FINAL TERMINAL 91 2016 TRAFFIC MONITORING STUDY

Prepared for:
Port of Seattle

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Table of Contents

Appendix

Figures

Tables

Introduction

This report presents the results of the traffic monitoring study conducted at the Port of Seattle's Terminal 91 in August and September 2016. This study was conducted in accordance with the Terminal 91 Short Fill Redevelopment Agreement (SFRA) between the Port of Seattle and the neighborhood community councils of Magnolia and Queen Anne[1]. For this analysis, new traffic counts were collected at Terminal 91 access points and compared to thresholds identified in the SFRA. The results of this study were also compared to previous studies conducted since 2009, when the Port opened Smith Cove Cruise Terminal.

Monitoring Process and Thresholds

The SFRA was a "comprehensive resolution of all disputes regarding the Port's 'short fill' redevelopment of Terminal 91." Additionally, the SFRA provided procedures for resolving future issues. The establishment of a traffic monitoring program was one of the elements of the SFRA, and detailed procedures for monitoring traffic are outlined in Section F of the agreement. It states that, "the purpose of the monitoring program is to determine whether future traffic volumes and levels of service stay within estimated ranges. The Port and the Communities have established "trigger" levels for traffic volumes which, if exceeded, will result in more intensive review by the Port and action if required."

Key steps within the monitoring program stated in the SFRA are as follows:

- ***Gates:*** The Port will obtain daily (24 hour), AM and PM peak period gate counts of trucks and autos entering or leaving all Terminal 91 gates for one (1) week each quarter. Gate counts will be reported as trip ends. A trip end is an arrival or a departure. Thus, a single vehicle which enters and then leaves the terminal will generate two trip ends.

- ***Intersections:*** Congestion and delay at intersections are measured in terms of Level of Service (LOS) under a system described in Interim Materials on Highway Capacity (Transportation Research Board, 1980). Levels of service range from A through F, with LOS A representing congestion-free service and LOS F representing jammed conditions. The Port will obtain LOS determinations for the peak hours at the following intersections once a year: Elliott and Galer; Elliott/15th Avenue and Garfield; 15th and Dravus (until Galer access is completed), West Mercer Place and Elliott; and 20th and Dravus.

According to industry standard, the methodology to determine level of service has been updated many times since the original SFRA agreement was drafted. The original methodology for determining level of service was via hand-calculations. Computers now allow for detailed simulations that more accurately measure intersection operations and vehicle delays. For this report, Trafficware's Synchro software (version 9) was used.

Another change that has occurred since the SFRA was created is construction of the Galer Flyover. Therefore, the Galer Flyover/Elliott Avenue W intersection was evaluated instead of the Galer Street/Elliott Avenue intersection (which still exists, but is a minor intersection with no connection across the railroad tracks to Terminal 91). Finally, because the Center Gate to Terminal 91 is not currently active, no analysis was performed along the Magnolia Bridge.

1 Short Fill Redevelopment Agreement, As amended 1985 including 1998 Second Amendment; Port of Seattle, Magnolia Community Club, and Queen Anne Community Council; January 2000.

The SFRA outlined thresholds for both auto and truck traffic volumes over three specific time periods. The time periods and volume thresholds are summarized in Table 1. It is noted that the AM and PM peak periods differ from traditional traffic analysis time periods. The SFRA defines a 75-minute period for the AM peak and a 105-minute period for the PM peak; a typical traffic analysis would evaluate a 60-minute peak period.

Table 1. SFRA Traffic Volume Threshold Criteria

	Time Period	Automobiles	Trucks
AM Peak	7:15 – 8:30 A.M.	395	25
PM Peak	3:45 – 5:30 P.M.	612	48
Daily	24 hours	3,500	325

Gate and Terminal Counts

Count Locations

During the course of this study there were two locations where vehicular traffic could enter and exit Terminal 91; these are shown in Figure 1.

1. **East Gate** – This gate is located off Alaskan Way W, and is accessed by the Galer Flyover.
2. **West Gate** – On days with cruise activity, a retractable gate at the west end of the Magnolia Bridge is open. Vehicles can enter this gate and park, or traverse the yard beneath the Magnolia Bridge to access Pier 91 south of the bridge. Vehicles also exit the parking lot via this gate. When cruise vessels are at sea, the gate is locked to the public in order to secure the parking lot.

Figure 1. Terminal 91 Access Locations

Vehicle classification counts were performed at both Terminal 91 access locations in late August and early September 2016. The classification counts (performed by pneumatic tubes) track the types of vehicles entering and exiting the terminals for each hour of the day. These data were collected over a ten-day period from Friday, August 26, 2016 through Sunday, September 04, 2016.

To augment the machine counts, camera counts were performed for four days: Thursday, August 25; Friday, August 26; Saturday, August 27; and Sunday, August 28. Three of these days, Friday, Saturday, and Sunday were cruise days and Thursday was a non-cruise day. These counts were performed during the peak hours for disembarkation (7:30 to 9:45 A.M.) and embarkation (11:00 A.M. to 12:45 P.M.). The vehicle types were categorized: passenger vehicle (non-commercial), taxi, limo/towncar, shuttle van/bus, charter bus, school bus, small truck, medium truck and large truck.

The machine counts classify vehicles by number and spacing of axles; however, the accuracy of the machine classification counts can be affected by travel speed. A vehicle that travels faster or slower than expected could be registered as a different type of vehicle. For example, a large truck could be recorded as two closely-spaced passenger vehicles. The camera counts were used to validate the machine counts and determine if adjustments were needed. While discrepancies between the vehicle classification counts and the pneumatic tube counts did exist at certain time periods, no clear pattern of discrepancy was discernable between the two count types. As a result, the vehicle classification counts were not adjusted.

Cruise Vessel Schedule

Cruise vessels called at Terminal 91 on eight of the ten days surveyed in 2016. Table 2 presents the cruise schedule during the survey period, and the numbers of passengers that embarked or disembarked each vessel while it was at Terminal 91. As shown, the highest passenger volumes occurred on the two surveyed Fridays when two ships called at Terminal 91. There were no cruise ship calls on Wednesday or Thursday of the survey week.

Table 2. Cruise Passengers at Terminal 91 During 2016 Monitoring Survey

		Number of Passengers		
Date	**Vessel**	**Disembark**	**Embark**	**Total Passengers**
Fri, 8/26/16	Celebrity Solstice	2,888	2,913	5,801
	Explorer of the Seas	3,558	3,613	7,171
Sat, 8/27/16	Crown Princess	3,221	3,237	6,458
	Westerdam	1,936	1,922	3,858
Sun, 8/28/16	Ruby Princess	3,215	3,264	6,479
	Amsterdam	1,465	1,454	2,919
Mon, 8/29/16	MAASDAM	1,052	1,185	2,237
Tues, 8/30/16	Carnival Legend	2,182	2,288	4,470
Wed, 8/31/16	None			
Thur, 9/1/16	None			
Fri, 9/2/16	Explorer of the Seas	3,320	3,520	6,840
	Celebrity Solstice	2,813	2,855	5,668
Sat, 9/3/16	Crown Princess	3,017	3,211	6,228
	Westerdam	1,900	1,927	3,827
Sun, 9/4/16	Ruby Princess	3,135	3,184	6,319
	Amsterdam	1,429	1,466	2,895

Source: *Port of Seattle and Cruise Terminals of America*, 2016. Does not include passengers who stay on ship to future port of call (passengers in transit.)

Automobile Traffic

Automobile traffic that entered or exited Terminal 91 was summed for both access locations. The total reflects the “trip ends” defined by the SFRA. Vans and small shuttles, such as those used by Shuttle Express and other service providers, are classified as an automobile. Table 3 summarizes the automobile trip ends and compares them to the thresholds established in the SFRA. Figure 2 through Figure 4 show these data graphically for the three respective time periods. As shown, the AM peak period exceeded the thresholds on Fridays, Saturdays and Sundays when there were two cruise ships that called at the terminal each day; volumes did not exceed the threshold on Monday or Tuesday when there was only one cruise ship call. Daily automobile thresholds were exceeded on seven of the eight days when there was cruise activity at the terminal. None of the days exceeded the threshold for the PM peak period.

Table 3. Automobile Traffic to and from Terminal 91

Date	AM Peak (7:15 – 8:30 AM) Threshold = 395	PM Peak (3:45 – 5:30 PM) Threshold = 612	Daily (24-Hour) Threshold = 3,500
Fri, 8/26/16	**883**	151	**8,063**
Sat, 8/27/16	**713**	75	**5,857**
Sun, 8/28/16	**610**	52	**5,188**
Mon, 8/29/16	318	150	3,385
Tues, 8/30/16	377	190	**4,284**
Wed, 8/31/16	132	141	1,818
Thur, 9/1/16	109	153	1,812
Fri, 9/2/16	**912**	146	**8,000**
Sat, 9/3/16	**658**	77	**5,472**
Sun, 9/4/16	**586**	90	**5,404**

Source: *Ten-day tube counts conducted by IDAX, Friday, August 26 to Sunday, September 4,2016. Combined volumes at both East Gate and West Gate for entry to and from Terminal 91.*
Volumes in bold identify time periods where the Short-Fill Redevelopment Agreement threshold limit is met or exceeded.

Figure 2. Automobile Traffic – AM Peak Period (7:15 – 8:30 AM)

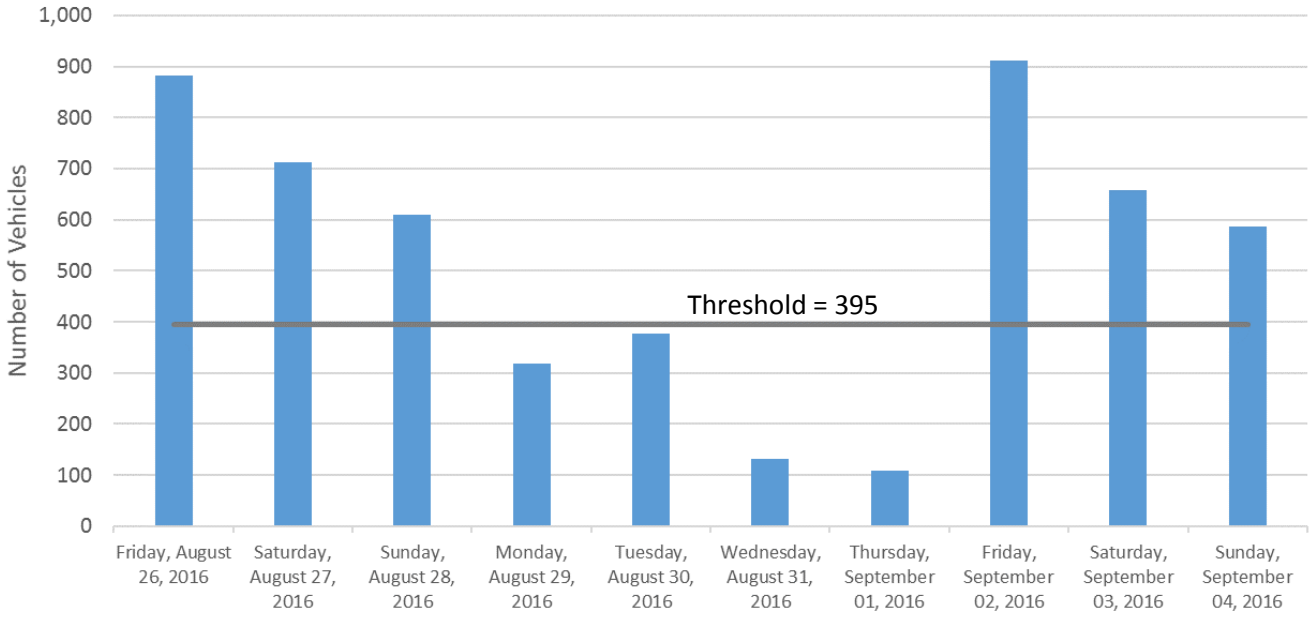


Figure 3. Automobile Traffic – PM Peak Period (3:45 – 5:30 PM)

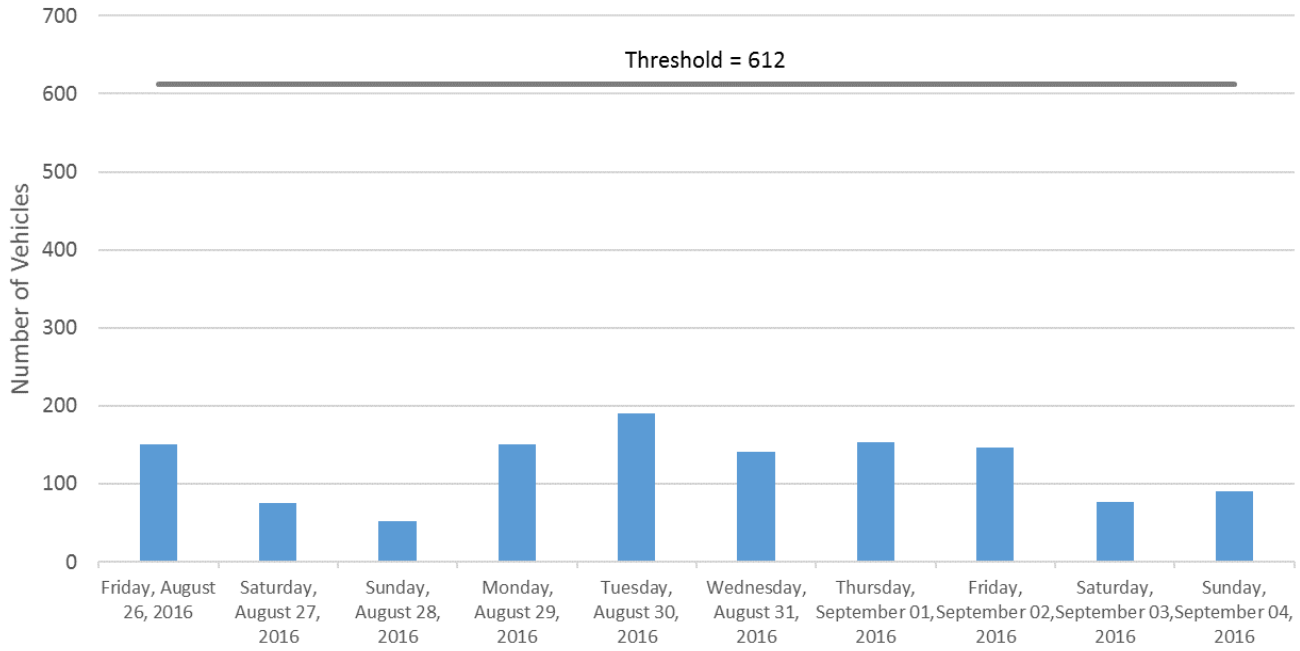
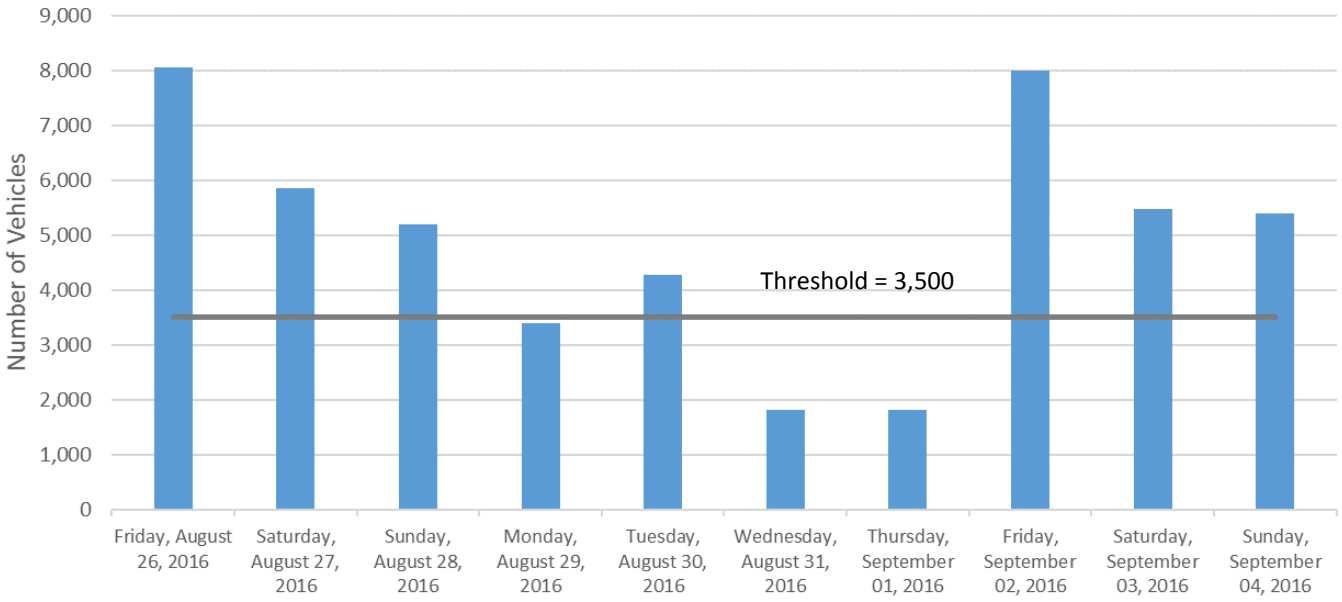
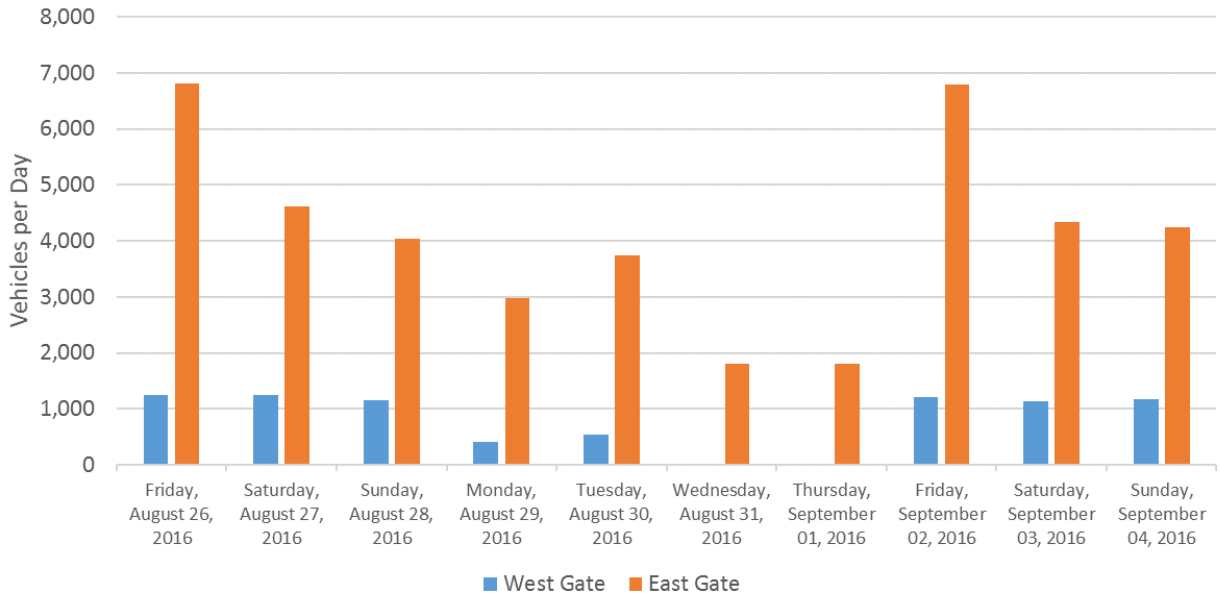


Figure 4. Automobile Traffic – Daily (24-Hour Period)



The volume by access location is shown on Figure 5. On days without a cruise ship call, the parking lot at the West Gate is locked, and the very small number of trips that entered or exiting the terminal at the West Gate is likely related to security or maintenance personnel (20 or fewer trips on those days). The largest fluctuations in volume occur at the East Gate on days when there is cruise activity. Figure 5 shows the daily automobile volumes by access location.

Figure 5. Daily Automobile Trips by Access Location



Truck Traffic (and other Large Vehicles)

As with prior Terminal 91 monitoring efforts, the “truck traffic” thresholds were measured for all large vehicles generated by Terminal 91 including charter buses, school buses, and shuttles. Almost all large vehicles access the terminal through the East Gate, although some smaller trucks and shuttles may use the West Gate. The volumes of trucks, buses, and shuttles were derived from the vehicle classification counts. The total number of truck trip ends for both access locations is summarized in Table 4. As shown, the volume of trucks and buses exceeded the AM peak and daily thresholds on all days of the week. The PM peak threshold was never exceeded.

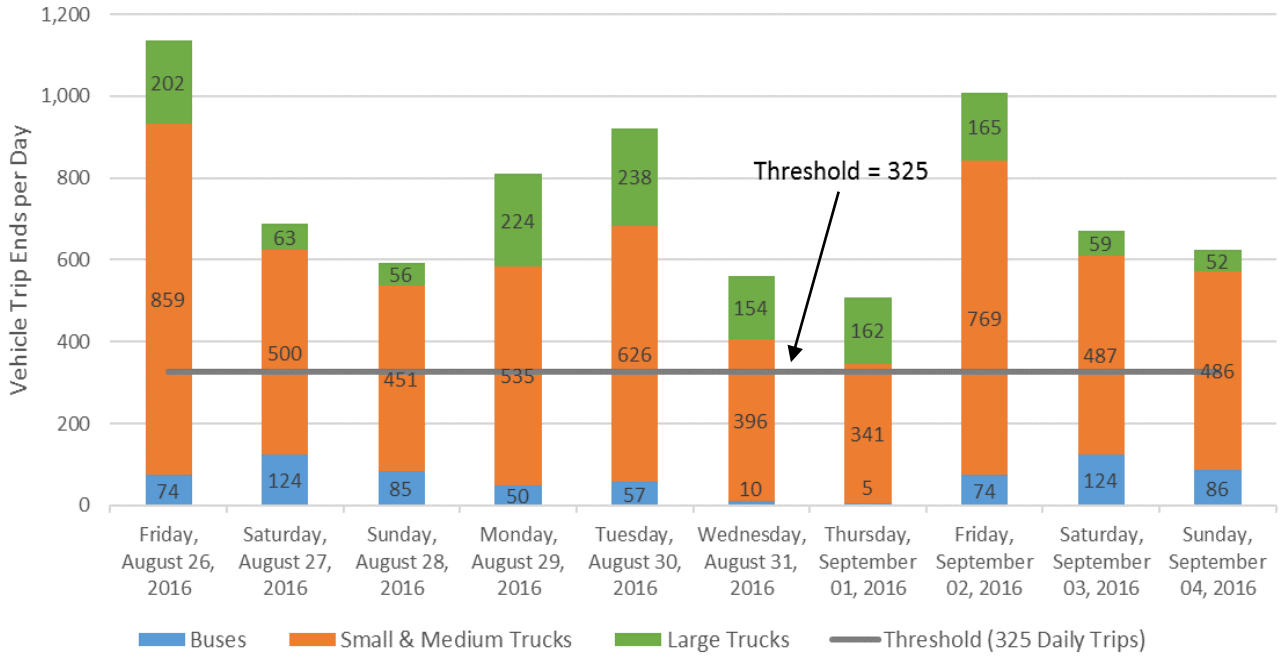
Table 4. Truck and Bus Volumes to and from Terminal 91

Date	AM Peak (7:15 – 8:30 AM) Threshold = 25	PM Peak (3:45 – 5:30 PM) Threshold = 48	Daily (24-Hour) Threshold = 325
Fri, 8/26/16	**137**	27	**1,135**
Sat, 8/27/16	**74**	11	**687**
Sun, 8/28/16	**65**	10	**592**
Mon, 8/29/16	**81**	18	**809**
Tues, 8/30/16	**80**	21	**921**
Wed, 8/31/16	**35**	24	**560**
Thur, 9/1/16	**38**	24	**508**
Fri, 9/2/16	**118**	26	**1,008**
Sat, 9/3/16	**74**	5	**670**
Sun, 9/4/16	**86**	11	**624**

Source: *Ten-day tube counts conducted by IDAX, Friday, August 26 to Sunday, September 4,2016. Combined volumes at both East Gate and West Gate for entry to and from Terminal 91.*
Volumes in bold identify time periods where the Short-Fill Redevelopment Agreement threshold limit is met or exceeded.

The types of vehicles were compiled for each day to show the proportion of each type of large vehicle: buses, small and medium trucks (2 to 4 axles), and large trucks (more than 5 axles). These are shown on Figure 6. It is noted that the First Student School Bus base that was formerly located at Terminal 91 is no longer in operation; it closed prior to the 2014 survey.

Figure 6. Large Vehicles by Day of Week



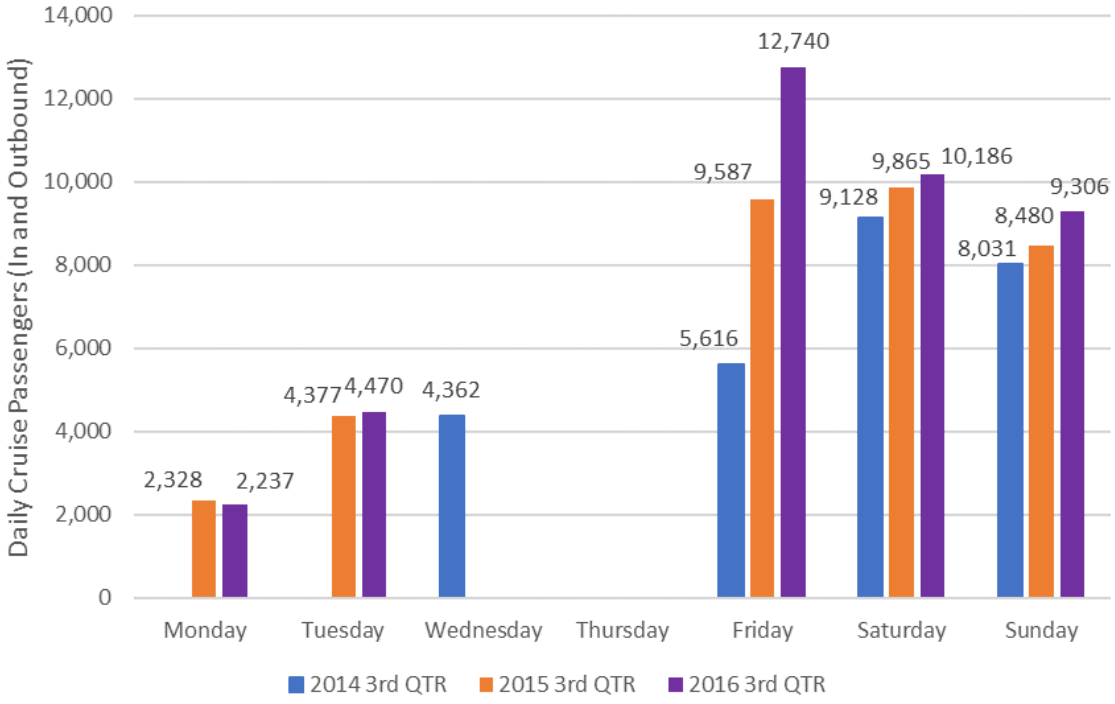
Historic Trends

This section compares results from the three most recent traffic monitoring studies—September 2014, 2015 and 2016—representing the conditions after the Port opened Smith Cove Cruise Terminal in 2009.

Passenger Trends

Traffic volumes at Terminal 91 fluctuate from day to day. The largest changes result from cruise activities. Figure 7 shows the number of passengers that embark and disembark cruise ships at the terminal by day of week for the past three monitoring years. As shown, cruise activity in the mid-week has changed over the years; in 2015 and 2016 there were no ships on Wednesday or Thursday. Cruise volumes on Monday and Tuesday show little to no growth over the last year, while weekend activity has increased significantly. The majority of cruise ship passenger volume growth is on Friday, which now exceeds weekend cruise ship passenger volumes.

Figure 7. Cruise Ship Passenger Volume Trends



Automobile Traffic Trends

Figures 8, 9, and 10 compare historic automobile traffic monitoring results for the AM peak, PM peak and 24-hour periods, respectively. Aside from one anomaly in 2015 (Saturday during the AM peak hour), traffic volumes are consistent with cruise ship passenger trends during the last three years of traffic monitoring. The AM peak period automobile traffic volumes continue to cross the threshold on Friday, Saturday and Sunday. PM peak period automobile traffic volumes have decreased on almost every day of the week from 2015, and are well below the established threshold. Daily automobile traffic volumes exceed the threshold on Tuesday, Friday, Saturday and Sunday. Monday daily automobile volumes are nearly at the 3,500 vehicle threshold.

Figure 8. Automobile Trends – AM Peak Period (7:15 – 8:30 AM)

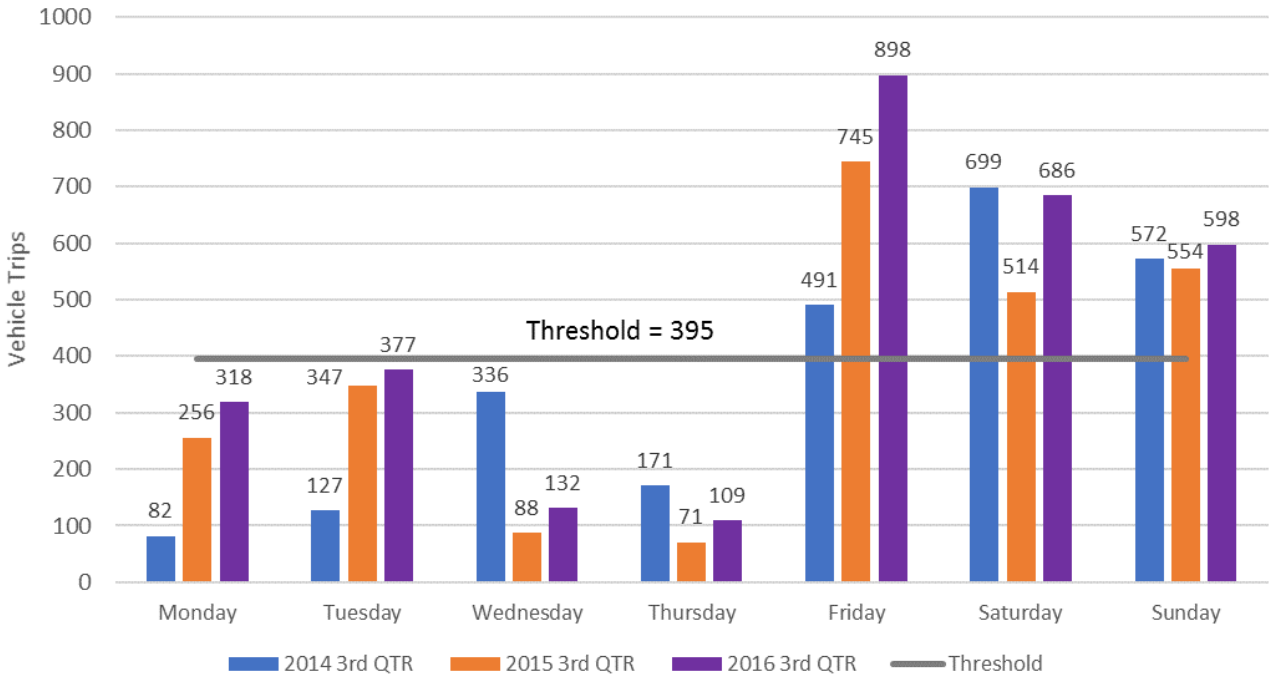


Figure 9. Automobile Trends – PM Peak Period (3:45 – 5:30 PM)

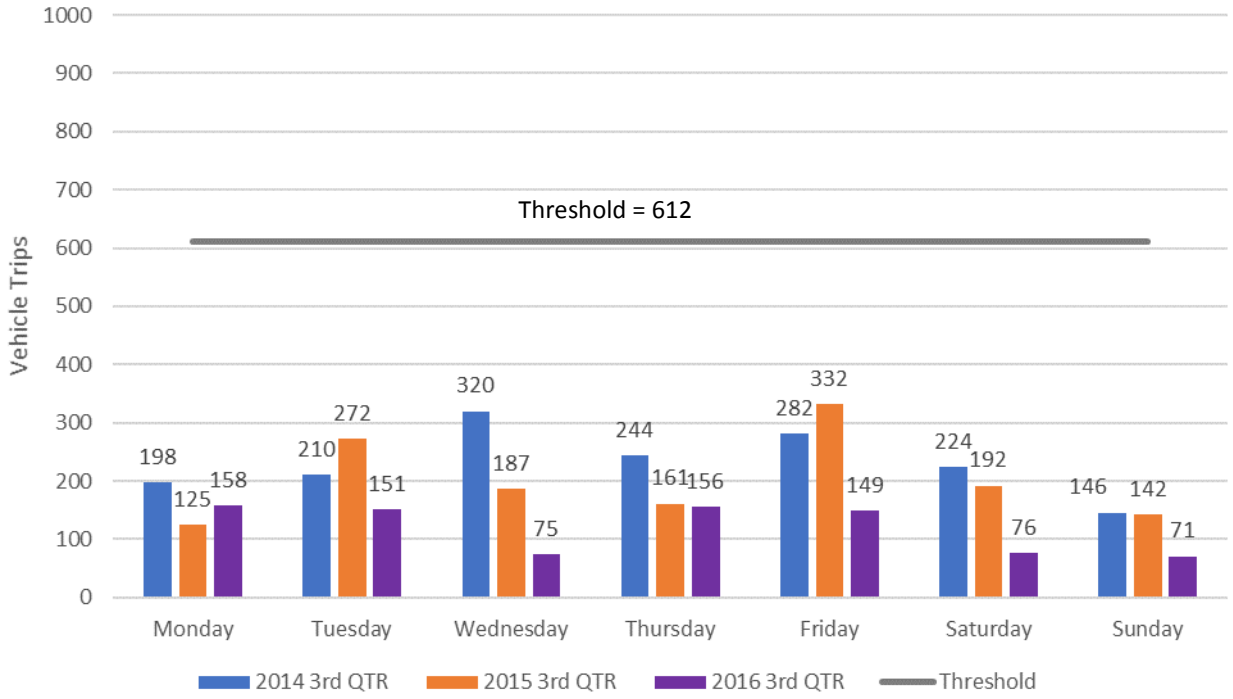
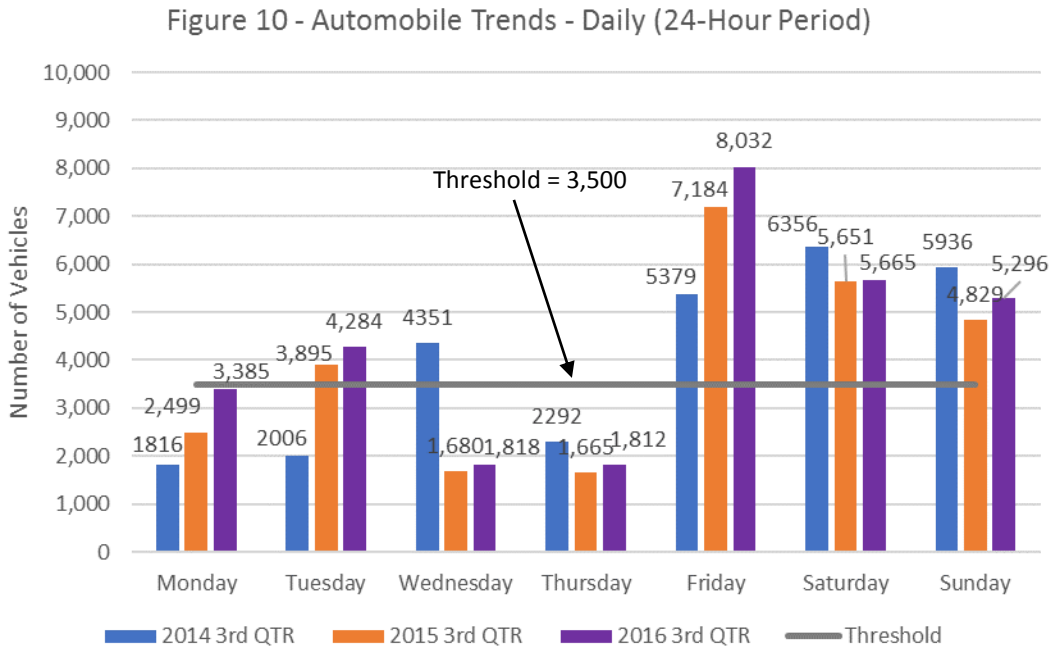


Figure 10. Automobile Trends – Daily (24-Hour Period)



Truck and Bus Traffic Trends

Figures 11, 12, and 13 compare truck volumes to prior monitoring results for the AM peak, PM peak, and 24-hour periods, respectively. These volumes include buses and trucks. The AM peak period, PM peak period and daily volumes of trucks have generally decreased during the weekdays (apart from Monday, where in 2015 the volumes were low due to the holiday) but increased on the weekends (including Friday). Truck volumes thresholds were met or exceeded every day during the AM peak period and the daily (24-hour) period. The PM peak period threshold was not met for any day of the week.

Figure 11. Truck and Bus Trends – AM Peak Period (7:15 – 8:30 AM)

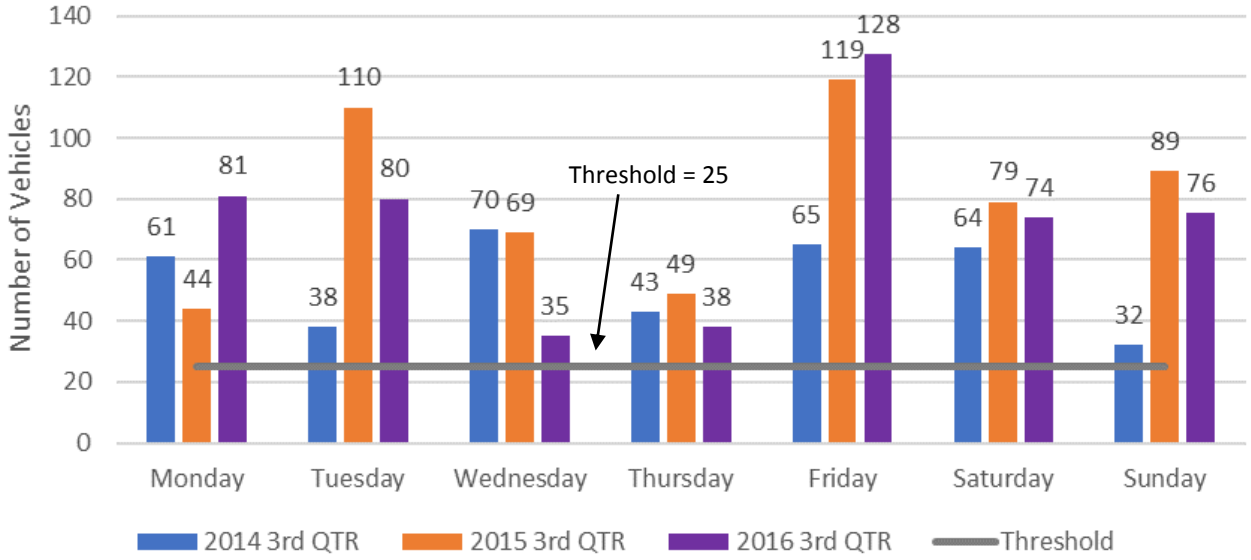


Figure 12. Truck and Bus Trends – PM Peak Period (3:45 – 5:30 PM)

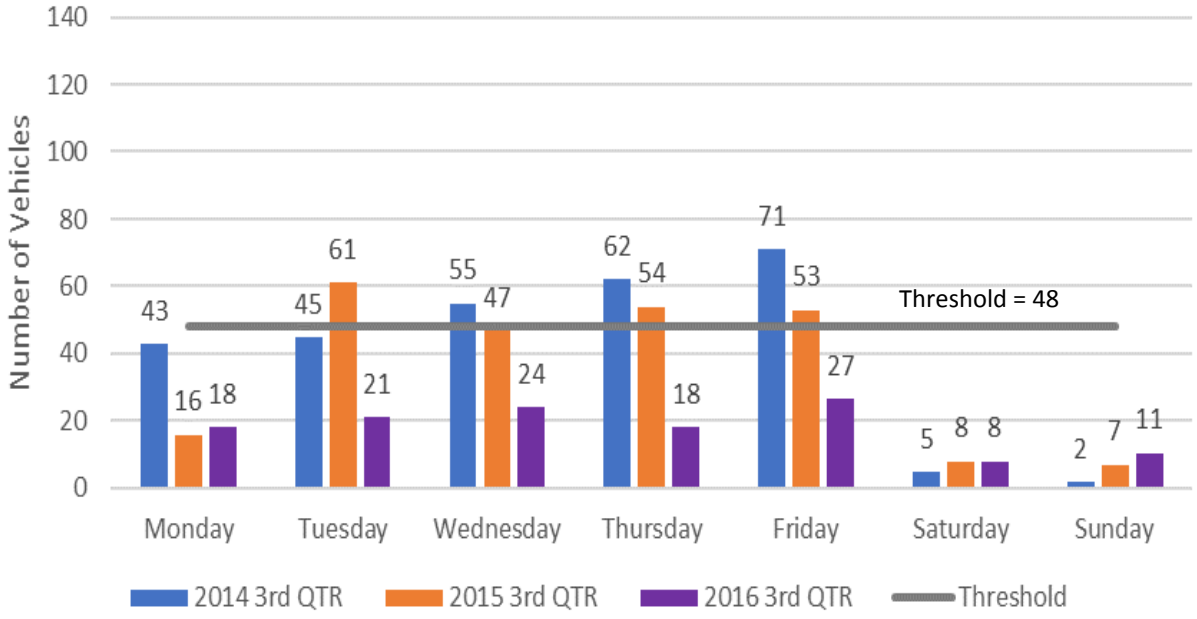
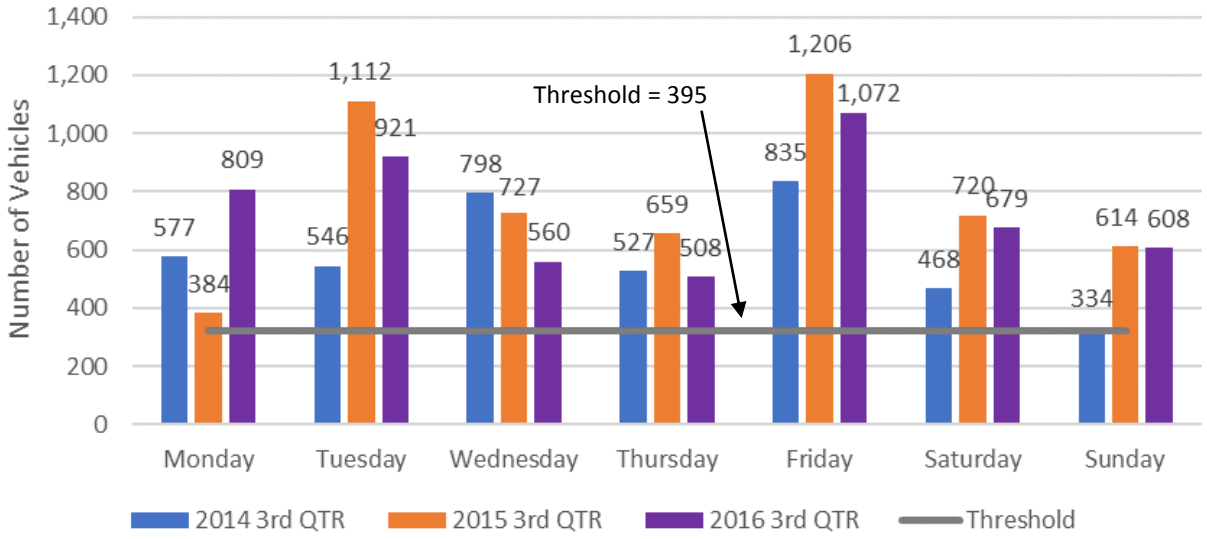


Figure 13. Truck and Bus Trends – Daily (24-Hour Period)



Intersection Level of Service

Trigger Levels

The SFRA established level of service trigger levels for three off-site intersections. Level of service is a qualitative measure used to characterize traffic operating conditions. Six letter designations, "A" through "F," are used to define level of service. LOS A is the best and represents good traffic operations with little or no delay to motorists. LOS F is the worst and indicates poor traffic operations with long delays. The trigger levels are summarized in Table 5. It is noted that the SFRA included the W Galer Street intersection on Elliott Avenue W, which was the primary access to Terminal 91 when the SFRA was created. That access has been replaced with the Galer Street Flyover. Therefore, the trigger level previously established for Galer Street was applied to the Elliott Avenue W/Galer Flyover intersection.

Table 5. Level of Service Trigger Levels from SFRA

Intersection	**Trigger Level**
Elliot Avenue W / Galer Flyover	**LOS E**
Elliot Avenue W / W Garfield Street	**LOS C**
Elliot Ave W / W Mercer Place	**LOS E**

Source: *Short-Fill Redevelopment Agreement, January 2000.*
SFRA included the Elliott Avenue W / W Galer Street Intersection, which was the primary access to Terminal 91. That access has been replaced with the Galer Street Flyover

As previously discussed, the level of service methodology prescribed by the SFRA (Critical Lane Analysis) is outdated. Computers now allow more complex calculations to occur, which have resulted in more accurate analyses of intersection operations. For this study, intersection levels of service were determined using the methodologies in the Highway Capacity Manual (Transportation Research Board, 2000). Levels of service for study area intersections were calculated using Trafficware's Synchro 9 traffic operations analysis software, which is also the

latest version of software. Current level of service criteria for signalized intersections can be found in Appendix B.

In 2013, SDOT installed Traffic Responsive Operations Systems technology along the Elliott/15th Avenue corridor between W Armour Street and W Harrison Street. The signalized intersections along this corridor section use volume detection technology to change the traffic signal cycles and operation based on traffic volume. The technology allows for 15 different operational programs that are available during the day (five AM peak hour options, five PM peak hour options, and five off-peak options), instead of just one per time period under the former signal system. Each operational program is triggered when a specific traffic demand threshold is met. Since the operations can change as volumes change throughout the day, SDOT staff recommended that the Synchro model's cycle length and signal phase times should be "optimized" for each condition. This analysis uses the recommended approach.

The levels of service models developed by Seattle Department of Transportation (SDOT) for the Elliott/15th Avenue corridor were used for all analyses; these models reflect the current configuration (with the BAT lanes) and the volume-responsive traffic signal timing. However, these models use phasing plans that are not compatible with the stricter HCM 2010 phasing requirements (such as dedicated pedestrian phases). As a result HCM 2000 was used to evaluate the intersection level of service. It is noted that HCM methodology was not used to calculate intersection level of service in previous years. This change, along with slight alterations to the signal timing and phasings done by the City of Seattle, results in more variation in average vehicle delay when comparing 2016 to previous years as seen in Figures 19 and 20.

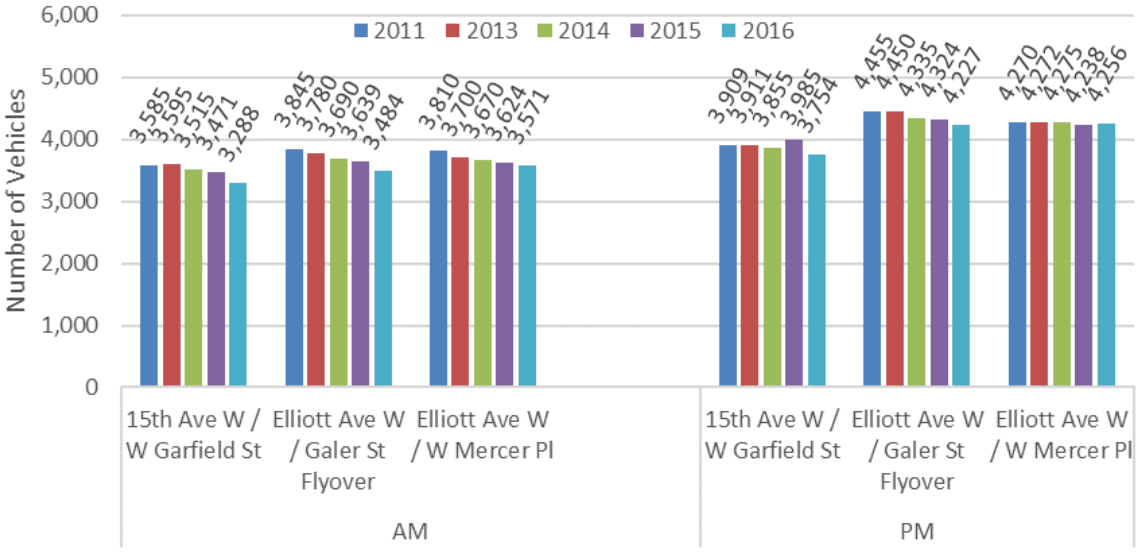
Year 2016 Traffic Volumes

No Cruise Activity

New intersection counts were performed at all three study intersections on Thursday August 25, 2016 for two hours during the AM (7:00 – 9:00 AM) and PM (4:00 – 6:00 PM) peak periods. These counts were performed when no cruise activity was occurring at the Port. The peak one hour during each of the count periods was identified and used for the intersection analysis. These peak one hour traffic volumes are reported from 8:00 to 9:00 A.M. and from 4:00 to 5:00 P.M. It is noted that these peak hours differ from the longer-than-60-minute periods prescribed by the SFRA. The peak hours were selected to meet industry standard for traffic analysis and level of service definitions, and are consistent with other traffic studies performed by the City of Seattle. Traffic volumes without cruise activity are shown on Figures 15 and 16 for the AM and PM peak hours, respectively. Additionally, the raw intersection turning movement counts are shown in Appendix A.

It is interesting to note that traffic volumes have changed very little since 2011. For each year since 2011, the total number of vehicles entering each of the intersections during the peak hours is compared on Figure 14. All sets of counts reflect late August or September conditions without cruise activity at Terminal 91. Volumes during both the AM and PM peak hours are either remaining constant, or decreasing slightly from 2011 to 2016.

Figure 14. Total Traffic Entering Intersection – Without Cruise Activity



Source: Intersection turning movement counts performed for the respective Terminal 91 Monitoring Studies. All sets of counts reflect Q3 conditions without cruise activity at Terminal 91.

With Cruise Activity

The gate counts described in the prior sections were used to determine the net change in AM and PM peak hour traffic associated with cruise activity at Terminal 91. Two conditions with cruise activity were evaluated: a typical weekday with one ship call at the terminal (Tuesday) and a peak weekday with two ship calls (Friday). These were compared to a day with no cruise (Thursday) to determine the traffic associated with cruise activity. The trip generation estimates are summarized in Table 6. As shown, cruise related trips are highest during the AM peak hour with 773 trips generated on the peak Friday. During the PM peak hour, on the same day, there were 35 cruise-related trips. Additionally, the raw intersection turning movement counts are shown in Appendix A.

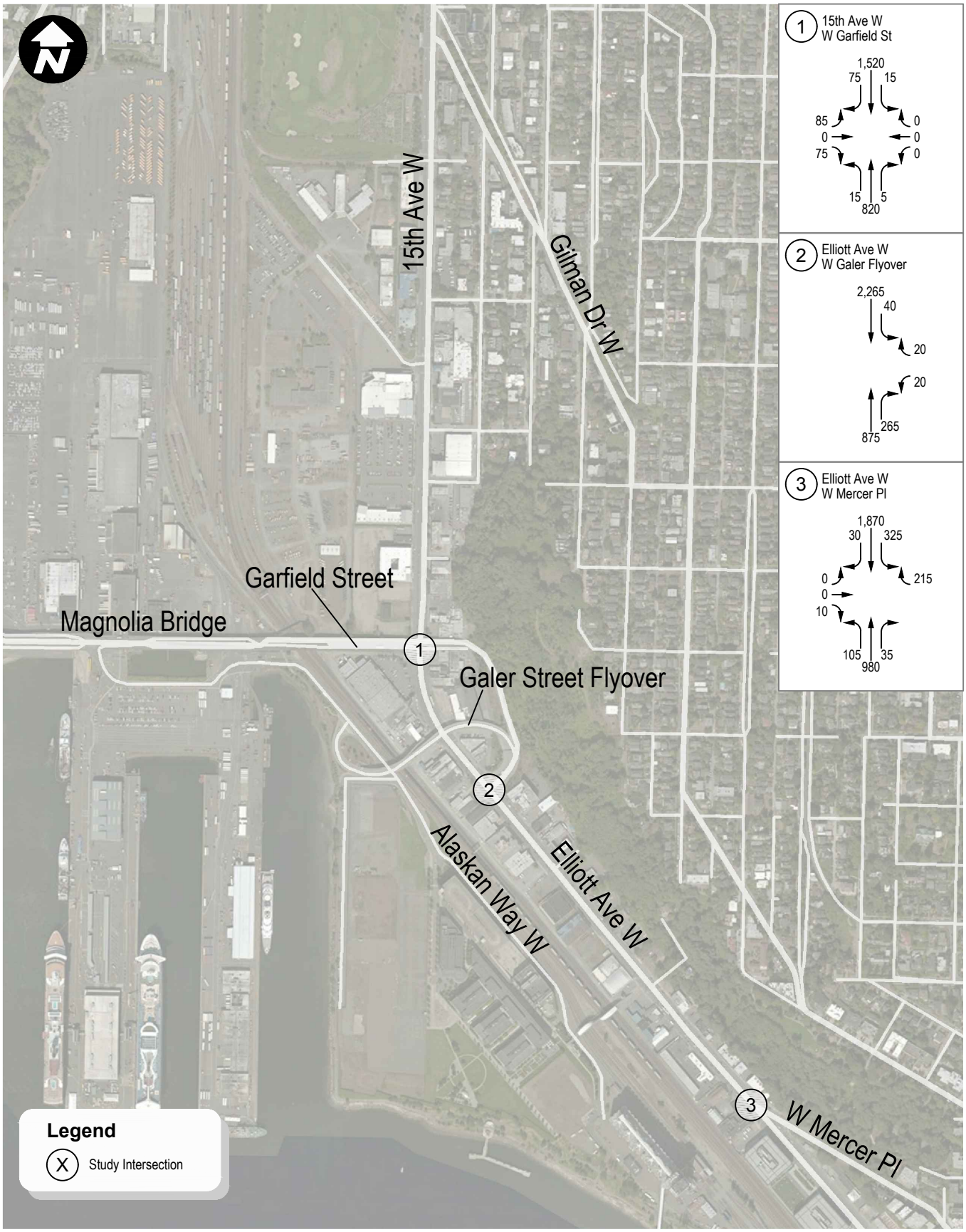
It is noted that during the PM peak hour, the trips derived for the one-ship condition have some negative values at the East and West Gate. Because the traffic volumes are so low in the PM peak at both gates, in addition to the small number of vehicles generated by one cruise in the PM peak, a small change in daily traffic volumes can result in a net negative number of vehicles when comparing a cruise day to a non-cruise day. However, the total vehicle trips to and from Terminal 91 (when combining both the East and West gates) are always a net positive for both one cruise and two cruise days.

Table 6. Weekday Peak Hour Traffic: Cruise Day vs. Non-Cruise Day - 2016

	East Gate		West Gate		Total Terminal 91		
	Enter	Exit	Enter	Exit	Enter	Exit	Total
AM Peak Hour (8:00 AM to 9:00 AM)							
Non-Cruise Day (Wed 8/31/16)	74	54	5	1	75	55	134
Typical Weekday Cruise Day (Tues 8/30/16)	207	203	38	44	245	247	492
Peak Weekday Cruise Day (Fri 8/26/16)	359	353	83	112	442	465	907
Net Change with Typical Weekday Cruise	**133**	**149**	**33**	**43**	**166**	**192**	**358**
Net Change with Peak Weekday Cruise	**285**	**299**	**78**	**111**	**363**	**410**	**773**
PM Peak Hour (4:00 PM to 5:00 PM)							
Non-Cruise Day (Wed 8/31/16)	8	28	0	2	8	30	38
Typical Weekday Cruise Day (Tues 8/30/16)	7	49	5	0	12	49	61
Peak Weekday Cruise Day (Fri 8/26/16)	16	51	4	2	20	53	73
Net Change with Typical Weekday Cruise	**-1**	**21**	**5**	**-2**	**4**	**19**	**23**
Net Change with Peak Weekday Cruise	**8**	**23**	**4**	**0**	**12**	**23**	**35**

Source: *Ten-day tube counts conducted by IDAX, Friday, August 26 to Sunday, September 4,2016. Combined volumes at both East Gate and West Gate for entry to and from Terminal 91.*
Volumes in bold identify time periods where the Short-Fill Redevelopment Agreement threshold limit is met or exceeded.

The additional peak hour traffic generated by the cruise terminal on an average weekday (with one ship call) and the peak weekday (two ship calls) was distributed to the roadway network and assigned to the study-area intersections according to travel patterns defined by traffic counts performed for the 2010 Monitoring study. The AM and PM cruise terminal trips are shown on Figures 17 and 18, respectively.



Terminal 91 - 2016 Traffic Monitoring
Existing 2016 AM Peak Hour Traffic Volumes (Without Cruise)

FIGURE
15

2016 Terminal 91 Traffic Monitoring

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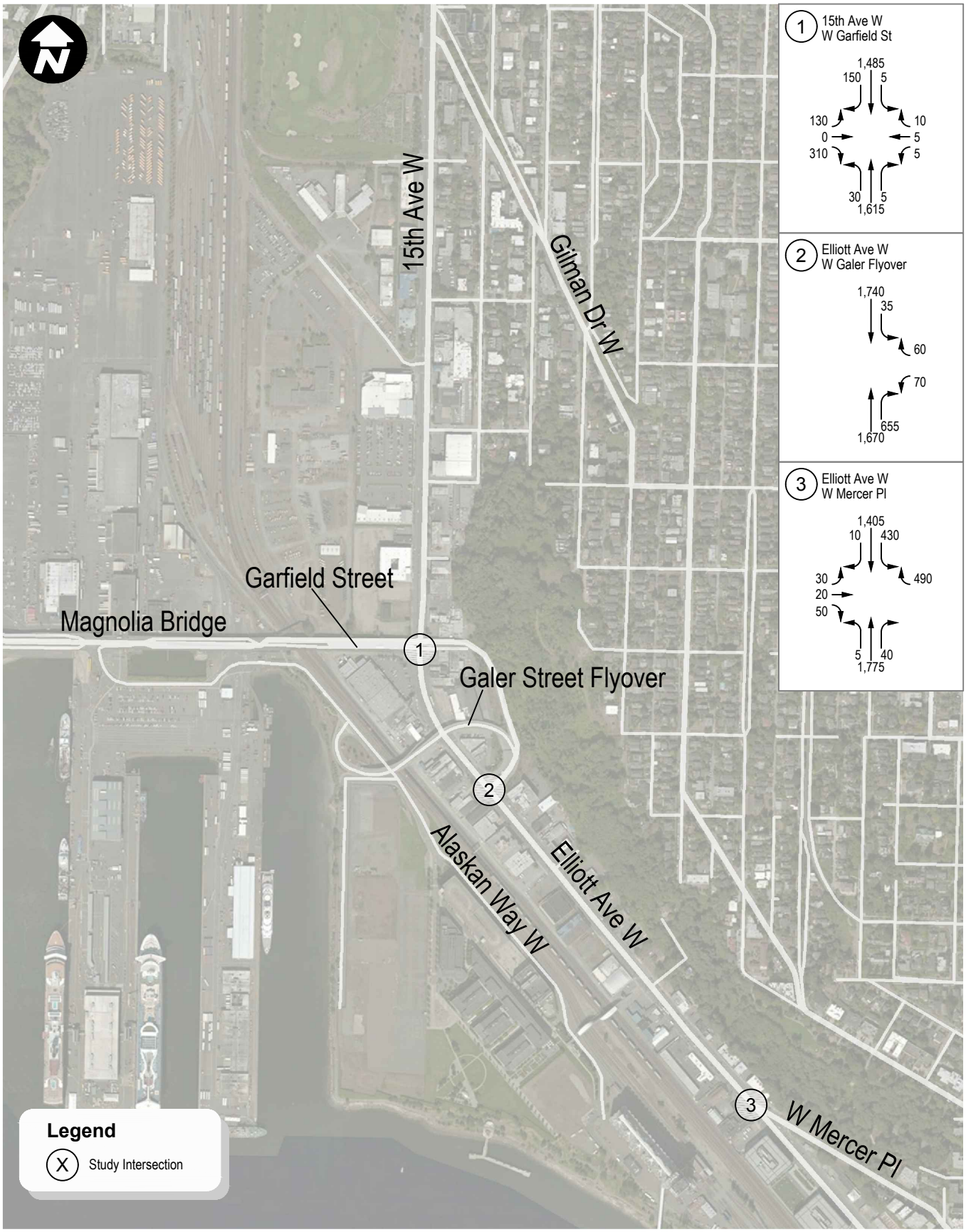
WHAT TRANSPORTATION CAN BE.

Dec 15, 2016 - 2:50pm PaulS \\srv-dfs-wa\Projects\16\16075.00 - Port of Seattle Environmental Review\SD1\Graphics\Intersection TMC and Trip Distribution.dwg Layout: AM Vols No Cruise



Terminal 91 - 2016 Traffic Monitoring
Existing 2016 PM Peak Hour Traffic Volumes (Without Cruise)

FIGURE
16

2016 Terminal 91 Traffic Monitoring

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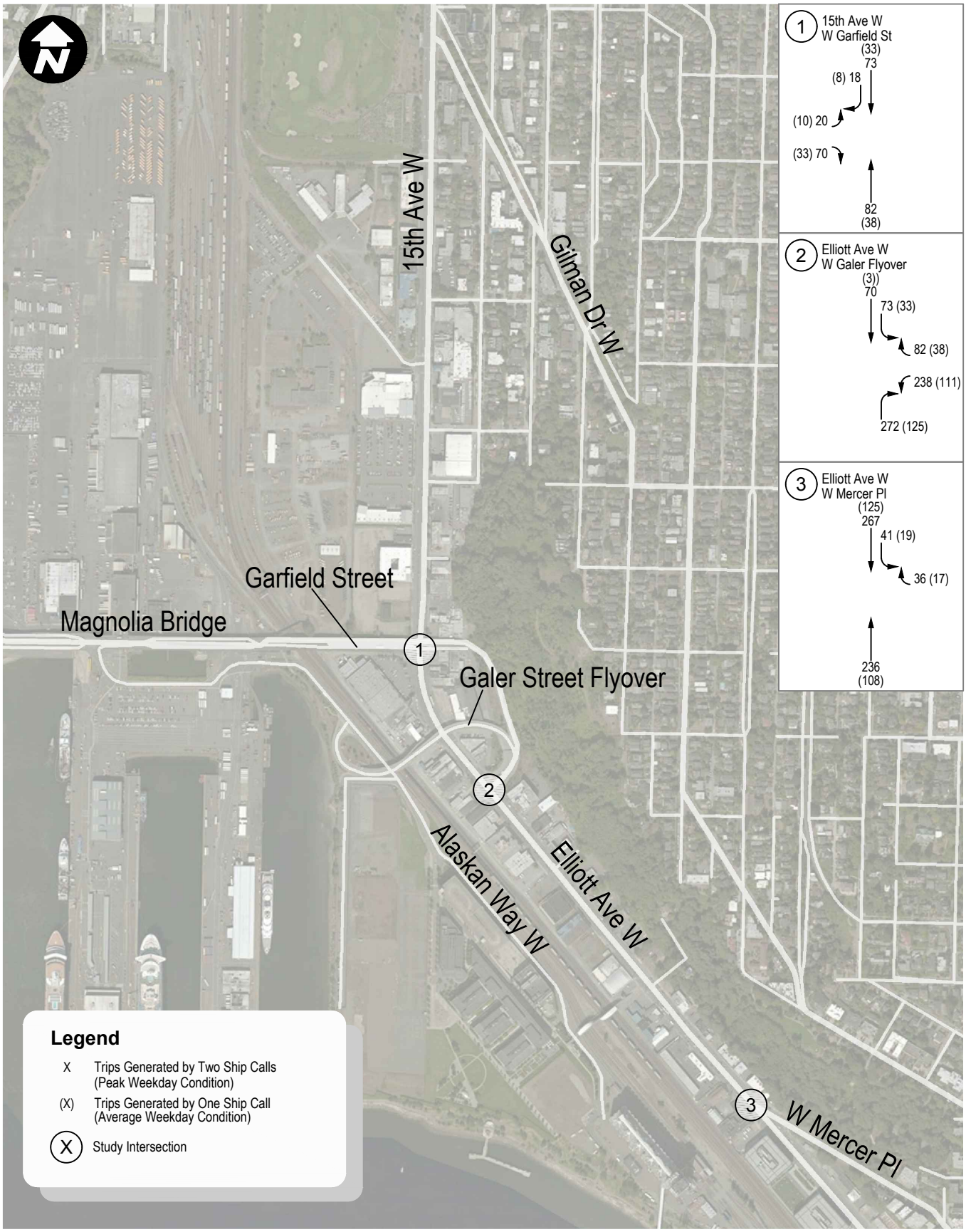
WHAT TRANSPORTATION CAN BE.

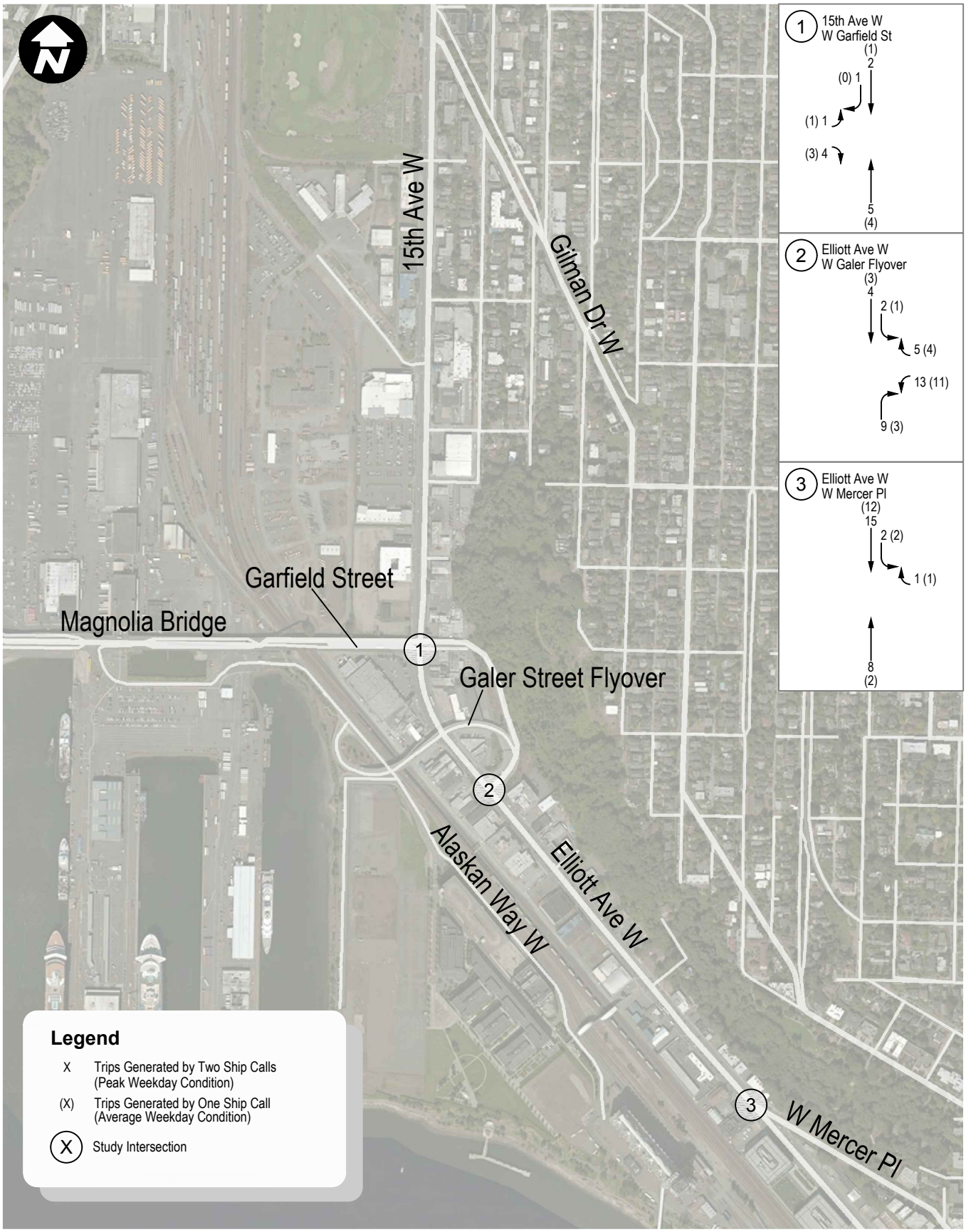


Terminal 91 - 2016 Traffic Monitoring
Trips Generated by Weekday Cruise Operations (AM Peak Hour)

FIGURE
17

2016 Terminal 91 Traffic Monitoring

transpogroup
WHAT TRANSPORTATION CAN BE.



Terminal 91 - 2016 Traffic Monitoring
Trips Generated by Weekday Cruise Operations (PM Peak Hour)

FIGURE **18**

2016 Terminal 91 Traffic Monitoring

transpogroup
WHAT TRANSPORTATION CAN BE.

Level of Service Analysis

Peak hour traffic volumes shown on Figures 15 through 18 were used to determine the levels of service for study-area intersections. This analysis reflects existing conditions on a normal day (without cruise operations at Terminal 91), on a weekday with an average cruise (one ship call), and on a weekday with peak cruise operations (two ship calls). The methodology used to determine level of service was previously described in the *Trigger Levels* section. The results are summarized in Table 7, and the detailed level of service reports can be found in Appendix C.

The level of service results for the without cruise conditions at each study intersection all operate well below the SFRA threshold level. The addition of the traffic resulting from a typical one-cruise day does not significantly impact operations at any of the three study intersections. On two-cruise ship days, intersection LOS results also fall below the SFRA threshold level. During the periods of heaviest activity in 2016, queuing occasionally occurred along the Galer flyover stretching onto Elliott.

Table 7. Weekday Peak Hour Traffic: Cruise Day vs. Non-Cruise Day - 2016

	SFRA Trigger Level[A]	Average Weekday Without Cruise		Average Weekday With One Cruise		Peak Weekday With Two Cruises	
		LOS[B]	Delay[C]	LOS	Delay	LOS	Delay
AM Peak Hour							
15th Ave / Garfield Street	LOS C	A	4.7	A	4.7	A	5.5
Elliott Ave / Galer Flyover	LOS E	A	4.5	A	9.0	B	13.5
Elliott Ave / W Mercer Place	LOS E	C	24.2	C	25.0	D	36.2
PM Peak Hour							
15th Ave / Garfield Street	LOS C	A	5.9	A	6.0	A	6.0
Elliott Ave / Galer Flyover	LOS E	B	19.8	C	21.1	C	22.0
Elliott Ave / W Mercer Place	LOS E	C	29.7	C	30.0	C	30.4

Source: Levels of service were calculated using traffic operations models developed by SDOT for the Elliott Avenue corridor. They reflect existing signal timing and lane geometry. All analysis was performed using the Synchro 9.0 model and analysis methodology.

A. Level of service threshold established by Short-Fill Redevelopment Agreement, January 2000. The SFRA included the Elliot Avenue W / W Galer Street intersection which was the primary access to Terminal 91. That access has been replaced with the Galer Street Flyover.

B. Level of Service

C. Average delay per vehicle in seconds.

Level of service results from Terminal 91 Monitoring Reports dating back to 2011 are compared on Figure 19 for the Elliott Avenue W/Galer Flyover intersection and on Figure 20 for the Elliott Avenue W/W Mercer Place intersection. The charts compare the average vehicle delay without and with cruise traffic. The condition with one cruise ship is used because that is the only condition that existed in prior years for an accurate comparison. Operations during the PM peak period saw an increase in delay during non-cruise conditions, and thus saw an increase in delay during cruise conditions as well. The chart also shows the higher delay condition that existed in 2011 at the Elliott Avenue W/W Mercer Place intersection before left turn lane improvements were made. Those improvements lengthened the left turn lane and added vehicle detection at the end of that lane so that the green phase for that movement is extended when longer queues exist. Those improvements did benefit the AM peak hour conditions. The charts also show that both intersections operate well within the delay associated with the LOS E threshold established by the SFRA.

Figure 19. Traffic Operations at Elliott Ave W / Galer Flyover Intersection

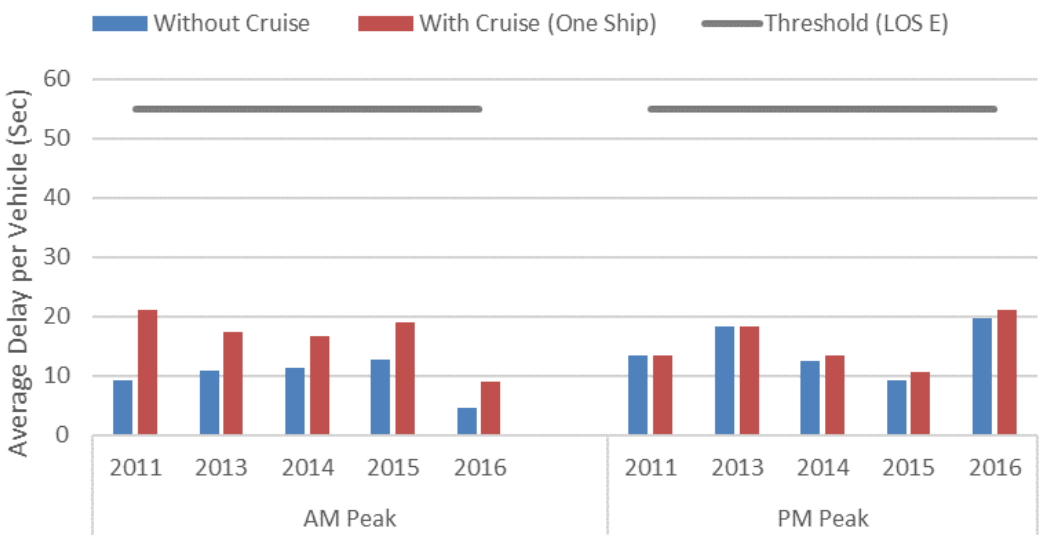
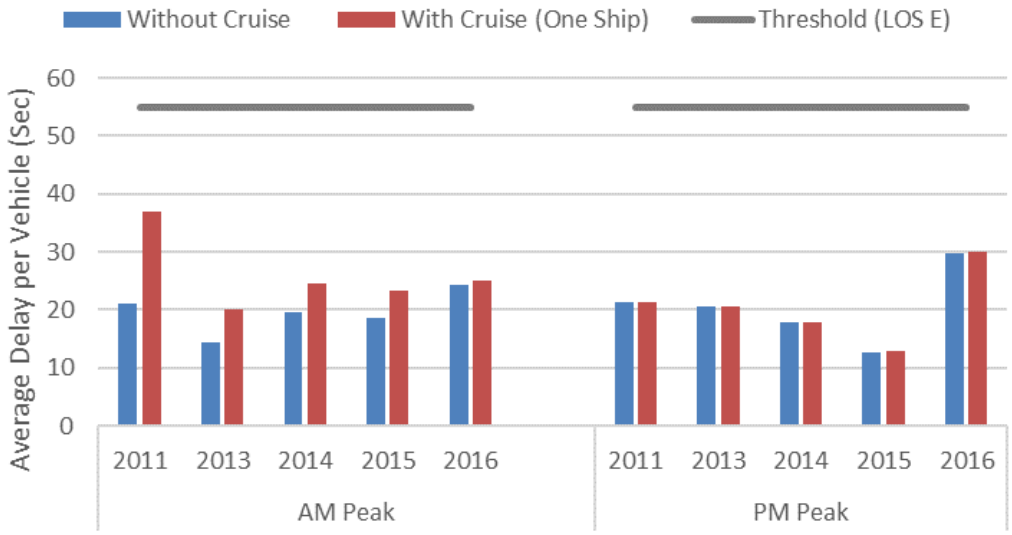


Figure 20. Traffic Operations at Elliott Ave W / W Mercer Place Intersection



Conclusions

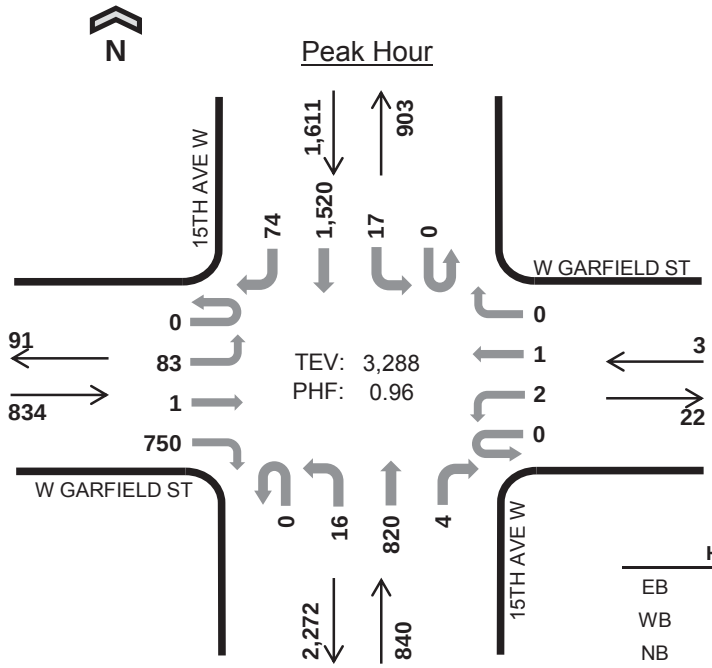
This 2016 Terminal 91 Monitoring Study shows that truck trips continue to exceed the volume thresholds for AM, PM and daily periods, and have exceeded those thresholds for many years. Automobile trips exceed the thresholds during the AM and daily periods on days with cruise operations. However, despite the fact that the traffic volume thresholds are exceeded, traffic operations along the Elliott Avenue/15th Avenue W corridor still operate below the trigger levels at each of the study intersections during both the AM and PM peak hours.

Appendix A:Intersection Traffic Counts

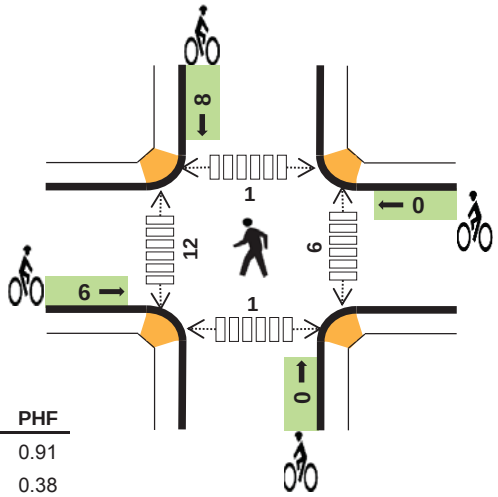
AM Counts

15TH AVE W
W GARFIELD ST

Peak Hour



Date: Thu, Aug 25, 2016
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	2.2%	0.91
WB	0.0%	0.38
NB	7.9%	0.88
SB	3.6%	0.92
TOTAL	4.3%	0.96

Two-Hour Count Summaries

Interval Start	W GARFIELD ST Eastbound				W GARFIELD ST Westbound				15TH AVE W Northbound				15TH AVE W Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	8	1	155	0	0	0	0	0	3	162	0	0	3	361	13	706	0
7:15 AM	0	17	0	186	0	0	0	0	0	2	172	0	0	2	398	18	795	0
7:30 AM	0	12	0	204	0	0	0	0	0	4	217	0	1	4	409	13	864	0
7:45 AM	0	15	1	187	0	0	0	0	0	2	200	1	0	8	343	22	779	3,144
8:00 AM	**0**	**20**	**1**	**188**	**0**	**0**	**0**	**0**	**0**	**2**	**173**	**0**	**0**	**8**	**414**	**14**	**820**	3,258
8:15 AM	**0**	**20**	**0**	**209**	**0**	**2**	**0**	**0**	**0**	**5**	**189**	**2**	**0**	**5**	**363**	**19**	**814**	3,277
8:30 AM	**0**	**17**	**0**	**203**	**0**	**0**	**0**	**0**	**0**	**2**	**236**	**2**	**0**	**3**	**380**	**17**	**860**	3,273
8:45 AM	**0**	**26**	**0**	**150**	**0**	**0**	**1**	**0**	**0**	**7**	**222**	**0**	**0**	**1**	**363**	**24**	**794**	**3,288**
Count Total	0	135	3	1,482	0	2	1	0	0	27	1,571	5	1	34	3,031	140	6,432	0
Peak Hour	**0**	**83**	**1**	**750**	**0**	**2**	**1**	**0**	**0**	**16**	**820**	**4**	**0**	**17**	**1,520**	**74**	**3,288**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	3	0	21	10	*34*	0	0	0	1	*1*	1	0	0	0	*1*
7:15 AM	5	0	14	12	*31*	1	0	1	6	*8*	3	0	0	0	*3*
7:30 AM	4	0	22	14	*40*	0	0	0	5	*5*	1	4	0	0	*5*
7:45 AM	3	0	13	14	*30*	0	0	0	1	*1*	0	3	0	0	*3*
8:00 AM	**8**	**0**	**21**	**14**	***43***	**2**	**0**	**0**	**1**	***3***	**1**	**2**	**0**	**1**	*4*
8:15 AM	**2**	**0**	**12**	**15**	***29***	**1**	**0**	**0**	**1**	***2***	**1**	**2**	**1**	**0**	*4*
8:30 AM	**5**	**0**	**19**	**14**	***38***	**2**	**0**	**0**	**3**	***5***	**3**	**5**	**0**	**0**	*8*
8:45 AM	**3**	**0**	**14**	**15**	***32***	**1**	**0**	**0**	**3**	***4***	**1**	**3**	**0**	**0**	***4***
Count Total	33	0	136	108	*277*	7	0	1	21	*29*	11	19	1	1	*32*
Peak Hour	**18**	**0**	**66**	**58**	***142***	**6**	**0**	**0**	**8**	***14***	**6**	**12**	**1**	**1**	***20***

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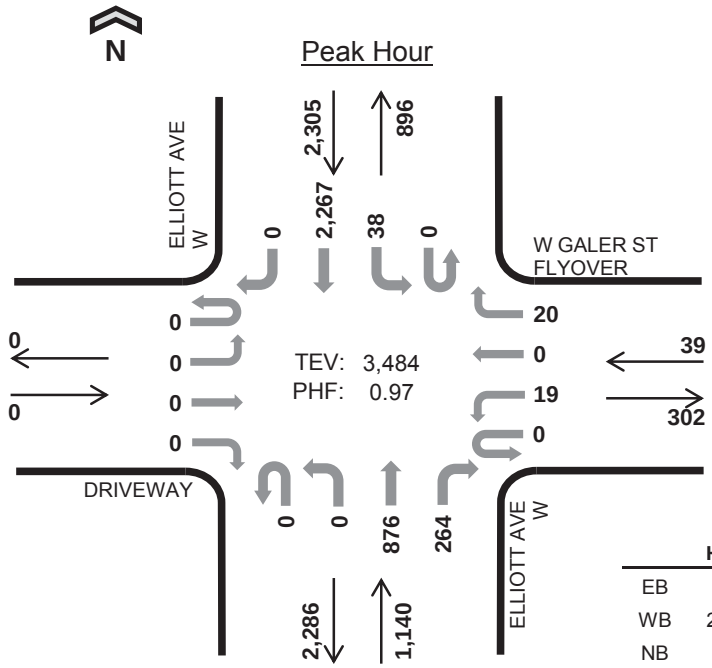
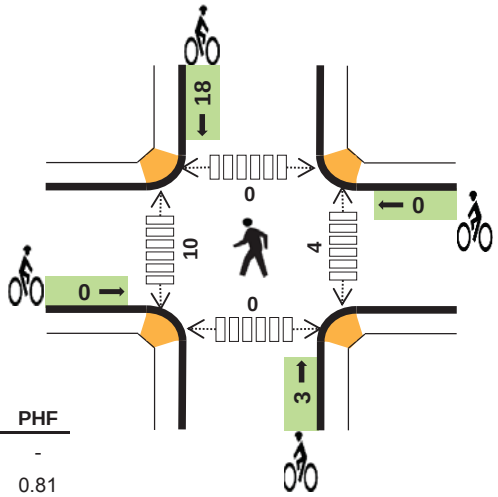
ELLIOTT AVE W
W GALER ST FLYOVER

Date: Thu, Aug 25, 2016
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 8:00 AM to 9:00 AM





	HV %:	PHF
EB	-	-
WB	28.2%	0.81
NB	8.0%	0.91
SB	3.1%	0.98
TOTAL	5.0%	0.97

Two-Hour Count Summaries

Interval Start	DRIVEWAY Eastbound				W GALER ST FLYOVER Westbound				ELLIOTT AVE W Northbound				ELLIOTT AVE W Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	0	0	0	0	5	0	4	0	0	174	55	1	5	514	0	758	0
7:15 AM	0	0	0	0	0	2	0	4	0	0	188	69	0	11	574	0	848	0
7:30 AM	0	0	0	0	0	10	0	1	0	0	198	66	0	12	583	0	870	0
7:45 AM	0	0	0	0	0	5	0	8	0	0	202	74	0	11	508	0	808	3,284
8:00 AM	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**1**	**0**	**0**	**196**	**56**	**0**	**12**	**561**	**0**	**833**	3,359
8:15 AM	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**4**	**0**	**0**	**209**	**61**	**0**	**6**	**585**	**0**	**869**	3,380
8:30 AM	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**7**	**0**	**0**	**252**	**61**	**0**	**11**	**559**	**0**	**894**	3,404
8:45 AM	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**8**	**0**	**0**	**219**	**86**	**0**	**9**	**562**	**0**	**888**	**3,484**
Count Total	0	0	0	0	0	41	0	37	0	0	1,638	528	1	77	4,446	0	6,768	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**20**	**0**	**0**	**876**	**264**	**0**	**38**	**2,267**	**0**	**3,484**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	0	4	27	10	*41*	0	0	1	1	*2*	0	1	0	1	*2*
7:15 AM	0	1	26	16	*43*	0	0	0	9	*9*	2	2	0	3	*7*
7:30 AM	0	4	29	17	*50*	0	0	0	7	*7*	1	6	0	1	*8*
7:45 AM	0	4	18	19	*41*	0	1	1	1	*3*	0	2	0	0	*2*
8:00 AM	**0**	**4**	**26**	**19**	***49***	**0**	**0**	**1**	**4**	***5***	**0**	**2**	**0**	**0**	*2*
8:15 AM	**0**	**3**	**20**	**16**	***39***	**0**	**0**	**0**	**2**	***2***	**1**	**1**	**0**	**0**	*2*
8:30 AM	**0**	**2**	**20**	**19**	***41***	**0**	**0**	**1**	**6**	***7***	**3**	**5**	**0**	**0**	*8*
8:45 AM	**0**	**2**	**25**	**18**	***45***	**0**	**0**	**1**	**6**	***7***	**0**	**2**	**0**	**0**	***2***
Count Total	0	24	191	134	*349*	0	1	5	36	*42*	7	21	0	5	*33*
Peak Hour	**0**	**11**	**91**	**72**	***174***	**0**	**0**	**3**	**18**	***21***	**4**	**10**	**0**	**0**	***14***

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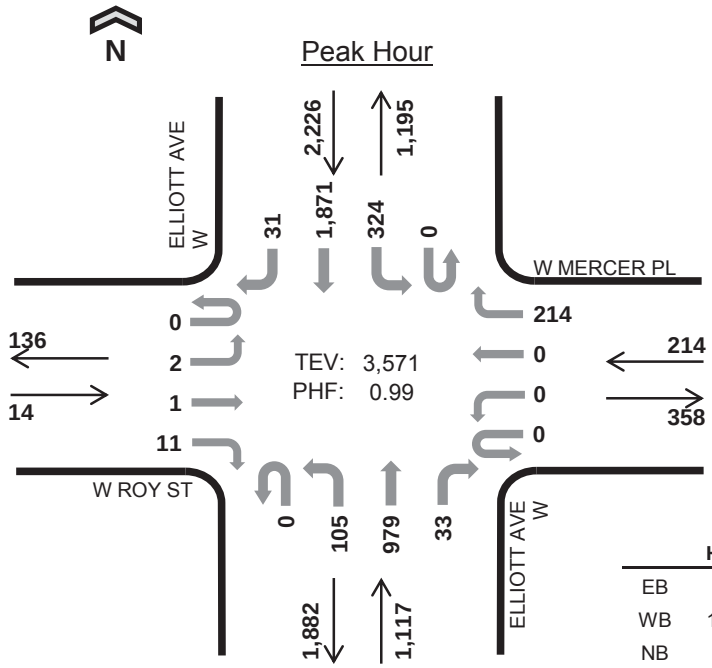
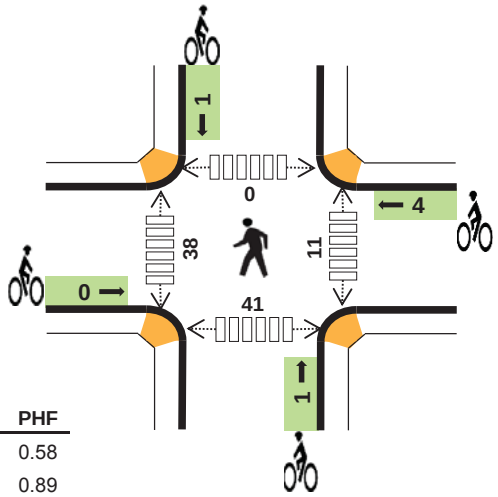
ELLIOTT AVE W
W MERCER PL

Date: Thu, Aug 25, 2016
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:45 AM to 8:45 AM





	HV %:	PHF
EB	0.0%	0.58
WB	11.7%	0.89
NB	6.3%	0.94
SB	3.6%	0.97
TOTAL	4.9%	0.99

Two-Hour Count Summaries

Interval Start	W ROY ST Eastbound				W MERCER PL Westbound				ELLIOTT AVE W Northbound				ELLIOTT AVE W Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	1	0	0	0	0	0	40	0	9	197	10	0	68	430	9	764	0
7:15 AM	0	3	0	1	0	0	0	45	0	20	220	9	0	62	477	8	845	0
7:30 AM	0	0	0	0	0	0	0	37	0	16	235	10	0	62	471	11	842	0
7:45 AM	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**54**	**0**	**30**	**239**	**12**	**0**	**99**	**464**	**6**	**905**	3,356
8:00 AM	**0**	**1**	**0**	**5**	**0**	**0**	**0**	**46**	**0**	**25**	**243**	**9**	**0**	**64**	**460**	**8**	**861**	3,453
8:15 AM	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**60**	**0**	**30**	**226**	**6**	**0**	**81**	**488**	**6**	**899**	3,507
8:30 AM	**0**	**1**	**0**	**4**	**0**	**0**	**0**	**54**	**0**	**20**	**271**	**6**	**0**	**80**	**459**	**11**	**906**	**3,571**
8:45 AM	0	1	0	1	0	0	0	71	0	21	241	7	0	95	458	9	904	3,570
Count Total	0	7	1	13	0	0	0	407	0	171	1,872	69	0	611	3,707	68	6,926	0
Peak Hour	**0**	**2**	**1**	**11**	**0**	**0**	**0**	**214**	**0**	**105**	**979**	**33**	**0**	**324**	**1,871**	**31**	**3,571**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	0	6	22	15	*43*	0	1	0	1	*2*	0	8	0	4	*12*
7:15 AM	0	5	17	11	*33*	0	0	1	7	*8*	2	12	0	6	*20*
7:30 AM	0	4	27	22	*53*	0	0	0	6	*6*	3	12	0	15	*30*
7:45 AM	**0**	**8**	**13**	**21**	***42***	**0**	**3**	**1**	**0**	***4***	**4**	**3**	**0**	**15**	*22*
8:00 AM	**0**	**5**	**23**	**20**	***48***	**0**	**0**	**0**	**1**	***1***	**4**	**16**	**0**	**12**	*32*
8:15 AM	**0**	**7**	**14**	**18**	***39***	**0**	**0**	**0**	**0**	***0***	**0**	**6**	**0**	**2**	*8*
8:30 AM	**0**	**5**	**20**	**22**	***47***	**0**	**1**	**0**	**0**	***1***	**3**	**13**	**0**	**12**	***28***
8:45 AM	0	5	21	20	*46*	0	0	0	0	*0*	6	11	0	6	*23*
Count Total	0	45	157	149	*351*	0	5	2	15	*22*	22	81	0	72	*175*
Peak Hour	**0**	**25**	**70**	**81**	***176***	**0**	**4**	**1**	**1**	***6***	**11**	**38**	**0**	**41**	***90***

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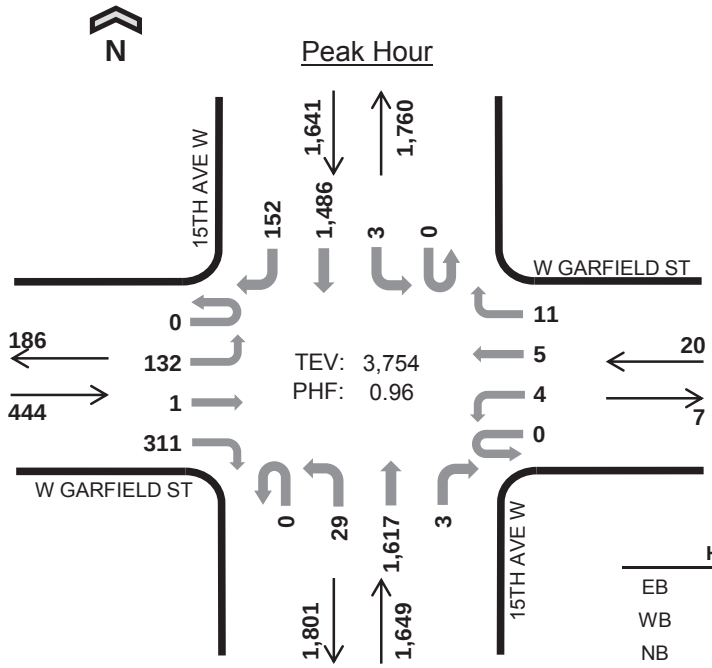
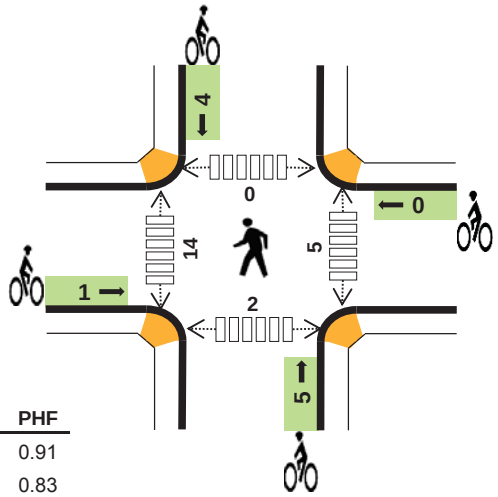
PM Counts

15TH AVE W
W GARFIELD ST



Date: Thu, Aug 25, 2016
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM



	HV %:	PHF
EB	3.6%	0.91
WB	0.0%	0.83
NB	2.1%	0.95
SB	3.9%	0.96
TOTAL	3.0%	0.96

Two-Hour Count Summaries

Interval Start	W GARFIELD ST Eastbound				W GARFIELD ST Westbound				15TH AVE W Northbound				15TH AVE W Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**29**	**0**	**93**	**0**	**1**	**1**	**4**	**0**	**10**	**358**	**3**	**0**	**0**	**397**	**31**	**927**	0
4:15 PM	**0**	**29**	**0**	**80**	**0**	**1**	**2**	**3**	**0**	**8**	**422**	**0**	**0**	**1**	**380**	**38**	**964**	0
4:30 PM	**0**	**32**	**1**	**73**	**0**	**2**	**1**	**2**	**0**	**3**	**431**	**0**	**0**	**1**	**386**	**41**	**973**	0
4:45 PM	**0**	**42**	**0**	**65**	**0**	**0**	**1**	**2**	**0**	**8**	**406**	**0**	**0**	**1**	**323**	**42**	**890**	**3,754**
5:00 PM	0	49	0	61	0	0	2	0	0	5	361	0	0	1	309	44	832	3,659
5:15 PM	0	30	3	74	0	0	6	0	0	6	442	1	0	0	312	60	934	3,629
5:30 PM	0	46	0	48	0	0	0	0	0	5	351	0	0	0	282	50	782	3,438
5:45 PM	0	31	0	85	0	0	1	0	0	4	375	1	0	0	305	46	848	3,396
Count Total	0	288	4	579	0	4	14	11	0	49	3,146	5	0	4	2,694	352	7,150	0
Peak Hour	**0**	**132**	**1**	**311**	**0**	**4**	**5**	**11**	**0**	**29**	**1,617**	**3**	**0**	**3**	**1,486**	**152**	**3,754**	**0**

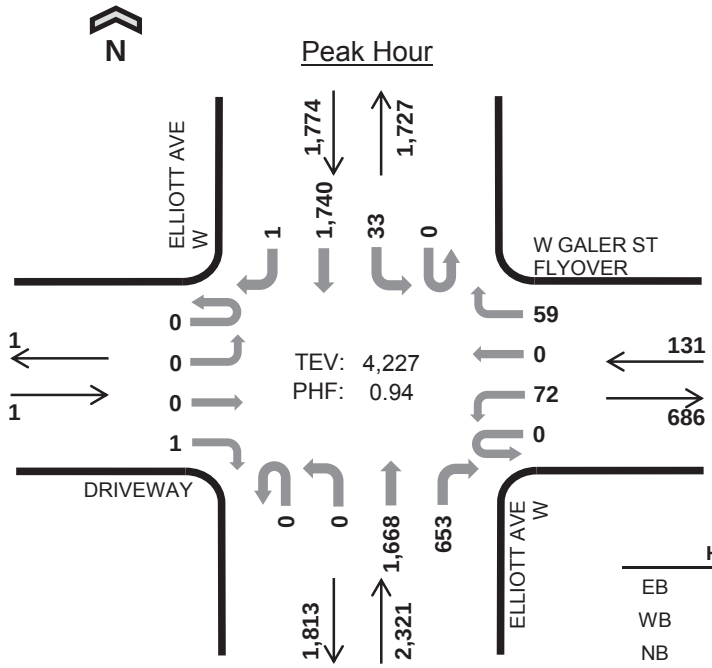
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

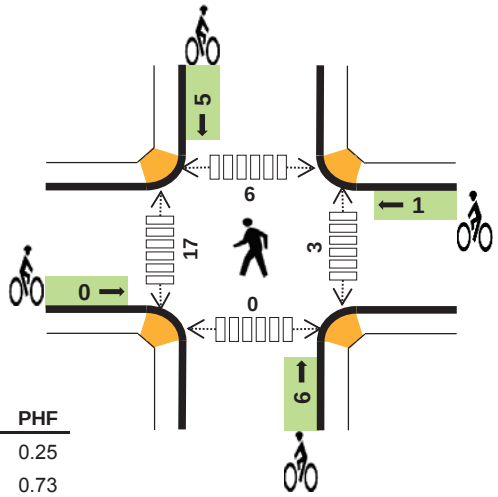
Interval Start	Heavy Vehicle Totals EB	WB	NB	SB	Total	Bicycles EB	WB	NB	SB	Total	Pedestrians (Crossing Leg) East	West	North	South	Total
4:00 PM	**4**	**0**	**11**	**14**	***29***	**0**	**0**	**0**	**1**	***1***	**0**	**7**	**0**	**1**	*8*
4:15 PM	**6**	**0**	**8**	**15**	***29***	**0**	**0**	**0**	**0**	***0***	**1**	**2**	**0**	**0**	*3*
4:30 PM	**4**	**0**	**5**	**18**	***27***	**0**	**0**	**5**	**3**	***8***	**2**	**4**	**0**	**1**	*7*
4:45 PM	**2**	**0**	**10**	**17**	***29***	**1**	**0**	**0**	**0**	***1***	**2**	**1**	**0**	**0**	***3***
5:00 PM	2	0	8	9	*19*	0	0	1	2	*3*	1	1	0	0	*2*
5:15 PM	2	0	11	14	*27*	0	0	1	0	*1*	0	3	0	0	*3*
5:30 PM	5	0	5	14	*24*	1	0	1	3	*5*	0	2	0	0	*2*
5:45 PM	2	0	11	12	*25*	0	0	1	0	*1*	0	2	0	0	*2*
Count Total	27	0	69	113	*209*	2	0	9	9	*20*	6	22	0	2	*30*
Peak Hour	**16**	**0**	**34**	**64**	***114***	**1**	**0**	**5**	**4**	***10***	**5**	**14**	**0**	**2**	***21***

Mark Skaggs: (425) 250-0777 mark.skaggs@idaxdata.com

ELLIOTT AVE W
W GALER ST FLYOVER

Date: Thu, Aug 25, 2016
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM





	HV %:	PHF
EB	0.0%	0.25
WB	7.6%	0.73
NB	1.7%	0.91
SB	4.3%	0.92
TOTAL	3.0%	0.94

Two-Hour Count Summaries

Interval Start	DRIVEWAY				W GALER ST FLYOVER				ELLIOTT AVE W				ELLIOTT AVE W				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**0**	**0**	**1**	**0**	**26**	**0**	**19**	**0**	**0**	**384**	**133**	**0**	**7**	**475**	**0**	**1,045**	0
4:15 PM	**0**	**0**	**0**	**0**	**0**	**29**	**0**	**16**	**0**	**0**	**429**	**181**	**0**	**13**	**457**	**0**	**1,125**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**11**	**0**	**0**	**403**	**154**	**0**	**5**	**441**	**1**	**1,027**	0
4:45 PM	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**13**	**0**	**0**	**452**	**185**	**0**	**8**	**367**	**0**	**1,030**	**4,227**
5:00 PM	0	0	0	0	0	8	0	4	0	0	391	158	0	8	405	0	974	4,156
5:15 PM	0	0	0	1	0	2	0	15	1	0	437	225	0	8	367	0	1,056	4,087
5:30 PM	0	0	0	0	0	4	0	9	0	0	365	216	0	10	357	0	961	4,021
5:45 PM	0	0	0	0	0	11	0	5	0	0	423	203	0	8	388	0	1,038	4,029
Count Total	0	0	0	2	0	97	0	92	1	0	3,284	1,455	0	67	3,257	1	8,256	0
Peak Hour	**0**	**0**	**0**	**1**	**0**	**72**	**0**	**59**	**0**	**0**	**1,668**	**653**	**0**	**33**	**1,740**	**1**	**4,227**	**0**

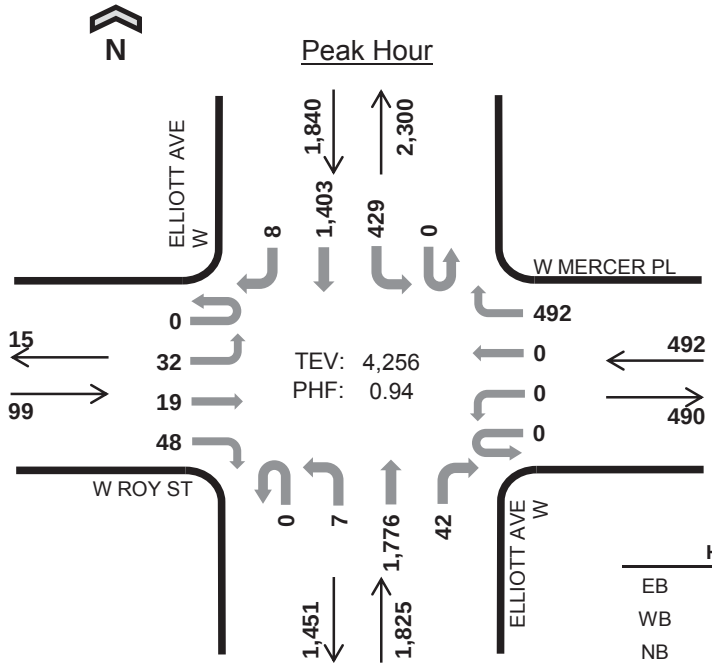
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

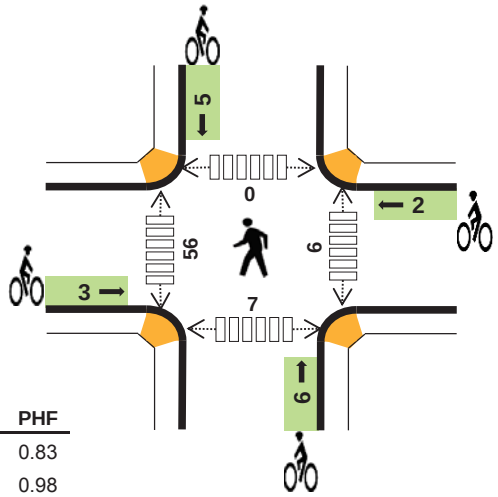
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	**0**	**6**	**15**	**16**	***37***	**0**	**0**	**0**	**1**	***1***	**0**	**4**	**0**	**0**	*4*
4:15 PM	**0**	**1**	**6**	**24**	***31***	**0**	**1**	**2**	**2**	***5***	**1**	**4**	**1**	**0**	*6*
4:30 PM	**0**	**1**	**8**	**21**	***30***	**0**	**0**	**2**	**2**	***4***	**1**	**7**	**4**	**0**	*12*
4:45 PM	**0**	**2**	**11**	**15**	***28***	**0**	**0**	**2**	**0**	***2***	**1**	**2**	**1**	**0**	***4***
5:00 PM	0	0	14	14	*28*	0	1	3	2	*6*	3	2	1	0	*6*
5:15 PM	0	1	12	13	*26*	1	0	4	1	*6*	3	5	1	0	*9*
5:30 PM	0	0	13	17	*30*	0	1	4	0	*5*	3	1	0	0	*4*
5:45 PM	0	1	13	16	*30*	0	0	0	2	*2*	5	10	2	0	*17*
Count Total	0	12	92	136	*240*	1	3	17	10	*31*	17	35	10	0	*62*
Peak Hour	**0**	**10**	**40**	**76**	***126***	**0**	**1**	**6**	**5**	***12***	**3**	**17**	**6**	**0**	***26***

Mark Skaggs: (425) 250-0777 mark.skaggs@idaxdata.com

ELLIOTT AVE W
W MERCER PL

Date: Thu, Aug 25, 2016
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM





	HV %:	PHF
EB	0.0%	0.83
WB	2.8%	0.98
NB	1.6%	0.91
SB	4.0%	0.92
TOTAL	2.8%	0.94

Two-Hour Count Summaries

Interval Start	W ROY ST Eastbound				W MERCER PL Westbound				ELLIOTT AVE W Northbound				ELLIOTT AVE W Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**5**	**6**	**15**	**0**	**0**	**0**	**118**	**0**	**1**	**387**	**8**	**0**	**71**	**395**	**1**	**1,007**	0
4:15 PM	**0**	**6**	**5**	**9**	**0**	**0**	**0**	**122**	**0**	**2**	**479**	**8**	**0**	**85**	**417**	**0**	**1,133**	0
4:30 PM	**0**	**15**	**5**	**10**	**0**	**0**	**0**	**126**	**0**	**3**	**416**	**17**	**0**	**148**	**325**	**2**	**1,067**	0
4:45 PM	**0**	**6**	**3**	**14**	**0**	**0**	**0**	**126**	**0**	**1**	**494**	**9**	**0**	**125**	**266**	**5**	**1,049**	**4,256**
5:00 PM	0	15	5	4	0	0	0	133	0	0	413	11	0	103	286	5	975	4,224
5:15 PM	0	10	5	7	0	0	0	146	0	3	473	13	0	117	288	1	1,063	4,154
5:30 PM	0	10	0	4	0	0	0	135	1	0	477	10	0	69	268	2	976	4,063
5:45 PM	0	9	0	9	0	0	0	118	0	2	477	6	0	74	289	2	986	4,000
Count Total	0	76	29	72	0	0	0	1,024	1	12	3,616	82	0	792	2,534	18	8,256	0
Peak Hour	**0**	**32**	**19**	**48**	**0**	**0**	**0**	**492**	**0**	**7**	**1,776**	**42**	**0**	**429**	**1,403**	**8**	**4,256**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	**0**	**3**	**12**	**15**	***30***	**2**	**0**	**0**	**1**	***3***	**2**	**13**	**0**	**0**	*15*
4:15 PM	**0**	**3**	**4**	**21**	***28***	**0**	**1**	**2**	**1**	***4***	**0**	**13**	**0**	**2**	*15*
4:30 PM	**0**	**3**	**7**	**18**	***28***	**1**	**0**	**2**	**3**	***6***	**2**	**18**	**0**	**4**	*24*
4:45 PM	**0**	**5**	**7**	**20**	***32***	**0**	**1**	**2**	**0**	***3***	**2**	**12**	**0**	**1**	***15***
5:00 PM	0	5	9	12	*26*	0	2	1	0	*3*	4	27	0	3	*34*
5:15 PM	0	2	9	18	*29*	1	3	4	1	*9*	5	6	0	2	*13*
5:30 PM	0	7	7	16	*30*	1	0	2	1	*4*	2	14	0	4	*20*
5:45 PM	0	3	8	15	*26*	1	2	2	0	*5*	1	19	0	7	*27*
Count Total	0	31	63	135	*229*	6	9	15	7	*37*	18	122	0	23	*163*
Peak Hour	**0**	**14**	**30**	**74**	***118***	**3**	**2**	**6**	**5**	***16***	**6**	**56**	**0**	**7**	***69***

Appendix B: Level of Service Definitions

Highway Capacity Manual, 2000

Signalized intersection level of service (LOS) is defined in terms of the average total vehicle delay of all movements through an intersection. Vehicle delay is a method of quantifying several intangible factors, including driver discomfort, frustration, and lost travel time. Specifically, LOS criteria are stated in terms of average delay per vehicle during a specified time period (for example, the PM peak hour). Vehicle delay is a complex measure based on many variables, including signal phasing (i.e., progression of movements through the intersection), signal cycle length, and traffic volumes with respect to intersection capacity. The Table below shows LOS criteria for signalized intersections, as described in the *Highway Capacity Manual* (Transportation Research Board, Special Report 209, 2000).

Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (sec/veh)	General Description (Signalized Intersections)
A	≤10	Free Flow
B	>10 - 20	Stable Flow (slight delays)
C	>20 - 35	Stable flow (acceptable delays)
D	>35 - 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 - 80	Unstable flow (intolerable delay)
F	>80	Forced flow (jammed)

Source: *Highway Capacity Manual*, Transportation Research Board, Special Report 209, 2000.

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop-controlled and two-way stop-controlled. All-way, stop-controlled intersection LOS is expressed in terms of the average vehicle delay of all of the movements, much like that of a signalized intersection. Two-way, stop-controlled intersection LOS is defined in terms of the average vehicle delay of an individual movement(s). This is because the performance of a two-way, stop-controlled intersection is more closely reflected in terms of its individual movements, rather than its performance overall. For this reason, LOS for a two-way, stop-controlled intersection is defined in terms of its individual movements. With this in mind, total average vehicle delay (i.e., average delay of all movements) for a two-way, stop-controlled intersection should be viewed with discretion. Table 2 shows LOS criteria for unsignalized intersections (both all-way and two-way, stop-controlled).

Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (sec/veh)
A	0 - 10
B	>10 - 15
C	>15 - 25
D	>25 - 35
E	>35 - 50
F	>50

Source: *Highway Capacity Manual*, Transportation Research Board, Special Report 209, 2000.

Appendix C: Intersection Operations Level of Service Reports

2016 – Existing

HCM Signalized Intersection Capacity Analysis
1: 15th & W Garfield St

11/30/2016

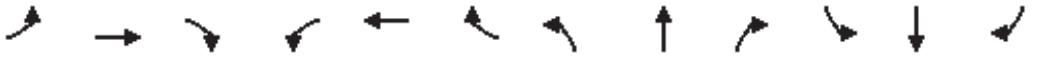
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	5	750	5	5	0	15	820	5	15	1520	75
Future Volume (vph)	85	5	750	5	5	0	15	820	5	15	1520	75
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	12	12	12	12	11	10	12	11	10	12
Grade (%)		-7%			0%			-1%			0%	
Total Lost time (s)		4.5	4.5		4.5		4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.99		1.00		1.00	1.00	0.95	1.00	1.00	0.91
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00	1.00	0.99	1.00	1.00
Frt		1.00	0.85		1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.95	1.00		0.98		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1715	1619		1852		1624	3135	1421	1663	3240	1415
Flt Permitted		0.73	1.00		0.89		0.14	1.00	1.00	0.32	1.00	1.00
Satd. Flow (perm)		1312	1619		1684		232	3135	1421	561	3240	1415
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	89	5	781	5	5	0	16	854	5	16	1583	78
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	1	0	0	12
Lane Group Flow (vph)	0	94	781	0	10	0	16	854	4	16	1583	66
Confl. Peds. (#/hr)	1		1	1		1	12		6	6		12
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	8%	8%	8%	4%	4%	4%
Turn Type	Perm	NA	custom	Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4	4		4			2			2	
Permitted Phases	4		2	4			2		2	2		2
Actuated Green, G (s)		15.9	131.0		15.9		115.1	115.1	115.1	115.1	115.1	115.1
Effective Green, g (s)		15.9	131.0		15.9		115.1	115.1	115.1	115.1	115.1	115.1
Actuated g/C Ratio		0.11	0.94		0.11		0.82	0.82	0.82	0.82	0.82	0.82
Clearance Time (s)		4.5	4.5		4.5		4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		2.0	2.0		2.0		1.0	1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)		149	1619		191		190	2577	1168	461	2663	1163
v/s Ratio Prot			0.05					0.27			c0.49	
v/s Ratio Perm		c0.07	0.43		0.01		0.07		0.00	0.03		0.05
v/c Ratio		0.63	0.48		0.05		0.08	0.33	0.00	0.03	0.59	0.06
Uniform Delay, d1		59.2	0.5		55.3		2.4	3.0	2.2	2.3	4.3	2.3
Progression Factor		1.00	1.00		1.00		0.01	0.02	0.00	1.00	1.00	1.00
Incremental Delay, d2		6.2	0.1		0.0		0.8	0.3	0.0	0.1	1.0	0.1
Delay (s)		65.5	0.6		55.4		0.8	0.4	0.0	2.4	5.3	2.4
Level of Service		E	A		E		A	A	A	A	A	A
Approach Delay (s)		7.6			55.4			0.4			5.2	
Approach LOS		A			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	104.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	875	265	40	2265	20	20
Future Volume (vph)	875	265	40	2265	20	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	10	13	9	10	14	16
Total Lost time (s)	5.5	5.0	5.0	5.5	5.0	5.0
Lane Util. Factor	0.95	1.00	1.00	0.91	0.97	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3120	1545	1577	4700	2918	1430
Flt Permitted	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3120	1545	1577	4700	2918	1430
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	902	273	41	2335	21	21
RTOR Reduction (vph)	0	82	0	0	0	19
Lane Group Flow (vph)	902	191	41	2335	21	2
Confl. Peds. (#/hr)		4	4			
Heavy Vehicles (%)	8%	8%	3%	3%	28%	28%
Turn Type	NA	custom	Prot	NA	Prot	Perm
Protected Phases	1	4 7	2	1 2	4	
Permitted Phases						4
Actuated Green, G (s)	97.8	83.7	16.0	119.3	10.7	10.7
Effective Green, g (s)	97.8	83.7	16.0	119.3	10.7	10.7
Actuated g/C Ratio	0.70	0.60	0.11	0.85	0.08	0.08
Clearance Time (s)	5.5		5.0		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	2179	923	180	4005	223	109
v/s Ratio Prot	0.29	c0.12	0.03	c0.50	0.01	
v/s Ratio Perm						0.00
v/c Ratio	0.41	0.21	0.23	0.58	0.09	0.01
Uniform Delay, d1	8.9	12.9	56.4	3.0	60.1	59.8
Progression Factor	0.27	1.37	0.93	0.53	1.00	1.00
Incremental Delay, d2	0.5	0.1	0.5	0.2	0.2	0.1
Delay (s)	2.9	17.7	53.0	1.8	60.3	59.8
Level of Service	A	B	D	A	E	E
Approach Delay (s)	6.3			2.7	60.1	
Approach LOS	A			A	E	

Intersection Summary			
HCM 2000 Control Delay	4.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.5
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	5	10	0	0	215	105	980	35	325	1870	30
Future Volume (vph)	5	5	10	0	0	215	105	980	35	325	1870	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	10	12	10	10	12
Grade (%)		5%			0%			1%			0%	
Total Lost time (s)		4.5				4.0	5.5	4.5	4.5	5.5	4.5	4.5
Lane Util. Factor		1.00				1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		0.84				1.00	1.00	1.00	0.97	1.00	1.00	0.87
Flpb, ped/bikes		1.00				1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.93				0.86	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99				1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1431				1467	1694	3163	1468	3143	3037	1346
Flt Permitted		0.99				1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1431				1467	1694	3163	1468	3143	3037	1346
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	5	5	10	0	0	217	106	990	35	328	1889	30
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	19	0	0	9
Lane Group Flow (vph)	0	10	0	0	0	217	106	990	16	328	1889	21
Confl. Peds. (#/hr)			41	41			38		11	11		38
Heavy Vehicles (%)	0%	0%	0%	12%	12%	12%	6%	6%	6%	4%	4%	4%
Parking (#/hr)											5	
Turn Type	Split	NA				Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	3	3					5	2		1 4	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)		4.5				140.0	12.2	65.5	65.5	55.5	99.3	99.3
Effective Green, g (s)		4.5				140.0	12.2	65.5	65.5	52.0	99.3	99.3
Actuated g/C Ratio		0.03				1.00	0.09	0.47	0.47	0.37	0.71	0.71
Clearance Time (s)		4.5					5.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)		3.0					0.2	0.2	0.2		0.2	0.2
Lane Grp Cap (vph)		45				1467	147	1479	686	1167	2154	954
v/s Ratio Prot		0.01					c0.06	0.31		c0.10	c0.62	
v/s Ratio Perm						c0.15			0.01			0.02
v/c Ratio		0.23				0.15	0.72	0.67	0.02	0.28	0.88	0.02
Uniform Delay, d1		66.1				0.0	62.2	28.9	20.0	30.9	15.7	6.0
Progression Factor		1.00				1.00	1.00	1.00	1.00	0.94	0.95	1.00
Incremental Delay, d2		2.6				0.2	13.7	2.4	0.1	0.1	4.5	0.0
Delay (s)		68.7				0.2	75.9	31.3	20.1	29.2	19.4	6.0
Level of Service		E				A	E	C	C	C	B	A
Approach Delay (s)		68.7			0.2			35.1			20.6	
Approach LOS		E			A			D			C	

Intersection Summary			
HCM 2000 Control Delay	24.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	5	310	5	5	10	29	1617	3	5	1485	150
Future Volume (vph)	130	5	310	5	5	10	29	1617	3	5	1485	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	12	12	12	12	11	10	12	11	10	12
Grade (%)		-7%			0%			-1%			0%	
Total Lost time (s)		4.5	4.0		4.5		4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00	0.95	1.00	1.00	0.90
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		0.93		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.95	1.00		0.99		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1684	1574		1748		1719	3320	1514	1678	3240	1398
Flt Permitted		0.72	1.00		0.94		0.14	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)		1269	1574		1657		247	3320	1514	200	3240	1398
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	135	5	323	5	5	10	30	1684	3	5	1547	156
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	1	0	0	25
Lane Group Flow (vph)	0	140	323	0	11	0	30	1684	2	5	1547	131
Confl. Peds. (#/hr)			2	2			14		5	5		14
Heavy Vehicles (%)	4%	4%	4%	0%	0%	0%	2%	2%	2%	4%	4%	4%
Turn Type	Perm	NA	Free	Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			4			2			2	
Permitted Phases	4		Free	4			2		2	2		2
Actuated Green, G (s)		19.8	140.0		19.8		111.2	111.2	111.2	111.2	111.2	111.2
Effective Green, g (s)		19.8	140.0		19.8		111.2	111.2	111.2	111.2	111.2	111.2
Actuated g/C Ratio		0.14	1.00		0.14		0.79	0.79	0.79	0.79	0.79	0.79
Clearance Time (s)		4.5			4.5		4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		2.0			2.0		1.0	1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)		179	1574		234		196	2637	1202	158	2573	1110
v/s Ratio Prot								c0.51			0.48	
v/s Ratio Perm		c0.11	0.21		0.01		0.12		0.00	0.02		0.09
v/c Ratio		0.78	0.21		0.05		0.15	0.64	0.00	0.03	0.60	0.12
Uniform Delay, d1		58.0	0.0		52.0		3.4	6.0	3.0	3.0	5.7	3.3
Progression Factor		1.00	1.00		1.00		0.05	0.03	0.00	1.00	1.00	1.00
Incremental Delay, d2		18.3	0.3		0.0		0.1	0.1	0.0	0.4	1.0	0.2
Delay (s)		76.3	0.3		52.0		0.3	0.3	0.0	3.4	6.7	3.5
Level of Service		E	A		D		A	A	A	A	A	A
Approach Delay (s)		23.3			52.0			0.3			6.4	
Approach LOS		C			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	5.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBL2	SBL	NWR	NWR2	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	35	1740	1670	655	70	60
Future Volume (vph)	35	1740	1670	655	70	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	9	10	10	13	14	16
Total Lost time (s)	5.0	5.5	5.5	5.0	5.0	5.0
Lane Util. Factor	1.00	0.97	0.88	1.00	0.97	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	0.85	1.00	0.85
Flt Protected	0.95	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1562	3143	2601	1632	3458	1656
Flt Permitted	0.95	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1562	3143	2601	1632	3458	1656
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor (vph)	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	37	1851	1777	697	74	64
RTOR Reduction (vph)	0	0	0	22	0	57
Lane Group Flow (vph)	37	1851	1777	675	74	7
Confl. Peds. (#/hr)	3			3		6
Heavy Vehicles (%)	4%	4%	2%	2%	8%	8%
Turn Type	Prot	Prot	Over	pt+ov	Prot	Perm
Protected Phases	2	1 2	1	4 7	4	
Permitted Phases				2		4
Actuated Green, G (s)	17.0	113.9	91.4	129.5	16.1	16.1
Effective Green, g (s)	17.0	113.9	91.4	129.5	16.1	16.1
Actuated g/C Ratio	0.12	0.81	0.65	0.92	0.12	0.12
Clearance Time (s)	5.0		5.5		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	189	2557	1698	1567	397	190
v/s Ratio Prot	0.02	c0.59	c0.68	c0.35	0.02	
v/s Ratio Perm				0.07		0.00
v/c Ratio	0.20	0.72	1.05	0.43	0.19	0.04
Uniform Delay, d1	55.3	5.9	24.3	0.7	56.0	55.1
Progression Factor	0.89	0.68	0.33	1.16	1.00	1.00
Incremental Delay, d2	2.0	1.6	30.6	0.1	0.2	0.1
Delay (s)	51.0	5.6	38.7	0.9	56.3	55.2
Level of Service	D	A	D	A	E	E
Approach Delay (s)		6.5	28.0		55.7	
Approach LOS		A	C		E	

Intersection Summary			
HCM 2000 Control Delay	19.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.5
Intersection Capacity Utilization	81.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	SEL	SET	SER	NWL	NWT	NWR	NEL	NER	NER2
Lane Configurations											
Traffic Volume (vph)	0	490	430	1405	10	5	1775	40	30	20	50
Future Volume (vph)	0	490	430	1405	10	5	1775	40	30	20	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	12	12	10	12	12	12	12
Grade (%)	0%			0%			1%		5%		
Total Lost time (s)		4.0	5.5	4.5	4.5	5.5	4.5	4.5	4.5		
Lane Util. Factor		1.00	0.97	0.95	1.00	1.00	0.95	1.00	1.00		
Frpb, ped/bikes		1.00	1.00	1.00	0.81	1.00	1.00	0.98	0.96		
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Frt		0.86	1.00	1.00	0.85	1.00	1.00	0.85	0.91		
Flt Protected		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.99		
Satd. Flow (prot)		1596	3143	3037	1262	1761	3287	1540	1588		
Flt Permitted		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.99		
Satd. Flow (perm)		1596	3143	3037	1262	1761	3287	1540	1588		
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	0	521	457	1495	11	5	1888	43	32	21	53
RTOR Reduction (vph)	0	0	0	0	4	0	0	17	101	0	0
Lane Group Flow (vph)	0	521	457	1495	7	5	1888	26	5	0	0
Confl. Peds. (#/hr)			6		56	56		6			7
Heavy Vehicles (%)	3%	3%	4%	4%	4%	2%	2%	2%	0%	0%	0%
Parking (#/hr)				5							
Turn Type		Free	Prot	NA	Perm	Prot	NA	Perm	Prot		
Protected Phases			1 4	6		5	2		3		
Permitted Phases		Free			6			2	3		
Actuated Green, G (s)		140.0	32.9	90.1	90.1	1.0	86.1	86.1	6.5		
Effective Green, g (s)		140.0	29.4	90.1	90.1	1.0	86.1	86.1	6.5		
Actuated g/C Ratio		1.00	0.21	0.64	0.64	0.01	0.61	0.61	0.05		
Clearance Time (s)				4.5	4.5	5.5	4.5	4.5	4.5		
Vehicle Extension (s)				0.2	0.2	0.2	0.2	0.2	3.0		
Lane Grp Cap (vph)		1596	660	1954	812	12	2021	947	73		
v/s Ratio Prot			c0.15	0.49		0.00	c0.57		0.00		
v/s Ratio Perm		c0.33			0.01			0.02			
v/c Ratio		0.33	0.69	0.77	0.01	0.42	0.93	0.03	0.07		
Uniform Delay, d1		0.0	51.1	17.5	8.9	69.2	24.4	10.6	63.9		
Progression Factor		1.00	0.88	1.44	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2		0.5	1.8	2.1	0.0	8.3	9.6	0.1	0.4		
Delay (s)		0.5	46.8	27.3	9.0	77.5	33.9	10.6	64.2		
Level of Service		A	D	C	A	E	C	B	E		
Approach Delay (s)	0.5			31.8			33.5		64.2		
Approach LOS	A			C			C		E		

Intersection Summary			
HCM 2000 Control Delay	29.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		

2016 – One Cruise Call

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	95	0	783	0	0	0	15	858	5	15	1553	83
Future Volume (vph)	95	0	783	0	0	0	15	858	5	15	1553	83
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	12	12	12	12	11	10	12	11	10	12
Grade (%)		-7%			0%			-1%			0%	
Total Lost time (s)		4.5	4.5				4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	1.00				1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.99				1.00	1.00	0.95	1.00	1.00	0.91
Flpb, ped/bikes		1.00	1.00				1.00	1.00	1.00	0.99	1.00	1.00
Frt		1.00	0.85				1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.95	1.00				0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1706	1619				1624	3135	1421	1664	3240	1415
Flt Permitted		0.76	1.00				0.13	1.00	1.00	0.31	1.00	1.00
Satd. Flow (perm)		1360	1619				221	3135	1421	536	3240	1415
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	99	0	816	0	0	0	16	894	5	16	1618	86
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	1	0	0	13
Lane Group Flow (vph)	0	99	816	0	0	0	16	894	4	16	1618	73
Confl. Peds. (#/hr)	1		1	1		1	12		6	6		12
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	8%	8%	8%	4%	4%	4%
Turn Type	Perm	NA	custom				Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4	4		4			2			2	
Permitted Phases	4		2	4			2		2	2		2
Actuated Green, G (s)		16.2	131.0				114.8	114.8	114.8	114.8	114.8	114.8
Effective Green, g (s)		16.2	131.0				114.8	114.8	114.8	114.8	114.8	114.8
Actuated g/C Ratio		0.12	0.94				0.82	0.82	0.82	0.82	0.82	0.82
Clearance Time (s)		4.5	4.5				4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		2.0	2.0				1.0	1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)		157	1619				181	2570	1165	439	2656	1160
v/s Ratio Prot			c0.06					0.29			c0.50	
v/s Ratio Perm		0.07	0.45				0.07		0.00	0.03		0.05
v/c Ratio		0.63	0.50				0.09	0.35	0.00	0.04	0.61	0.06
Uniform Delay, d1		59.0	0.5				2.4	3.2	2.3	2.3	4.5	2.4
Progression Factor		1.00	1.00				0.05	0.05	0.00	1.00	1.00	1.00
Incremental Delay, d2		5.9	0.1				0.9	0.3	0.0	0.2	1.1	0.1
Delay (s)		65.0	0.6				1.0	0.5	0.0	2.5	5.6	2.5
Level of Service		E	A				A	A	A	A	A	A
Approach Delay (s)		7.6			0.0			0.5			5.4	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	99.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	875	390	73	2298	131	58
Future Volume (vph)	875	390	73	2298	131	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	10	13	9	10	14	16
Total Lost time (s)	5.5	5.0	5.0	5.5	5.0	5.0
Lane Util. Factor	0.95	1.00	1.00	0.91	0.97	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3120	1545	1577	4700	2918	1430
Flt Permitted	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3120	1545	1577	4700	2918	1430
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	902	402	75	2369	135	60
RTOR Reduction (vph)	0	120	0	0	0	53
Lane Group Flow (vph)	902	282	75	2369	135	8
Confl. Peds. (#/hr)		4	4			
Heavy Vehicles (%)	8%	8%	3%	3%	28%	28%
Turn Type	NA	custom	Prot	NA	Prot	Perm
Protected Phases	1	4 7	2	1 2	4	
Permitted Phases						4
Actuated Green, G (s)	91.0	83.7	16.0	112.5	17.5	17.5
Effective Green, g (s)	91.0	83.7	16.0	112.5	17.5	17.5
Actuated g/C Ratio	0.65	0.60	0.11	0.80	0.12	0.12
Clearance Time (s)	5.5		5.0		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	2028	923	180	3776	364	178
v/s Ratio Prot	0.29	0.18	0.05	c0.50	c0.05	
v/s Ratio Perm						0.01
v/c Ratio	0.44	0.31	0.42	0.63	0.37	0.04
Uniform Delay, d1	12.1	13.9	57.7	5.4	56.2	53.9
Progression Factor	0.36	1.48	0.94	0.55	1.00	1.00
Incremental Delay, d2	0.5	0.1	1.3	0.3	0.6	0.1
Delay (s)	4.9	20.7	55.2	3.3	56.8	54.0
Level of Service	A	C	E	A	E	D
Approach Delay (s)	9.8			4.9	56.0	
Approach LOS	A			A	E	

Intersection Summary			
HCM 2000 Control Delay	9.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.5
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	10	0	0	232	105	1088	35	344	1995	30
Future Volume (vph)	0	0	10	0	0	232	105	1088	35	344	1995	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	10	12	10	10	12
Grade (%)		5%			0%			1%			0%	
Total Lost time (s)		4.5				4.0	5.5	4.5	4.5	5.5	4.5	4.5
Lane Util. Factor		1.00				1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		0.46				1.00	1.00	1.00	0.97	1.00	1.00	0.87
Flpb, ped/bikes		1.00				1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.86				0.86	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		1.00				1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		735				1467	1694	3163	1468	3143	3037	1346
Flt Permitted		1.00				1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		735				1467	1694	3163	1468	3143	3037	1346
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	0	0	10	0	0	234	106	1099	35	347	2015	30
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	19	0	0	8
Lane Group Flow (vph)	0	0	0	0	0	234	106	1099	16	347	2015	22
Confl. Peds. (#/hr)			41	41			38		11	11		38
Heavy Vehicles (%)	0%	0%	0%	12%	12%	12%	6%	6%	6%	4%	4%	4%
Parking (#/hr)											5	
Turn Type		NA				Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	3	3					5	2		1 4	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)		1.1				140.0	12.8	65.5	65.5	58.9	102.1	102.1
Effective Green, g (s)		1.1				140.0	12.8	65.5	65.5	55.4	102.1	102.1
Actuated g/C Ratio		0.01				1.00	0.09	0.47	0.47	0.40	0.73	0.73
Clearance Time (s)		4.5					5.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)		3.0					0.2	0.2	0.2		0.2	0.2
Lane Grp Cap (vph)		5				1467	154	1479	686	1243	2214	981
v/s Ratio Prot		0.00					c0.06	0.35		c0.11	c0.66	
v/s Ratio Perm						c0.16			0.01			0.02
v/c Ratio		0.02				0.16	0.69	0.74	0.02	0.28	0.91	0.02
Uniform Delay, d1		68.9				0.0	61.7	30.4	20.0	28.7	15.3	5.2
Progression Factor		1.00				1.00	1.00	1.00	1.00	0.99	0.95	1.00
Incremental Delay, d2		1.3				0.2	9.8	3.4	0.1	0.1	5.7	0.0
Delay (s)		70.2				0.2	71.4	33.8	20.1	28.6	20.2	5.2
Level of Service		E				A	E	C	C	C	C	A
Approach Delay (s)		70.2			0.2			36.6			21.2	
Approach LOS		E			A			D			C	

Intersection Summary			
HCM 2000 Control Delay	25.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	131	5	313	5	5	10	30	1619	5	5	1485	150
Future Volume (vph)	131	5	313	5	5	10	30	1619	5	5	1485	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	12	12	12	12	11	10	12	11	10	12
Grade (%)		-7%			0%			-1%			0%	
Total Lost time (s)		4.5	4.0		4.5		4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00	0.95	1.00	1.00	0.90
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		0.93		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.95	1.00		0.99		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1684	1574		1748		1719	3320	1514	1678	3240	1398
Flt Permitted		0.72	1.00		0.94		0.14	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)		1269	1574		1657		247	3320	1514	199	3240	1398
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	136	5	326	5	5	10	31	1686	5	5	1547	156
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	1	0	0	25
Lane Group Flow (vph)	0	141	326	0	11	0	31	1686	4	5	1547	131
Confl. Peds. (#/hr)			2	2			14		5	5		14
Heavy Vehicles (%)	4%	4%	4%	0%	0%	0%	2%	2%	2%	4%	4%	4%
Turn Type	Perm	NA	Free	Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			4			2			2	
Permitted Phases	4		Free	4			2		2	2		2
Actuated Green, G (s)		19.9	140.0		19.9		111.1	111.1	111.1	111.1	111.1	111.1
Effective Green, g (s)		19.9	140.0		19.9		111.1	111.1	111.1	111.1	111.1	111.1
Actuated g/C Ratio		0.14	1.00		0.14		0.79	0.79	0.79	0.79	0.79	0.79
Clearance Time (s)		4.5			4.5		4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		2.0			2.0		1.0	1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)		180	1574		235		196	2634	1201	157	2571	1109
v/s Ratio Prot								c0.51			0.48	
v/s Ratio Perm		c0.11	0.21		0.01		0.13		0.00	0.03		0.09
v/c Ratio		0.78	0.21		0.05		0.16	0.64	0.00	0.03	0.60	0.12
Uniform Delay, d1		58.0	0.0		51.9		3.4	6.1	3.0	3.1	5.7	3.3
Progression Factor		1.00	1.00		1.00		0.05	0.03	0.00	1.00	1.00	1.00
Incremental Delay, d2		18.3	0.3		0.0		0.2	0.1	0.0	0.4	1.1	0.2
Delay (s)		76.2	0.3		51.9		0.3	0.3	0.0	3.4	6.8	3.5
Level of Service		E	A		D		A	A	A	A	A	A
Approach Delay (s)		23.2			51.9			0.3			6.5	
Approach LOS		C			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	66.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBL2	SBL	NWR	NWR2	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	36	1743	1670	658	81	64
Future Volume (vph)	36	1743	1670	658	81	64
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	9	10	10	13	14	16
Total Lost time (s)	5.0	5.5	5.5	5.0	5.0	5.0
Lane Util. Factor	1.00	0.97	0.88	1.00	0.97	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	0.85	1.00	0.85
Flt Protected	0.95	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1562	3143	2601	1632	3458	1656
Flt Permitted	0.95	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1562	3143	2601	1632	3458	1656
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor (vph)	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	38	1854	1777	700	86	68
RTOR Reduction (vph)	0	0	0	22	0	60
Lane Group Flow (vph)	38	1854	1777	678	86	8
Confl. Peds. (#/hr)	3			3		6
Heavy Vehicles (%)	4%	4%	2%	2%	8%	8%
Turn Type	Prot	Prot	Over	pt+ov	Prot	Perm
Protected Phases	2	1 2	1	4 7	4	
Permitted Phases				2		4
Actuated Green, G (s)	17.0	113.3	90.8	129.5	16.7	16.7
Effective Green, g (s)	17.0	113.3	90.8	129.5	16.7	16.7
Actuated g/C Ratio	0.12	0.81	0.65	0.92	0.12	0.12
Clearance Time (s)	5.0		5.5		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	189	2543	1686	1567	412	197
v/s Ratio Prot	0.02	c0.59	c0.68	c0.35	0.02	
v/s Ratio Perm				0.07		0.00
v/c Ratio	0.20	0.73	1.05	0.43	0.21	0.04
Uniform Delay, d1	55.4	6.2	24.6	0.7	55.7	54.6
Progression Factor	0.89	0.66	0.34	1.16	1.00	1.00
Incremental Delay, d2	2.0	1.6	33.2	0.1	0.3	0.1
Delay (s)	51.5	5.7	41.5	0.9	55.9	54.7
Level of Service	D	A	D	A	E	D
Approach Delay (s)		6.6	30.0		55.4	
Approach LOS		A	C		E	

Intersection Summary			
HCM 2000 Control Delay	21.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.5
Intersection Capacity Utilization	82.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	SEL	SET	SER	NWL	NWT	NWR	NEL	NER	NER2
Lane Configurations											
Traffic Volume (vph)	0	491	432	1417	10	5	1777	40	30	20	50
Future Volume (vph)	0	491	432	1417	10	5	1777	40	30	20	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	12	12	10	12	12	12	12
Grade (%)	0%			0%			1%		5%		
Total Lost time (s)		4.0	5.5	4.5	4.5	5.5	4.5	4.5	4.5		
Lane Util. Factor		1.00	0.97	0.95	1.00	1.00	0.95	1.00	1.00		
Frpb, ped/bikes		1.00	1.00	1.00	0.81	1.00	1.00	0.98	0.96		
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Frt		0.86	1.00	1.00	0.85	1.00	1.00	0.85	0.91		
Flt Protected		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.99		
Satd. Flow (prot)		1596	3143	3037	1262	1761	3287	1540	1588		
Flt Permitted		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.99		
Satd. Flow (perm)		1596	3143	3037	1262	1761	3287	1540	1588		
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	0	522	460	1507	11	5	1890	43	32	21	53
RTOR Reduction (vph)	0	0	0	0	4	0	0	17	101	0	0
Lane Group Flow (vph)	0	522	460	1507	7	5	1890	26	5	0	0
Confl. Peds. (#/hr)			6		56	56		6			7
Heavy Vehicles (%)	3%	3%	4%	4%	4%	2%	2%	2%	0%	0%	0%
Parking (#/hr)				5							
Turn Type		Free	Prot	NA	Perm	Prot	NA	Perm	Prot		
Protected Phases			1 4	6		5	2		3		
Permitted Phases		Free			6			2	3		
Actuated Green, G (s)		140.0	33.0	90.0	90.0	1.0	86.0	86.0	6.5		
Effective Green, g (s)		140.0	29.5	90.0	90.0	1.0	86.0	86.0	6.5		
Actuated g/C Ratio		1.00	0.21	0.64	0.64	0.01	0.61	0.61	0.05		
Clearance Time (s)				4.5	4.5	5.5	4.5	4.5	4.5		
Vehicle Extension (s)				0.2	0.2	0.2	0.2	0.2	3.0		
Lane Grp Cap (vph)		1596	662	1952	811	12	2019	946	73		
v/s Ratio Prot			c0.15	0.50		0.00	c0.58		0.00		
v/s Ratio Perm		c0.33			0.01			0.02			
v/c Ratio		0.33	0.69	0.77	0.01	0.42	0.94	0.03	0.07		
Uniform Delay, d1		0.0	51.1	17.7	9.0	69.2	24.5	10.6	63.9		
Progression Factor		1.00	0.88	1.45	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2		0.5	1.8	2.2	0.0	8.3	9.8	0.1	0.4		
Delay (s)		0.5	46.9	27.9	9.0	77.5	34.3	10.7	64.2		
Level of Service		A	D	C	A	E	C	B	E		
Approach Delay (s)	0.5			32.2			33.8		64.2		
Approach LOS	A			C			C		E		

Intersection Summary			
HCM 2000 Control Delay	30.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		

2016 – Two Cruise Calls

HCM Signalized Intersection Capacity Analysis
1: 15th & W Garfield St

11/30/2016

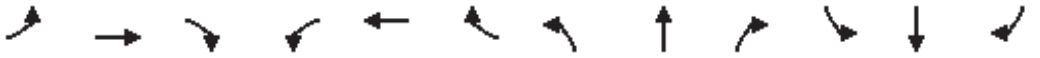
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	5	820	5	5	0	15	920	5	15	1593	93
Future Volume (vph)	105	5	820	5	5	0	15	920	5	15	1593	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	12	12	12	12	11	10	12	11	10	12
Grade (%)		-7%			0%			-1%			0%	
Total Lost time (s)		4.5	4.5		4.5		4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.99		1.00		1.00	1.00	0.95	1.00	1.00	0.91
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00	1.00	0.99	1.00	1.00
Frt		1.00	0.85		1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.95	1.00		0.98		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1714	1619		1852		1624	3135	1421	1666	3240	1415
Flt Permitted		0.73	1.00		0.89		0.12	1.00	1.00	0.28	1.00	1.00
Satd. Flow (perm)		1308	1619		1685		206	3135	1421	497	3240	1415
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	109	5	854	5	5	0	16	958	5	16	1659	97
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	1	0	0	15
Lane Group Flow (vph)	0	114	854	0	10	0	16	958	4	16	1659	82
Confl. Peds. (#/hr)	1		1	1		1	12		6	6		12
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	8%	8%	8%	4%	4%	4%
Turn Type	Perm	NA	custom	Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4	4		4			2			2	
Permitted Phases	4		2	4			2		2	2		2
Actuated Green, G (s)		17.7	131.0		17.7		113.3	113.3	113.3	113.3	113.3	113.3
Effective Green, g (s)		17.7	131.0		17.7		113.3	113.3	113.3	113.3	113.3	113.3
Actuated g/C Ratio		0.13	0.94		0.13		0.81	0.81	0.81	0.81	0.81	0.81
Clearance Time (s)		4.5	4.5		4.5		4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		2.0	2.0		2.0		1.0	1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)		165	1619		213		166	2537	1149	402	2622	1145
v/s Ratio Prot			0.07					0.31			c0.51	
v/s Ratio Perm		c0.09	0.46		0.01		0.08		0.00	0.03		0.06
v/c Ratio		0.69	0.53		0.05		0.10	0.38	0.00	0.04	0.63	0.07
Uniform Delay, d1		58.5	0.6		53.7		2.8	3.7	2.6	2.6	5.2	2.7
Progression Factor		1.00	1.00		1.00		0.11	0.08	0.03	1.00	1.00	1.00
Incremental Delay, d2		9.6	0.1		0.0		1.0	0.4	0.0	0.2	1.2	0.1
Delay (s)		68.2	0.7		53.8		1.3	0.7	0.1	2.8	6.4	2.8
Level of Service		E	A		D		A	A	A	A	A	A
Approach Delay (s)		8.7			53.8			0.7			6.2	
Approach LOS		A			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	5.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	110.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	875	537	113	2335	258	102
Future Volume (vph)	875	537	113	2335	258	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	10	13	9	10	14	16
Total Lost time (s)	5.5	5.0	5.0	5.5	5.0	5.0
Lane Util. Factor	0.95	1.00	1.00	0.91	0.97	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3120	1545	1577	4700	2918	1430
Flt Permitted	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3120	1545	1577	4700	2918	1430
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Growth Factor (vph)	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	902	554	116	2407	266	105
RTOR Reduction (vph)	0	165	0	0	0	86
Lane Group Flow (vph)	902	389	116	2407	266	19
Confl. Peds. (#/hr)		4	4			
Heavy Vehicles (%)	8%	8%	3%	3%	28%	28%
Turn Type	NA	custom	Prot	NA	Prot	Perm
Protected Phases	1	4 7	2	1 2	4	
Permitted Phases						4
Actuated Green, G (s)	83.8	83.7	16.0	105.3	24.7	24.7
Effective Green, g (s)	83.8	83.7	16.0	105.3	24.7	24.7
Actuated g/C Ratio	0.60	0.60	0.11	0.75	0.18	0.18
Clearance Time (s)	5.5		5.0		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	1867	923	180	3535	514	252
v/s Ratio Prot	0.29	0.25	0.07	c0.51	c0.09	
v/s Ratio Perm						0.01
v/c Ratio	0.48	0.42	0.64	0.68	0.52	0.07
Uniform Delay, d1	15.9	15.1	59.3	8.8	52.2	48.1
Progression Factor	0.40	1.52	0.92	0.59	1.00	1.00
Incremental Delay, d2	0.6	0.2	6.2	0.4	0.9	0.1
Delay (s)	6.9	23.3	61.0	5.6	53.1	48.2
Level of Service	A	C	E	A	D	D
Approach Delay (s)	13.1			8.2	51.7	
Approach LOS	B			A	D	

Intersection Summary			
HCM 2000 Control Delay	13.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.5
Intersection Capacity Utilization	61.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	5	10	0	0	251	105	1216	35	366	2137	30
Future Volume (vph)	5	5	10	0	0	251	105	1216	35	366	2137	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	10	12	10	10	12
Grade (%)		5%			0%			1%			0%	
Total Lost time (s)		4.5				4.0	5.5	4.5	4.5	5.5	4.5	4.5
Lane Util. Factor		1.00				1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		0.84				1.00	1.00	1.00	0.97	1.00	1.00	0.87
Flpb, ped/bikes		1.00				1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.93				0.86	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99				1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1431				1467	1694	3163	1468	3143	3037	1346
Flt Permitted		0.99				1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1431				1467	1694	3163	1468	3143	3037	1346
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	5	5	10	0	0	254	106	1228	35	370	2159	30
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	19	0	0	9
Lane Group Flow (vph)	0	10	0	0	0	254	106	1228	16	370	2159	21
Confl. Peds. (#/hr)			41	41			38		11	11		38
Heavy Vehicles (%)	0%	0%	0%	12%	12%	12%	6%	6%	6%	4%	4%	4%
Parking (#/hr)											5	
Turn Type	Split	NA				Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	3	3					5	2		1 4	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)		4.5				140.0	12.2	65.5	65.5	55.5	99.3	99.3
Effective Green, g (s)		4.5				140.0	12.2	65.5	65.5	52.0	99.3	99.3
Actuated g/C Ratio		0.03				1.00	0.09	0.47	0.47	0.37	0.71	0.71
Clearance Time (s)		4.5					5.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)		3.0					0.2	0.2	0.2		0.2	0.2
Lane Grp Cap (vph)		45				1467	147	1479	686	1167	2154	954
v/s Ratio Prot		0.01					c0.06	0.39		c0.12	c0.71	
v/s Ratio Perm						c0.17			0.01			0.02
v/c Ratio		0.23				0.17	0.72	0.83	0.02	0.32	1.00	0.02
Uniform Delay, d1		66.1				0.0	62.2	32.4	20.0	31.3	20.4	6.0
Progression Factor		1.00				1.00	1.00	1.00	1.00	0.97	1.05	1.00
Incremental Delay, d2		2.6				0.3	13.7	5.6	0.1	0.1	17.3	0.0
Delay (s)		68.7				0.3	75.9	38.0	20.1	30.5	38.8	6.0
Level of Service		E				A	E	D	C	C	D	A
Approach Delay (s)		68.7			0.3			40.4			37.2	
Approach LOS		E			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	36.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.1%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	131	5	314	5	5	10	30	1620	5	5	1487	151
Future Volume (vph)	131	5	314	5	5	10	30	1620	5	5	1487	151
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	12	12	12	12	11	10	12	11	10	12
Grade (%)		-7%			0%			-1%			0%	
Total Lost time (s)		4.5	4.0		4.5		4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00	0.95	1.00	1.00	0.90
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		0.93		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.95	1.00		0.99		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1684	1574		1748		1719	3320	1514	1678	3240	1398
Flt Permitted		0.72	1.00		0.94		0.14	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)		1269	1574		1657		246	3320	1514	199	3240	1398
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	136	5	327	5	5	10	31	1688	5	5	1549	157
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	1	0	0	25
Lane Group Flow (vph)	0	141	327	0	11	0	31	1688	4	5	1549	132
Confl. Peds. (#/hr)			2	2			14		5	5		14
Heavy Vehicles (%)	4%	4%	4%	0%	0%	0%	2%	2%	2%	4%	4%	4%
Turn Type	Perm	NA	Free	Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			4			2			2	
Permitted Phases	4		Free	4			2		2	2		2
Actuated Green, G (s)		19.9	140.0		19.9		111.1	111.1	111.1	111.1	111.1	111.1
Effective Green, g (s)		19.9	140.0		19.9		111.1	111.1	111.1	111.1	111.1	111.1
Actuated g/C Ratio		0.14	1.00		0.14		0.79	0.79	0.79	0.79	0.79	0.79
Clearance Time (s)		4.5			4.5		4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		2.0			2.0		1.0	1.0	1.0	1.0	1.0	1.0
Lane Grp Cap (vph)		180	1574		235		195	2634	1201	157	2571	1109
v/s Ratio Prot								c0.51			0.48	
v/s Ratio Perm		c0.11	0.21		0.01		0.13		0.00	0.03		0.09
v/c Ratio		0.78	0.21		0.05		0.16	0.64	0.00	0.03	0.60	0.12
Uniform Delay, d1		58.0	0.0		51.9		3.4	6.1	3.0	3.1	5.7	3.3
Progression Factor		1.00	1.00		1.00		0.05	0.04	0.00	1.00	1.00	1.00
Incremental Delay, d2		18.3	0.3		0.0		0.2	0.1	0.0	0.4	1.1	0.2
Delay (s)		76.2	0.3		51.9		0.3	0.3	0.0	3.4	6.8	3.5
Level of Service		E	A		D		A	A	A	A	A	A
Approach Delay (s)		23.2			51.9			0.3			6.5	
Approach LOS		C			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	66.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBL2	SBL	NWR	NWR2	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	37	1744	1670	664	83	65
Future Volume (vph)	37	1744	1670	664	83	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	9	10	10	13	14	16
Total Lost time (s)	5.0	5.5	5.5	5.0	5.0	5.0
Lane Util. Factor	1.00	0.97	0.88	1.00	0.97	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	0.85	1.00	0.85
Flt Protected	0.95	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1562	3143	2601	1632	3458	1656
Flt Permitted	0.95	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1562	3143	2601	1632	3458	1656
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor (vph)	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	39	1855	1777	706	88	69
RTOR Reduction (vph)	0	0	0	22	0	61
Lane Group Flow (vph)	39	1855	1777	684	88	8
Confl. Peds. (#/hr)	3			3		6
Heavy Vehicles (%)	4%	4%	2%	2%	8%	8%
Turn Type	Prot	Prot	Over	pt+ov	Prot	Perm
Protected Phases	2	1 2	1	4 7	4	
Permitted Phases				2		4
Actuated Green, G (s)	17.0	112.8	90.3	129.5	17.2	17.2
Effective Green, g (s)	17.0	112.8	90.3	129.5	17.2	17.2
Actuated g/C Ratio	0.12	0.81	0.64	0.92	0.12	0.12
Clearance Time (s)	5.0		5.5		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	189	2532	1677	1567	424	203
v/s Ratio Prot	0.02	c0.59	c0.68	c0.35	0.03	
v/s Ratio Perm				0.07		0.01
v/c Ratio	0.21	0.73	1.06	0.44	0.21	0.04
Uniform Delay, d1	55.4	6.4	24.9	0.7	55.3	54.1
Progression Factor	0.89	0.64	0.34	1.16	1.00	1.00
Incremental Delay, d2	2.1	1.7	35.3	0.1	0.2	0.1
Delay (s)	51.7	5.8	43.7	0.9	55.5	54.2
Level of Service	D	A	D	A	E	D
Approach Delay (s)		6.7	31.5		54.9	
Approach LOS		A	C		D	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.5
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	SEL	SET	SER	NWL	NWT	NWR	NEL	NER	NER2
Lane Configurations											
Traffic Volume (vph)	0	491	432	1420	10	5	1783	40	30	20	50
Future Volume (vph)	0	491	432	1420	10	5	1783	40	30	20	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	12	12	10	12	12	12	12
Grade (%)	0%			0%			1%		5%		
Total Lost time (s)		4.0	5.5	4.5	4.5	5.5	4.5	4.5	4.5		
Lane Util. Factor		1.00	0.97	0.95	1.00	1.00	0.95	1.00	1.00		
Frpb, ped/bikes		1.00	1.00	1.00	0.81	1.00	1.00	0.98	0.96		
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Frt		0.86	1.00	1.00	0.85	1.00	1.00	0.85	0.91		
Flt Protected		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.99		
Satd. Flow (prot)		1596	3143	3037	1262	1761	3287	1540	1588		
Flt Permitted		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.99		
Satd. Flow (perm)		1596	3143	3037	1262	1761	3287	1540	1588		
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor (vph)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Adj. Flow (vph)	0	522	460	1511	11	5	1897	43	32	21	53
RTOR Reduction (vph)	0	0	0	0	4	0	0	17	101	0	0
Lane Group Flow (vph)	0	522	460	1511	7	5	1897	26	5	0	0
Confl. Peds. (#/hr)			6		56	56		6			7
Heavy Vehicles (%)	3%	3%	4%	4%	4%	2%	2%	2%	0%	0%	0%
Parking (#/hr)				5							
Turn Type		Free	Prot	NA	Perm	Prot	NA	Perm	Prot		
Protected Phases			1 4	6		5	2		3		
Permitted Phases		Free			6			2	3		
Actuated Green, G (s)		140.0	33.0	90.0	90.0	1.0	86.0	86.0	6.5		
Effective Green, g (s)		140.0	29.5	90.0	90.0	1.0	86.0	86.0	6.5		
Actuated g/C Ratio		1.00	0.21	0.64	0.64	0.01	0.61	0.61	0.05		
Clearance Time (s)				4.5	4.5	5.5	4.5	4.5	4.5		
Vehicle Extension (s)				0.2	0.2	0.2	0.2	0.2	3.0		
Lane Grp Cap (vph)		1596	662	1952	811	12	2019	946	73		
v/s Ratio Prot			c0.15	0.50		0.00	c0.58		0.00		
v/s Ratio Perm		c0.33			0.01			0.02			
v/c Ratio		0.33	0.69	0.77	0.01	0.42	0.94	0.03	0.07		
Uniform Delay, d1		0.0	51.1	17.8	9.0	69.2	24.6	10.6	63.9		
Progression Factor		1.00	0.88	1.48	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2		0.5	1.8	2.2	0.0	8.3	10.1	0.1	0.4		
Delay (s)		0.5	46.8	28.6	9.0	77.5	34.7	10.7	64.2		
Level of Service		A	D	C	A	E	C	B	E		
Approach Delay (s)	0.5			32.7			34.3		64.2		
Approach LOS	A			C			C		E		

Intersection Summary			
HCM 2000 Control Delay	30.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		