



NE 132nd Street Roadway Master Plan

Traffic Analysis Report

City of Kirkland



April 2008

Prepared for
City of Kirkland
123 5th Avenue
Kirkland, WA 98033

Prepared by



Mirai Transportation Planning & Engineering



KPG Inc.

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EXECUTIVE SUMMARY

Purpose

The NE 132nd Street corridor considered in this report lies between 100th Avenue NE and 132nd Avenue NE. The purpose of the NE 132nd Street Roadway Master Plan Study is to identify a standard roadway cross section that meets the current and future needs of the corridor (through 2030); provide for all travel modes (including bicycle, pedestrian, transit and auto); identify how the proposed half-interchange at I-405 will affect the operation of the corridor; and provide a guide for how to best improve the NE 132nd Street roadway to meet the overall community needs while continuing to serve the adjacent neighborhoods. Through this study the consultant and City team developed a list of projects to address the NE 132nd Street corridor's needs for today and the future. The traffic projections, analysis, and proposed layouts have been reviewed and approved by the City's Transportation Commission.

Background

The NE 132nd Street corridor is currently under King County ownership and is primarily a residential corridor. The City of Kirkland prepared this study to assist with their annexation analysis of the North Kirkland area. West of I-405 NE 132nd Street is a two lane roadway with narrow bike lanes. East of I-405 it is a two lane roadway with wide bike lanes and turn lanes at major intersections. Juanita High School and Fire Station # 27 are adjacent to NE 132nd Street west of I-405. East of I-405 there are several large subdivisions that outlet to NE 132nd Street. Ten metro bus routes run along NE 132nd Street. The speed limit along NE 132nd Street is 35 mph and the average weekday traffic ranges from approximately 12,000 to 20,000 vehicles per day. There are sidewalks along both sides of NE 132nd Street the length of the corridor and planter strips in most places.

Existing traffic counts and projections show a heavy southeast to northwest commuting pattern that crosses the study area along NE 116th Street, NE 124th Street and NE 132nd Street. Modeling for the year 2030 indicates that capacity will need to be added to the east-west corridors in order to reduce congestion and intersection delays.

Recommendations

One of the primary outcomes of this study is that the new half diamond interchange at I-405 will not require a major reconstruction or widening of NE 132nd Street.

The study did develop the following recommendations for the NE 132nd Street.

- Maintain a three-lane cross section for NE 132nd Street. (see typical cross sections in Appendix A).
- Implement the following intersection and roadway improvement projects along NE 132nd Street (see plan layouts and cost estimates in Appendix A):
 - 100th Avenue NE intersection – Extend the westbound left and right turn lanes to 500 feet. Approximate cost \$1 million.

- Juanita High School intersection – Add a 250-foot eastbound right turn lane. Approximate cost \$750,000.
- 108th Avenue NE intersection – Add a 250-foot westbound right turn lane. Approximate cost \$500,000.
- Modify the signal at the fire station to include a pedestrian actuated option. Approximate cost \$300,000.
- West Segment: Overlay and restripe roadway, add landscaped center medians and perform sidewalk repairs between the east end of the 100th Avenue NE intersection project and the west end of the I-405 project. Approximate cost \$1.2 million.
- Revise the WSDOT half-interchange design at 116th Way NE as follows: restripe northbound approach for one left turn lane and one left + right turn lane, modify the southbound off-ramp to remove the traffic island and stripe for one left turn lane, one through + left lane and one through + right lane. Assume that these changes are part of the WSDOT project with no cost to the City.
- Central Segment: Overlay and restripe roadway, add landscaped center medians and perform sidewalk repairs between the east end of the I-405 project and the west end of the 124th Avenue NE project. Approximate cost \$300,000.
- 124th Avenue NE Intersection – Continue to monitor this intersection to verify the traffic model conclusions of this study. If the eastbound to northbound left turn volumes remain as high as the model is anticipating then the City will need to extend the existing eastbound left turn lane to 500 feet and add a second 500-foot eastbound left turn lane. Widen and restripe east leg at the intersection to match west leg. Widen and restripe north leg for 1000 feet to provide two northbound through lanes, one southbound left turn lane and one southbound through + right turn lane. Restripe south leg at the intersection to match north leg. Approximate cost \$4.5 million.
- East Segment: Overlay and restripe roadway, add landscaped center medians and perform sidewalk repairs between the east end of the 124th Avenue NE project and the west end of the 132nd Avenue NE project . Approximate cost \$1 million.
- 132nd Avenue NE Intersection – Extend eastbound left and right turn lanes to 500 feet. Approximate cost \$700,000.
- Integrate components of the Kirkland ITS Plan into the NE 132nd Street corridor as part of either Overlay or Intersection projects.
 - Upgrade the traffic signal controllers and consider video detection for the intersections
 - Install interconnect system from 100th Avenue NE to 132nd Avenue NE
 - Install CCTV cameras to monitor and manage traffic congestion and queues. Locations could include 100th Avenue NE, Totem Lake Boulevard and 124th Avenue NE intersections to provide visibility throughout the two-mile corridor.

- Implement transit signal priority in the corridor to assist transit passage through the congested intersections. In particular, passage through the interchange area near I-405 will be critical for transit to maintain its schedule.
- Work with King County Metro to consolidate transit stops with improved pedestrian crossing treatments in conjunction with overlay project segments and construction of landscaped medians through the corridor.
- Explore pedestrian-level lighting for the corridor, in conjunction with sidewalk and transit stop enhancements.

Priorities for Implementation

There are many changes underway in the Totem Lake area that will influence travel patterns and traffic demand on NE 132nd Street. This corridor analysis reflects the expected traffic growth assigned to the corridor based on current traffic volumes and patterns.

Changes in circulation are expected with the new NE 128th Street arterial connection across I-405 that provides HOV direct access to I-405. WSDOT plans to construct a half-interchange at NE 132nd Street and this will likely result in additional shifts in traffic and circulation.

The intersection LOS analysis indicates that the 100th Avenue NE and 124th Avenue NE intersection projects should be the first ones to be constructed, due to the high level of congestion. The project at 100th Avenue NE is likely warranted regardless of the circulation changes near I-405. A project to improve access at the Juanita High School signal would also be justified near-term.

Modifying the channelization east of I-405 temporarily to match the Alternate Roadway Section shown in Appendix A is also a near term recommendation. This will provide a consistent bike lane treatment for the corridor.

We recommend that the City monitor traffic volumes on NE 132nd Street, especially east of I-405 to affirm the sequence of the intersection projects in the proposed Master Plan for NE 132nd Street Roadway. The restriping, crosswalk and sidewalk enhancements and center medians could be incorporated into the arterial overlay program or could be stand alone projects.

INTRODUCTION

NE 132nd Street provides an important east-west connection from the growing residential areas of north Kirkland and unincorporated King County to the Totem Lake urban center. NE 132nd Street also provides the connection to major facilities including Juanita High School, Kirkland Fire Station 27, the Kingsgate Park and Ride, the Evergreen Hospital campus and the 132nd Street Square Park. Currently, the street is the boundary between the City of Kirkland and unincorporated King County. The area to the north of NE 132nd Street is included as part of Kirkland’s potential annexation area (PAA).



In the near future, several projects along Interstate 405 (I-405) will have an impact on this corridor. Currently, the Washington State Department of Transportation (WSDOT) and Sound Transit are constructing the new Totem Lake Freeway Station. This project is near completion and will provide direct access ramps for buses, carpools and vanpools from the I-405 high occupancy vehicle (HOV) lanes to and from the new NE 128th Street overpass. Another project that will impact NE 132nd Street is the I-405/NE 132nd Street Interchange Improvement Project. WSDOT will construct a new half interchange to and from the north at NE 132nd Street.



In the Totem Lake urban center, the Evergreen Hospital Medical Center recently expanded their Emergency Department and added a new Inpatient Facility. In addition to these buildings, Sound Transit has partnered with Evergreen Health Care to build the new Totem Lake Transit Center on their medical center campus. This six-bay transit center will include sheltered passenger waiting area and bus layover space. Just to the south, Developer Diversified Reality has plans for a major redevelopment of the Totem Lake Mall. The redevelopment includes street reconfigurations,

new housing and denser commercial development.

This report documents the analysis of the current and future needs and conditions for all modes of travel along NE 132nd Street. The focus for the study is a 2-mile section of NE 132nd Street between 100th Avenue NE and 132nd Avenue NE.

EXISTING CONDITIONS

Roadway System

NE 132nd Street is one of three roadways that make up the Totem Lake east-west corridor serving the Totem Lake urban center. This corridor includes:

- NE 132nd Street
- NE 124th Street
- NE 116th Street

The three roadways collectively serve a significant east-west travel demand in the north area of Kirkland. The I-405 freeway divides the travel-shed for the roadway located approximately half-way along the study focus of NE 132nd Street. A full interchange provides access to I-405 at NE 124th Street, with an additional northbound ramp to Totem Lake Boulevard. A half-interchange provides I-405 access to and from the south at NE 116th Street.

Existing roadway configuration and intersection controls are indicated in **Figure 1**. NE 132nd Street has one continuous through lane in each direction between 100th Avenue NE and 132nd Avenue NE. It is a three-lane section with a center, two-way left-turn lane between 100th Avenue NE and I-405. East of I-405, NE 132nd Street is a two-lane roadway with left-turn pockets at signalized intersections.

Direct driveway access is limited along NE 132nd Street, however, 32 cross streets and private drives intersect this 2 mile section. Eight of the intersections are signalized. These intersections are:

- 100th Avenue NE
- Juanita High School
- 108th Avenue NE
- 116th Way NE
- 116th Avenue NE/Totem Lake Boulevard NE
- 120th Avenue NE
- 124th Avenue NE
- 132nd Avenue NE

Figure 1 shows where the signal controlled intersections are located. King County controls the signals at 100th Avenue NE, Juanita High School, 108th Avenue NE and 132nd Avenue NE. The other four intersections are controlled and coordinated by the City of Kirkland. Kirkland Fire Station # 27 controls an emergency signal located near 113th Place NE.

Figure 2 provides the speed limits for the streets along the corridor. The posted speed limit along NE 132nd Street is 35 mph. When children are present, a 20 mph school zone exists near Juanita High School. Helen Keller Elementary school is located at 13820 108th Avenue NE, approximately six blocks to the north of NE 132nd Street. An adult school crossing guard is stationed at the 108th Avenue NE signalized intersection to assist elementary school students to cross during both morning and after-school time periods.



Figure 1. Existing Roadway Configuration and Intersection Control

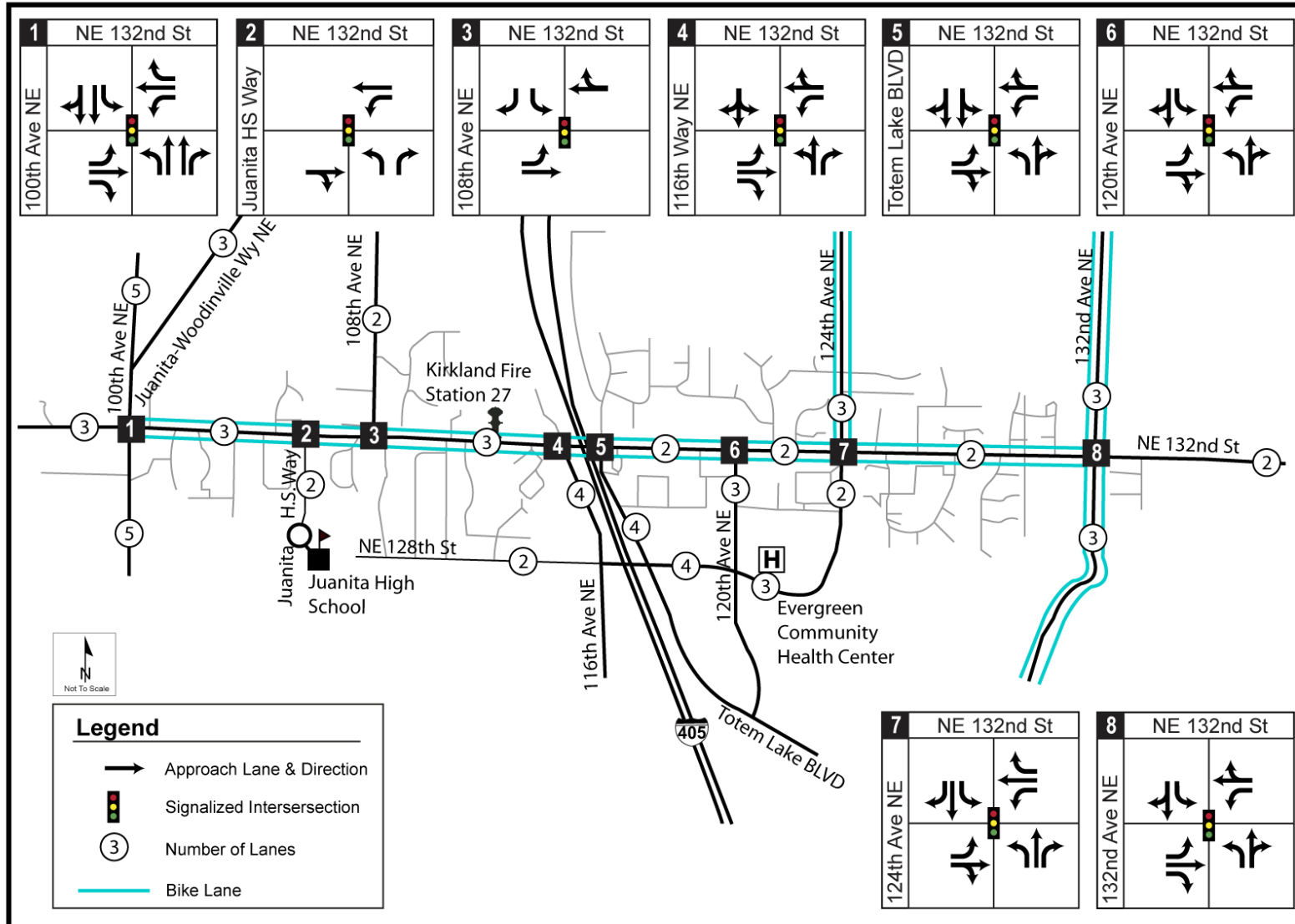


Figure 2. Existing Speed Limit and Intersection Control

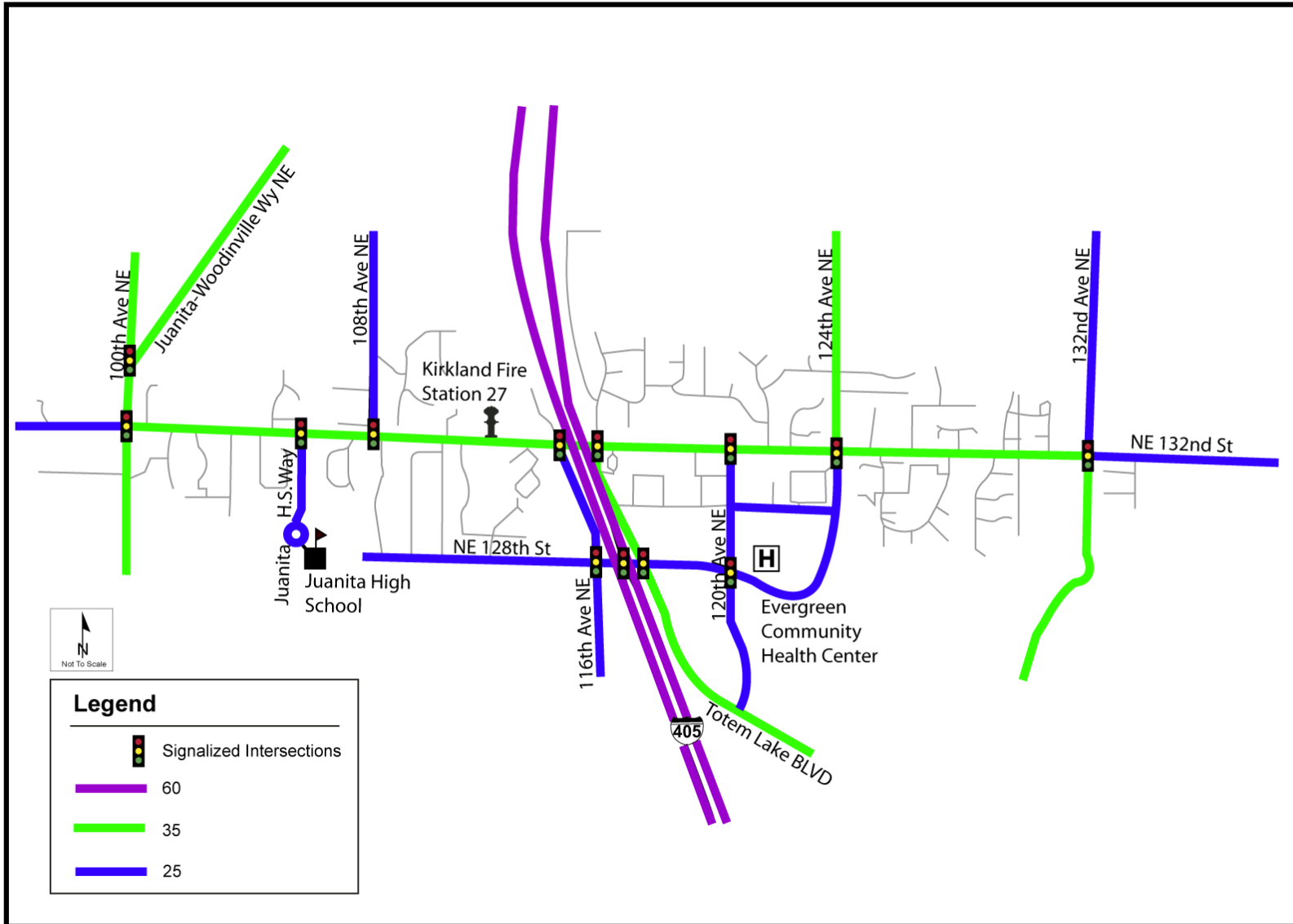


Figure 3 shows the street classifications in the corridor. Note that NE 132nd Street forms the boundary between the City of Kirkland to the south and unincorporated King County to the north between 100th Avenue NE and 128th Avenue NE. East of 128th Avenue NE, NE 132nd Street is within unincorporated King County. The Kirkland Comprehensive Plan identifies NE 132nd Street east of 100th Avenue NE as a principal arterial. The King County street classification map dated June 15, 2005, shows NE 132nd Street as a minor arterial.

Figure 4 provides the average weekday daily traffic, as collected in 2005. However, 116th Way NE was closed to through traffic during much of the study period, due to construction of the direct access ramps at the interchange of NE 128th Street and I-405, Traffic data collected in 2005 form the basis for current conditions of the corridor.

Bicycle System

Figure 1 also shows the location of bike lanes along the corridor. Bicycle lanes are provided along the majority of the NE 132nd Street corridor. The bicycle lane widths vary and are dependent upon the number of travel and turning lanes for that roadway section. Generally, the bicycle lanes are striped to be three feet wide. Where a turning lane is not provided, the lane widens to eight feet wide. The bicycle lane in the eastbound direction ends prior to the 132nd Avenue NE intersection. In the westbound direction, the bike lane ends prior to the 100th Avenue NE intersection. Signage is provided after major intersections to indicate the presence of bicycle lanes.

Pedestrian System

Sidewalks are provided on both sides of the street along the entire NE 132nd Street corridor. The sidewalks are continuous through the study area and conditions are fair to good except where tree roots have grown under the sidewalk causing the sidewalk to buckle. Underneath the I-405 overpass, recent construction has either removed some sidewalk sections or damaged the surface but these will be replaced with completion of the freeway work. Generally, the sidewalks are four to five feet wide with a 3-foot wide planting strip with street trees. Where a planting strip does not exist, the sidewalk is five to six feet wide.

Where trees are in a planter strip adjacent to the roadway, the mature tree roots have often caused sidewalk damage and uneven surfaces near the tree well. This may pose a tripping hazard especially for handicapped and visually impaired persons. The remaining sidewalk width at the tree well is less than three feet – and does not meet current standards for American Disability Association (ADA) access.



Figure 3. Street Classification

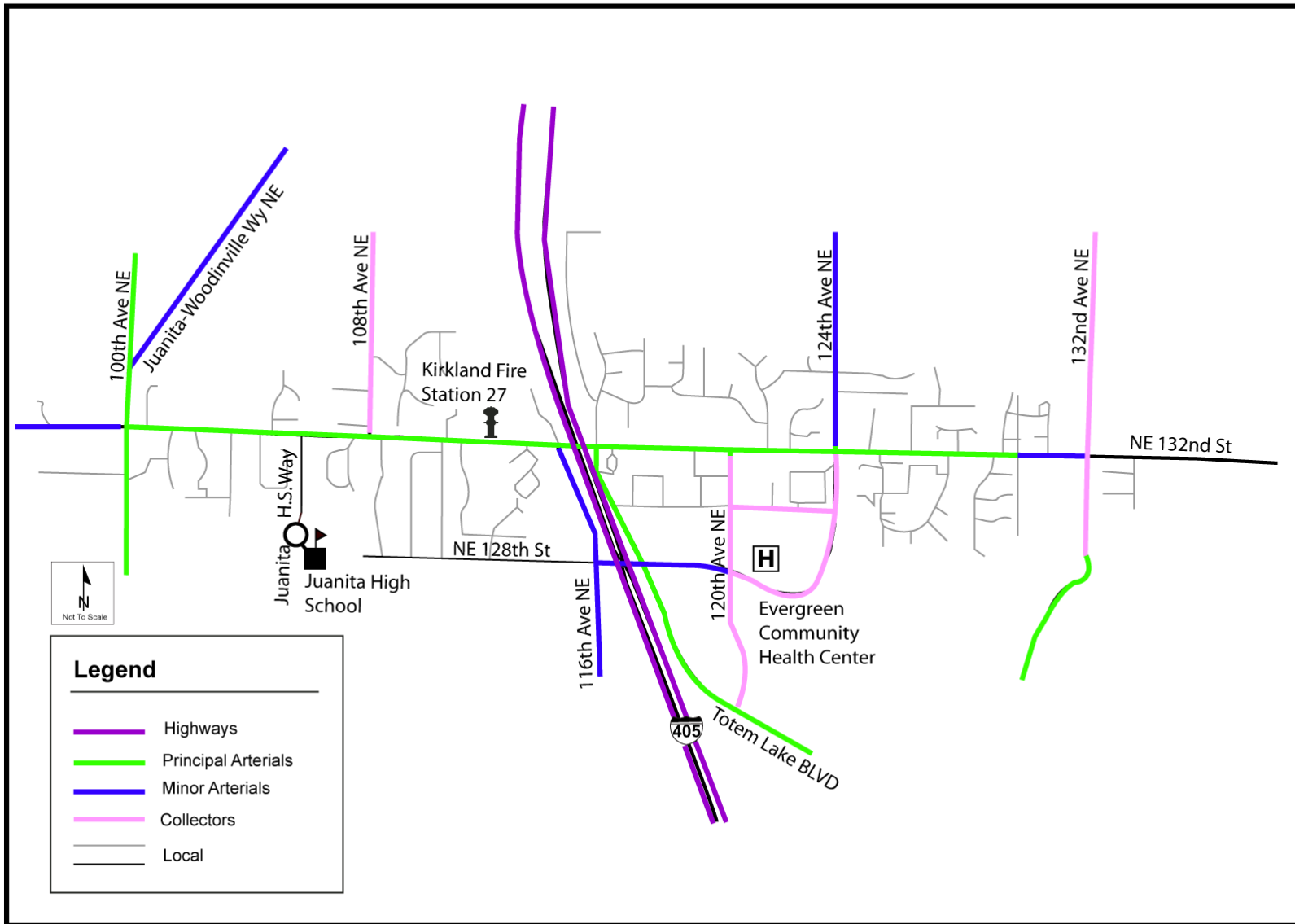


Figure 4. 2005 Average Weekday Daily Traffic

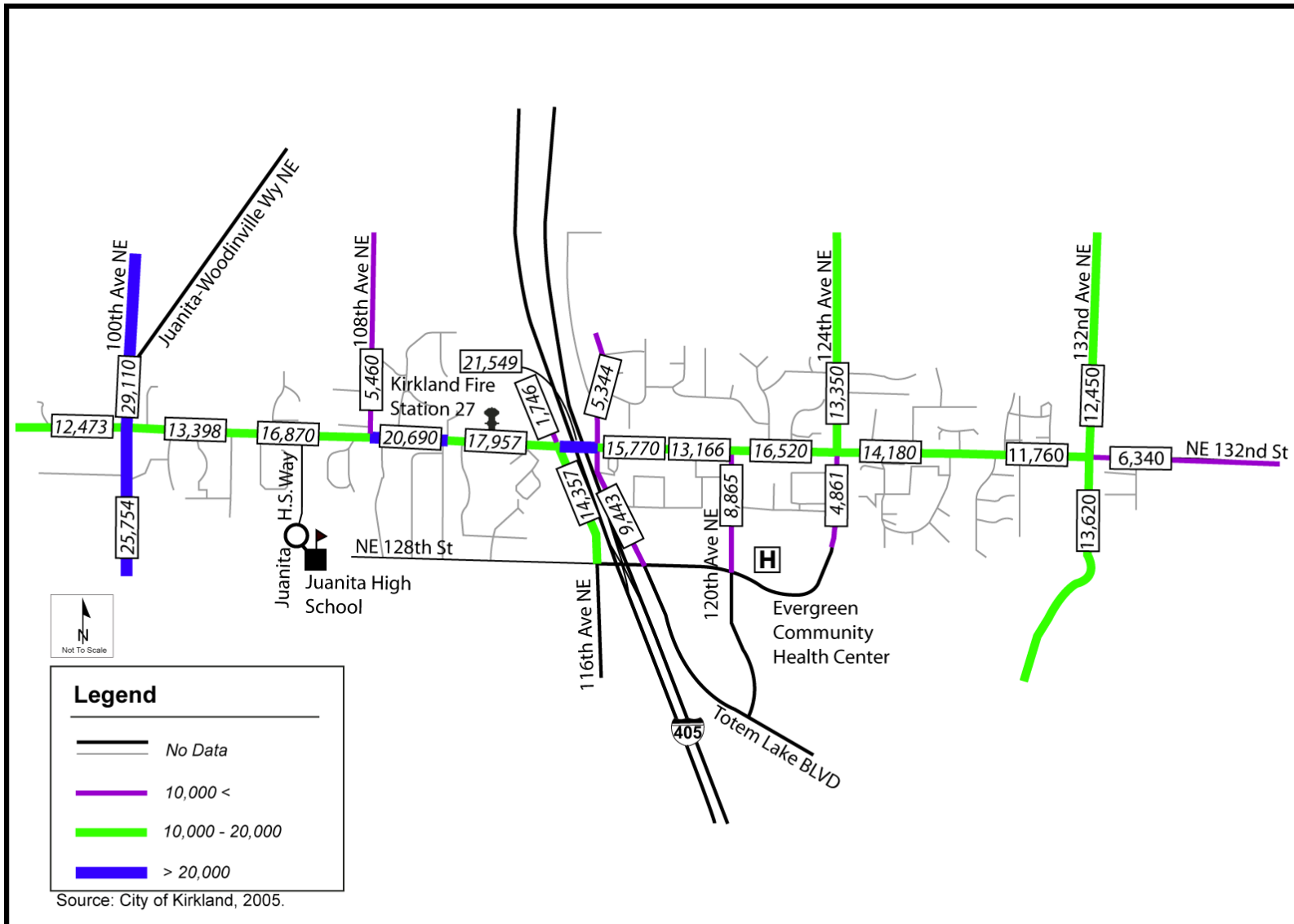


Figure 5 provides the locations of unsignalized marked pedestrian crossings. Crossings are marked at all eight signalized intersections. An additional five marked crossings are located near transit stops or schools at unsignalized intersections. A pedestrian or children crossing sign is posted in both directions prior to each unsignalized, marked crossing. These locations are:

- the west leg at 105th Avenue NE
- the west leg at 109th Avenue NE
- the east leg at 111th Place NE
- the west leg of 121st Avenue NE
- the east leg of 129th Avenue NE

Handicap ramps are provided at all intersection corners, however, they were all built at different times with different standards. Many of these ramps need to be examined for ADA compliance. Truncated domes are only present at newer ramps.

The street trees along the corridor are mature with a full canopy resulting in a tunnel effect for the sidewalks on the south side of NE 132nd Street where trees are in a planting strip. The roadway lighting on the power poles on the north side of NE 132nd Street does not provide pedestrian-level lighting for much of the sidewalk access to transit stops or along the corridor.

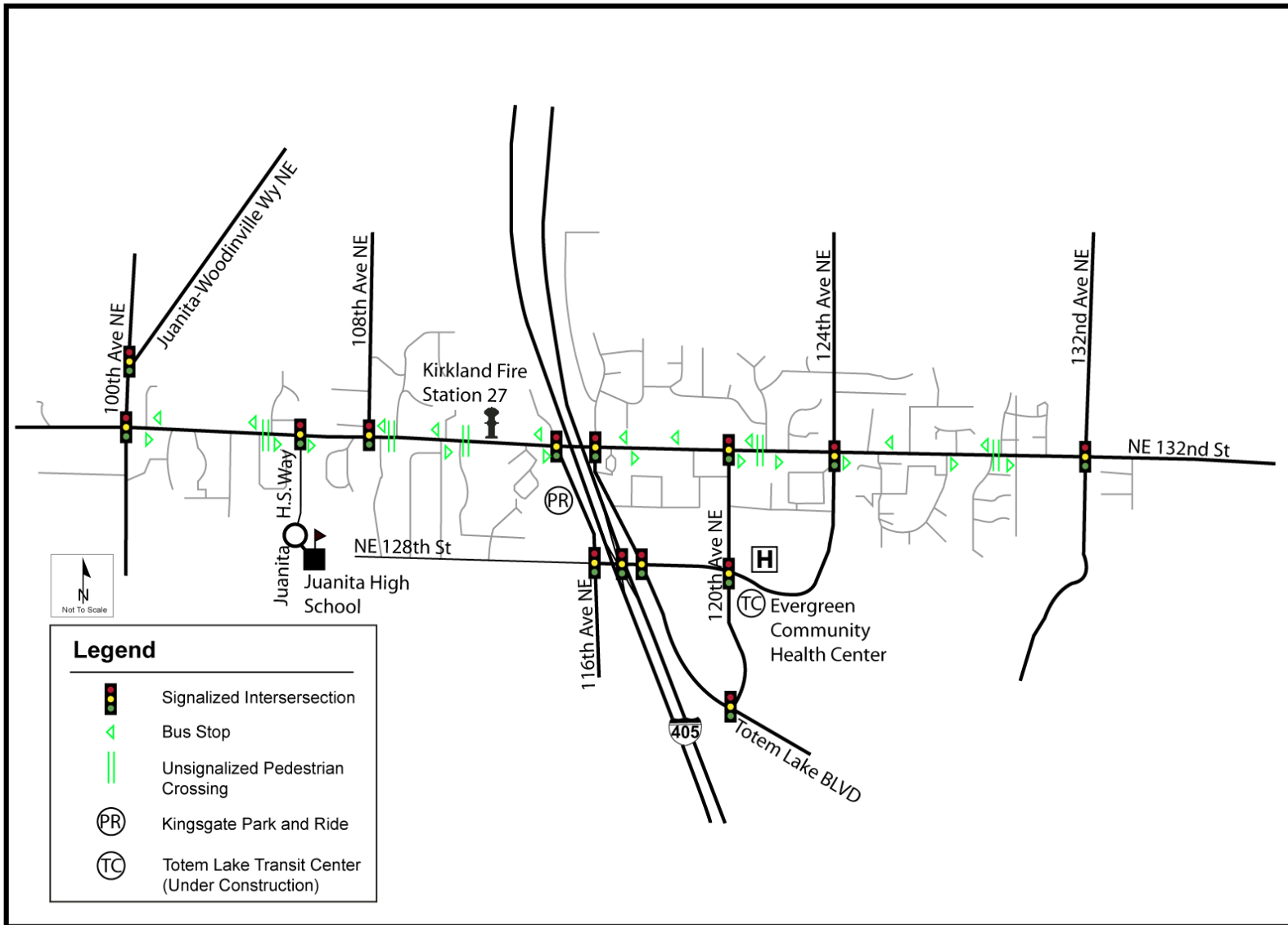


Transit System

Figure 5 also shows the transit facility locations. King County Metro provides the transit service along NE 132nd Street. There are 11 stops on the south side (eastbound) of NE 132nd Street, and 10 stops on the north side (westbound). The stops are spaced roughly every 1,000 feet. The stop on the north side of NE 132nd Street near 121st Avenue NE is the only stop with a shelter.

Ten bus routes travel along this stretch on NE 132nd Street. The majority of these routes make a trip to, from or through the Kingsgate Park and Ride, which is located just south of NE 132nd Street along the west side of 116th Way NE. About half of the routes serve riders during the peak period only. The remaining routes provide all day service on both weekdays and weekends. These routes provide connections to neighboring cities of Bellevue, Redmond, Woodinville and Kenmore. **Table 1** summarizes the transit service along this corridor. Note that during the construction of the Totem Lake Freeway Station and Transit Center, many routes were altered.

Figure 5. Crosswalk and Transit Facility Locations



According to passenger data by stop, provided by King County Metro, the busiest bus zones, with over 20 passengers per day, are located at 100th Avenue NE, 116th Avenue NE, 120th Avenue NE, 121st Avenue NE, 124th Avenue NE in the eastbound direction and at 116th Avenue NE and 121st Avenue NE in the westbound direction. Other locations range from 5 to 19 passengers per day. Some locations are fairly closely spaced and there may be the opportunity to consolidate stops with the potential for improved crosswalk locations.

Table 1. King County Metro Transit Service

Route #	Service Destination	Headways (peak/midday/ evening/Sat/Sun)	Service Period
230	Kingsgate P&R, Totem Lake, Kirkland TC, Bellevue TC, Overlake TC, Redmond	30/30/60/60/60	Weekday/Sat/Sun
236	Woodinville P&R, Kingsgate, Totem Lake, Juanita, Kirkland TC	30/30/30/60/60	Weekday/Sat/Sun
238	UW Bothell, Brickyard P&R, Kingsgate P&R, Totem Lake, Rose Hill, Kirkland TC	30/30/60/60/60	Weekday/Sat/Sun
252	Kingsgate P&R, Downtown Seattle	10-20/ - / - / - / -	Weekday peak direction
255	Brickyard P&R, Kingsgate P&R, Juanita, Kirkland TC, Downtown Seattle	10-15/30/60/ 30-60/30-60	Weekday/Sat/Sun
257	Kingsgate P&R, Downtown Seattle	30/ - / - / - / -	Weekday peak direction
277	Kingsgate P&R, University District	30/ - / - / - / -	Weekday peak direction
630	Kingsgate P&R, Bellevue TC	30/ - / - / - / -	Weekday peak
644	Kenmore P&R, Kingsgate P&R, Overlake TC	30/ - / - / - / -	Weekday peak direction
935	Kenmore, Juanita, Totem Lake, Kingsgate P&R	30/60/ DART / DART / DART	Weekday/Sat/Sun

Note: DART = Dial a Ride Transit

Collisions

King County and the City of Kirkland maintain collision data along NE 132nd Street. King County has three years of collision data for a period starting on January 1, 2002 and ending on December 31, 2004. The City of Kirkland has six years worth of collision data starting from January 1, 2001 and ending on December 31, 2006.

Collision history indicates that most locations along the NE 132nd Street Corridor have less than three accidents per year. Locations with more than three collisions per year tended to be clustered around congested intersections, including:

- 100th Avenue NE/NE 132nd Street
- 116th Way NE/NE 132nd Street
- Totem Lake Boulevard/NE 132nd Street
- 132nd Avenue NE/NE 132nd Street

The largest number of collisions is recorded at the 100th Avenue NE intersection, followed by the Totem Lake Boulevard NE/116th Avenue NE intersection. The largest number of mid-block collisions is noted between 116th Way NE and Totem Lake Boulevard NE/116th Avenue NE. The most common collision type rear endings are noted at two intersections: 100th Avenue NE/NE 132nd Street and 116th Way NE/NE 132nd Street as well as certain mid-block stretches along NE 132nd Street. These patterns and types of recorded collisions suggest that congestion is a major cause.

Figure 6 provides an overview of the total number and most common type of collisions for the three-year collision history. **Figure 7** provides the average number of collisions for the NE 132nd Street corridor.

Figure 6. Total Number and Type of Collisions

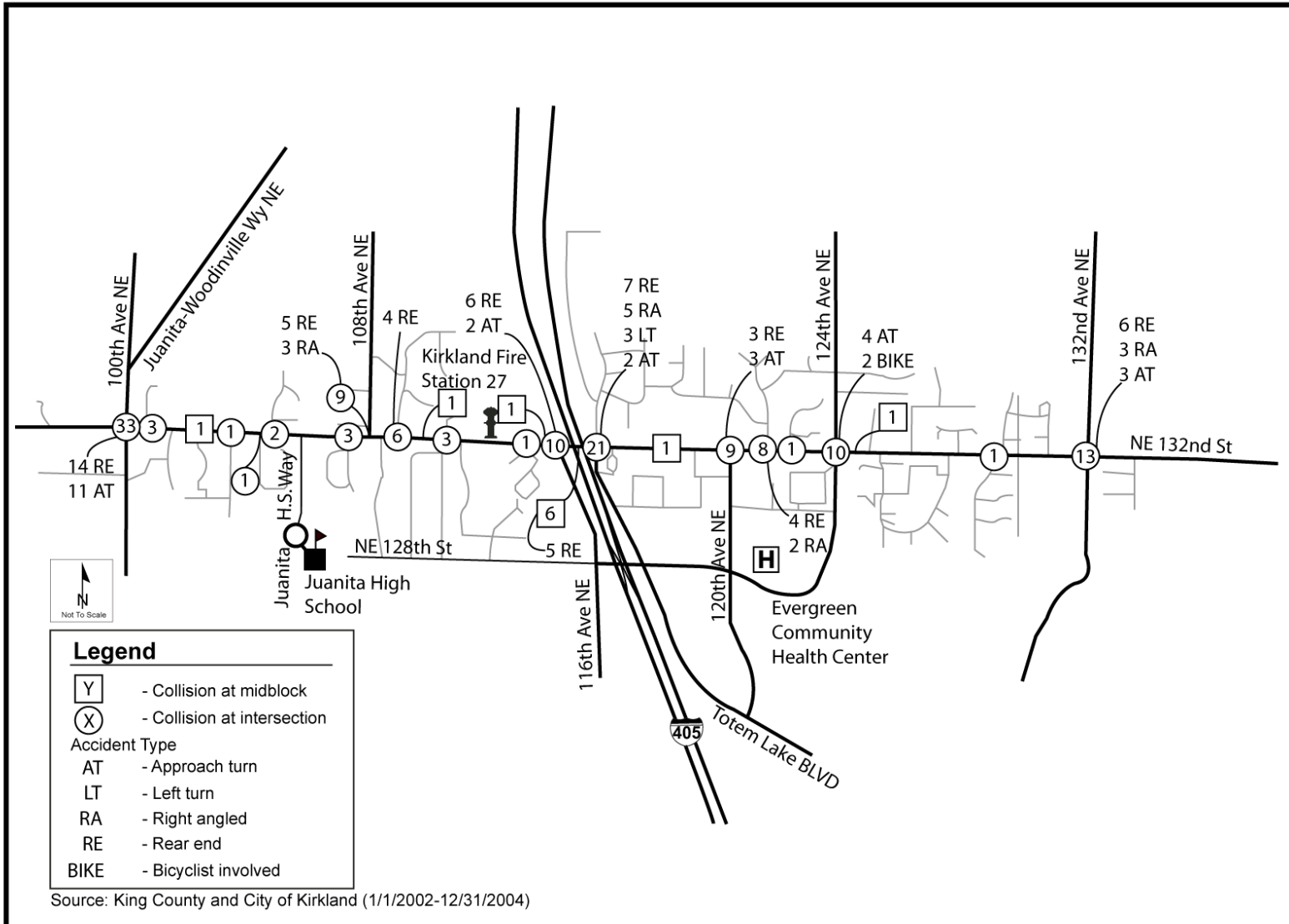
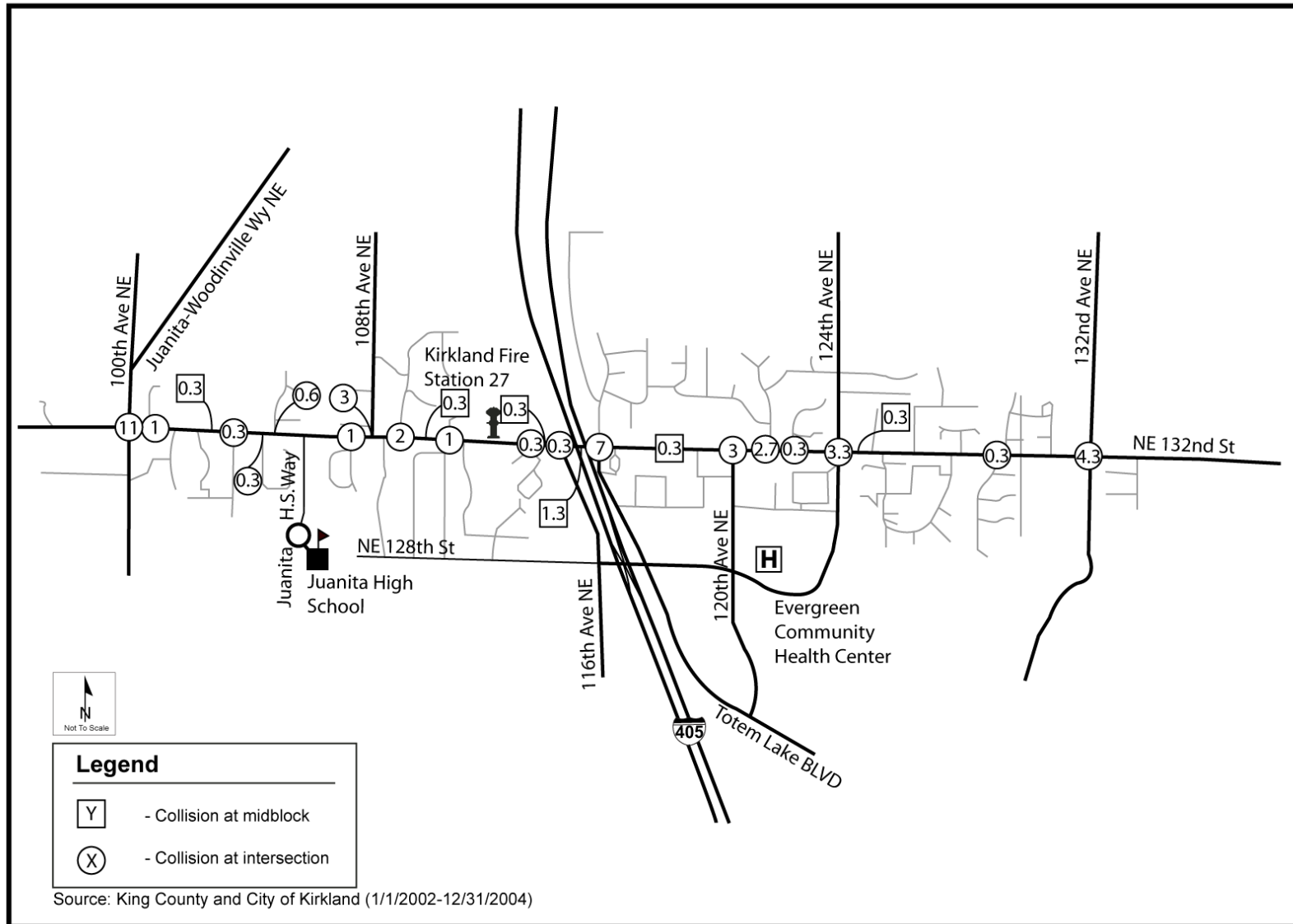


Figure 7. Average Number of Collisions per Year



Traffic Analysis

Mirai analyzed NE 132nd Street operations from 100th Avenue NE to 132nd Avenue NE with the Synchro 6.14 software. This operations analysis software is frequently used by agencies for local street analyses. The main inputs into the Synchro model are lane geometry, roadway speed limits, vehicular traffic volumes, peak hour factor, heavy vehicle percentage and signal phasing and timing information.

The intersections are evaluated based on level of service (LOS) as defined in the Highway Capacity Manual (HCM). Intersection LOS is a measurement of the quality of traffic flow or traffic congestion at an intersection. The LOS grading ranges from A to F, with LOS A assigned when minimal delays are present and low volumes are experienced. LOS F indicates stop-and-go conditions with frequent and lengthy delays.

Synchro calculates intersection LOS, which is defined by the amount of intersection delay per vehicle. For instance, a signalized intersection operating at an average delay per vehicle exceeding 80 seconds is reported to operate at LOS F. The intersection delay for a signalized intersection takes into account the delay caused by the signal control and the queue delay caused by spilling and storage blockage from the adjacent intersections in the network. The average intersection delay for unsignalized intersections, based on the HCM method, is estimated as an average of each traffic movement's delay and does not include delays caused by queuing.

SimTraffic is an extended feature of Synchro that performs micro-simulation and animation of vehicle traffic. With SimTraffic, individual vehicles are modeled and displayed traveling a street network. SimTraffic models signalized and unsignalized intersection operations with cars and heavy vehicles such as trucks and buses. SimTraffic takes multiple inputs from the Synchro model, and then employs driver behavior theories in a further effort to accurately simulate the traffic. Visual and numerical data from the simulation can be used to study traffic flow through the network and identify potential problem areas.

Kirkland assesses the roadway network concurrency on an area-wide basis using a volume to capacity (V/C) ratio for key intersections to identify any potential project requirements. This V/C ratio is determined using the National Cooperative Highway Research Program (NCHRP) Circular 212 method for evaluating intersection operation with the conflicting traffic volumes at an intersection. Kirkland's V/C ratio concurrency standard is 1.40 for individual intersection. Mirai calculated the concurrency V/C values for existing, 2007 and mid-term future year, 2014.

Current Traffic Volumes

Our study was initiated when there were some construction roadway closures in the study area. The construction of the NE 128th Street roadway crossing I-405 and the direct access ramp intersection required partial closure of 116th Way NE south of NE 132nd Street. This change in the network did influence the traffic patterns for travelers accessing southbound I-405. City of Kirkland provided traffic counts from year 2005 as a baseline for the analysis and we conducted some additional turning movement counts at three intersections along the corridor to fill in the gaps in data

and to confirm baseline traffic volumes and conditions. Current traffic volumes for year 2007 were developed using the 2005 counts and applying a small growth factor for two years. Traffic volumes for the NE 132nd Street corridor were adjusted between intersections to use counts from different periods.

AM Peak Hour Conditions

Figure 8 shows the AM peak hour turning movement volumes. During the AM peak hour, traffic congestion is observed in the eastbound and westbound direction approaching the signal at Juanita High School. Morning school peak coincides with the commute peak period and this overlap results in congestion along NE 132nd Street that stretches and impacts the operation of the 100th Avenue NE at the NE 132nd Street signal. The morning peak at Juanita High School is approximately a half-hour during the AM peak hour – and the intensity has an impact on overall travel along NE 132nd Street on the west side of the corridor. To some extent, the signals at 100th Avenue NE and 108th Avenue NE meter the southbound traffic toward the high school. Also, the limitations for entering traffic to flow freely on the school campus leads to backups for traffic on NE 132nd Street on the west side of the corridor.

On-site circulation at the high school provides for access to parking, bus circulation and drop-off traffic – all converging at the traffic circle central to the campus. The single entry lane does not meet the demand for arriving traffic at the school in the morning peak. The constrained entry to the high school creates problems in the morning peak period along the NE 132nd Street arterial.

Traffic simulation of the corridor using the current traffic counts also indicates a high demand for 116th Way NE to be used to access I-405 ramps at the Totem Lake interchange. Morning peak period backups on NE 132nd Street also radiate from the 116th Way NE intersection, at times extending through the signal at 108th Avenue NE. However, congestion at 116th Way NE is not as severe or intense as at the Juanita High School access, especially for the half-hour of student arrivals.

Figure 9 provides an overview of the current AM peak operation at the corridor traffic signals, showing intersection LOS and average delay for the intersection.

PM Peak hour Conditions

Figure 10 shows the PM peak hour turning movement volumes. During the PM peak hour, traffic congestion is observed in the westbound direction towards 100th Avenue NE. This intersection is a node of congestion, with high travel demand in the northbound direction as well as substantial westbound demand from NE 132nd Street. Mirai's observations and traffic simulations suggest that the signal at 100th Avenue NE favors the heavy northbound movements, resulting in travel delays for the lower volume traffic on NE 132nd Street. Many times, the queues in the westbound direction along NE 132nd Street can back up well beyond 108th Avenue NE and a rolling queue can extend through the Totem Lake Boulevard intersection, just to the east of I-405.

Congestion is also observed in the vicinity of the closely spaced intersections at 116th Way NE and 116th Avenue NE/Totem Lake Boulevard NE. At 116th Way NE, the

heavy westbound movement conflicts with the northbound left-turn movements from 116th Way NE. At 116th Avenue NE/Totem Lake Boulevard NE, the eastbound and westbound through movement conflict with the heavy northbound left-turn movement from Totem Lake Boulevard NE. The short spacing between the two intersections and limited storage length for all lane capacity constrain the amount of northbound left-turning vehicles clearing the signal.

At 124th Avenue NE, traffic counts and Mirai observations show a heavy demand for the eastbound left-turn movement. Many times, the left-turn pocket is filled to capacity. However, the queues generally clear within one cycle.

Figure 11 provides an overview of the current PM peak operation at the corridor traffic signals. Currently, the intersections meet the concurrency standards for the City of Kirkland, with V/C ratios under 1.40.

Figure 8. 2007 AM Peak Hour Turning Movement Volumes

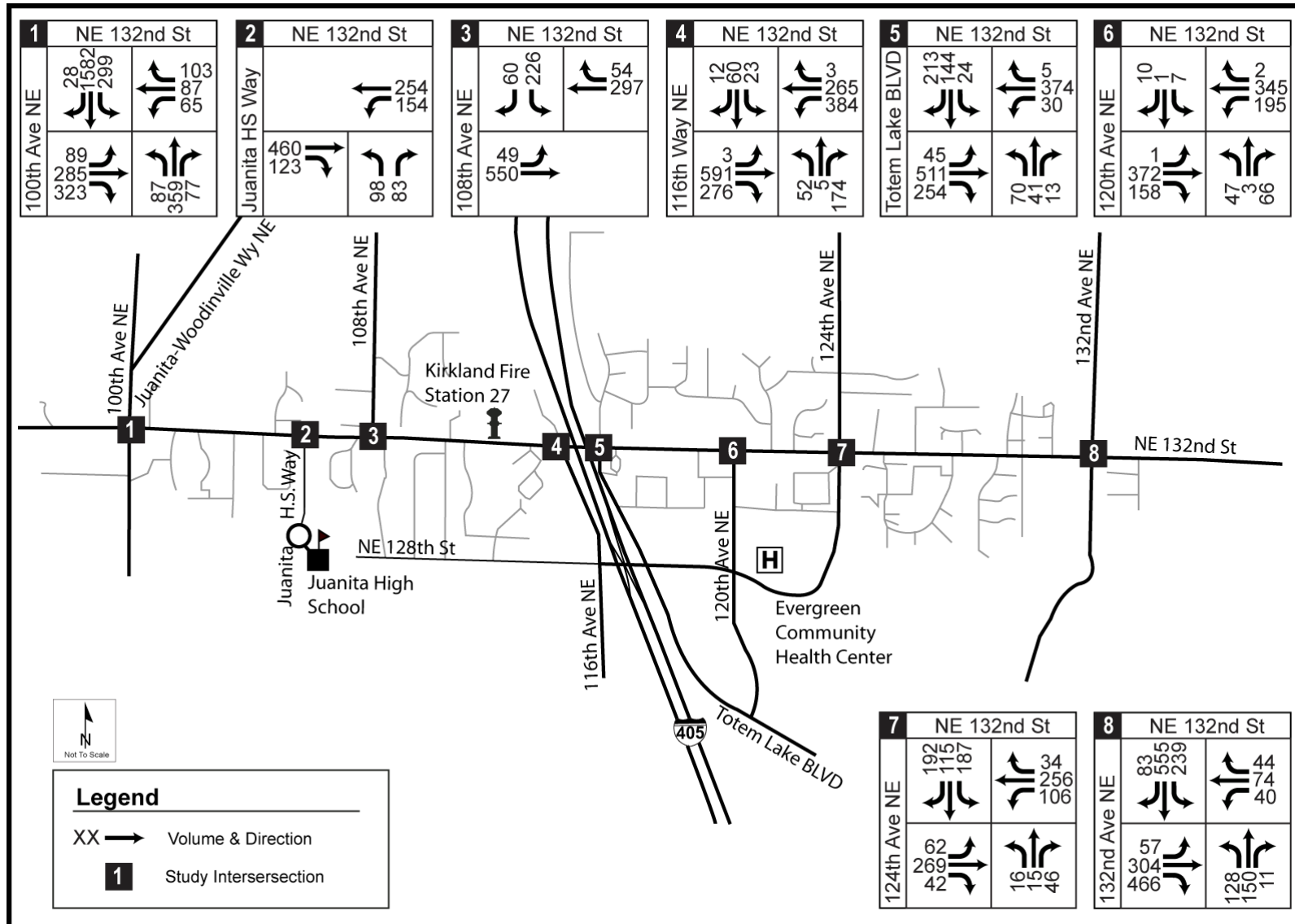


Figure 9. 2007 AM Peak Hour Operations

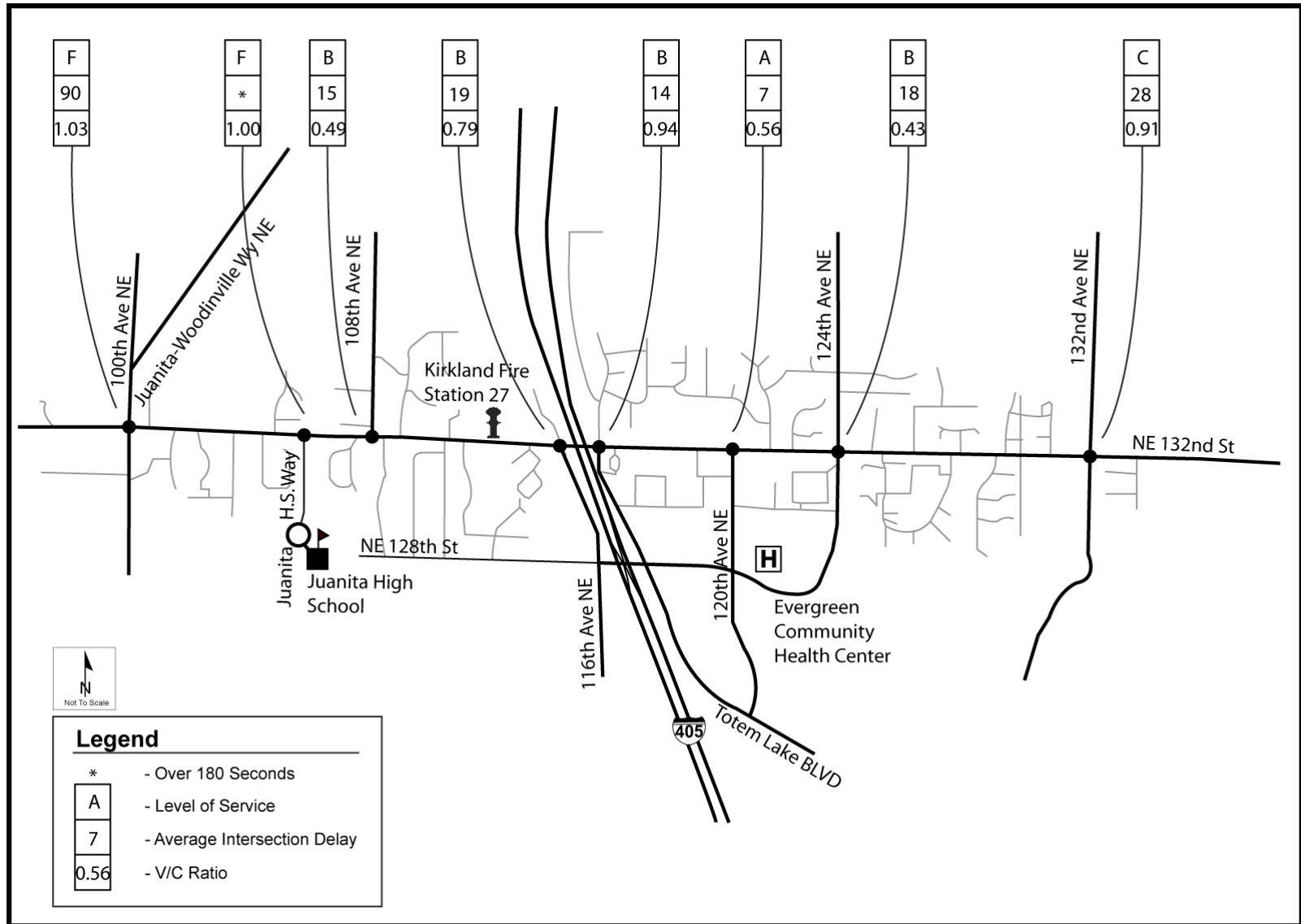


Figure 10. 2007 PM Peak Hour Turning Movement Volumes

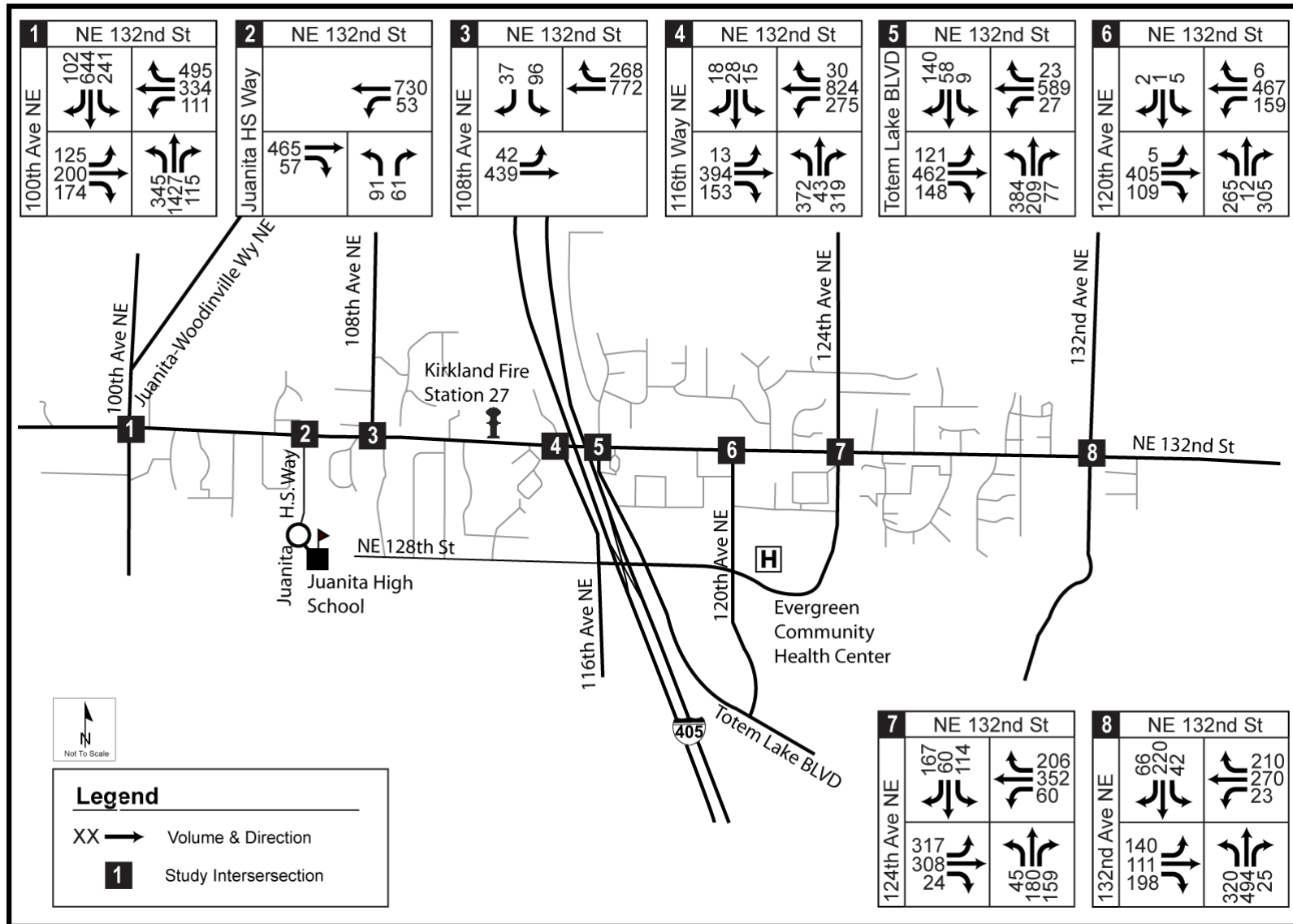
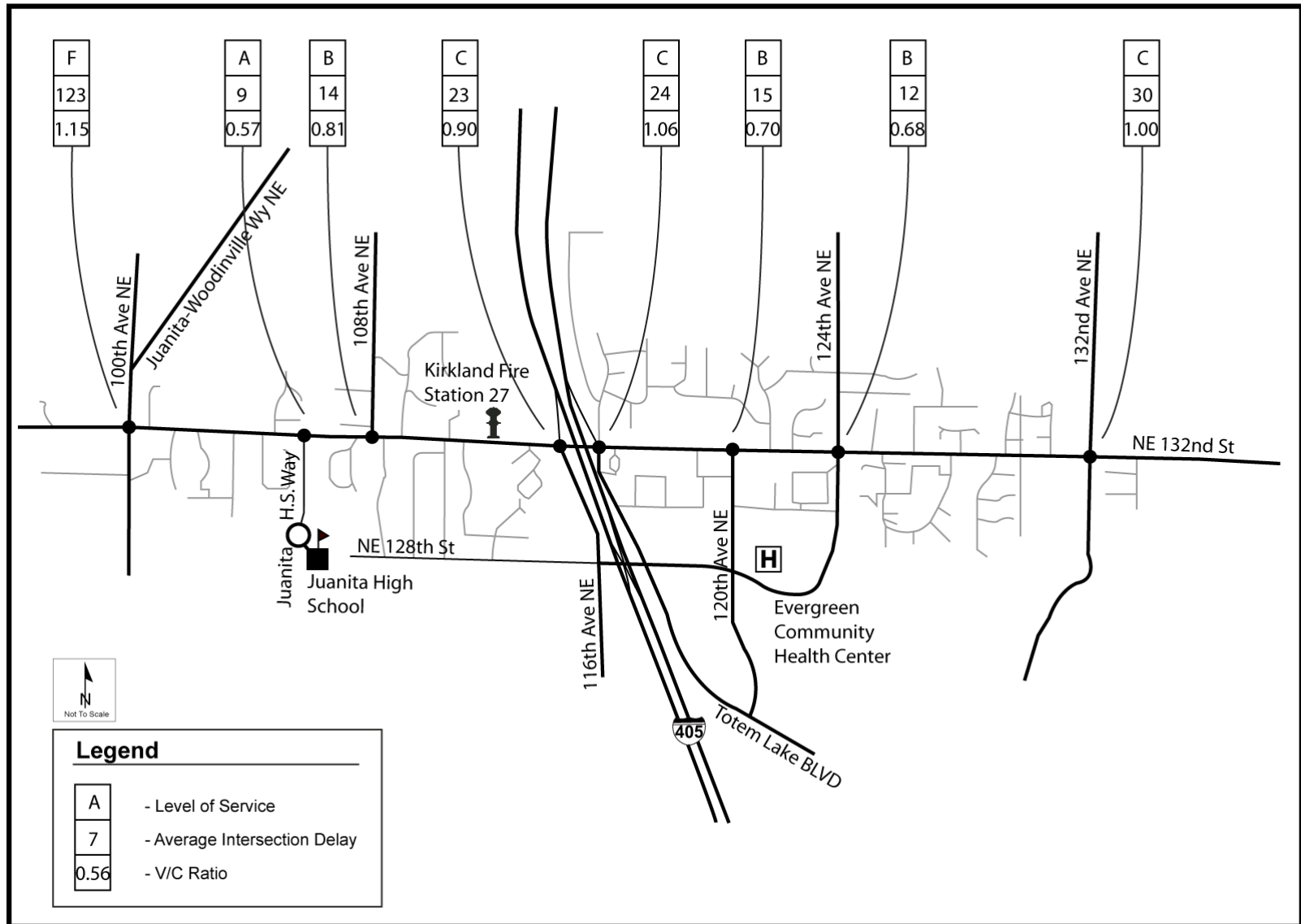


Figure 11. 2007 PM Peak Hour Operations



FUTURE CONDITIONS

An important part of any corridor analysis is to examine the future traffic conditions with the expected roadway configuration. We developed the 2030 forecast for traffic using the Bellevue-Kirkland-Redmond (BKR) travel forecasting model developed for these three cities. This model has land use forecasts approved by both the cities of Redmond and Bellevue. Mirai provided refinements to reflect Kirkland’s growth beyond the adopted 2022 land use assumptions. We also assessed traffic operations in the corridor for a mid-year condition in 2014 to reflect how concurrency would be met under the alternatives examined. Traffic volumes for the 2014 PM peak hour turning movement volumes were estimated by interpolating the volumes between existing 2005 volumes and forecasted 2030 volumes.

Year 2030 Forecasts: Travel Demand Modeling

The BKR model was used for this project to estimate traffic volumes for the 2030 PM peak period. Mirai validated the BKR model using 2005/2007 traffic counts along NE 132nd Street, NE 124th Street and NE 116th Street. We can expect traffic growth to increase on all roadways in the study area and throughout the eastside, and as well as expect an overall increase in congestion. The anticipated growth in the area is summarized in **Table 2**; the annualized average growth is shown in **Table 3**. Both of these tables reveal that growth in Bellevue, Kirkland and Redmond is expected to be higher than the growth for the remainder of King, Snohomish, Pierce and Kitsap Counties.

Table 2. Growth between 2005 and 2030 in the Study Area

City	2005		2030			
	Origins	Destinations	Origins		Destinations	
			Number	Percent	Number	Percent
Bellevue	50,193	42,508	87,083	73%	68,268	61%
Kirkland	27,173	27,530	41,807	54%	42,134	53%
Redmond	29,203	25,593	50,799	74%	42,278	65%
Rest of 4 Counties	592,600	603,538	879,440	48%	906,429	50%
TOTAL	699,169	699,169	1,059,109		1,059,109	

Table 3. Annualized Average Growth between 2005 and 2030 in Percentage

City	Origins	Destinations
Bellevue	2.23%	1.91%
Kirkland	1.74%	1.72%
Redmond	2.24%	2.03%
Rest of 4 Counties	1.59%	1.64%

Most of the increase in vehicle trips is oriented north and south and is located along I-405. There is also a significant increase in vehicle trips along SR 202, Woodinville-Redmond Road. The 2005 to 2030 traffic growth is shown in **Figure 12**.

Figure 13 shows the results of the select link analysis for westbound trips on NE 132nd Street east of I-405. This figure shows that most of the trips come from the south or southeast and have destinations north and west of the NE 132nd Street Corridor. NE 132nd Street is one of several paths used to complete these trips connecting the southeast and northwest areas.

Northbound trips using the Totem Lake east-west corridor are shown in **Figure 14**. This select link analysis for northbound trips on I-405 south of NE 116th Street show that most of these trips are destined to the north or northeast and not going east or west along NE 132nd Street.

Totem Lake Corridor Growth

Screenline volumes were developed for the Totem Lake east-west corridor to the east and to the west of I-405, for traffic assigned to NE 116th Street, NE 124th Street and NE 132nd Street. As noted previously, these three arterials make up the east-west travel corridor that serves the Totem Lake urban center and there is substantial interrelation between the three roadways.

The peak hour volumes for the three roadways are summarized in **Figure 15** for 2005 and 2030. Comparing the volumes for several conditions, 2007, three-lane with the 2030, three-lane with I-405 ramps, this figure shows a forecast increase of 1,095 eastbound trips and 2,180 westbound trips in the PM peak hour for the corridor as a whole west of I-405. This same figure shows an increase of 1,280 eastbound trips and 690 westbound trips for the corridor to the east of I-405. This summary indicates a need for additional capacity within the corridor, but does not indicate where it should be implemented.

Of the three arterials, NE 124th Street is the major arterial serving a predominantly commercial and multi-family mix of development. It is the only street with a full interchange connection to I-405. Both NE 116th Street and NE 132nd Street serve predominantly residential land uses and neighborhoods.

Figure 12. Forecast PM Peak Hour Traffic Growth from 2005 to 2030

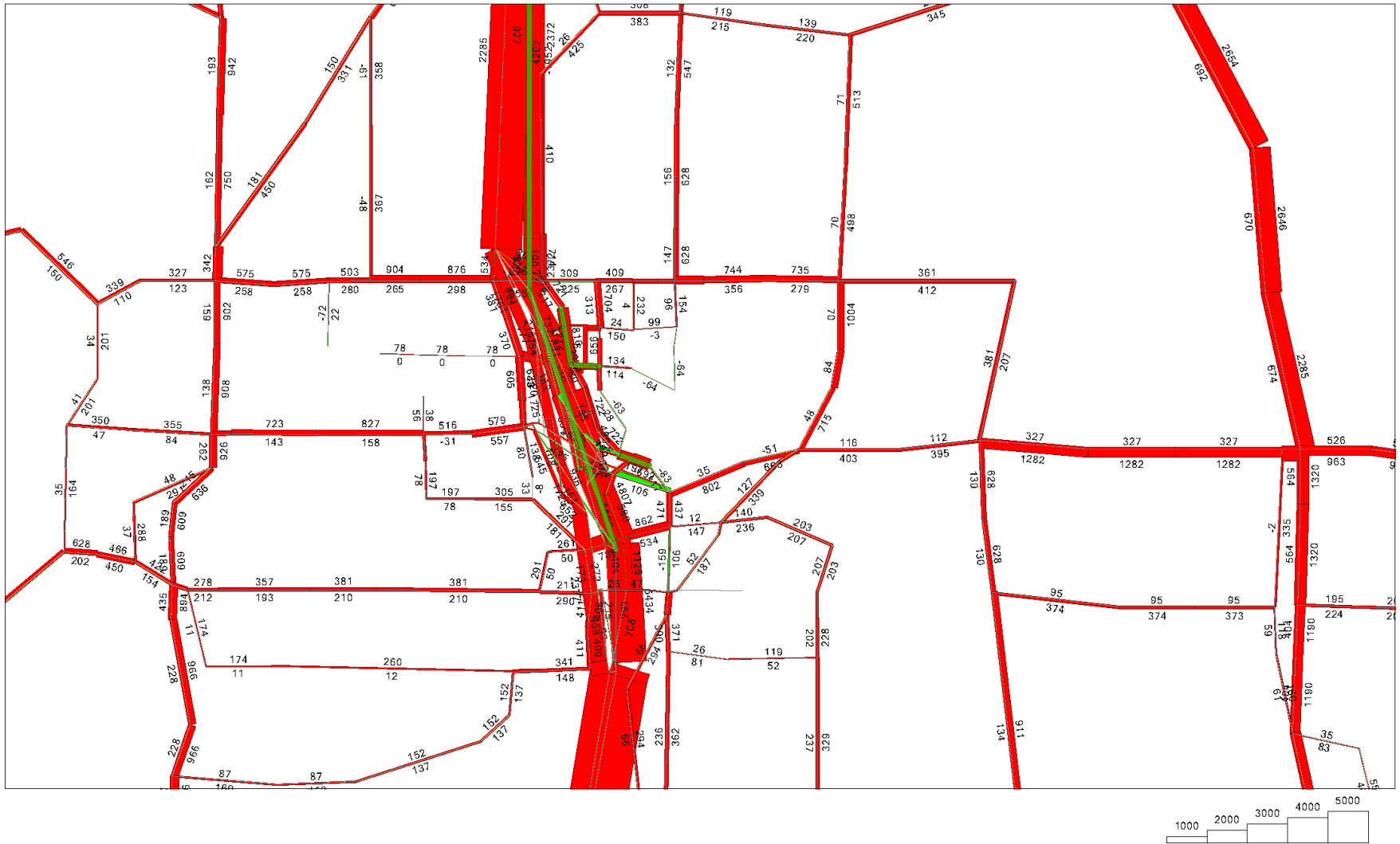
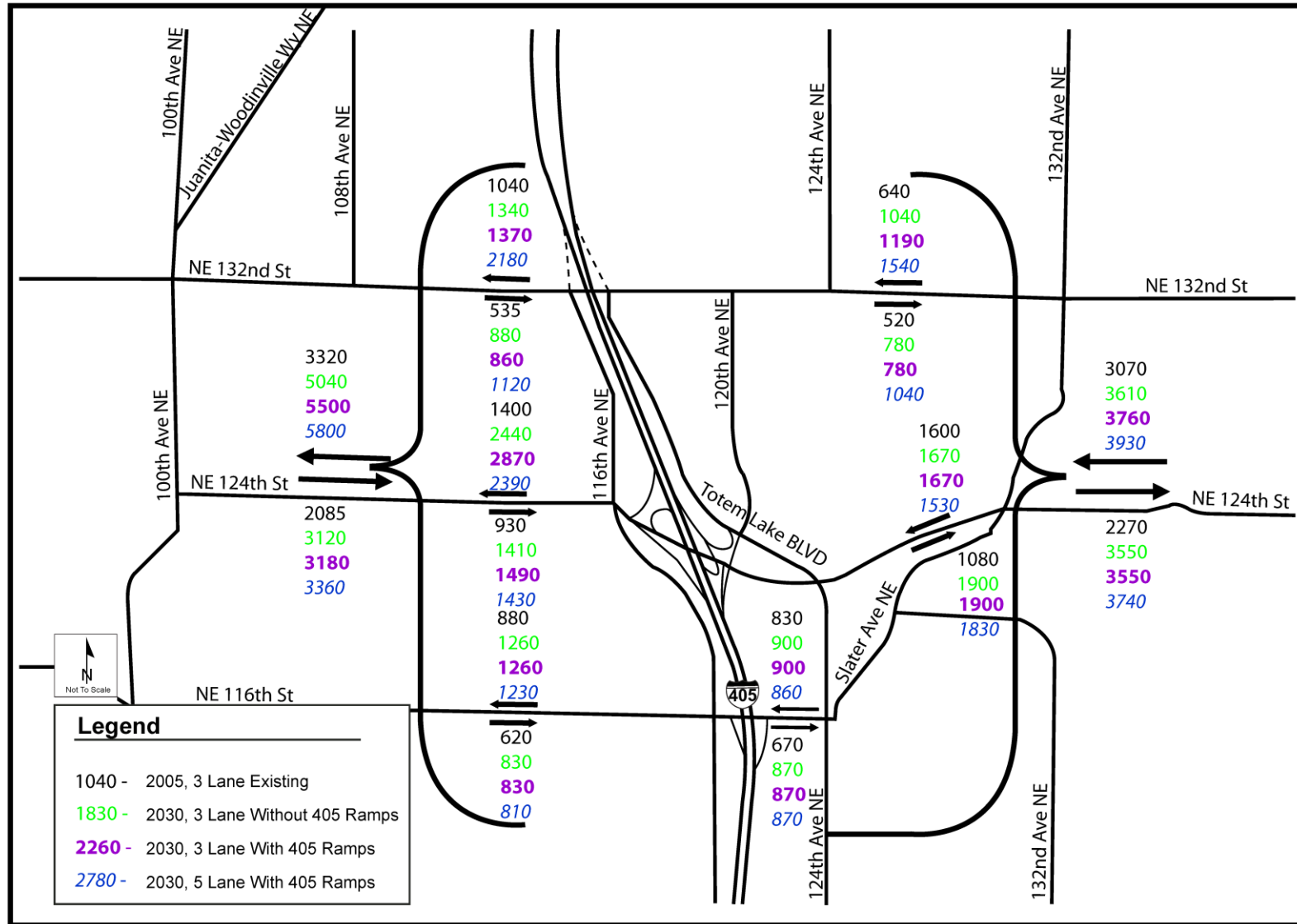


Figure 15. Comparison of 2005 and 2030 Forecast PM Peak Hour Volumes



Totem Lake East-West Corridor Analysis

The Totem Lake east-west corridor will need additional capacity to meet the estimated peak hour demand identified by the BKR model for 2030. However, identifying the best place to add capacity in this corridor goes beyond the analysis for NE 132nd Street alone, and necessitates the exploration of where else capacity could be added in this corridor. Mirai ran some options using the BKR model to estimate the traffic demand under two scenarios:

- Adding a lane in each direction to NE 132nd Street for a five-lane roadway,
- Adding a lane in each direction to NE 124th Street for a 7-lane roadway.

Figure 16 shows the volume changes that would result from adding two lanes to NE 132nd Street. The addition of two lanes would increase the number of trips on NE 132nd Street and decrease the number of trips on NE 124th Street. This shift of trips from NE 124th Street to NE 132nd Street is due to the additional capacity on NE 132nd Street, which reflects a traveler's desire to seek the path with the higher capacity. The number of vehicles using the new half interchange does not change under this scenario. However, the decrease in assigned traffic along NE 124th Street is not realistic since NE 124th Street has the most direct access to the full interchange at I-405 and serves the commercial area of Totem Lake. The addition of lanes on NE 132nd Street could draw traffic from the major arterial in this corridor, which may not be desirable to either the City or to the neighborhoods adjacent to NE 132nd Street.

Under the second scenario two lanes added to NE 124th Street rather than to NE 132nd Street, **Figure 17**, shows a significant increase in trips along NE 124th Street as well as an increase in trips along 100th Avenue NE between NE 124th Street and NE 132nd Street. Meanwhile the number of trips on both NE 116th Street and NE 132nd Street showed some reduction. This option could better serve the overall travel demand patterns between the interchange area and the Willows Road corridor to the east when compared to adding capacity to NE 132nd Street.

Figure 16. Forecast 2030 PM Peak Hour Volume Change from a 3-Lane to 5-Lane NE 132nd Street

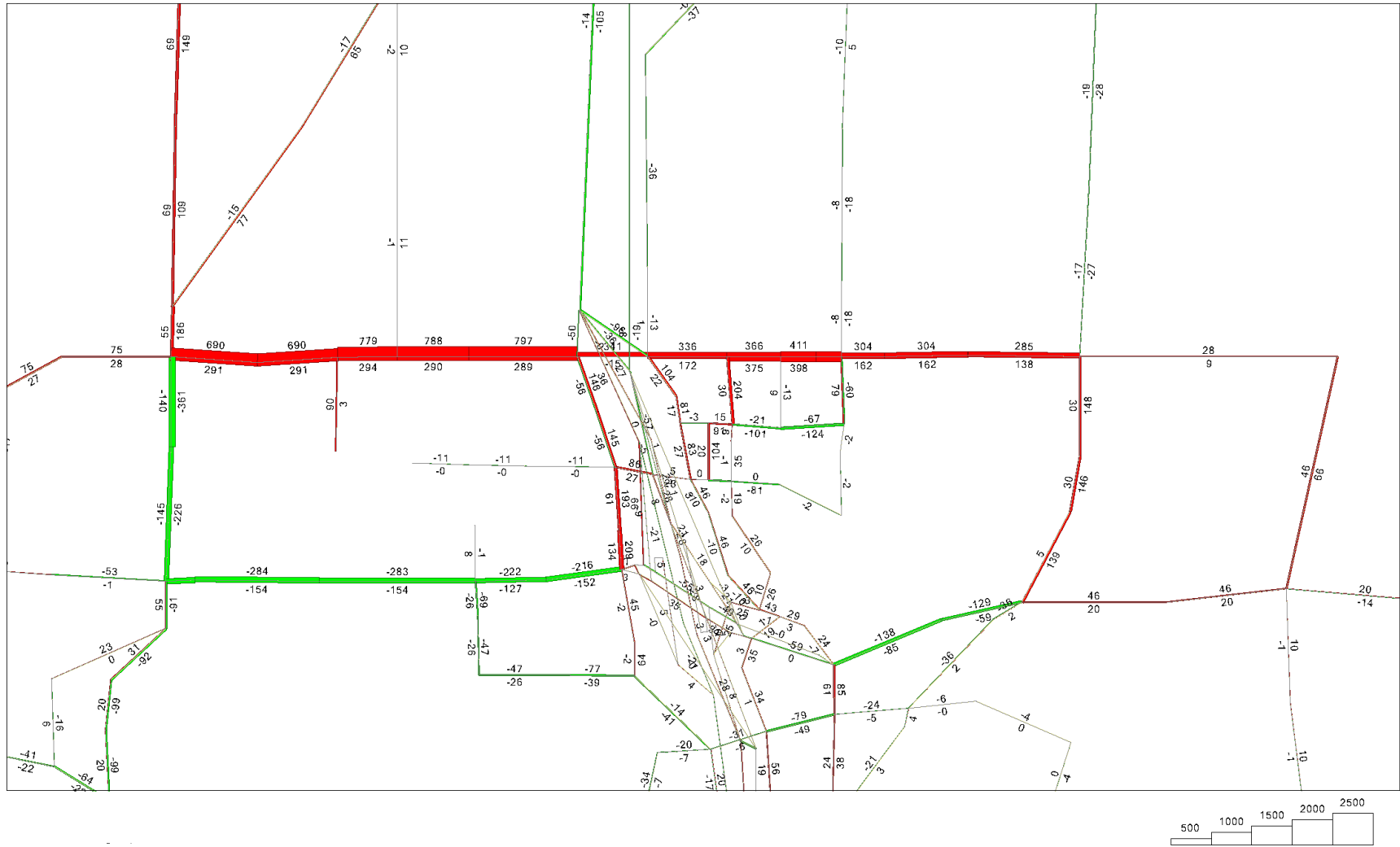
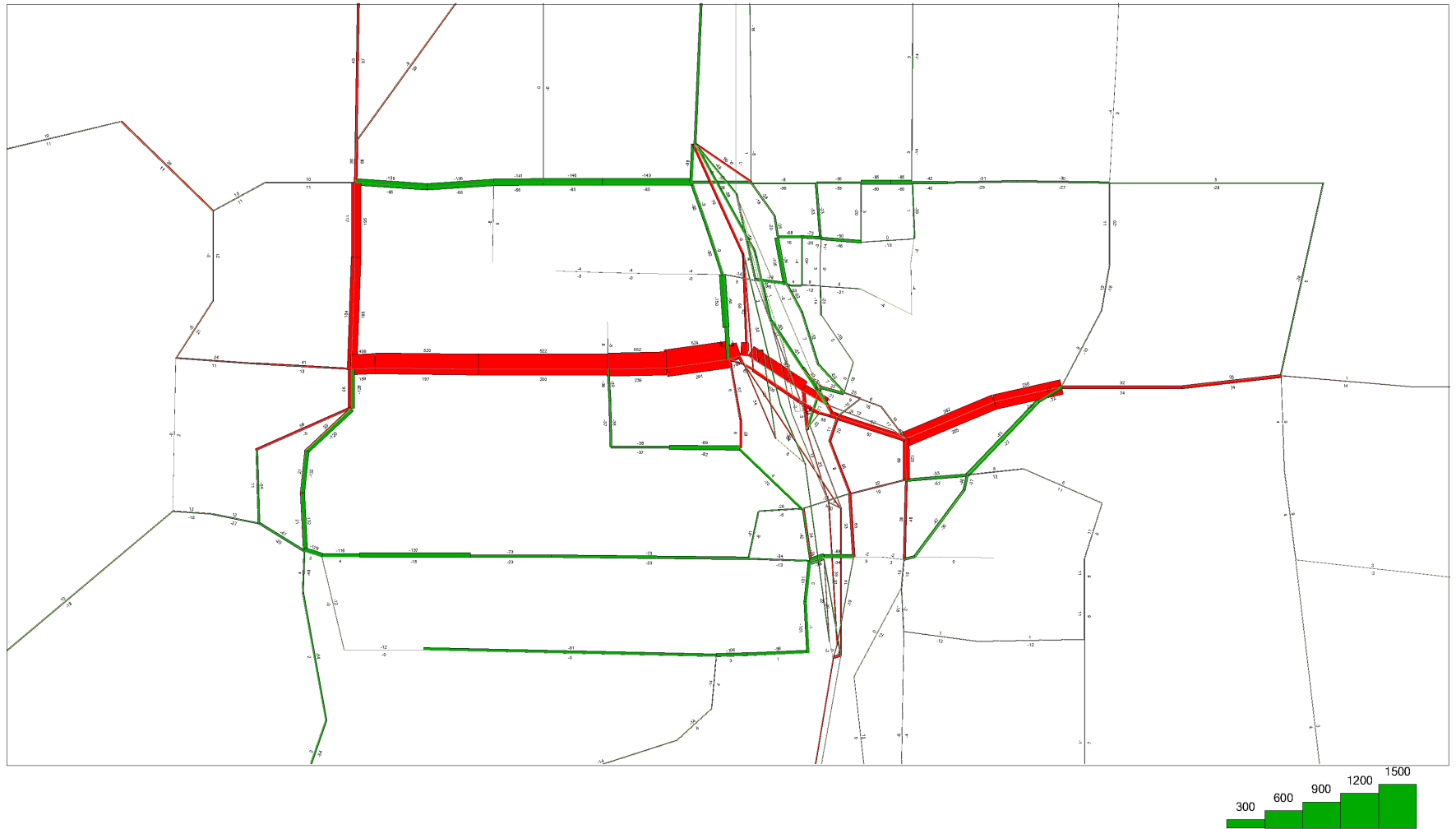


Figure 17. Forecast 2030 PM Peak Hour Volume Change from a 5-Lane to 7-Lane NE 124th Street



FUTURE BASELINE CONDITIONS

The half interchange to be constructed by WSDOT at I-405 and NE 132nd Street will connect with I-405 to and from the north. The project is scheduled to be completed by 2013, prior to this study's forecast year of 2030. The 2030 baseline and mid-year conditions in 2014 for this study include the half interchange but no other improvements to the Totem Lake east-west corridor.

Traffic volume forecasts for NE 132nd Street were developed using the BKR model for year 2030 with the planned half-interchange to I-405. WSDOT is in the process of designing the new ramps, providing a southbound off-ramp and a northbound on-ramp to and from NE 132nd Street. The two intersections adjacent to I-405 will both be modified by adding lanes and changing the signal operations to incorporate the freeway access. Currently, the north leg of the 116th Way NE intersection is a primary access for a multi-family development. This will be relocated to the west, with a separate driveway intersection on NE 132nd Street. No additional improvements are assumed for 2030. See **Figure 18** for the proposed WSDOT layout of the new interchange and the modifications to NE 132nd Street which are part of the project.

Figure 19 shows the 2030 PM peak hour turning volumes for the baseline condition, rounded to the nearest 5 trips. Mirai developed these numbers by validating the model results, adjusting for the volume balancing and comparing to the existing traffic patterns.

Using Synchro software, Mirai conducted traffic operation analysis and traffic simulations of the corridor to assess the expected operation under the future baseline conditions. For future conditions, signals were optimized for cycle lengths and offsets. The maximum cycle length considered for optimization was 120 seconds. Existing coordinated signals were included under the baseline conditions analysis. Additional signal coordination was only considered for tested scenarios.

Figure 20 provides an overview for the expected 2030 PM peak hour intersection operations, the average intersection delays and V/C ratios for the eight signals along the corridor. Based on the observations of the simulation, the corridor will continue to experience some peak period congestion and queuing, specifically on both 116th Way NE and Totem Lake Boulevard northbound approaching NE 132nd Street intersections, and on NE 132nd Street approaching 100th Avenue NE, 124th Avenue NE and 132nd Avenue NE.

Figure 21 provides the PM peak hour turning volumes under the baseline conditions in year 2014. Mirai developed a forecast for this interim year, to give an indication of near term operations in the corridor. **Figure 22** provides an overview of 2014 roadway operations along NE 132nd Street. Even with the planned WSDOT interchange and associated intersection improvements, the congestion and backups will remain along NE 132nd Street, especially at 100th Avenue NE.

Figure 18. WSDOT Proposed I-405 Half Interchange at NE 132nd Street

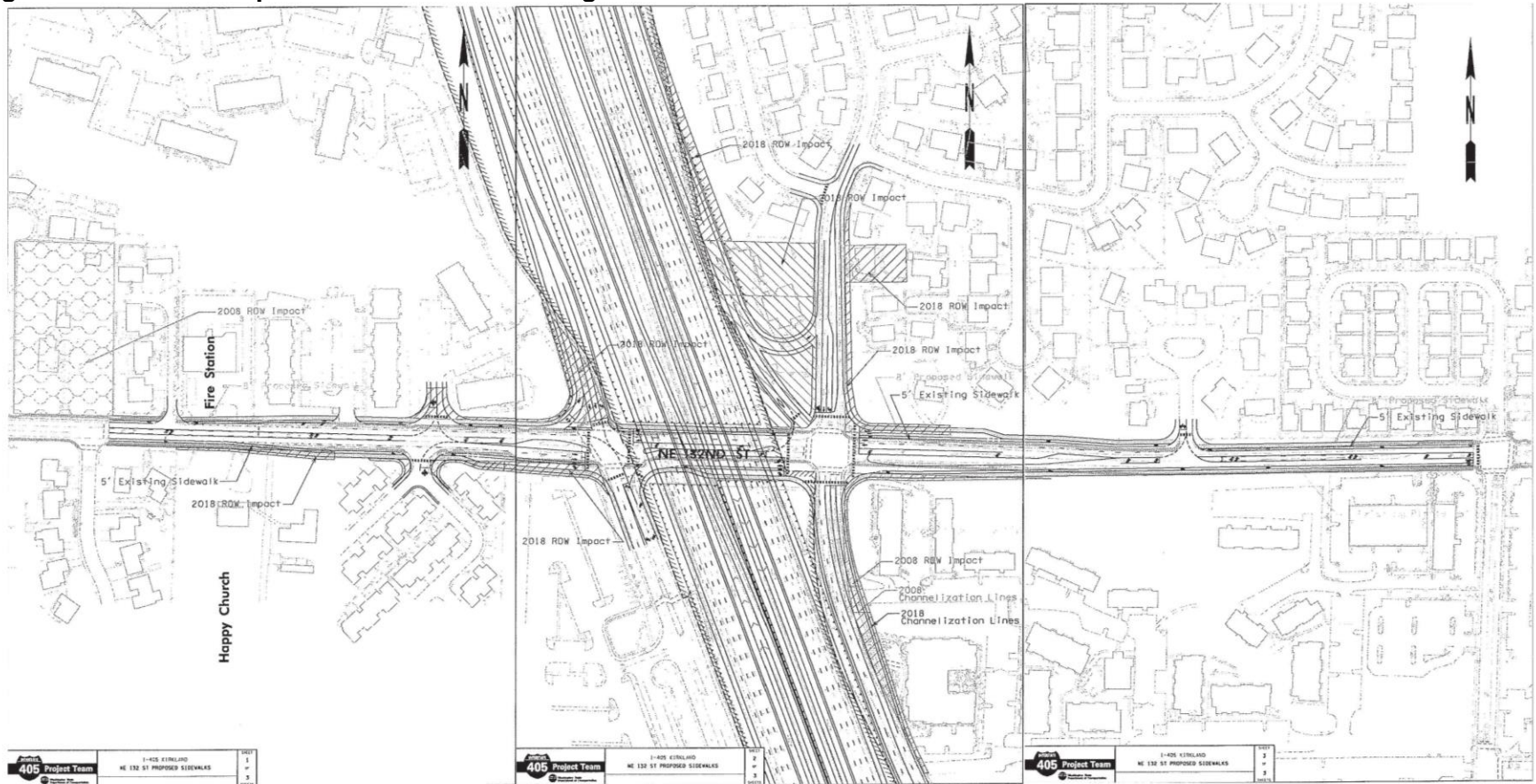


Figure 19. 2030 PM Peak Hour Turning Movement Volumes – Baseline Conditions

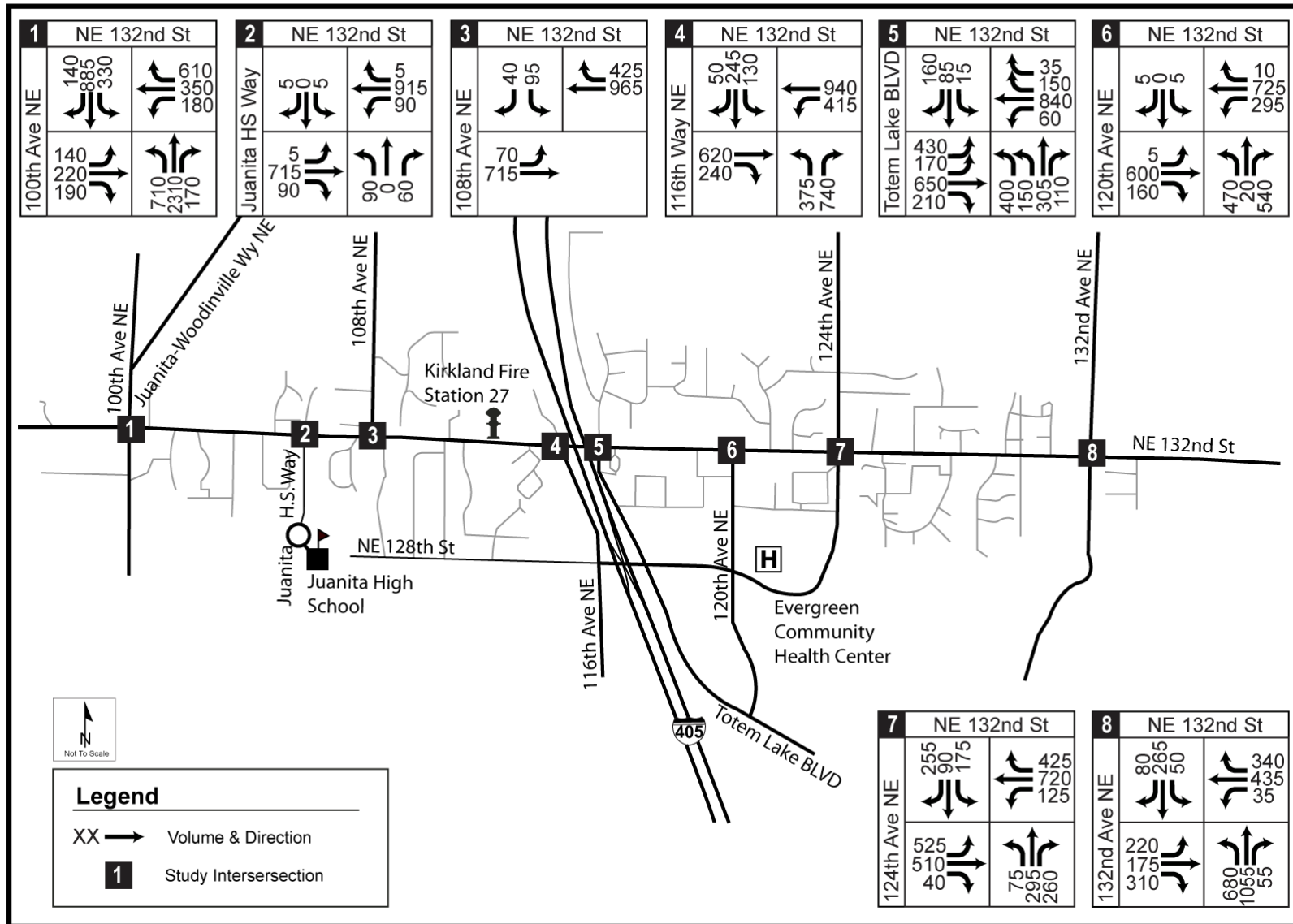


Figure 20. 2030 PM Peak Hour Operations – Baseline Conditions

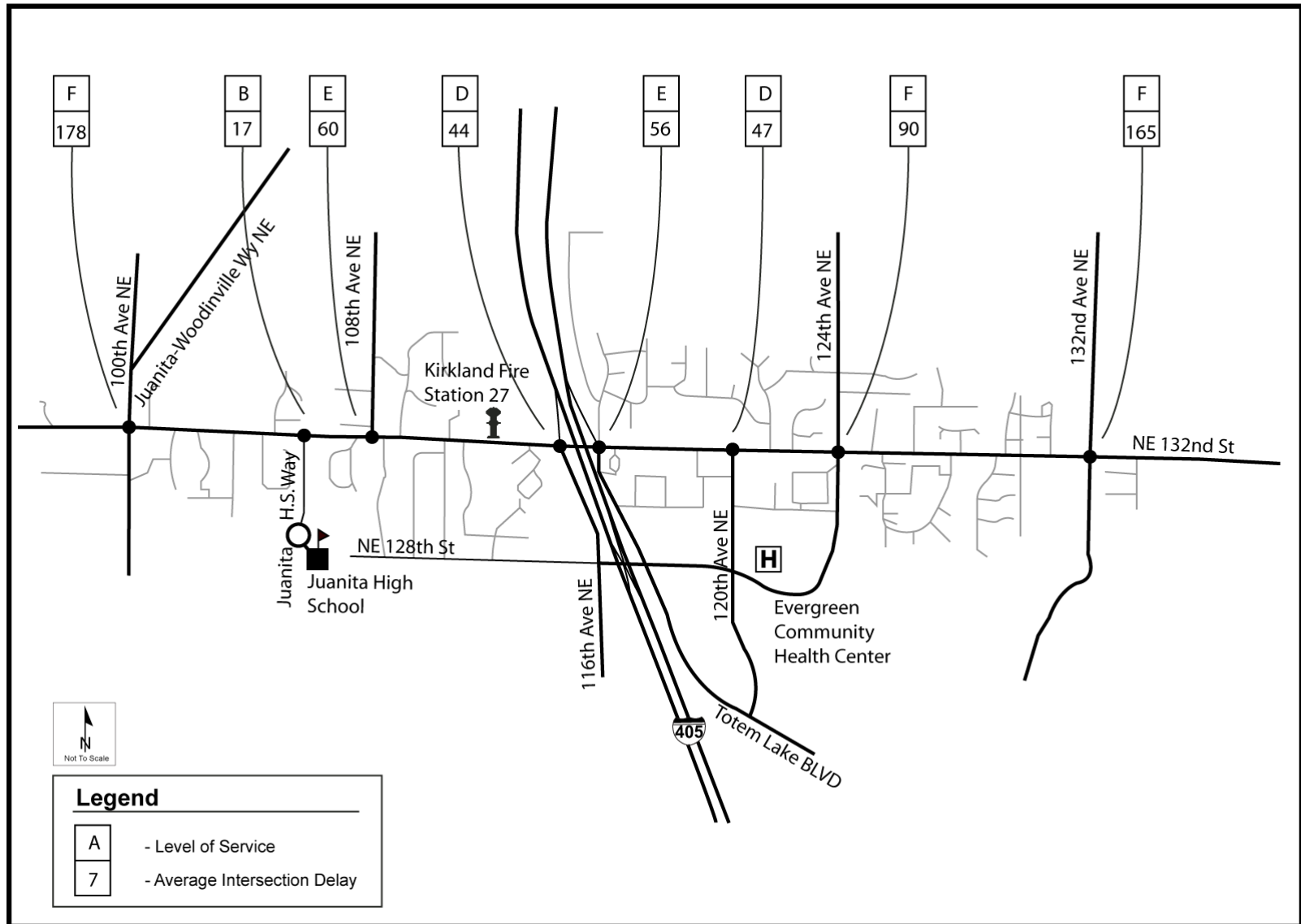


Figure 21. 2014 PM Peak Hour Turning Movement Volumes – Baseline Conditions

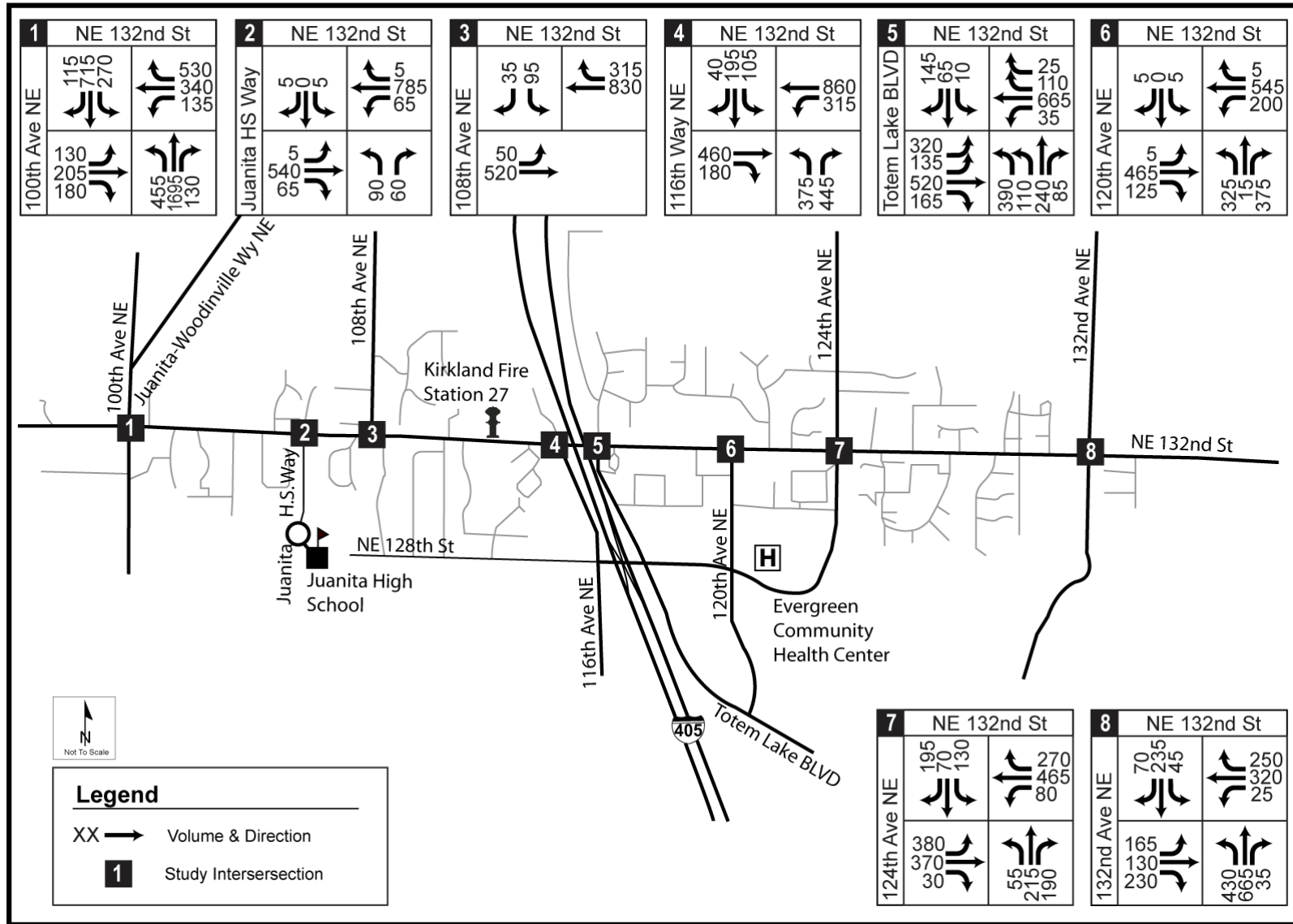
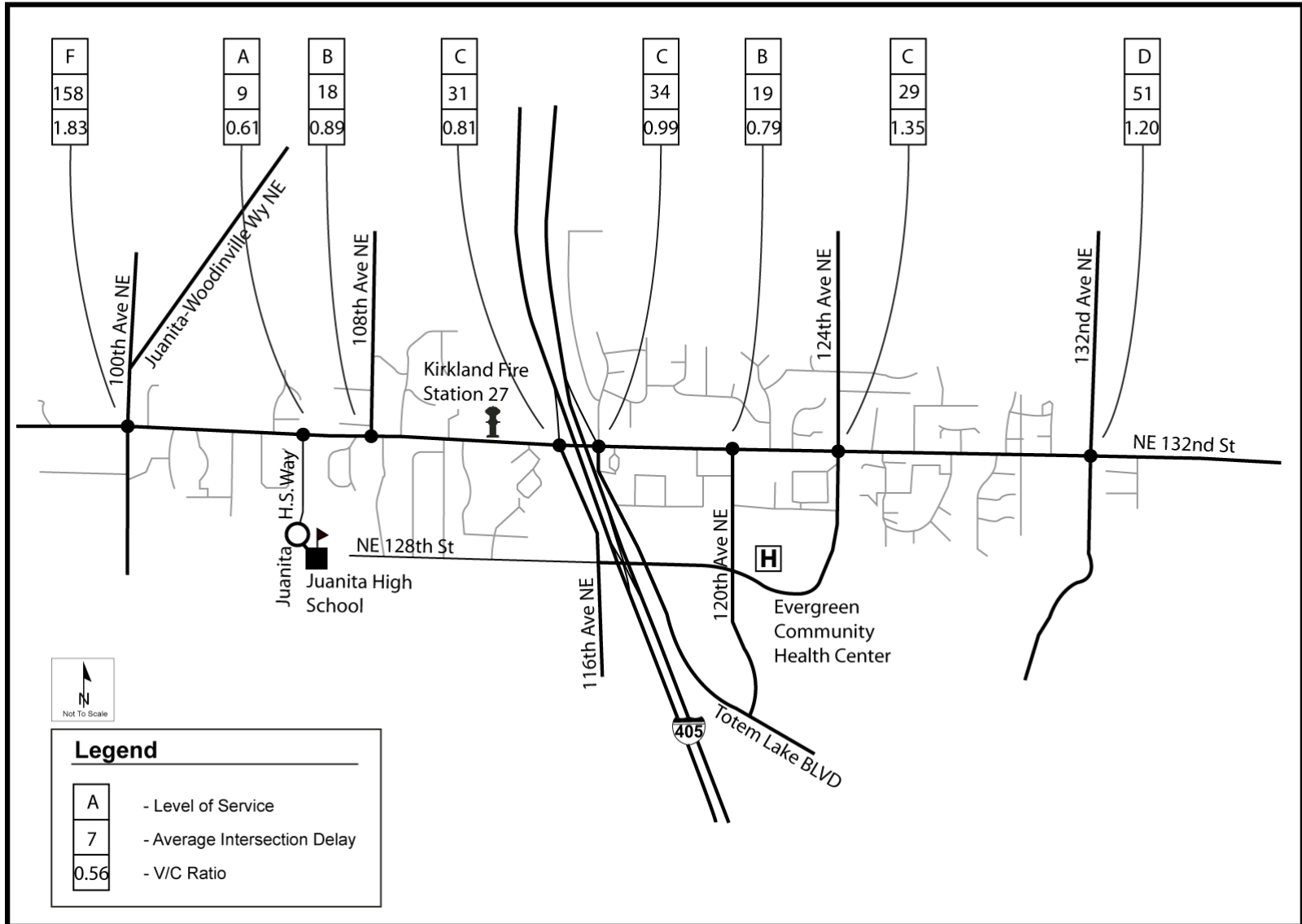


Figure 22. 2014 PM Peak Hour Operations – Baseline Conditions



ROADWAY ALTERNATIVES

Two alternatives were identified for evaluation in this study for the NE 132nd Street corridor:

- Three-lane Roadway with spot improvements at key intersections (Enhanced Three-Lane)
- Five-lane Roadway

Both alternatives incorporate the planned half-interchange at I-405. The three-lane roadway alternative reflects how the existing roadway could be modified for improved operation by adding lanes at key congested intersections. The five-lane roadway alternative examines traffic demand, which would increase with the added capacity, and identifies what is needed to make the five-lane facility work.

Enhanced Three-Lane Roadway Alternative

Based on the congestion and queue lengths in the Synchro analysis for the 2030 Baseline condition, several modifications for the signalized intersections in the NE 132nd Street Corridor were analyzed as part of a three-lane enhanced corridor alternative. This alternative consists of lane additions and modifications at key intersections where congestion and queuing are at issue. Below is a list of the intersection projects that make up the enhanced three-lane alternative.

- Lengthen the westbound, right-turn pocket approaching the 100th Avenue NE intersection. Revise striping to lengthen the westbound left-turn pocket.
- Add a right-turn pocket for the eastbound approach to Juanita High School intersection.
- Add a westbound, right-turn pocket at 108th Avenue NE.
- I-405 Half-Interchange at NE 132nd Street: Reconfigure the southbound off-ramp to have one left-turn lane, one shared through + left turn lane and one shared through + right turn lane. Reconfigure the northbound approach for one left-turn lane and one shared right, left-turn lane.
- 124th Avenue NE: Add a second left-turn lane for the westbound traffic at 124th Avenue NE and add a second northbound exit lane on the north leg. Convert the northbound right-turn lane to be a shared through + right-turn lane at 124th Avenue NE.
- Add a westbound right-turn pocket at 132nd Avenue NE.

The results of the analysis for the enhanced three-lane alternative are presented in **Figure 23**. Congestion would be improved with reduced overall delay and shortened queues in the corridor. Additional analyses tested the value of the westbound right-turn pockets at 108th and 132nd Avenue NE. The analysis confirms that that the proposed westbound right-turn pockets have a dramatic beneficial effect on traffic. **Figure 24** illustrates the operation without the two right turn project elements. Results for the enhanced three-lane alternative with the interim year 2014 traffic volumes are also provided to check for concurrency, see **Figure 25**.

Figure 23. 2030 PM Peak Hour Operations – Enhanced Three-Lane Roadway

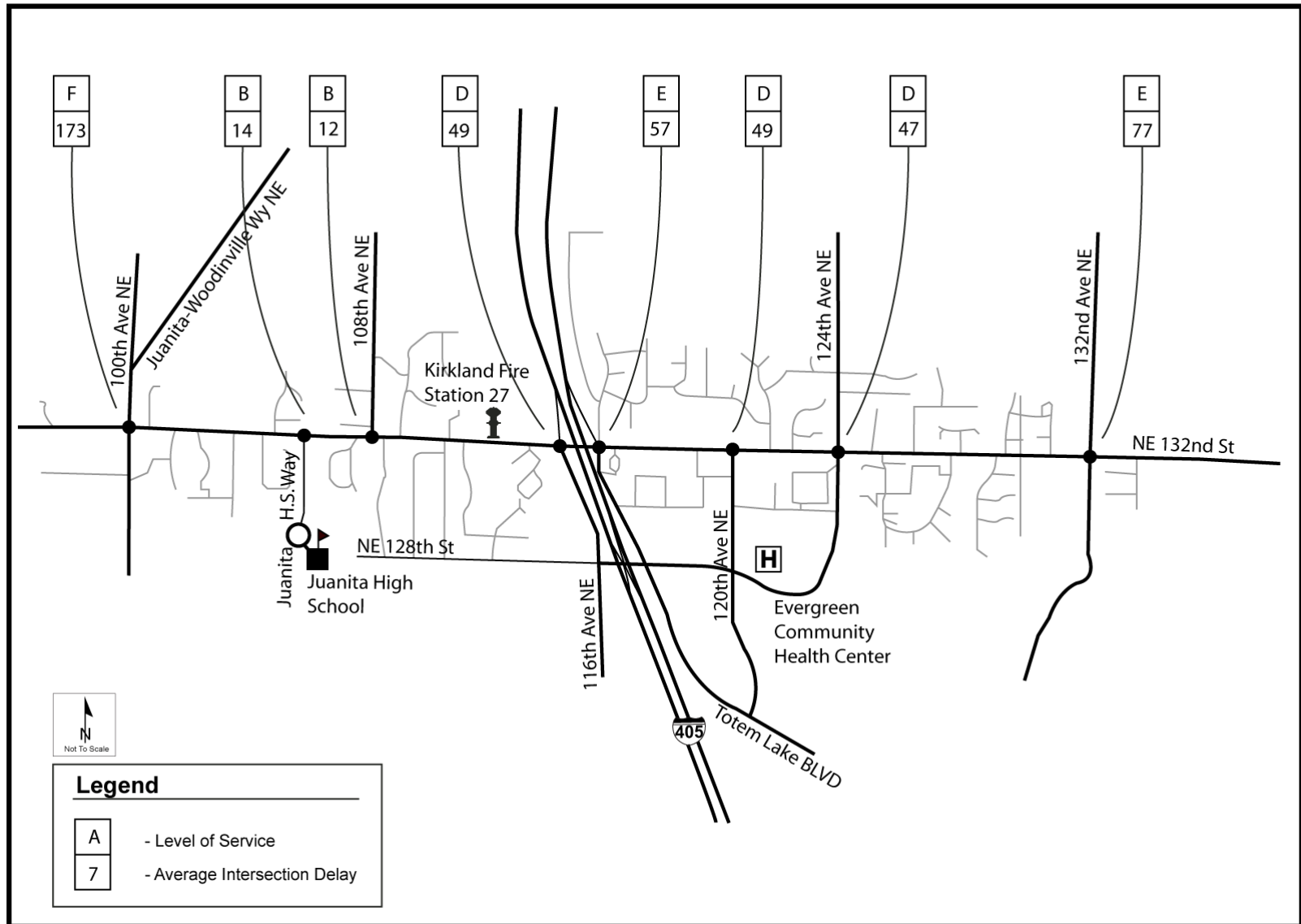


Figure 24. 2030 PM Peak Hour Operations – Enhanced Three-Lane Roadway, Without Right-turn Pockets at 108th Avenue NE and 132nd Avenue NE

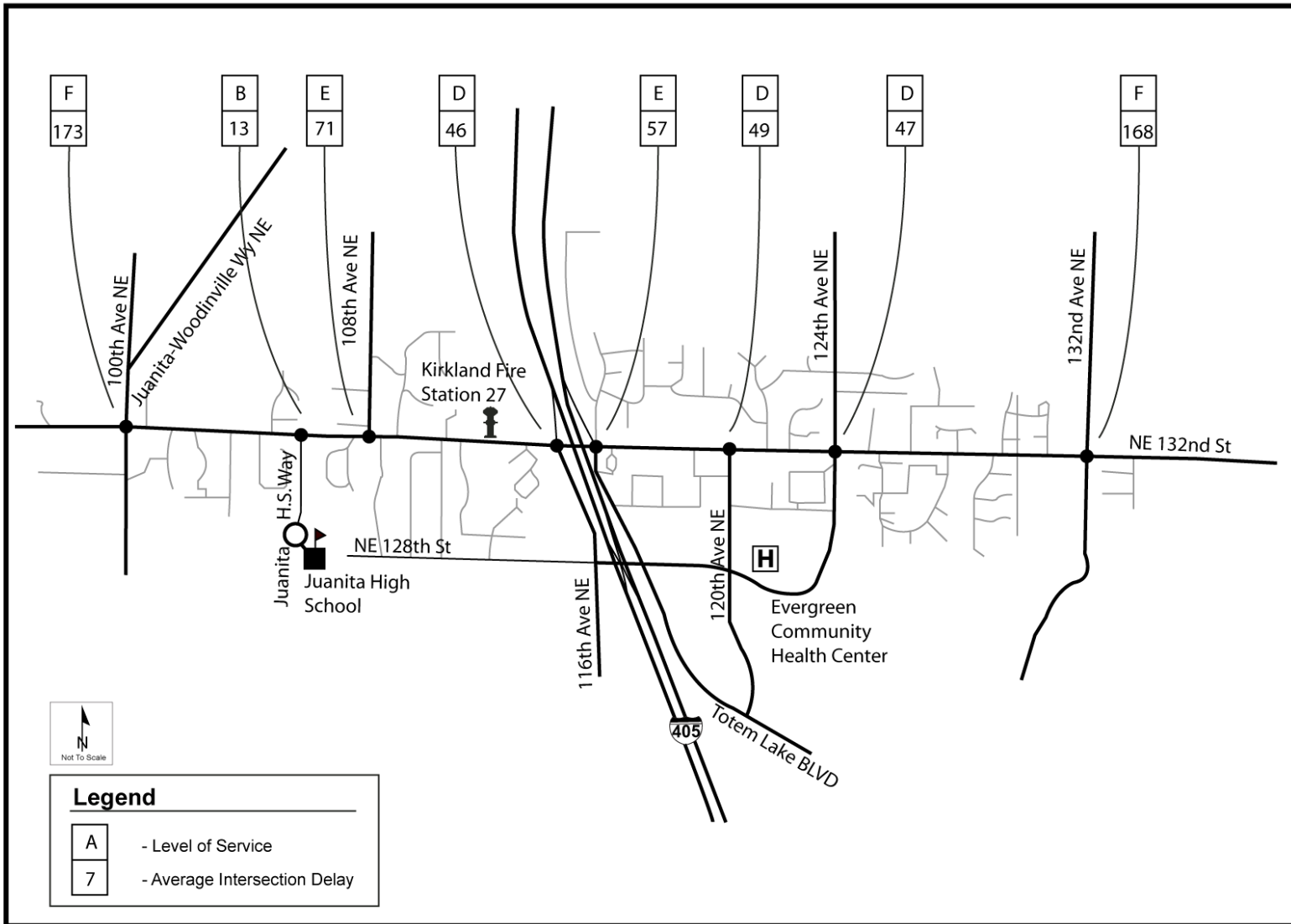
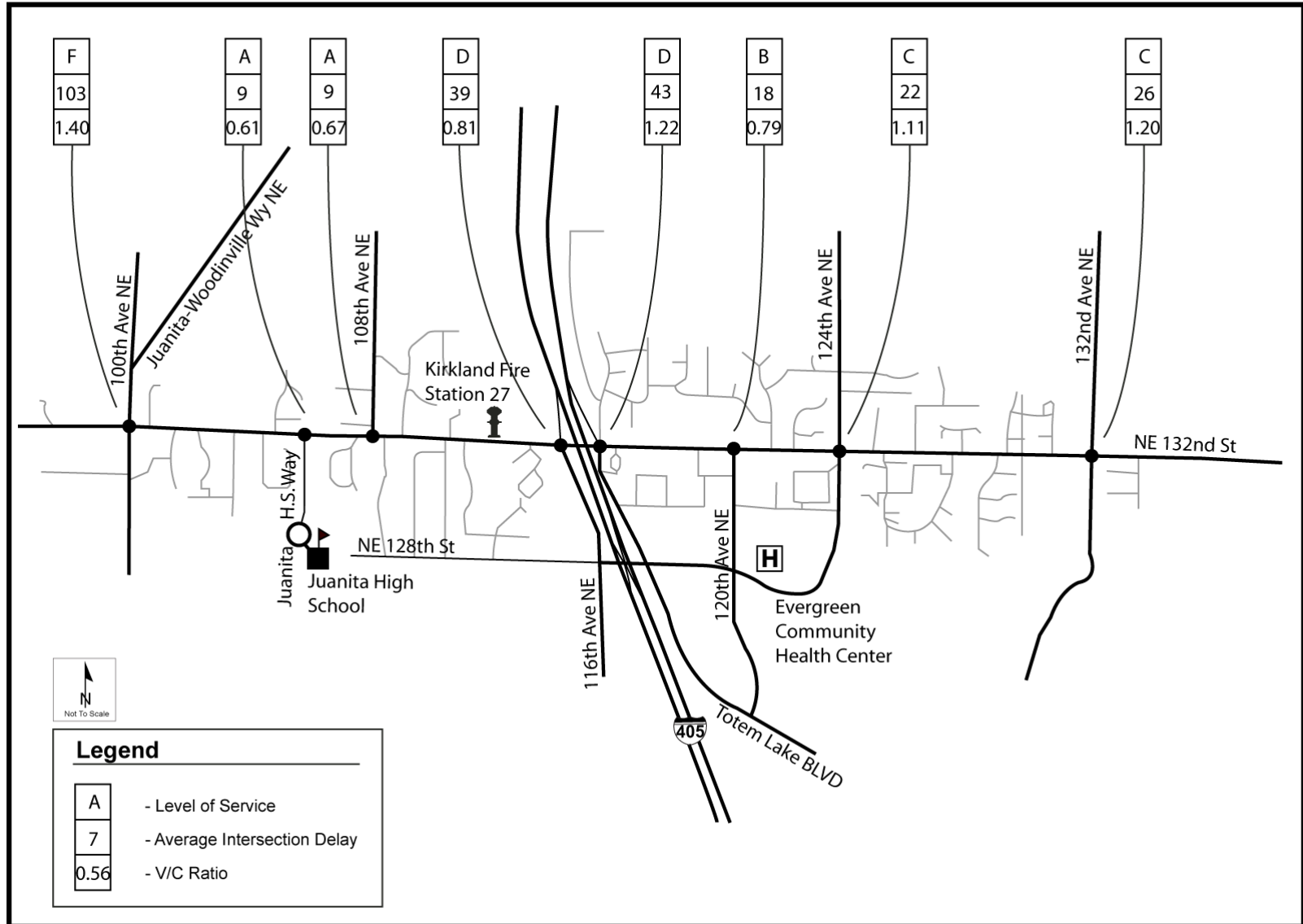


Figure 25. 2014 PM Peak Hour Operations – Enhanced Three-Lane Roadway



Five-Lane Roadway Alternative

Traffic volumes for the five-lane roadway configuration of NE 132nd Street were post-processed from the BKR model output. The volumes are higher than for the three-lane baseline and enhanced alternatives. **Figure 26** summarizes PM peak hour turning volumes with a five-lane configuration. The traffic operation results for the five-lane configuration are shown in **Figure 27**. Congestion is better managed with the five lanes, but intersection operation would still fail at 100th Avenue NE and 132nd Avenue NE, since this alternative has a higher travel demand. Additional right of way is required throughout the length of the corridor in order to construct the five-lane roadway. The net return in traffic operations to reduce congestion and queues may not justify this degree of disruption to the community along the whole corridor.

Refinements to the five-lane configuration would include some of the same modifications as for the three-lane alternative including:

- Retain the westbound, right-turn pocket with the five-lane configuration approaching 100th Avenue NE intersection, and add a receiving lane on the west leg.
- I-405 Half Interchange at NE 132nd Street: Reconfigure the northbound approach at 116th Way NE to have one left-turn lane and one shared right + left-turn lane. Reconfigure WSDOT's I-405 southbound off-ramp lane configuration to be one exclusive right-turn pocket without channelization, one exclusive through lane, one shared through + left-turn lane and one exclusive left-turn pocket.
- Separate out the northbound through and right-turn movement at Totem Lake Boulevard by adding a right-turn pocket
- 124th Avenue NE: Add a second left-turn lane for the eastbound traffic at 124th Avenue NE and add a second northbound, exiting lane on the north leg. Convert the northbound right-turn lane to be a shared through + right-turn lane at 124th Avenue NE.
- Add a westbound shared through, right-turn pocket at 132nd Avenue NE.

Figure 26. 2030 PM Peak Hour Turning Movement Volumes – Five-Lane Roadway

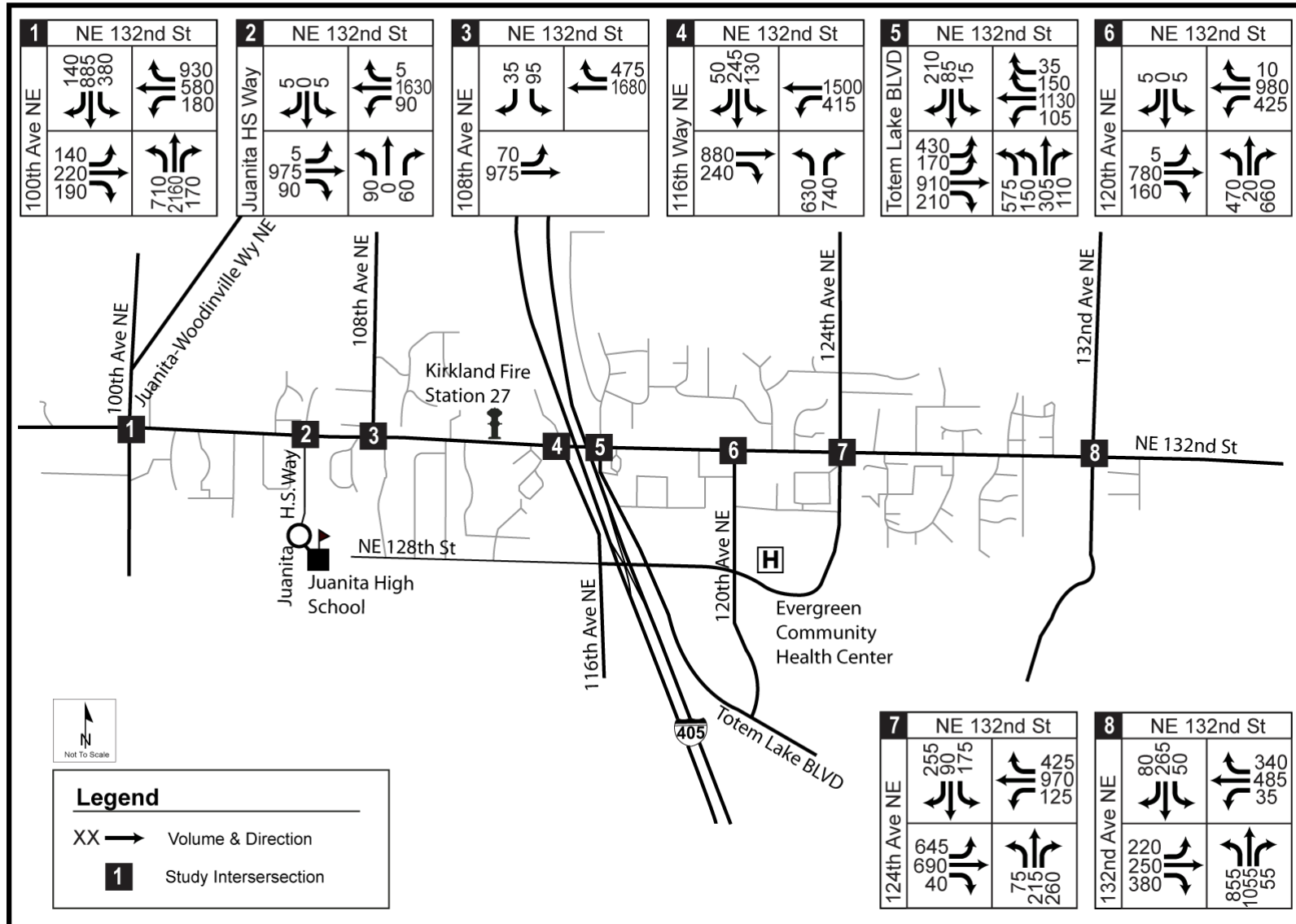
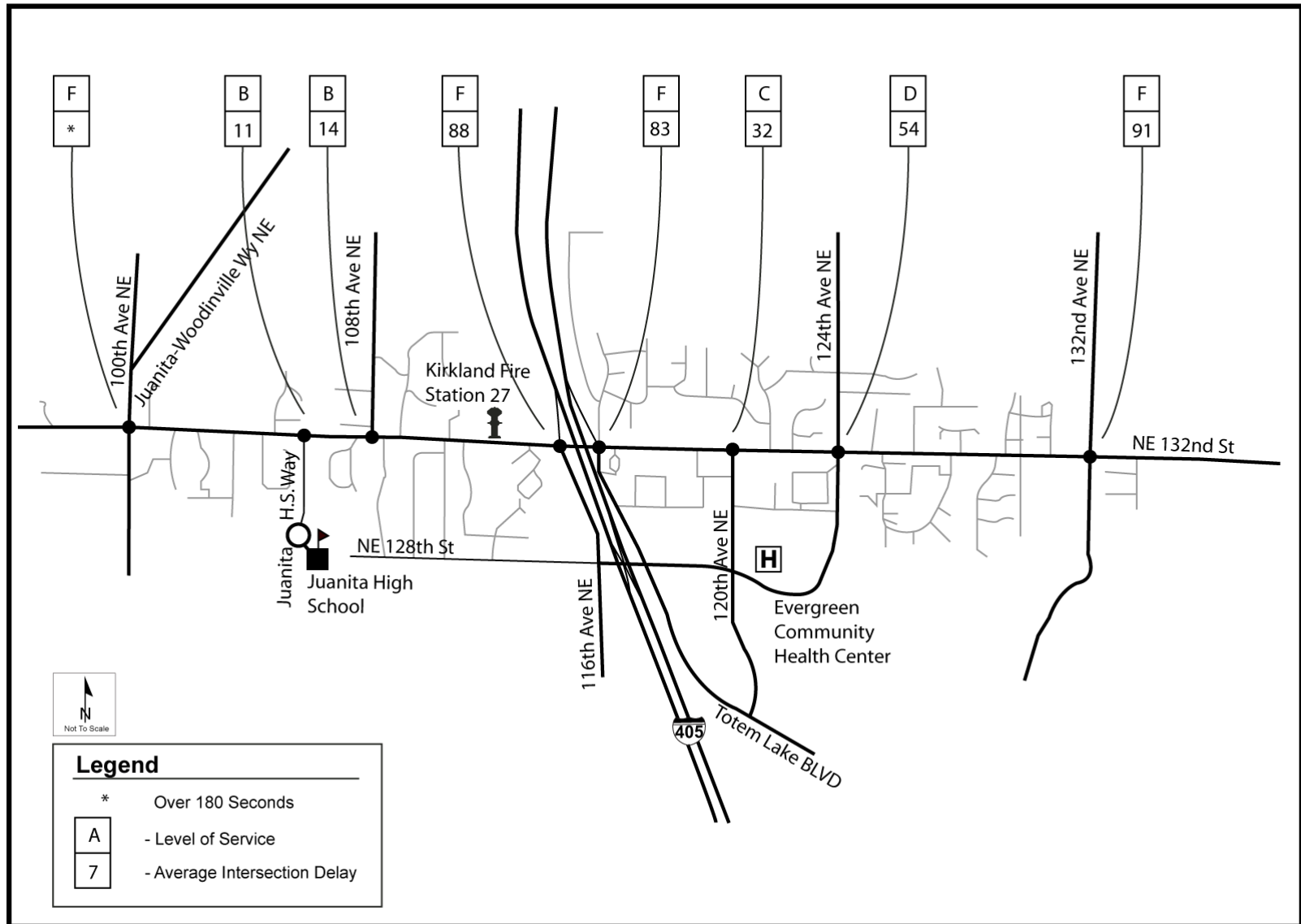


Figure 27. 2030 PM Peak Hour Operations – Five-Lane Roadway



Corridor Analysis Comparisons

Travel Time

Mirai used SimTraffic to calculate the travel time and queue length values for the NE 132nd Street corridor under the 2030 conditions. Travel times were calculated for both eastbound and westbound traffic during the PM peak hour between 100th and 132nd Avenue NE. Congestion in 2030 is expected to be substantially worse than current conditions with slower travel time through the corridor. **Figure 28** summarizes these travel times. Westbound travel time is consistently greater than eastbound travel time. Both the enhanced three-lane and five-lane alternatives show significantly improved travel time when compared to the future baseline, with greater decreases in travel time for the westbound traffic than for eastbound. The future baseline westbound travel time for this corridor is estimated at 62 minutes, based on the forecasted traffic in the peak hour.

The enhanced three-lane alternative would have a travel time of 23 minutes with comparable traffic volumes and the five-lane alternative travel time would be 12 minutes with slightly higher traffic. This would be a decrease of 39 minutes with enhanced three-lanes and 50 minutes with five-lanes on NE 132nd Street. The enhanced three-lane alternative without the right-turn pockets at 108th Avenue NE and 132nd Avenue NE would result in some travel time savings when compared with the baseline, but not as substantial an improvement as the enhanced three-lane configuration. In other words, the proposed right-turn pockets at 108th and 132nd Avenues NE could make a very significant decrease in westbound travel time.

Queue Lengths

Queue lengths along this corridor were also reviewed for each alternative. PM peak hour queue lengths are shown in **Figure 29** in bar chart format. Consistent with greater travel time for westbound traffic, queue lengths are greater for westbound traffic than for eastbound traffic during the PM peak hour. In general the queue lengths are longest for the future baseline condition. The queues for the enhanced three-lane are generally shorter than the baseline queues, and the queues for five-lane roadway are generally shorter than enhanced three-lane queues. One exception is where the westbound queues for the enhanced three-lane layout at Totem Lake Boulevard NE and at 120th Avenue NE are slightly longer than the baseline queues.

Concurrency Analysis

Kirkland's V/C ratio concurrency standard is 1.40 for an individual intersection. Using concurrency as a criterion for comparison, the existing 2007 PM peak hour conditions show that all eight signalized intersections meet or exceed the standard. Under year 2014 baseline conditions, the intersection at 100th Avenue NE would not meet concurrency. However, under the 2014 enhanced three-lane alternative, all intersections would meet concurrency.

Figure 28. PM Peak Hour Travel Time Comparison for NE 132nd Street (100th Ave – 132nd Ave NE)

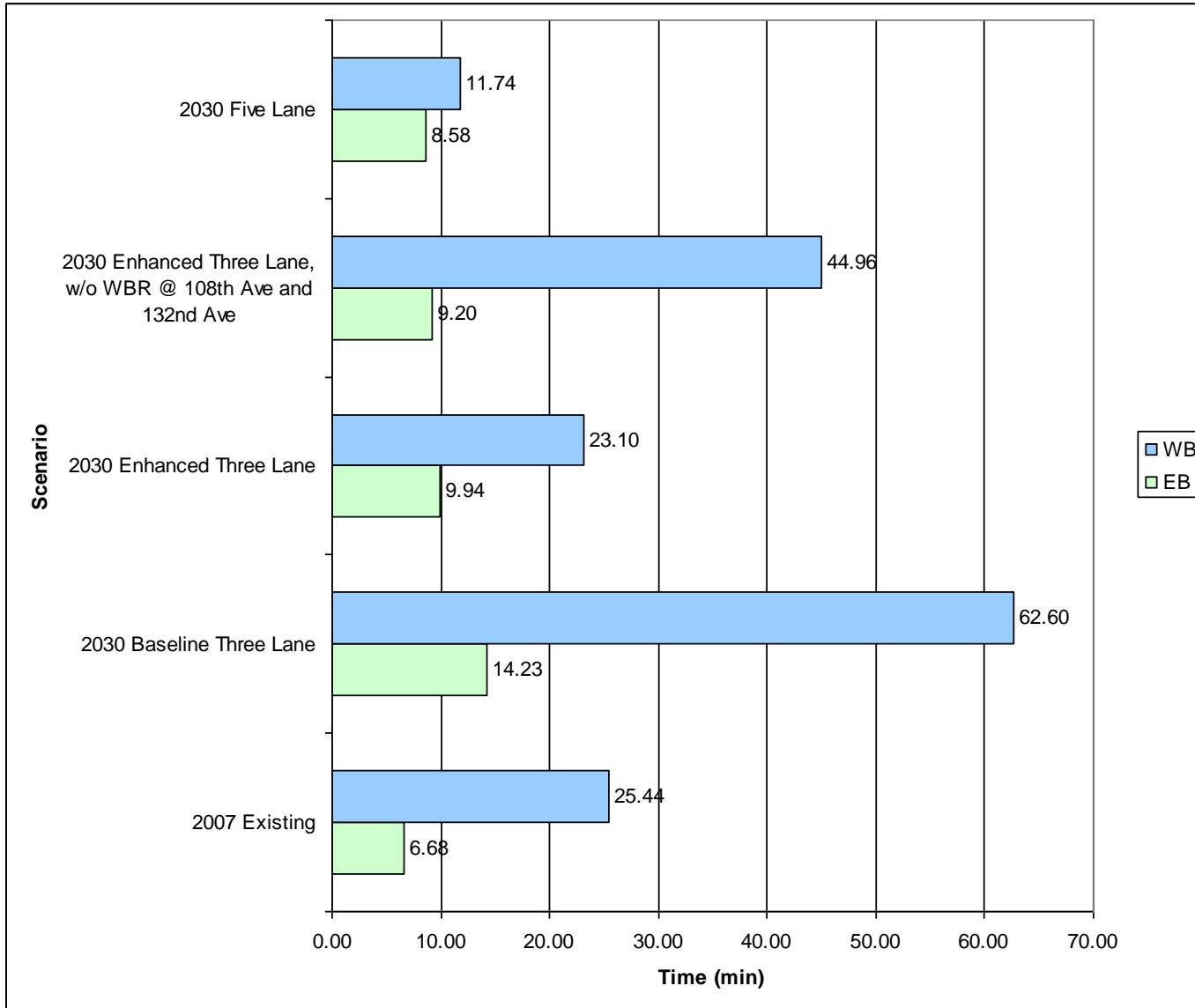
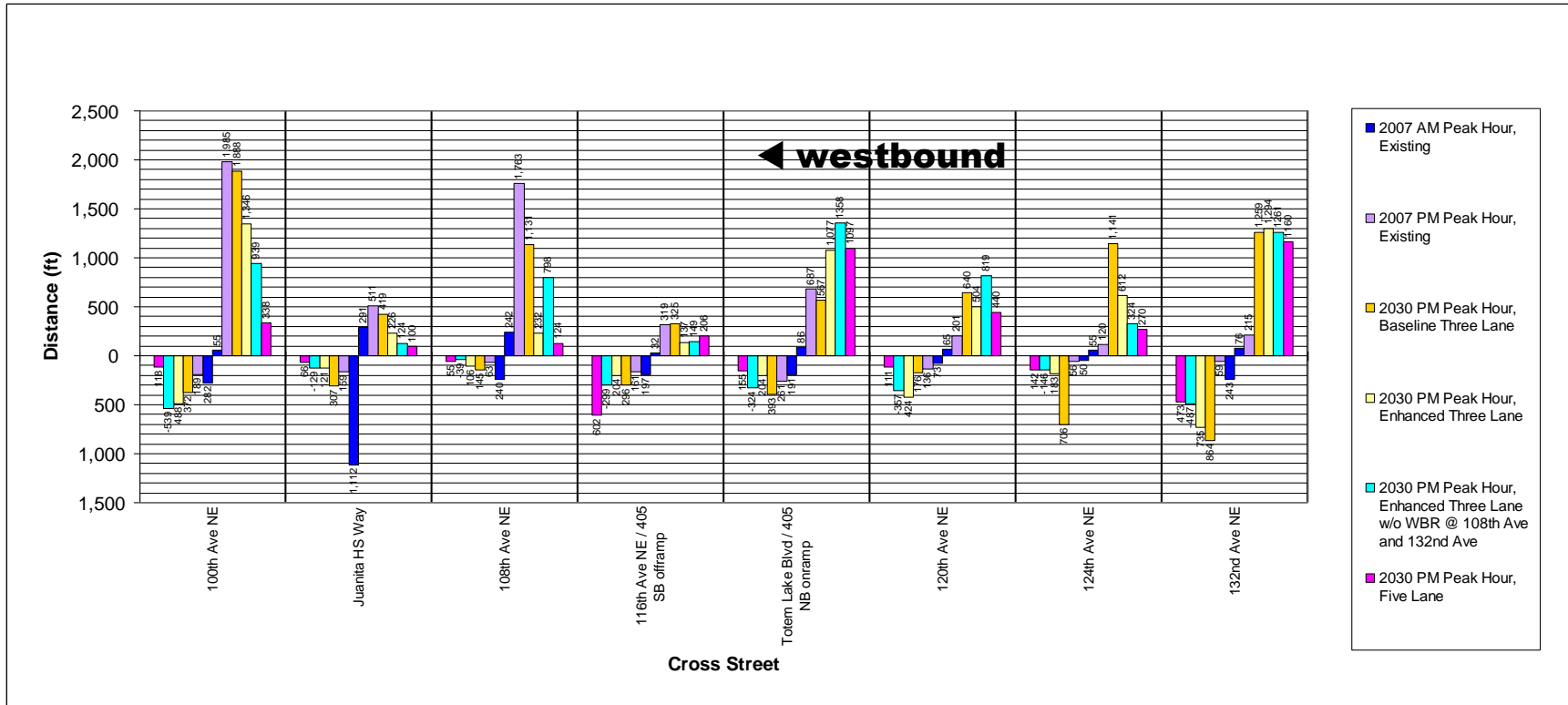


Figure 29. NE 132nd Street Intersection Peak Hour Queue Length Comparison



Congestion

The LOS and intersection delay were calculated for each of the signalized intersections along the NE 132nd Street Corridor. Under the 2007 existing conditions, the intersection at 100th Avenue NE is the only one in the PM peak hour with LOS F. All other intersections operate at LOS C or higher for the intersection as a whole (all movements) and for the peak hour as a whole. Note that the morning peak at the high school is short in duration and quite intense. Peak hour queuing does extend between intersections in the corridor with rolling queues. By 2014 under baseline conditions, 100th Avenue NE would remain at LOS F, and 132nd Avenue NE would drop to LOS D. The average intersection delay at 100th Avenue NE would increase from 123 seconds in 2007 to 158 seconds in 2014. However, under the 2014 enhanced three-lane configuration, the 100th Avenue NE intersection delay would decrease to 103 seconds.

By 2030, under the baseline conditions, the intersections at 100th, 124th and 132nd Avenue NE would operate at LOS F. The 108th Avenue and Totem Lake Boulevard intersections would operate at capacity, or LOS E. The intersections at 116th Way NE and 124th Avenue would operate at LOS D. Under the enhanced three-lane alternative, 100th Avenue NE would remain at LOS F with a slight improvement in delays. However, the improvements under the enhanced three-lane alternative would improve the LOS and delays at 108th and 132nd Avenue NE. The LOS and delays at 116th Way NE and 124th Avenue NE would be similar to those of the baseline. Only one intersection would remain at LOS F and two at LOS E. Without right turn pockets at 108th and 132nd Avenues NE, the enhanced three-lane alternative, the intersection LOS and delays at 108th and 132nd Avenue NE would be the same as with the baseline.

For the five-lane alternative, the LOS and intersection delays would be worse than the enhanced three-lane alternative at several intersections due to the increased traffic in the corridor, attracted to the wider roadway.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

NE 132nd Street is an important multi-modal roadway serving the needs of the residents in the area as well as being an important arterial connection in the Totem Lake urban center. Growth in the Kirkland, Bellevue and Redmond area is expected to continue at a significant rate and this corridor will continue to play a major role. WSDOT is beginning design for a new half interchange at I-405 and NE 132nd Street and Sound Transit, in conjunction with WSDOT, is completing the HOV direct access ramps at NE 128th Street.

Existing traffic counts and projections show a heavy southeast to northwest commuting pattern that crosses the study area along NE 116th Street, NE 124th Street and NE 132nd Street. Modeling for the year 2030 indicates that capacity will need to be added to the east-west corridors in order to reduce congestion and intersection delays. This capacity could be added at either NE 124th Street or NE 132nd Street. Increasing NE 132nd Street to a five lane roadway between 100th Ave NE and 132nd Ave NE would significantly change the nature and character of the corridor. It would be necessary to take large amounts of right-of-way along the entire corridor, in some cases entire properties would need to be purchased. In contrast NE 124th Street is currently a five-lane major arterial in a largely commercial area. Business and large apartment complexes are set well off the existing roadway. Adding a lane in either direction would not significantly impact most properties along this corridor. NE 124th Street currently has a full interchange at I-405. Travel demand modeling indicates that NE 124th Street is where drivers would prefer to travel if capacity is increased.

The travel demand modeling also indicates that the planned half interchange at I-405 and NE 132nd Street will not significantly alter the traffic patterns and volumes along the NE 132nd Street corridor between 100th Ave NE and 132nd Ave NE. Congestion on I-405 will continue to increase at a significant rate. The only planned improvement to I-405 in this area between now and 2030 is the addition of one lane in the northbound direction. This will not be enough to handle the increased volume in northbound traffic. Drivers will continue to look for alternate north-south routes. As a result the half interchange will not be the most significant contributor to traffic along NE 132nd Street.

Recommendations

This study indicates that capacity does need to be added to the east-west corridors between 100th Ave NE and 132nd Ave NE. Adding travel lanes to NE 124th Street would increase capacity, allow drivers to maintain their desired routes with full access to the Totem Lake interchange at I-405 and keep NE 132nd Street and NE 116th Street as primarily residential arterial corridors.

In order to manage peak period congestion, maintain acceptable travel times and intersection level of service, we recommend several improvement projects to be implemented along NE 132nd Street. While these projects are critical for improving traffic flow to meet future demand, they can be constructed independently of each

other and they do not need to be completed before the half interchange at I-405 is constructed.

Based on the corridor analysis, we recommend WSDOT make two modifications to the preliminary interchange design. This will maintain flow and take advantage of the two westbound lanes on NE 132nd Street. See layout in Appendix A.

- 116th Way NE should be restriped for northbound exclusive left turn and left + right turn lane.
- Modify the southbound off-ramp to remove the traffic island and stripe for one left turn lane, one through + left lane and one through + right lane.

In addition to the modifications to the half-interchange project discussed above, we have identified the following projects necessary to meet 2030 traffic volume projections along the NE 132nd Street corridor. Budget level estimates for each improvement are shown in parentheses.

- Maintain the proposed three-lane cross section for NE 132nd Street. (see typical cross-sections in Appendix A).
- Implement the following intersection and roadway improvement projects along NE 132nd Street (see plan layouts and cost estimates in Appendix A):
 - 100th Avenue NE intersection – Extend the westbound left and right turn lanes to 500 feet (\$1 million).
 - Juanita High School intersection – Add a 250-foot eastbound right turn lane (\$750,000).
 - 108th Avenue NE intersection – Add a 250-foot westbound right turn lane (\$500,000).
 - Modify the signal at the fire station to include a pedestrian actuated option (\$300,000).
 - NE 132nd Street West Segment: Overlay and restripe roadway, add landscaped center medians and perform sidewalk repairs between the east end of the 100th Avenue NE intersection project and the west end of the I-405 project (\$1.2 million).
 - NE 132nd Street Central Segment: Overlay and restripe roadway, add landscaped center medians and perform sidewalk repairs between the east end of the I-405 project and the west end of the 124th Avenue NE project (\$300,000).
 - 124th Avenue NE intersection – Continue to monitor this intersection to verify the traffic model conclusions of this study. If the eastbound to northbound left turn volumes remain as high as the model is anticipating then the City will need to extend the existing eastbound left turn lane to 500 feet and add a second 500-foot eastbound left turn lane. Widen and restripe east leg at the intersection to match west leg. Widen and restripe north leg for 1000 feet to provide two northbound through lanes, one southbound left turn lane and one southbound through/right turn lane. Restripe south leg at the intersection to match north leg (\$4.5 million).
 - NE 132nd Street East Segment: Overlay and restripe roadway, add landscaped center medians and perform sidewalk repairs between the

east end of the 124th Avenue NE project and the west end of the 132nd Avenue NE project (\$1 million).

- 132nd Avenue NE intersection – Extend eastbound left and right turn lanes to 500 feet (\$700,000).
- Integrate components of the Kirkland ITS Plan into the NE 132nd Street corridor as part of either Overlay or Intersection projects.
 - Upgrade the traffic signal controllers and consider video detection for the intersections
 - Install interconnect system from 100th Avenue NE to 132nd Avenue NE
 - Install CCTV cameras to monitor and manage traffic congestion and queues. Locations could include 100th Avenue NE, Totem Lake Boulevard and 124th Avenue NE intersections to provide visibility throughout the two-mile corridor.
 - Implement transit signal priority in the corridor to assist transit passage through the congested intersections. In particular, passage through the interchange area near I-405 will be critical for transit schedule maintenance.
- Work with King County Metro to consolidate transit stops with improved pedestrian crossing treatments in conjunction with overlay project segments and construction of landscaped medians through the corridor.
- Explore pedestrian-level lighting for the corridor, in conjunction with sidewalk and transit stop enhancements.

See Appendix A for corridor layouts and preliminary cost estimates.

Priorities for Implementation

There are many changes underway in the Totem Lake area that will influence travel patterns and traffic demand on NE 132nd Street. This corridor analysis reflects the expected traffic growth assigned to the corridor based on current traffic volumes and patterns.

Changes in circulation are expected with the new NE 128th Street arterial connection across I-405 that provides HOV direct access to I-405. WSDOT plans to construct a half-interchange at NE 132nd Street and this will likely result in additional shifts in traffic and circulation.

The intersection LOS analysis indicates that the 100th Avenue NE/124th Avenue NE intersection projects should be the first ones to be constructed, due to the high level of congestion. The project at 100th Avenue NE is likely warranted regardless of the circulation changes near I-405. A project to improve access at the Juanita High School signal would also be justified near-term.

Modifying the channelization east of I-405 temporarily to match the Alternate Roadway Section shown in Appendix A is also a near term recommendation. This will provide a consistent bike lane treatment for the corridor.

We recommend that the City monitor traffic volumes on NE 132nd Street, especially east of I-405 to affirm the sequence of the intersection projects in the proposed Master Plan for NE 132nd Street Roadway. The restriping, crosswalk and sidewalk enhancements

and center medians could be incorporated into the arterial overlay program or could be stand alone projects.