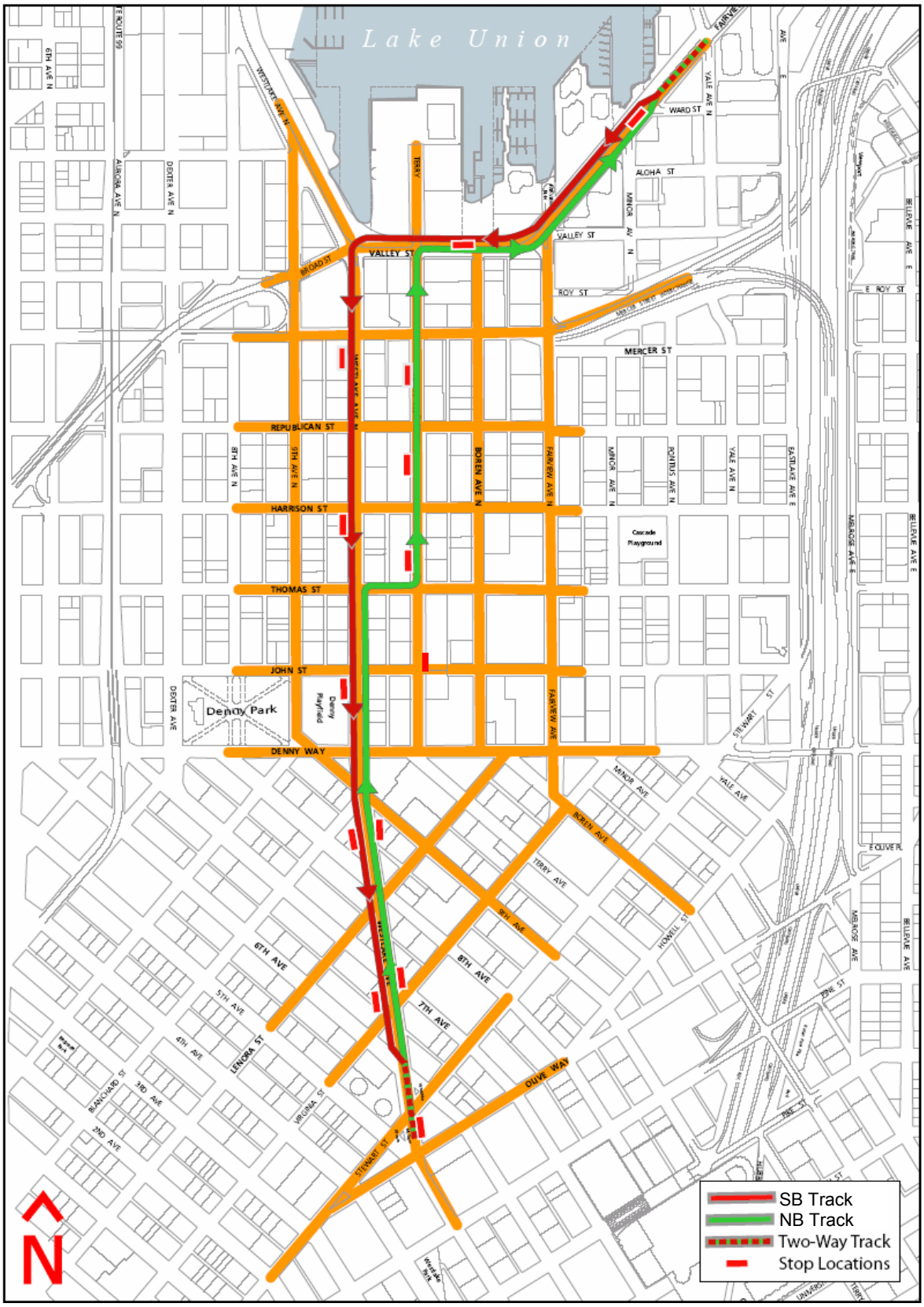

Figure 6-1: Streetcar Alignment

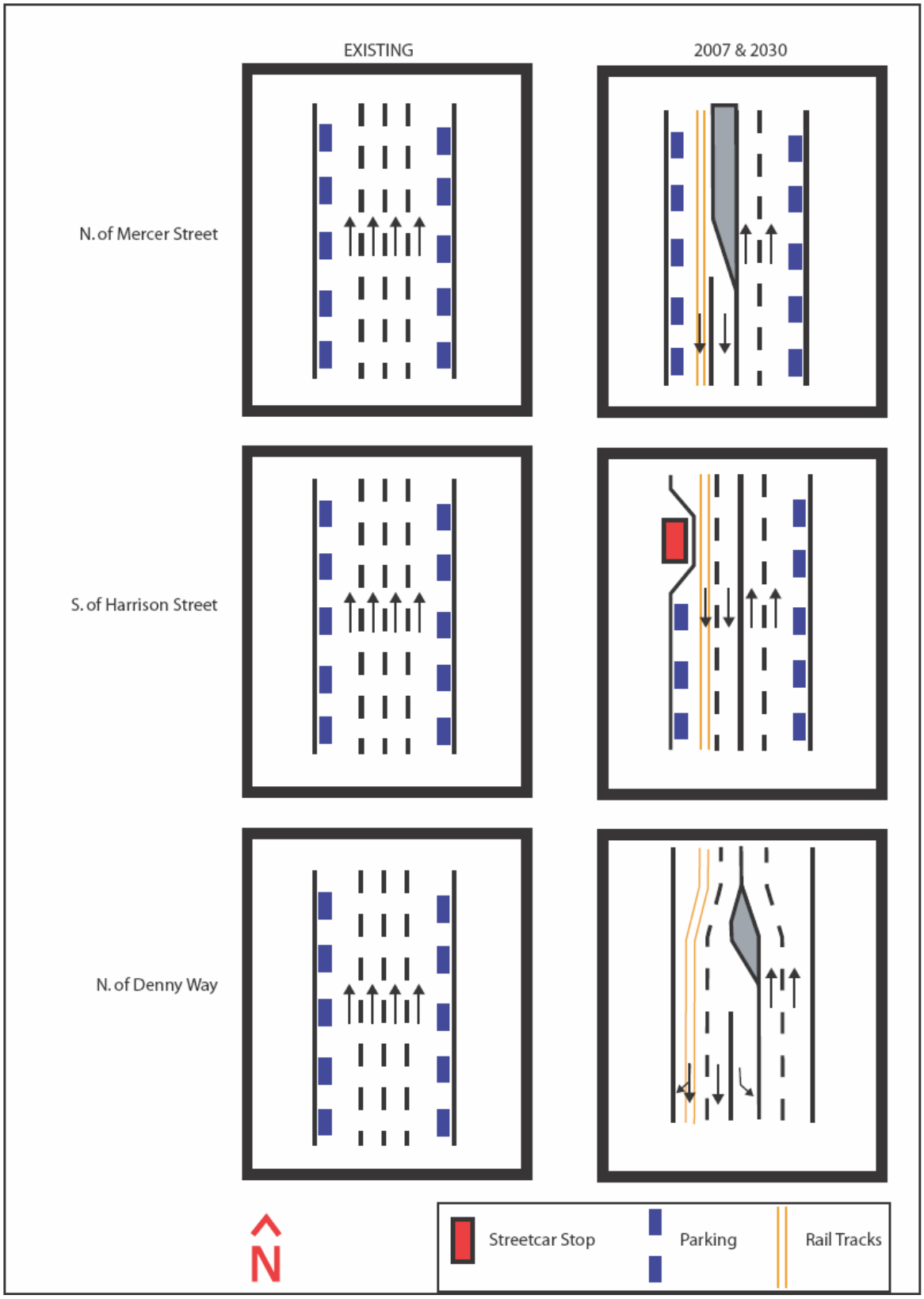

Figure 6-2: Existing and Proposed Westlake Avenue Configuration

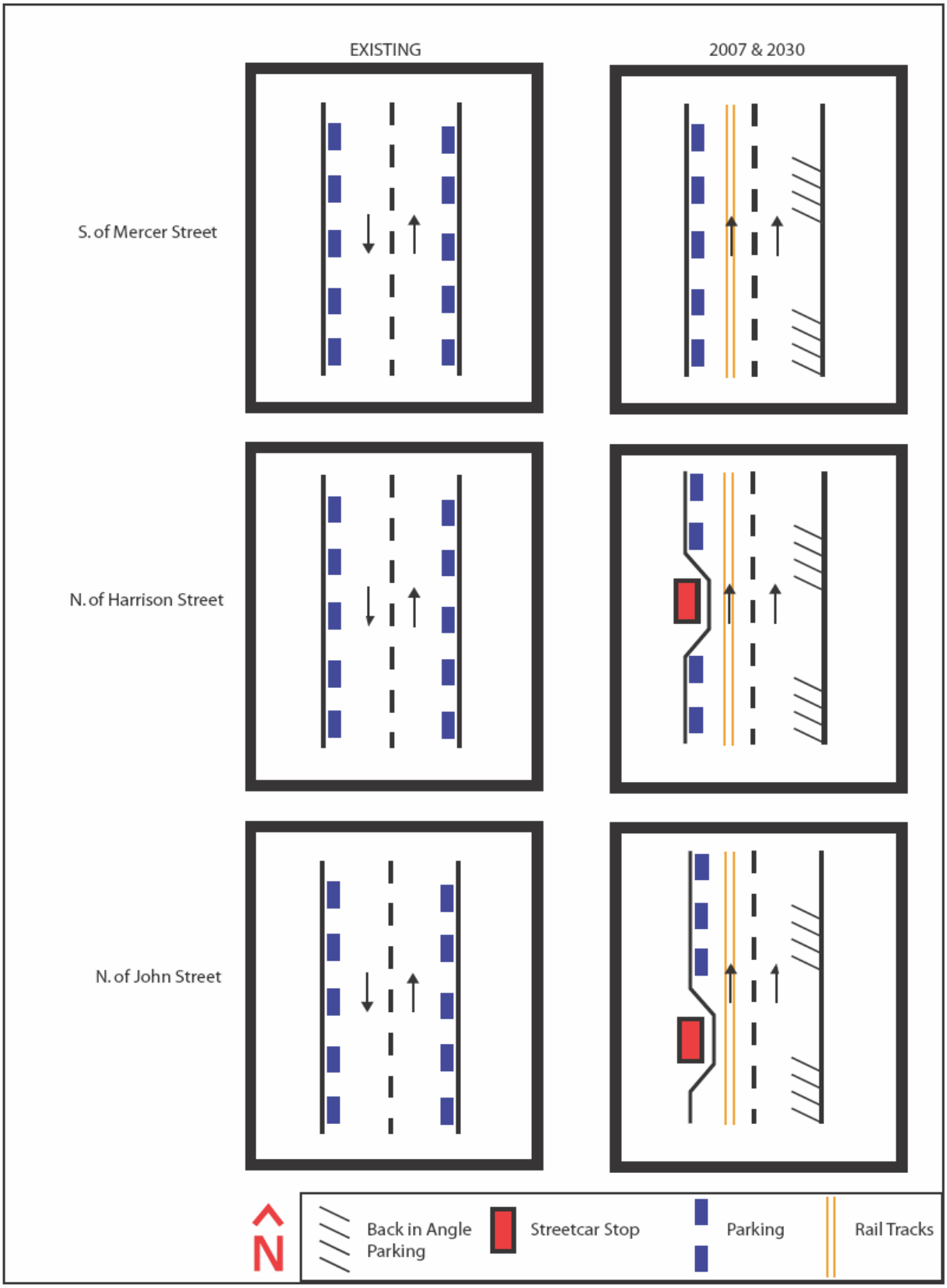

Figure 6-3: Existing and Proposed Terry Avenue Configuration

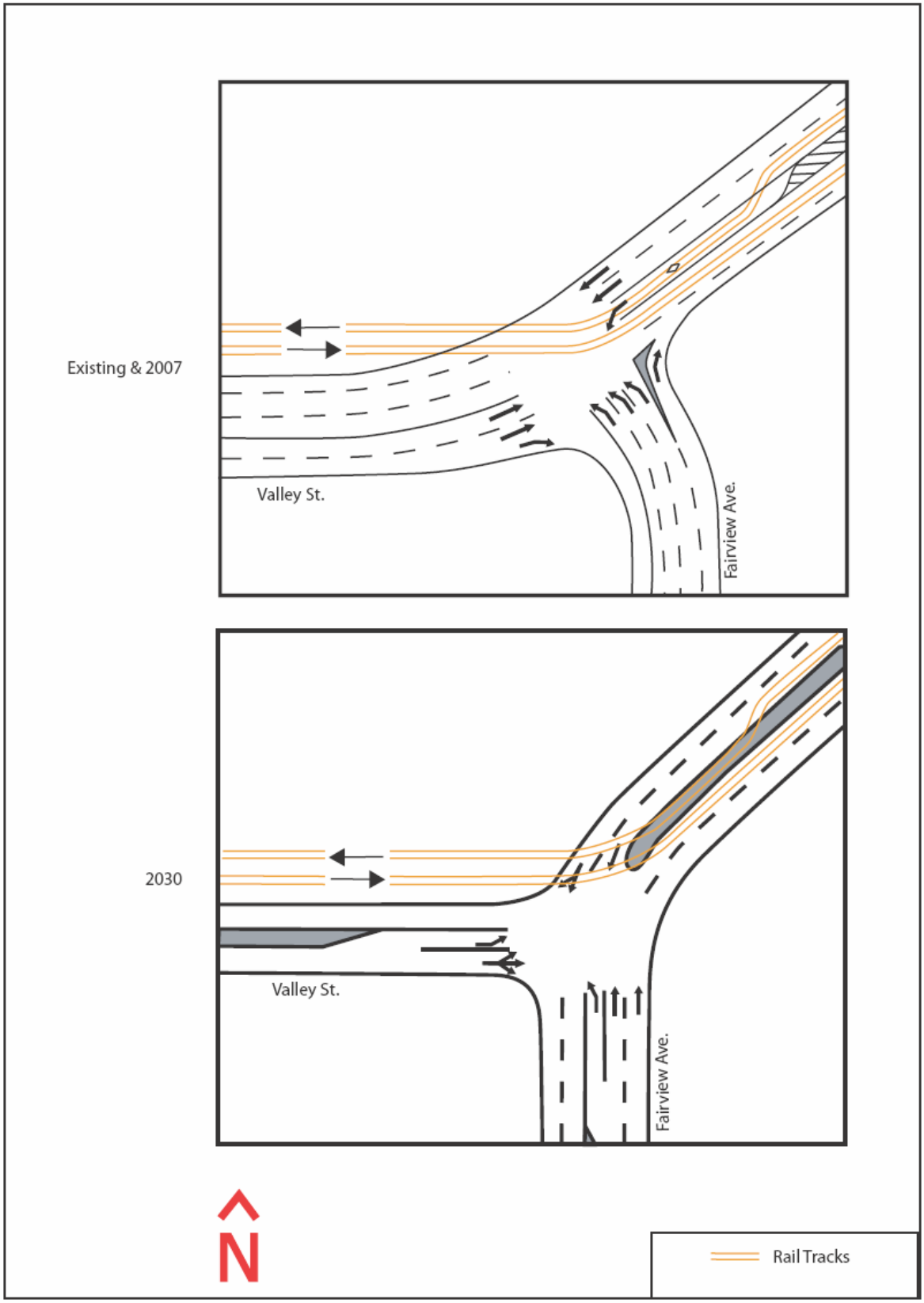

Figure 6-4: Existing and Proposed Fairview Avenue Configuration

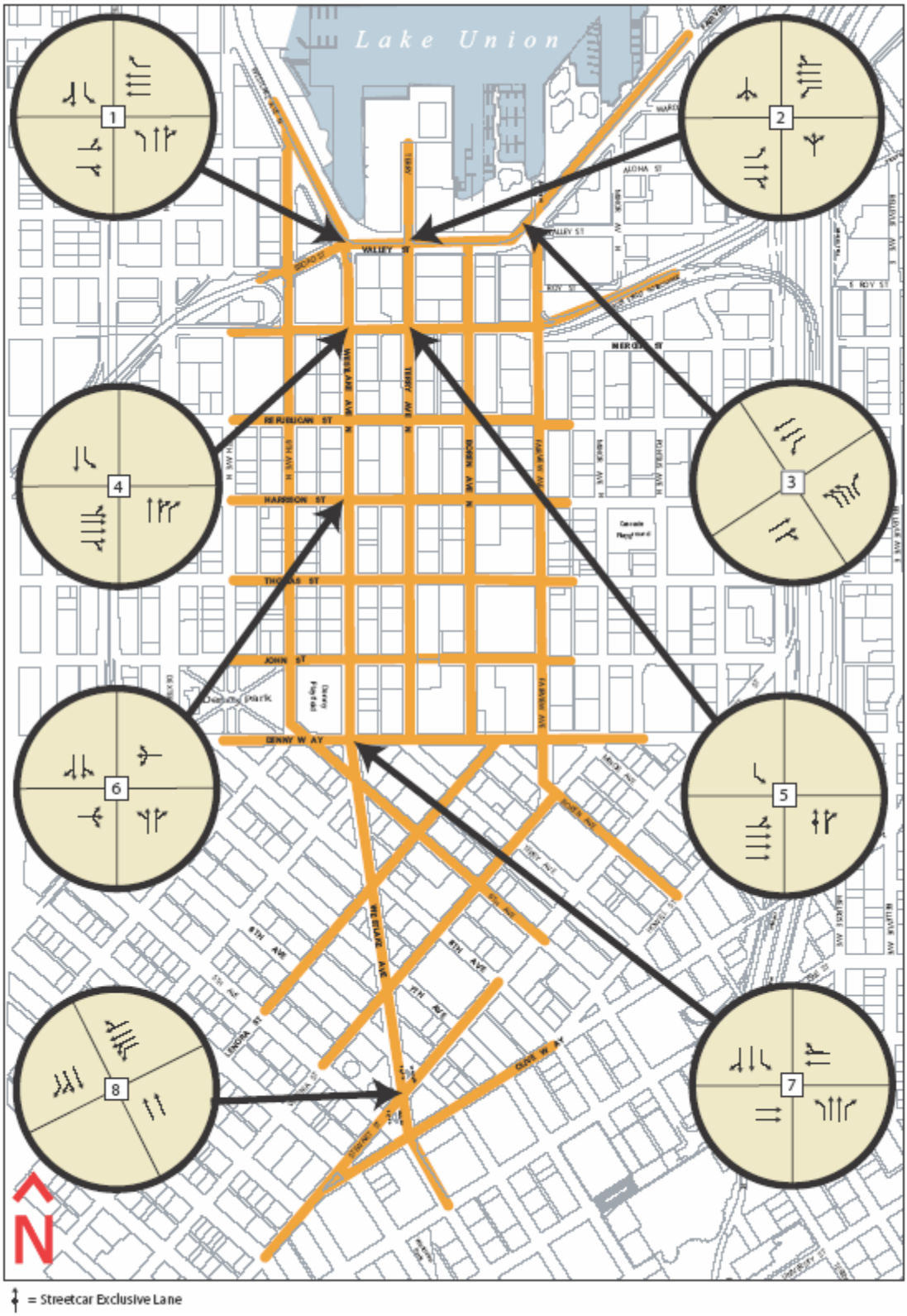

Figure 6-5: Future 2007 Lane Geometry

2030 Network Changes

Network changes for the long-range 2030 scenarios assume the same reconfigurations described for the 2007 scenarios for Westlake and Terry avenues and the same driveway consolidation efforts near the intersection of Fairview Avenue/Valley Street (for Build conditions). These roadway changes also include other major street conversions, arterial realignments and intersection-level geometric improvements within the study area.

The additional 2030 long-range network changes reflect the intersection and arterial improvements outlined in the SLU Transportation Study and center on the widening and conversion of Mercer Street to a two-way arterial. A summary of the 2030 improvements (beyond those assumed for the 2007 Streetcar network) is shown in Table 6-1.

Table 6-1: 2030 Network Assumptions (Beyond 2007 Network Changes)

Arterial or Intersection	Limits of Improvement	Description
Mercer Street	5th Avenue to Fairview Avenue	Widen to seven/eight lanes and convert to two-way.
Valley Street	Westlake Avenue to Fairview Avenue	Narrowed cross-section to three lanes with one lane each direction and left-turn pockets. Deemphasized vehicular traffic function.
9th Avenue	Westlake Avenue to south of Denny Way	Convert to two-way operations.
Harrison Street	5th Avenue to Fairview Avenue	New connection over SR-99 (bridge) and add center left-turn lane to increase capacity.
Fairview/Valley	Intersection	Realign Fairview Avenue to serve as a primary north-south through arterial (two lanes each direction with center left-turn lane). Deemphasize Valley Street, as described previously.
Broad Street	Between 9th Avenue and Westlake Avenue, West of 9th Avenue to 5th Avenue	Remove/eliminate segment west of 9th Avenue to 5th Avenue. Narrow Broad Street between 9th Avenue and Westlake Avenue.

The changes discussed previously are reflected in Figure 6-6 and highlight the 2030 intersection lane configurations at the selected hot spot locations. However, despite these changes for the 2030 scenarios, the *arterial* lane configurations shown in Figures 6-2 through 6-4 for 2007 conditions would apply to the long-range 2030 conditions, because no impacts to Westlake Avenue and Terry Avenue would arise from the Mercer Street and Valley Street modifications. In addition, the changes to Mercer Street, Valley Street, Harrison Street, and 9th Avenue would not impact the alignment of the streetcar line or the Westlake Avenue and Terry Avenue cross-sections.

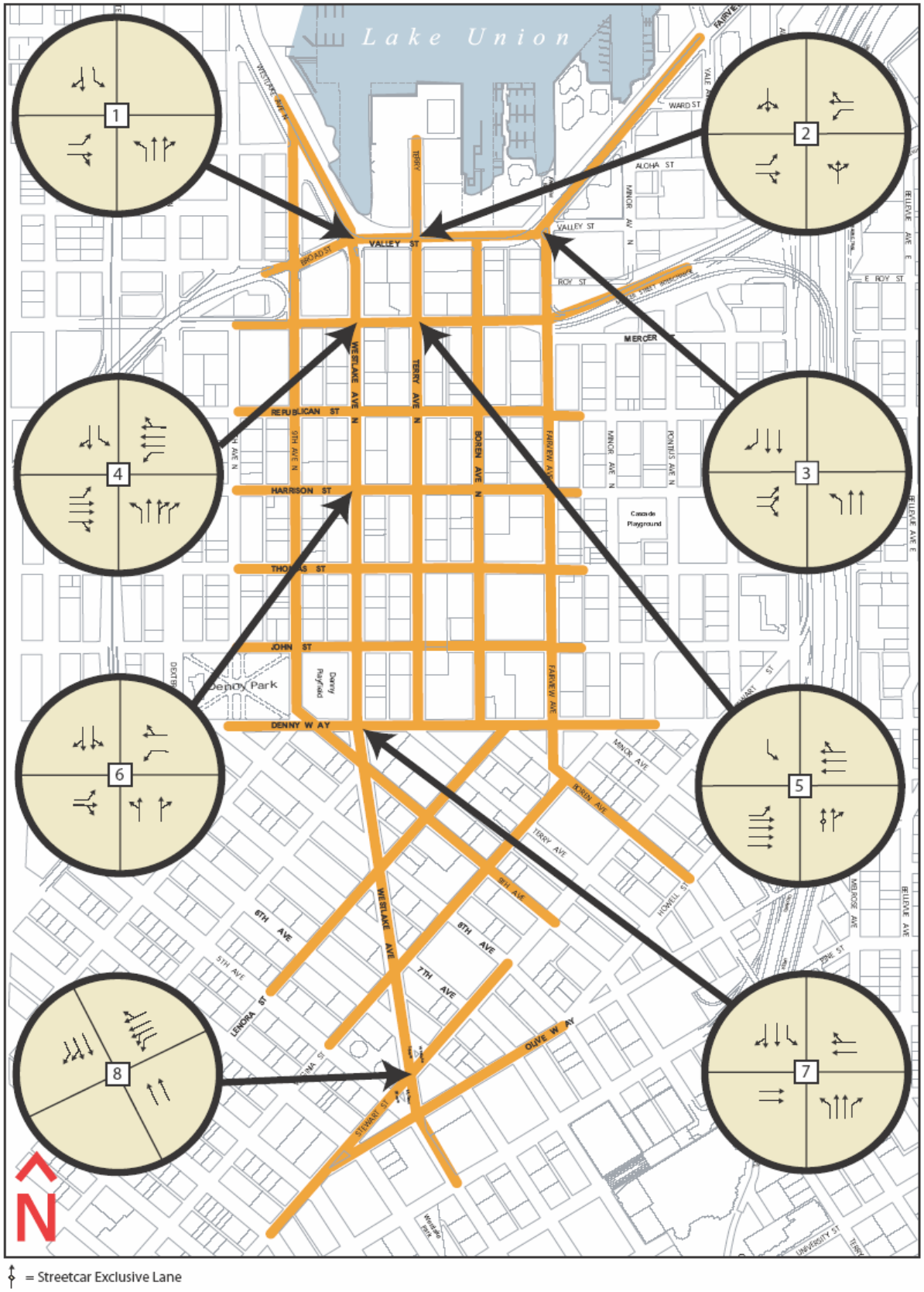

Figure 6-6: Future 2030 Lane Geometry

6.2 PM Peak-Hour Traffic Forecasts

2007 Turning-Movement Volumes

As discussed in the *Methodology* section (Chapter 4), traffic volume forecasts for the 2007 No Build and Build scenarios were developed based primarily on historical traffic volumes (1998-2002), background growth rates related to these historical volumes, and refinements to "raw" traffic forecasts. Similar to the existing conditions analysis, the 2007 scenarios focused on eight intersection locations.

Forecasted intersection volumes for the 2007 No Build and Build scenarios are shown in Figure 6-7 and Figure 6-8. (These figures also include 2007 level of service analysis and average intersection delay results.)

2030 Turning-Movement Volumes

Future PM peak-hour traffic forecasts for the 2030 No Build and Build scenarios were derived from work conducted previously for the SLU Transportation Study based on the City of Seattle's EMME/2 Travel Demand Forecasting model. Aside from the proposed streetcar headways of ten-minutes (i.e. six streetcar vehicles during any given hour with three cars in service), the long-range 2030 No Build and Build scenario traffic volumes were similar.

The long-range 2030 No Build and Build scenario intersection volumes forecasts are shown in Figure 6-9 and Figure 6-10. (These figures also include 2030 level of service analysis and average intersection delay results.)

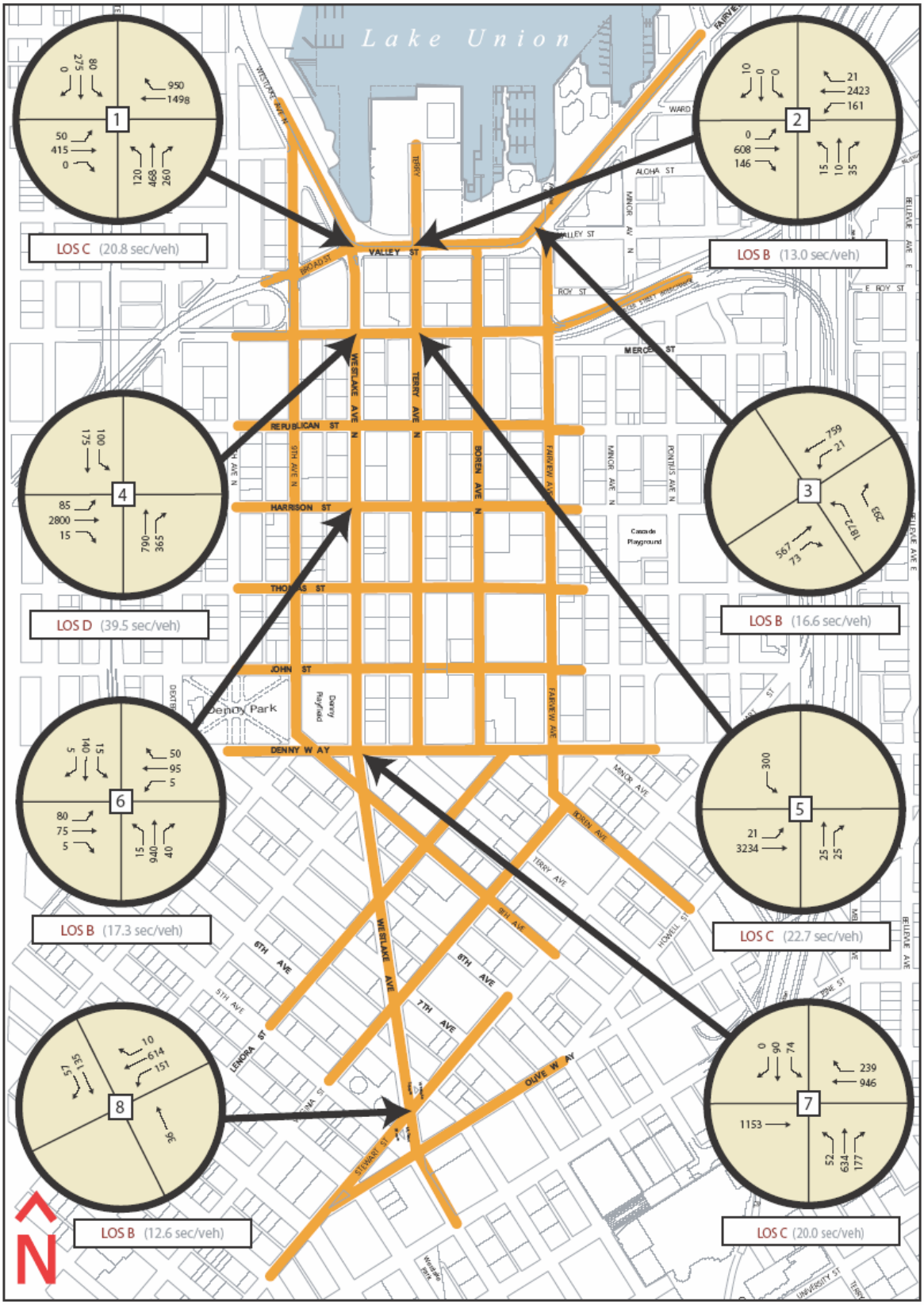

Figure 6-7: 2007 No Build Traffic Volumes and Hot Spot Levels of Service (LOS)

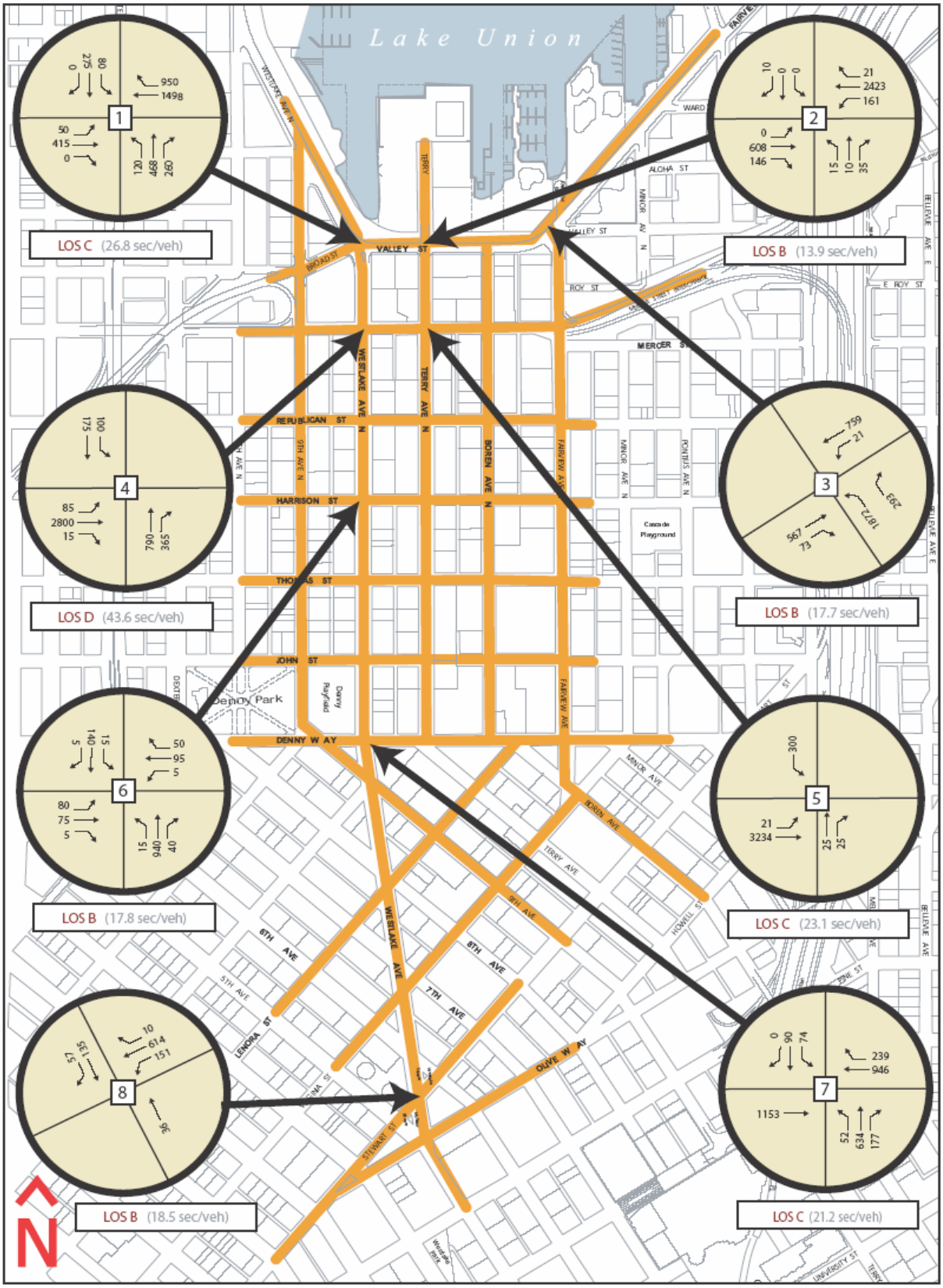

Figure 6-8: 2007 Build Traffic Volumes and Hot Spot Levels of Service (LOS)

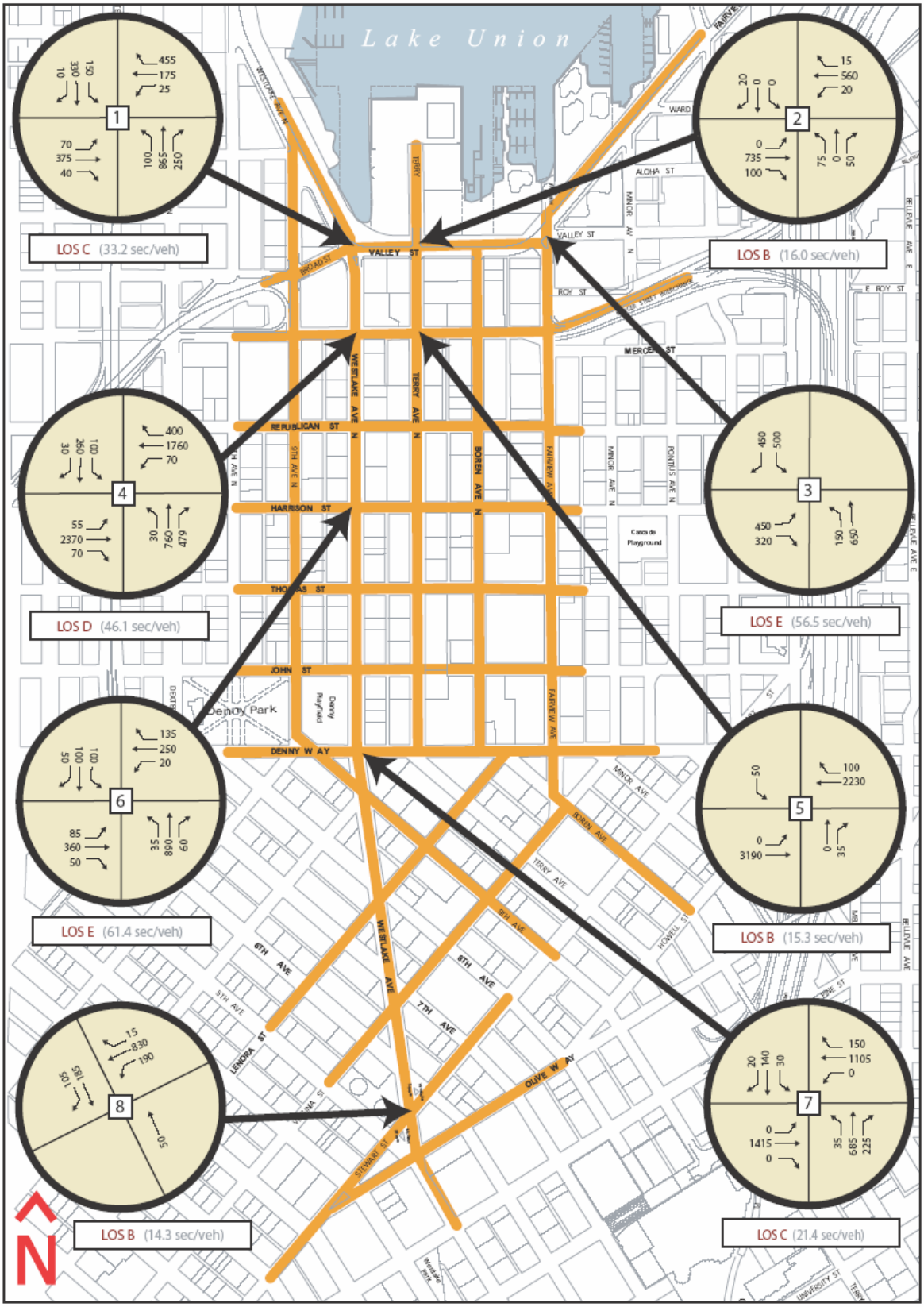

Figure 6-9: 2030 No Build Traffic Volumes and Hot Spot Levels of Service (LOS)

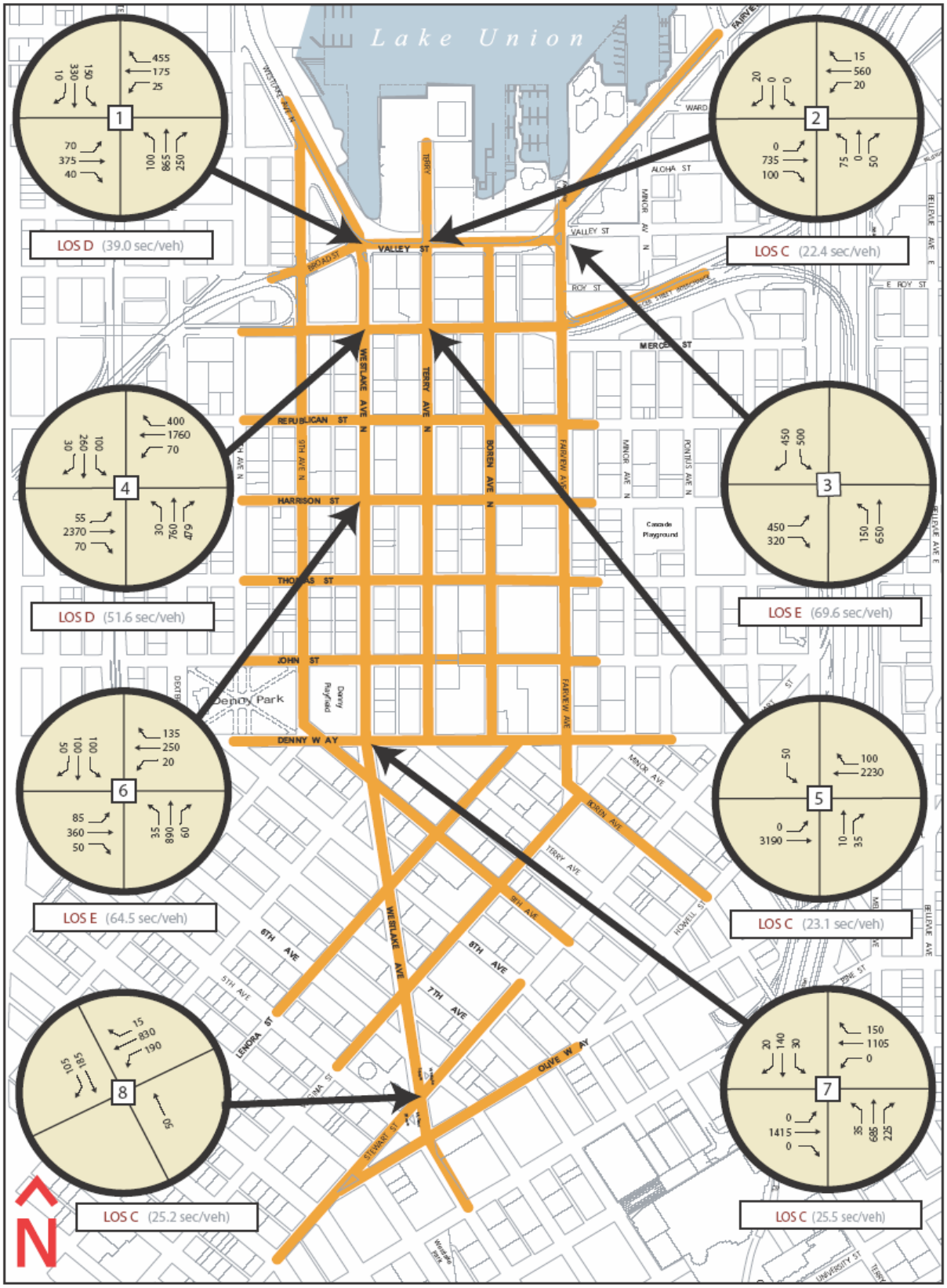

Figure 6-10: 2030 Build Traffic Volumes and Hot Spot Levels of Service (LOS)

6.3 Intersection Level of Service

2007 PM Peak-Hour Level of Service

Short-term operational analysis of 2007 PM peak-hour traffic conditions was performed for the eight hot spot locations again using the Synchro/SimTraffic analysis package. The traffic forecasts derived from historical growth rates (described previously) were used as inputs for the analysis, along with the geometric changes assumed for the critical Westlake and Terry Avenue corridors. Signal timing input data for the 2007 No Build and Build evaluations were modified (compared to the existing conditions analysis), to reflect the critical roadway configuration changes for the north-south arterials.

Network differences between the No Build and Build analysis were minor. They consisted of further signal timing changes, to accommodate exclusive streetcar movements at specific intersections and additional heavy vehicle volumes to represent 15-minute streetcar headways (two streetcar vehicles assumed to be in service). The results of the 2007 No Build and Build analyses are summarized in Figure 6-7 and Figure 6-8 (shown previously) and represented by overall average vehicle delays and corresponding level of service (LOS) estimates.

As shown in Figure 6-7 and Figure 6-8, the average delay results indicate only modest differences between the No Build and Build scenarios for most intersections. This is due to the similarities of the two scenarios with respect to input volumes and overall intersection signal timing. The minor changes for the Build scenario primarily affect specific intersections where exclusive streetcar phases are provided to allow protected vehicle movements. Delay increases at these intersections are generally between 10 and 25 percent. However, these added delays do not result in any changes to overall intersection LOS. Even at intersections where streetcar movements are expected to stop all traffic streams (e.g. at Westlake Avenue/Stewart Street) only minor increases in delay would occur between No Build and Build conditions.

2030 PM Peak-Hour Level of Service

A long-range 2030 operational analysis of PM peak-hour traffic conditions was performed using the Synchro/SimTraffic analysis package for critical intersection locations. As discussed previously, traffic forecasts for 2030 conditions were derived from the SLU Transportation Study and refined to reflect changes to the roadway system not included in the SLU study. The resulting 2030 forecasts were used as inputs for the operational analysis, along with the minor geometric revisions (compared to the SLU Study) assumed for the long-range streetcar plan.

As with the 2007 scenarios, differences between the No Build and Build analysis for 2030 conditions were minor. They consisted of signal timing changes to accommodate exclusive streetcar movements at specific intersections, and additional heavy vehicle volumes to represent ten-minute streetcar headways (based on three vehicles in service).

Analysis results for the 2030 No Build and Build analyses are summarized in Figure 6-9 and Figure 6-10 (shown previously) and are represented by overall average vehicle

delays and level of service. As with the existing conditions and 2007 analysis scenarios, only the eight hot spot locations are reflected in these two figures.

Based on the results shown in Figure 6-9 and Figure 6-10, for most of the intersections the average delay results for Build conditions are only slightly higher that those for No Build conditions. Input volumes and overall intersection signal timings are similar for both the No Build and Build scenarios, so the minor differences in delay are reasonably explained. Nonetheless, delay changes related to the Build scenario are primarily attributed to the exclusive phases needed to protect specific streetcar movements. The delay increases for Build conditions vary noticeably, but do not result in substantial changes in intersection LOS.

For reference, Table 6-2 shows the differences between the existing conditions analysis results and results associated with the four future conditions scenarios (two for 2007 and two for 2030).

Table 6-2: Comparison of Hot Spot Delays and Level of Service

		Existing		2007 No Build		2007 Build		2030 No Build		2030 Build	
Intersection	I.D.	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Valley St & Westlake Ave	1	12.2 sec/veh	B	20.8 sec/veh	C	26.8 sec/veh	C	33.2 sec/veh	C	39.0 sec/veh	D
Valley St & Terry Ave	2	6.4 sec/veh	A	13.0 sec/veh	B	13.9 sec/veh	B	16.0 sec/veh	B	22.4 sec/veh	C
Fairview Ave & Valley St	3	17.4 sec/veh	B	16.6 sec/veh	B	17.7 sec/veh	B	56.5 sec/veh	E	69.6 sec/veh	E
Mercer St & Westlake Ave	4	31.3 sec/veh	C	39.5 sec/veh	D	43.6 sec/veh	D	46.1 sec/veh	D	51.6 sec/veh	D
Mercer St & Terry Ave	5	29.9 sec/veh	C	22.7 sec/veh	C	23.1 sec/veh	C	15.3 sec/veh	B	23.1 sec/veh	C
Harrison St & Westlake Ave	6	14.6 sec/veh	B	17.3 sec/veh	B	17.8 sec/veh	B	61.4 sec/veh	E	64.5 sec/veh	E
Denny Way & Westlake Ave	7	16.2 sec/veh	B	20.0 sec/veh	C	21.2 sec/veh	C	21.4 sec/veh	C	25.5 sec/veh	C
Stewart St & Westlake Ave	8	11.5 sec/veh	B	12.6 sec/veh	B	18.5 sec/veh	B	14.3 sec/veh	B	25.2 sec/veh	C
Northbound Travel Time		---		---		7.2 min		---		9.6 min	
Average Vehicle Speed		---		---		9.1 mph		---		6.9 mph	
Southbound Travel Time		---		---		7.4 min		---		8.3 min	
Average Vehicle Speed		---		---		8.8 mph		---		7.8 mph	

From this comparison, some differences in delay for the 2007 No Build and Build scenarios are found for the intersections of Valley Street/Westlake Avenue and Mercer Street/Terry Avenue. For example for the Build scenario, delays at Valley Street/Westlake Avenue are slightly greater than for No Build conditions. This is due to the exclusive signal phase required to protect the westbound-to-southbound movement from the railbank (eastbound) to Westlake Avenue (southbound). For the eight intersections analyzed, there were differences in the amount of delay projected for the 2007 No Build and 2007 Build scenarios, but the overall level of service remained the same for all eight.

Comparing the 2030 No Build and 2030 Build scenarios, four intersections show no change in the overall level of service and four intersections show a level of service that is decreased by one grade. The two intersections with the lowest projected level of service in 2030 (Fairview/Valley and Westlake/Harrison) would be at Level of Service E in both the Build and No Build scenarios.

6.4 Construction Impacts

Detailed technical analysis of traffic operations for the construction phase (2006-2007) was not conducted, under the premise that only minor disruptions to traffic flow would occur. During track construction along Westlake Avenue north of Denny Way, the existing four-lane cross-section would be reduced to two northbound travel lanes and parking would be maintained on the east side of the street. Maintaining three lanes of northbound traffic may also be possible for most of the track construction process, because staging activity could be contained within the west side parking lane. However, when lane re-striping begins for converting the arterial to two-way traffic (e.g. to delineate a centerline, left-turn pockets, etc), closure of two travel lanes in addition to the west parking lane may be required for one or more days.

Implementation and phasing of the rail tracks and station improvements would be achieved while maintaining reasonable traffic capacity (i.e., keeping a minimum of two lanes northbound open along Westlake Avenue). As discussed previously, based on standard construction practices, signal modifications and installation of new signals would be made without major disruptions to traffic on Westlake or Terry avenues.

Thomas Street would likely be closed between Westlake Avenue and Terry Avenue during track construction and staging. The duration of these closures would be relatively short (a few weeks), because the construction would only affect one block of Thomas Street. Alternative routes such as Harrison Street and John Street would be sufficient for the short duration anticipated.

Lane closures on Fairview Avenue would occur for the inside (nearest the centerline) lanes between Valley Street and Ward Street. These impacts could be limited to a single direction at a time (construct one side first, then the other side) to minimize capacity reductions, especially during high traffic-volume periods of the day. Similar construction activities would take place in Valley Street near Fairview Avenue for the maintenance base access tracks.

With lane closures on Fairview Avenue, the transition of Valley Street into Fairview Avenue would be constrained, particularly when the northbound track is constructed and one northbound lane on Fairview Avenue is closed. Also, access to businesses on the north side of Valley Street (and west of Fairview Avenue) would likely be rerouted during the construction process to facilitate efficient construction movement.

General impacts that may result during the streetcar construction phase may include:

1) Slightly increased congestion and delays along Westlake Avenue (northbound direction), particularly at the intersection of Westlake Avenue/Mercer Street when final construction and re-striping efforts begin.
2) Terry Avenue southbound traffic redistribution to alternative streets such as Boren Avenue, Fairview Avenue, or 9th Avenue (due to one-way conversion).
3) Slightly increased travel times for King County Metro Bus Route 17 on Westlake Avenue due to reduced capacity (especially when two lanes are closed).

4) Increased delays on Fairview Avenue and Valley Street due to the construction-related capacity reduction on Fairview Avenue (particularly northbound from Valley Street to Ward Street).

5) Short-term traffic disruption on Thomas Street due to track construction and staging. The segment between Westlake Avenue and Terry Avenue would be closed to general-purpose traffic (both directions).

6.5 Parking Impacts

Parking availability along Westlake Avenue north of Denny Way would be reduced as a result of the one-way to two-way conversion discussed previously. For both the 2007 and 2030 horizon years, center left-turn pockets on Westlake Avenue are assumed to be provided at intersections such as Valley Street, Mercer Street, Republican Street, and Denny Way. In order to accommodate these left-turn pockets, removal of parking on both sides of the arterial (only part of the blocks) would be required to dedicate sufficient width for the additional turn lane. Parking loss on Westlake Avenue specifically related to the streetcar line would only consist of approximately 9 to 12 spaces for curb bulbs required for the streetcar station platforms. With the planned reconstruction of Terry Avenue to a one-way pedestrian and retail-oriented corridor, defined parking spaces would be added to the hardscape as part of the long-term design. The Terry Avenue design would likely include back-in angle parking on the east side of Terry Avenue and parallel parking spaces on the west side. Table 6-3 summarizes the estimated parking supply for Westlake Avenue in 2007 and 2030.

Table 6-3: Westlake Avenue Parking – Valley Street to Stewart Street

Year	Westside	Eastside	Total	Difference
Existing	110	84	194	---
2007 Year-of-Opening	72	77	149	-45
2030 Long-Range	59	61	120	-74

As shown from Table 6-3, compared to the existing parking inventory on Westlake Avenue, a net loss of 40 to 50 spaces could occur by the 2007 horizon with the conversion to two-way operations. By the 2030 horizon year, a reduction of 70 to 80 spaces could occur. The difference between the 2007 and 2030 parking losses would be attributed to longer (and greater numbers of) left-turn storage pockets by the 2030 horizon. Specifically related to the streetcar line, a reduction of roughly nine to twelve parking spaces total are expected on Westlake Avenue for the segment between Denny Way and Valley Street. These impacts would primarily consist of loss of parking at stop locations where designated curb bulbs are needed. The curb bulbs would allow in-lane stops and minimize the number of bends in the overall streetcar alignment. For each curb bulb used, approximately two to four parking spaces would be removed, depending on the length and requirements of the specific stop location. South of Denny Way, parking impacts on Westlake Avenue would also relate to new curb bulbs required for the various streetcar stations (in both directions).

Construction of the streetcar tracks would eliminate informal off-street parking in the railbank area. As discussed in Chapter 5, parking availability in this zone is undefined due to an absence of any delineation or markings, but a total of 40 to 45 parking spaces were estimated based on a field count of parked vehicles (weekday count during mid-day). These parking spaces would be permanently removed. The removal of this parking would not cause an impact because there is available parking capacity within the study area, including pay lots at the following locations, which are within one to two blocks of most eliminated street parking:

- North of Valley Street at Boren Avenue N.
- Northeast corner of Terry Avenue N. and Republican Street
- North and south of Harrison Street between Terry Avenue N and Boren Avenue N
- Between Westlake Avenue N and Terry Avenue N between Thomas Street and Harrison Street
- Southeast corner of Thomas Street and Westlake Avenue N.
- Northeast corner of Westlake Avenue N. and Denny Way, and
- Southeast corner of Westlake Avenue and 8th Avenue.

6.6 Non-Motorized Impacts

6.6.1 Pedestrians

Streetcar impacts to pedestrian circulation within the study area would generally be modest in terms of specific impacts to existing sidewalk facilities and intersection crossings. No substantial measures are anticipated to be needed to maintain pedestrian mobility within the study area.

6.6.2 Bicycles

In general, streetcar impacts to bicycle travel can occur in two ways: one is when the cyclists need to cross the streetcar tracks, and the other is when the tracks are parallel to a lane where bicycles travel. Crossings can be accommodated, and the ideal crossing angle is ninety degrees. Parallel travel can be accommodated if the tracks are in the inside lanes and cyclists can use the outer lanes.

Bicycle travel on Fairview Avenue between Valley Street and Ward Street would continue to occur on the outside (curbside) lanes, where the streetcar tracks are in the inside lanes. On Valley Street, cyclists will need to cross the mainline streetcar tracks near Fairview Ave N. and at Westlake Ave N., as well as the maintenance base access tracks (near Boren Ave. N.). Along Westlake Avenue between Olive and Thomas streets, where the streetcar tracks are in the outer travel lanes that would typically be used by cyclists, cyclists will be required to use alternate routes.

Chapter 7 Mitigation

7.1 Short-Term (2007) Measures

The key roadway and traffic circulation elements included as part of the initial streetcar line are expected to adequately serve study area needs from a vehicular traffic operations standpoint. As shown by the technical analysis results, in the short-term the traffic impacts from streetcar operations would not warrant substantial mitigation measures in terms of general roadway capacity or traffic control.

To address and minimize potential bicycle impacts at track crossings, the track and roadway channelization should be designed to make the crossings as close to 90 degrees as possible.

7.2 Long-Range (2030) Measures

Consideration for a northbound right turn pocket at Denny Way/Westlake Avenue may be required prior to 2030 to accommodate heavy right turn vehicles from Westlake Avenue to Denny Way. While this measure is not needed by the 2007 horizon, some treatment for right turn vehicles (and subsequently streetcar movements) may be needed prior to the long-range 2030 design year. Based on the long-range traffic analysis results, streetcar-related traffic impacts (i.e. Build conditions vs. Baseline conditions) would not trigger any other mitigation needs; therefore, none are proposed.

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