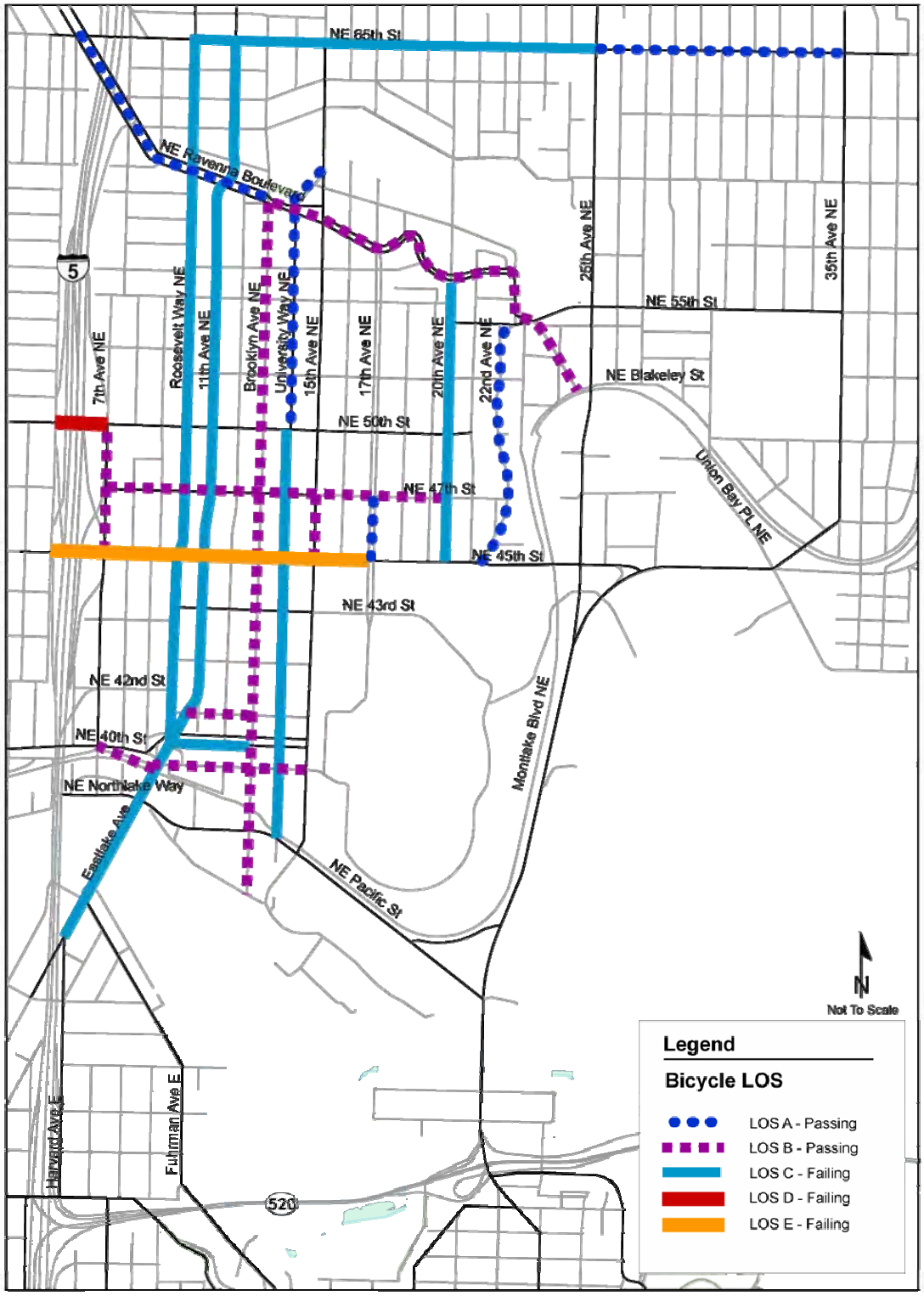
Figure 11. Bicycle Level of Service Results



TRANSIT SYSTEMS

Transit in the UATAS study area is an important part of the transportation system. King County Metro, Community Transit, Sound Transit and the University of Washington all provide transit services within the area.

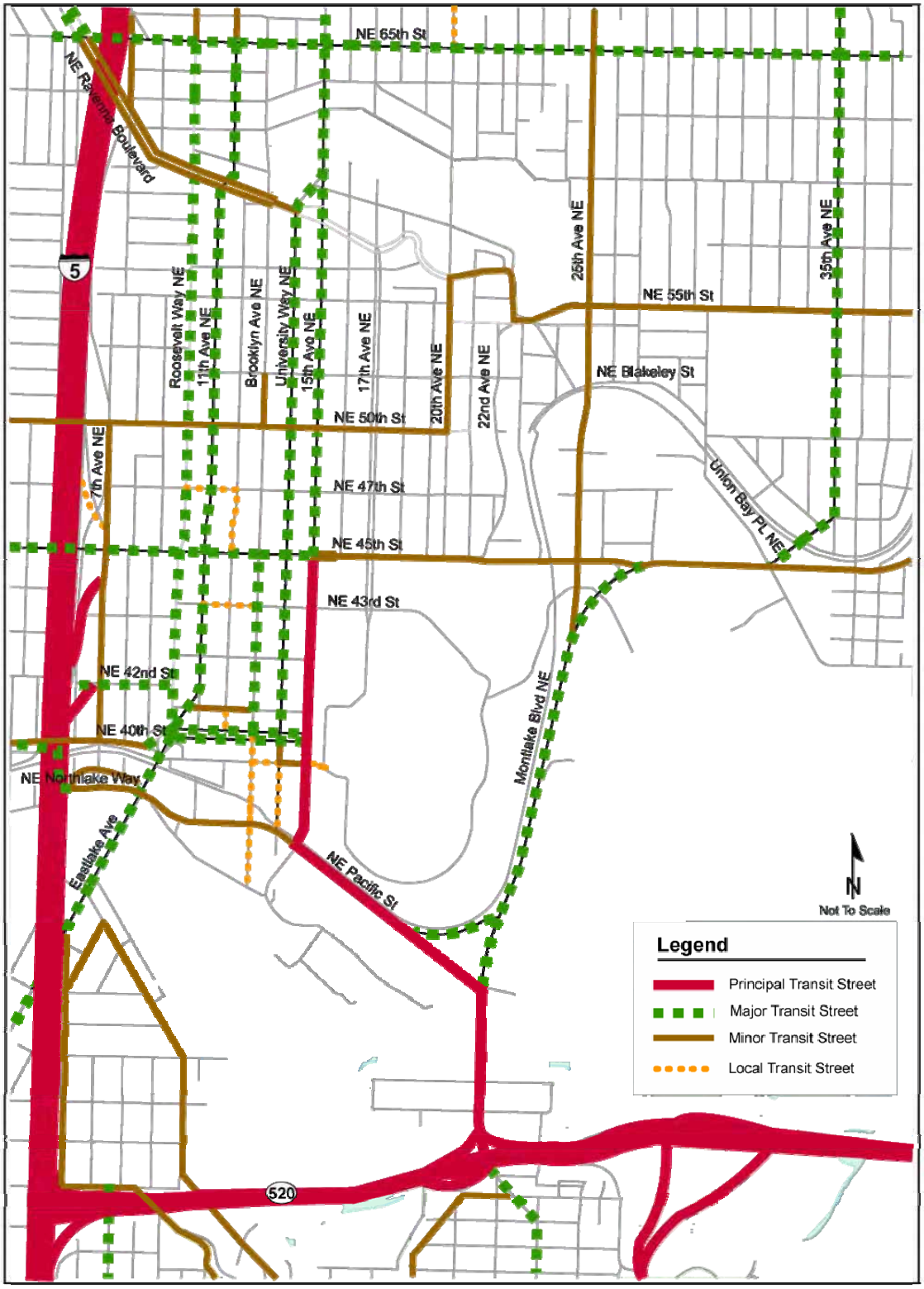
In 2005, the City of Seattle developed the *Seattle Transit Plan*, to provide a vision of the future transit system within Seattle and a strategy to better connect urban villages and major activity centers. The purpose of the plan is to help the City plan and coordinate transit service improvements and to commit to developing arterial streets to maintain transit speed and reliability. A key component was the designation of a transit street classification and Urban Village Transit Network (UVTN) corridors. **Figure 12** shows the transit classification of the roadway network as designated by the *Seattle Transit Plan*. The transit streets are designated with the following definitions:

- Transit Way: Provides frequent, high speed, high capacity and intermediate capacity service.
- Principal Transit Street: Provides for high-volume transit service, often for regional or citywide trips.
- Major Transit Street: Provides concentrated transit service to connect and reinforce major activity centers and residential areas.
- Minor Transit Street: Provides local and neighborhood transit service.
- Local Transit Street: Provides local and neighborhood transit service.

Transit System Performance

For the UATAS, two kinds of transit performance measures are used: The Urban Village Transit Network (UVTN) and the adequacy of bus shelters. The UVTN is a series of performance measures developed for the *Seattle Transit Plan* in order to assess the adequacy of transit within the city-designated Urban Villages. The bus shelter measure uses King County Metro's standard for provision of bus shelters at locations with 50 or more boardings.

Figure 12. Transit Street Classification



UVTN Performance Measure

The *Seattle Transit Plan* established performance criteria for the evaluation of the UVTN transit services based on key dimensions of transit quality: frequency, span of service, speed, reliability and passenger loading. The *UVTN Monitoring Project* (February 2007) used available monitoring data to provided a status report of the designated transit corridors. In some cases, the report modified the calculation methodology of the performance criteria to match available data. In addition, the report set an interim threshold for the "Span of Service" standard of 12 hours to provide an indication of the progress towards the meeting the ultimate goal of 18 hours. For the UATS report, we used the 18-hour service goal set in the *Seattle Transit Plan.* **Table 8** defines each of the performance measures and provides the UVTN threshold for evaluation.

Table 8. UVTN Criteria and Thresholds for Transit Corridors

UVTN Criteria	Definition	Threshold
Frequency of Service	The length of time in minutes between scheduled transit arrivals	15 minutes or less
Span of Service	The number of hours that service operates at 15 minutes or less headways	18 hours or more
Speed	The percent of the average operating speed is to the posted speed limit	30% of the posted speed limit
Reliability	The actual travel time compared to the base travel time using an index	0.4 or less
Loading	The passenger load as a percent of seat capacity	90% of seated capacity

The *UVTN Monitoring Project* report evaluated the performance measurements of the designated transit corridors. **Figures 13 through 17** indicate the results of the five performance criteria. **Table 9** summarizes the UVTN findings.

Figure 13. Transit Frequency – Maximum Headways during Mid-day Hours

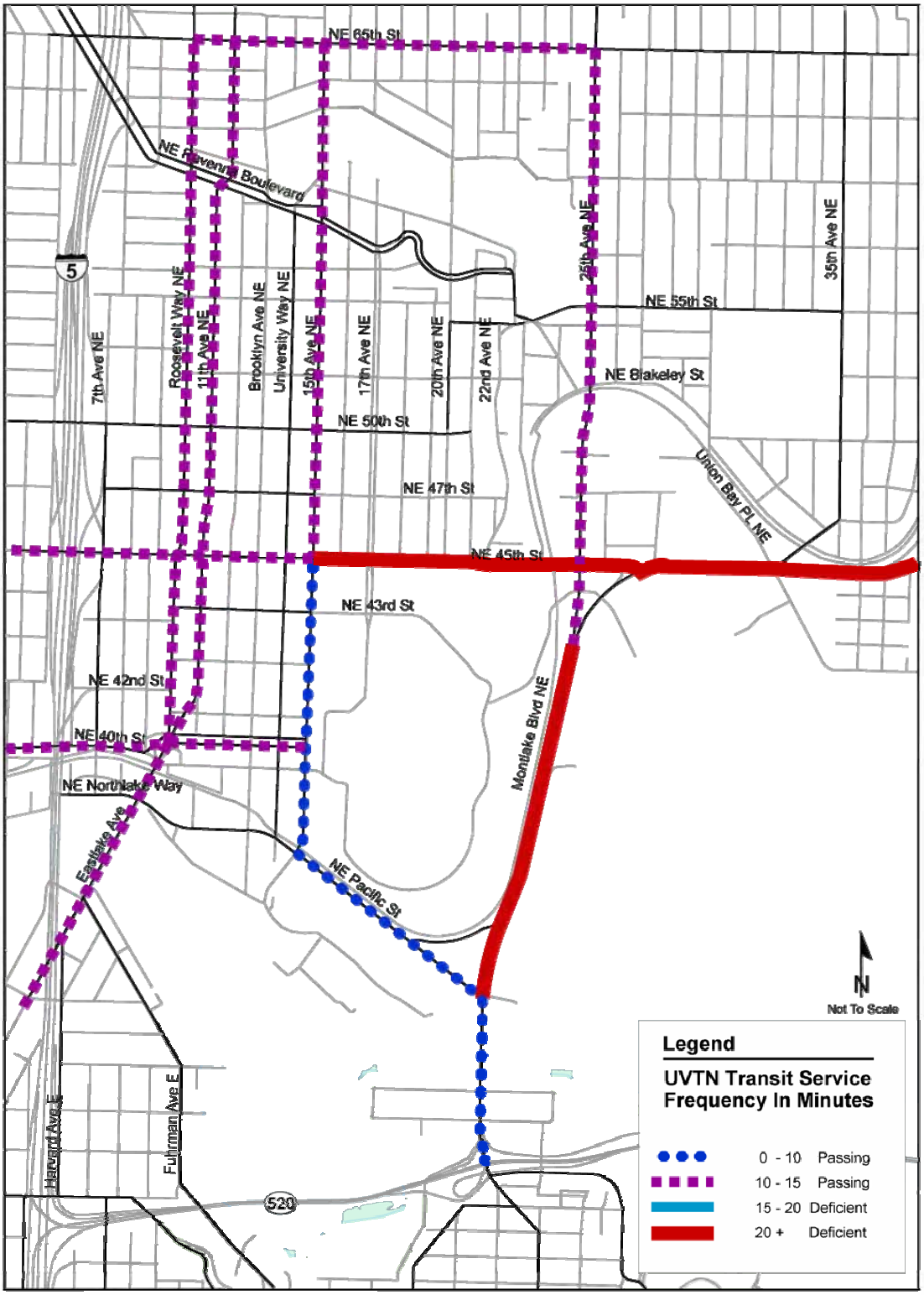


Figure 14. UVTN Span of Service (Hours operating at 15 minute Headways)

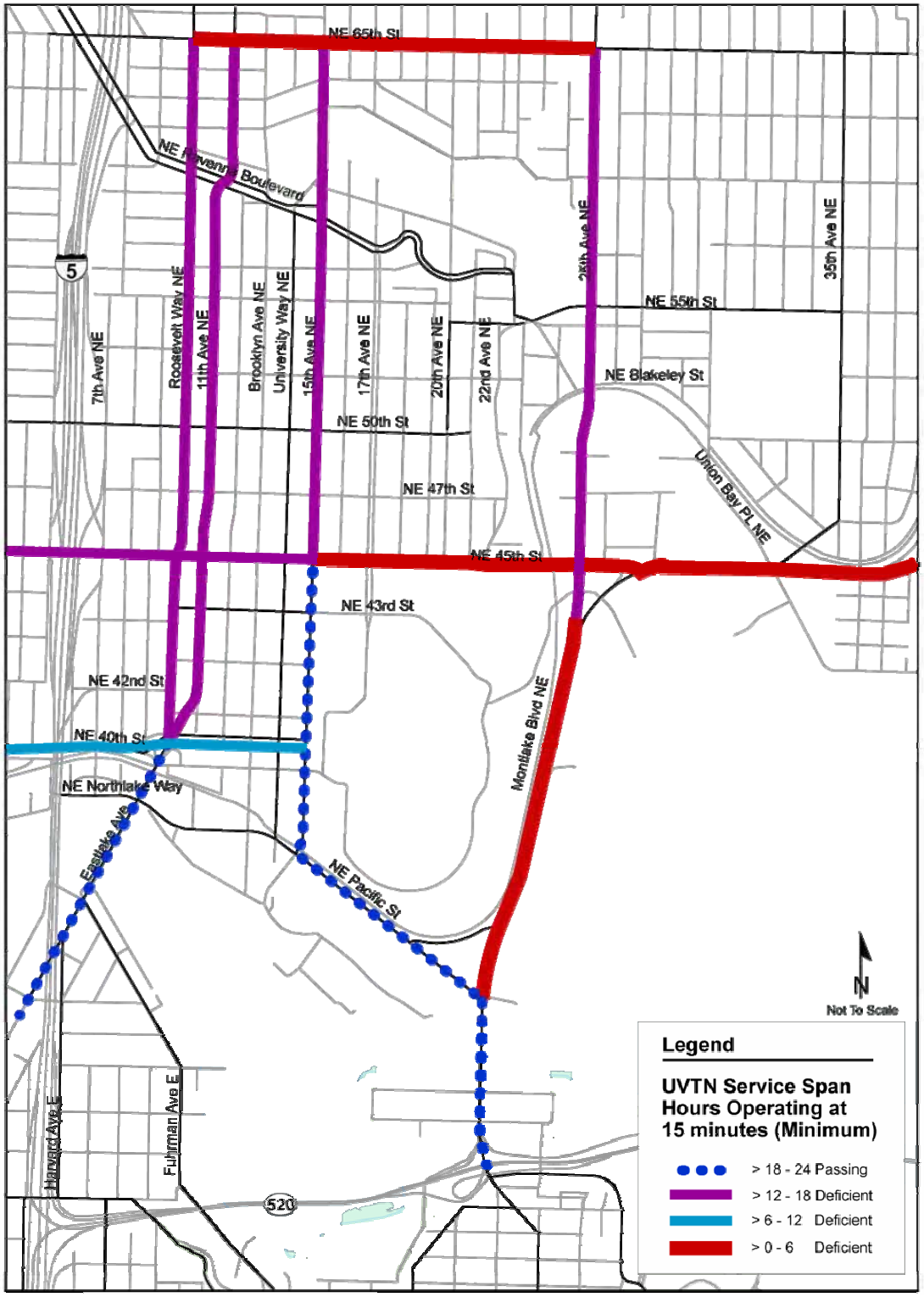


Figure 15. Average Travel Speed to Posted Speed

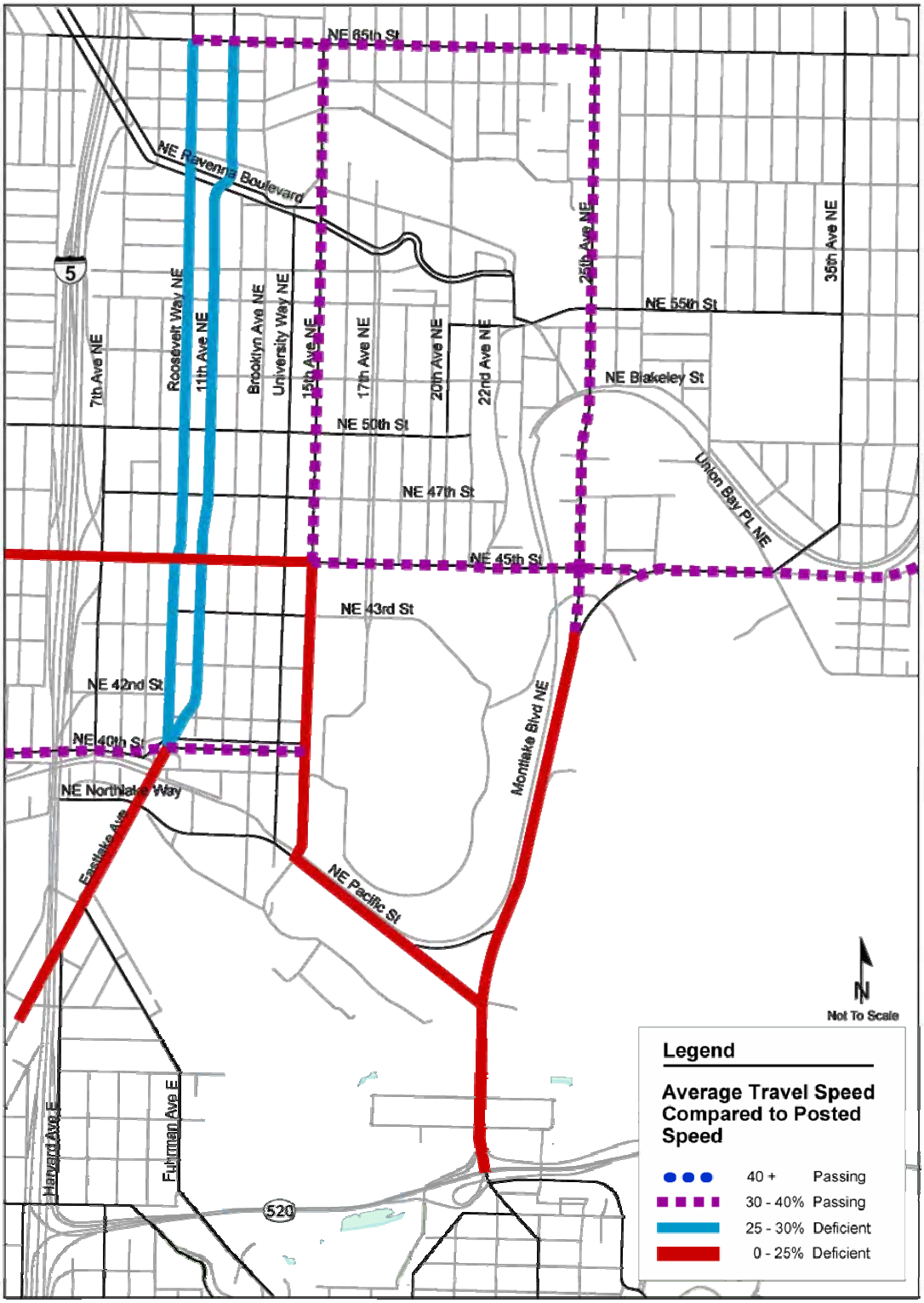


Figure 16. UVTN Service Reliability Index

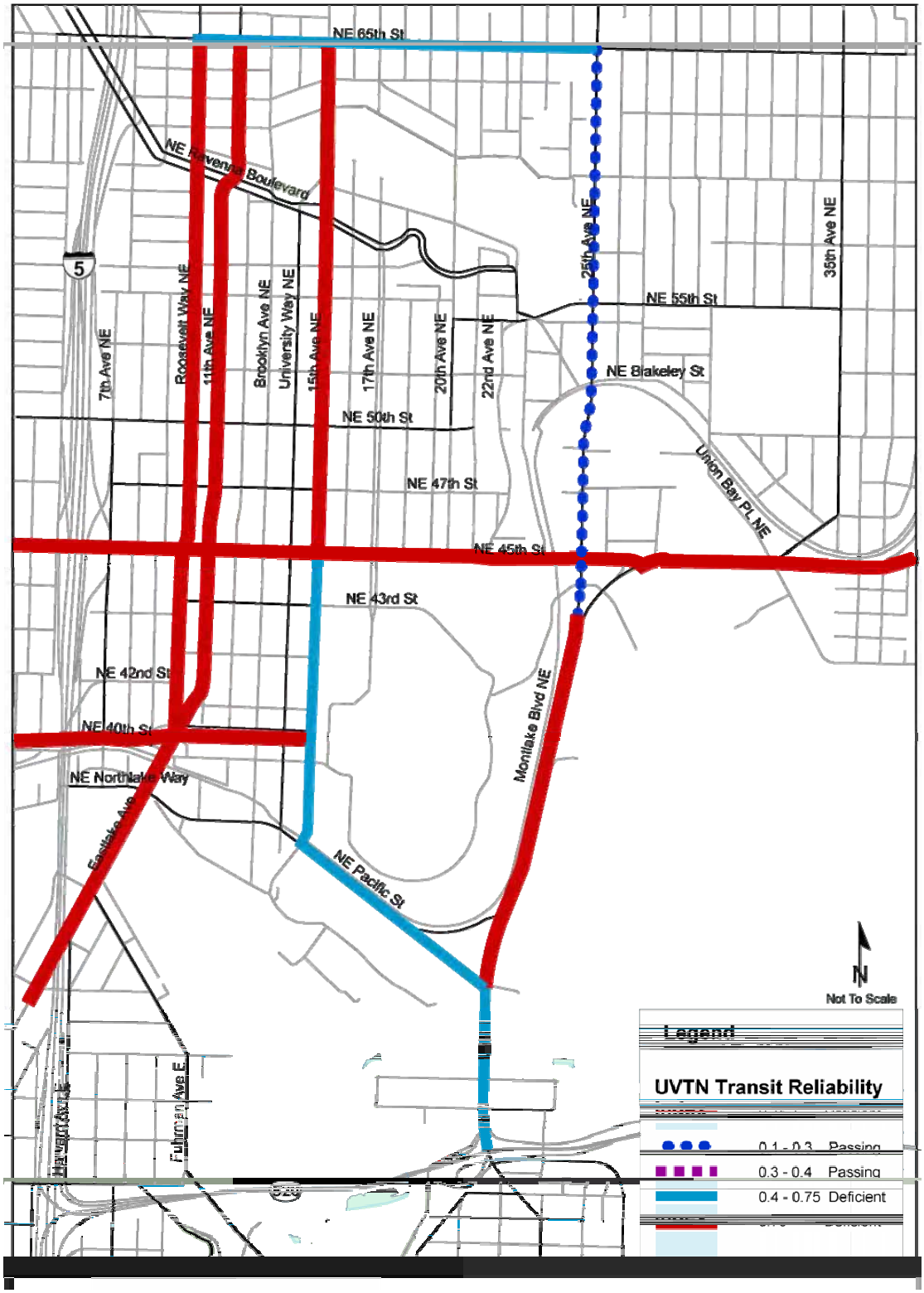


Figure 17. UVTN Passenger Loading (Maximum)

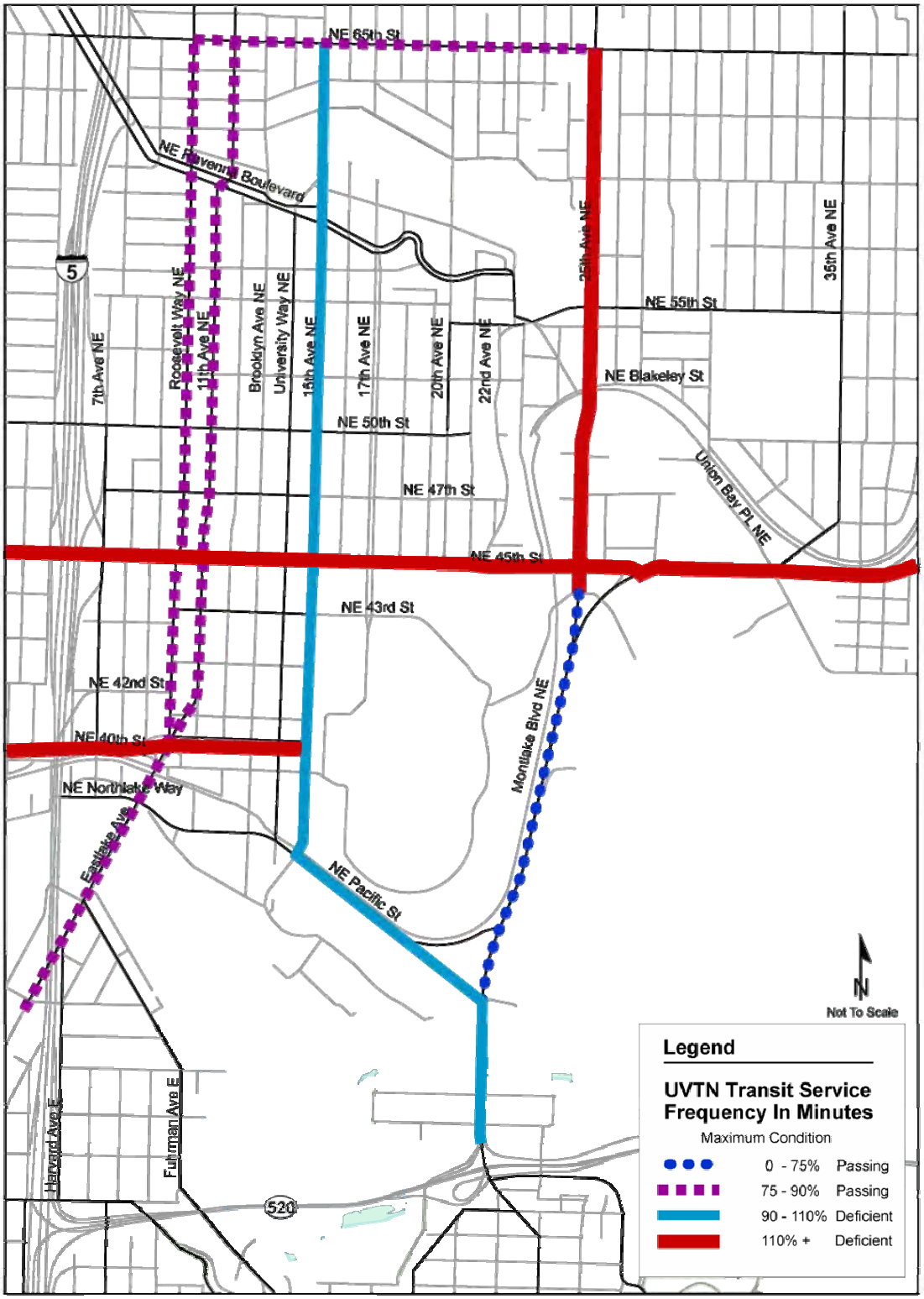


Table 9. UVTN Monitoring Results

ID	Primary Street of Corridor Segment	Limits		Frequency (MAX)	Span (MIN)	Speed (AVG)	Reliability (MAX)	Load (MAX)
1	Fairview/Eastlake	Stewart St	Campus Pkwy	15.0 Pass	18 Pass	24% Fail	1.87 Fail	89% Pass
20	N/NE 45th St	Stone Way N	15th Av NE	15.0 Pass	14 Fail	22% Fail	2.20 Fail	113% Fail
23	N/NE 40th St	Stone Way N	15th Av NE	15.0 Pass	10 Fail	37% Pass	0.92 Fail	127% Fail
26	15th Ave NE	NE 45th St	NE 65th St	15.0 Pass	13 Fail	31% Pass	0.86 Fail	103% Fail
28	25th Ave NE	NE 45th St	NE 65th St	14.6 Pass	12 Fail	37% Pass	0.14 Pass	140% Fail
30	Montlake Blvd NE	NE Pacific St	NE 45th St	N/A Fail	0 Fail	21% Fail	0.79 Fail	36% Pass
31	NE 45th St, Sand Point	15th Av NE	Sand Point Way NE	60.0 Fail	4 Fail	31% Pass	2.20 Fail	113% Fail
32	NE 65th St	Roosevelt Way NE	25th Ave NE	30.0 Fail	5 Fail	32% Pass	0.46 Fail	80% Pass
33	NE Pacific St	Montlake Blvd NE	NE 45th St	4.8 Pass	19 Fail	21% Fail	0.72 Fail	103% Fail
60	11th Ave NE, Roosevelt Wy	NE 40th St	NE 65th St	15.0 Pass	14 Fail	26% Fail	1.11 Fail	79% Pass

MAX based on the highest data point along the corridor
MIN based on the lowest data point along the corridor
AVG based on the average of data points of the corridor

Findings: UVTN Performance

- Of the ten UVTN corridors analyzed:
- 70% have adequate frequency of bus service
- Only two have buses operating at least 18 hours a day
- 50% maintain adequate speeds, but 50% do not
- Only one of the ten maintains adequate reliability (on-time performance)
- 60% are overloaded.

Transit Shelters

King County Metro's standards call for the agency to provide transit shelters at bus stops that have 50 or more boardings per day. There is high transit use and activity throughout the University area. **Table 10** lists the stop locations with 50 or more boardings that do not have a bus shelter in the University area in 2006.

Table 10. Bus Stops without a Shelter with 50 or more Daily Boardings

Stop Reference	Direction	Street	Cross-Street	Daily Boarding (Weekday)
35720	East	NE Campus Pkwy	University Way NE	457
7941	North	25th Avenue NE	NE Blakely Street	416
82155	North	University Way NE	NE 55th Street	227
35741	South	NE Campus Pkwy	11th Avenue NE	156
7912	North	25th Avenue NE	NE 55th Street	138
26860	North	15th Avenue NE	NE 45th Street	128
9900	South	12th Avenue NE	NE 47th Street	117
37670	West	15th Avenue NE	NE 65th Street	101
7880	North	25th Avenue NE	NE 65th Street	88
6652	West	11th Avenue NE	NE 42nd Street	88
24950	South	15th Avenue NE	NE 55th Street	88
28080	South	15th Avenue NE	NE 50th Street	85
38700	North	Roosevelt Way NE	NE 50th Street	75
29429	East	NE 65th Street	15th Avenue NE	73
9575	East	12th Avenue NE	NE 45th Street	72
29140	West	NE 47th Street	11th Avenue NE	62
18040	South	Brooklyn Avenue NE	NE 50th Street	57
25960	North	15th Avenue NE	NE 52nd Street	56
9130	North	11th Avenue NE	NE 50th Street	55

Findings – Bus Shelters

Nineteen bus stops, where there are 50 or more passengers a day, do not have bus shelters.

At Campus Parkway/University Way bus stop, over 450 passengers board the bus each day, but there is no shelter.

The stop at 25th Avenue NE/NE Blakely Street serves over 400 passengers a day, without a shelter.

VEHICLE SYSTEM

The roadway system of the UATAS study area is bordered and restricted on three sides by Interstate 5 to the west, SR 520 to the south and Lake Washington to the east. Bridges and overpasses provide the main connections to the west and south, while traffic continuing to the east side of Lake Washington must funnel south across the Montlake Bridge or travel west to access I-5 to cross on SR 520.

Street Classification

The City of Seattle classifies its streets according the function and purpose of the roadway. Within the UATAS study area, some streets emphasize the movement of traffic while others are focused on providing access to property. **Figure 18** shows the street classification of the arterial roadways within the UATAS study area, which are defined as follows:

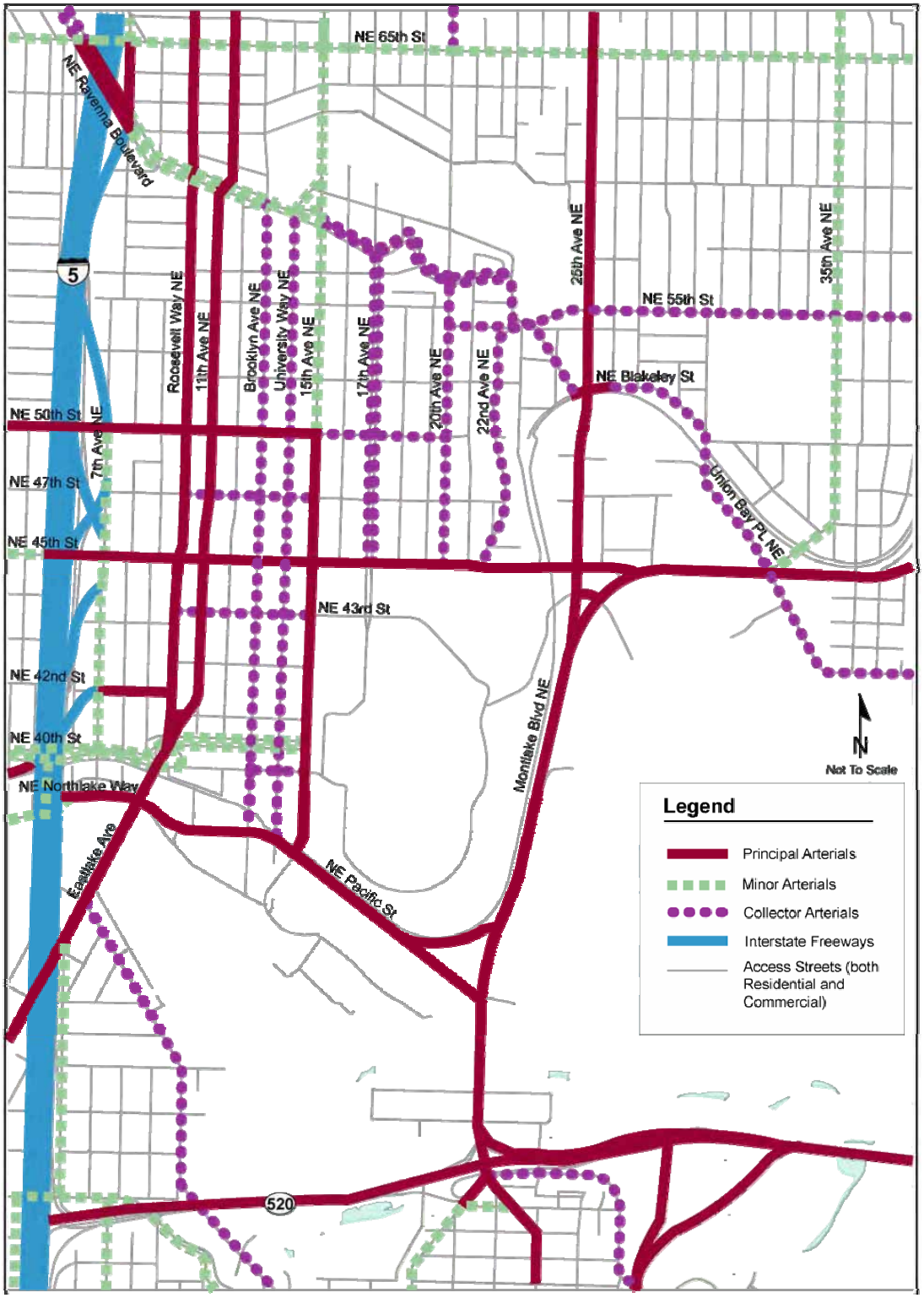
Freeways and Highways: Roadways that provide the highest capacity and least impeded traffic flow for longer vehicle trips. Interstate 5 and State Route 520 circulate traffic to and around the UATAS study area.

Principal Arterials: Roadways that serve as the primary routes for moving traffic through the city connecting urban centers and urban villages to one another, or to the regional transportation network. Montlake Boulevard, NE 45th Street, Eastlake Avenue, 11th Avenue NE, 12th Avenue NE, 25th Avenue NE and portions of NE 50th Street and 15th Avenue NE are classified as principal arterials.

Minor Arterials: Roadways that distribute traffic from principal arterials to collector arterials and access streets. NE 65th Street, NE Ravenna Boulevard, NE 40th Street/Campus Parkway, 15th Avenue NE (north of NE 50th Street) and 35th Avenue NE are all examples of minor arterials within the UATAS area.

Collector Arterials: Roadways that collect and distribute traffic from principal and minor arterials to local access streets or provide direct access to destinations. NE Ravenna Boulevard, NE 55th Street, University Way NE, Brooklyn Avenue NE and 20th Avenue NE are examples of collector arterial streets within the UATAS study area.

Figure 18. Street Classification



Traffic Volumes

The principal arterials carry high volumes of daily and peak hour traffic through the study area. For north-south arterials, Montlake Boulevard NE carries over 45,000 daily trips and over 3,000 trips during the PM peak hour. The Roosevelt Way-11th/12th Avenue couplet carries 22,000 daily trips and 1,700 PM peak hour trips. 25th Avenue NE also carries 18,000 daily trips and 1,300 PM peak hour trips. For east-west arterials, NE 45th Street carries the highest daily (36,000) and peak hour (2,300) traffic, followed by NE Pacific Street (27,000 daily and 2,300 peak). **Figure 19** shows the total average daily trips and **Figure 20** shows PM peak hour volumes by direction on the arterial system.

Traffic Growth Trends

Traffic volumes on roadways within the UATAS area generally have remained level or decreased over the last 16 years. This section describes the daily (1991-2006) and the PM peak hour (2000-2006) traffic trends on north-south and east-west arterial roadways and bridges.

North-South Arterials

The north-south arterial system provides local access to the University area and distributes traffic from the University Bridge and Montlake Bridge (**Figure 21**). To see how volumes have changed over time, 15th Avenue NE, 25th Avenue NE, 35th Avenue NE, Roosevelt Way NE and 12th Avenue NE were reviewed to see changes in volumes during daily and peak travel hours. Traffic volumes have generally been stable or slightly decreasing along north-south arterial roadways. **Figures 22** to **23** show the daily and PM peak hour volume trends.

East-West Arterials

The east-west arterial system provides access to and from Interstate 5 from the University area. Locations along NE 45th Street, NE 50th Street, NE 65th Street and NE Pacific Street were reviewed for changes in volumes during daily and peak travel hours. Over the period, traffic volumes have generally been stable or slightly decreasing along north-south arterial roadways. **Figures 24** to **25** show the daily and PM peak hour volume trends for east-west arterial streets.

Findings – Traffic Volumes

- Over the last 16 years, traffic in major corridors generally remained level or decreased.
- Traffic on both the Montlake and University bridges decreased slightly between 1991 and 2006.

Figure 19. Average Daily Weekday Traffic

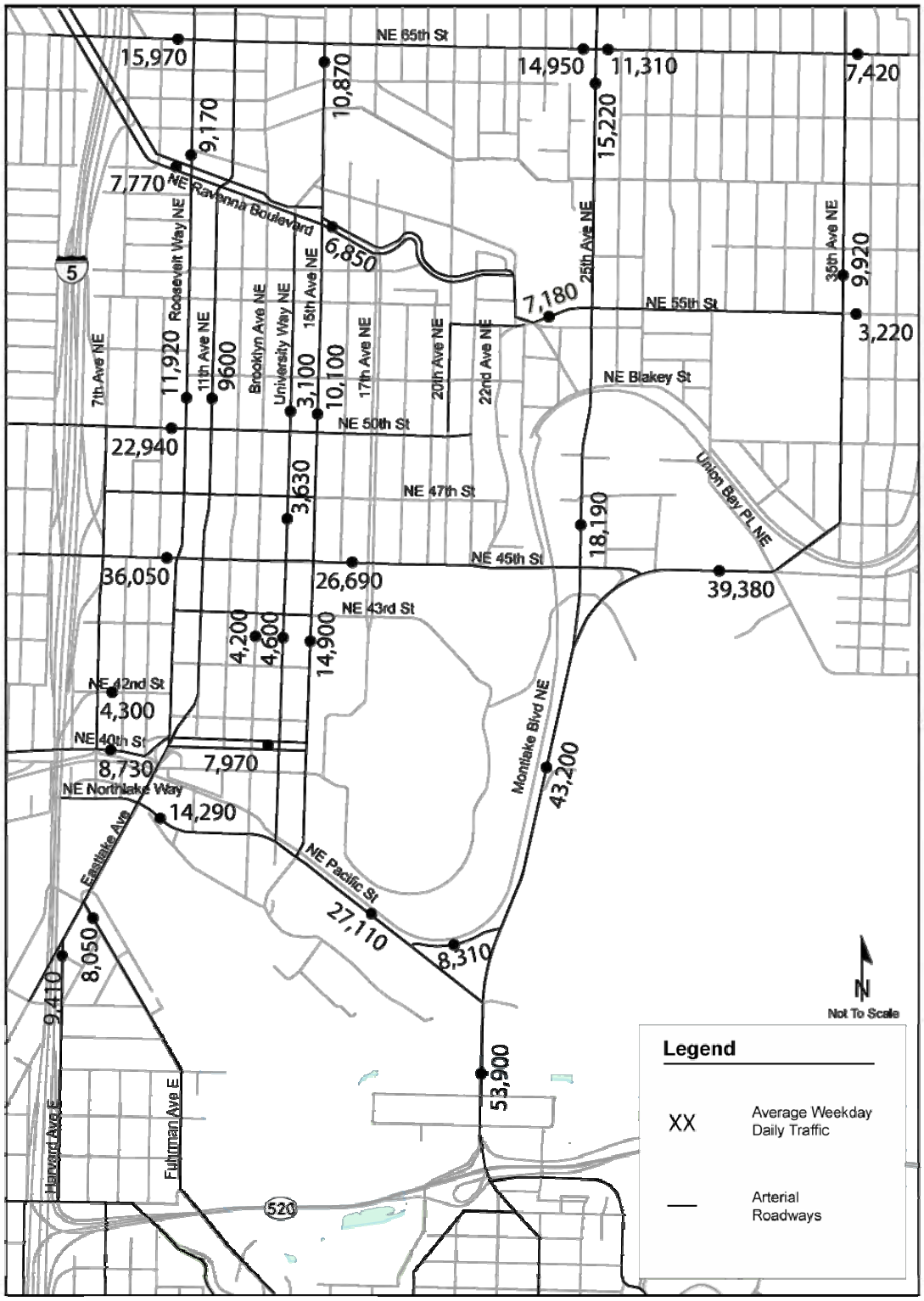


Figure 20. PM Peak Hour Volumes by Direction

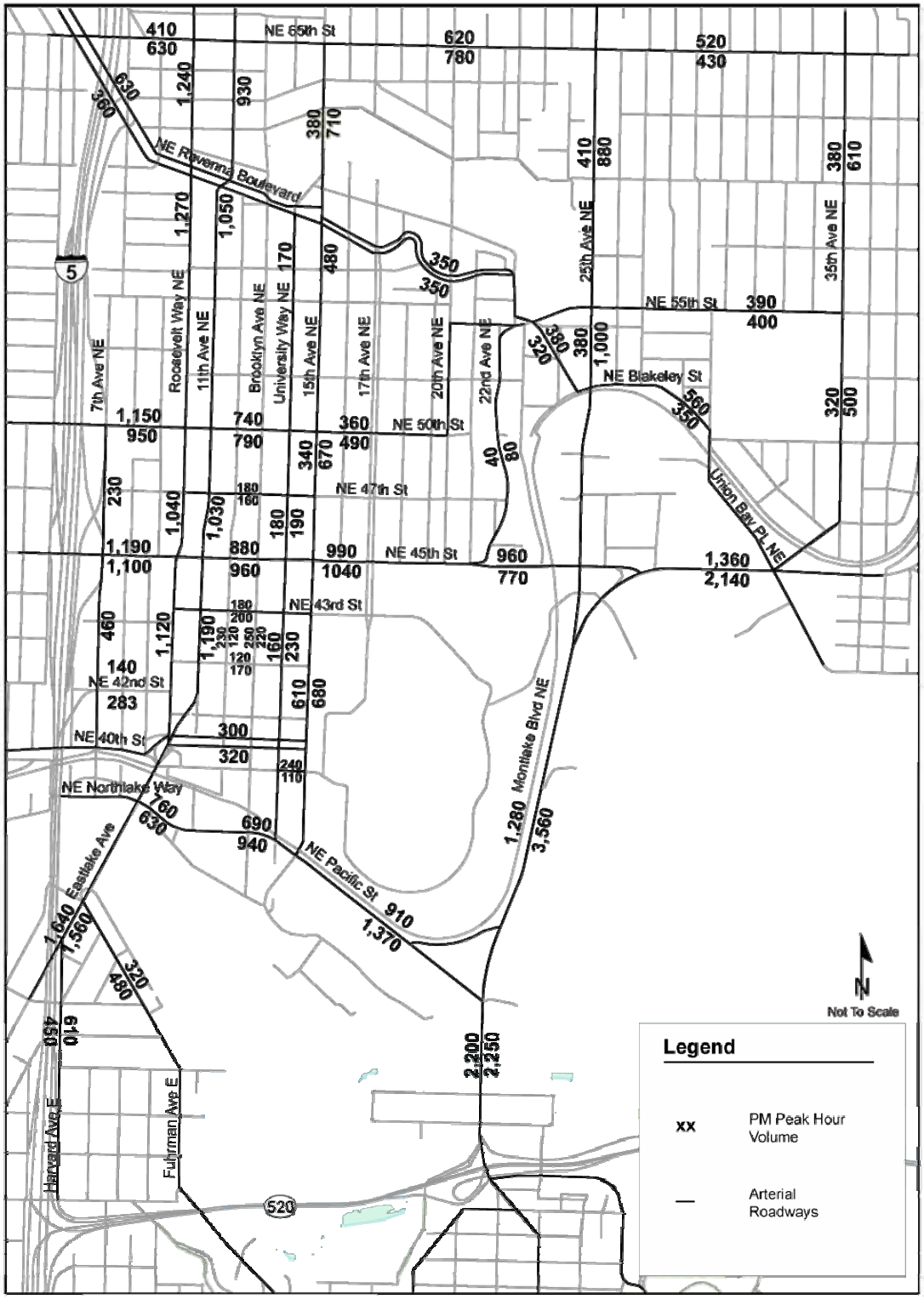


Figure 21. Average Weekday Volumes for Montlake and University Bridges

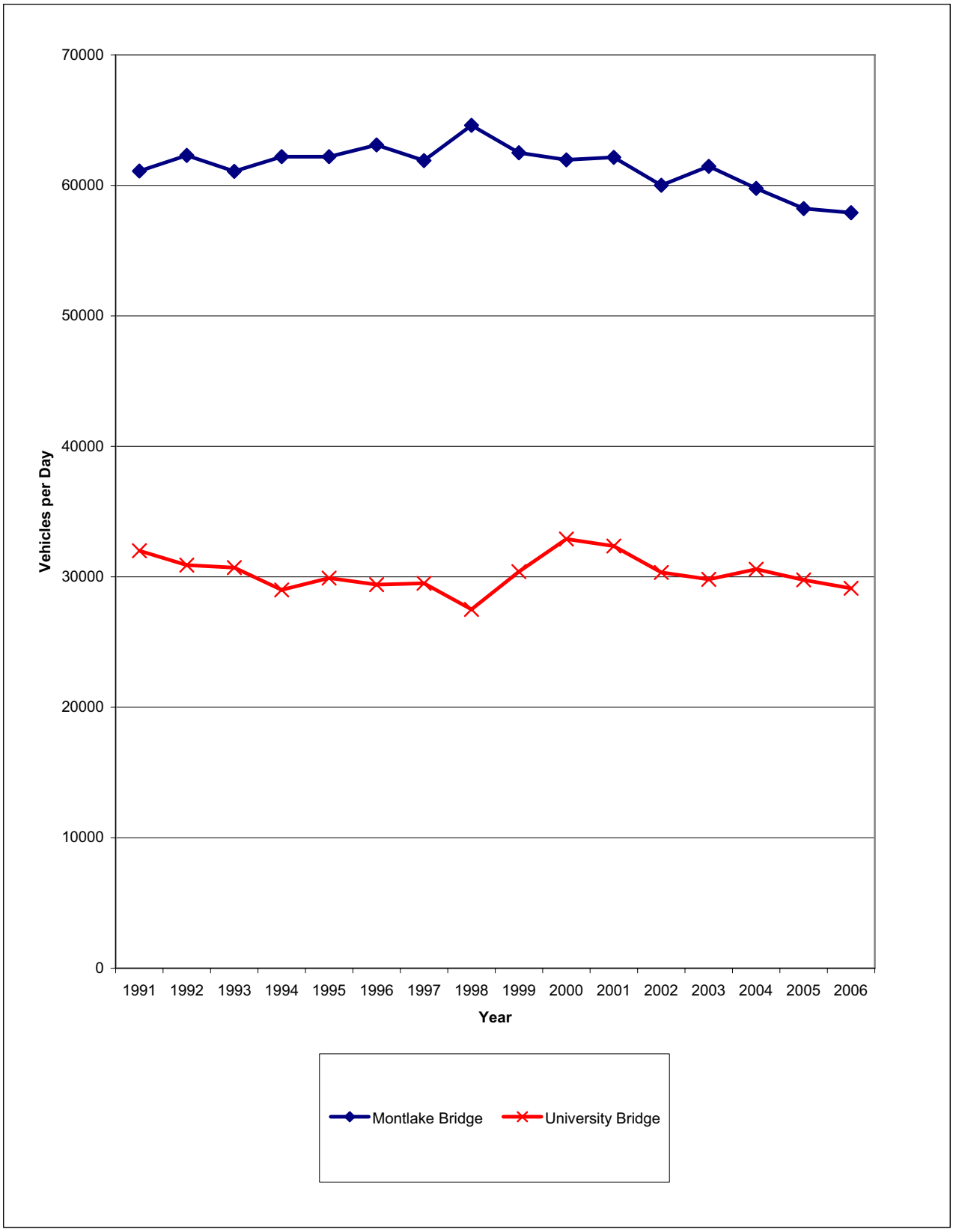


Figure 22. Average Weekday Volumes for North-South Corridors 1991-2006

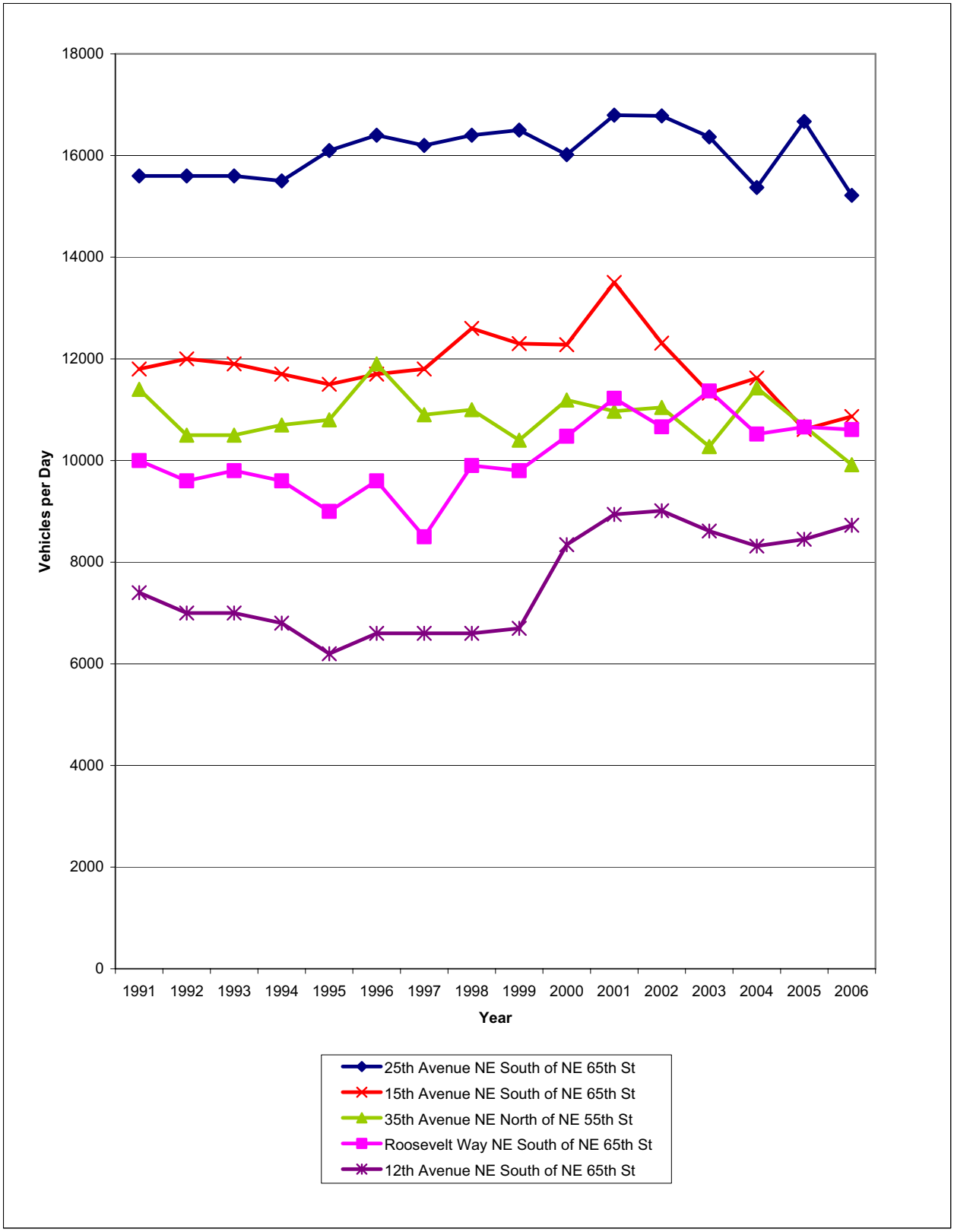


Figure 23. PM Peak Hour Volumes for North-South Corridors 2000-2006

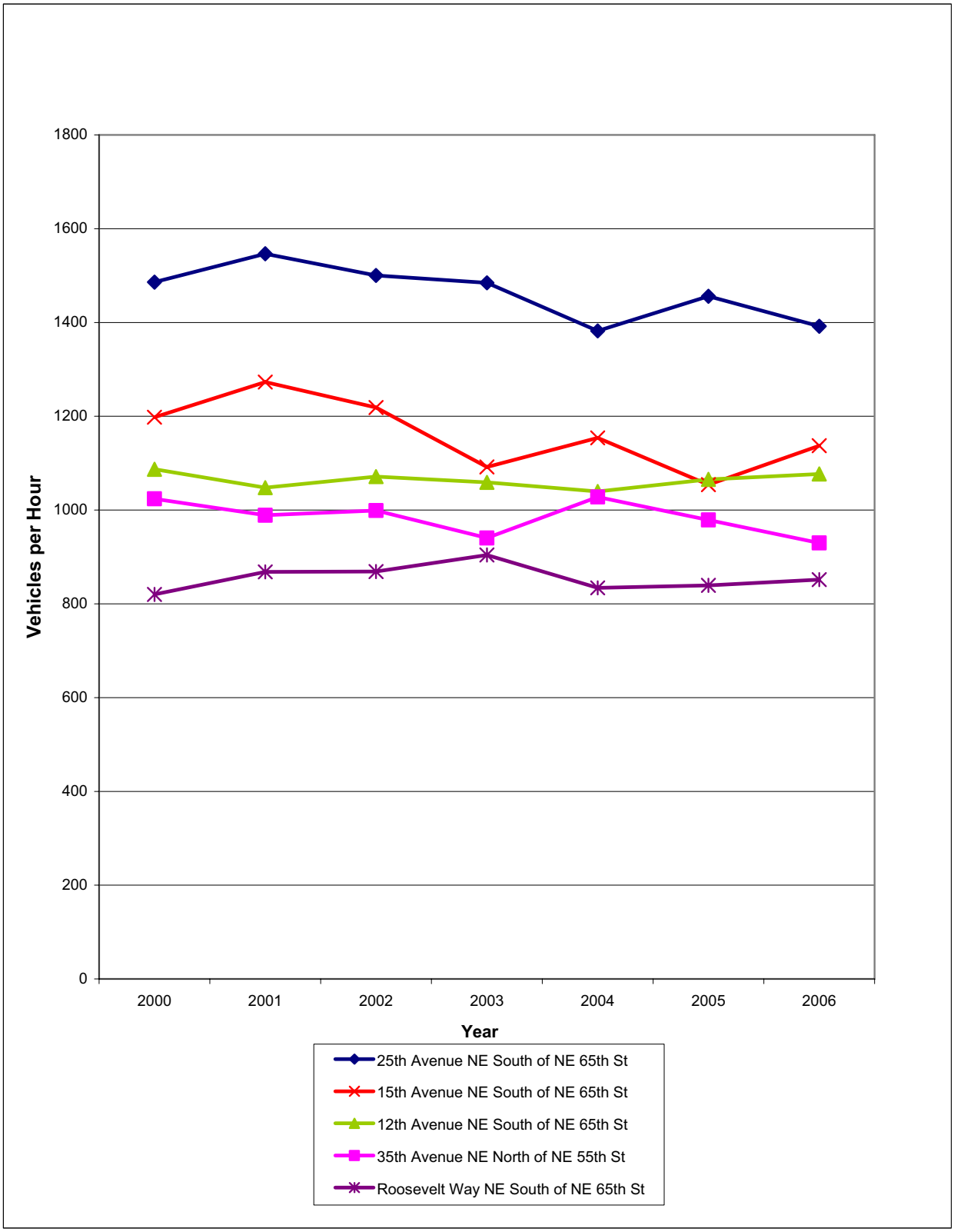


Figure 24. Average Weekday Volumes for East-West Corridors 1991-2006

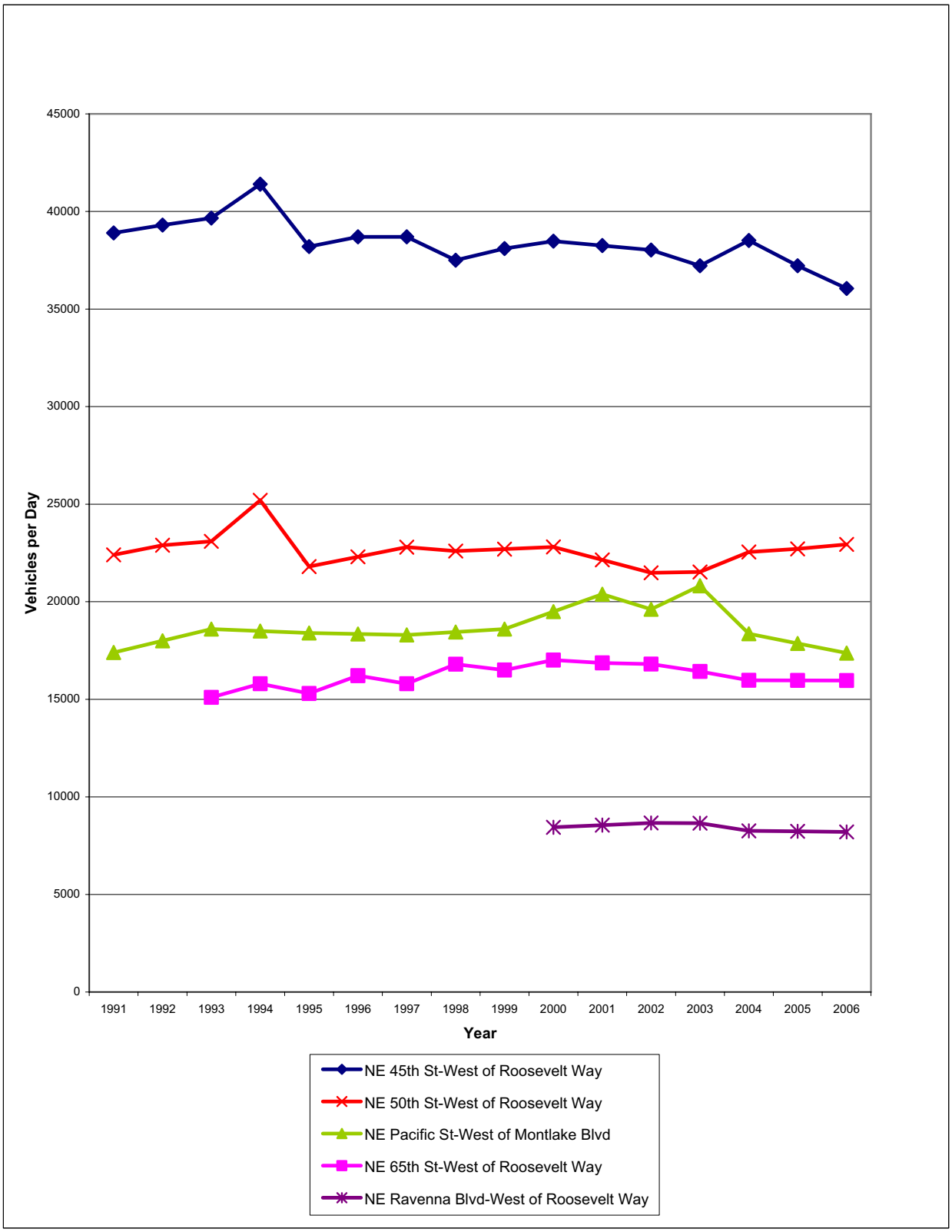
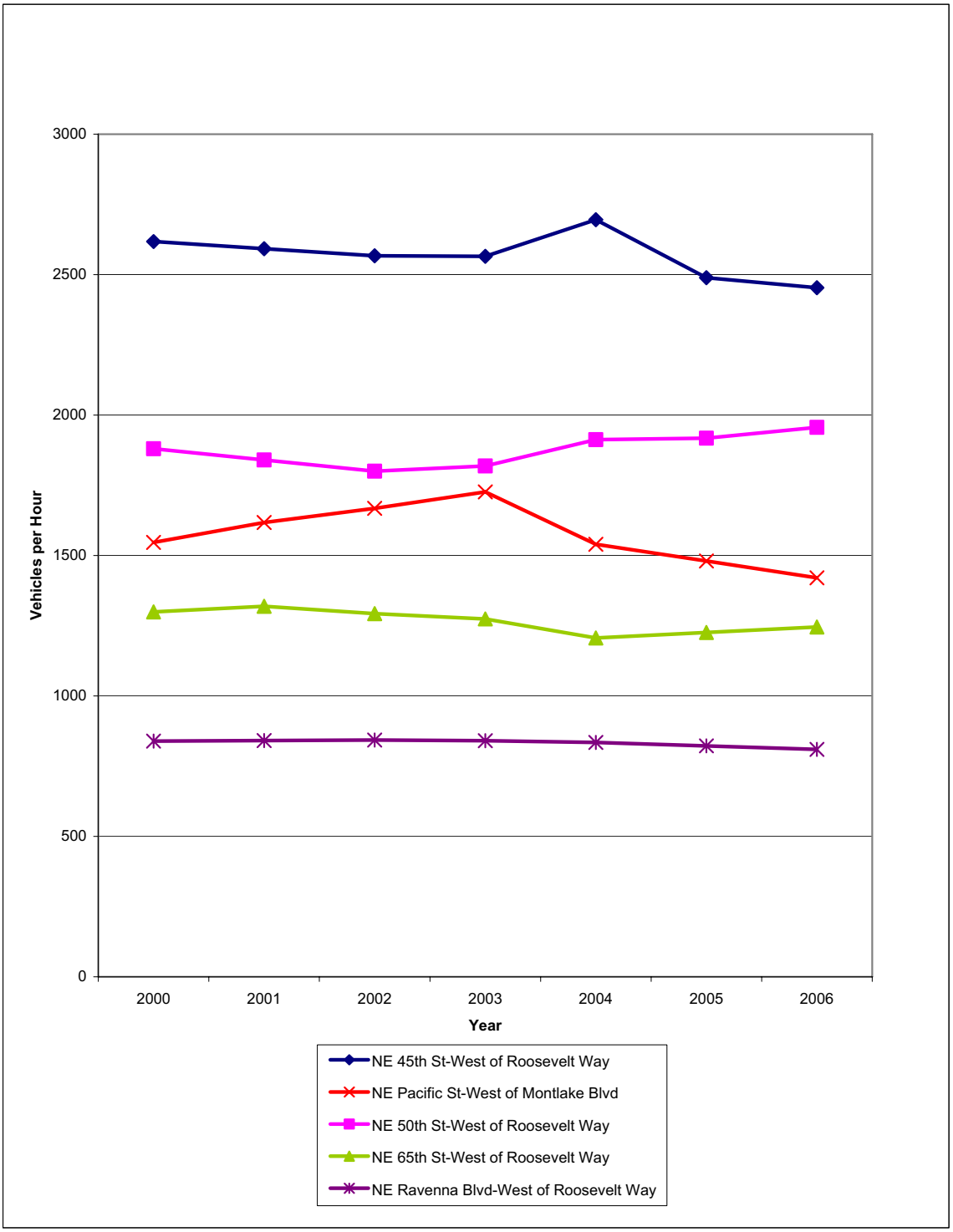


Figure 25. PM Peak Hour Volumes for East-West Corridors 2000-2006



Vehicle System Performance

The UATAS study uses four categories of performance measures to evaluate the roadway network: traffic safety, level of service for arterial corridors, level of service for signalized intersections and level of service for unsignalized intersections.

Traffic Safety

The number of traffic collisions and collision rates are the predominant measures of traffic safety. The following performance measure thresholds are used to evaluate signalized and unsignalized collisions.

- Average number of collisions for signalized intersections: 10 per year
- Average number of collisions for unsignalized intersections: 5 per year
- Average number of collisions for mid-block locations: 5 per year
- Collision rates for signalized intersections: 1.5 per million annual vehicles (The collision rate threshold is based on the experience for the Northgate CTIP)

Figure 26 reviews the 2004-2006 collision data provided by the city for intersection and mid-block locations. **Figure 27** displays the collision rates per million annual vehicles.

Findings – Traffic Safety

- All of the intersections reviewed met the safety thresholds for average number of collisions.
- Five mid-block locations failed the safety thresholds for average number of collisions:
  - NE 45th Street between Montlake Boulevard NE and 45th Place NE
  - NE 45th Street between University Way and 15th Avenue NE
  - Montlake Boulevard between NE Pacific Street and NE 45th Street
  - Montlake Boulevard between Montlake Bridge and NE Pacific Street
  - Montlake Boulevard south of the Montlake Bridge

Figure 26. Average Annual Collisions 2004-2006

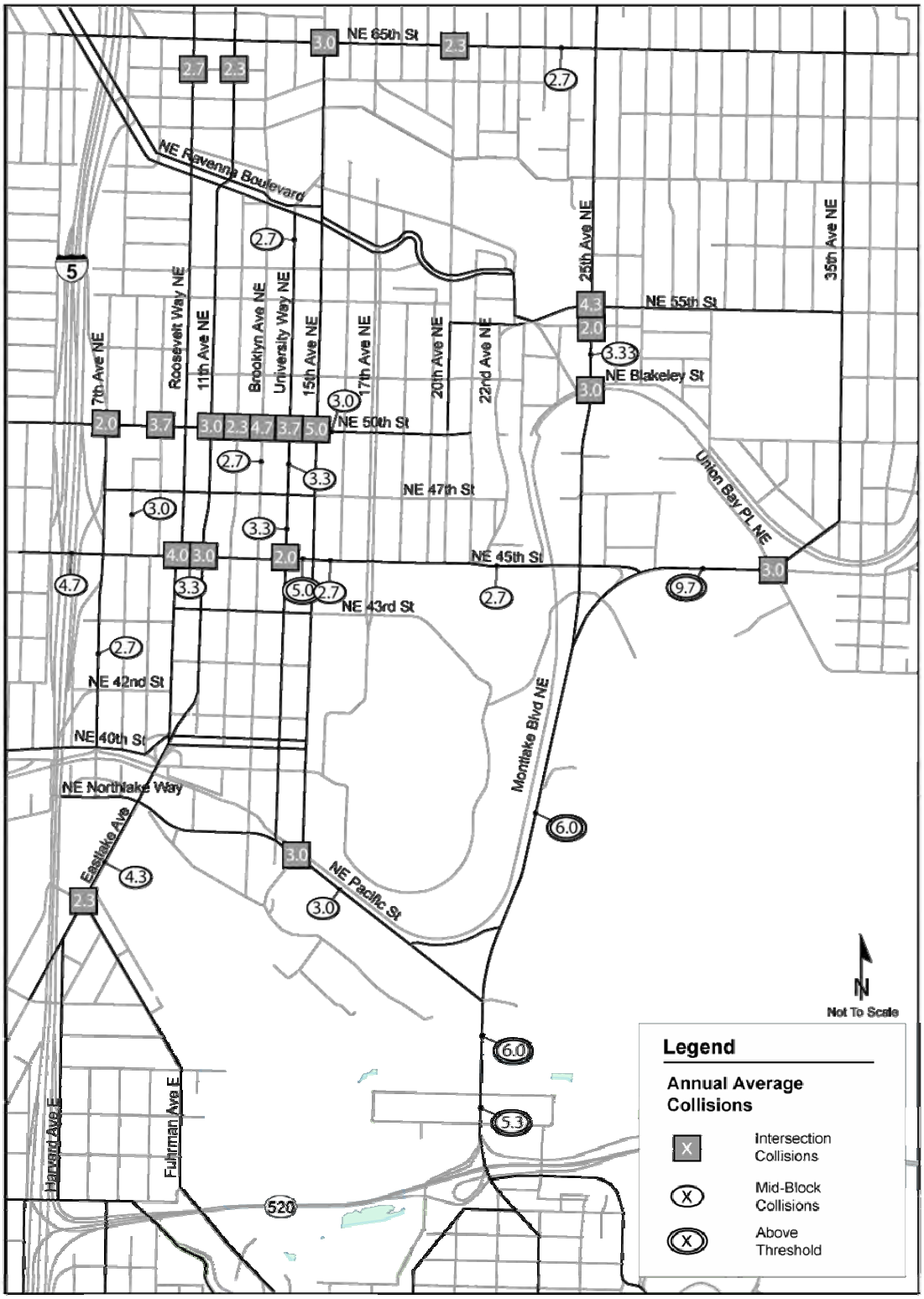
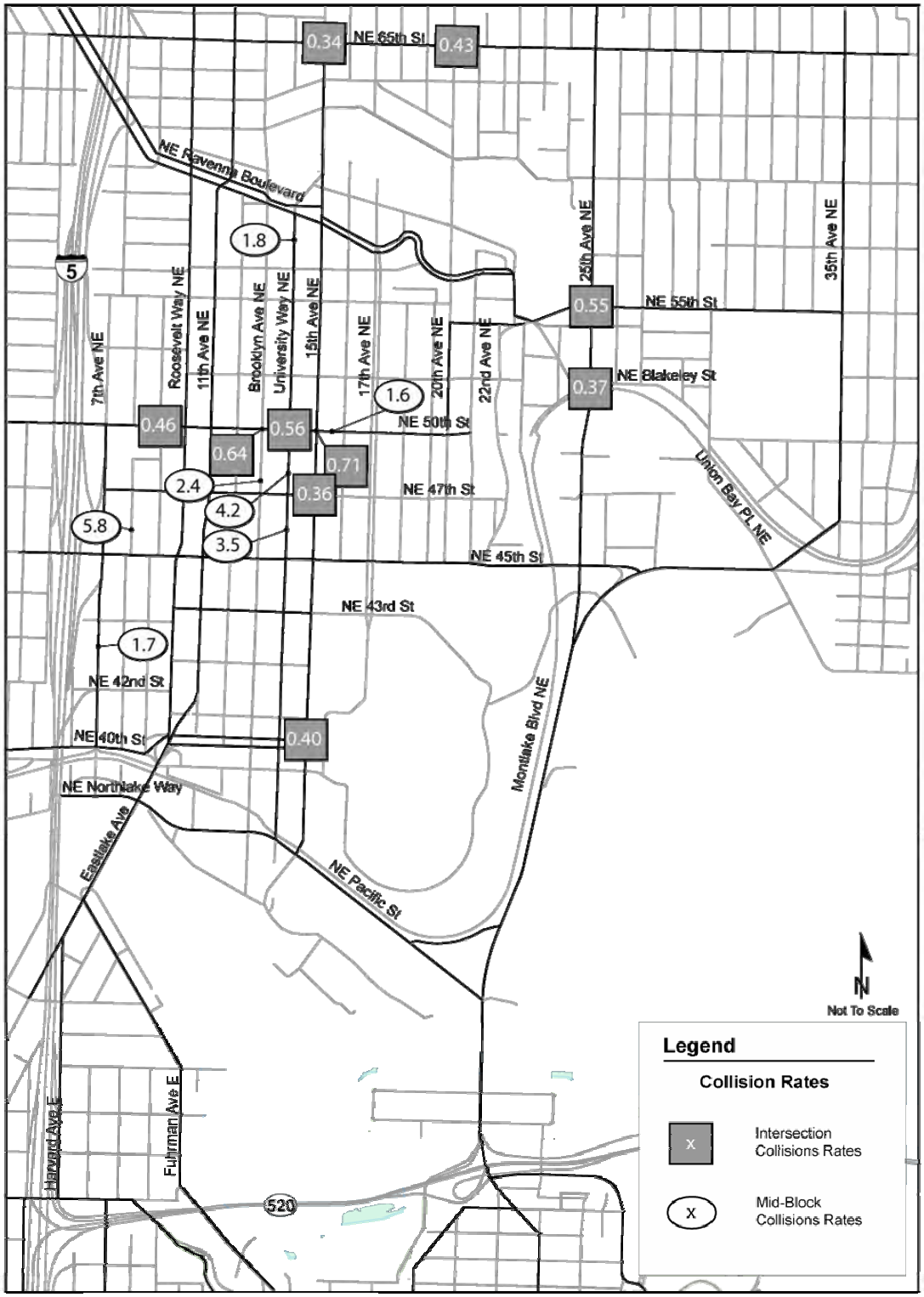


Figure 27. Collisions Rate (Collisions per Million Annual Vehicles)



Level of Service for Arterials Corridors

An arterial corridor's performance is measured by the average travel speed for through-traveling vehicles along an urban street. The average travel speed is influenced by the delay experienced at signals and speeds obtained between intersections. **Figure 28** and **Figure 29** shows the travel times and level of service for the north-south and east-west corridors.

The performance of the roadway arterial system is based on the corridor level of service concept described in the *2000 Highway Capacity Manual*. **Table 11** shows the definitions of arterial corridor level of service.

Table 11. Definitions of Arterial Corridor Levels of Service

LOS	Average Travel Speed (mph)
A	> 30
B	>24-30
C	>18-24
D	>14-18
E	>10-14
F	10 or less
Threshold = Arterial LOS F	

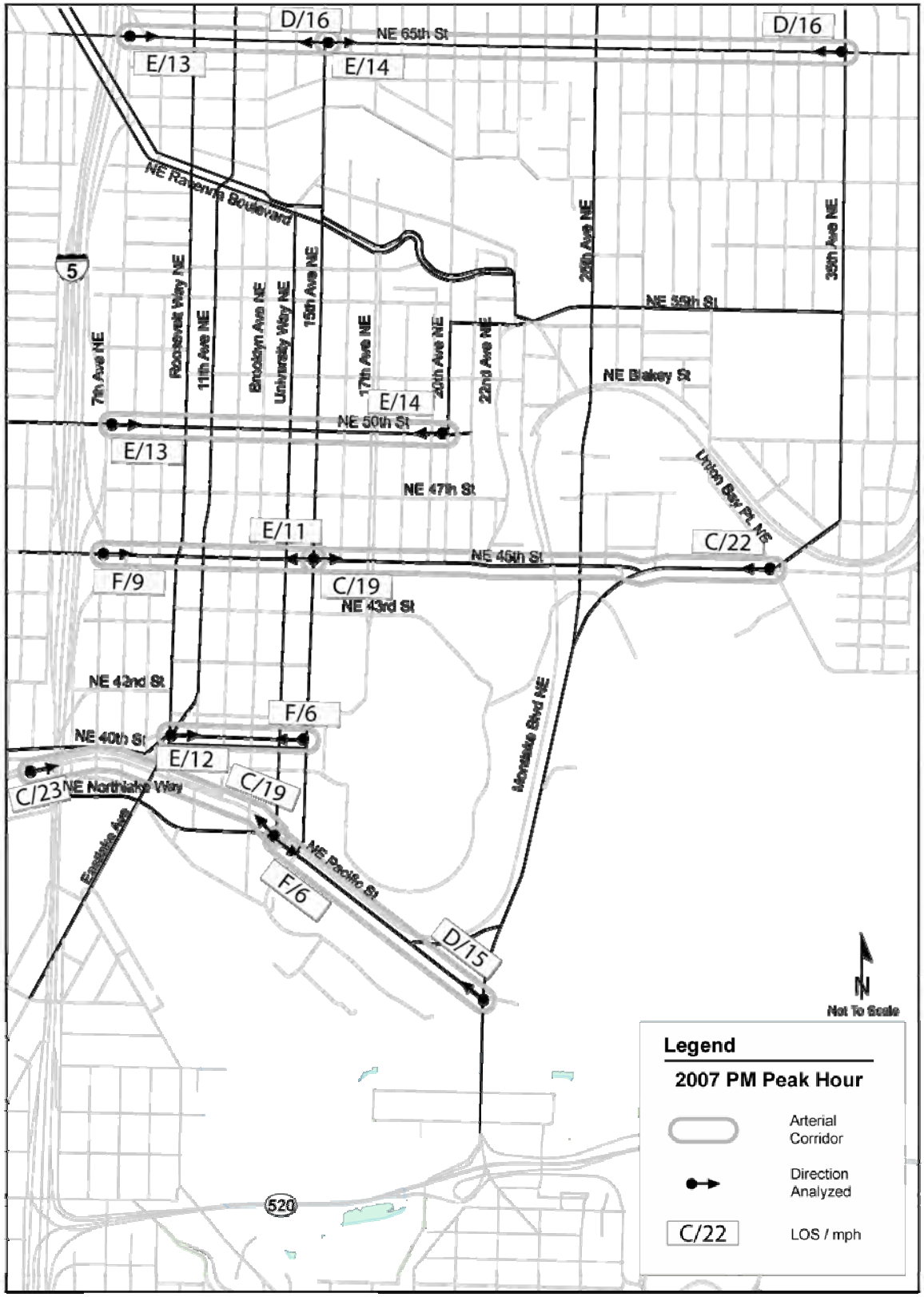
As corridors become more congested the average speed decreases. Corridors with average travel speeds of 10 mph or less (LOF F) fail to meet the threshold.

Findings – Travel Time

- Seven corridors operate below 10 mph in one or both direction in the PM peak hour.
  - Montlake Boulevard (3 mph – below walking speed)
  - University Way (9 mph)
  - Pacific Street (6 mph)
  - 7th Avenue (9 mph)
  - 15th Avenue (9 mph)
  - NE 40th Street (6 mph)
- Twelve additional corridors operate between 10 and 14 mph in the PM peak hour.
- Only two East/West corridors achieve LOS C or above in both directions, and three North/South corridors do so.

Figure 28. Travel Times and Level of Service for North-South Corridors

Figure 29. Travel Times and Level of Service for East-West Corridors



Level of Service for Signalized Intersections

Traffic signals allow the organized flow of through and turning traffic through intersections. The performance of the intersection uses the Highway Capacity Manual (HCM) 2000 to estimate the average vehicle delay during the PM peak hour. The HCM 2000 analysis focuses on the operation of traffic at a single intersection, but does not include the interactions between intersections along a corridor.

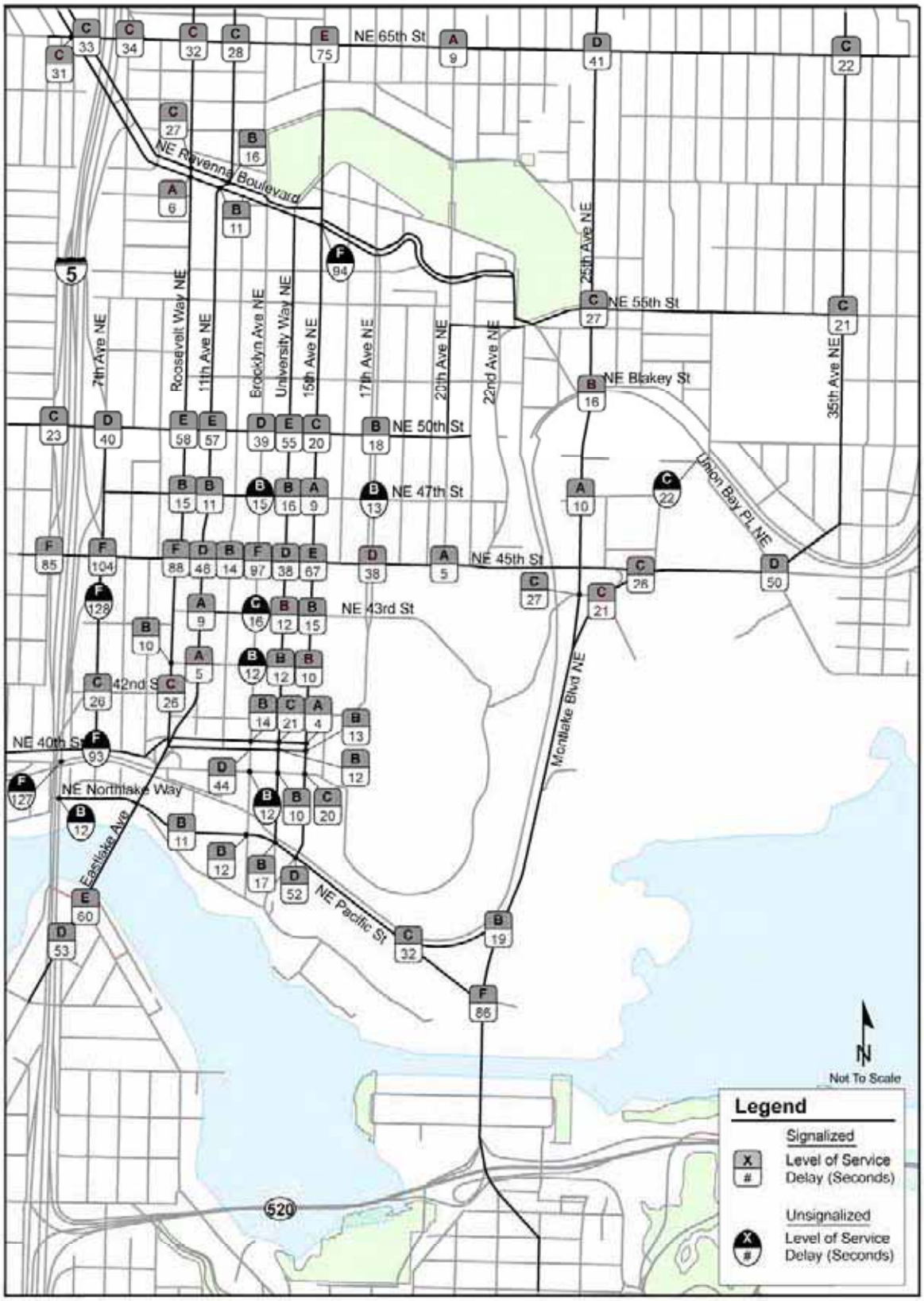
For the performance measure, the performance of the intersections is evaluated based on the averaged intersection delay of the approaches. **Table 12** shows the definition of intersection level of service.

Table 12. Definition of Level of Service for Signalized Intersections

	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Averaged Intersection Delay (seconds)	Less than 10	between 10 and 20	between 20 and 35	between 35 and 55	between 55 and 80	greater than 80
Threshold = LOS E						

Congested conditions at intersections occur along corridors with high levels of signal delay, backups from highway and freeway ramps and along corridors where arterials intersect. These intersections are characterized as having vehicle queues and high levels of delay. **Figure 30** shows the LOS and average delay at each intersection within the study area.

Figure 30. PM Peak Hour Intersection Level of Service



Results – Signalized Intersection Level of Service

- Of 69 signalized intersections evaluated, only 5 operate at LOS F during the PM peak hour; 4 of these are on NE 45th and the fifth is at Montlake/Pacific.
- NE 45th Street/7th Avenue NE (I-5 ramps northbound) had the highest PM peak hour average delay at a signalized intersection: 104 seconds per vehicle.

Level of Service for Unsignalized Intersections

The performance of a minor street stop-sign controlled intersection is measured for the worst movement of the intersection. At all-way stop-sign controlled intersections, the approach vehicle delays are averaged to determine the level of service. Unsignalized intersections are evaluated individually rather than for a corridor; the performance threshold is LOS E. **Table 13** show the definition of level of service for unsignalized intersections.

Table 13. Definition of Level of Service for Unsignalized Intersections

	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Stop Sign Control Delay (Seconds)	Less than 10	between 10 and 15	between 15 and 25	between 25 and 35	between 35 and 50	greater than 50
Threshold = E						

Results of the LOS analysis found five unsignalized intersections that operate at LOS E or worse: NE 40th St/6th Ave NE; NE 40th St/7th Ave NE; NE 50th St/12th Ave NE; and I-5 off-ramp/7th Ave NE. Where the approach volumes are relatively light, there may be less need to make changes and accept the poor operating conditions. **Figure 30** shows the LOS and average delay for the worst movement of the unsignalized intersections.

Findings – Unsignalized Intersection LOS

- Four of the 11 unsignalized intersections evaluated operate at LOS F during the PM peak hour, including two with the longest delays in the study area: the I-5 off-ramp/7th Avenue, and NE 40th Street/6th Avenue, both of which exceed two minute delays.