430 IACC Building – Fargo, ND 58105
Tel 701-231-8058 – Fax 701-231-1945
www.ugpti.org – www.atacenter.org

Washington St. & Ash Coulee Dr./43rd Ave Intersection Study

Final Report

April 2007

Prepared for:
City of Bismarck, ND

Prepared by:
Advanced Traffic Analysis Center
Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

Introduction

The intersection of Washington St. and Ash Coulee Dr./43rd Ave is located in the northern part of Bismarck, which is experiencing significant development. In recent years, several requests have been made to the City Commission to install a traffic signal at this location in an effort to alleviate traffic congestion and safety issues. The concerns are primarily related to traffic conditions during Horizon Middle School (HMS) start and dismissal times. Horizon Middle School is located approximately half a mile to the west of Washington St. on the north side of Ash Coulee Dr., and has an enrollment of approximately 600 students. The City of Bismarck contacted the Advanced Traffic Analysis Center (ATAC) to evaluate the intersection of Washington St. and Ash Coulee Dr./43rd Ave.

Both Washington St. and 43rd Ave. are classified as minor arterials with average daily traffic (ADT) of 5,051 and 3,282 vehicles per day, respectively. Washington St. is a 2-lane roadway, with left-turn lanes for both the southbound and northbound approaches at the intersection (Figure 1). Ash Coulee Dr./43rd Ave is a 2-lane roadway which composes the minor approaches at the intersection. Ash Coulee Dr. is located to the west of the intersection and is currently the only access road for the residential development in the area around HMS. The west approach (Ash Coulee Dr.) consists of a through/left-turn lane and a right-turn lane, while the east approach (43rd Ave.) consists of one lane for through, left, and right-turning traffic. The posted speed limits at the intersection are 35 mph (N-S) and 25 mph (E-W).

The intersection of Washington St. and Ash Coulee/43rd Ave. has been evaluated by the City of Bismarck in the past, but no significant deficiencies were identified. Although a traffic signal has not been warranted for this intersection based on previous traffic counts and studies, it was requested that ATAC conduct a thorough evaluation to determine if and when a signal would be warranted. The main tasks included in this study include the following:

- data collection (turning movement counts for vehicular and pedestrian traffic for a 16-hour period)
- data analysis (delay study for the AM and PM peaks)
- traffic signal warrant analysis
- delay time comparisons between two-way stop, 4-way stop, and signalized control
- traffic signal analysis using future road network and land development
- summary of the results and recommendations

Figure 1. Washington St. & Ash Coulee Dr./43rd Ave. Aerial Photo (2006)

Traffic Data

Traffic data were collected at the intersection on Wednesday, February 7, 2007, from 6:00 AM to 10:00 PM using ATAC's Traffic Data Collection System (TDCS). The system consists of a 6'x10' cargo trailer that houses a 42-foot pneumatic, extendable mast. Two pan-tilt-zoom cameras are mounted on the top of the mast and are connected to a video recording/processing unit in the trailer. The intersection was recorded for 16 hours, and the videotapes were processed in the ATAC lab.

Turning movement counts were gathered for the intersection for the entire 16-hour period. A delay study was also conducted for the AM and PM peak hours. Additional vehicle movements during the PM peak were videotaped and photographed to supplement the TDCS data.

Data were collected mid-week to capture the average weekday traffic patterns. This time period was chosen to obtain the majority of the daily traffic movements at the

intersection. Two previous counts were conducted at the intersection in the spring and fall of 2006. The new count data were compared with previous counts at the intersection in order to identify any potential trends in traffic growth and to verify the peak hour volumes.

Overall, traffic volumes observed at the intersection were similar to previous count data, as shown in Figure 2. The AM and PM peak hour volumes were almost identical among the three counts, as were the times in which they occurred. Both the AM peak (7:15 – 8:15) and the PM peak (3:15 – 4:15) appeared to consist primarily of school traffic. Figure 2 illustrates the correlation among the three traffic counts at this intersection.

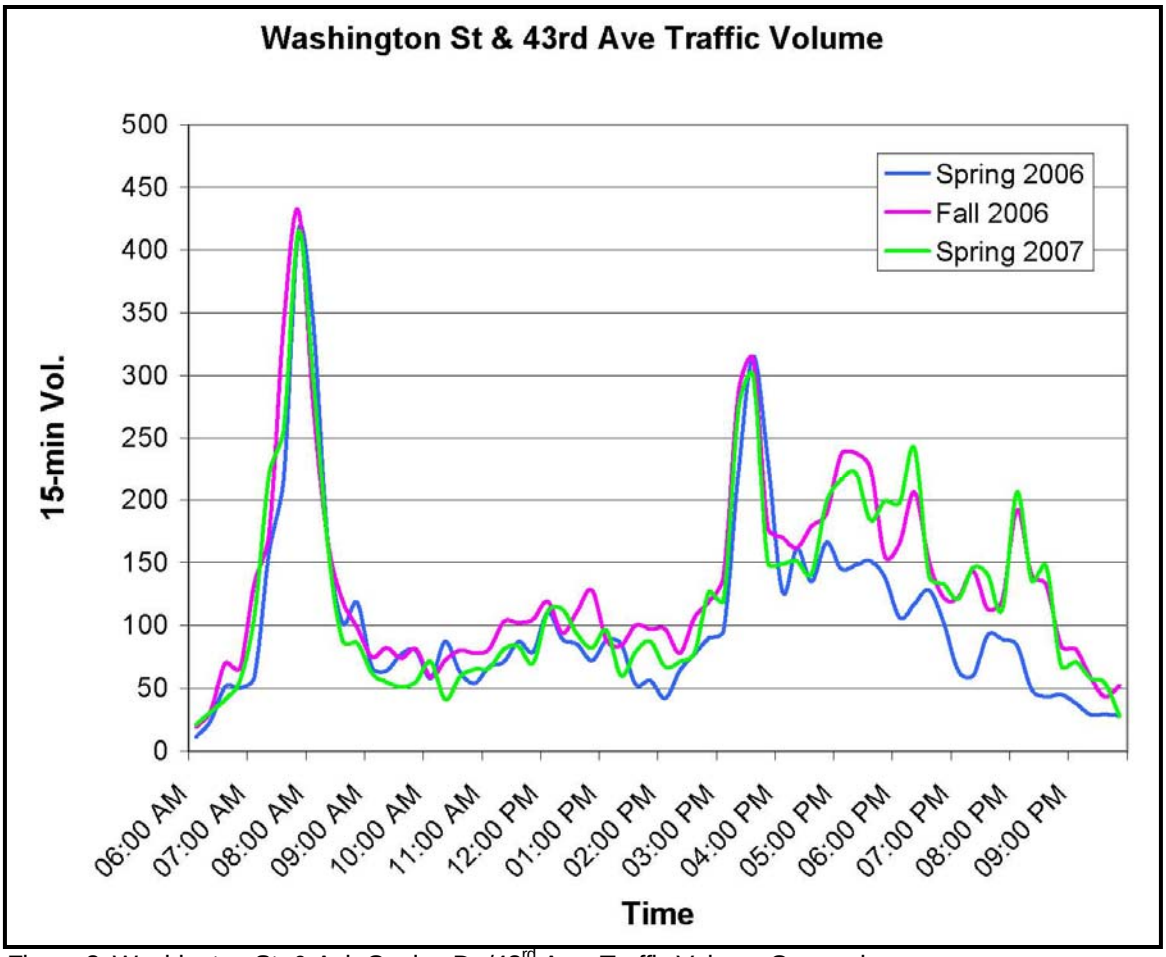


Figure 2. Washington St. & Ash Coulee Dr./43rd Ave. Traffic Volume Comparison

Traffic patterns at this intersection reflect the movement of vehicles to and from the development to the west of the intersection and south toward the city of Bismarck. The two highest turning movement volumes for the 16-hour count at the intersection are for the northbound left (1,265 vehicles), and the eastbound right (1,222 vehicles). The eastbound right-turn movement makes up 69% of the vehicle movements at the

eastbound approach. A summary of the turning movement volumes for each approach and the corresponding percentage is shown in Table 1.

Table 1. Daily Traffic Volume Summary

Washington St. & Ash Coulee Dr./43rd Ave. Traffic Volumes					
Northbound Approach 3359 Total			Southbound Approach 1439 Total		
Left	Through	Right	Left	Through	Right
1265 38%	1158 34%	936 28%	108 8%	1178 82%	153 11%
Eastbound Approach 1764 Total			Westbound Approach 1354 Total		
Left	Through	Right	Left	Through	Right
74 4%	468 27%	1222 69%	795 59%	449 33%	110 8%

Traffic Signal Warrant Criteria

It is a popular misconception that the installation of a traffic signal will always improve the operation of an intersection. The most common arguments for the placement of a traffic signal are safety and delay. Traffic signals can reduce the number of broadside and left-turn accidents, but in many cases the number of rear-end accidents increase. In addition, an un-warranted signal may actually increase the overall delay incurred at an intersection.

The Manual on Uniform Traffic Control Devices (MUTCD), which is developed by the Federal Highway Administration (FHWA), serves as the standard for justifying the installation of traffic signals. The MUTCD specifies that an engineering study of the traffic conditions, pedestrian movements, and physical characteristics of an intersection be performed based on eight factors pertaining to the existing operation and safety of an intersection. These eight factors (warrants) are as follows:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing
- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network

Although at least one warrant needs to be met to justify installing a traffic signal, there is a caveat in the MUTCD guidelines which states that the satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal. The MUTCD does not present the warrant criteria as absolutes. Many sections of the MUTCD refer to engineering judgment and how the traffic and intersection data is interpreted.

As a result, along with the warrants, the MUTCD provides additional guidance on traffic signal installations, such as:

1) traffic control signals should not be installed unless one or more of the warrants are met,
2) traffic control signals should not be installed unless an engineering study indicates that installing a traffic control signal will improve the overall safety and/or operation of the intersection, and
3) traffic control signals should not be installed if they will seriously disrupt progressive traffic flow.

Vehicle Delay Analysis

A delay analysis was conducted during both the AM and PM peak hours to determine the intersection's level of performance. The delay was calculated for both the eastbound and westbound approaches using the Traffic Tracker program. This program allows users to timestamp vehicle movements. Each vehicle during the peak hour was time-stamped when it stopped at the stop sign or at the end of a queue, and again when it moved through the intersection. Subtracting the time stamp data provides the stop delay time for each vehicle. The delay times for the eastbound approach were separated into movements due to the presence of a right-turn lane. This allowed for a more detailed analysis of the delay experienced by the right-turn traffic. The summary of the delay for both the eastbound and westbound approaches is illustrated in the following table.

Table 2. Ash Coulee Dr./43rd Ave. Delay Calculation Summary

Intersection Approach		Eastbound		Westbound	
Peak Period		AM	PM	AM	PM
Number of Vehicles		435	325	60	92
(sec/veh)	Minimum Delay	1	2	1	1
	Maximum Delay	50	73	199	64
	Average Delay	13.9	22.7	27.2	13.7
	1st Quartile	5	11	4	4
	2nd Quartile	11	18	9	8
	3rd Quartile	20	29	24	19

The highest delay time was experienced during the AM peak for the westbound approach, and during the PM peak for the eastbound approach. Average delays during the peak hours range from 13.7 seconds/vehicle to 27.2 seconds/vehicle for both approaches. Another important finding from the statistical analysis of the delay study can be seen from the quartile values. For the case of the westbound AM peak, where the maximum delay incurred by a vehicle was 199 seconds, 75% of the vehicles had a delay of 24 seconds or less. The same can be seen for the eastbound PM peak where 75% of vehicles experienced a delay of 29 seconds or

less. When plotting the delay time for the two highest-delay approaches, the WB approach had 10 vehicles with a delay time of 60 seconds or higher, while the EB approach had 15 vehicles (less than 4.6% of the traffic during the PM peak) with delay times of 60 seconds or higher (Figures 3 and 4).
In addition, the recorded delay time for each vehicle during the peak hours was graphed to show the variation in delay for the eastbound and westbound approaches. The graphs, which can be seen in Appendix D, illustrate how the excessive delay times are concentrated within the peak hour.

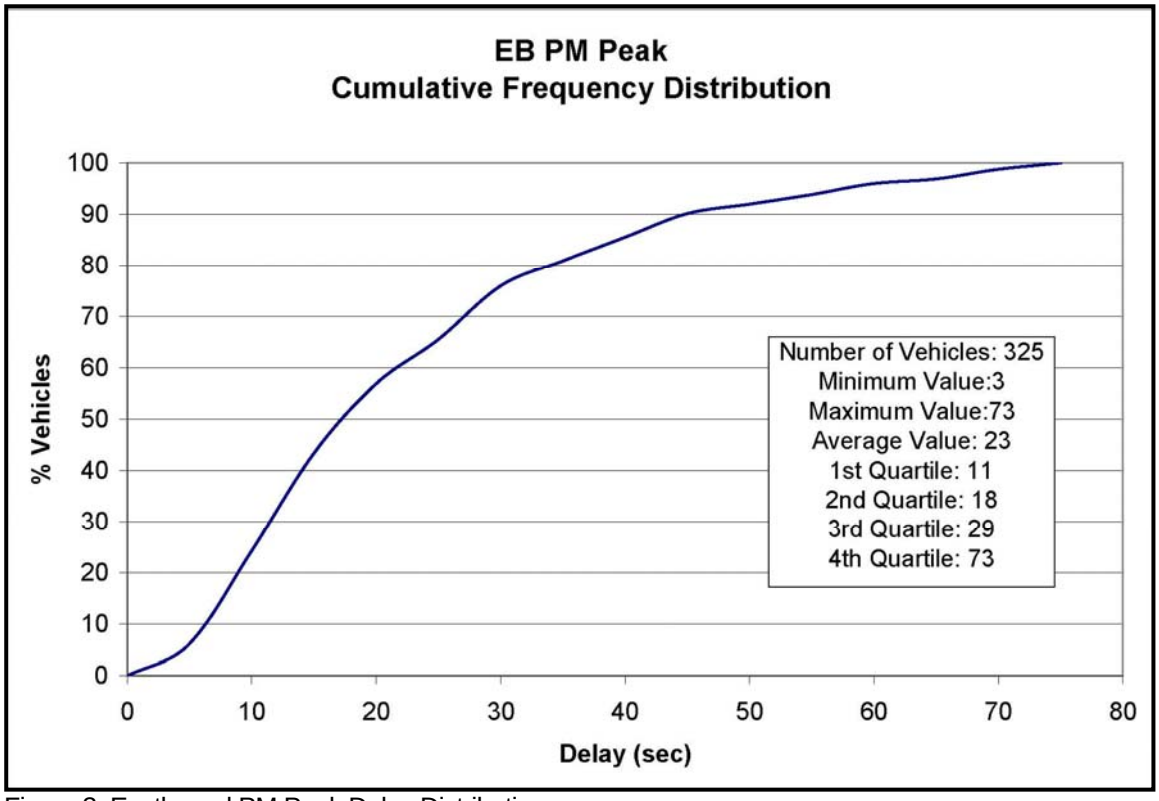


Figure 3. Eastbound PM Peak Delay Distribution

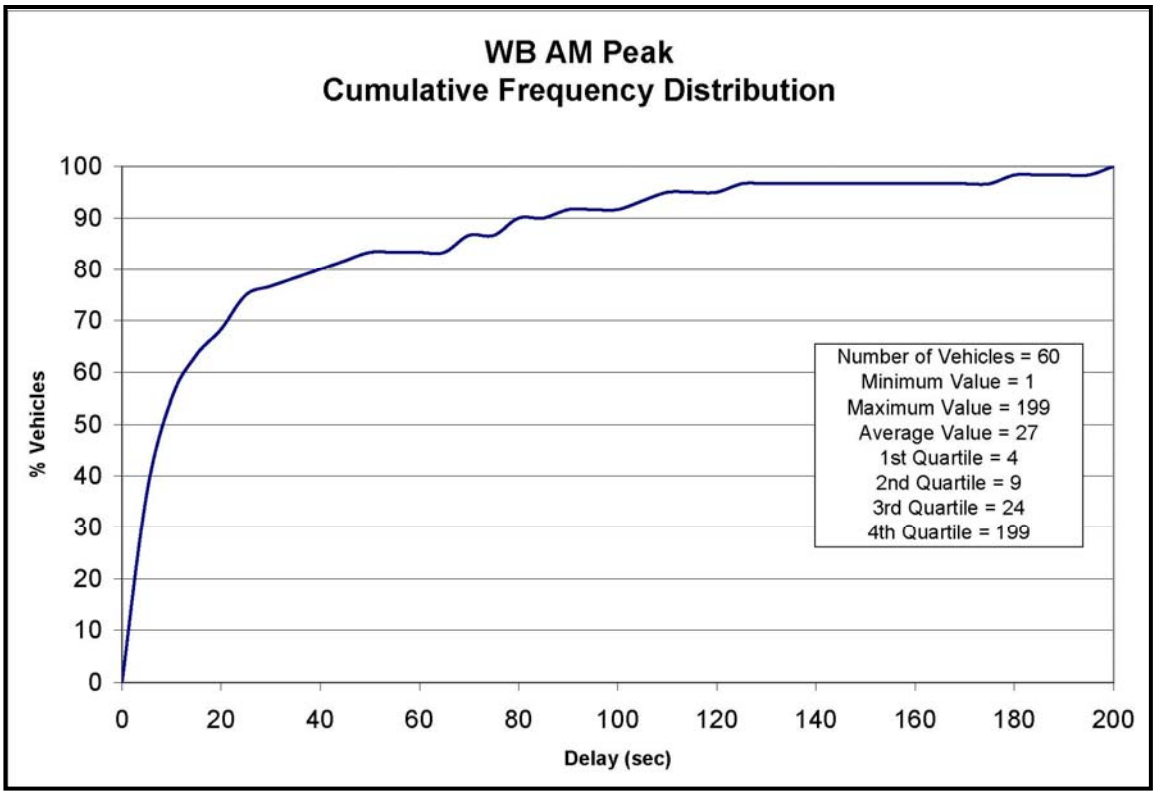


Figure 4. Westbound AM Peak Delay Distribution

Another delay time comparison was performed to evaluate the intersection performance under 2-way stop, 4-way stop, and signalized control. The hourly peak volumes obtained from the traffic counts were entered into Synchro, an intersection/corridor traffic analysis tool. Using the existing geometric and operational characteristics such as turning lane length, number of lanes, and speed limit the intersection control was changed to determine the delay time impacts (Tables 3 and 4).

Table 3. Intersection Delay Comparison Using Various Traffic Control

Description	Intersection Control Delay (sec/veh)	Intersection Control Delay (veh-hr)
2-way stop	6.6	16.8
Signalized	7.8	19.0
4-way stop	8.4	20.0

Note: Delay based on a 16-hour time period.

Table 4. Approach Delay Comparison Using Various Traffic Control

Washington St. & Ash Coulee Dr./43rd Ave.						
	2-way stop		4-way stop		Signalized	
Approach	sec/veh	veh-hr	sec/veh	veh-hr	sec/veh	veh-hr
Northbound	2.4	2.7	8.5	8.3	4.9	5.0
Southbound	0.7	0.2	7.9	3.5	11.0	5.3
Eastbound	10.8	6.9	9.1	4.8	6.9	3.9
Westbound	15.9	6.9	8.4	3.4	11.4	4.8

Note: Delay based on a 16-hour time period.

It can be seen from the delay comparison (Table 3) that the current 2-way stop control has the lowest intersection delay among the three types of control, while the 4-way stop control experienced the highest intersection delay. It should be noted that the delay time for the east and west approach is only high during a short period of time for the AM and PM peak periods. Although the delay time for the east and west approach is reduced when the intersection control is changed from a 2-way stop to a signalized intersection, the delay time for the north and south approaches is significantly increased (Table 4).

The actual delay time for each case will be larger than what is shown in the tables since the input volume for Synchro is evenly distributed over the entire hour. However, the conditions at this intersection illustrate that the vehicle volume is not evenly distributed over the hour. Intersections located close to schools experience a relatively short 5-10 minute interval in which there is a large influx of vehicles. This time period is when the highest delay occurs (in one case it was in excess of three minutes for the westbound approach).

Crash Data Summary

Crash data collected from the intersection were obtained from the City of Bismarck and analyzed to determine the deficiencies in intersection control. According to the North Dakota Department of Transportation there have been seven crashes at this intersection since 2002. Two types of crashes were documented for this intersection: right angle and left turn (Table 5).

One of the criteria for the consideration of a signal at an intersection is the occurrence of 5 or more reported crashes of types susceptible to correction by a traffic signal within a 12-month period. Two of the seven crashes that occurred at this intersection (10/6/2004 and 12/2/2004) involved northbound and southbound drivers. In both cases, the northbound driver attempted to make a left turn and did not see the southbound vehicle approaching. These two crashes were not likely correctable by a signal. Since 2 crashes occurred in 2006, the crash criteria is not met.

Table 5. Intersection Crash Data

Washington St. & Ash Coulee Dr./43rd Ave. Crash Data*		
Date	Approach	Type
8/19/2002	East	Right Angle
9/13/2002	South	Right Angle
10/6/2004	North	Left Turn
12/2/2004	South	Left Turn
12/3/2004	West	Right Angle
3/14/2006	West	Right Angle
12/15/2006	West	Left Turn

*Need a minimum of 5 relevant crashes in a 12-month period

Signal Warrant Analysis

The traffic signal warrant study was conducted as specified in Chapter 4C of the 2003 MUTCD. As mentioned previously, there are eight warrants to consider when evaluating the placement of a traffic signal at an intersection.

Due to the lack of pedestrian movements at this intersection, Warrants 4 and 5 were not applicable to this study. In addition, Warrant 6 was not applicable due to the isolated nature of this intersection. Therefore, only Warrants 1-3 and 7-8 were used for this evaluation.

At this time none of the warrants were met for the intersection. The only warrant coming close to being met was Warrant 3, which deals with peak hour traffic. This warrant can only be used in certain situations where large amounts of traffic are attracted or discharged over a short time period. Typically this type of traffic behavior is seen at office complexes, commercial facilities, and industrial developments. In this case, the close proximity of HMS justifies the use of Warrant 3 due to the similar characteristics as the examples listed above. During the analysis of Warrant 3, the eastbound approach was aggregated to one lane, due to the large amount of traffic and the queuing that was observed. This queuing resulted from the insufficient capacity of the right-turn lane.

Several guidelines are outlined in the MUTCD which refer to approach geometry involving a through lane and a turn lane on the minor street. Site specific traffic characteristics dictate whether an approach should be considered as one lane or two lanes, and engineering judgment is necessary in such cases. The MUTCD states that in the case of a minor approach with one lane plus a right turn lane, the degree of conflict between the minor-street right turn traffic and the major street traffic should be considered. The right turn traffic should not be considered in the minor-street volume if the movement enters the major street with minimal conflict. The approach should be evaluated as a one-lane approach with only the traffic from the through/left-turn lane considered. However, the MUTCD also states that the minor approach should be considered two lanes if approximately half of the traffic on the approach turns right and the right turn lane is of sufficient length to accommodate all of the right turn vehicles.

Since it was observed that right turn traffic queues past the right turn lane on the eastbound approach during peak periods, the approach was considered as having one lane. However, not all of the right turning traffic was disregarded during the peak hour. The right-turn vehicles that impeded vehicles on the through lane were included in the volume for Warrant 3. During the AM and PM peak periods, 337 (77%) and 129 (40%) vehicles were disregarded during the warrant analysis, respectively.

All-Way-Stop Warrant

Using the current traffic volumes and delay times for the intersection, a 4-way stop is also not warranted at this time (see Table 6). However, the MUTCD states that other criteria may be considered in an engineering study. One of the criteria states that a multiway stop should be considered at an intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multiway stop control would improve traffic operation characteristics of the intersection.

Table 6. All-Way-Stop Warrant

8-Highest Hours	Major Street Volume (both approaches >300)	Minor Street Volume (both approaches >200)	Highest-Hour Delay (AM) (>30 sec/veh)
7:00 - 8:00	594	410	16
17:00 - 18:00	513	258	
15:00 - 16:00	445	150	
18:00 - 19:00	442	143	
16:00 - 17:00	396	399	
8:00 - 9:00	378	243	
12:00 - 13:00	249	270	
14:00 - 15:00	200	161	

Intersection Geometry Evaluation

One of the primary factors impacting intersection operations is the roadway geometry at the intersection. Modifying the geometry at an intersection can help reduce delay and improve safety. Improving site distance can significantly reduce the number of crashes because drivers have more reaction time. The number of lanes also affects the capacity of an intersection. Adding turning lanes can greatly reduce the delay incurred at an approach.

The City of Bismarck has received several complaints from drivers about the perceived safety and delay problems at the intersection. During the site visit by ATAC, traffic movements were observed particularly during the peak hours. There clearly was an issue with regard to the intersection geometry for the eastbound approach. Although there is a dedicated right turn lane at this approach, its capacity, specifically during the peak hours, is inadequate for the number of vehicles making the right turn. The length of the right-turn bay was estimated to be approximately 80-feet, with a corresponding capacity of about 4 vehicles.

This limited capacity causes the right-turn traffic, which normally has no significant impact on delays at a stop sign, to queue past the turning bay onto the eastbound through lane.

The delay at the eastbound approach of the intersection was analyzed using a microscopic traffic simulation program to demonstrate the effect of increasing the capacity of the right-turn lane. The average delay for the volume within the peak 15-minute interval during the PM peak hour on the eastbound approach was calculated to be 23.7 sec/veh from the manual analysis. The network was calibrated to the existing conditions based on the 15-minute interval and 30 simulation runs were conducted to get an average value for the control delay on the eastbound approach. The average delay obtained from the 30 simulation runs was 24.1 sec/veh, which was comparable to the value obtained from the manual delay analysis. The right-turn lane was then increased by 50% and 75% in the simulation network to determine the reduction in delay for the approach. The 50% increase creates 120-feet of storage, which reduced delay by 15%. The delay times calculated from the simulation program showed that increasing the right-turn bay length by 75% to create approximately 140-feet of storage, reduced the approach control delay by about 35%. Further increase in right-turn storage length had minimal delay time savings so a storage length of approximately 150-feet should be sufficient when considering delay time.

Future Traffic Projections

The traffic projections for this study were obtained using Bismarck/Mandan's travel demand model. Growth factors were calculated using the projected model volumes between 2008 and 2030. The 2008 network includes additional roadways such as Valley Dr., Amber Glow Dr., and Medora Ave. In addition, the 2008 network used the projected number of households for the area (Appendix A). The 2030 network used the projected road network and households, and constitutes a full-build scenario. These roadways are the key routes that will impact traffic movements throughout the area. The growth factors found from the model are shown in Table 7.

Table 7. Growth Factors (2008 - 2030)

Approach	Growth Factor
Northbound	4.1%
Southbound	1.8%
Eastbound	4.5%
Westbound	7.0%

The 2008 network assumes that the proposed roadways are in place in the vicinity of the intersection of Washington St. and Ash Coulee Dr./43rd St. These additional routes will have a significant impact on traffic patterns through the intersection. The projected volumes for 2008 are 8,882 vehicles per day (vpd) through the intersection. The 2007 volumes at the intersection are approximately 8,333 vpd. This estimation was based on the 16-hour count at the intersection, assuming that the 16-hour count

was 95% of the daily traffic. Although the overall intersection volume is projected to increase by 7% in the next year, the approaches will see a shift in turning movements. The eastbound approach, which is the critical approach at this intersection, will see an overall increase in volume of 58% by 2008. However, right-turn traffic at this approach will decrease due to the addition of Valley Dr., which provides access to the south. Current approach volumes illustrate that 69% of eastbound vehicles are making a right-turn. Future traffic projections show that only 30% of eastbound vehicles will be making a right-turn. Since a majority of the school trips make an eastbound right-turn, the additional routes will significantly decrease delay time.

Future Warrants

The intersection was also evaluated to determine when signal warrants would be met in the future. For this type of calculation, only two of the warrants can be considered, Warrant 1 (8-hour volume) and Warrant 2 (4-hour volume). The methodology for determining the future warrants is explained in the following sections.

Warrant 1: 8-hour Volume

The current 2007 percentage of the daily traffic volume from the 8-hour period was calculated to be 67% for the major street and 66% for the minor street. This percentage was applied to the projected daily volumes for the 2008, 2012, 2015, and 2017 scenarios. Once the percentage was applied to the volume, it was divided by eight to get an average hourly value for each of the eight hours. This average value was then applied to Warrant 1. Since 30% of the traffic on Ash Coulee Dr. turns right, future volume projections for eastbound vehicles were also decreased by 30%. This decrease was done to coincide with the methodology for the 2007 signal warrant analysis of disregarding right-turn vehicles. Using the calculated growth factor, Warrant 1 is projected to be met in 2017 (Table 8).

Table 8: Projected Volumes for Warrant 1

Year	Major (both)*	Minor (highest)**
2007	402	141
2008	385	161
2012	435	191
2015	476	218
2017	**506**	**238**
	67% of ADT	66% of ADT

* The total of both major approaches must be greater than 500 veh/hr

** The highest minor approach must have a minimum volume of 150 veh/hr

Warrant 2: 4-hour Volume

Similar to Warrant 1, the percentage of daily traffic volumes was found for the highest four hours during the day and was applied to future volume projections for both Washington St. (major approach) and Ash Coulee Dr. (higher-volume minor approach). Currently, the 4 highest hours account for 45% of the major street ADT

and 41% of the minor street ADT. Following the same methodology as Warrant 1, the warrant was met for the 2015 traffic volumes (Table 9).

Table 9. Warrant 2 Projected Volumes

Year	Major Street Vol. (both)	Minor Street Vol. (highest)
2007	538	112
2008	518	200
2012	584	238
2015	**640**	**271**
	45% of ADT	41% of ADT

Summary and Recommendations

Current traffic conditions do not warrant a signal at the intersection of Washington St. and Ash Coulee Dr./43rd Ave. Several factors are contributing to operational deficiencies at this intersection:

1. Only one access to the west of Washington St (Ash Coulee Dr.)
2. The close proximity of Horizon Middle School to the intersection (approximately ½ mile to the west)
3. The right-turn lane on the eastbound approach (Ash Coulee Dr.) lacks the storage capacity to prevent spillback onto the through lane

The addition of Valley Dr. to the west of the intersection will provide access to the south, which should alleviate the number of eastbound right-turn movements. Other roadways planned for the coming year are Amber Glow Dr. to the west of Horizon Middle School, and Medora Ave. located to the north of Horizon Middle School, which will provide an additional access point to Washington St.

The proximity of Horizon Middle School introduces unique characteristics to traffic patterns at this intersection. The AM and PM peak hours coincide with school start and end times. In this case, traffic volumes were observed to significantly increase for vehicles making a northbound left (driving to the school) and eastbound right (leaving the school) especially for a 5-10 minute period during each peak hour. It is a safe assumption that a majority of these vehicles are parents dropping off/picking up their children. Delay for a majority of traffic using the intersection was low. However, there were a small number of vehicles which experienced significant delay.

The deficient capacity of the right-turn lane on Ash Coulee Dr. is causing excessive queues and potential safety issues for eastbound traffic. A majority of vehicles traveling eastbound on Ash Coulee Dr. are making a right turn which is the critical movement at this intersection. It was observed that a maximum of 4 vehicles could fit in the right-turn lane before impeding through traffic. Intersecting arterials serving school traffic should have the capacity to provide for all movements. This issue should be addressed for future school construction.

Based on the field observations, engineering analysis, and MUTCD standards a traffic signal will not alleviate operational issues at the Washington St. and Ash Coulee Dr./43rd Ave intersection. There are several alternatives to a traffic signal which will provide better results to the operation of this intersection. One important issue that must be addressed for motorists traveling to/from HMS is to manage public expectations. A small percentage of the drivers traveling though the intersection experience any significant delay. Delay times experienced by drivers during the off-peak periods at the intersection are negligible. Drivers must realize that although this intersection provides a major access point to Horizon Middle School, installing a traffic signal will be more detrimental to the operation of the intersection, especially when new roads are added. Several short-term and long-term improvements can be made to improve traffic flow at this intersection, which include the following:

Short-term Recommendations:

- Do nothing, as traffic congestion at the peak hours will be alleviated with the construction of new roadways
- Educate drivers/parents in order to manage expectations regarding delay times at the intersection
- Monitor the intersection operation in the fall 2007 to determine changes in traffic patterns
- Extend the eastbound right-turn lane to increase the capacity

Long-term Recommendations:

- Continue to monitor the intersection every two years
- Improve lane geometry on all approaches at the intersection
- Install a 4-way stop and traffic signal controller when warranted (~2015)

Appendix A
(Area Maps)

Intersection Directional Traffic Volumes

Map Legend

- 2007 Traffic Counts
- 2008 Traffic Projections
- 2012 Traffic Projections

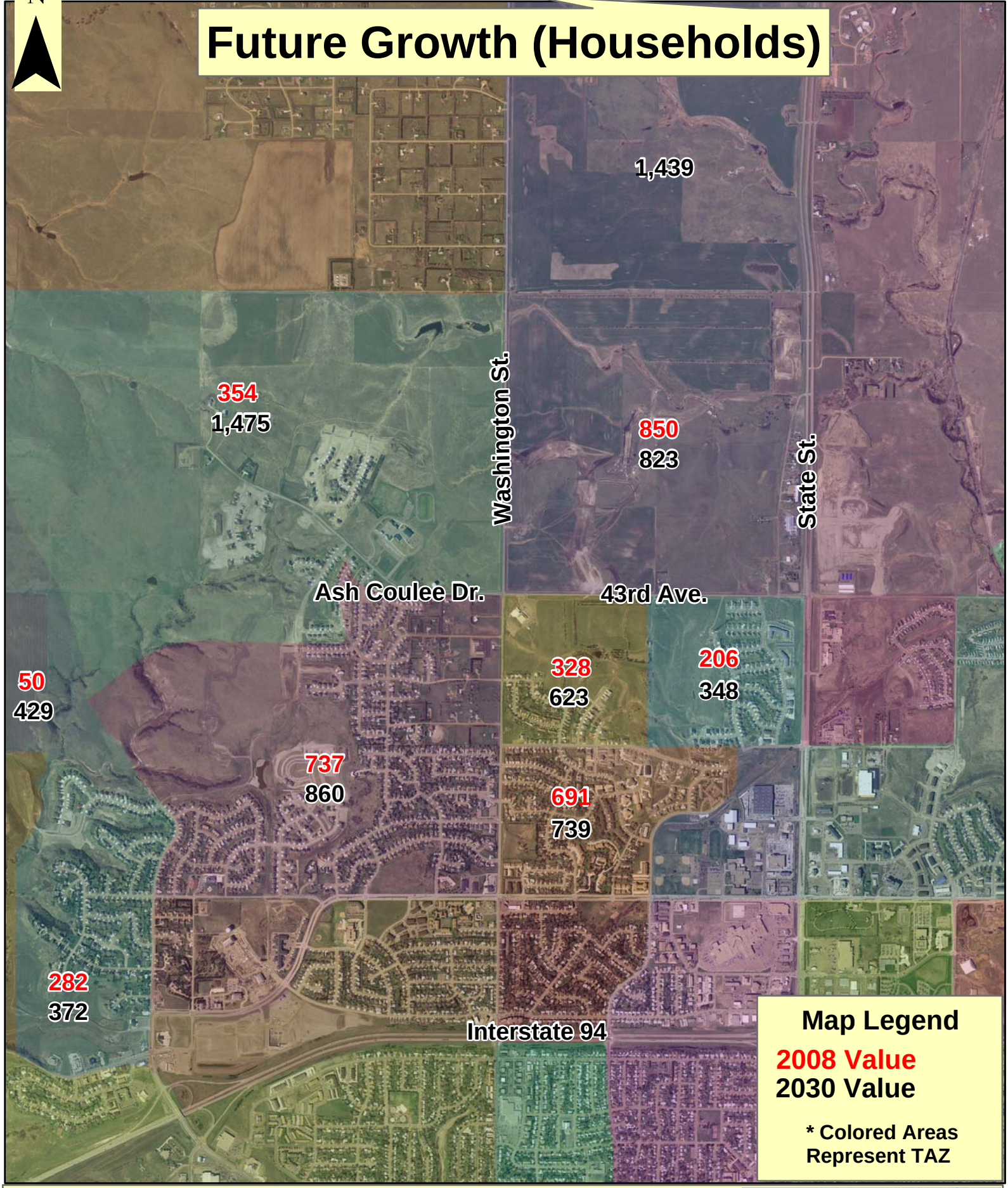
Intersection Analysis of Washington St. and Ash Coulee Dr./43rd Ave.

Bismarck, ND

ATAC ADVANCED TRAFFIC ANALYSIS CENTER

March 2007

Source: ATAC
Created in ArcGIS 8.3 using ArcMap



Intersection Analysis of Washington St. and Ash Coulee Dr./43rd Ave.

Bismarck, ND

ATAC ADVANCED TRAFFIC ANALYSIS CENTER

March 2007

Source: ATAC
Created in ArcGIS 8.3 using ArcMap

Appendix B
(Turning Movement Count Data)

Advanced Traffic Analysis Center

430 IACC Bldg. NDSU
Fargo, ND 58105

File Name : 16_hour_count_no_peds
Site Code : 00000000
Start Date : 2/7/2007
Page No : 1

Groups Printed- Cars - Trucks

	Washington St Southbound				43rd Ave Westbound				Washington St Northbound				43rd Ave Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
06:00 AM	0	5	1	6	0	0	1	1	4	1	2	7	4	2	1	7	21
06:15 AM	1	11	0	12	0	2	3	5	1	4	1	6	5	3	0	8	31
06:30 AM	0	14	1	15	0	0	6	6	5	5	3	13	5	2	0	7	41
06:45 AM	0	18	0	18	0	0	7	7	5	5	3	13	10	7	1	18	56
Total	1	48	2	51	0	2	17	19	15	15	9	39	24	14	2	40	149
07:00 AM	3	22	1	26	2	6	8	16	5	6	19	30	19	17	0	36	108
07:15 AM	15	56	0	71	0	12	6	18	6	4	36	46	57	29	1	87	222
07:30 AM	13	52	5	70	1	13	2	16	9	8	57	74	75	22	2	99	259
07:45 AM	41	68	7	116	1	9	2	12	18	16	127	161	120	6	0	126	415
Total	72	198	13	283	4	40	18	62	38	34	239	311	271	74	3	348	1004
08:00 AM	15	56	3	74	1	7	6	14	14	9	64	87	102	20	1	123	298
08:15 AM	2	50	1	53	1	8	15	24	11	15	23	49	30	8	0	38	164
08:30 AM	1	20	1	22	0	2	9	11	9	13	19	41	8	4	2	14	88
08:45 AM	0	19	2	21	1	3	12	16	8	17	6	31	11	5	2	18	86
Total	18	145	7	170	3	20	42	65	42	54	112	208	151	37	5	193	636
09:00 AM	1	10	4	15	1	4	3	8	6	13	7	26	10	3	0	13	62
09:15 AM	0	11	1	12	0	1	7	8	9	8	6	23	6	4	2	12	55
09:30 AM	0	17	0	17	0	4	6	10	7	7	4	18	6	0	0	6	51
09:45 AM	0	7	0	7	3	3	7	13	7	12	4	23	7	4	1	12	55
Total	1	45	5	51	4	12	23	39	29	40	21	90	29	11	3	43	223
10:00 AM	1	13	2	16	1	3	7	11	12	12	10	34	6	3	1	10	71
10:15 AM	0	6	2	8	2	0	9	11	5	4	5	14	4	4	0	8	41
10:30 AM	0	10	1	11	3	3	7	13	9	6	10	25	6	3	1	10	59
10:45 AM	0	11	1	12	1	3	8	12	9	14	6	29	11	1	0	12	65
Total	1	40	6	47	7	9	31	47	35	36	31	102	27	11	2	40	236
11:00 AM	1	10	0	11	0	4	13	17	14	13	6	33	5	0	0	5	66
11:15 AM	2	14	1	17	0	5	8	13	16	8	11	35	7	8	1	16	81
11:30 AM	0	13	3	16	3	5	14	22	7	8	17	32	11	2	0	13	83
11:45 AM	0	18	2	20	0	4	10	14	9	6	6	21	13	2	0	15	70
Total	3	55	6	64	3	18	45	66	46	35	40	121	36	12	1	49	300
12:00 PM	2	15	4	21	1	9	19	29	14	18	11	43	8	9	1	18	111
12:15 PM	0	15	1	16	2	10	9	21	14	28	11	53	14	9	0	23	113
12:30 PM	2	21	2	25	4	7	4	15	16	6	12	34	11	7	1	19	93
12:45 PM	0	12	2	14	1	3	12	16	20	15	8	43	6	2	1	9	82
Total	4	63	9	76	8	29	44	81	64	67	42	173	39	27	3	69	399
01:00 PM	0	22	2	24	2	5	11	18	12	20	12	44	5	5	0	10	96
01:15 PM	0	15	1	16	3	0	4	7	11	12	4	27	10	0	0	10	60
01:30 PM	1	11	1	13	1	5	11	17	12	15	6	33	10	5	1	16	79
01:45 PM	1	12	3	16	3	4	10	17	18	11	6	35	13	6	0	19	87
Total	2	60	7	69	9	14	36	59	53	58	28	139	38	16	1	55	322
02:00 PM	2	5	1	8	4	3	17	24	8	8	7	23	8	3	1	12	67
02:15 PM	2	13	1	16	2	4	15	21	7	7	7	21	7	6	0	13	71
02:30 PM	1	12	0	13	3	3	5	11	13	17	7	37	13	4	0	17	78
02:45 PM	2	25	2	29	1	11	13	25	16	23	14	53	14	6	0	20	127
Total	7	55	4	66	10	21	50	81	44	55	35	134	42	19	1	62	343
03:00 PM	3	19	1	23	0	11	14	25	15	17	26	58	10	4	0	14	120
03:15 PM	4	16	0	20	1	12	14	27	14	29	105	148	55	21	3	79	274
03:30 PM	0	13	3	16	1	16	6	23	19	22	61	102	117	30	12	159	300
03:45 PM	1	11	1	13	2	9	11	22	17	24	24	65	34	14	2	50	150
Total	8	59	5	72	4	48	45	97	65	92	216	373	216	69	17	302	844
04:00 PM	3	19	1	23	1	9	11	21	26	17	25	68	28	7	2	37	149
04:15 PM	1	13	2	16	2	8	15	25	21	31	30	82	17	10	1	28	151
04:30 PM	2	11	6	19	0	7	11	18	15	34	27	76	21	3	4	28	141
04:45 PM	3	16	1	20	4	19	19	42	22	35	35	92	29	11	4	44	198
Total	9	59	10	78	7	43	56	106	84	117	117	318	95	31	11	137	639

Advanced Traffic Analysis Center
430 IACC Bldg. NDSU
Fargo, ND 58105

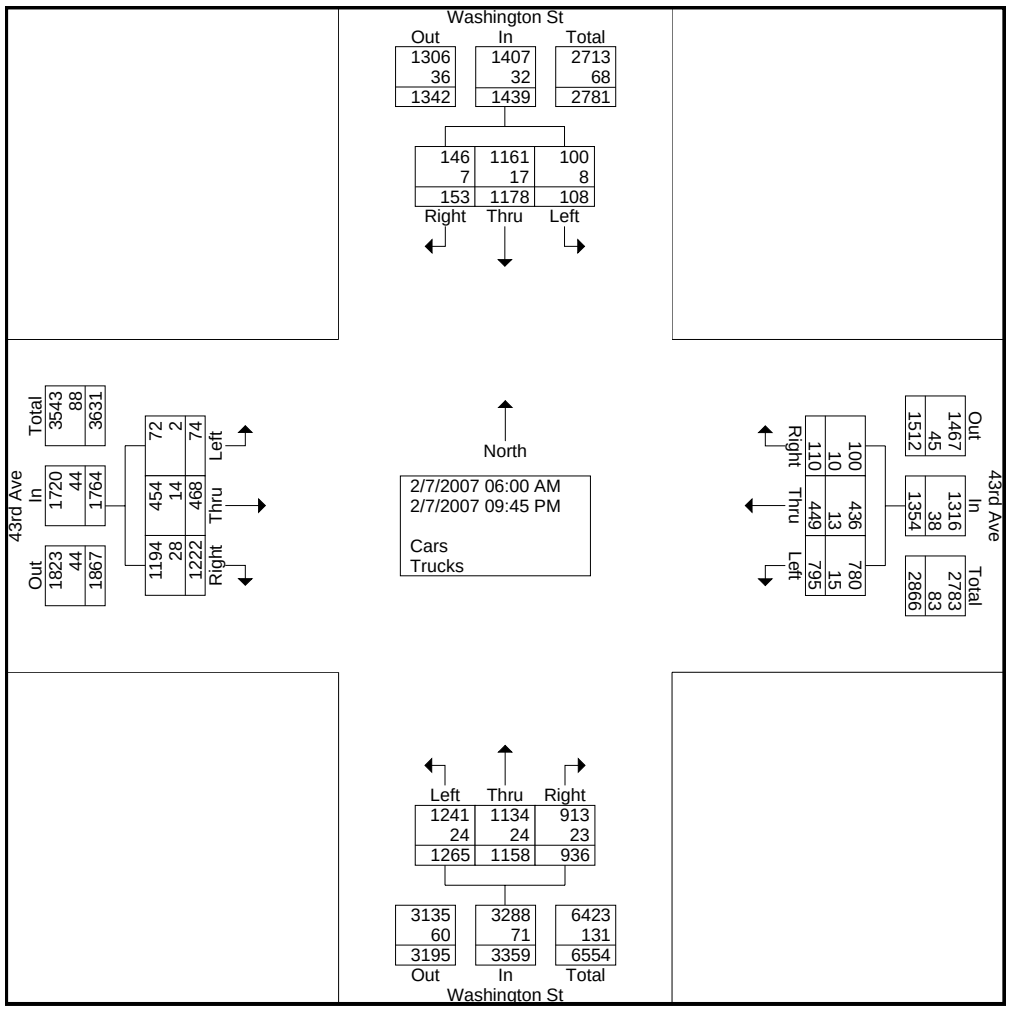
File Name : 16_hour_count_no_peds
Site Code : 00000000
Start Date : 2/7/2007
Page No : 2

Groups Printed- Cars - Trucks

	Washington St Southbound				43rd Ave Westbound				Washington St Northbound				43rd Ave Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
05:00 PM	3	24	1	28	2	13	30	45	27	51	28	106	22	12	3	37	216
05:15 PM	2	24	1	27	4	12	23	39	33	42	48	123	29	4	0	33	222
05:30 PM	3	25	1	29	4	16	12	32	19	30	35	84	23	14	2	39	184
05:45 PM	2	27	4	33	3	23	22	48	11	48	24	83	22	11	2	35	199
Total	10	100	7	117	13	64	87	164	90	171	135	396	96	41	7	144	821
06:00 PM	0	35	3	38	3	11	31	45	34	29	30	93	10	10	2	22	198
06:15 PM	1	36	7	44	1	23	38	62	61	17	26	104	20	11	1	32	242
06:30 PM	1	17	2	20	2	5	26	33	25	26	17	68	9	9	0	18	139
06:45 PM	0	26	2	28	1	6	23	30	14	24	9	47	15	11	2	28	133
Total	2	114	14	130	7	45	118	170	134	96	82	312	54	41	5	100	712
07:00 PM	0	14	0	14	0	10	17	27	23	27	15	65	10	3	2	15	121
07:15 PM	3	26	2	31	2	7	18	27	17	40	16	73	13	1	1	15	146
07:30 PM	1	22	2	25	4	10	13	27	23	33	25	81	2	3	2	7	140
07:45 PM	1	7	2	10	2	8	17	27	17	22	21	60	8	7	1	16	113
Total	5	69	6	80	8	35	65	108	80	122	77	279	33	14	6	53	520
08:00 PM	2	9	1	12	9	16	46	71	34	24	15	73	29	20	1	50	206
08:15 PM	2	4	0	6	7	5	28	40	16	34	17	67	8	13	2	23	136
08:30 PM	5	26	3	34	6	12	11	29	20	35	18	73	8	1	2	11	147
08:45 PM	0	11	2	13	0	5	4	9	15	15	5	35	6	5	0	11	68
Total	9	50	6	65	22	38	89	149	85	108	55	248	51	39	5	95	557
09:00 PM	0	8	0	8	0	6	16	22	6	13	5	24	14	3	0	17	71
09:15 PM	0	2	0	2	1	2	10	13	8	19	10	37	3	1	2	6	58
09:30 PM	1	5	1	7	0	0	3	3	10	17	8	35	3	6	0	9	54
09:45 PM	0	3	0	3	0	3	0	3	8	9	3	20	0	2	0	2	28
Total	1	18	1	20	1	11	29	41	32	58	26	116	20	12	2	34	211
Grand Total	153	1178	108	1439	110	449	795	1354	936	1158	1265	3359	1222	468	74	1764	7916
Apprch %	10.6	81.9	7.5		8.1	33.2	58.7		27.9	34.5	37.7		69.3	26.5	4.2		
Total %	1.9	14.9	1.4	18.2	1.4	5.7	10	17.1	11.8	14.6	16	42.4	15.4	5.9	0.9	22.3	
Cars	146	1161	100	1407	100	436	780	1316	913	1134	1241	3288	1194	454	72	1720	7731
% Cars	95.4	98.6	92.6	97.8	90.9	97.1	98.1	97.2	97.5	97.9	98.1	97.9	97.7	97	97.3	97.5	97.7
Trucks	7	17	8	32	10	13	15	38	23	24	24	71	28	14	2	44	185
% Trucks	4.6	1.4	7.4	2.2	9.1	2.9	1.9	2.8	2.5	2.1	1.9	2.1	2.3	3	2.7	2.5	2.3

Advanced Traffic Analysis Center
430 IACC Bldg. NDSU
Fargo, ND 58105

File Name : 16_hour_count_no_peds
Site Code : 00000000
Start Date : 2/7/2007
Page No : 3



Advanced Traffic Analysis Center
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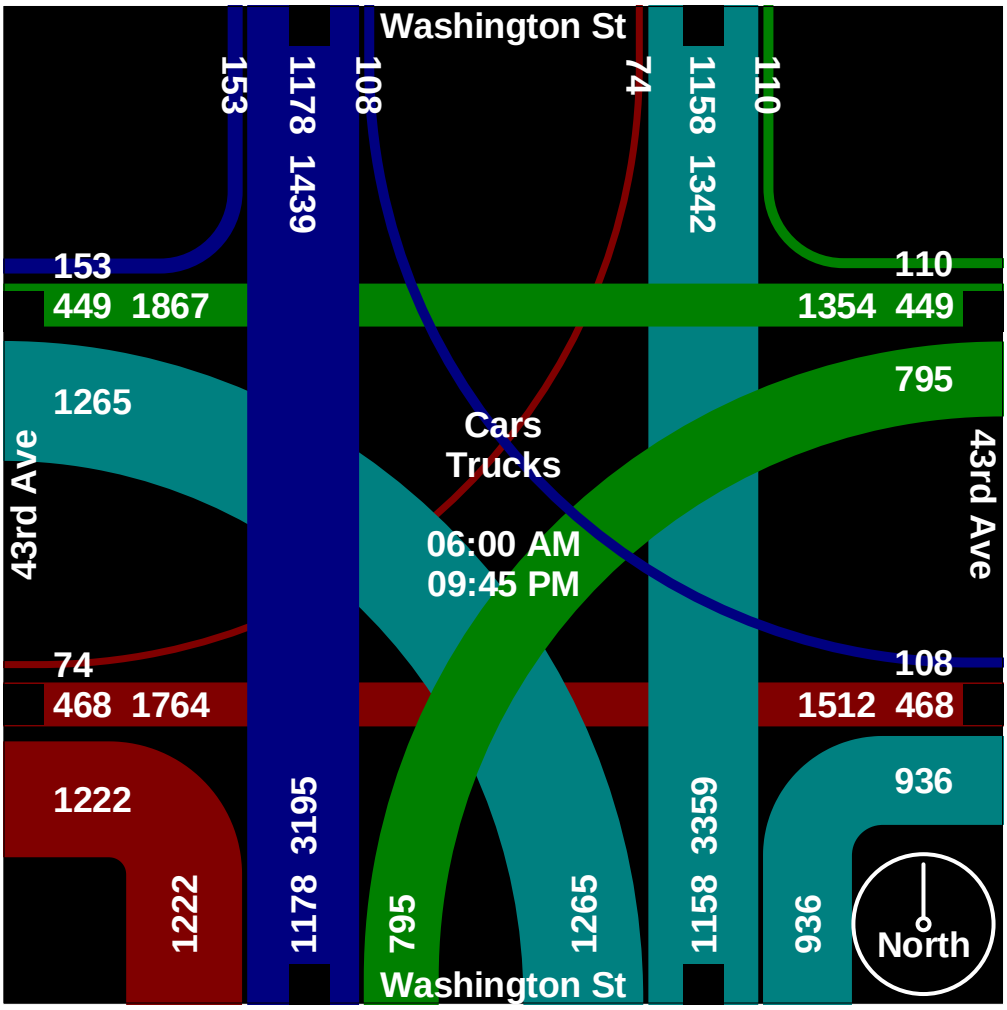
Fargo, ND 58105

File Name : 16_hour_count_no_peds
Site Code : 00000000
Start Date : 2/7/2007
Page No : 4



Appendix C
(Traffic Signal Warrant Data)

TRAFFIC SIGNAL WARRANT SUMMARY

City: **Bismarck** Organization: **Advanced Traffic Analysis Center**
County: **Burleigh** Date: **February 20, 2007**

Major Street: **Washington St.** Lanes: **2** Critical Approach Speed: **25**
Minor Street: **Ash Coulee/43rd Ave.** Lanes: **1**

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph)? ☐ Yes ☑ No
2. Is the intersection in a built-up area of isolated community of <10,000 population? ☐ Yes ☑ No

If Question 1 or 2 above is answered "Yes", then use "70%" volume level ☐ 70% ☑ 100%

WARRANT 1 - EIGHT-HOUR VEHICULAR VOLUME

Applicable: ☑ Yes ☐ No
Satisfied: ☐ Yes ☑ No

Warrant 1 is satisfied if Condition A or Condition B is "100%" satisfied.
Warrant is also satisfied if both Condition A and Condition B are "80%" satisfied.

Condition A - Minimum Vehicular Volume

100% Satisfied: ☐ Yes ☑ No
80% Satisfied: ☐ Yes ☑ No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Brackets)				Eight Highest Hours							
					7:00 - 8:00	17:00 - 18:00	15:00 - 16:00	18:00 - 19:00	16:00 - 17:00	8:00 - 9:00	12:00 - 13:00	14:00 - 15:00
Approach Lanes	**1**		**2 or more**									
Volume Level	**100%**	**70%**	**100%**	**70%**								
Both Approaches on Major Street	500 (400)	350	600 (480)	420	594	513	445	442	396	378	249	200
Highest Approach on Minor Street	150 (120)	105	200 (160)	140	94	164	191	170	106	65	81	81

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is 80% satisfied if parenthetical volumes are met for eight hours.

Condition B - Interruption of Continuous Traffic

Condition B is intended for application where the traffic volume is so heavy that traffic on the minor street suffers excessive delay.

Applicable: ☑ Yes ☐ No
Excessive Delay: ☐ Yes ☑ No
100% Satisfied: ☐ Yes ☑ No
80% Satisfied: ☐ Yes ☑ No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Brackets)				Eight Highest Hours							
					7:00 - 8:00	17:00 - 18:00	15:00 - 16:00	18:00 - 19:00	16:00 - 17:00	8:00 - 9:00	12:00 - 13:00	14:00 - 15:00
Approach Lanes	**1**		**2 or more**									
Volume Level	**100%**	**70%**	**100%**	**70%**								
Both Approaches on Major Street	750 (600)	525	900 (720)	630	594	513	445	442	396	378	249	200
Highest Approach on Minor Street	75 (60)	53	100 (80)	70	94	164	191	170	106	65	81	81

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is 80% satisfied if parenthetical volumes are met for eight hours.

Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01)
NCHRP Report 457, 2001
Manual on Uniform Traffic Control Devices 2003 (July 21, 2004)

TRAFFIC SIGNAL WARRANT SUMMARY

City: **Bismarck** Organization: **Advanced Traffic Analysis Center**
County: **Burleigh** Date: **February 20, 2007**

Major Street: **Washington St.** Lanes: **2** Critical Approach Speed: **25**
Minor Street: **Ash Coulee/43rd Ave.** Lanes: **1**

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph) ? ☐ Yes ☑ No
2. Is the intersection in a built-up area of isolated community of <10,000 population? ☐ Yes ☑ No

If Question 1 or 2 above is answered "Yes", then use "70%" volume level ☐ 70% ☑ 100%

WARRANT 2 - FOUR-HOUR VEHICULAR VOLUME

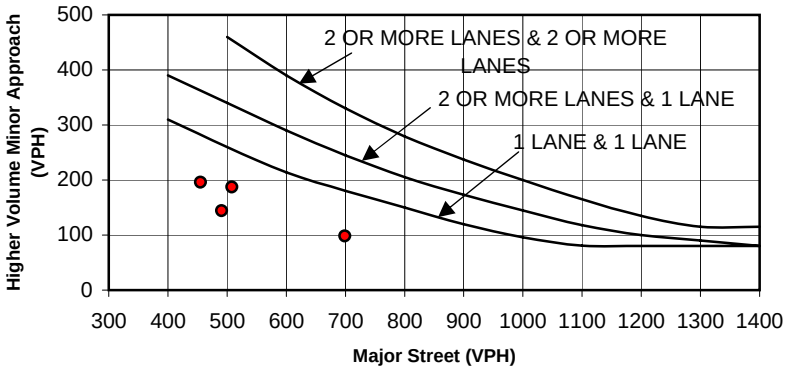
If four or more points lie above the appropriate line, then the warrant is satisfied.

Applicable: ☑ Yes ☐ No
Satisfied: ☐ Yes ☑ No

Four Highest Hours	Volumes	
	Major Street	Minor Street
7:15 AM - 8:15 AM	699	98
5:30 PM - 6:30 PM	508	187
3:15 PM - 4:15 PM	455	196
4:30 PM - 5:30 PM	491	144

Use the middle curve of Figure 4C-1

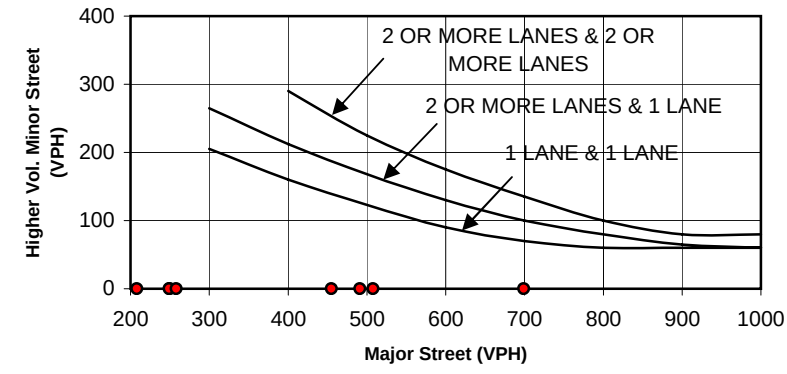
Figure 4C-1



** Note: 115 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 80 vph applies as the lower threshold volume threshold for a minor street approach with one lane.*

Use the middle curve of Figure 4C-1

Figure 4C-2 (70% Factor)



** Note: 80 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 60 vph applies as the lower threshold volume threshold for a minor street approach with one lane.*

Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01)
NCHRP Report 457, 2001
Manual on Uniform Traffic Control Devices 2003 (July 21, 2004)

TRAFFIC SIGNAL WARRANT SUMMARY

City: **Bismarck** Organization: **Advanced Traffic Analysis Center**
County: **Burleigh** Date: **February 20, 2007**

Major Street: **Washington St.** Lanes: **2** Critical Approach Speed: **25**
Minor Street: **Ash Coulee/43rd Ave.** Lanes: **1**

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph) ? ☐ Yes ☑ No
2. Is the intersection in a built-up area of isolated community of <10,000 population? ☐ Yes ☑ No

If Question 1 or 2 above is answered "Yes", then use "70%" volume level ☐ 70% ☑ 100%

WARRANT 3 - PEAK HOUR

Applicable: ☑ Yes ☐ No
Satisfied: ☐ Yes ☑ No

If all three criteria are fullfilled (Condition A) or the plotted point lies above the appropriate line (Condition B),then the warrant is satisfed.

Use the middle curve of Figure 4C-3

Unusual condition justifying use of warrant:
Close proximity to a middle school.

Record hour when criteria are fulfilled and the corresponding delay or volume in boxes provided.

Peak Hour		
7:15	-	8:15

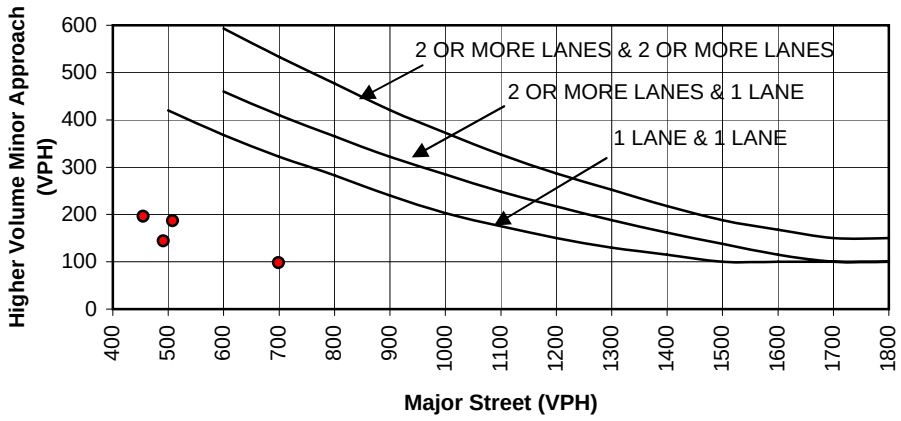
Criteria

1. Delay on Minor Approach *(vehicle-hours)		
Approach Lanes	1	2
Delay Criteria*	4.0	5.0
Delay*		1.7
Fulfilled?: ☐ Yes		☑ No

2. Volume on Minor Approach *(vehicles per hour)		
Approach Lanes	1	2
Volume Criteria*	100	150
Volume*	98	
Fulfilled?: ☐ Yes		☑ No

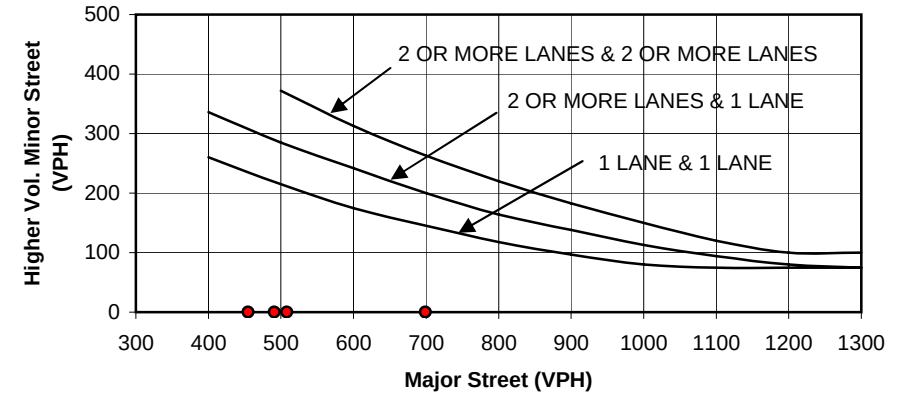
3. Total Entering Volume *(vehicles per hour)		
No. of Approaches	3	4
Volume Criteria*	650	800
Volume*		797
Fulfilled?: ☐ Yes		☑ No

Figure 4C-3



** Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume threshold for a minor street approach with one lane.*

Figure 4C-4 (70% Factor)



** Note: 100 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 75 vph applies as the lower threshold volume threshold for a minor street approach with one lane.*

Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01)
NCHRP Report 457, 2001
Manual on Uniform Traffic Control Devices 2003 (July 21, 2004)

TRAFFIC SIGNAL WARRANT SUMMARY

City: **Bismarck** Organization: **Advanced Traffic Analysis Center**
County: **Burleigh** Date: **February 20, 2007**

Major Street: **Washington St.** Lanes: **2** Critical Approach Speed: **25**
Minor Street: **Ash Coulee/43rd Ave.** Lanes: **1**

WARRANT 4 - PEDESTRIAN VOLUME

Applicable: ☐ Yes ☑ No
Satisfied: ☐ Yes ☑ No

Record hours where criteria are fulfilled and the corresponding volume or gap frequency in the boxes provided. The warrant is satisfied if condition 1 or 2 is fulfilled and condition 3 is fulfilled.

Criteria	Hour		Pedestrian Volume	Pedestrian Gaps	Fulfilled? Yes	Fulfilled? No
1. Pedestrian volume crossing the major street is 100 ped/hr or more for each of any four hours and there are less than 60 gaps/hour in the major street traffic stream of adequate length.	7:00 AM	8:00 AM	0	0		X
	7:00 AM	8:00 AM	0	0		X
	7:00 AM	8:00 AM	0	0		X
	7:00 AM	8:00 AM	0	0		X
2. Pedestrian volume crossing the major street is 190 ped/hr or more for any one hour and there are less than 60 gaps/hour in the major street traffic stream of adequate length.	7:00 AM	- 8:00 AM				X
3. The nearest traffic signal along the major street is located more than 90 m (300 ft) away, or the nearest signal is within 90 m (300 ft) but the proposed traffic signal will not restrict the progressive movement of traffic.					X	

WARRANT 5 - SCHOOL CROSSING

Applicable: ☐ Yes ☑ No
Satisfied: ☐ Yes ☑ No

Record hours where criteria are fulfilled and the corresponding volume or gap frequency in the boxes provided. The warrant is satisfied if all three of the criteria are fulfilled.

Criteria				Fulfilled? Yes	Fulfilled? No
1. A minimum of 20 students crossing the major street during the highest crossing hour.	Students:	Hour:			X
2. Fewer adequate gaps in the major street traffic stream during the period when the children are using the crossing than the number of minutes in the same period.		Minutes:	Gaps:		X
3. The nearest traffic signal along the major street is located more than 90 m (300 ft) away, or the nearest signal is within 90 m (300 ft) but the proposed traffic signal will not restrict the progressive movement of traffic.					X

WARRANT 6 - COORDINATED SIGNAL SYSTEM

Applicable: ☐ Yes ☑ No
Satisfied: ☐ Yes ☑ No

Indicate if the criteria are fulfilled in the boxes provided. The warrant is satisfied if either criterion is fulfilled. This warrant should not be applied when the resulting signal spacing would be less than 300 m (1,000 ft).

Criteria	Fulfilled? Yes	Fulfilled? No
1. On a one-way street or a street that has traffic predominately in one direction, the adjacent signals are so far apart that they do not provide the necessary degree of vehicle platooning.		X
2. On a two-way street, adjacent signals do not provide the necessary degree of platooning, and the proposed and adjacent signals will collectively provide a progressive operation.		X

Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01)
NCHRP Report 457, 2001
Manual on Uniform Traffic Control Devices 2003 (July 21, 2004)

TRAFFIC SIGNAL WARRANT SUMMARY

City: **Bismarck** Organization: **Advanced Traffic Analysis Center**
County: **Burleigh** Date: **February 20, 2007**

Major Street: **Washington St.** Lanes: **2** Critical Approach Speed: **25**
Minor Street: **Ash Coulee/43rd Ave.** Lanes: **1**

WARRANT 7 - CRASH EXPERIENCE

Applicable: ☑ Yes ☐ No
Satisfied: ☐ Yes ☑ No

Record hours where criteria are fulfilled, the corresponding volume, and other information in the boxes provided. The warrant is satisfied if all three of the criteria are fulfilled.

Criteria		Hour	Volume	Met? Yes	Met? No	Fulfilled? Yes	Fulfilled? No
1. One of the warrants to the right is met.	Warrant 1, Condition A (80% satisfied)				X		X
	Warrant 1, Condition B (80% satisfied)				X		
	Warrant 4, Pedestrian Volume at 80% of volume requirements: 80 ped/hr for four (4) hours or 152 ped/hr for one (1) hour		0		X		
			0				
			0				
			0				
2. Adequate trial of other remedial measure has failed to reduce crash frequency.		Measure tried:	N/A				X
3. Five or more reported crashes, of types susceptible to correction by signal, have occurred within a 12-mo. period.		Number of crashes per 12 months:	**2**				X

WARRANT 8 - ROADWAY NETWORK

Applicable: ☑ Yes ☐ No
Satisfied: ☐ Yes ☑ No

Record hours where criteria are fulfilled, and the corresponding volume or other information in the boxes provided. The warrant is satisfied if at least one of the criteria is fulfilled and if all intersecting routes have one or more of the characteristics listed.

Criteria							Met? Yes	Met? No	Fulfilled? Yes	Fulfilled? No
1. Both of the criteria to the right are met.	a. Total entering volume of at least 1,000 veh/hr during a typical weekday peak hour.		Entering Volume: 797					X		X
	b. Five-year projected volumes that satisfy one or more of Warrants 1, 2, or 3.	Warrant:	1	2	3			X		
		Satisfied?:								
2. Total entering volume at least 1,000 veh/hr for each of any 5 hrs of a non-normal business day (Sat. or Sun.)						← Hour				X
						← Volume				

Characteristics of Major Routes		Met? Yes	Met? No	Fulfilled? Yes	Fulfilled? No
1. Part of the street or highway system that serves as the principal roadway network for through traffic flow.	Major Street:	X		X	
	Minor Street:	X			
2. Rural or suburban highway outside of, entering, or traversing a city.	Major Street:	X			
	Minor Street:	X			
3. Appears as a major route on an official plan.	Major Street:	X			
	Minor Street:	X			

CONCLUSIONS

Warrants Satisfied: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

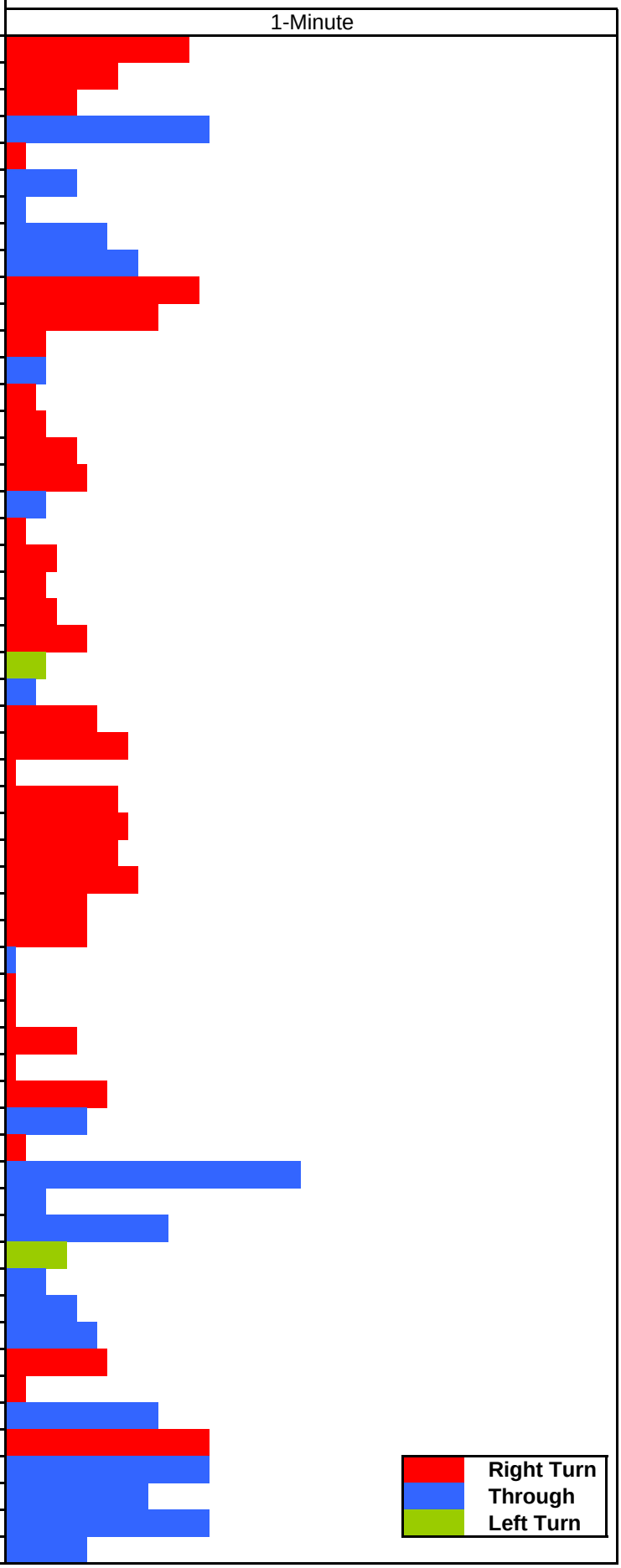
Remarks: _____

Sources: Revised from Florida DOT's Traffic Signal Warrant Summary (Form 750-020-01)
NCHRP Report 457, 2001
Manual on Uniform Traffic Control Devices 2003 (July 21, 2004)

Appendix D
(Delay Study Data)

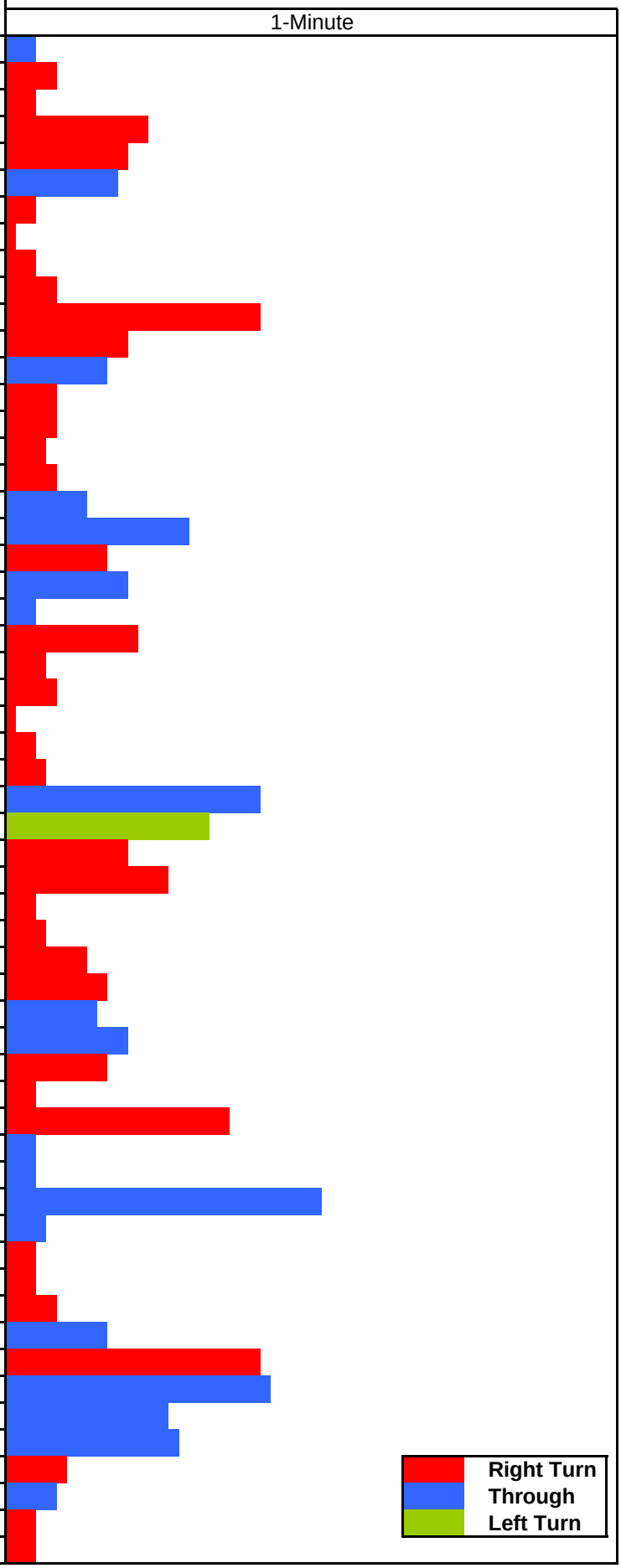
Eastbound AM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
1	7:15:19 AM	7:15:37 AM	18
2	7:15:32 AM	7:15:43 AM	11
3	7:15:38 AM	7:15:45 AM	7
4	7:15:39 AM	7:15:59 AM	20
5	7:16:13 AM	7:16:15 AM	2
6	7:16:18 AM	7:16:25 AM	7
7	7:16:27 AM	7:16:29 AM	2
8	7:17:15 AM	7:17:25 AM	10
9	7:17:17 AM	7:17:30 AM	13
10	7:17:33 AM	7:17:52 AM	19
11	7:18:02 AM	7:18:17 AM	15
12	7:18:24 AM	7:18:28 AM	4
13	7:18:27 AM	7:18:31 AM	4
14	7:18:37 AM	7:18:40 AM	3
15	7:18:52 AM	7:18:56 AM	4
16	7:18:54 AM	7:19:01 AM	7
17	7:18:56 AM	7:19:04 AM	8
18	7:19:21 AM	7:19:25 AM	4
19	7:19:29 AM	7:19:31 AM	2
20	7:19:49 AM	7:19:54 AM	5
21	7:19:55 AM	7:19:59 AM	4
22	7:20:04 AM	7:20:09 AM	5
23	7:20:13 AM	7:20:21 AM	8
24	7:20:23 AM	7:20:27 AM	4
25	7:20:28 AM	7:20:31 AM	3
26	7:20:38 AM	7:20:47 AM	9
27	7:20:40 AM	7:20:52 AM	12
28	7:20:57 AM	7:20:58 AM	1
29	7:21:08 AM	7:21:19 AM	11
30	7:21:10 AM	7:21:22 AM	12
31	7:21:14 AM	7:21:25 AM	11
32	7:21:15 AM	7:21:28 AM	13
33	7:21:27 AM	7:21:35 AM	8
34	7:21:31 AM	7:21:39 AM	8
35	7:21:39 AM	7:21:40 AM	1
36	7:21:52 AM	7:21:53 AM	1
37	7:22:10 AM	7:22:11 AM	1
38	7:22:15 AM	7:22:22 AM	7
39	7:22:28 AM	7:22:29 AM	1
40	7:22:30 AM	7:22:40 AM	10
41	7:22:34 AM	7:22:42 AM	8
42	7:22:44 AM	7:22:46 AM	2
43	7:23:01 AM	7:23:30 AM	29
44	7:23:53 AM	7:23:57 AM	4
45	7:23:56 AM	7:24:12 AM	16
46	7:24:16 AM	7:24:22 AM	6
47	7:24:21 AM	7:24:25 AM	4
48	7:24:22 AM	7:24:29 AM	7
49	7:24:25 AM	7:24:34 AM	9
50	7:24:28 AM	7:24:38 AM	10
51	7:24:39 AM	7:24:41 AM	2
52	7:24:40 AM	7:24:55 AM	15
53	7:24:59 AM	7:25:19 AM	20
54	7:25:02 AM	7:25:22 AM	20
55	7:25:10 AM	7:25:24 AM	14
56	7:25:16 AM	7:25:36 AM	20
57	7:25:30 AM	7:25:38 AM	8



Eastbound AM Peak Delay Times

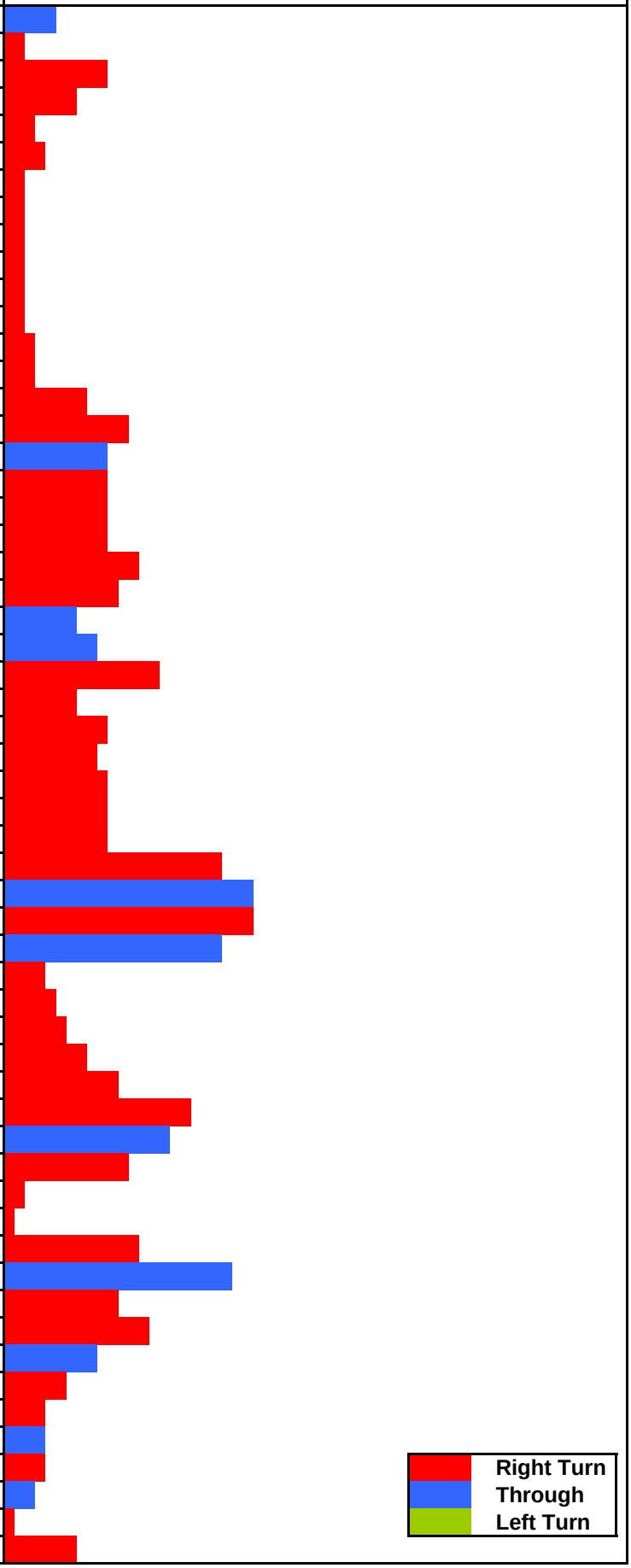
Vehicle Number	Joined Queue	Released from Queue	Time in Queue
58	7:25:40 AM	7:25:43 AM	3
59	7:25:57 AM	7:26:02 AM	5
60	7:26:21 AM	7:26:24 AM	3
61	7:26:22 AM	7:26:36 AM	14
62	7:26:28 AM	7:26:40 AM	12
63	7:26:35 AM	7:26:46 AM	11
64	7:27:01 AM	7:27:04 AM	3
65	7:27:07 AM	7:27:08 AM	1
66	7:27:10 AM	7:27:13 AM	3
67	7:27:12 AM	7:27:17 AM	5
68	7:27:15 AM	7:27:40 AM	25
69	7:27:33 AM	7:27:45 AM	12
70	7:27:41 AM	7:27:51 AM	10
71	7:28:21 AM	7:28:26 AM	5
72	7:28:26 AM	7:28:31 AM	5
73	7:28:31 AM	7:28:35 AM	4
74	7:28:34 AM	7:28:39 AM	5
75	7:28:36 AM	7:28:44 AM	8
76	7:28:40 AM	7:28:58 AM	18
77	7:28:49 AM	7:28:59 AM	10
78	7:28:52 AM	7:29:04 AM	12
79	7:29:06 AM	7:29:09 AM	3
80	7:29:07 AM	7:29:20 AM	13
81	7:29:23 AM	7:29:27 AM	4
82	7:29:24 AM	7:29:29 AM	5
83	7:29:39 AM	7:29:40 AM	1
84	7:29:42 AM	7:29:45 AM	3
85	7:29:46 AM	7:29:50 AM	4
86	7:29:56 AM	7:30:21 AM	25
87	7:30:14 AM	7:30:34 AM	20
88	7:30:23 AM	7:30:35 AM	12
89	7:30:42 AM	7:30:58 AM	16
90	7:31:04 AM	7:31:07 AM	3
91	7:31:12 AM	7:31:16 AM	4
92	7:31:22 AM	7:31:30 AM	8
93	7:31:23 AM	7:31:33 AM	10
94	7:31:26 AM	7:31:35 AM	9
95	7:31:28 AM	7:31:40 AM	12
96	7:31:32 AM	7:31:42 AM	10
97	7:31:46 AM	7:31:49 AM	3
98	7:31:51 AM	7:32:13 AM	22
99	7:32:11 AM	7:32:14 AM	3
100	7:32:14 AM	7:32:17 AM	3
101	7:32:38 AM	7:33:09 AM	31
102	7:33:08 AM	7:33:12 AM	4
103	7:33:21 AM	7:33:24 AM	3
104	7:33:44 AM	7:33:47 AM	3
105	7:33:49 AM	7:33:54 AM	5
106	7:33:50 AM	7:34:00 AM	10
107	7:33:52 AM	7:34:17 AM	25
108	7:33:54 AM	7:34:20 AM	26
109	7:34:06 AM	7:34:22 AM	16
110	7:34:12 AM	7:34:29 AM	17
111	7:34:24 AM	7:34:30 AM	6
112	7:34:28 AM	7:34:33 AM	5
113	7:34:43 AM	7:34:46 AM	3
114	7:34:45 AM	7:34:48 AM	3



Eastbound AM Peak Delay Times

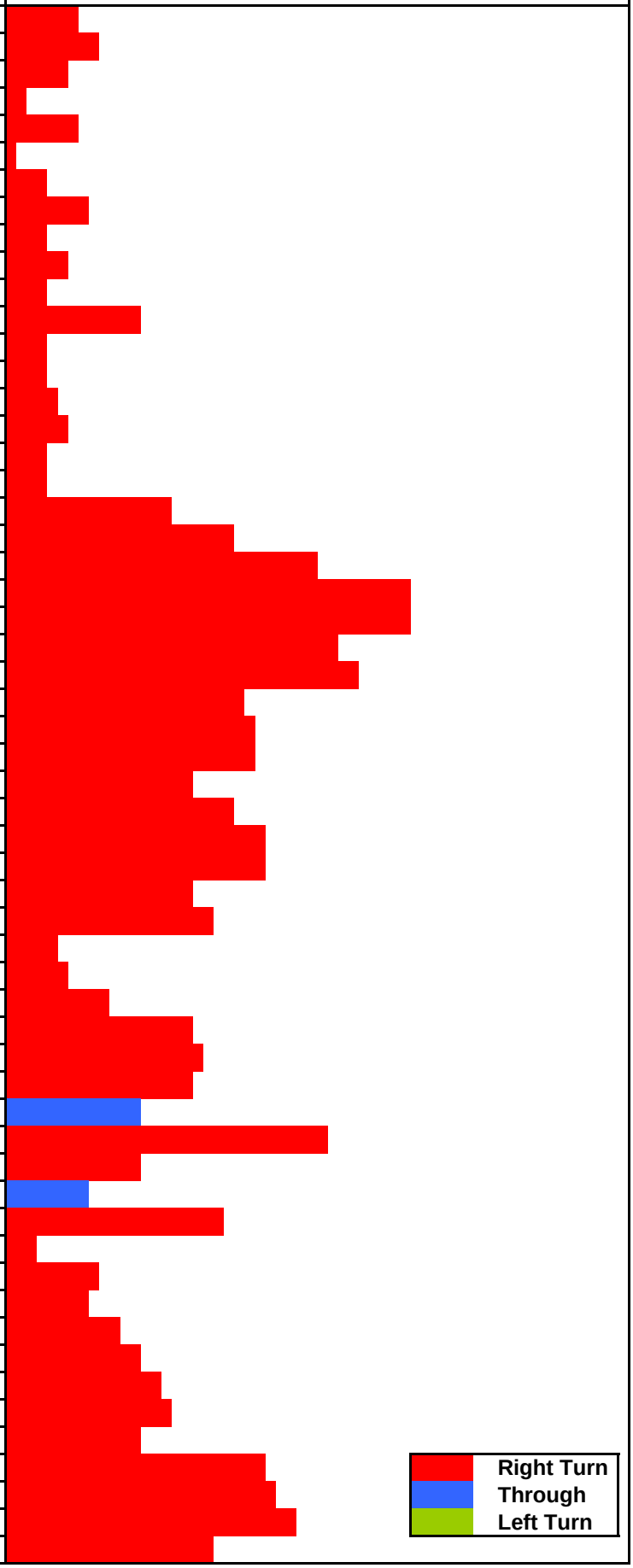
Vehicle Number	Joined Queue	Released from Queue	Time in Queue
115	7:34:51 AM	7:34:56 AM	5
116	7:35:01 AM	7:35:03 AM	2
117	7:35:14 AM	7:35:24 AM	10
118	7:35:37 AM	7:35:44 AM	7
119	7:35:50 AM	7:35:53 AM	3
120	7:35:52 AM	7:35:56 AM	4
121	7:35:59 AM	7:36:01 AM	2
122	7:36:01 AM	7:36:03 AM	2
123	7:36:04 AM	7:36:06 AM	2
124	7:36:07 AM	7:36:09 AM	2
125	7:36:32 AM	7:36:34 AM	2
126	7:36:38 AM	7:36:40 AM	2
127	7:37:25 AM	7:37:28 AM	3
128	7:37:29 AM	7:37:32 AM	3
129	7:37:30 AM	7:37:38 AM	8
130	7:37:31 AM	7:37:43 AM	12
131	7:37:35 AM	7:37:45 AM	10
132	7:37:38 AM	7:37:48 AM	10
133	7:37:41 AM	7:37:51 AM	10
134	7:37:48 AM	7:37:58 AM	10
135	7:37:50 AM	7:38:03 AM	13
136	7:37:57 AM	7:38:08 AM	11
137	7:38:05 AM	7:38:12 AM	7
138	7:38:14 AM	7:38:23 AM	9
139	7:38:35 AM	7:38:50 AM	15
140	7:38:49 AM	7:38:56 AM	7
141	7:39:22 AM	7:39:32 AM	10
142	7:39:25 AM	7:39:34 AM	9
143	7:39:27 AM	7:39:37 AM	10
144	7:39:30 AM	7:39:40 AM	10
145	7:39:34 AM	7:39:44 AM	10
146	7:39:35 AM	7:39:56 AM	21
147	7:39:39 AM	7:40:03 AM	24
148	7:39:40 AM	7:40:04 AM	24
149	7:39:44 AM	7:40:05 AM	21
150	7:40:07 AM	7:40:11 AM	4
151	7:40:14 AM	7:40:19 AM	5
152	7:40:17 AM	7:40:23 AM	6
153	7:40:19 AM	7:40:27 AM	8
154	7:40:22 AM	7:40:33 AM	11
155	7:40:27 AM	7:40:45 AM	18
156	7:40:35 AM	7:40:51 AM	16
157	7:40:46 AM	7:40:58 AM	12
158	7:41:15 AM	7:41:17 AM	2
159	7:41:18 AM	7:41:19 AM	1
160	7:41:30 AM	7:41:43 AM	13
161	7:41:35 AM	7:41:57 AM	22
162	7:42:03 AM	7:42:14 AM	11
163	7:42:08 AM	7:42:22 AM	14
164	7:42:14 AM	7:42:23 AM	9
165	7:42:19 AM	7:42:25 AM	6
166	7:42:30 AM	7:42:34 AM	4
167	7:42:38 AM	7:42:42 AM	4
168	7:42:40 AM	7:42:44 AM	4
169	7:42:42 AM	7:42:45 AM	3
170	7:42:51 AM	7:42:52 AM	1
171	7:43:03 AM	7:43:10 AM	7

1-Minute



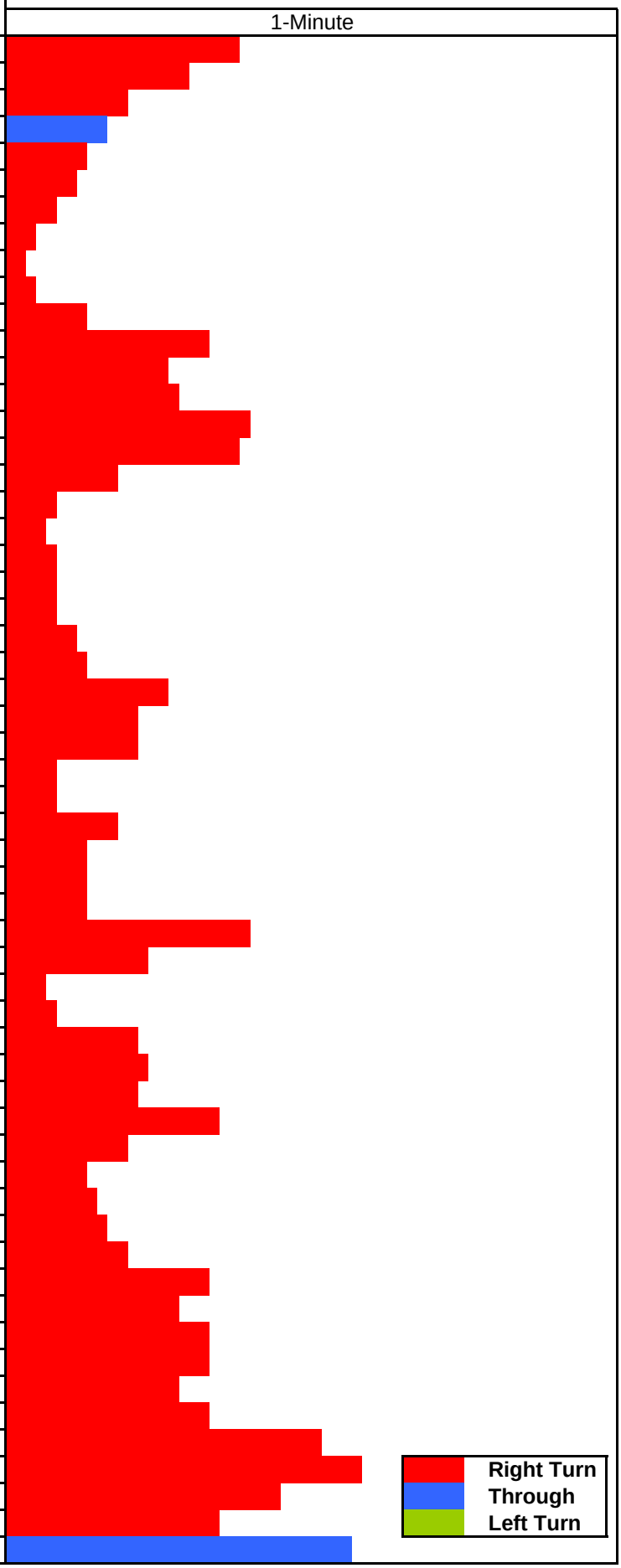
Eastbound AM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
172	7:43:07 AM	7:43:14 AM	7
173	7:43:09 AM	7:43:18 AM	9
174	7:43:14 AM	7:43:20 AM	6
175	7:43:22 AM	7:43:24 AM	2
176	7:43:23 AM	7:43:30 AM	7
177	7:43:35 AM	7:43:34 AM	1
178	7:43:39 AM	7:43:43 AM	4
179	7:43:56 AM	7:43:48 AM	8
180	7:43:57 AM	7:44:01 AM	4
181	7:44:05 AM	7:44:11 AM	6
182	7:44:24 AM	7:44:28 AM	4
183	7:44:40 AM	7:44:53 AM	13
184	7:44:55 AM	7:44:59 AM	4
185	7:44:58 AM	7:45:02 AM	4
186	7:45:12 AM	7:45:17 AM	5
187	7:45:31 AM	7:45:37 AM	6
188	7:45:36 AM	7:45:40 AM	4
189	7:45:39 AM	7:45:43 AM	4
190	7:45:49 AM	7:46:05 AM	16
191	7:45:50 AM	7:46:12 AM	22
192	7:45:57 AM	7:46:27 AM	30
193	7:45:58 AM	7:46:37 AM	39
194	7:46:01 AM	7:46:40 AM	39
195	7:46:11 AM	7:46:43 AM	32
196	7:46:15 AM	7:46:49 AM	34
197	7:46:35 AM	7:46:58 AM	23
198	7:46:38 AM	7:47:02 AM	24
199	7:46:44 AM	7:47:08 AM	24
200	7:47:05 AM	7:47:23 AM	18
201	7:47:07 AM	7:47:29 AM	22
202	7:47:16 AM	7:47:41 AM	25
203	7:47:21 AM	7:47:46 AM	25
204	7:47:33 AM	7:47:51 AM	18
205	7:47:34 AM	7:47:54 AM	20
206	7:47:54 AM	7:47:59 AM	5
207	7:48:01 AM	7:48:07 AM	6
208	7:48:04 AM	7:48:14 AM	10
209	7:48:05 AM	7:48:23 AM	18
210	7:48:13 AM	7:48:32 AM	19
211	7:48:20 AM	7:48:38 AM	18
212	7:48:28 AM	7:48:41 AM	13
213	7:48:34 AM	7:49:05 AM	31
214	7:48:59 AM	7:49:12 AM	13
215	7:49:06 AM	7:49:14 AM	8
216	7:49:15 AM	7:49:36 AM	21
217	7:50:19 AM	7:50:22 AM	3
218	7:50:26 AM	7:50:35 AM	9
219	7:50:30 AM	7:50:38 AM	8
220	7:50:38 AM	7:50:49 AM	11
221	7:50:41 AM	7:50:54 AM	13
222	7:50:44 AM	7:50:59 AM	15
223	7:50:46 AM	7:51:02 AM	16
224	7:50:53 AM	7:51:06 AM	13
225	7:50:55 AM	7:51:20 AM	25
226	7:50:56 AM	7:51:22 AM	26
227	7:50:57 AM	7:51:25 AM	28
228	7:51:08 AM	7:51:28 AM	20



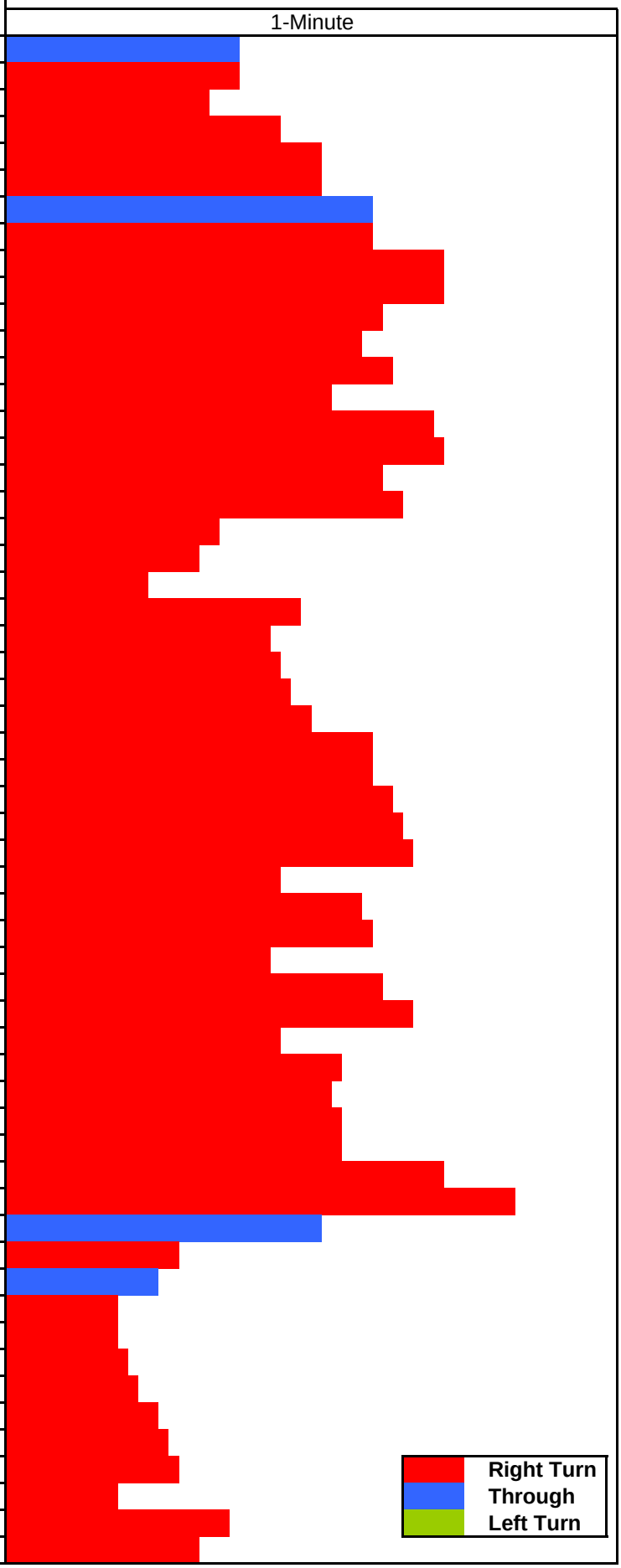
Eastbound AM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
229	7:51:09 AM	7:51:32 AM	23
230	7:51:24 AM	7:51:42 AM	18
231	7:51:35 AM	7:51:47 AM	12
232	7:51:40 AM	7:51:50 AM	10
233	7:51:44 AM	7:51:52 AM	8
234	7:51:49 AM	7:51:56 AM	7
235	7:52:01 AM	7:52:06 AM	5
236	7:52:04 AM	7:52:07 AM	3
237	7:52:07 AM	7:52:09 AM	2
238	7:52:10 AM	7:52:13 AM	3
239	7:52:15 AM	7:52:23 AM	8
240	7:52:16 AM	7:52:36 AM	20
241	7:52:21 AM	7:52:37 AM	16
242	7:52:23 AM	7:52:40 AM	17
243	7:52:28 AM	7:52:52 AM	24
244	7:52:32 AM	7:52:55 AM	23
245	7:52:49 AM	7:53:00 AM	11
246	7:52:56 AM	7:53:01 AM	5
247	7:53:03 AM	7:53:07 AM	4
248	7:53:07 AM	7:53:12 AM	5
249	7:53:23 AM	7:53:28 AM	5
250	7:53:28 AM	7:53:33 AM	5
251	7:53:31 AM	7:53:38 AM	7
252	7:53:36 AM	7:53:44 AM	8
253	7:53:40 AM	7:53:56 AM	16
254	7:53:46 AM	7:53:59 AM	13
255	7:53:48 AM	7:54:01 AM	13
256	7:54:01 AM	7:54:06 AM	5
257	7:54:06 AM	7:54:11 AM	5
258	7:54:12 AM	7:54:23 AM	11
259	7:54:18 AM	7:54:26 AM	8
260	7:54:21 AM	7:54:29 AM	8
261	7:54:24 AM	7:54:32 AM	8
262	7:54:27 AM	7:54:51 AM	24
263	7:54:40 AM	7:54:54 AM	14
264	7:54:56 AM	7:55:00 AM	4
265	7:55:02 AM	7:55:07 AM	5
266	7:55:14 AM	7:55:27 AM	13
267	7:55:20 AM	7:55:34 AM	14
268	7:55:29 AM	7:55:42 AM	13
269	7:55:32 AM	7:55:53 AM	21
270	7:55:48 AM	7:56:00 AM	12
271	7:55:55 AM	7:56:03 AM	8
272	7:55:59 AM	7:56:08 AM	9
273	7:56:02 AM	7:56:12 AM	10
274	7:56:07 AM	7:56:19 AM	12
275	7:56:12 AM	7:56:32 AM	20
276	7:56:21 AM	7:56:38 AM	17
277	7:56:24 AM	7:56:44 AM	20
278	7:56:30 AM	7:56:50 AM	20
279	7:56:35 AM	7:56:52 AM	17
280	7:56:36 AM	7:56:56 AM	20
281	7:56:37 AM	7:57:08 AM	31
282	7:56:39 AM	7:57:14 AM	35
283	7:56:49 AM	7:57:16 AM	27
284	7:56:58 AM	7:57:19 AM	21
285	7:57:07 AM	7:57:41 AM	34



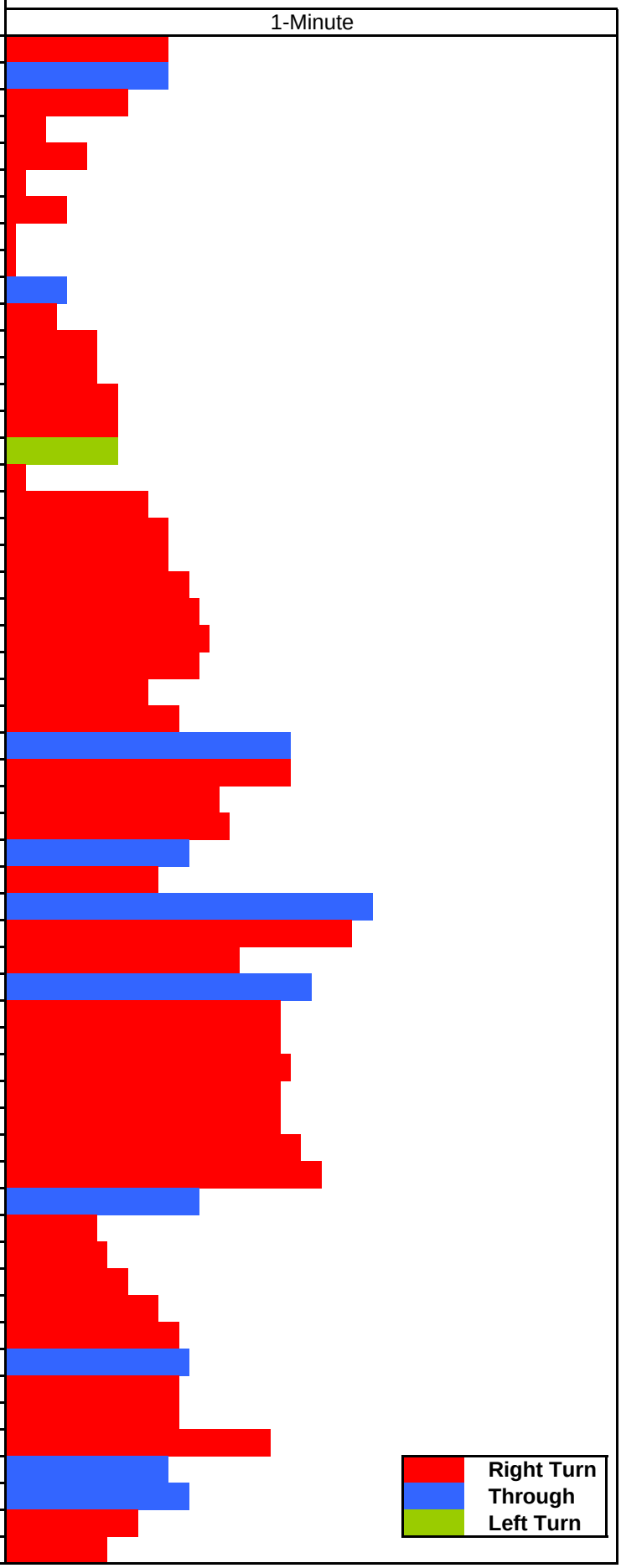
Eastbound AM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
286	7:57:20 AM	7:57:43 AM	23
287	7:57:24 AM	7:57:47 AM	23
288	7:57:32 AM	7:57:52 AM	20
289	7:57:40 AM	7:58:07 AM	27
290	7:57:41 AM	7:58:12 AM	31
291	7:57:46 AM	7:58:17 AM	31
292	7:57:50 AM	7:58:26 AM	36
293	7:57:52 AM	7:58:28 AM	36
294	7:57:55 AM	7:58:38 AM	43
295	7:58:03 AM	7:58:46 AM	43
296	7:58:12 AM	7:58:49 AM	37
297	7:58:18 AM	7:58:53 AM	35
298	7:58:23 AM	7:59:01 AM	38
299	7:58:32 AM	7:59:04 AM	32
300	7:58:33 AM	7:59:15 AM	42
301	7:58:38 AM	7:59:21 AM	43
302	7:58:50 AM	7:59:27 AM	37
303	7:58:52 AM	7:59:31 AM	39
304	7:59:14 AM	7:59:35 AM	21
305	7:59:19 AM	7:59:38 AM	19
306	7:59:28 AM	7:59:42 AM	14
307	7:59:36 AM	8:00:05 AM	29
308	7:59:43 AM	8:00:09 AM	26
309	7:59:46 AM	8:00:13 AM	27
310	7:59:50 AM	8:00:18 AM	28
311	7:59:51 AM	8:00:21 AM	30
312	7:59:52 AM	8:00:28 AM	36
313	7:59:55 AM	8:00:31 AM	36
314	7:59:57 AM	8:00:35 AM	38
315	7:59:58 AM	8:00:37 AM	39
316	8:00:01 AM	8:00:41 AM	40
317	8:00:19 AM	8:00:46 AM	27
318	8:00:36 AM	8:01:11 AM	35
319	8:00:39 AM	8:01:15 AM	36
320	8:00:53 AM	8:01:19 AM	26
321	8:01:06 AM	8:01:43 AM	37
322	8:01:08 AM	8:01:48 AM	40
323	8:01:25 AM	8:01:52 AM	27
324	8:01:28 AM	8:02:01 AM	33
325	8:01:33 AM	8:02:05 AM	32
326	8:01:35 AM	8:02:08 AM	33
327	8:01:39 AM	8:02:12 AM	33
328	8:01:54 AM	8:02:37 AM	43
329	8:01:56 AM	8:02:46 AM	50
330	8:02:17 AM	8:02:48 AM	31
331	8:02:39 AM	8:02:56 AM	17
332	8:02:43 AM	8:02:58 AM	15
333	8:02:56 AM	8:03:07 AM	11
334	8:02:59 AM	8:03:10 AM	11
335	8:03:08 AM	8:03:20 AM	12
336	8:03:10 AM	8:03:23 AM	13
337	8:03:13 AM	8:03:28 AM	15
338	8:03:17 AM	8:03:33 AM	16
339	8:03:18 AM	8:03:35 AM	17
340	8:03:28 AM	8:03:39 AM	11
341	8:03:35 AM	8:03:57 AM	22
342	8:03:42 AM	8:04:01 AM	19



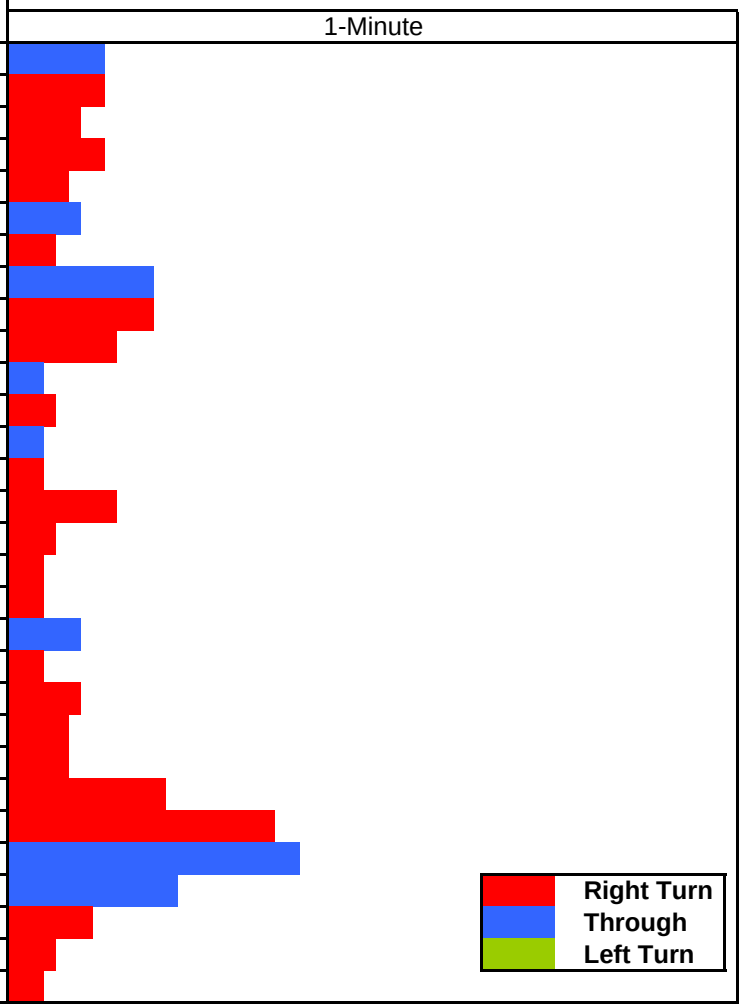
Eastbound AM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
343	8:03:48 AM	8:04:04 AM	16
344	8:03:51 AM	8:04:07 AM	16
345	8:03:56 AM	8:04:08 AM	12
346	8:04:08 AM	8:04:12 AM	4
347	8:04:14 AM	8:04:22 AM	8
348	8:04:27 AM	8:04:29 AM	2
349	8:04:30 AM	8:04:36 AM	6
350	8:04:38 AM	8:04:39 AM	1
351	8:04:43 AM	8:04:44 AM	1
352	8:04:48 AM	8:04:54 AM	6
353	8:04:53 AM	8:04:58 AM	5
354	8:04:58 AM	8:05:07 AM	9
355	8:05:01 AM	8:05:10 AM	9
356	8:05:02 AM	8:05:13 AM	11
357	8:05:05 AM	8:05:16 AM	11
358	8:05:14 AM	8:05:25 AM	11
359	8:05:29 AM	8:05:31 AM	2
360	8:05:47 AM	8:06:01 AM	14
361	8:05:49 AM	8:06:05 AM	16
362	8:05:52 AM	8:06:08 AM	16
363	8:05:55 AM	8:06:13 AM	18
364	8:05:59 AM	8:06:18 AM	19
365	8:06:00 AM	8:06:20 AM	20
366	8:06:04 AM	8:06:23 AM	19
367	8:06:14 AM	8:06:28 AM	14
368	8:06:15 AM	8:06:32 AM	17
369	8:06:16 AM	8:06:44 AM	28
370	8:06:17 AM	8:06:45 AM	28
371	8:06:29 AM	8:06:50 AM	21
372	8:06:31 AM	8:06:53 AM	22
373	8:06:36 AM	8:06:54 AM	18
374	8:06:40 AM	8:06:55 AM	15
375	8:06:43 AM	8:07:19 AM	36
376	8:06:47 AM	8:07:21 AM	34
377	8:06:59 AM	8:07:22 AM	23
378	8:07:01 AM	8:07:31 AM	30
379	8:07:04 AM	8:07:31 AM	27
380	8:07:06 AM	8:07:33 AM	27
381	8:07:07 AM	8:07:35 AM	28
382	8:07:13 AM	8:07:40 AM	27
383	8:07:17 AM	8:07:44 AM	27
384	8:07:18 AM	8:07:47 AM	29
385	8:07:20 AM	8:07:51 AM	31
386	8:07:33 AM	8:07:52 AM	19
387	8:07:47 AM	8:07:56 AM	9
388	8:07:50 AM	8:08:00 AM	10
389	8:07:51 AM	8:08:03 AM	12
390	8:07:52 AM	8:08:07 AM	15
391	8:07:54 AM	8:08:11 AM	17
392	8:07:55 AM	8:08:13 AM	18
393	8:07:59 AM	8:08:16 AM	17
394	8:08:06 AM	8:08:23 AM	17
395	8:08:07 AM	8:08:33 AM	26
396	8:08:18 AM	8:08:34 AM	16
397	8:08:20 AM	8:08:38 AM	18
398	8:08:28 AM	8:08:41 AM	13
399	8:08:33 AM	8:08:43 AM	10



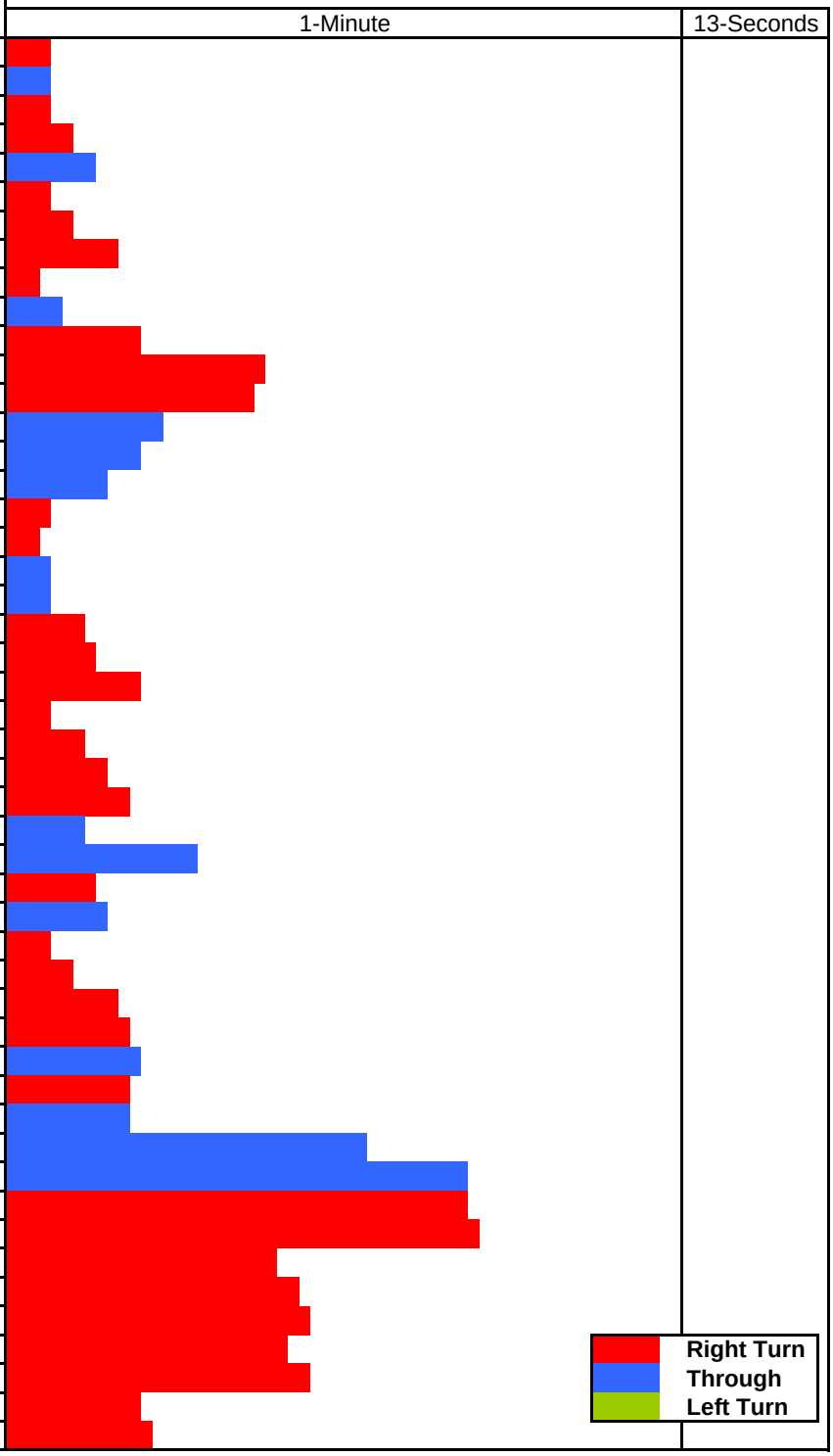
Eastbound AM Peak Delay Times 8/8

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
400	8:08:38 AM	8:08:46 AM	8
401	8:08:39 AM	8:08:47 AM	8
402	8:08:45 AM	8:08:51 AM	6
403	8:08:47 AM	8:08:55 AM	8
404	8:09:04 AM	8:09:09 AM	5
405	8:09:08 AM	8:09:14 AM	6
406	8:09:11 AM	8:09:15 AM	4
407	8:09:16 AM	8:09:28 AM	12
408	8:09:17 AM	8:09:29 AM	12
409	8:09:21 AM	8:09:30 AM	9
410	8:09:43 AM	8:09:46 AM	3
411	8:09:47 AM	8:09:51 AM	4
412	8:09:49 AM	8:09:52 AM	3
413	8:09:54 AM	8:09:57 AM	3
414	8:10:00 AM	8:10:09 AM	9
415	8:10:30 AM	8:10:34 AM	4
416	8:10:34 AM	8:10:37 AM	3
417	8:10:51 AM	8:10:54 AM	3
418	8:11:27 AM	8:11:33 AM	6
419	8:11:37 AM	8:11:40 AM	3
420	8:11:44 AM	8:11:50 AM	6
421	8:12:14 AM	8:12:19 AM	5
422	8:12:36 AM	8:12:41 AM	5
423	8:12:38 AM	8:12:51 AM	13
424	8:12:44 AM	8:13:06 AM	22
425	8:12:46 AM	8:13:10 AM	24
426	8:12:57 AM	8:13:11 AM	14
427	8:13:23 AM	8:13:30 AM	7
428	8:13:47 AM	8:13:51 AM	4
429	8:14:46 AM	8:14:49 AM	3



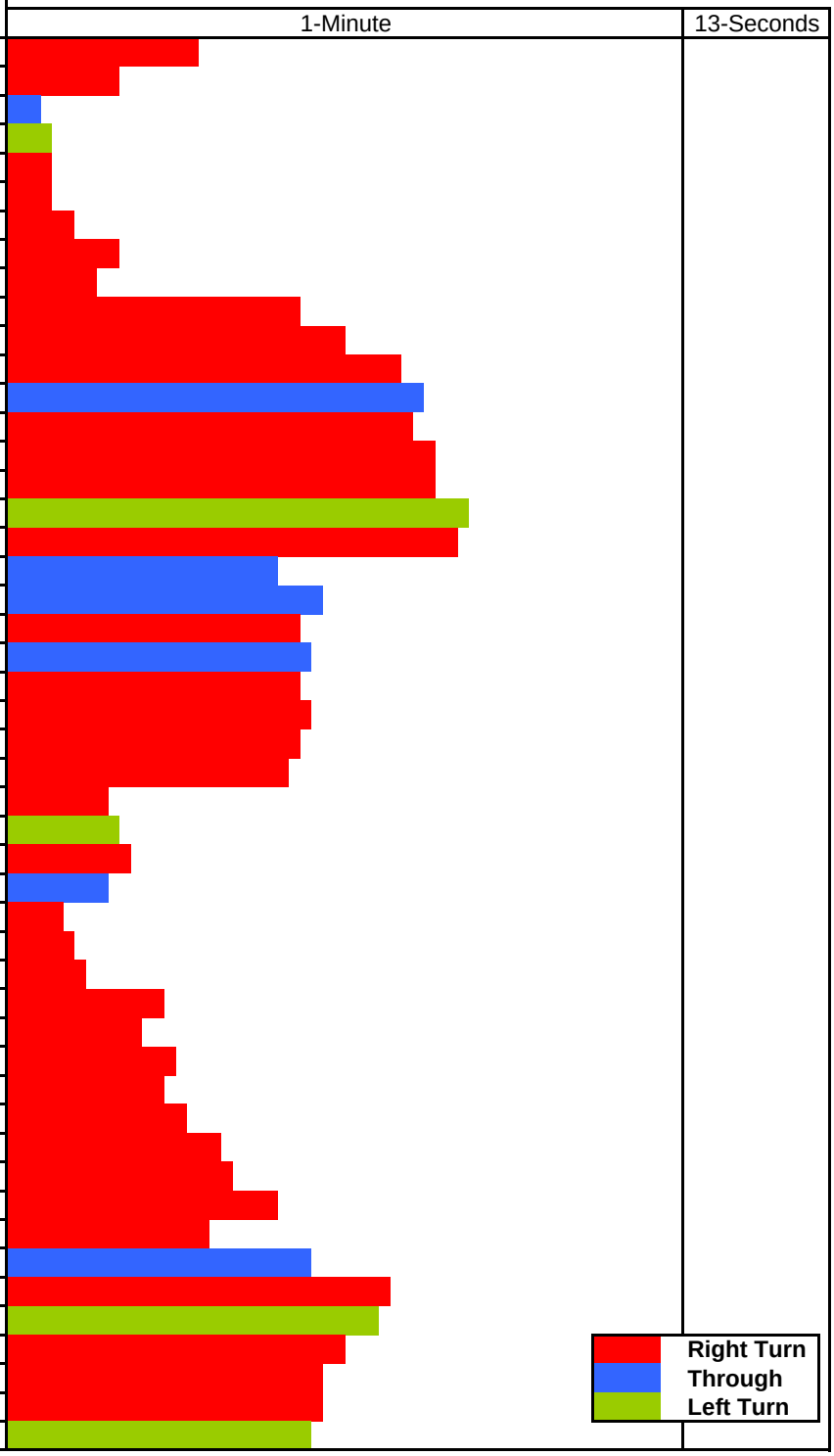
Eastbound PM Peak Delay Times 1/7

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
1	3:15:33 PM	3:15:37 PM	4
2	3:16:28 PM	3:16:32 PM	4
3	3:17:27 PM	3:17:31 PM	4
4	3:19:08 PM	3:19:14 PM	6
5	3:20:10 PM	3:20:18 PM	8
6	3:21:29 PM	3:21:33 PM	4
7	3:21:32 PM	3:21:38 PM	6
8	3:21:33 PM	3:21:43 PM	10
9	3:22:45 PM	3:22:48 PM	3
10	3:22:54 PM	3:22:59 PM	5
11	3:23:30 PM	3:23:42 PM	12
12	3:23:33 PM	3:23:56 PM	23
13	3:23:38 PM	3:24:00 PM	22
14	3:23:53 PM	3:24:07 PM	14
15	3:23:58 PM	3:24:10 PM	12
16	3:24:10 PM	3:24:19 PM	9
17	3:24:47 PM	3:24:51 PM	4
18	3:24:57 PM	3:25:00 PM	3
19	3:25:08 PM	3:25:12 PM	4
20	3:25:13 PM	3:25:17 PM	4
21	3:25:22 PM	3:25:29 PM	7
22	3:25:25 PM	3:25:33 PM	8
23	3:25:26 PM	3:25:38 PM	12
24	3:25:43 PM	3:25:47 PM	4
25	3:25:48 PM	3:25:55 PM	7
26	3:25:54 PM	3:26:03 PM	9
27	3:25:59 PM	3:26:10 PM	11
28	3:26:06 PM	3:26:13 PM	7
29	3:26:07 PM	3:26:24 PM	17
30	3:26:17 PM	3:26:25 PM	8
31	3:26:21 PM	3:26:30 PM	9
32	3:26:27 PM	3:26:31 PM	4
33	3:26:29 PM	3:26:35 PM	6
34	3:26:32 PM	3:26:42 PM	10
35	3:26:36 PM	3:26:47 PM	11
36	3:26:37 PM	3:26:49 PM	12
37	3:26:40 PM	3:26:51 PM	11
38	3:26:43 PM	3:26:54 PM	11
39	3:26:44 PM	3:27:16 PM	32
40	3:26:46 PM	3:27:27 PM	41
41	3:26:47 PM	3:27:28 PM	41
42	3:26:49 PM	3:27:31 PM	42
43	3:27:11 PM	3:27:35 PM	24
44	3:27:15 PM	3:27:41 PM	26
45	3:27:18 PM	3:27:45 PM	27
46	3:27:23 PM	3:27:48 PM	25
47	3:27:26 PM	3:27:53 PM	27
48	3:27:49 PM	3:28:01 PM	12
49	3:27:50 PM	3:28:03 PM	13



Eastbound PM Peak Delay Times 2/7

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
50	3:27:52 PM	3:28:09 PM	17
51	3:28:03 PM	3:28:13 PM	10
52	3:28:10 PM	3:28:13 PM	3
53	3:28:14 PM	3:28:18 PM	4
54	3:28:17 PM	3:28:21 PM	4
55	3:28:19 PM	3:28:23 PM	4
56	3:28:21 PM	3:28:27 PM	6
57	3:28:24 PM	3:28:34 PM	10
58	3:28:29 PM	3:28:37 PM	8
59	3:28:31 PM	3:28:57 PM	26
60	3:28:33 PM	3:29:03 PM	30
61	3:28:34 PM	3:29:09 PM	35
62	3:28:37 PM	3:29:14 PM	37
63	3:28:39 PM	3:29:15 PM	36
64	3:28:40 PM	3:29:18 PM	38
65	3:28:43 PM	3:29:21 PM	38
66	3:28:46 PM	3:29:27 PM	41
67	3:28:48 PM	3:29:28 PM	40
68	3:29:05 PM	3:29:29 PM	24
69	3:29:06 PM	3:29:34 PM	28
70	3:29:09 PM	3:29:35 PM	26
71	3:29:10 PM	3:29:37 PM	27
72	3:29:12 PM	3:29:38 PM	26
73	3:29:14 PM	3:29:41 PM	27
74	3:29:17 PM	3:29:43 PM	26
75	3:29:23 PM	3:29:48 PM	25
76	3:29:43 PM	3:29:52 PM	9
77	3:29:45 PM	3:29:55 PM	10
78	3:29:47 PM	3:29:58 PM	11
79	3:29:49 PM	3:29:58 PM	9
80	3:30:02 PM	3:30:07 PM	5
81	3:30:05 PM	3:30:11 PM	6
82	3:30:07 PM	3:30:14 PM	7
83	3:30:09 PM	3:30:23 PM	14
84	3:30:14 PM	3:30:26 PM	12
85	3:30:17 PM	3:30:32 PM	15
86	3:30:19 PM	3:30:33 PM	14
87	3:30:20 PM	3:30:36 PM	16
88	3:30:22 PM	3:30:41 PM	19
89	3:30:24 PM	3:30:44 PM	20
90	3:30:25 PM	3:30:49 PM	24
91	3:30:39 PM	3:30:57 PM	18
92	3:30:50 PM	3:31:17 PM	27
93	3:30:54 PM	3:31:28 PM	34
94	3:31:00 PM	3:31:33 PM	33
95	3:31:05 PM	3:31:35 PM	30
96	3:31:08 PM	3:31:36 PM	28
97	3:31:11 PM	3:31:39 PM	28
98	3:31:14 PM	3:31:41 PM	27



Eastbound PM Peak Delay Times 3/7

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
99	3:31:23 PM	3:31:43 PM	20
100	3:31:32 PM	3:31:45 PM	13
101	3:31:36 PM	3:31:51 PM	15
102	3:31:47 PM	3:31:57 PM	10
103	3:31:51 PM	3:31:58 PM	7
104	3:31:55 PM	3:32:02 PM	7
105	3:31:58 PM	3:32:17 PM	19
106	3:32:00 PM	3:32:19 PM	19
107	3:32:03 PM	3:32:29 PM	26
108	3:32:06 PM	3:32:37 PM	31
109	3:32:21 PM	3:32:41 PM	20
110	3:32:29 PM	3:32:51 PM	22
111	3:32:31 PM	3:32:54 PM	23
112	3:32:35 PM	3:32:55 PM	20
113	3:32:42 PM	3:32:57 PM	15
114	3:32:43 PM	3:33:05 PM	22
115	3:32:48 PM	3:33:10 PM	22
116	3:32:53 PM	3:33:20 PM	27
117	3:32:59 PM	3:33:23 PM	24
118	3:33:07 PM	3:33:25 PM	18
119	3:33:09 PM	3:33:29 PM	20
120	3:33:13 PM	3:33:31 PM	18
121	3:33:16 PM	3:33:33 PM	17
122	3:33:17 PM	3:33:36 PM	19
123	3:33:23 PM	3:33:39 PM	16
124	3:33:25 PM	3:33:43 PM	18
125	3:33:32 PM	3:33:47 PM	15
126	3:33:38 PM	3:33:53 PM	15
127	3:33:40 PM	3:34:00 PM	20
128	3:33:47 PM	3:34:01 PM	14
129	3:33:52 PM	3:34:02 PM	10
130	3:33:55 PM	3:34:03 PM	8
131	3:33:57 PM	3:34:08 PM	11
132	3:33:58 PM	3:34:10 PM	12
133	3:34:09 PM	3:34:13 PM	4
134	3:34:18 PM	3:34:23 PM	5
135	3:34:19 PM	3:34:27 PM	8
136	3:34:20 PM	3:34:31 PM	11
137	3:34:21 PM	3:34:35 PM	14
138	3:34:31 PM	3:34:39 PM	8
139	3:34:36 PM	3:34:44 PM	8
140	3:34:44 PM	3:34:49 PM	5
141	3:34:45 PM	3:35:05 PM	20
142	3:34:55 PM	3:35:09 PM	14
143	3:34:57 PM	3:35:12 PM	15
144	3:35:00 PM	3:35:13 PM	13
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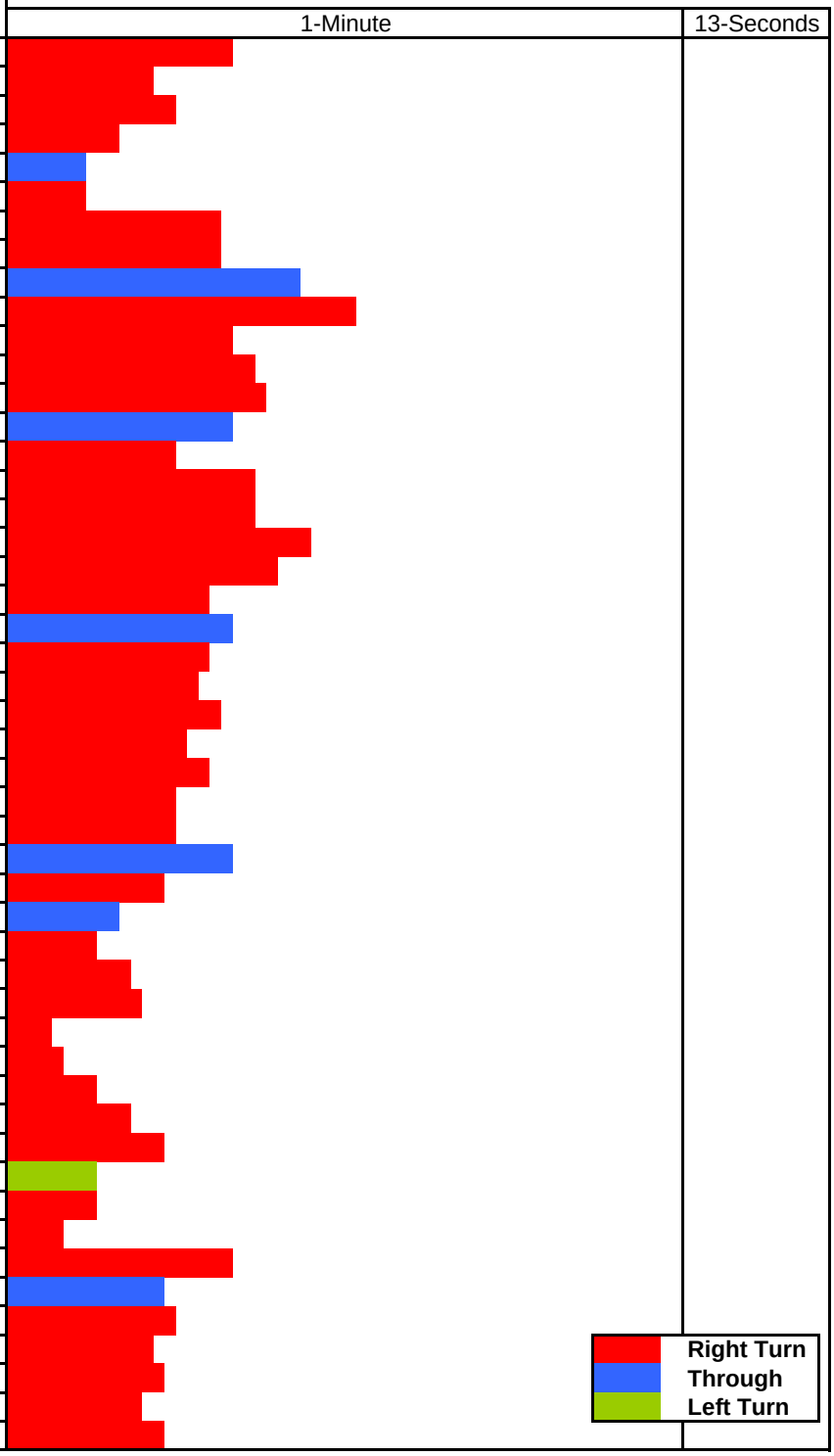
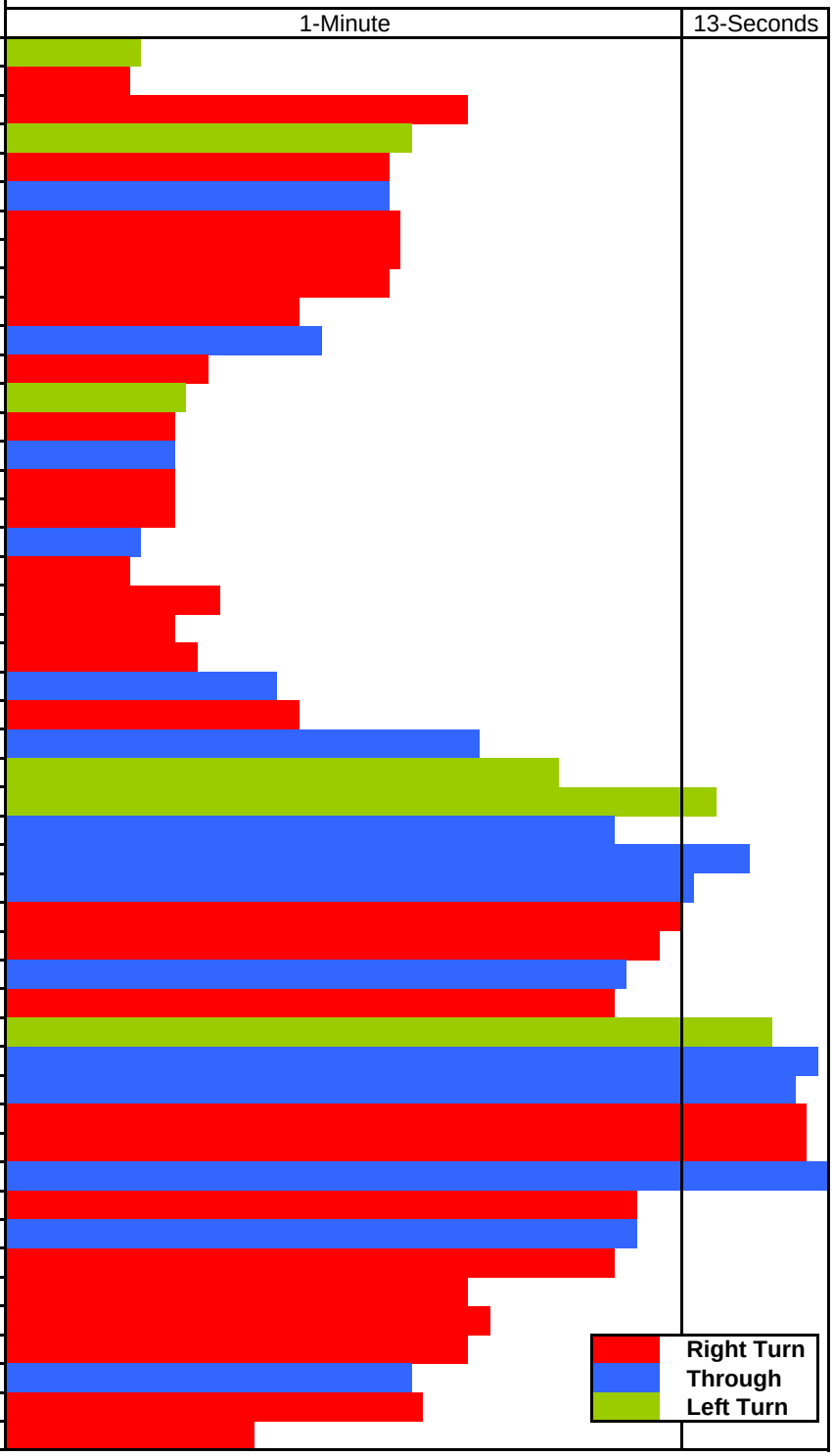
146	3:35:12 PM	3:35:24 PM	12
147	3:35:14 PM	3:35:28 PM	14



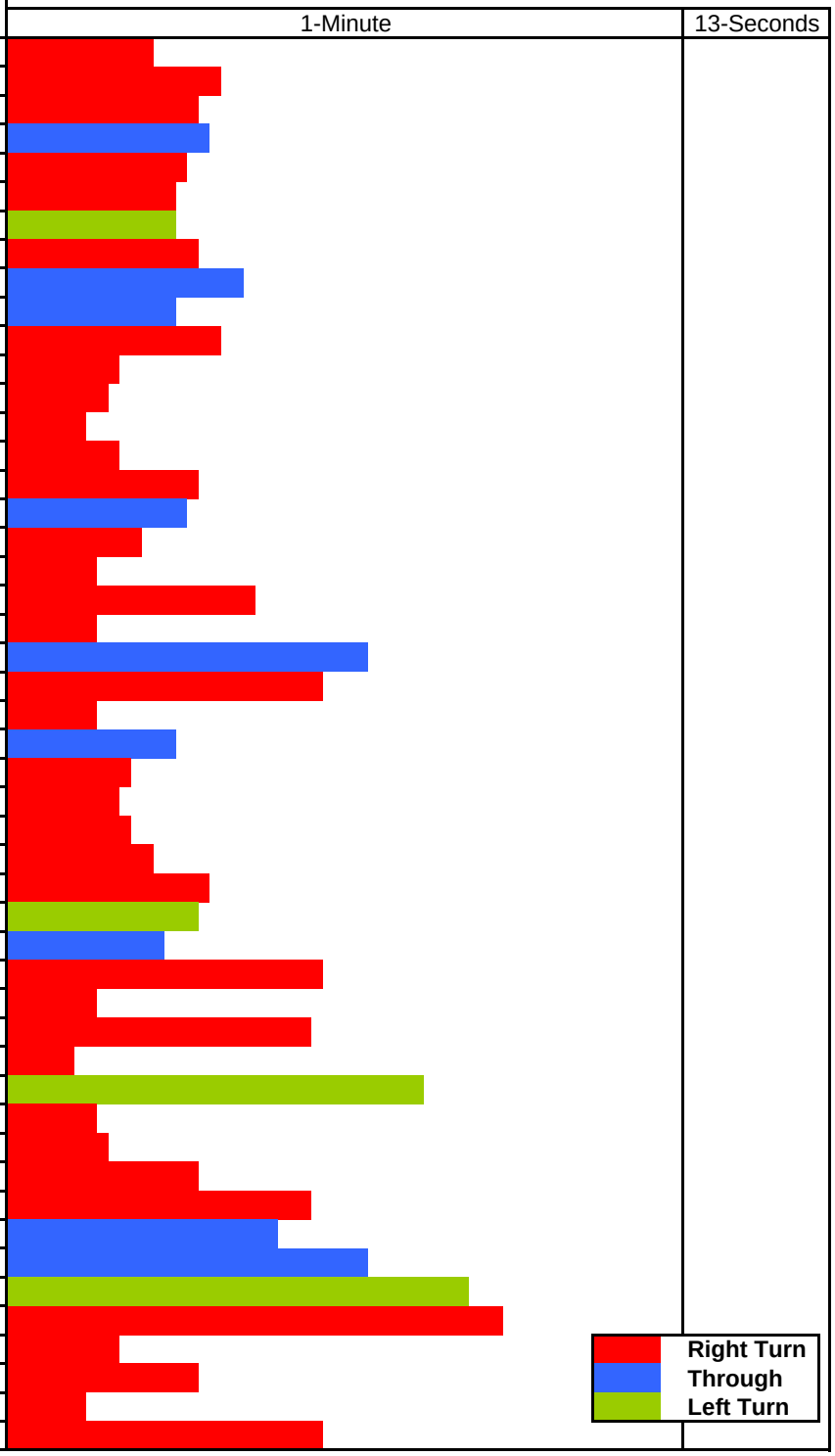
Eastbound PM Peak Delay Times 4/7

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
148	3:35:18 PM	3:35:30 PM	12
149	3:35:21 PM	3:35:32 PM	11
150	3:35:26 PM	3:36:07 PM	41
151	3:35:31 PM	3:36:07 PM	36
152	3:35:35 PM	3:36:09 PM	34
153	3:35:37 PM	3:36:11 PM	34
154	3:35:38 PM	3:36:13 PM	35
155	3:35:41 PM	3:36:16 PM	35
156	3:35:46 PM	3:36:20 PM	34
157	3:35:59 PM	3:36:25 PM	26
158	3:36:02 PM	3:36:30 PM	28
159	3:36:15 PM	3:36:33 PM	18
160	3:36:20 PM	3:36:36 PM	16
161	3:36:22 PM	3:36:37 PM	15
162	3:36:24 PM	3:36:39 PM	15
163	3:36:26 PM	3:36:41 PM	15
164	3:36:29 PM	3:36:44 PM	15
165	3:36:37 PM	3:36:49 PM	12
166	3:36:43 PM	3:36:54 PM	11
167	3:36:45 PM	3:37:04 PM	19
168	3:36:51 PM	3:37:06 PM	15
169	3:36:54 PM	3:37:11 PM	17
170	3:36:58 PM	3:37:22 PM	24
171	3:37:00 PM	3:37:26 PM	26
172	3:37:03 PM	3:37:45 PM	42
173	3:37:06 PM	3:37:55 PM	49
174	3:37:07 PM	3:38:10 PM	63
175	3:37:17 PM	3:38:11 PM	54
176	3:37:18 PM	3:38:24 PM	66
177	3:37:25 PM	3:38:26 PM	61
178	3:37:27 PM	3:38:27 PM	60
179	3:37:31 PM	3:38:29 PM	58
180	3:37:37 PM	3:38:32 PM	55
181	3:37:40 PM	3:38:34 PM	54
182	3:37:42 PM	3:38:50 PM	68
183	3:37:43 PM	3:38:55 PM	72
184	3:37:48 PM	3:38:58 PM	70
185	3:37:51 PM	3:39:02 PM	71
186	3:37:53 PM	3:39:04 PM	71
187	3:37:54 PM	3:39:07 PM	73
188	3:38:13 PM	3:39:09 PM	56
189	3:38:14 PM	3:39:10 PM	56
190	3:38:17 PM	3:39:11 PM	54
191	3:38:32 PM	3:39:13 PM	41
192	3:38:34 PM	3:39:17 PM	43
193	3:38:39 PM	3:39:20 PM	41
194	3:38:46 PM	3:39:22 PM	36
195	3:38:47 PM	3:39:24 PM	37
196	3:39:06 PM	3:39:28 PM	22



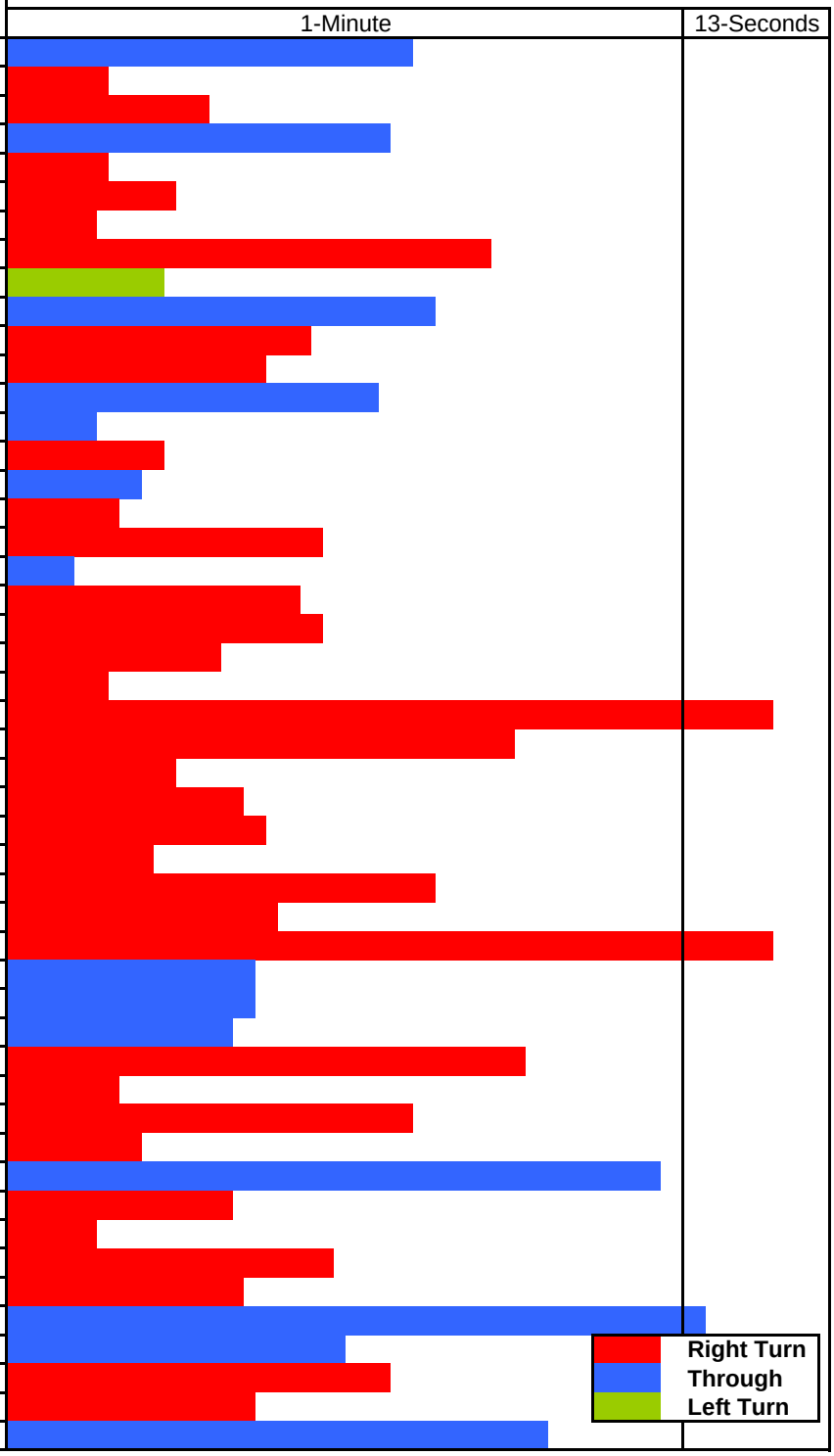
Eastbound PM Peak Delay Times 5/7

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
197	3:39:19 PM	3:39:32 PM	13
198	3:39:21 PM	3:39:40 PM	19
199	3:39:27 PM	3:39:44 PM	17
200	3:39:30 PM	3:39:48 PM	18
201	3:39:32 PM	3:39:48 PM	16
202	3:39:36 PM	3:39:51 PM	15
203	3:39:39 PM	3:39:54 PM	15
204	3:39:42 PM	3:39:59 PM	17
205	3:39:43 PM	3:40:04 PM	21
206	3:39:52 PM	3:40:07 PM	15
207	3:39:56 PM	3:40:15 PM	19
208	3:40:07 PM	3:40:17 PM	10
209	3:40:12 PM	3:40:21 PM	9
210	3:40:16 PM	3:40:23 PM	7
211	3:40:19 PM	3:40:29 PM	10
212	3:40:23 PM	3:40:40 PM	17
213	3:40:24 PM	3:40:40 PM	16
214	3:40:32 PM	3:40:44 PM	12
215	3:40:37 PM	3:40:45 PM	8
216	3:40:39 PM	3:41:01 PM	22
217	3:40:56 PM	3:41:04 PM	8
218	3:41:00 PM	3:41:32 PM	32
219	3:41:24 PM	3:41:52 PM	28
220	3:41:49 PM	3:41:57 PM	8
221	3:41:51 PM	3:42:06 PM	15
222	3:42:00 PM	3:42:11 PM	11
223	3:42:06 PM	3:42:16 PM	10
224	3:42:13 PM	3:42:24 PM	11
225	3:42:21 PM	3:42:34 PM	13
226	3:42:31 PM	3:42:49 PM	18
227	3:42:39 PM	3:42:56 PM	17
228	3:42:44 PM	3:42:58 PM	14
229	3:42:46 PM	3:43:14 PM	28
230	3:43:09 PM	3:43:17 PM	8
231	3:43:14 PM	3:43:41 PM	27
232	3:43:37 PM	3:43:43 PM	6
233	3:43:41 PM	3:44:18 PM	37
234	3:44:11 PM	3:44:19 PM	8
235	3:44:12 PM	3:44:21 PM	9
236	3:44:17 PM	3:44:34 PM	17
237	3:44:30 PM	3:44:57 PM	27
238	3:44:50 PM	3:45:14 PM	24
239	3:44:53 PM	3:45:25 PM	32
240	3:45:01 PM	3:45:42 PM	41
241	3:45:34 PM	3:46:18 PM	44
242	3:46:09 PM	3:46:19 PM	10
243	3:46:12 PM	3:46:29 PM	17
244	3:46:27 PM	3:46:34 PM	7
245	3:46:31 PM	3:46:59 PM	28



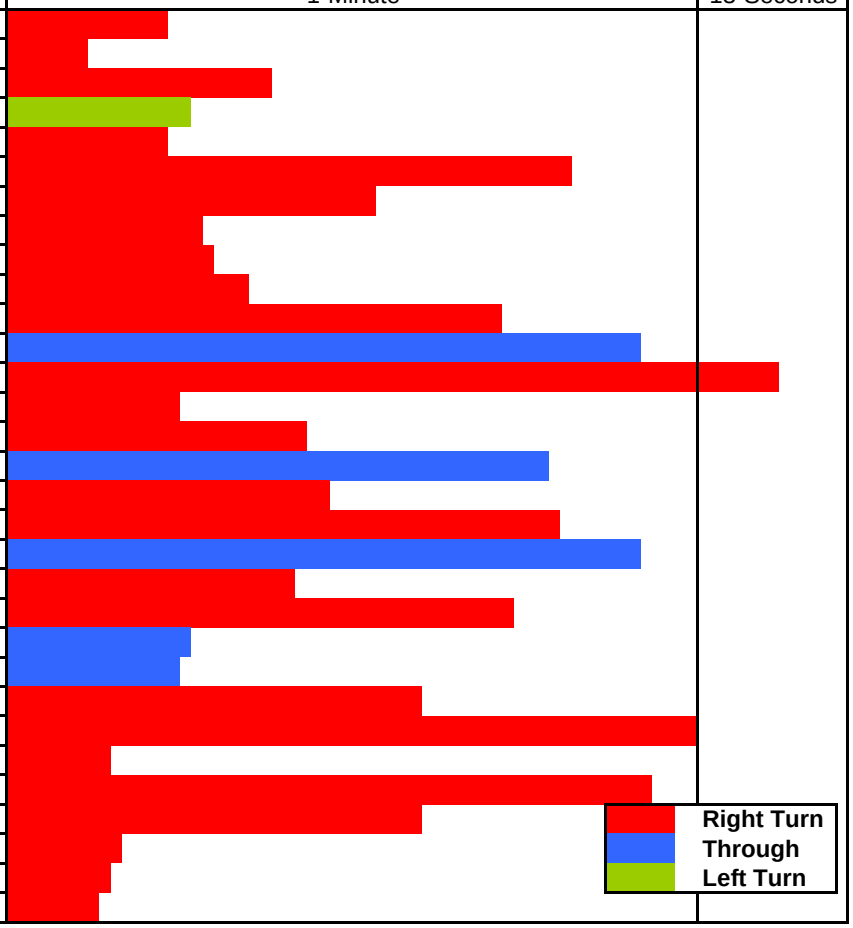
Eastbound PM Peak Delay Times 6/7

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
246	3:46:56 PM	3:47:32 PM	36
247	3:47:28 PM	3:47:37 PM	9
248	3:47:32 PM	3:47:50 PM	18
249	3:47:46 PM	3:48:20 PM	34
250	3:48:12 PM	3:48:21 PM	9
251	3:48:15 PM	3:48:30 PM	15
252	3:48:24 PM	3:48:32 PM	8
253	3:48:26 PM	3:49:09 PM	43
254	3:49:02 PM	3:49:16 PM	14
255	3:49:04 PM	3:49:42 PM	38
256	3:49:34 PM	3:50:01 PM	27
257	3:49:58 PM	3:50:21 PM	23
258	3:50:19 PM	3:50:52 PM	33
259	3:50:47 PM	3:50:55 PM	8
260	3:50:49 PM	3:51:03 PM	14
261	3:50:55 PM	3:51:07 PM	12
262	3:50:58 PM	3:51:08 PM	10
263	3:51:05 PM	3:51:33 PM	28
264	3:51:30 PM	3:51:36 PM	6
265	3:51:32 PM	3:51:58 PM	26
266	3:51:53 PM	3:52:21 PM	28
267	3:52:17 PM	3:52:36 PM	19
268	3:52:29 PM	3:52:38 PM	9
269	3:52:35 PM	3:53:43 PM	68
270	3:53:37 PM	3:54:22 PM	45
271	3:54:17 PM	3:54:32 PM	15
272	3:54:28 PM	3:54:49 PM	21
273	3:54:44 PM	3:55:07 PM	23
274	3:55:03 PM	3:55:16 PM	13
275	3:55:13 PM	3:55:51 PM	38
276	3:55:44 PM	3:56:08 PM	24
277	3:56:05 PM	3:57:13 PM	68
278	3:57:06 PM	3:57:28 PM	22
279	3:57:09 PM	3:57:31 PM	22
280	3:57:14 PM	3:57:34 PM	20
281	3:57:18 PM	3:58:04 PM	46
282	3:57:56 PM	3:58:06 PM	10
283	3:57:57 PM	3:58:33 PM	36
284	3:58:28 PM	3:58:40 PM	12
285	3:58:35 PM	3:59:33 PM	58
286	3:59:18 PM	3:59:38 PM	20
287	3:59:32 PM	3:59:40 PM	8
288	3:59:35 PM	4:00:04 PM	29
289	4:00:00 PM	4:00:21 PM	21
290	4:00:19 PM	4:01:21 PM	62
291	4:00:58 PM	4:01:28 PM	30
292	4:01:08 PM	4:01:42 PM	34
293	4:01:39 PM	4:02:01 PM	22
294	4:01:58 PM	4:02:46 PM	48



Eastbound PM Peak Delay Times 7/7

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
295	4:02:33 PM	4:02:47 PM	14
296	4:02:44 PM	4:02:51 PM	7
297	4:02:46 PM	4:03:09 PM	23
298	4:03:07 PM	4:03:23 PM	16
299	4:03:14 PM	4:03:28 PM	14
300	4:03:27 PM	4:04:16 PM	49
301	4:04:13 PM	4:04:45 PM	32
302	4:04:41 PM	4:04:58 PM	17
303	4:04:53 PM	4:05:11 PM	18
304	4:05:00 PM	4:05:21 PM	21
305	4:05:15 PM	4:05:58 PM	43
306	4:05:46 PM	4:06:41 PM	55
307	4:06:28 PM	4:07:35 PM	67
308	4:07:31 PM	4:07:46 PM	15
309	4:07:44 PM	4:08:10 PM	26
310	4:08:04 PM	4:08:51 PM	47
311	4:08:41 PM	4:09:09 PM	28
312	4:09:05 PM	4:09:53 PM	48
313	4:09:49 PM	4:10:44 PM	55
314	4:10:41 PM	4:11:06 PM	25
315	4:11:01 PM	4:11:45 PM	44
316	4:11:37 PM	4:11:53 PM	16
317	4:11:40 PM	4:11:55 PM	15
318	4:11:47 PM	4:12:23 PM	36
319	4:12:16 PM	4:13:16 PM	60
320	4:13:11 PM	4:13:20 PM	9
321	4:13:15 PM	4:14:11 PM	56
322	4:14:01 PM	4:14:37 PM	36
323	4:14:34 PM	4:14:44 PM	10
324	4:14:40 PM	4:14:49 PM	9
325	4:14:47 PM	4:14:55 PM	8

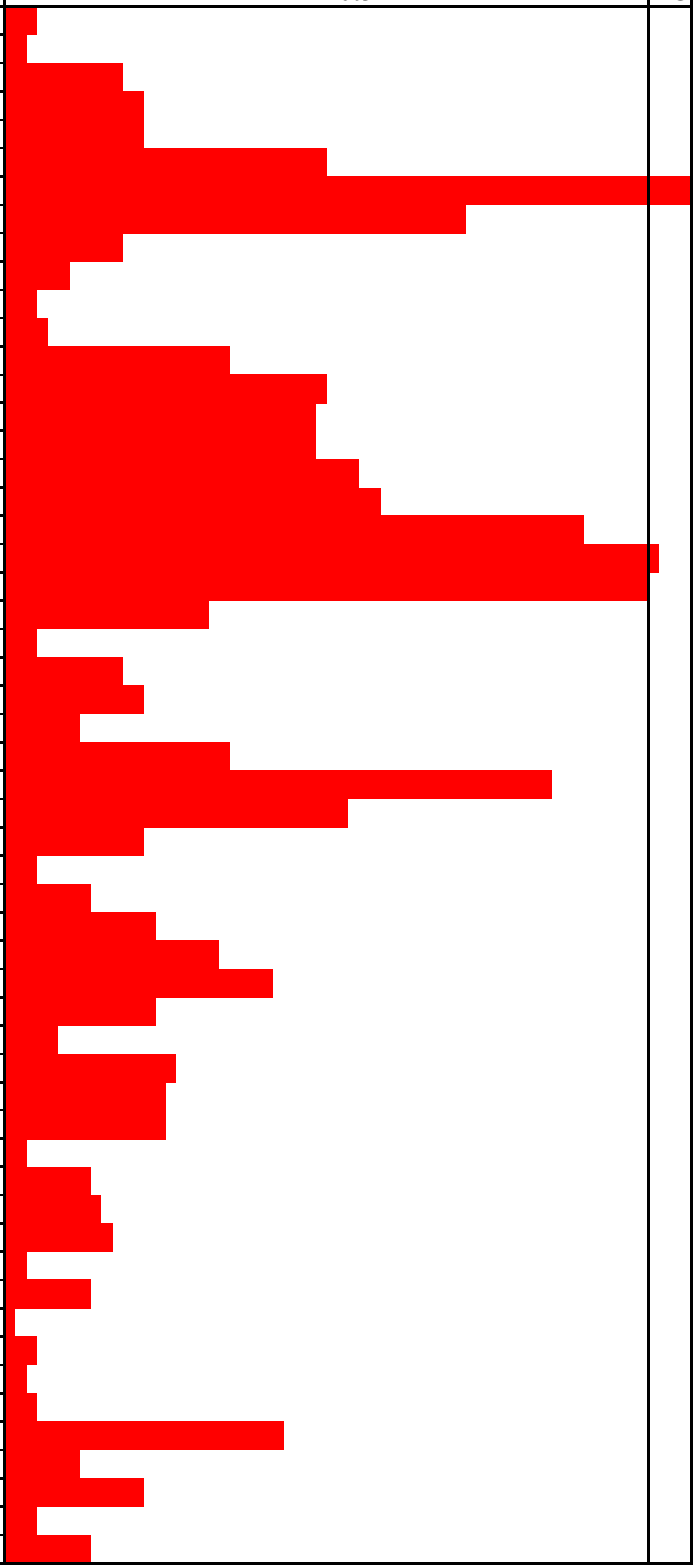


Westbound AM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
1	7:15:00 AM	7:15:12 AM	12
2	7:15:50 AM	7:16:12 AM	22
3	7:15:54 AM	7:16:25 AM	31
4	7:16:57 AM	7:17:10 AM	13
5	7:18:07 AM	7:18:10 AM	3
6	7:18:25 AM	7:18:26 AM	1
7	7:19:06 AM	7:19:07 AM	1
8	7:19:17 AM	7:19:20 AM	3
9	7:23:03 AM	7:23:16 AM	13
10	7:24:11 AM	7:24:13 AM	2
11	7:24:15 AM	7:24:17 AM	2
12	7:24:29 AM	7:24:42 AM	13
13	7:24:35 AM	7:24:58 AM	23
14	7:24:40 AM	7:25:02 AM	22
15	7:25:53 AM	7:26:02 AM	9
16	7:26:57 AM	7:27:34 AM	37
17	7:27:09 AM	7:27:57 AM	48
18	7:28:44 AM	7:28:50 AM	6
19	7:30:01 AM	7:30:06 AM	5
20	7:30:03 AM	7:30:07 AM	4
21	7:30:16 AM	7:30:58 AM	42
22	7:31:44 AM	7:31:50 AM	6
23	7:33:06 AM	7:33:08 AM	2
24	7:34:10 AM	7:34:15 AM	5
25	7:34:19 AM	7:34:21 AM	2
26	7:35:33 AM	7:35:36 AM	3
27	7:36:11 AM	7:36:15 AM	4
28	7:36:22 AM	7:36:29 AM	7
29	7:37:40 AM	7:37:58 AM	18
30	7:39:17 AM	7:39:24 AM	7
31	7:40:48 AM	7:40:50 AM	2
32	7:41:47 AM	7:41:48 AM	1
33	7:43:17 AM	7:43:19 AM	2
34	7:43:43 AM	7:43:47 AM	4
35	7:45:04 AM	7:46:24 AM	80
36	7:45:19 AM	7:48:15 AM	176
37	7:46:17 AM	7:48:18 AM	121
38	7:46:34 AM	7:48:24 AM	110
39	7:49:09 AM	7:50:50 AM	101
40	7:49:23 AM	7:50:53 AM	90
41	7:50:03 AM	7:51:10 AM	67
42	7:51:33 AM	7:51:36 AM	3
43	7:52:11 AM	7:53:21 AM	70
44	7:53:59 AM	7:54:19 AM	20
45	7:55:09 AM	7:55:15 AM	6
46	7:56:13 AM	7:59:32 AM	199
47	7:58:49 AM	8:00:08 AM	79
48	8:02:14 AM	8:02:32 AM	18
49	8:02:22 AM	8:02:44 AM	22
50	8:04:51 AM	8:04:55 AM	4
51	8:04:58 AM	8:05:05 AM	7
52	8:05:23 AM	8:05:31 AM	8
53	8:07:14 AM	8:07:16 AM	2
54	8:08:36 AM	8:08:39 AM	3
55	8:08:52 AM	8:08:59 AM	7
56	8:09:50 AM	8:09:59 AM	9
57	8:10:42 AM	8:10:47 AM	5
58	8:12:23 AM	8:12:51 AM	28
59	8:13:11 AM	8:13:23 AM	12
60	8:14:13 AM	8:14:22 AM	9

Westbound PM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue
1	3:15:01 PM	3:15:04 PM	3
2	3:16:33 PM	3:16:35 PM	2
3	3:16:41 PM	3:16:52 PM	11
4	3:17:58 PM	3:18:11 PM	13
5	3:18:01 PM	3:18:14 PM	13
6	3:18:04 PM	3:18:34 PM	30
7	3:18:07 PM	3:19:11 PM	64
8	3:19:03 PM	3:19:46 PM	43
9	3:19:38 PM	3:19:49 PM	11
10	3:19:48 PM	3:19:54 PM	6
11	3:19:56 PM	3:19:59 PM	3
12	3:19:59 PM	3:20:03 PM	4
13	3:20:00 PM	3:20:21 PM	21
14	3:20:01 PM	3:20:31 PM	30
15	3:20:03 PM	3:20:32 PM	29
16	3:20:11 PM	3:20:40 PM	29
17	3:20:17 PM	3:20:50 PM	33
18	3:20:30 PM	3:21:05 PM	35
19	3:20:41 PM	3:21:35 PM	54
20	3:20:46 PM	3:21:47 PM	61
21	3:20:52 PM	3:21:52 PM	60
22	3:23:52 PM	3:24:11 PM	19
23	3:24:24 PM	3:24:27 PM	3
24	3:24:47 PM	3:24:58 PM	11
25	3:25:39 PM	3:25:52 PM	13
26	3:26:10 PM	3:26:17 PM	7
27	3:27:12 PM	3:27:33 PM	21
28	3:30:01 PM	3:30:52 PM	51
29	3:30:26 PM	3:30:58 PM	32
30	3:31:38 PM	3:31:51 PM	13
31	3:31:55 PM	3:31:58 PM	3
32	3:31:57 PM	3:32:05 PM	8
33	3:32:03 PM	3:32:17 PM	14
34	3:32:04 PM	3:32:24 PM	20
35	3:32:07 PM	3:32:32 PM	25
36	3:35:12 PM	3:35:26 PM	14
37	3:36:05 PM	3:36:10 PM	5
38	3:36:55 PM	3:37:11 PM	16
39	3:36:58 PM	3:37:13 PM	15
40	3:37:03 PM	3:37:18 PM	15
41	3:37:50 PM	3:37:52 PM	2
42	3:39:37 PM	3:39:45 PM	8
43	3:39:40 PM	3:39:49 PM	9
44	3:39:43 PM	3:39:53 PM	10
45	3:41:40 PM	3:41:42 PM	2
46	3:42:13 PM	3:42:21 PM	8
47	3:43:23 PM	3:43:24 PM	1
48	3:43:26 PM	3:43:29 PM	3
49	3:43:48 PM	3:43:50 PM	2
50	3:43:51 PM	3:43:54 PM	3
51	3:44:17 PM	3:44:43 PM	26
52	3:44:44 PM	3:44:51 PM	7
53	3:45:37 PM	3:45:50 PM	13
54	3:45:52 PM	3:45:55 PM	3
55	3:45:58 PM	3:46:06 PM	8



Westbound PM Peak Delay Times

Vehicle Number	Joined Queue	Released from Queue	Time in Queue	1-Minute	4-S
56	3:47:09 PM	3:47:28 PM	19		
57	3:47:11 PM	3:47:32 PM	21		
58	3:48:28 PM	3:48:35 PM	7		
59	3:49:12 PM	3:49:14 PM	2		
60	3:50:11 PM	3:50:19 PM	8		
61	3:50:23 PM	3:50:27 PM	4		
62	3:50:45 PM	3:50:49 PM	4		
63	3:50:57 PM	3:51:02 PM	5		
64	3:51:01 PM	3:51:24 PM	23		
65	3:51:22 PM	3:51:29 PM	7		
66	3:52:07 PM	3:52:09 PM	2		
67	3:52:27 PM	3:52:28 PM	1		
68	3:54:01 PM	3:54:08 PM	7		
69	3:54:15 PM	3:54:17 PM	2		
70	3:57:50 PM	3:57:53 PM	3		
71	3:58:19 PM	3:58:32 PM	13		
72	3:59:15 PM	3:59:19 PM	4		
73	4:00:19 PM	4:00:25 PM	6		
74	4:00:24 PM	4:00:37 PM	13		
75	4:01:11 PM	4:01:33 PM	22		
76	4:01:59 PM	4:02:05 PM	6		
77	4:02:40 PM	4:02:43 PM	3		
78	4:03:35 PM	4:03:56 PM	21		
79	4:03:58 PM	4:04:01 PM	3		
80	4:04:16 PM	4:04:18 PM	2		
81	4:04:44 PM	4:05:04 PM	20		
82	4:06:25 PM	4:06:28 PM	3		
83	4:06:58 PM	4:07:04 PM	6		
84	4:07:40 PM	4:07:50 PM	10		
85	4:08:20 PM	4:08:29 PM	9		
86	4:09:10 PM	4:09:15 PM	5		
87	4:09:59 PM	4:10:02 PM	3		
88	4:10:52 PM	4:10:55 PM	3		
89	4:11:10 PM	4:11:18 PM	8		
90	4:11:25 PM	4:11:32 PM	7		
91	4:13:13 PM	4:13:17 PM	4		
92	4:13:35 PM	4:13:41 PM	6		