84TH AVENUE NE CORRIDOR STUDY

FINAL NEIGHBORHOOD TRAFFIC MANAGEMENT REPORT

Clyde Hill, WA

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1.0 Introduction

State Route 520 (SR 520) is the primary regional route for travel across the north end of Lake Washington. It connects the east side cities to the greater City of Seattle area. Near the east end of the lake bridge, SR 520 directly serves the Cities of Clyde Hill, Medina, Hunts Point and Yarrow Point. Access to SR 520 is provided at 84th Avenue NE and 92nd Avenue NE. When SR 520 is congested, regional traffic diverts onto the local city's street systems and significantly alters travel conditions in those neighborhoods. The 84th Avenue NE approach to SR 520 has been observed as being the most impacted city street. The purpose of this traffic management plan is to better understand this regional traffic diversion, which can vary from day-to-day, and then to develop local solutions to manage this traffic that impacts the safety and livability of these communities.

In 2011, under supervision of the Washington State Department of Transportation (WSDOT), the State Route 520 (SR 520) Bridge Replacement Program started construction of the new SR 520 bridge spanning across Lake Washington. Eastside construction began in 2011 and was completed in spring 2016. The new SR 520 bridge is open to traffic. Construction crews have started work on upgrading the west side approach to SR 520, which is expected to finish next summer.

2.0 Project Location and Study Area

The project location is along 84th Avenue from just south of the SR 520 ramp roundabout to NE 24th Street. To examine travel patterns within the surrounding area, the study area from 84th Avenue NE on the west to Bellevue Way NE on the east, and NE 8th Street on the south to the SR 520 Ramps to the north. Bellevue Way NE, Lake Washington Blvd NE and 84th Avenue NE were corridors highlighted in the analysis as well as 11 key study intersections. Figure 1 shows the project location, key study intersections, as well as a summary of the functional classifications within the study area.

Figure 1: Study Area Map

2.1 Roadway Description

Within the study area, 84th Avenue NE is a minor arterial roadway with a three-lane cross-section, one lane in each direction with a center median, left turn pockets at key intersections and bike lanes in each direction between NE 12th Street and NE 24th Street. From NE 24th Street to the SR 520 roundabout, the roadway changes to a four-lane cross-section with no center median and no bike facilities. The speed limit along the corridor is 35 MPH.

The remaining city streets within Clyde Hill and Medina typically are two-lane roads and they have a 25 MPH speed limit. There is one traffic signal in either city is at the intersection of 84th Avenue NE and NE 24th Street.

2.2 Existing Traffic Volume

Intersection turning movement counts were collected during weekday PM peak hours to capture peak commuter activity. 24-hour tube counts and origin-destination surveys were collected over a week as well. Counts were conducted as follows:

Turning Movement Counts: Wednesday March 2, 2016, 4:00 pm - 6:00 pm.

24-Hour Tube Counts and Origin-Destination Surveys: Monday February 29, 2016 to Sunday March 6, 2016.

Turning movement counts can be found in Appendix A. Peak hour traffic volumes were balanced to provide the basis for analyzing traffic conditions during peak hours. Pedestrians and bicyclists travel through the corridor sparingly during the PM peak and the corresponding volumes are relatively low at the intersections.

2.3 Collision Analysis

Collision history for the past three full calendar years (2013-2015) was reviewed in the study area. Within the study area, no collisions resulted in a fatality. Figure 2 shows the collision history. Of the 72 total collisions, approximately 29% of those resulted in injury while 71% were property damage only collisions.

Key causes to injury related accidents were failure to grant right-of-way and following too closely. Other causes included failure to yield to pedestrians, distracted driving, and disregarding stop and go lights. Roadways with crash rates higher than the county average include NE 24th St, and Bellevue Way near the SR 520 interchange.

Accidents and injuries by time of day are shown in Figure 3. About 90% of injury accidents occurred during the daytime, while 10% occurred during the AM peak and 52% during the PM peak. Figure 4 shows the accidents by type. The three types of accidents predominantly occurring in the study area were angled (43%), rear ends (23%) and fixed objects (21%).

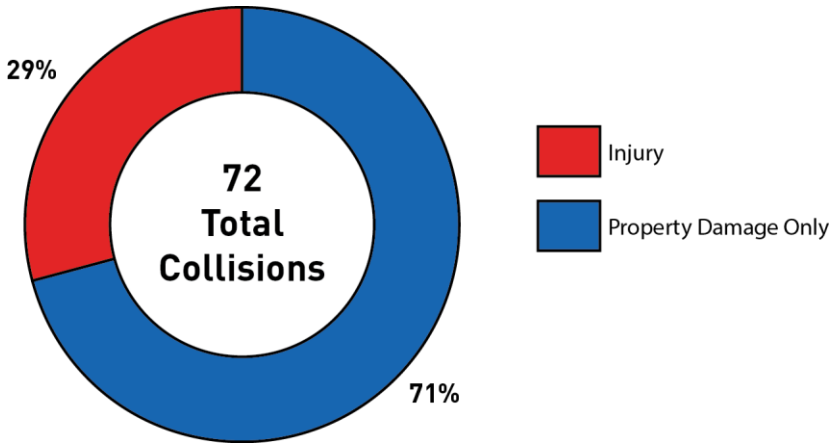


Figure 2: Collision History within the Study Area from 2013-2015

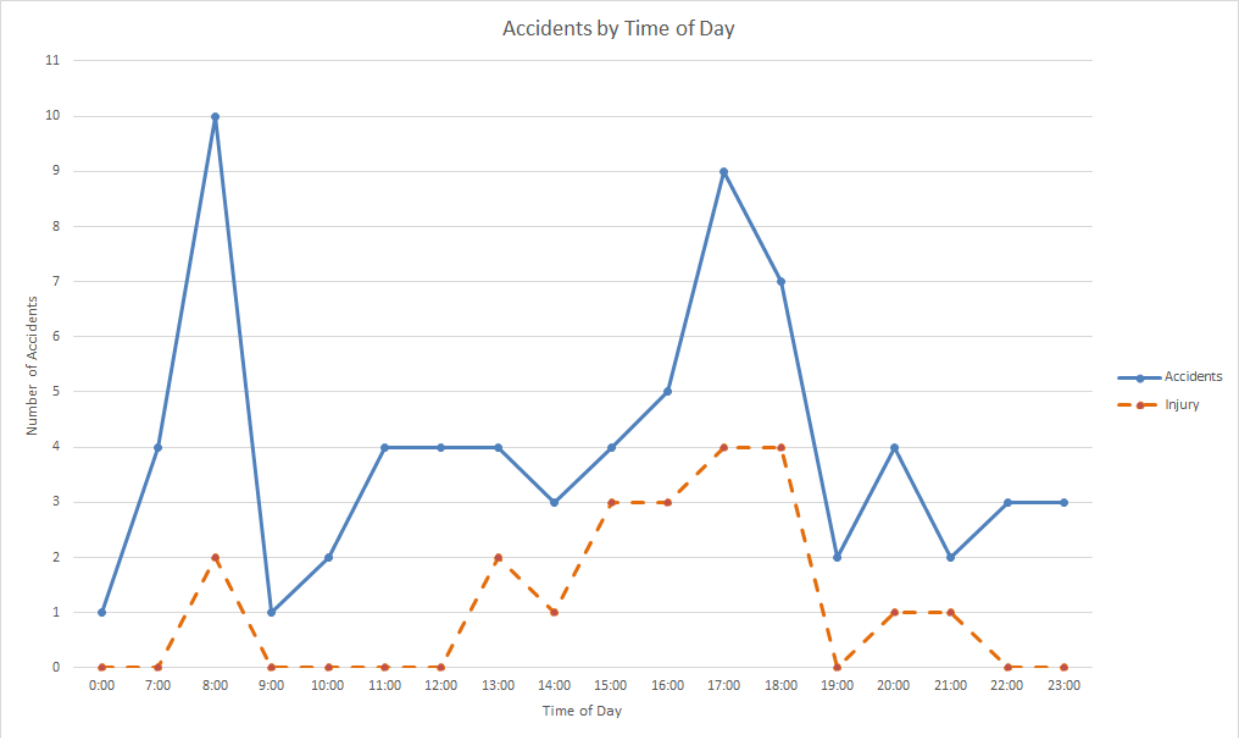


Figure 3: Accidents by Time of Day

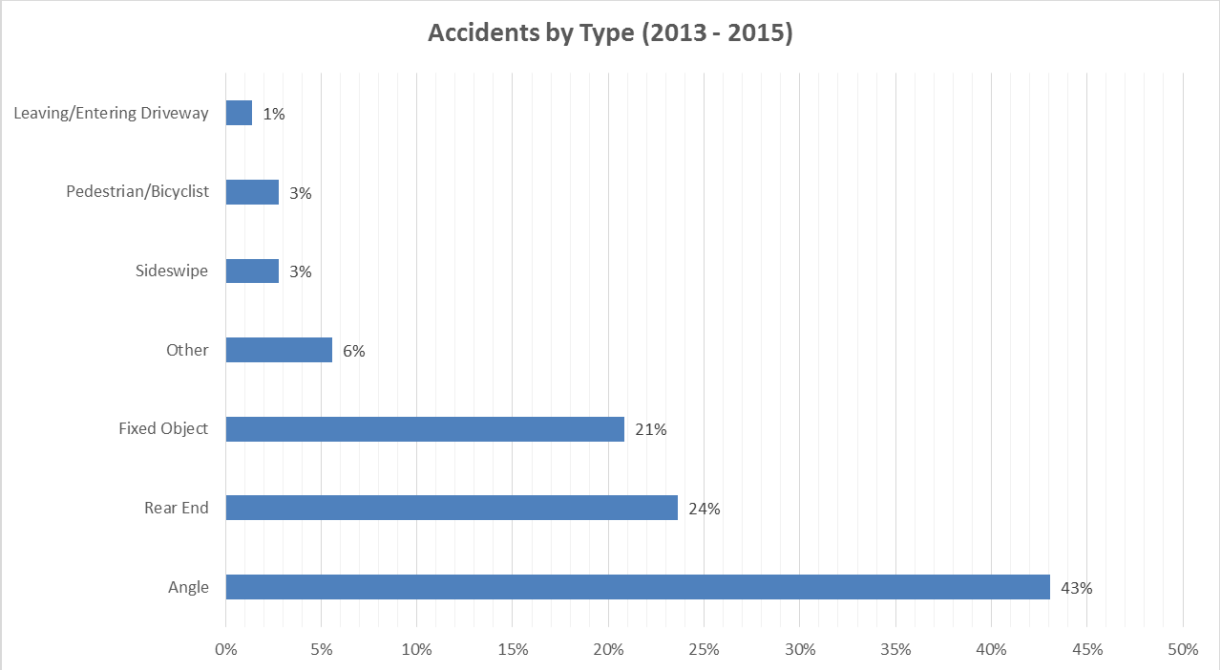


Figure 4: Accidents by Type

3.0 Clyde Hill Traffic Study

3.1 Online Survey and Public Feedback

Prior to the study, an online survey was taken by residents of Clyde Hill, Medina, Hunts Point and Yarrow Point. The survey collected community input to help identify traffic related concerns within the study area. Over 550 surveys were completed and a summary can be found in Appendix B. The primary feedback from the community showed the following:

- Traffic queues approaching SR 520 was the biggest concern and how those queues affect local circulation and safety
- The worst queues occur in the afternoon peak commute hours
- Over 80% of respondents said that the critical improvement needs are on the 84th Avenue NE corridor and its intersection at 24th Avenue NE.

The survey feedback from local community members confirmed the initial understanding of the study purpose and the need to focus on the 84th Avenue NE corridor in developing solutions.

3.2 SR 520 Phased Improvement

SR 520 is one of four toll facilities within the state. Access to SR 520 is provided at 84th Avenue NE and 92nd Avenue NE for the Cities of Clyde Hill, Medina, Hunts Point and Yarrow Point. Of those two, only the 84th Avenue interchange provides access to westbound SR 20. The next interchange to the east is at Bellevue Way, which is a major arterial five-lane facility serving the Cities of Bellevue and Kirkland. A new SR 520 bridge with a six-lane cross-section was completed to replace the old four-lane facility. The new bridge provides two general-purpose lanes in each direction and a high occupancy vehicle (HOV) lane. The SR 520 Bridge Replacement has been broken out into phases of construction with the most recent phase resulting in the floating bridge being open to traffic with six lanes leading up to the west end of the floating bridge. Figure 5 below shows the phases for project completion for the SR 520 Bridge replacement project.

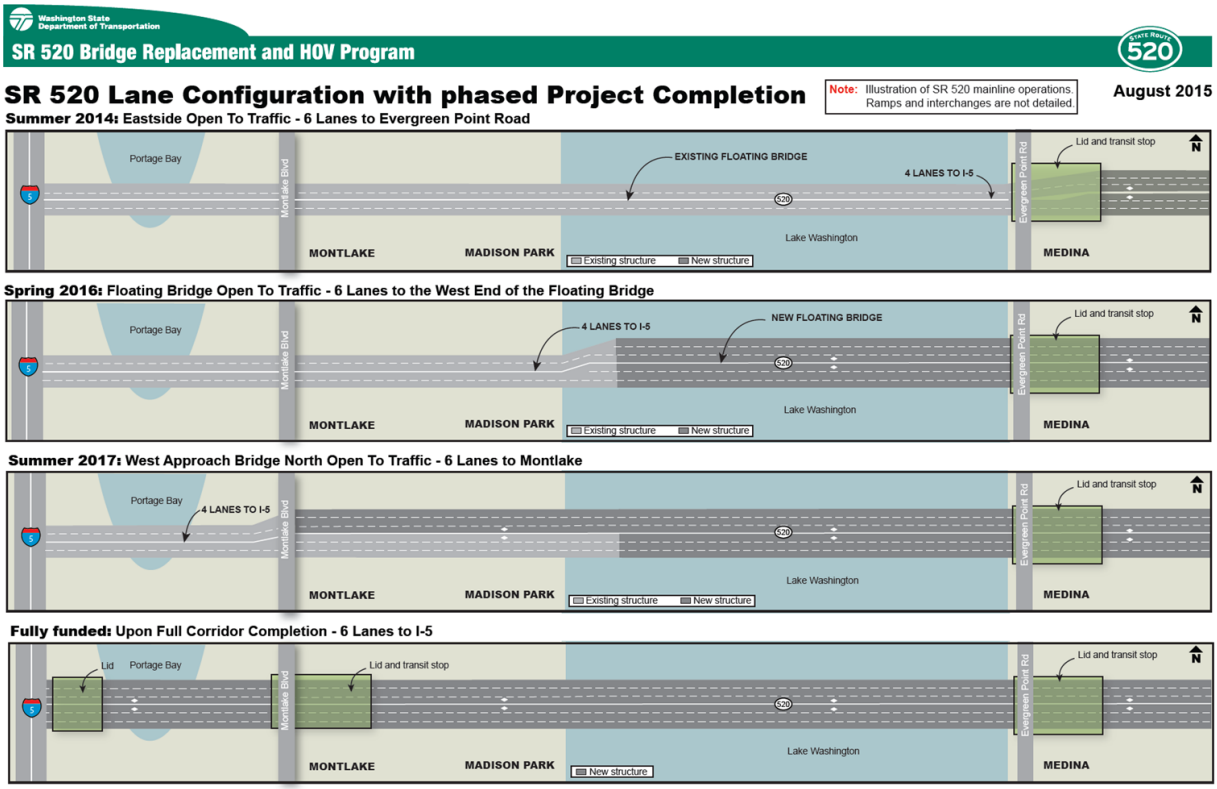


Figure 5: SR 520 Bridge Replacement Phase Schedule

Traffic growth at the SR 520 interchanges was examined to see the possible impacts to the three interchange areas within the study area. Data was used from the 2006 Environmental Impact Statement (EIS) developed for the SR 520 construction project. From the EIS, 2006 volumes and 2030 projections at the interchanges were compared to counts done in 2016. Figure 6 below shows the three sets of volumes at the three interchange areas. Currently 2016 volumes are lower than they were in 2006. Growth between the 2006 and 2030 projects showed minimal growth at both the 84th Avenue NE and 92nd Avenue NE Roundabouts while the Bellevue Way (Lake Washington Blvd NE) and SR 520 Ramps were expected to see a more moderate amount of growth in 2030. With volumes currently lower than in 2006, these growths could be minimal by 2030.

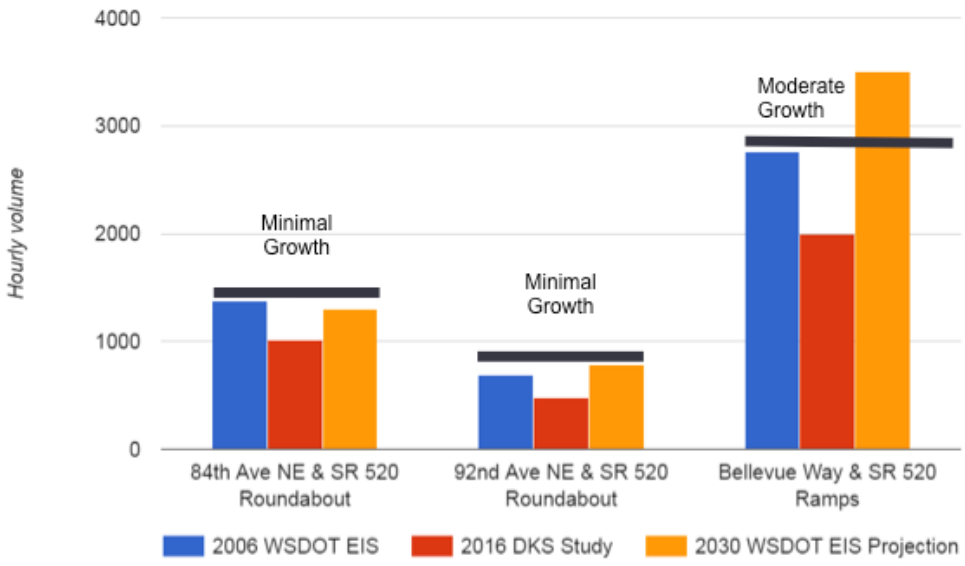


Figure 6: Projected SR 520 Traffic Growth at Interchange Areas within Study Area

3.3 Duration of Congestion on Westbound SR 520

Regional traffic diversion onto city street systems occurs periodically along SR 520 in this area. To understand how congestion varies from day-to-day, we evaluated travel speed data on SR 520 for three days of Tuesday March 1st, 2016 to Thursday March 3rd, 2016, which coincided with other system observations that were made for this study. Using loop detector data provided by WSDOT, travel times between 84th Avenue NE and Bellevue Way along westbound SR 520 were analyzed. The PM peak period was isolated (see Figure **7**), which illustrates how congestion varies from about 1 minute, under free flow conditions, to over 6 minutes. Delays begin to increase at 4:00 pm during the three weekdays and grow quite large during the 5:00 pm to 6:00 pm hour. Tuesday results show that congestion along SR 520 begins an hour earlier than it usually does whereas Wednesday and Thursday travel conditions follow the same general trend.

We compared the data collected on the local streets and found that on days where SR 520 Westbound congestion started earlier there was greater evidence of higher traffic volumes and longer delays on the city streets. In other words, the longer duration of severe congestion on SR 520, the greater chance those regional trips will divert onto city streets.

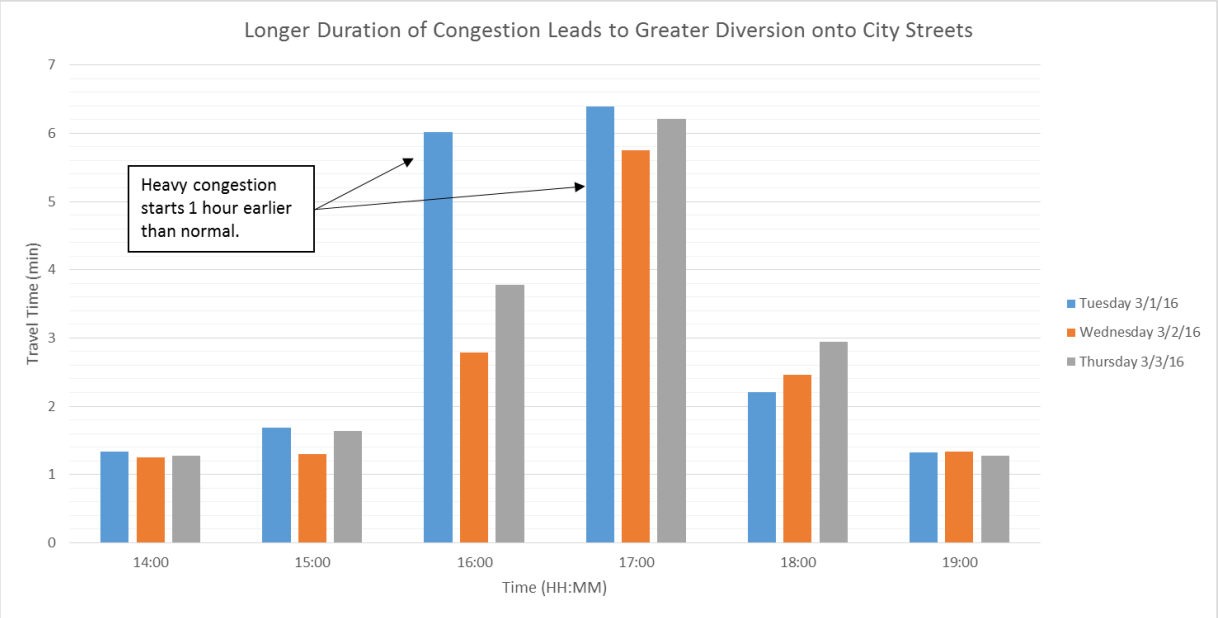


Figure 7: SR 520 Westbound PM Peak Travel Times between Bellevue Way and 84th Avenue NE

3.4 Intersection Operations

Existing intersection conditions operations can be found in Table 1 below. The analysis approach and methodology for the intersection operations can be found in Appendix C. The conditions reflect local operations on Wednesday, March 2nd 2016, a day where the freeway experienced less congestion and queues did not adversely impact local operations. On days where queues are present, local operations would show much worse performance than in the table of results below. All the intersections operate at LOS C or better outside of unsignalized intersection of 92nd Avenue NE and NE 24th Street in the PM peak.

The intersection control at 84th Avenue NE and NE 24th Street was analyzed for signalized, roundabout or unsignalized intersection control. The operations at the intersection perform equally well with either the traffic signal or the roundabout controls. When the intersection control is switched to an all-way stop for the unsignalized intersection control, the northbound traffic experiences delays resulting in a LOS F condition.

Table 2 shows the intersection operations assuming the 2030 projected volumes. The intersections at these interchange areas can serve the 2030 traffic volumes assuming that SR 520 performs well.

Table 1: Summary of 2016 Intersection Operations within the Study Area

Intersection Name	Intersection Control	Intersection LOS	Delay (sec)
84th Avenue NE & SR 520	Roundabout	A	8
92nd Avenue & Points Drive	Roundabout	A	5
92nd Avenue & SR 520 On-Ramp	Unsignalized	B	11
92nd Avenue NE & Points Drive	Unsignalized	C	22
Bellevue Way & SR 520 WB On-Ramp	Signalized	A	2
Bellevue Way & SR 520 EB Off-Ramp	Signalized	B	16
84th Avenue NE & NE 24th Street	Signalized	B	10
	Roundabout	B	14
92nd Avenue NE and NE 24th Street	Unsignalized	E	34
100th Avenue NE and NE 24th Street	Unsignalized	C	25
84th Avenue NE and NE 12th Street	Unsignalized	C	15
92nd Avenue NE and NE 8th Street	Signalized	B	12

Table 2: Summary of 2030 Intersection Operations

Intersection Name	Intersection Control	Intersection LOS	Delay (sec)
84th Avenue NE & SR 520	Roundabout	A	8
92nd Avenue & Points Drive	Roundabout	A	6
92nd Avenue & SR 520 On-Ramp	Unsignalized	B	12
Bellevue Way & SR 520 WB On-Ramp	Signalized	A	3
Bellevue Way & SR 520 EB Off-Ramp	Signalized	B	18

3.5 Origin-Destination and Travel Time Study

The origin-destination (OD) study was done to understand local travel patterns and how they vary by time of day. Data was collected at nine locations shown in Figure 8 below for a 10 day period. The OD study looked at patterns and travel times between nine sampling stations and results varied by day of the week and time of day. The three days of Tuesday March 1st, 2016 to Thursday March 3rd, 2016 were highlighted within this study.

Results showed that travel times along Bellevue Way delivered consistent travel times while routes through Clyde Hill and Medina (shown as dashed lines below) increased when SR 520 westbound is slow. A summary of travel times along these routes are shown in Table 3. The extra time along these routes during congested freeway days is similar to the extra time observed on the SR 520 WB loop detectors.

Table 3: Summary of Route Travel Times through Clyde Hill and Medina

Route to SR 520	Quickest Travel Time (mins)	Longest Travel Time (mins)	Extra Time During Congested Freeway Days (mins)
Bellevue Way to NE 24th Street to 84th Avenue NE	7	12	5
NE 8th Street to NE 12th Street to 84th Avenue NE	6	11.5	5.5
100th Avenue NE to NE 24th Street to 84th Avenue NE	7.5	12	4.5
Bellevue Way	3.5	4.2	< 1

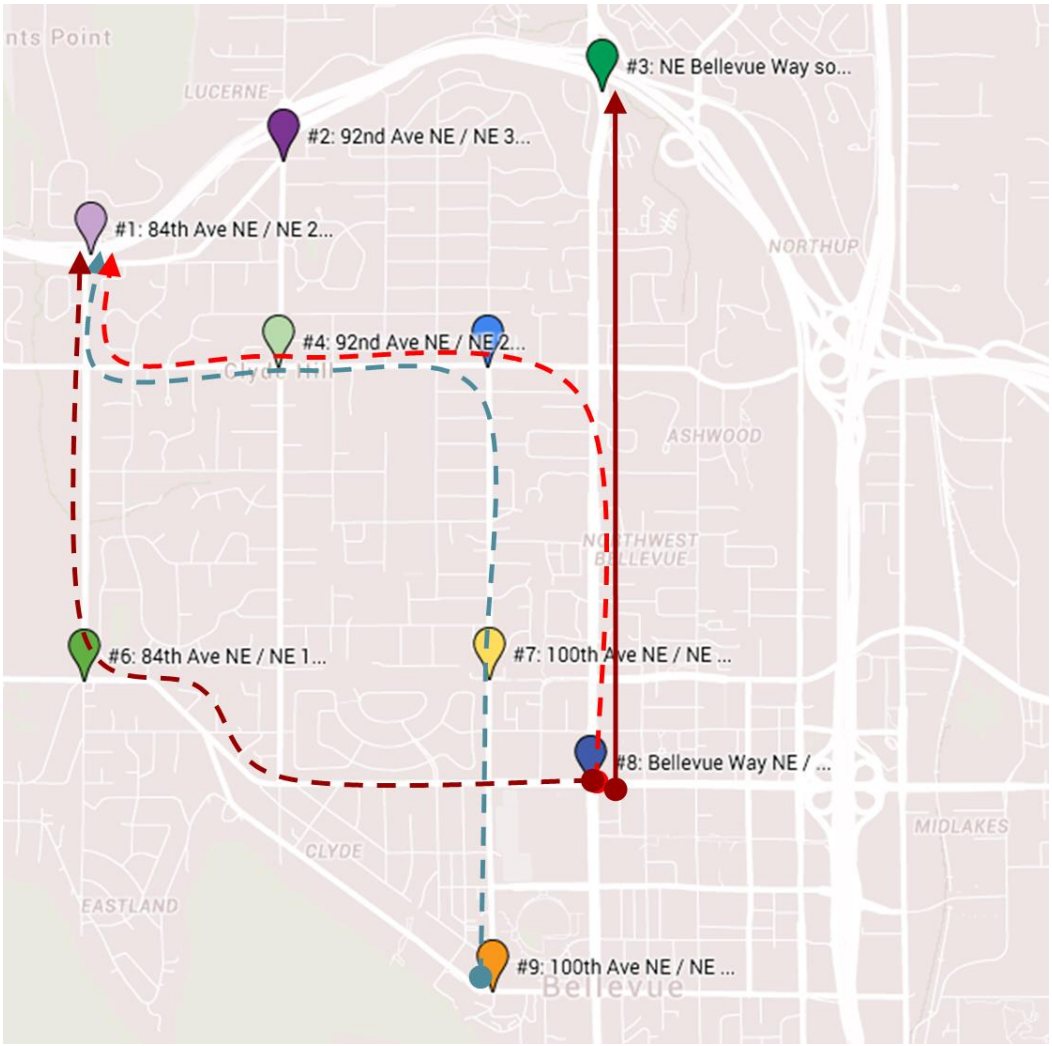


Figure 8: Travel Patterns Examined Through Origin-Destination Study

Figure 9 shows Clyde Hill traffic flow results for the origin of Bellevue Way and NE 8th Street on Thursday during the PM peak. The larger circles indicate a higher traffic volume at each location while the larger bands from origin to destination show a larger amount of traffic flow using the route. The results show a significant amount of diversion through Clyde Hill during the PM peak period.

An examination of regional traffic using the PSRC EMME regional traffic model was done to see the percentage of regional traffic traveling along 84th Avenue NE. The results showed that regional traffic, trips that start outside of Clyde Hill and Medina, accounted for 70% to 80% of the volume during weekday commute peaks.

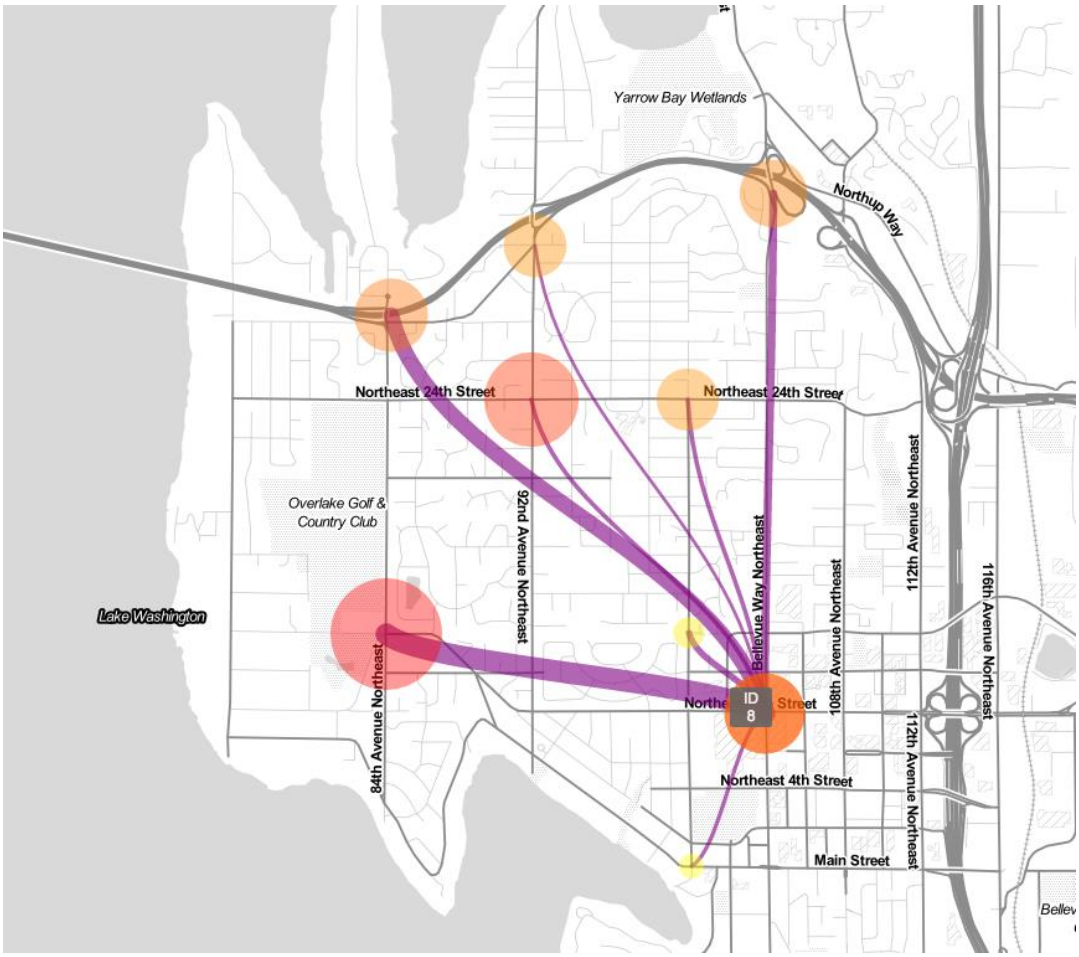


Figure 9: Clyde Hill Traffic Flows for Origin at Bellevue Way NE and NE 8th Street

4.0 Potential Management Plan Concepts

The following section discusses the management plan elements and resulting potential concepts to deal with the cut-through traffic and maintaining neighborhood safety.

With the large amount of traffic diversion to 84th Avenue NE, the objectives for the management concepts looked at making diversion routes less attractive to have regional traffic users traveling on Bellevue Way instead, where travel times have been steadier and is a roadway that drives users to and from the freeway system. Other objectives included minimizing the impacts to local users, cost effectiveness and flexibility. The key issues to address with the management concepts were queues that approached SR 520, neighborhood cut-through traffic and pedestrian and bicycle safety within the area.

Improvements to the intersection of 84th Avenue NE and NE 24th Street are currently in design. Three alternatives have been proposed and a preferred alternative will be determined at a later date.

4.1 Concept #1: Reduce Vehicle Capacity

The first option looks at reducing peak hour vehicle capacity approaching the 84th Avenue interchange during the weekday PM peak hours to make it less attractive for regional travelers. Our traffic studies showed that regional travelers have about an even trade-off when considering routes choices during heavy congestion on westbound SR 520. The extra travel time if they access SR 520 at Bellevue Way is about 6 minutes during heavy congestion and the extra time on local routes via 84th Avenue NE is about 5 or 6 minutes. Many regional travelers are facility agnostic, and typically will seek the shortest time path regardless of the route.

Multiple options were examined for this concept to influence how traffic is controlled through this corridor. The general idea is to extend the travel time along diversion routes as congestion builds on SR 520 westbound. The options included the following:

1. Reduce maximum green time at traffic signals northbound on Bellevue Way that are making left-turns toward 84th Avenue. This would primarily be at 24th Avenue NE.

2. Reduce the metering rate entering westbound SR 520 On-Ramp from the general purpose lanes. The HOV bypass lane would be unaffected.

3. Trigger all-way flashing red signals at 84th Avenue NE and NE 24th Street during the weekday PM peak hours. This could be triggered by the time of day, or dynamically based on traffic inputs, such as the loop detectors used on SR 520.

This concept addresses the objectives by making this diversion route less attractive by minimizing the green time that vehicles can travel through intersections. It is also flexible and allows for adjustments based on time of day to address the high demand during the PM peak hours while being easy to revert back to the existing conditions. We recommend that the any management option be evaluated through a pilot testing process to consider the effectiveness of the treatment in solving the diversions, and possible negative impacts of added delays for local trips.

As in Transportation Policy 1.3 in the Clyde Hill Comprehensive Plan, designing 84th Avenue NE and NE 24th Street as an intersection that serves the community efficiently and effectively throughout the day is key. The design should not be limited to serving the community only during the peak periods solely because of the congestion during this time period. The design should address the needs of the community during the whole day to provide use and limit impacts to the local users who are using the facility outside the PM peak as well as during it.

The issues that result from this concept include impacts to all vehicles, both local and regional traffic using the corridor. No preferential treatment is given to local users because the capacity reduction affects all uses. Finally, the changing of traffic signal timing may impact safety as users adjust to the new green times.

4.2 Concept #2: Strengthen Traffic Calming

The second concept looks at strengthening traffic calming in locations around the study area to increase safety and reduce traffic speeds. Solutions include raised pavement crosswalks within the city or radar speed signs with the posted speed limit for the roadway.

Raised pavement crosswalks along with high visibility signage provide pedestrians with pavement crossings that are above the roadway surface and let users know that a crosswalk is

ahead. The raised surface also forces vehicles to slow down as they cross the surface to reduce damage to their vehicle. Radar speed signs display the current speed limit along the roadway as well as let users know how fast they are traveling. The sign flashes with their current speed as vehicles exceed the speed limit, letting the driver know to slow down. Excessive speeding causes the sign to flash red with the text "SLOW DOWN" to warn drivers to reduce speeds greatly to match the speed limit.

The concept has demonstrated effectiveness in reducing speeds due to the physical nature of the infrastructure. It also improves pedestrian crossings and safety. Issues with the concept include the solutions being less effective in reducing volumes, the infrastructure being more permanent and the higher constructions costs.

4.3 Concept #3: Reduce Queue Impacts

The third concept looks at reducing queue impacts from recurring blockages. Two areas for this improvement are in Medina Circle and Hawthorne Court. The solution looks at posting DO NOT BLOCK signs (as seen in Figure 10) and adding pavement markings to delineate the area that needs to be vacated from blockages. Figure 11 below shows an example layout for the pavement markings and signage that would be put into place. The benefits to this solution allow for vehicles to turn into residential areas during times when queuing is an issue on local streets, benefiting the local user. It does not address the queuing issues directly and could have safety concerns of drivers fail to yield as local vehicles are making turns into and out of residential areas.

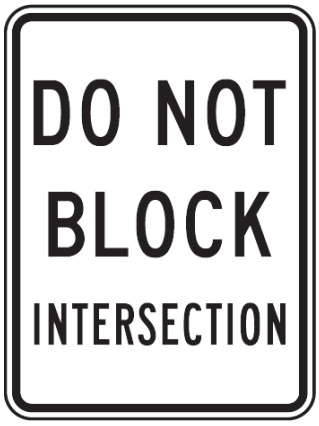


Figure 10: Do Not Block Intersection Sign (MUTCD, 2009)

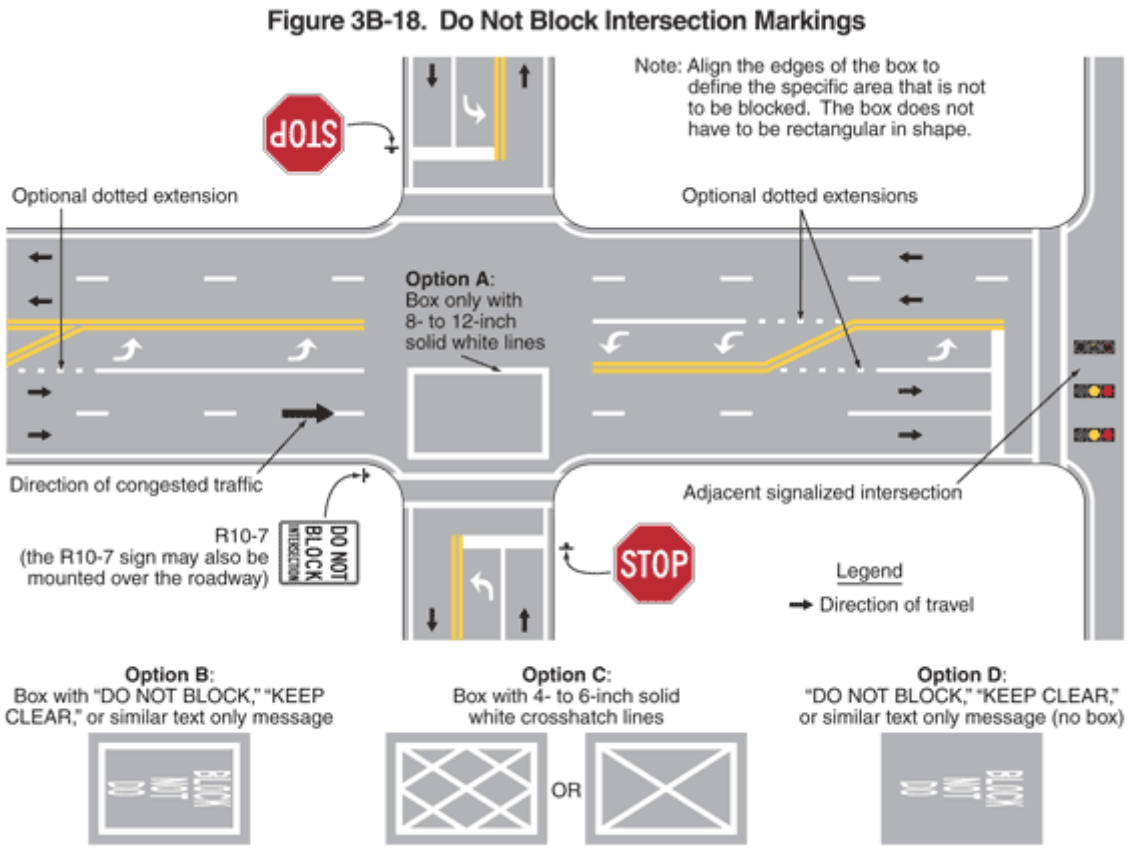


Figure 11: Do Not Block Intersection Markings (MUTCD, 2009)

4.4 Concept #4: Completion of SR 520 Improvements

Another concept is to hold off on temporary solutions until the SR 520 improvements are completed. Because SR 520 drives much of the local system during the PM peak period, waiting to see the full effects from the SR 520 improvements could help drive other solutions while reducing the construction costs for temporary fixes that may not be beneficial or necessary when SR 520 is complete.

4.5 Concept #5: Coordinate with City and State Agencies

The last concept highlights Transportation Policy 1.1 in the Clyde Hill Comprehensive Plan, which would be to coordinate with surrounding agencies. Coordination with the City of Bellevue on strategies to manage turning volume from Bellevue Way could help. Examples include an emphasis on Bellevue Way as a major route to SR 520 in traffic demand management (TDM)

goals, as opposed to drivers using other alternative routes through Clyde Hill, or signal timing changes to reduce left turn volume from Bellevue Way onto 24th Street NE. Coordination with the City of Bellevue and WSDOT will be necessary to obtain data, procedures and methodology which can provide necessary information along key roadways surrounding the 84th Avenue NE corridor. Real-time data and the ability to connect it to the 84th Avenue NE/24th Street NE intersection would be key components to a management concept that would rely on conditions in surrounding areas that can vary greatly.

5.0 Summary and Conclusions

From the study, it can be seen that the local system conditions are greatly influenced by the operations of the freeway system. When SR 520 is operating normally, the local system works. When freeway congestion occurs along westbound SR 520, the queuing along nearby blocks and driveways start to build up and more traffic diverts to 84th Avenue NE. Throughout the different conditions along SR 520, travel times on Bellevue Way tend to remain steady. Results show a large diversion onto 84th Avenue NE and regional traffic accounts for approximately 70% to 80% of traffic along 84th Avenue NE during the weekday commute periods.

The suggested traffic management solutions listed in the management plan concepts section are solutions that are temporary and provide partial fixes. Moving forward, the following is recommended:

1. Educating downtown Bellevue commuters about the benefits of traveling on Bellevue Way. It provides direct access to SR 520 and has a travel time that remains fairly steady regardless of the variation of congestion along westbound SR 520.

2. Providing a continuous bike facility on 84th Avenue NE. A bike facility currently extends north along 84th Avenue NE between NE 12th Street and just south of NE 24th Street in both directions. A continuous bicycle facility that extends north would provide safety to bicyclists along the corridor.

3. Install latest traffic signal control system at the intersection of 84th Avenue NE and NE 24th Street to take advantage of the advanced traffic management methods mentioned in Concept #1. This intersection would be operated as a stand-alone location during most hours of the day.

4. Interconnect communications for the new signal with the City of Bellevue's signal system or WSDOT's detector system to adjust the local timing plans, accordingly, with coordination with both agencies as mentioned in Concept #5. Conduct pilot testing of the selected management plan prior to permanent installation.

APPENDIX A

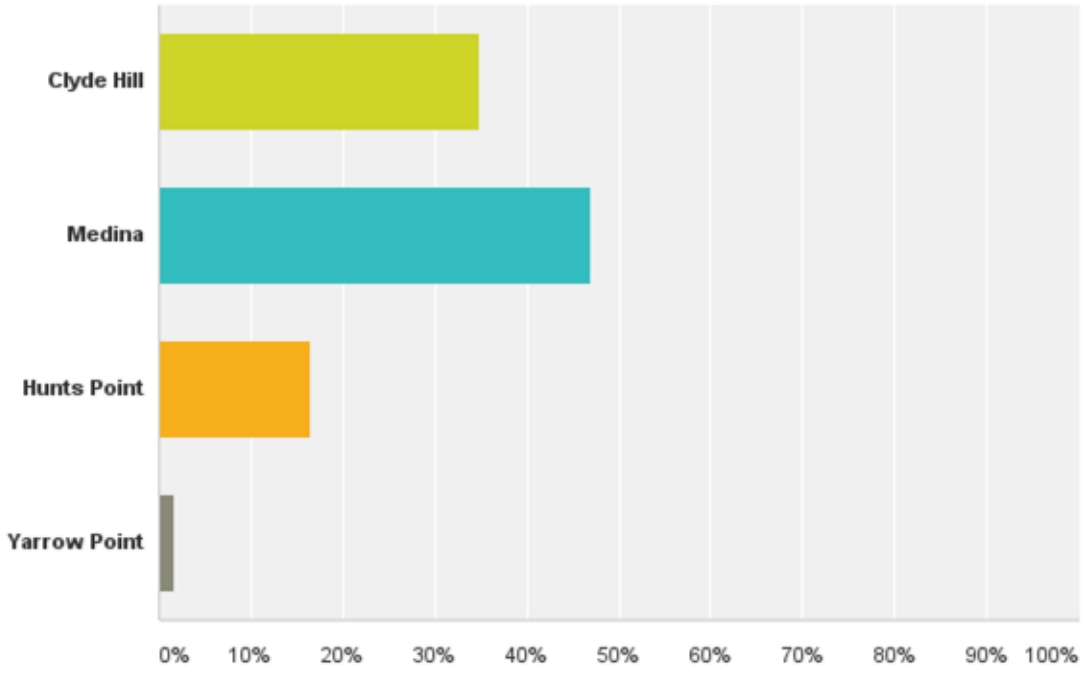
Traffic Counts

APPENDIX B

Summary of Online Survey Results

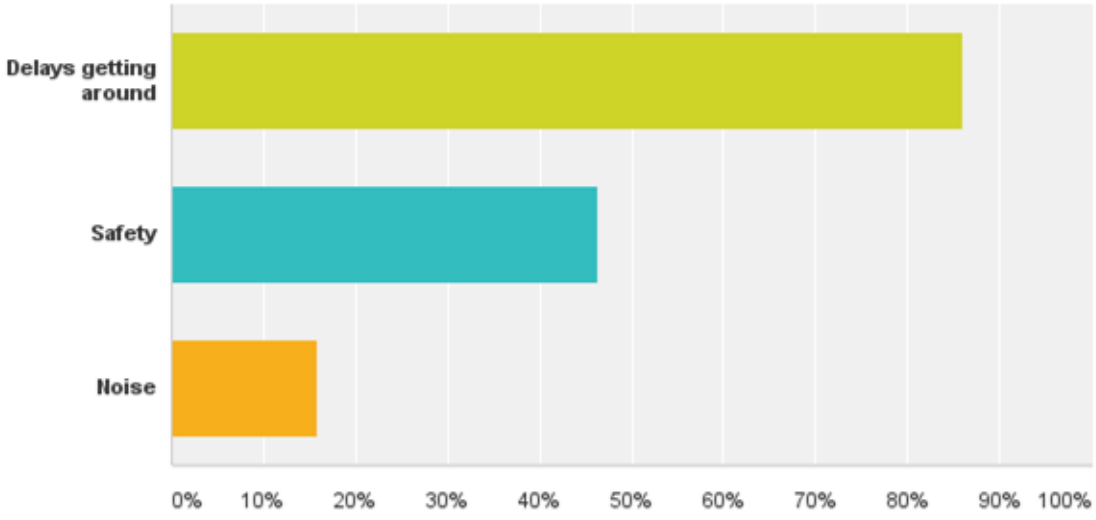
Q1 What city do you live in?

Answered: 524 Skipped: 34



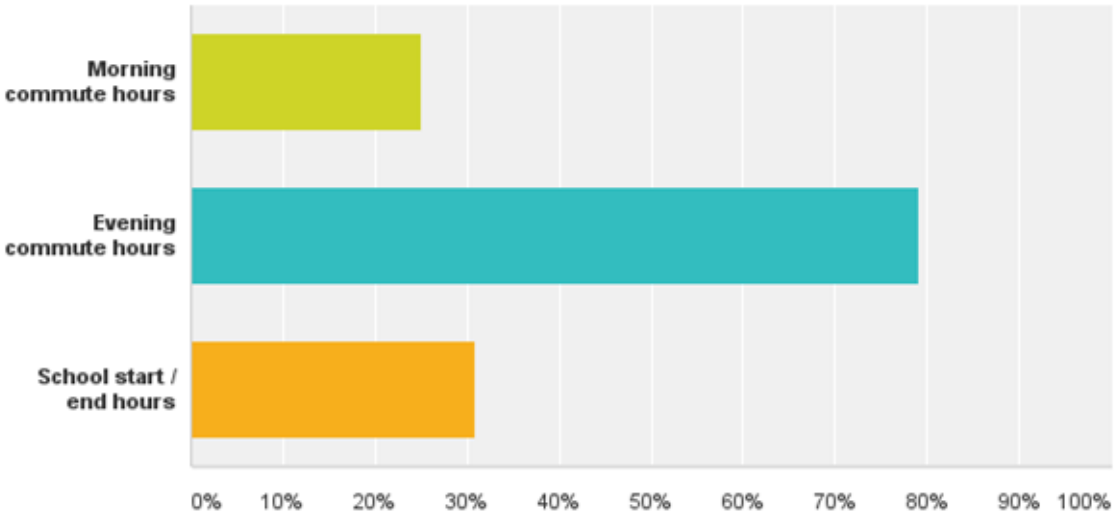
Q2 What are your primary concerns about traffic congestion in town?

Answered: 530 Skipped: 28



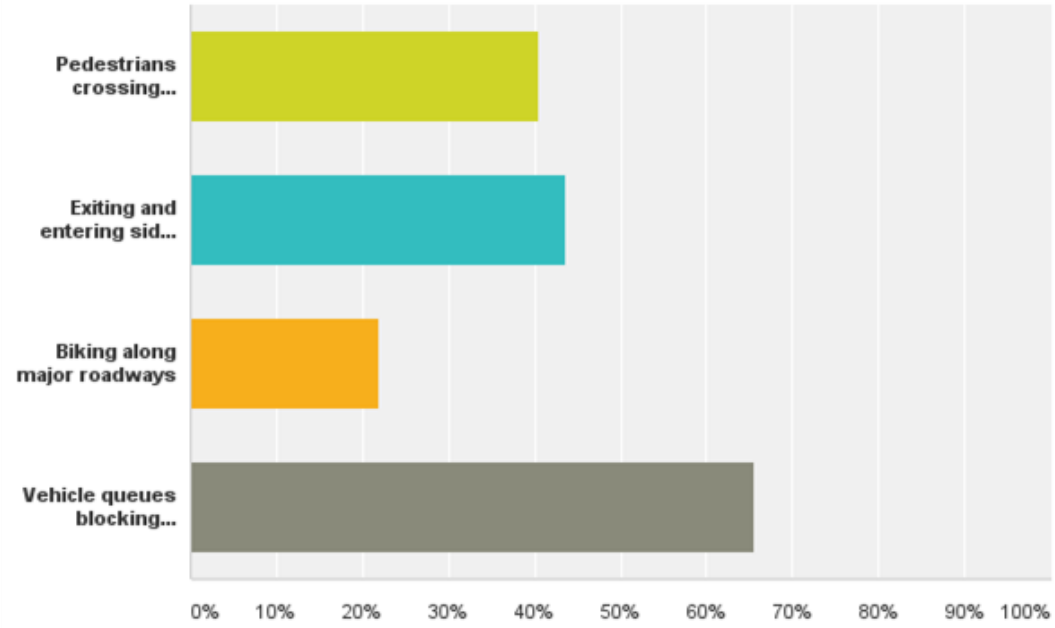
Q3 What time of day is most important for you?

Answered: 546 Skipped: 12



Q5 What kinds of safety concerns are most important to you?

Answered: 442 Skipped: 116



APPENDIX C

Intersection Analysis Approach and Methodology

Level of service (LOS) is the term used to denote the different operating conditions which occur on a given roadway segment under various traffic volume loads and operating conditions. It is a qualitative measure used to describe a quantitative analysis taking into account factors such as roadway geometrics, signal phasing, speed, travel delay, freedom to maneuver, and safety. LOS provides an index to the operational qualities of a roadway segment or an intersection. LOS designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions. LOS designation is reported differently for signalized, roundabout and unsignalized intersections.

Signalized intersections were analyzed under PM peak hour conditions. Average vehicle delay and LOS were determined utilizing the methodology found in Chapter 18 of the 2010 Highway Capacity Manual (HCM), with the assistance of the Synchro (version 9.1) traffic simulation software.

Unsignalized intersections were analyzed under PM peak hour conditions. Average vehicle delay and LOS were determined based upon the procedures found in Chapter 19 of the 2010 HCM, with the assistance of the Synchro (version 9.1) traffic simulation software. Typically, the LOS for an unsignalized intersection is reported for the approach that has the highest average delay per vehicle.