

Reconstruction of Route 2A (Ayer Road) At Willow Road and Bruce Street Littleton, Massachusetts

MassDOT Contract No. 608443



Prepared for



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Prepared by



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1.0 INTRODUCTION

This Functional Design Report for the reconstruction of Route 2A/110 (Ayer Road) at Willow Road/Bruce Street in the Town of Littleton has been prepared to evaluate and analyze safety concerns at this intersection. The signalized intersection of Route 2A/110 at Willow Road/Bruce Street is located in the northwest of the Town of Littleton in the close vicinity of the Ayer town line. Providing the east-west movements at the intersection, Route 2A/110 is classified as an urban principal arterial and is owned and maintained by the Massachusetts Department of Transportation (MassDOT). This roadway connects downtown Littleton and downtown Ayer, as well as downtown Ayer to I-495. Both Willow Road and Bruce Street are classified as urban collectors, and both are under town jurisdiction. Prior to the installation of the temporary traffic signal at the intersection during summer 2016, both Willow Road and Bruce Street provided the northwest and southwest “STOP” controlled approaches to the unsignalized intersection, respectively.

2.0 EXISTING CONDITIONS

Route 2A/110

Route 2A/110 is a two-lane, two-way road and is classified as an urban principal arterial under MassDOT jurisdiction. In the vicinity of the study intersection, Route 2A/110, runs east-west and is typically 25 - 30 feet wide. Route 2A/110 is typically striped with double solid yellow center lines and single white edge lines. The travel lanes are about 11-12 feet wide. Shoulder widths are quite variable and range from 2 to 4.5 feet in width. There are neither bicycle nor pedestrian accommodations along the corridor. No sidewalk exists along either side of the roadway. The posted speed limit in the vicinity of study intersection is 45 mph in both directions.

In the vicinity of the study intersection, most of the abutting properties along Route 2A/110 are businesses, while many of the intersecting side streets provide access to residences.

Bruce Street

Bruce Street is classified as an urban collector under Town of Littleton jurisdiction in the vicinity of the study intersection. It is a narrow 20-foot wide roadway without pavement markings. There are berms on both sides of the road in the vicinity of the intersection. The posted speed limit near the study intersection is 30 mph. Bruce Street generally runs southeast-northwest, and mostly provides residential access.

Willow Road

Willow Road is also classified as an urban collector under the jurisdiction of the Towns of Littleton and Ayer, whose border is just north of the study intersection. In the vicinity of the intersection, Willow Road is striped with double yellow center lines and single white edge lines. The lane widths range from 10.5-12 feet, with shoulders on both sides less than 2 feet wide. The posted speed limit on Willow Road in the vicinity of the study intersection is 35 mph. Willow Road continues the path of Bruce Street north from the intersection into Ayer, providing access to residences and businesses (commercial and industrial) before curving toward downtown Ayer.



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SCALE: 1" = 500'

Project Locus
Reconstruction of Route 2A/110 (Ayer Road) at Willow Road/Bruce Street
Littleton and Ayer, Massachusetts

Route 2A/110 at Willow Road/Bruce Street

The east-west running Route 2A/110 intersects Willow Road and Bruce Street to form a four-way, skewed intersection. Route 2A/110 provides the eastern and western legs, with Willow Road and Bruce Street forming the northwestern and southeastern legs, respectively. Each leg provides a single approaching lane and a single receiving lane. All the approaches widen at the intersection for truck movements. The intersection was unsignalized before summer 2016. Both the Willow Road and Bruce Street approaches operated under STOP control at the intersection, while vehicular traffic on Route 2A ran “freely”. Temporary traffic signals were installed to the intersection in summer 2016 by MassDOT District 3 to address safety concerns at this intersection.



Route 2A/110, looking west towards the unsignalized intersection with Willow Road/Bruce Street

Chip Shots Pub is located on the north side of the Route 2A/110 westbound approach. Prior to the installation of the temporary traffic signal at the intersection, Chip Shots Pub had two full-access (enter/exit) driveways along Route 2A/110 in the vicinity of the intersection. The installation of the temporary traffic signal also included the removal of the western full-access driveway, leaving the eastern driveway as the sole driveway providing access to/from the pub. At the northeast corner of the intersection is a single residence addressed 245 Ayer Road. The house is adjacent to the pub on the western side and has its driveway within the intersection from the northeast. This driveway is signalized. On the northwest corner of the intersection there is a truck parking lot with a wide, undefined curb cut allowing access to Route 2A/110. On the southwest corner of the intersection, across from the truck parking lot, is the Gulf Gas Station with two driveways along Route 2A/110. The easterly driveway is signalized. At the acute southeast corner of the intersection is Matheson Farm and on the southwest side of Bruce Street is a single house (addressed 5 Bruce Street) with a driveway just off the intersection.

The pavement at the intersection is in overall fair condition, with patched potholes on both sides of the Route 2A eastbound approach. Pavement markings at the intersection are faded. During the field visit in early May 2016, MassDOT Safety Review Prompt List was used to identify opportunities to enhance safety. High travel speeds on Route 2A/110 and frequent truck traffic between Willow Road and Route 2A/110 were observed. Prior to the temporary signal installation, it was noticeable that the multiple driveways at the intersection caused access management problems and posed potential threats to traffic safety and operation.

3.0 TRAFFIC VOLUMES

A traffic counting program was conducted as part of this study to analyze existing and proposed traffic operational conditions.

3.1 Existing Traffic Volumes

The initial traffic counting program included twenty-four (24) hour Automatic Traffic Recorder (ATR) counts on Route 2A/110 and Willow Road from midnight on Tuesday November 10, 2015 to midnight on Wednesday November 11, 2015 at three locations. A summary of the 2015 ATR data is found in Table 3.1. The complete ATR data are included in the Appendix.

Table 3.1 – 2015 ATR Data Summary

LOCATION	85 TH PERCENTILE SPEED	AVERAGE WEEKDAY VOLUME	WEEKDAY AM PEAK HOUR				WEEKDAY PM PEAK HOUR			
			TIME	VOLUME	K- FACTOR	DIR. DIST.	TIME	VOLUME	K- FACTOR	DIR. DIST.
Route 2A/110, west of Willow Road	51 MPH EB 47 MPH WB	12,022 vpd	6:45 AM to 7:45 AM	1,122 vph	9.3%	73.6% EB	3:45 PM to 4:45 PM	981 vph	8.2%	55.9% WB
Route 2A/110, east of Willow Road	44 MPH EB 42 MPH WB	14,504 vpd	6:45 AM to 7:45 AM	1,230 vph	8.5%	68.0% EB	4:30 PM to 5:30 PM	1,201 vph	8.3%	65.4% WB
Willow Road, north of Route 2A/110	42 MPH NB 42 MPH SB	4,436 vpd	7:00 AM to 8:00 AM	374 vph	8.4%	63.4% SB	4:30 PM to 5:30 PM	437 vph	9.9%	68.6% NB
Abbreviations: vpd = vehicles per day vph = vehicles per hour										
K-Factor = Percentage of daily traffic that occurs during the peak hour Dir. Dist. = Directional Distribution										

In addition to the ATR counts, manual Turning Moving Counts (TMCs) were taken on a weekday (November 10th, 2015) at the intersection. Peak hour TMCs (7am-9am and 4pm-6pm) were used for operational analysis of the unsignalized intersection. The peak hours for the study intersection were determined based on the TMCs. It was concluded that the AM peak hour occurs between 7:00 and 8:00, while the PM peak hour occurs between 4:30 and 5:30. The complete TMC data are included in the Appendix.

In determining seasonal variations in traffic volumes, data from the MassDOT permanent count station (No. 34) located on Route 2 in Lancaster, west of the project limits, were used. Between the years 2009-2015, MassDOT weekday seasonal factors indicate that traffic volumes in November are 1% below average annual traffic (this range was used in order to provide comprehensive monthly count data). Hence, a factor of 1.01 was applied to the count data to represent an annual average. Data from the MassDOT station are included in the Appendix. Figure 2 shows the 2015 peak hour traffic volumes.

As mentioned previously, a temporary traffic signal was installed and put into use at this intersection in summer 2016. Since then, Littleton Town officials and residents noticed changes in traffic patterns, especially increased traffic on the Bruce Street approach to the intersection and requested another traffic

counting program be performed to analyze the current traffic operating conditions at the intersection. In response to the request, forty-eight (48) hour ATR counts on Route 2A/110 (both east and west of the intersection), Willow Road and Bruce Street were taken from midday on Wednesday December 13, 2017 to midday on Friday December 15, 2017. A summary of the 2017 ATR data is found in Table 3.2. The complete 2017 ATR data are included in the Appendix.

Table 3.2 – 2017 ATR Data Summary

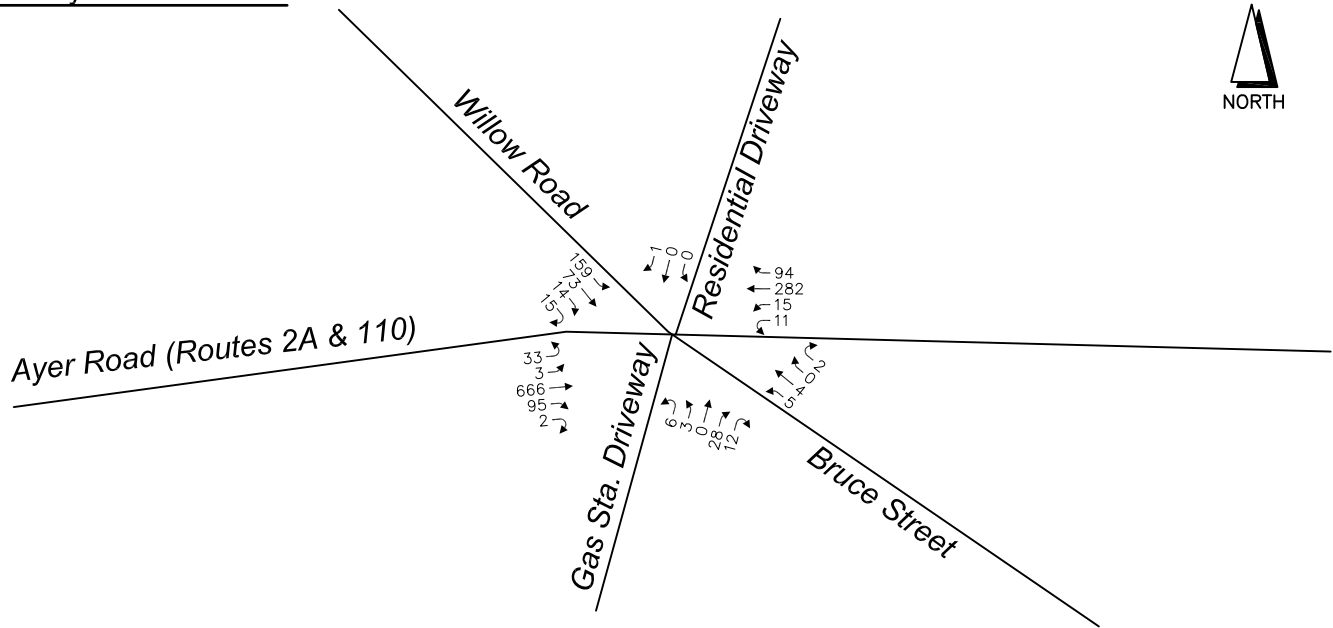
LOCATION	85 TH PERCENTILE SPEED	AVERAGE WEEKDAY VOLUME	WEEKDAY AM PEAK HOUR				WEEKDAY PM PEAK HOUR			
			TIME	VOLUME	K- FACTOR	DIR. DIST.	TIME	VOLUME	K- FACTOR	DIR. DIST.
Route 2A/110, west of Willow Road	43 MPH EB 47 MPH WB	11,420 vpd	8:00 AM to 9:00 AM	793 vph	6.9%	71.2% EB	4:00 PM to 5:00 PM	913 vph	8.0%	53.9% WB
Route 2A/110, east of Willow Road	44 MPH EB 42 MPH WB	13,774 vpd	8:00 AM to 9:00 AM	1,009 vph	7.3%	71.4% EB	6:00 PM to 7:00 PM	1,062 vph	7.7%	65.7% WB
Willow Road, north of Route 2A/110	39 MPH NB 38 MPH SB	4,691 vpd	8:00 AM to 9:00 AM	414 vph	8.8%	72.9% SB	6:00 PM to 7:00 PM	429 vph	9.1%	68.3% NB
Bruce Street, south of Route 2A/110	37 MPH NB 38 MPH SB	1,128 vpd	8:00 AM to 9:00 AM	143 vph	12.7%	86.0% SB	5:00 PM to 6:00 PM	122 vph	10.8%	68.9% NB
Abbreviations: vpd = vehicles per day vph = vehicles per hour K-Factor = Percentage of daily traffic that occurs during the peak hour Dir. Dist. = Directional Distribution										

In addition to the ATR counts, manual TMCs were taken on a weekday (December 13, 2017) at the signalized intersection. Peak hour TMCs (6am-9am and 3pm-6pm) were used for operational analysis of the signalized intersection. The peak hours for the study intersection were determined based on the TMCs. It was concluded that the AM peak hour occurs between 6:45 and 7:45, while the PM peak hour occurs between 4:30 and 5:30. The complete 2017 TMC data are included in the Appendix.

In determining seasonal variations in traffic volumes, data from the MassDOT permanent count station (No. 34) located on Route 2 in Lancaster, west of the project limits, were used again. Between the years 2009-2015, MassDOT weekday seasonal factors indicate that traffic volumes in December are 5% below average annual traffic (this range was used in order to provide comprehensive monthly count data). Hence, a factor of 1.05 was applied to the count data to represent an annual average. Figure 3 presents the 2017 peak hour traffic volumes.

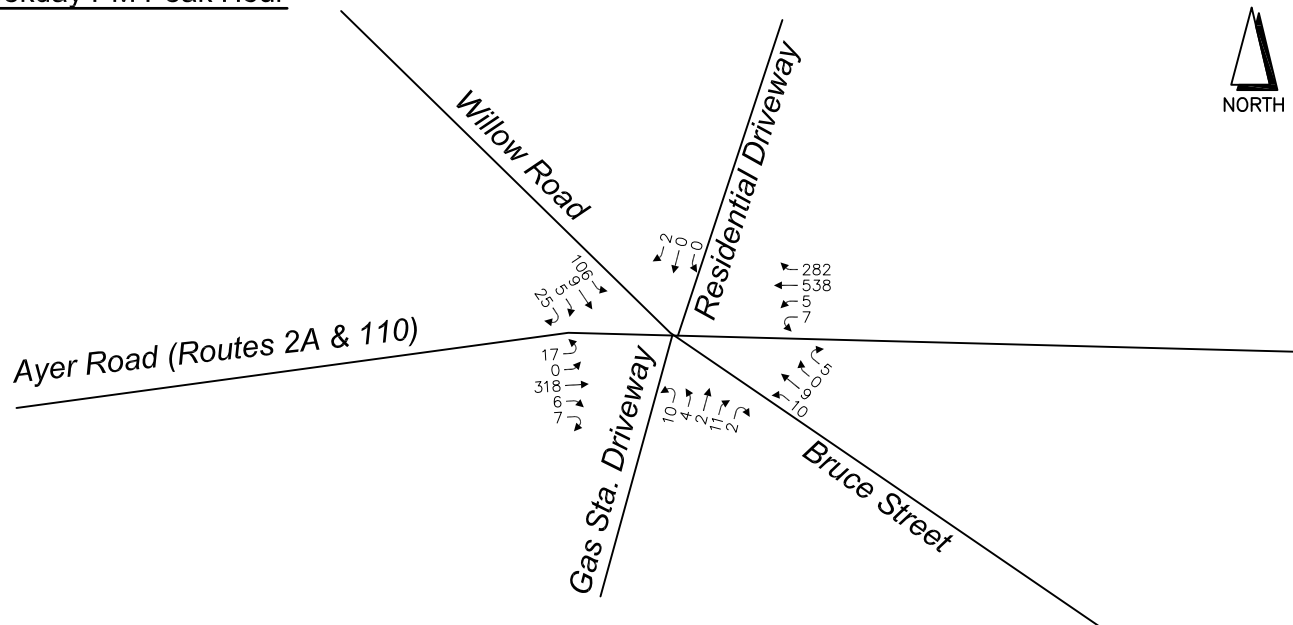
Comparing the data of 2015 and 2017, it can be seen that, in 2017, traffic has increased for both Willow Road and Bruce Street since the temporary signal has been in place. The traffic increase coincided with a decrease in traffic along Route 2A/110. It appears that the temporary signal has made turning maneuvers out of the side streets easier, and therefore, some of the Route 2A/110 drivers are using other routes to get through this intersection when compared to the 2015 pre-signalization condition.

Weekday AM Peak Hour



Not To Scale

Weekday PM Peak Hour



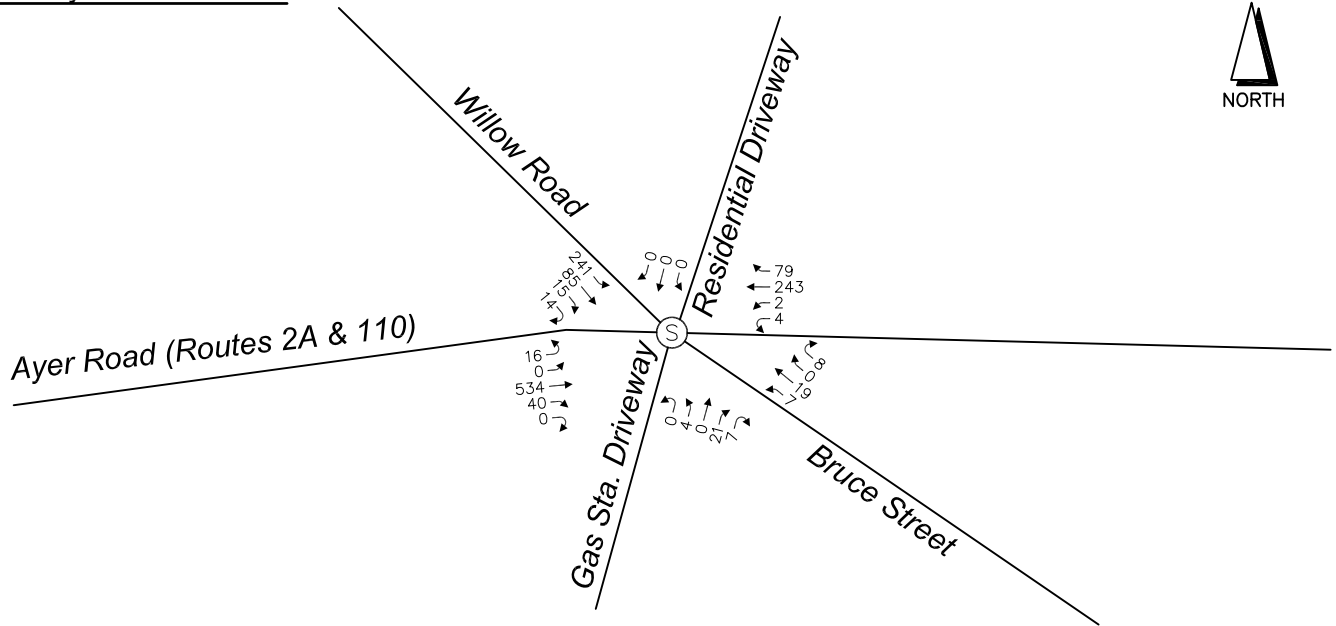
Not To Scale



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Figure 2
2015 Peak Hour Traffic Volumes
Ayer Road/Willow Road/Bruce Street
Littleton, MA

Weekday AM Peak Hour

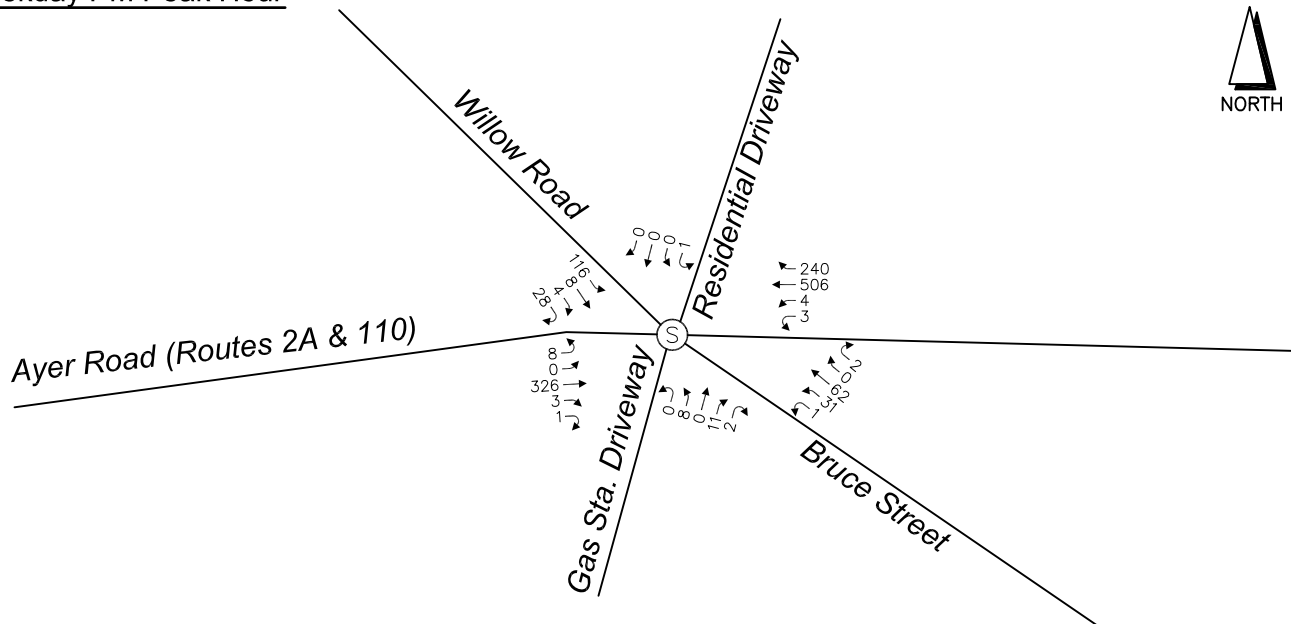


LEGEND

(S) - Signalized intersection

Not To Scale

Weekday PM Peak Hour



LEGEND

(S) - Signalized intersection

Not To Scale



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Figure 3
2017 Peak Hour Traffic Volumes
Ayer Road/Willow Road/Bruce Street
Littleton, MA

3.2 Future Traffic Volume Projections

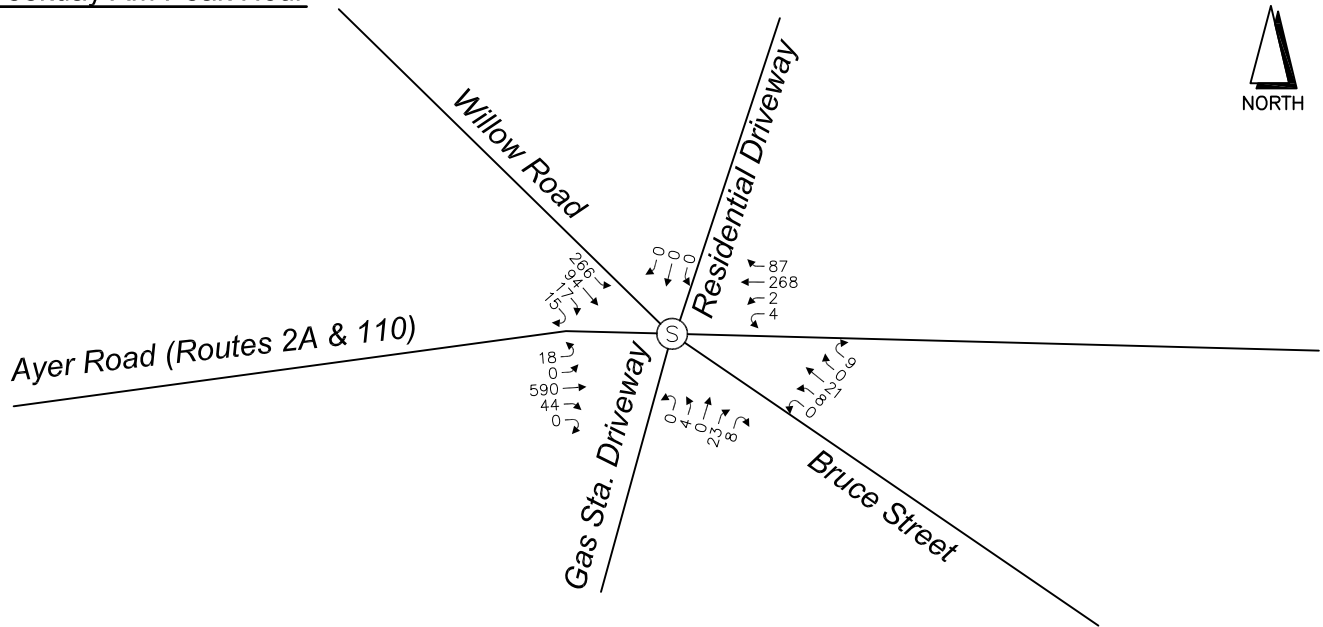
The 2017 existing traffic volumes were projected 20 years into the future for the design year 2037 by adding a background growth rate compounded annually.

In determining annual background growth rate, traffic counts in the vicinity of Route 2A/Willow Road/Bruce Street intersection from 1998 to 2017 were reviewed, and it was found that in general volumes has not increased over the years. An annual background growth rate of 0.5% per year was used to forecast volumes for the design year 2037 in order to provide a conservative analysis.

Coordination with the Towns of Littleton and Ayer revealed there are no projects that are predicted to substantially affect traffic volumes in the project area.

Figure 4 presents the projected Future 2037 AM and PM peak hour traffic volumes.

Weekday AM Peak Hour

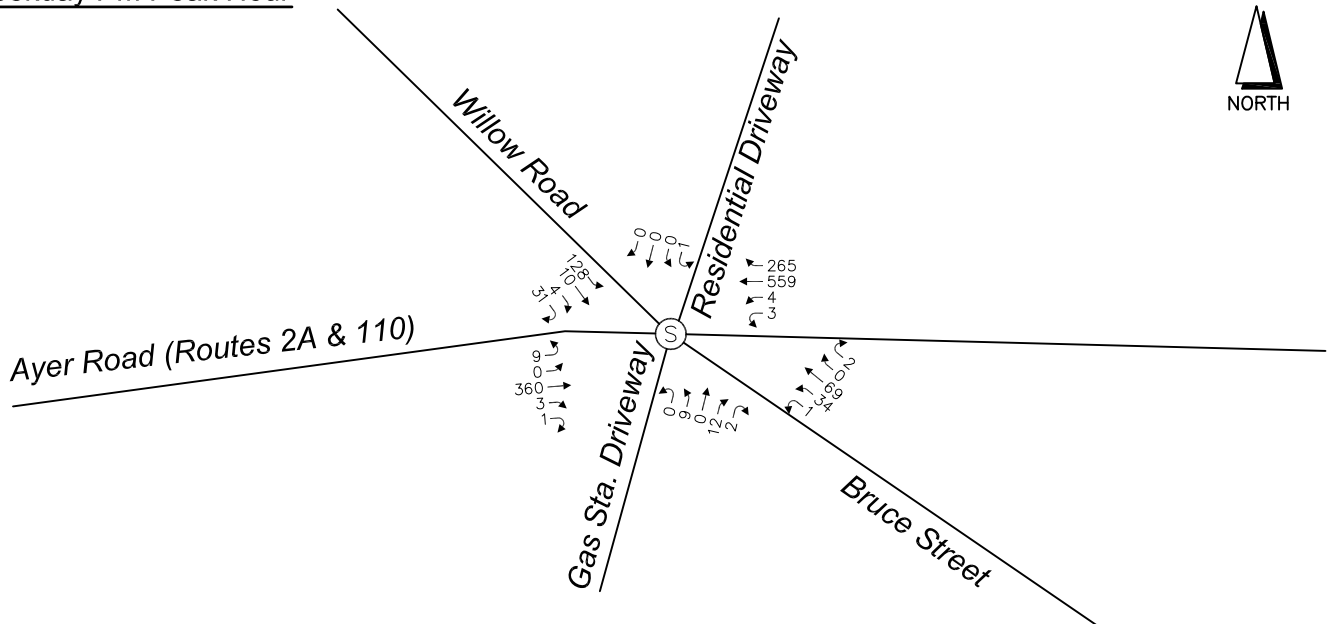


LEGEND

(S) - Signalized intersection

Not To Scale

Weekday PM Peak Hour



LEGEND

(S) - Signalized intersection

Not To Scale



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Figure 4
2037 Projected Traffic Volumes
Ayer Road/Willow Road/Bruce Street
Littleton, MA

4.0 SAFETY ANALYSIS

Crash data for the years 2013-2015 were obtained from MassDOT and the Littleton Police Department. The records from the local police in Littleton indicate that there were 23 crashes at the project intersection during the three-year study timeframe (the most recent years, 2013-2015). Approximately 50% of the crashes were angled collisions, a significantly larger percentage than any other crash type. This high percentage of angled collisions is likely due to the skewed angle of the intersection, as well as the lack of traffic control on the Route 2A/110 approaches. This could make it difficult for drivers coming from the Willow Road/Bruce Street approaches to find an acceptable gap to enter the intersection, leading them to make riskier choices. Safety could be improved here by realigning the northbound and southbound approaches to make them more perpendicular to Route 2A/110, as well as implementing traffic control on the eastbound and westbound approaches. A consolidated summary of the crash data obtained from MassDOT and the Littleton Police Department are presented in Table 4.1.

Please note that at the time of the 25% Design submittal, three full years of crash data is not yet available to evaluate the safety improvements that is expected to have resulted from the installation of the temporary signal, therefore, our safety analysis utilizes numbers from before the existing signal was installed. Based on observations and feedbacks from the community, the installation of the temporary signal appears to have addressed the identified safety concerns.

Table 4.1 – Summary of Intersection Crash Data

	Willow Rd / Bruce St / Rt 2A/110		
	2013	2014	2015
Severity			
Property Damage	1	4	7
Injury	3	4	3
Fatality			1
Unknown			
Collision Type			
Rear End	1	1	2
Angle	1	3	8
Side Swipe	1		
Head On		4	
Single Vehicle	1		1
Collision with Ped			
Collision with Bike			
Other/Unknown			
Time of Day			
6:01 AM – 10:00 AM	2	2	4
10:01 AM – 4:00 PM		2	4
4:01 PM – 7:00 PM	1	1	2
7:01 PM – 6:00 AM	1	3	1
Roadway Conditions			
Dry	2	6	9
Wet	1	2	1
Snow/Ice	1		
Other/Unknown			1
Season			
Dec-Feb	3	2	1
Mar-May			1
June-Aug		4	4
Sept-Nov	1	2	5
Light Conditions			
Daylight	2	4	11
Dawn/Dusk	1	1	
Dark (Unlit)			
Dark (Lit)	1	3	
Unknown			
Totals	4	8	11
Annual Average Crashes	7.67		
Intersection Crash Rate (MEV)	1.42		
MassDOT District 3 Average Crash Rate (MEV)	0.65		

5.0 TRAFFIC SIGNAL WARRANT ANALYSIS

Chapter 4C of the Manual on Uniform Traffic Control Devices (MUTCD) provides multiple warrants for determining if traffic signal control could be installed at an intersection. If one or more warrants are met, the installation of a traffic signal is not required but should be considered. While any of the traffic signal warrants may be used to justify a traffic signal, MassDOT generally prefers that Warrant 1 (Eight-hour vehicular volume) be satisfied prior to the installation of a traffic signal. Warrant 1 has two conditions, either of which may be used to satisfy the warrant. Condition A is Minimum Vehicular Volume and Condition B is interruption of Continuous Traffic Flow. Compared to Condition A, Condition B has a higher threshold for vehicular volume on the major street but a lower threshold for vehicular volume on the minor street.

A warrant analysis was performed for the intersection to see if installing a traffic signal would be justified. Year 2015 ATR data was used to estimate traffic at each of the approaches during a 24-hour span. Under the 2015 conditions, the intersection of Route 2A/110 and Willow Road/Bruce Street met the volume thresholds for Warrant 1 Condition A for 10 of the 24 hours that data were collected and met Condition B for 13 of the 24 hours. Therefore, a signal at this location is warranted. The warrant analysis for the 2015 conditions are summarized in Table 5.1. In addition to the preferred Warrant 1, the intersection also met Warrant 2 (Four-hour vehicular volumes) and Warrant 3 (One-hour vehicular volume). In both warrant analyses, the 70% volume threshold was used, due to the posted speed on Route 2A being greater than 40 MPH. The warrant analyses for these secondary warrants can be found in the Appendix. A temporary traffic signal system was installed by MassDOT District 3 in the summer of 2016.

Table 5.1 – Signal Warrant 1 Analysis, Route 2A at Willow Road/Bruce Street

2015 TRAFFIC VOLUMES						
WARRANT 1, EIGHT-HOUR VEHICULAR VOLUME	INTERSECTION APPROACH VOLUMES				CONDITION A MET?	CONDITION B MET?
	ROUTE 2A (TOTAL OF BOTH APPROACHES)	WILLOW Rd/BRUCE ST				
		WILLOW Rd SB APPROACH	BRUCE ST NB APPROACH	HIGHER APPROACH		
Condition A Thresholds	350			105		
Condition B Thresholds	525			53		
Time Period						
12:00 AM to 1:00 AM	71	7	-	7	No	No
1:00 AM to 2:00 AM	71	5	-	5	No	No
2:00 AM to 3:00 AM	39	6	-	6	No	No
3:00 AM to 4:00 AM	79	7	-	7	No	No
4:00 AM to 5:00 AM	132	25	-	25	No	No
5:00 AM to 6:00 AM	402	83	-	83	No	No
6:00 AM to 7:00 AM	937	169	-	169	Yes	Yes
7:00 AM to 8:00 AM	1195	237	-	237	Yes	Yes
8:00 AM to 9:00 AM	982	197	-	197	Yes	Yes
9:00 AM to 10:00 AM	717	156	-	156	Yes	Yes
10:00 AM to 11:00 AM	624	91	-	91	No	Yes
11:00 AM to 12:00 PM	654	122	-	122	Yes	Yes
12:00 PM to 1:00 PM	750	117	-	117	Yes	Yes
1:00 PM to 2:00 PM	687	88	-	88	No	Yes
2:00 PM to 3:00 PM	779	118	-	118	Yes	Yes
3:00 PM to 4:00 PM	1080	148	-	148	Yes	Yes
4:00 PM to 5:00 PM	1070	150	-	150	Yes	Yes
5:00 PM to 6:00 PM	1091	122	-	122	Yes	Yes
6:00 PM to 7:00 PM	787	100	-	100	No	Yes
7:00 PM to 8:00 PM	472	42	-	42	No	No
8:00 PM to 9:00 PM	330	33	-	33	No	No
9:00 PM to 10:00 PM	261	19	-	19	No	No
10:00 PM to 11:00 PM	191	8	-	8	No	No
11:00 PM to 12:00 AM	123	12	-	12	No	No
Number of Hours in which Condition is Met					10	13
Warrant 1 Satisfied?					Yes	
Note: Volume thresholds are based on “1” lane on the Major Street and “1” lane on the Minor Street						

6.0 PROPOSED CONDITIONS

This section describes the major features of the proposed intersection improvements and presents discussion on design alternatives considered.

The following alternatives were considered and evaluated at this intersection:

- Construct a roundabout, or
- Reconstruct the existing skewed intersection with different lane assignment and a new permanent traffic signal system
- Reconstruct this intersection as two offset intersections, a signalized intersection at Willow Road with an exclusive left-turn lane and a shared through-right lane on the Route 2A/110 westbound approach, and an unsignalized intersection at Bruce Street
- Reconstruct this intersection as two offset intersections, a signalized intersection at Willow Road with three exclusive lanes (left-turn, through, and right-turn) on the Route 2A/110 westbound approach, and an unsignalized intersection at Bruce Street

All alternatives will include improved pedestrian and bicycle facilities, including sidewalks on all legs of the intersection, crosswalks where possible, and five (5) foot wide shoulders along both Route 2A/110 approaches to accommodate bicycles. In all alternatives, crosswalks are provided to cross Willow Road and Bruce Street, while crosswalks are provided to cross Route 2A only where it is a signalized intersection with side streets.

The option to provide a single-lane roundabout at the intersection was evaluated and it was determined that it would require significant right-of-way takings, as the skew of the existing intersection requires realignments of approaches to form the roundabout appropriately. This would require a significant amount of space for the intersection above what is currently available. These right-of-way impacts also result in significant impacts to the functionality of the intersection, particularly at the residence on the northeast corner of the intersection where they would have extremely limited driveway access; the septic system on the southwest corner would also need to be relocated if a single-lane roundabout was constructed. For these reasons, a roundabout alternative was deemed infeasible and was not analyzed further alongside the other alternatives.

Common Elements of All Alternative Concepts

- Signalize Willow Road based on meeting the standard signal warrants.
- Roadway widening on Route 2A/110 to create left-turn lanes (in both directions) at Willow Road and Bruce Street. This should reduce the risk of rear-end collisions as vehicles stopped along Route 2A/110 that are waiting for gaps in the opposing through traffic.
- Widening of Willow Road to provide two approach lanes at Route 2A/110. This will separate left-turning traffic from right-turning traffic and will improve efficiency of signal operation at Willow Road and Route 2A/110.
- Addition of a 5' wide striped shoulder on both sides of Route 2A/110. This increases safety for bicyclists by providing a clearly defined and sufficiently wide roadway shoulder for bicycle traffic, separating bicycle traffic from vehicle traffic.

- Addition of 5' wide sidewalks (excluding the curb) along both sides of Route 2A/110. This improves pedestrian safety by physically separating pedestrians from bicycle and vehicle traffic and provides an ADA accessible route where one does not currently exist. Meanwhile, addition of sidewalk and curb and clearly defined driveways on the north side of Route 2A improves access management of the truck parking lot on the northwest corner of the intersection.
- Addition of crosswalks across all legs of the intersection, including across the gas station driveway, Willow Road, Bruce Street, and across Route 2A/110 on either side of Willow Road. The crosswalks greatly improve pedestrian safety by clearly defining the location of pedestrian crossings. This safety improvement is further enhanced by the incorporation of an exclusive pedestrian phase within the traffic signal; such that vehicle traffic will be stopped at all times during the pedestrian phase.

Conceptual design of the three options are included in the appendix.

Concept 1

Description

Concept 1 maintains the skewed intersection, with all legs under signal control. The Willow Street lane configuration on the approach to Route 2A/110 would provide a shared left-turn/through lane, and an exclusive right-turn lane. The eastern gas station driveway (on the southwest corner of the intersection) and the residential driveway (on the northeast corner) will also be included in the traffic signal operations. This is very similar to the temporary traffic signal that has been in place at the intersection since summer 2016.

Advantages

- Concept 1 requires the least amount of physical modifications, resulting in a shorter construction duration and overall lower construction cost.
- Of the three alternatives, this concept requires the least amount of Right-of-Way (ROW) acquisition, with approximately 2,705 SF of ROW impacts.

Disadvantages

- The traffic signal would function similarly to the temporary traffic signal condition in effect today. With the number of driveways and roadways included in the traffic signal, several exclusive signal phases are required for safe operation, leading to inefficient traffic operations. This concept creates a larger intersection area relative to alternatives 2A and 2B, resulting in longer clearance times that negatively impact the traffic signal operation.
- The overall intersection is anticipated to operate at Level of Service (LOS) C during both the weekday morning and afternoon peak hours (6:45 – 7:45 AM and 4:30 – 5:30 PM), with long vehicle queues (nearly 1000 ft) expected on Route 2A/110 during peak periods.
- To better align Willow Road and Bruce Street and to better accommodate large turning truck movements, the west edge of Bruce Street is shifted closer to the gas station. There is an existing septic tank in this area, which may restrict any future sidewalk construction along the west side of Bruce Street.
- The pedestrian crossing distance at Bruce Street is significantly longer than in Concept 2A and Concept 2B. This increases pedestrian exposure and reduces pedestrian safety.
- Vehicles exiting the gas station are not aligned with the northbound receiving lane on Willow Road, leading to skewed vehicle maneuvers.

- Maintaining the existing general intersection alignment does not improve the ability of large vehicles on Route 2A/110 westbound turning left onto Bruce Street. It is noted that school buses currently have difficulty completing this turning maneuver safely.

Concept 2A

Description

Concept 2A creates two separate intersections; Willow Road is aligned with the eastern gas station driveway to form a four-legged signalized intersection, while Bruce Street is realigned to intersect Route 2A/110 at a 2nd T-intersection with Bruce Street operating under STOP control at the unsignalized intersection. The Willow Street lane configuration on the approach to Route 2A/110 would provide an exclusive left-turn lane and a shared through/right-turn lane. While traffic volumes have increased on Bruce Street since the temporary signal was installed, a traffic signal is not warranted at the Bruce Street intersection. The projected peak hour traffic volumes on the Bruce Street approach are 38 vehicles during the weekday morning peak hour (6:45 – 7:45 AM) and 106 vehicles during the weekday afternoon peak hour (4:30 – 5:30 PM), with even lower traffic volumes during off-peak time periods.

Advantages

- The separation of the residential driveway on the northeast corner of the intersection and Bruce Street from the Willow Road intersection results in fewer approaches to the signalized intersection. Therefore, fewer traffic signal phases are required for safe traffic operations, which reduces the total cycle length of the traffic signal and significantly improves the operating conditions at the intersection. The smaller intersection size results in shorter clearance times through the intersection, further improving signal operation.
- The overall intersection is anticipated to operate at LOS C and LOS B during the weekday morning (6:45 - 7:45 AM) and afternoon peak (4:30 - 5:30 PM) hours, respectively. The vehicle queues on Route 2A/110 during peak periods are expected to be shorter (approximately 650 ft) when compared to Concept 1.
- The realignment of Bruce Street to a T-intersection with Route 2A/110 greatly reduces the pedestrian crossing distance across Bruce Street, improving pedestrian safety.
- The realignment of Bruce Street to a T-intersection with Route 2A/110 improves visibility and sight distances for vehicles exiting Bruce Street.
- The re-aligned Bruce Street will better accommodate trucks and other large vehicles turning left from Route 2A/110 westbound onto Bruce Street.
- The Bruce Street realignment away from the gas station, and existing septic system, increases the feasibility of a potential sidewalk along the west side of Bruce Street.

Disadvantages

- Concept 2A requires approximately 3,895 SF of ROW acquisition, more than the approximately 2,705 SF required under Concept 1.
- The Bruce Street approach currently operates under traffic signal control with the temporary traffic signal implemented at the intersection. Drivers may have become accustomed to the traffic signal control on this approach, which is removed with Concept 2A.
- The pedestrian crossing across Bruce Street is not under signalized control.

Concept 2B

Description

Concept 2B provides the same overall roadway alignment changes as Concept 2A, but further widens the Route 2A/110 westbound approach to provide an exclusive right-turn lane for vehicles turning right onto Willow Road.

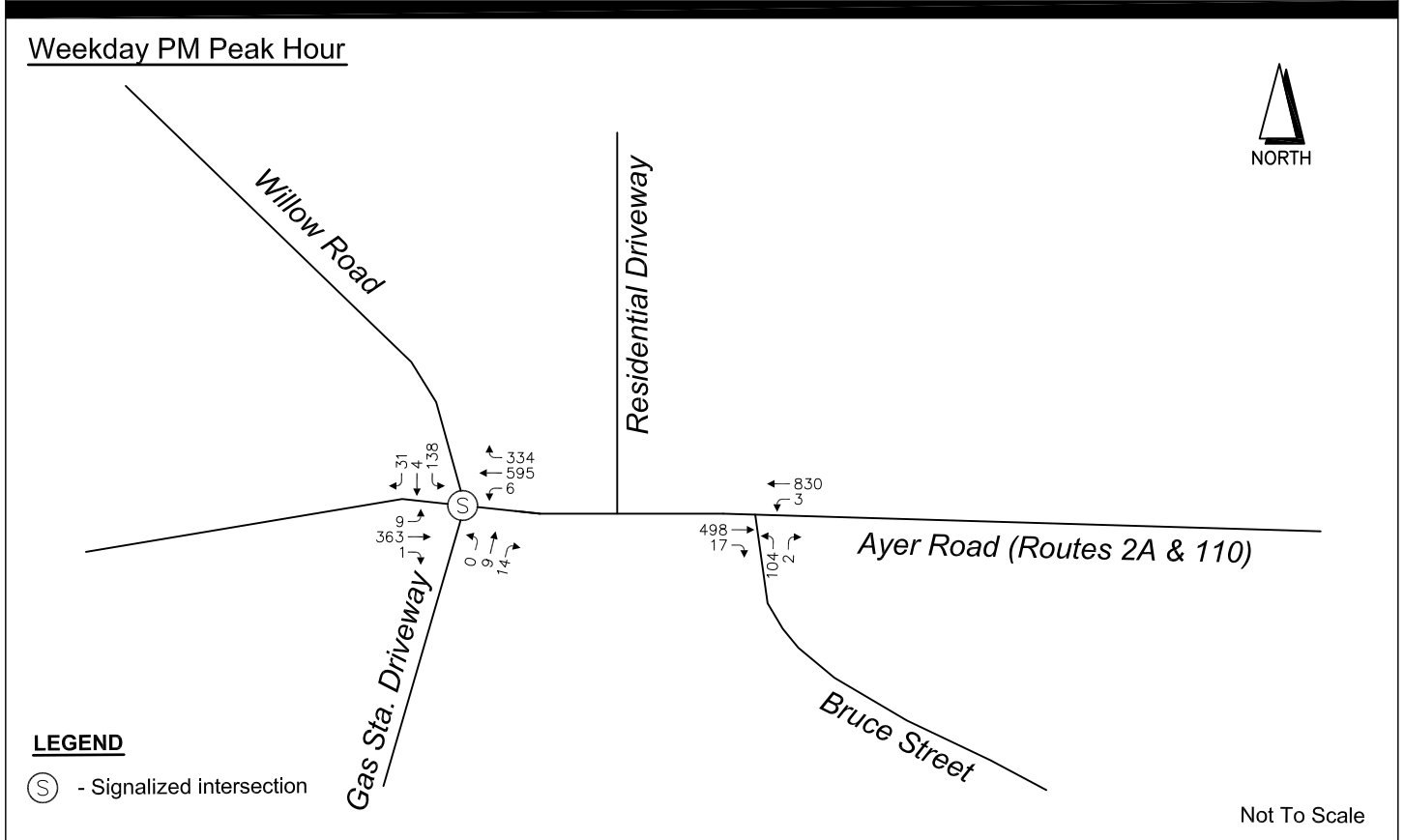
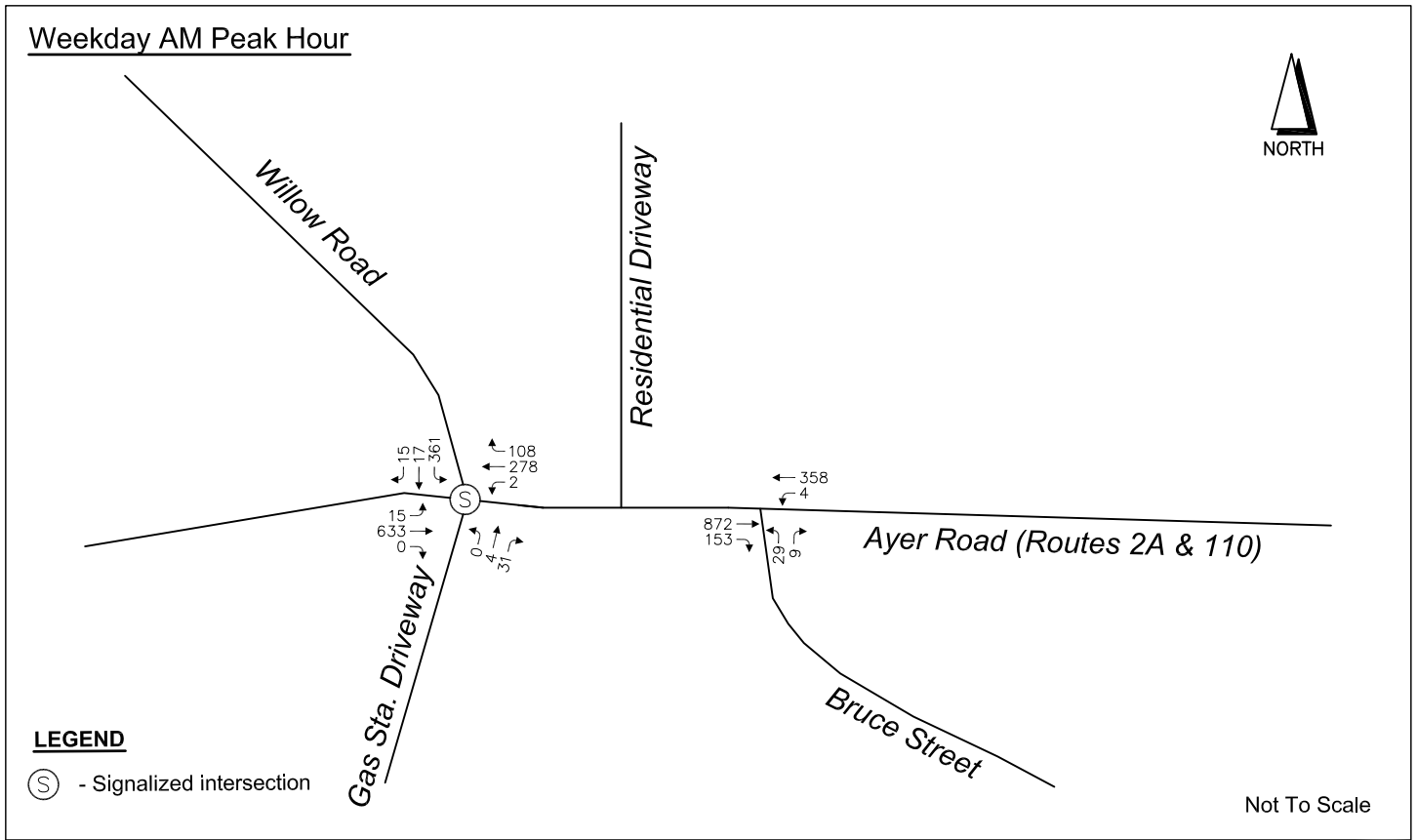
Advantages

- The advantages discussed above for Concept 2A are still applicable.
- The overall intersection is anticipated to operate at LOS C and LOS A during the weekday morning (6:45 - 7:45 AM) and afternoon peak hours (4:30 - 5:30 PM), respectively. The vehicle queues on Route 2A/110 WB during peak periods are expected to be significantly shorter (approximately 250 feet) when compared to Concept 2A. The addition of an exclusive right-turn lane on Route 2A/110 better accommodates the high volume of traffic turning from Route 2A/110 onto Willow Road and further improves traffic operations.

Disadvantages

- Concept 2B requires approximately 7,355 SF of ROW acquisition, more than the approximately 2,705 SF required for Concept 1 or the approximately 3,895 SF required for Concept 2A. It is noted that the additional ROW impacts are in front of the Chip Shots Pub but are not expected to significantly impact the existing parking lot or their business operations.
- The Bruce Street approach currently operates under traffic signal control with the temporary traffic signal implemented at the intersection. Drivers may have become accustomed to the traffic signal control on this approach, which is removed with Concept 2B.
- The pedestrian crossing across Bruce Street is not under signalized control.

Figure 5 presents the projected 2037 traffic volumes for Concepts 2A and 2B.



GREEN INTERNATIONAL AFFILIATES, INC.
 CIVIL AND STRUCTURAL ENGINEERS

Figure 5
Options 2A/2B - 2037 Projected Traffic Volumes
Proposed Intersection Layout
Ayer Road/Willow Road/Bruce Street
Littleton, MA

7.0 INTERSECTION CAPACITY ANALYSES

The study intersection was examined with regard to flow rates, capacity, and delay characteristics to determine the Level of Service (LOS) provided under existing and future (No-Build and Build) traffic conditions.

Level of Service is an indicator of operating conditions which occur on a given roadway feature while accommodating varying levels of traffic volumes. It is a qualitative measure that accounts for a number of operational factors including roadway geometry, speed, traffic composition, peak hour factors, travel delay, freedom to maneuver and driver expectation. When all of these measures are assessed, and a Level of Service is assigned to a roadway or intersection, it is equivalent to presenting an “index” to the operational qualities of the section under study. Level of Service is classified in the 6th edition of the Highway Capacity Manual (HCM 6)¹ into six levels that are designated ‘A’ through ‘F’ based on the control delay ranges they fall under. These ranges are presented in Table 7.1 for both unsignalized and signalized intersections.

Table 7.1 – Level of Service Criteria for Intersections

LEVEL OF SERVICE (LOS)	AVERAGE DELAY (SECONDS)	
	UNSIGNALIZED INTERSECTIONS	SIGNALIZED INTERSECTIONS
A	≤ 10	≤ 10
B	> 10 and ≤ 15	> 10 and ≤ 20
C	> 15 and ≤ 25	> 20 and ≤ 35
D	> 25 and ≤ 35	> 35 and ≤ 55
E	> 35 and ≤ 50	> 55 and ≤ 80
F	> 50 or v/c > 1.00	> 80 or v/c > 1.00

In practice, any given roadway/ intersection may operate at a wide LOS range depending upon time of day, day of week, or period of year. It should be noted that for unsignalized intersections, the Level of Service is not computed for the intersection as a whole. Instead, the level of service is determined by the computed or measured control delay for each individual critical movement. In addition to the delay thresholds, a movement at an intersection is considered to operate at LOS F if the volume-to-capacity (v/c) ratio exceeds 1.0, regardless of the computed delays for that movement.

The signalized intersection analyses under the Future Build Alternatives are based on the Synchro 10 statistical models rather than on strictly HCM 6 methodologies. While MassDOT generally prefers the use of HCM 6 intersection capacity analysis results, there are several limitations with the HCM 6 methodology. Most notably, the methodology does not allow the evaluation of traffic signals with an exclusive pedestrian phase. As the signalized intersections under the Future Build Alternatives are proposed to have exclusive pedestrian phases, the intersection capacity analyses based on the Synchro 10 statistical models were used. This is preferable to ignoring the presence of the pedestrian phases and results in more realistic and accurate analyses.

¹ Transportation Research Board, Highway Capacity Manual 6th Edition, Washington, D.C., 2016

Existing Conditions

The unsignalized intersection of Route 2A/110 at Willow/Bruce Streets operated at LOS 'F' and LOS 'A' during the 2015 morning and afternoon peak hour, respectively. With the temporary signal put in place during summer 2016, the intersection improved to operating at LOS 'C' in both the morning and afternoon peak hours. The intersection capacity analysis results for the 2015 Conditions (Weekday AM and PM Peak Hours) are summarized in Table 7.2, while the results for the 2017 Existing Conditions with the temporary signal are summarized in Table 7.3. The Synchro reports are presented in the appendix.

Table 7.2 – Intersection Capacity Analysis – 2015 Conditions (Unsignalized)

	WEEKDAY AM PEAK HOUR					WEEKDAY PM PEAK HOUR				
	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)
ROUTE 2A AT BRUCE ST/WILLOW RD										
Rt 2A EB LTR	8.3	A	0.03	-	3	9.7	A	0.02	-	3
Rt 2A WB LTR	9.4	A	0.01	-	0	7.9	A	0.01	-	0
Bruce St NB LTR	37.3	E	0.10	-	8	26.1	D	0.13	-	10
Willow Rd SB LTR	>300	F	1.71	-	488	63.2	F	0.75	-	125
Overall Intersection	70.1 (s/veh)	F				7.5 (s/veh)	A			

Table 7.3 – Intersection Capacity Analysis – Existing (2017) Conditions w Temp Signal

	WEEKDAY AM PEAK HOUR					WEEKDAY PM PEAK HOUR				
	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)
ROUTE 2A AT BRUCE ST/WILLOW RD										
Rt 2A EB LTR	21.5	C	0.80	149	335	7.7	A	0.32	48	171
Rt 2A WB LTR	13.5	B	0.50	69	164	19.1	B	0.81	172	672
Gas Sta Drwy NB LTR	0.2	A	0.04	0	0	0.3	A	0.04	0	0
Resid Drwy SB LTR	0.0	A	0.00	0	0	36.0	D	0.01	0	6
Willow Rd SEB LTR	60.2	E	0.95	107	429	65.4	E	0.85	56	240
Bruce St NWB LTR	0.2	A	0.06	0	0	2.3	A	0.29	0	4
Overall Intersection	29.2	C	0.95			20.3	C	0.85		

Future No-Build Conditions

The Future No-Build Conditions intersection capacity analysis assumes no geometry modifications have been made at the intersection of Route 2A/110 at Willow/Bruce Streets and that the intersection continues to operate under temporary signal control. Minor signal timing improvements were made from the Existing Conditions temporary signal operations to the Future No-Build Conditions permanent signal operations as it is reasonable to assume that timing improvements would be implemented at the intersection to improve traffic operations as the traffic volumes increase. The intersection capacity analysis results for the 2037 Future No-Build Conditions are summarized in Table 7.4. The Synchro reports of this conditions are shown in the appendix.

Table 7.4 - Intersection Capacity Analysis – Future (2037) No-Build Conditions

	WEEKDAY AM PEAK HOUR					WEEKDAY PM PEAK HOUR				
	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)
ROUTE 2A AT BRUCE ST/WILLOW RD										
Rt 2A EB LTR	41.3	D	0.88	444	686	15.1	B	0.38	154	282
Rt 2A WB LTR	24.6	C	0.53	194	291	40.5	D	0.94	586	1045
Gas Sta Drwy NB LTR	1.2	A	0.15	0	0	0.7	A	0.09	0	0
Resid Drwy SB LTR	0.0	A	0.00	0	0	52.0	D	0.01	1	7
Willow Rd SEB LTR	54.4	D	0.89	275	472	53.4	D	0.71	116	250
Bruce St NWB LTR	0.2	A	0.06	0	0	1.3	A	0.25	0	1
Overall Intersection	38.7	D	0.89			32.3	C	0.94		

Comparison of Build Alternatives

Operational comparisons of the three intersection improvement concepts can be seen in Tables 7.5 through 7.7. The corresponding Synchro reports are presented in the appendix. Concept 1 maintains delays below 32 seconds and 28 seconds at the signalized intersection during the morning and afternoon peak hours, respectively. Concept 2A has delays of 23.8 seconds in the morning peak hour and 15.9 seconds in the afternoon peak hour at the signalized intersection of Route 2A/110 at Willow Road. However, the Bruce Street approach at the unsignalized intersection of Route 2A/110 at Bruce Street presents delays of approximately 31 seconds and 16 seconds during the morning and afternoon peak hours, respectively. Concept 2B provides a good option for delays at the signalized intersection of Route 2A/110 at Willow Road as it experiences delays of approximately 23 seconds and 9 seconds during the morning and afternoon peak hours, respectively. But at the unsignalized intersection of Route 2A/110 at Bruce Street, the Bruce Street approach has delays of approximately 27 seconds and 31 seconds in the morning and afternoon peaks hours, respectively. It should be noted that these concepts were analyzed without accounting for pedestrian phases. Due to the low volume of pedestrians anticipated in the area, this omission should not have any effect on the analysis.

Table 7.5 – Intersection Capacity Analysis – Future (2037) Concept 1

	WEEKDAY AM PEAK HOUR					WEEKDAY PM PEAK HOUR				
	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)
ROUTE 2A AT BRUCE ST/WILLOW RD										
Rt 2A EB L	17.5	B	0.05	7	22	17.3	B	0.11	3	16
Rt 2A EB TR	34.7	C	0.82	398	617	14.5	B	0.37	140	264
Rt 2A WB L	18.3	B	0.04	2	11	13.2	B	0.01	2	11
RT 2A WB TR	23.7	C	0.53	183	278	43.6	D	0.95	558	1022
Gas Sta Drwy NB LTR	1.4	A	0.16	0	0	1.0	A	0.11	0	0
Resid Drwy SB LTR	0.0	A	0.00	0	0	50.0	D	0.01	1	7
Willow Rd SEB LT	53.7	D	0.87	244	425	55.7	E	0.66	94	216
Willow Rd SEB R	0.2	A	0.05	0	0	0.4	A	0.09	0	0
Bruce St NWB LT	25.3	C	0.06	14	37	44.7	D	0.43	67	139
Bruce St NWB R	0.1	A	0.02	0	0	0.0	A	0.00	0	0
Overall Intersection	34.5	C	0.87	-	-	35.7	D	0.95	-	-

Table 7.6 – Future (2037) Intersection Capacity Analysis - Concept 2A

	WEEKDAY AM PEAK HOUR					WEEKDAY PM PEAK HOUR				
	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)
Rt 2A AT GAS STA DRWY/WILLOW Rd (SIGNALIZED)										
Rt 2A EB L	9.2	A	0.04	3	12	5.3	A	0.05	1	7
Rt 2A EB TR	24.8	C	0.83	191	369	5.8	A	0.31	62	110
Rt 2A WB L	9.0	A	0.01	0	3	4.5	A	0.01	1	5
Rt 2A WB TR	13.7	B	0.57	86	159	17.0	B	0.82	278	628
Gas Sta Drwy NB LTR	6.0	A	0.06	1	17	14.9	B	0.07	3	22
Willow Rd SB L	36.7	D	0.84	121	263	37.4	D	0.61	58	115
Willow Rd SB TR	9.2	A	0.05	4	19	10.8	B	0.12	1	24
Overall Intersection	23.8	C	0.84	-	-	15.9	B	0.82	-	-
Rt 2A AT BRUCE St (UNSIGNALIZED)										
Rt 2A EB TR	0.0	A	-	-	0	0.0	A	-	-	0
Rt 2A WB L	10.5	B	0.01	-	0	8.6	A	0.00	-	0
Rt 2A WB T	0.0	A	-	-	0	0.0	A	-	-	0
Bruce St NB LR	31.1	D	0.22	-	20	93.2	F	0.82	-	130

Table 7.7 – Future (2037) Intersection Capacity Analysis - Concept 2B

	WEEKDAY AM PEAK HOUR					WEEKDAY PM PEAK HOUR				
	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)	DELAY (SEC)	LOS	v/c	50 TH Q (FT)	95 TH Q (FT)
Rt 2A AT GAS STA DRWY/WILLOW Rd (SIGNALIZED)										
Rt 2A EB L	9.1	A	0.03	3	11	5.9	A	0.03	1	7
Rt 2A EB TR	24.8	C	0.83	191	369	7.3	A	0.34	53	118
Rt 2A WB L	9.0	A	0.01	0	3	5.7	A	0.01	1	5
Rt 2A WB T	12.4	B	0.40	64	116	10.2	B	0.57	107	236
Rt 2A WB R	3.0	A	0.17	0	22	1.8	A	0.33	0	29
Gas Sta Drwy NB LTR	6.0	A	0.06	1	17	10.5	B	0.06	2	17
Willow Rd SB L	36.7	D	0.84	121	263	23.5	C	0.51	34	86
Willow Rd SB TR	9.2	A	0.05	4	19	7.9	A	0.10	1	19
Overall Intersection	22.8	C	0.84	-	-	8.8	A	0.57	-	-
Rt 2A AT BRUCE St (UNSIGNALIZED)										
Rt 2A EB TR	0.0	A	-	-	0	0.0	A	-	-	0
Rt 2A WB L	10.5	B	0.01	-	0	8.6	A	0.00	-	0
Rt 2A WB T	0.0	A	-	-	0	0.0	A	-	-	0
Bruce St NB LR	26.6	D	0.19	-	18	31.0	D	0.46	-	58

Public Information Meeting and Alternatives Discussion

A meeting was held on April 6, 2018 at MassDOT District 3 to discuss the comments received at the Public Information Meeting (PIM) held on March 14, 2018 for the subject project and to discuss the preferred alternative. Comments received at the PIM are summarized as:

- The majority of the comments received supported Option 1.
- The Littleton and Ayer Town Administrators supported Option 1.
- The owner of the Gulf Gas Station and truck lot on the northwest and southwest quadrants, respectively was concerned with limiting access to his parcels.
- There was concern regarding accommodating truck turning movements on Bruce Street. A dairy farm is located on the southern end of Bruce Street, and a WB-50 from Agrimark, the milk transport company, is scheduled to use the intersection for milk pick up every other day. The milk truck driver exits I-495 at Exit 30 and accesses the farm by taking a left from Route 2A onto Bruce Street. The truck driver leaves the farm via Bruce Street/Harvard Road intersection. The farmer, town officials, and other residents felt that the proposed pedestrian refuge would impede the truck accommodations.
- Other comments received included support for the proposed pedestrian and bicycle accommodations, and a suggestion for the "Signal Ahead" sign.

In a meeting between Green International Affiliates, Inc. (Green) and MassDOT in May 13, 2018, Option 1 was selected as the preferred alternative for this project based on the comments received at the PIM. At this meeting it was determined that Green will advance the design of this alternative moving forward.

Green presented proposed design modifications for Option 1 to improve truck accommodations on Bruce Street. They include:

- Moving the stop bar on Bruce Street further back to accommodate SU-40 turning movements.
- Eliminating the pedestrian refuge and reconfigure the crosswalks at the intersection.

8.0 TRAFFIC MANAGEMENT

Construction Management Outline

Major construction components of the project include, box-widening, paving, grading, drainage improvements, utility pole relocations, sidewalk construction, and construction of new traffic signals. It is anticipated that up to half of the roadway will be closed to traffic during work hours (weekday 9:00am-3:00pm). Minimum travel lane widths of 11 feet will be maintained.

The anticipated temporary roadway traffic control setups include shoulder closure, lane shifting, center of road closure setups where sufficient roadway width is available, and one lane alternating traffic setup with police/flagger directing traffic where there is insufficient roadway width to accommodate two travel lanes. The one-lane alternating traffic would only be permitted during midday off-peak hours. The anticipated temporary intersection traffic control setups include center closure and one quadrant closure setups.

The proposed traffic mitigation measures to limit impacts to traffic include: restricting the amount of work during peak hours; limiting work area/length during a typical work day to ensure the contractor is able to begin and complete a segment of roadway/intersection work such that normal traffic operations can be restored at the end of each work day, as needed.

\\fs1\engineering\Projects\2013\13033\13033.11X - Littleton Route 2A\Documents\FDR\FDR_Rev3.docx

APPENDIX 1 – 2015 TRAFFIC DATA



PRECISION
DATA
INDUSTRIES, LLC

PRECISION DATA INDUSTRIES, LLC

Office: 508.481.3999 Fax: 508.545.1234

Email: datarequests@pdillc.com

Traffic Counts with Precision



Google earth
© 2015 Google

Client:
Green International

Engineer:
J. Sobel

Site Code:
TBA

Date:
Tues11/10/15

PDI Job Number:
154787

City, State:
Littleton, MA

Ayer Road (Route 2A/110)
west of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



154787 A Volume
Site Code: TBA

Start	WB				EB				Combin ed		10-Nov- 15 Tue	
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.	
12:00	7		98		12		80		19		178	
12:15	14		102		2		97		16		199	
12:30	7		83		5		84		12		167	
12:45	5	33	89	372	3	22	83	344	8	55	172	716
01:00	5		65		3		74		8		139	
01:15	3		83		28		78		31		161	
01:30	5		75		16		90		21		165	
01:45	8	21	84	307	9	56	87	329	17	77	171	636
02:00	1		96		7		73		8		169	
02:15	4		86		2		92		6		178	
02:30	4		73		5		89		9		162	
02:45	9	18	92	347	2	16	102	356	11	34	194	703
03:00	4		125		12		118		16		243	
03:15	3		129		13		91		16		220	
03:30	9		116		11		126		20		242	
03:45	7	23	113	483	12	48	129	464	19	71	242	947
04:00	4		156		10		90		14		246	
04:15	5		126		15		104		20		230	
04:30	17		153		21		110		38		263	
04:45	10	36	119	554	25	71	70	374	35	107	189	928
05:00	14		154		43		66		57		220	
05:15	17		145		42		101		59		246	
05:30	47		148		71		79		118		227	
05:45	45	123	99	546	90	246	66	312	135	369	165	858
06:00	34		105		98		54		132		159	
06:15	51		122		144		60		195		182	
06:30	79		110		140		62		219		172	
06:45	73	237	80	417	222	604	60	236	295	841	140	653
07:00	64		72		236		48		300		120	
07:15	55		59		174		40		229		99	
07:30	104		55		194		26		298		81	
07:45	72	295	56	242	204	808	22	136	276	1103	78	378
08:00	86		63		166		27		252		90	
08:15	77		55		172		28		249		83	
08:30	74		43		162		9		236		52	
08:45	54	291	47	208	130	630	17	81	184	921	64	289
09:00	76		33		97		28		173		61	
09:15	85		43		83		18		168		61	
09:30	78		34		90		19		168		53	
09:45	65	304	44	154	83	353	16	81	148	657	60	235
10:00	55		32		76		14		131		46	
10:15	55		31		83		18		138		49	
10:30	79		28		67		10		146		38	
10:45	76	265	19	110	74	300	16	58	150	565	35	168
11:00	59		23		73		11		132		34	
11:15	68		17		84		9		152		26	
11:30	74		19		87		11		161		30	
11:45	68	269	16	75	83	327	9	40	151	596	25	115
Total	1915		3815		3481		2811		5396		6626	
Percent	35.5%		57.6%		64.5%		42.4%					
Day Total	5730				6292				12022			
Peak	07:30	-	04:30	-	06:45	-	03:00	-	06:45	-	03:45	-
Vol.	339	-	571	-	826	-	464	-	1122	-	981	-
P.H.F.	0.815		0.927		0.875		0.899		0.935		0.933	

Ayer Road (Route 2A/110)
west of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154787 A CLASS
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/10/1														
5	1	19	7	0	0	1	0	0	5	0	0	0	0	33
01:00	0	11	7	0	1	1	0	0	1	0	0	0	0	21
02:00	1	10	1	1	1	2	0	0	2	0	0	0	0	18
03:00	1	13	2	0	0	1	0	0	6	0	0	0	0	23
04:00	0	18	7	4	1	3	0	0	3	0	0	0	0	36
05:00	0	77	26	2	8	2	0	1	7	0	0	0	0	123
06:00	6	159	43	2	10	11	0	0	6	0	0	0	0	237
07:00	5	185	65	3	18	4	0	5	10	0	0	0	0	295
08:00	6	177	59	11	20	6	0	5	7	0	0	0	0	291
09:00	3	180	68	9	22	5	1	7	9	0	0	0	0	304
10:00	7	118	64	20	21	9	0	7	19	0	0	0	0	265
11:00	5	165	46	7	21	7	0	4	14	0	0	0	0	269
12 PM	3	223	88	6	23	6	1	5	17	0	0	0	0	372
13:00	11	186	52	4	19	8	1	5	21	0	0	0	0	307
14:00	6	235	52	9	17	6	2	2	18	0	0	0	0	347
15:00	4	330	99	4	26	6	0	3	11	0	0	0	0	483
16:00	12	376	116	5	26	9	1	1	8	0	0	0	0	554
17:00	6	417	94	0	20	1	0	2	6	0	0	0	0	546
18:00	1	336	57	1	12	3	0	0	7	0	0	0	0	417
19:00	1	196	38	1	4	0	0	1	1	0	0	0	0	242
20:00	0	170	32	0	2	0	0	0	4	0	0	0	0	208
21:00	0	120	25	1	4	0	0	0	4	0	0	0	0	154
22:00	1	87	16	0	4	0	0	0	2	0	0	0	0	110
23:00	0	56	13	0	1	0	0	0	5	0	0	0	0	75
Total	80	3864	1077	90	281	91	6	48	193	0	0	0	0	5730
Percent	1.4%	67.4%	18.8%	1.6%	4.9%	1.6%	0.1%	0.8%	3.4%	0.0%	0.0%	0.0%	0.0%	
AM Peak	10:00	07:00	09:00	10:00	09:00	06:00	09:00	09:00	10:00					09:00
Vol.	7	185	68	20	22	11	1	7	19					304
PM Peak	16:00	17:00	16:00	14:00	15:00	16:00	14:00	12:00	13:00					16:00
Vol.	12	417	116	9	26	9	2	5	21					554

Ayer Road (Route 2A/110)
west of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154787 A CLASS
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/10/1														
5	0	6	12	1	1	1	0	0	1	0	0	0	0	22
01:00	2	18	16	1	13	1	0	2	3	0	0	0	0	56
02:00	0	5	8	1	2	0	0	0	0	0	0	0	0	16
03:00	2	10	19	2	6	2	0	0	7	0	0	0	0	48
04:00	0	14	28	3	17	0	0	0	9	0	0	0	0	71
05:00	2	59	117	6	48	2	0	0	12	0	0	0	0	246
06:00	4	200	276	5	98	3	1	2	15	0	0	0	0	604
07:00	7	294	358	12	102	5	0	6	24	0	0	0	0	808
08:00	5	210	312	14	70	0	0	6	13	0	0	0	0	630
09:00	3	94	168	17	51	1	1	6	12	0	0	0	0	353
10:00	1	91	115	18	51	8	0	0	15	0	1	0	0	300
11:00	4	73	146	16	59	4	0	5	19	0	0	0	1	327
12 PM	2	97	142	12	64	6	0	6	15	0	0	0	0	344
13:00	4	82	142	11	67	7	0	8	8	0	0	0	0	329
14:00	4	102	146	13	61	5	0	5	20	0	0	0	0	356
15:00	10	143	212	9	67	2	0	4	17	0	0	0	0	464
16:00	7	125	176	8	40	5	0	5	8	0	0	0	0	374
17:00	3	104	161	1	38	2	0	1	2	0	0	0	0	312
18:00	0	78	106	3	39	1	0	0	9	0	0	0	0	236
19:00	3	50	63	2	9	3	0	1	5	0	0	0	0	136
20:00	0	25	41	0	10	1	0	1	3	0	0	0	0	81
21:00	0	25	41	0	12	1	0	0	2	0	0	0	0	81
22:00	0	22	28	0	6	1	0	0	1	0	0	0	0	58
23:00	1	16	16	0	5	0	0	0	2	0	0	0	0	40
Total	64	1943	2849	155	936	61	2	58	222	0	1	0	1	6292
Percent	1.0%	30.9%	45.3%	2.5%	14.9%	1.0%	0.0%	0.9%	3.5%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	07:00	10:00	07:00	10:00	06:00	07:00	07:00		10:00		11:00	07:00
Vol.	7	294	358	18	102	8	1	6	24		1		1	808
PM Peak	15:00	15:00	15:00	14:00	13:00	13:00		13:00	14:00					15:00
Vol.	10	143	212	13	67	7		8	20					464

Ayer Road (Route 2A/110)
west of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



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154787 A Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/10/																
15	0	0	0	0	0	7	11	10	3	2	0	0	0	33	49	44
01:00	0	0	0	0	0	3	8	7	3	0	0	0	0	21	48	44
02:00	0	0	0	0	1	0	7	8	1	0	0	1	0	18	48	46
03:00	0	0	0	1	1	0	14	5	1	1	0	0	0	23	47	43
04:00	0	0	0	0	0	7	10	14	5	0	0	0	0	36	48	44
05:00	0	0	0	0	5	16	59	37	6	0	0	0	0	123	47	43
06:00	0	0	1	0	3	48	114	59	12	0	0	0	0	237	47	43
07:00	1	0	0	0	2	49	154	79	10	0	0	0	0	295	46	43
08:00	2	0	1	2	9	57	114	96	9	1	0	0	0	291	47	42
09:00	1	0	3	3	7	41	150	89	9	1	0	0	0	304	46	42
10:00	3	0	0	1	4	33	141	76	7	0	0	0	0	265	46	42
11:00	0	0	0	0	6	32	134	92	5	0	0	0	0	269	47	43
12 PM	0	0	0	0	8	68	174	109	12	1	0	0	0	372	47	43
13:00	2	0	5	6	4	27	126	123	13	1	0	0	0	307	47	43
14:00	3	0	3	5	3	35	173	109	15	1	0	0	0	347	47	43
15:00	1	0	1	2	1	41	256	167	13	0	0	0	1	483	47	43
16:00	4	0	1	9	4	67	272	176	16	2	3	0	0	554	47	43
17:00	2	0	0	0	4	86	316	126	11	1	0	0	0	546	46	42
18:00	0	0	0	0	2	82	223	98	12	0	0	0	0	417	46	42
19:00	1	0	0	0	1	11	119	100	9	1	0	0	0	242	47	44
20:00	0	0	0	1	3	25	118	57	4	0	0	0	0	208	46	43
21:00	0	0	1	0	5	36	82	29	1	0	0	0	0	154	45	41
22:00	0	0	0	0	0	16	62	29	3	0	0	0	0	110	46	43
23:00	0	0	0	0	1	11	33	23	7	0	0	0	0	75	48	44
Total	20	0	16	30	74	798	2870	1718	187	12	3	1	1	5730		
%	0.3%	0.0%	0.3%	0.5%	1.3%	13.9%	50.1%	30.0%	3.3%	0.2%	0.1%	0.0%	0.0%			
AM Peak	10:00		09:00	09:00	08:00	08:00	07:00	08:00	06:00	00:00		02:00		09:00		
Vol.	3		3	3	9	57	154	96	12	2		1		304		
PM Peak	16:00		13:00	16:00	12:00	17:00	17:00	16:00	16:00	16:00	16:00		15:00	16:00		
Vol.	4		5	9	8	86	316	176	16	2	3		1	554		

Stats
15th Percentile : 38 MPH
50th Percentile : 42 MPH
85th Percentile : 47 MPH
95th Percentile : 48 MPH

Mean Speed(Average) : 43 MPH
10 MPH Pace Speed : 40-49 MPH
Number in Pace : 4588
Percent in Pace : 80.1%
Number of Vehicles > 45 MPH : 1578
Percent of Vehicles > 45 MPH : 27.5%

Ayer Road (Route 2A/110)
west of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



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154787 A Speed
Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/10/																
15	0	0	0	0	1	2	2	5	11	1	0	0	0	22	52	48
01:00	0	0	0	0	0	6	10	20	16	2	1	1	0	56	52	47
02:00	0	0	0	0	0	0	0	7	5	2	2	0	0	16	57	52
03:00	0	0	0	0	0	1	5	18	18	6	0	0	0	48	53	49
04:00	0	0	0	0	0	2	7	24	24	11	3	0	0	71	55	50
05:00	0	0	0	0	0	4	35	121	70	13	2	1	0	246	52	48
06:00	2	0	0	1	10	20	131	288	139	12	1	0	0	604	51	47
07:00	6	17	26	28	41	41	174	358	100	17	0	0	0	808	48	43
08:00	2	1	3	1	6	47	145	294	117	13	0	0	1	630	50	46
09:00	1	0	1	1	2	5	64	177	82	18	2	0	0	353	51	47
10:00	0	0	0	0	0	7	49	142	92	9	1	0	0	300	52	48
11:00	1	1	0	0	0	4	67	174	69	11	0	0	0	327	51	47
12 PM	0	0	0	2	4	13	95	159	61	9	1	0	0	344	50	46
13:00	1	0	0	0	0	4	86	156	70	12	0	0	0	329	51	47
14:00	1	0	0	0	2	26	69	156	92	10	0	0	0	356	51	47
15:00	4	0	0	0	6	32	114	200	94	10	4	0	0	464	51	46
16:00	3	0	0	0	2	28	102	164	68	6	0	0	1	374	50	46
17:00	0	0	0	0	1	18	93	140	51	9	0	0	0	312	50	46
18:00	0	0	0	0	2	11	76	101	36	9	0	0	1	236	50	46
19:00	0	0	0	1	5	14	39	42	26	8	0	1	0	136	51	46
20:00	0	0	0	0	3	2	21	38	15	2	0	0	0	81	50	46
21:00	0	0	0	0	0	7	24	31	18	0	1	0	0	81	50	46
22:00	0	0	0	0	1	2	19	22	12	2	0	0	0	58	51	46
23:00	1	0	0	0	1	2	4	19	8	4	1	0	0	40	53	47
Total	22	19	30	34	87	298	1431	2856	1294	196	19	3	3	6292		
%	0.3%	0.3%	0.5%	0.5%	1.4%	4.7%	22.7%	45.4%	20.6%	3.1%	0.3%	0.0%	0.0%			
AM Peak	07:00	07:00	07:00	07:00	07:00	08:00	07:00	07:00	06:00	09:00	04:00	01:00	08:00	07:00		
Vol.	6	17	26	28	41	47	174	358	139	18	3	1	1	808		
PM Peak	15:00			12:00	15:00	15:00	15:00	15:00	15:00	13:00	15:00	19:00	16:00	15:00		
Vol.	4			2	6	32	114	200	94	12	4	1	1	464		

Stats

15th Percentile :	40 MPH
50th Percentile :	46 MPH
85th Percentile :	51 MPH
95th Percentile :	53 MPH

Mean Speed(Average) :	46 MPH
10 MPH Pace Speed :	40-49 MPH
Number in Pace :	4287
Percent in Pace :	68.1%
Number of Vehicles > 45 MPH :	3800
Percent of Vehicles > 45 MPH :	60.4%

Ayer Road (Route 2A/110)
east of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



154787 B Volume
Site Code: TBA

Start	EB		WB		Combin		ed		10-Nov-15	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue	
12:00	18	73	9	109	27	182				
12:15	3	99	23	87	26	186				
12:30	7	102	11	101	18	203				
12:45	3	31 95	369	6 49	109	406	9 80	204	775	
01:00	2	88	2	83	4	171				
01:15	25	83	2	91	27	174				
01:30	22	108	5	92	27	200				
01:45	10	59 98	377	6 15	92	358	16 74	190	735	
02:00	7	82	4	116	11	198				
02:15	6	117	4	94	10	211				
02:30	6	103	6	91	12	194				
02:45	4	23 123	425	9 23	122	423	13 46	245	848	
03:00	8	132	8	137	16	269				
03:15	19	118	3	165	22	283				
03:30	11	135	12	162	23	297				
03:45	15	53 134	519	8 31	152	616	23 84	286	1135	
04:00	18	104	6	173	24	277				
04:15	15	121	8	167	23	288				
04:30	27	134	21	192	48	326				
04:45	33	93 92	451	26 61	164	696	59 154	256	1147	
05:00	52	91	18	224	70	315				
05:15	58	98	22	206	80	304				
05:30	80	88	55	213	135	301				
05:45	111	301 83	360	61 156	136	779	172 457	219	1139	
06:00	124	67	53	158	177	225				
06:15	157	70	77	153	234	223				
06:30	163	66	94	140	257	206				
06:45	233	677 67	270	109 333	100	551	342 1010	167	821	
07:00	240	48	84	109	324	157				
07:15	190	42	79	87	269	129				
07:30	173	31	122	75	295	106				
07:45	222	825 34	155	102 387	65	336	324 1212	99	491	
08:00	205	39	94	68	299	107				
08:15	221	34	82	65	303	99				
08:30	192	14	91	54	283	68				
08:45	159	777 22	109	85 352	62	249	244 1129	84	358	
09:00	134	24	101	38	235	62				
09:15	101	18	94	53	195	71				
09:30	113	20	92	45	205	65				
09:45	106	454 18	80	77 364	44	180	183 818	62	260	
10:00	100	12	63	42	163	54				
10:15	92	20	72	39	164	59				
10:30	87	14	101	32	188	46				
10:45	87	366 15	61	88 324	20	133	175 690	35	194	
11:00	92	15	84	28	176	43				
11:15	107	11	80	15	187	26				
11:30	102	13	84	20	186	33				
11:45	89	390 8	47	79 327	20	83	168 717	28	130	
Total	4049	3223	2422	4810	6471	8033				
Percent	62.6%	40.1%	37.4%	59.9%						
Day Total		7272		7232		14504				
Peak	07:45	- 03:00	- 07:30	- 04:45	- 06:45	- 04:30	- - -			
Vol.	840	- 519	- 400	- 807	- 1230	- 1201	- - -			
P.H.F.	0.875	0.961	0.820	0.901	0.899	0.921				

Ayer Road (Route 2A/110)
east of Willow Road
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154787 B CLASS
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/10/1														
5	3	13	9	1	2	2	0	0	1	0	0	0	0	31
01:00	2	29	10	1	10	2	0	1	4	0	0	0	0	59
02:00	2	13	4	2	1	1	0	0	0	0	0	0	0	23
03:00	3	17	13	3	6	2	0	0	9	0	0	0	0	53
04:00	8	37	19	2	11	6	0	0	10	0	0	0	0	93
05:00	11	138	76	8	47	5	1	1	14	0	0	0	0	301
06:00	12	402	143	2	93	8	0	2	15	0	0	0	0	677
07:00	22	469	173	11	108	12	4	4	21	0	0	0	1	825
08:00	23	456	179	17	65	10	1	10	15	0	0	0	1	777
09:00	17	221	107	20	58	7	3	7	14	0	0	0	0	454
10:00	17	153	95	22	52	10	3	2	12	0	0	0	0	366
11:00	14	162	99	19	57	13	2	5	19	0	0	0	0	390
12 PM	14	172	89	11	57	5	0	4	17	0	0	0	0	369
13:00	10	166	100	12	58	9	0	8	12	2	0	0	0	377
14:00	13	212	98	11	60	7	0	2	22	0	0	0	0	425
15:00	16	260	135	11	68	5	0	6	17	0	0	0	1	519
16:00	15	253	113	7	44	5	0	5	9	0	0	0	0	451
17:00	9	224	91	2	27	3	0	1	3	0	0	0	0	360
18:00	7	154	68	3	28	1	0	1	8	0	0	0	0	270
19:00	3	95	29	1	13	4	0	2	8	0	0	0	0	155
20:00	3	57	31	0	10	3	0	1	4	0	0	0	0	109
21:00	1	47	21	0	8	1	0	0	2	0	0	0	0	80
22:00	2	37	13	0	6	0	0	0	3	0	0	0	0	61
23:00	4	28	6	0	7	1	0	0	1	0	0	0	0	47
Total	231	3815	1721	166	896	122	14	62	240	2	0	0	3	7272
Percent	3.2%	52.5%	23.7%	2.3%	12.3%	1.7%	0.2%	0.9%	3.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	08:00	10:00	07:00	11:00	07:00	08:00	07:00				07:00	07:00
Vol.	23	469	179	22	108	13	4	10	21				1	825
PM Peak	15:00	15:00	15:00	13:00	15:00	13:00		13:00	14:00	13:00			15:00	15:00
Vol.	16	260	135	12	68	9		8	22	2			1	519

Ayer Road (Route 2A/110)
east of Willow Road
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WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/10/1														
5	4	19	13	1	3	3	0	1	5	0	0	0	0	49
01:00	0	7	3	0	3	1	0	0	1	0	0	0	0	15
02:00	1	7	8	2	1	1	0	0	3	0	0	0	0	23
03:00	3	9	9	2	1	1	0	0	6	0	0	0	0	31
04:00	4	26	14	5	6	2	0	0	4	0	0	0	0	61
05:00	6	70	41	3	25	3	0	2	6	0	0	0	0	156
06:00	19	143	83	7	57	18	0	0	6	0	0	0	0	333
07:00	18	183	85	10	74	8	0	3	5	0	0	0	1	387
08:00	13	151	97	19	45	13	2	4	8	0	0	0	0	352
09:00	17	133	110	19	54	12	1	5	13	0	0	0	0	364
10:00	16	102	86	21	57	15	1	8	18	0	0	0	0	324
11:00	20	113	98	15	41	22	1	5	12	0	0	0	0	327
12 PM	13	171	125	9	55	10	2	7	14	0	0	0	0	406
13:00	10	148	103	6	54	7	1	6	23	0	0	0	0	358
14:00	13	209	108	12	50	10	2	4	15	0	0	0	0	423
15:00	20	305	173	11	82	8	1	3	13	0	0	0	0	616
16:00	10	362	208	7	89	6	2	2	10	0	0	0	0	696
17:00	12	451	223	4	79	4	0	1	5	0	0	0	0	779
18:00	4	328	161	5	44	2	0	0	7	0	0	0	0	551
19:00	2	207	98	1	25	1	0	1	1	0	0	0	0	336
20:00	4	154	70	1	14	2	0	0	4	0	0	0	0	249
21:00	3	101	52	1	18	2	0	1	2	0	0	0	0	180
22:00	1	73	47	0	10	1	0	0	1	0	0	0	0	133
23:00	1	51	18	0	9	0	0	0	4	0	0	0	0	83
Total	214	3523	2033	161	896	152	13	53	186	0	0	0	1	7232
Percent	3.0%	48.7%	28.1%	2.2%	12.4%	2.1%	0.2%	0.7%	2.6%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	07:00	09:00	10:00	07:00	11:00	08:00	10:00	10:00				07:00	07:00
Vol.	20	183	110	21	74	22	2	8	18				1	387
PM Peak	15:00	17:00	17:00	14:00	16:00	12:00	12:00	12:00	13:00					17:00
Vol.	20	451	223	12	89	10	2	7	23					779

Ayer Road (Route 2A/110)
east of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154787 B Speed
Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/10/ 15	0	3	1	1	4	6	5	9	2	0	0	0	0	31	47	38
01:00	0	0	0	2	7	9	15	20	4	1	1	0	0	59	48	43
02:00	0	0	3	3	0	1	4	7	5	0	0	0	0	23	50	41
03:00	0	0	4	1	2	5	14	19	7	1	0	0	0	53	49	43
04:00	0	1	8	6	7	6	22	27	13	3	0	0	0	93	49	41
05:00	1	0	18	13	26	48	98	78	19	0	0	0	0	301	47	40
06:00	3	3	20	27	53	170	266	120	15	0	0	0	0	677	45	40
07:00	8	2	22	47	148	276	227	89	5	0	1	0	0	825	43	37
08:00	3	3	31	48	105	242	243	90	11	0	0	0	1	777	43	38
09:00	4	3	23	23	88	95	128	82	8	0	0	0	0	454	45	38
10:00	1	5	22	25	42	70	119	69	12	1	0	0	0	366	45	39
11:00	3	7	20	19	43	85	139	63	11	0	0	0	0	390	45	38
12 PM	7	8	19	15	56	79	133	47	4	0	1	0	0	369	43	37
13:00	1	3	7	12	50	92	150	55	7	0	0	0	0	377	44	39
14:00	5	4	18	25	60	98	130	76	9	0	0	0	0	425	45	38
15:00	10	2	17	40	84	166	146	46	7	1	0	0	0	519	43	37
16:00	10	4	11	16	75	159	137	36	3	0	0	0	0	451	42	37
17:00	4	2	5	16	60	122	112	33	5	1	0	0	0	360	43	38
18:00	2	0	8	20	48	86	82	21	3	0	0	0	0	270	42	37
19:00	1	4	3	11	21	43	40	27	5	0	0	0	0	155	45	38
20:00	0	4	3	9	16	20	32	24	1	0	0	0	0	109	45	38
21:00	1	0	3	2	9	17	26	17	3	1	0	0	1	80	46	40
22:00	0	3	0	0	6	10	17	20	5	0	0	0	0	61	47	41
23:00	0	1	1	1	5	10	13	11	4	1	0	0	0	47	48	41
Total	64	62	267	382	1015	1915	2298	1086	168	10	3	0	2	7272		
%	0.9%	0.9%	3.7%	5.3%	14.0%	26.3%	31.6%	14.9%	2.3%	0.1%	0.0%	0.0%	0.0%			
AM Peak	07:00	11:00	08:00	08:00	07:00	07:00	06:00	06:00	05:00	04:00	01:00		08:00	07:00		
Vol.	8	7	31	48	148	276	266	120	19	3	1		1	825		
PM Peak	15:00	12:00	12:00	15:00	15:00	15:00	13:00	14:00	14:00	15:00	12:00		21:00	15:00		
Vol.	10	8	19	40	84	166	150	76	9	1	1		1	519		

Stats
15th Percentile : 30 MPH
50th Percentile : 38 MPH
85th Percentile : 44 MPH
95th Percentile : 48 MPH

Mean Speed(Average) : 38 MPH
10 MPH Pace Speed : 35-44 MPH
Number in Pace : 4213
Percent in Pace : 57.9%
Number of Vehicles > 40 MPH : 3107
Percent of Vehicles > 40 MPH : 42.7%

Ayer Road (Route 2A/110)
east of Willow Road
City, State: Littleton, MA
Client: Green International/ J. Sobel



PRECISION
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154787 B Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/10/																
15	0	0	4	5	4	11	12	7	5	1	0	0	0	49	48	39
01:00	0	0	0	0	0	1	5	7	2	0	0	0	0	15	48	45
02:00	0	0	0	0	4	5	4	2	6	1	0	0	0	23	52	43
03:00	0	0	0	4	2	4	9	8	3	1	0	0	0	31	48	42
04:00	0	0	0	3	16	14	10	9	9	0	0	0	0	61	48	40
05:00	0	0	1	9	26	33	53	29	5	0	0	0	0	156	45	40
06:00	7	9	5	32	61	108	87	22	2	0	0	0	0	333	42	36
07:00	7	19	28	35	61	109	104	23	1	0	0	0	0	387	42	35
08:00	6	2	9	37	68	109	87	33	1	0	0	0	0	352	42	36
09:00	2	8	21	30	74	116	82	28	1	2	0	0	0	364	42	36
10:00	3	2	10	23	45	88	96	51	5	1	0	0	0	324	44	38
11:00	1	5	21	25	66	84	81	37	7	0	0	0	0	327	43	37
12 PM	8	14	18	38	73	131	87	36	0	0	1	0	0	406	42	35
13:00	3	2	4	15	59	93	126	51	4	0	0	0	1	358	44	39
14:00	2	12	10	18	72	149	131	22	7	0	0	0	0	423	42	37
15:00	7	3	22	42	135	220	148	37	1	1	0	0	0	616	42	36
16:00	6	8	19	74	168	230	165	26	0	0	0	0	0	696	41	35
17:00	9	8	21	61	277	306	85	12	0	0	0	0	0	779	38	34
18:00	3	0	5	78	183	193	83	6	0	0	0	0	0	551	39	34
19:00	0	0	6	22	68	112	90	35	3	0	0	0	0	336	43	38
20:00	3	0	5	21	45	77	85	13	0	0	0	0	0	249	42	37
21:00	2	2	3	8	27	60	58	19	1	0	0	0	0	180	43	38
22:00	0	0	2	7	17	41	45	18	3	0	0	0	0	133	44	39
23:00	0	1	2	4	12	14	24	23	3	0	0	0	0	83	46	40
Total	69	95	216	591	1563	2308	1757	554	69	7	1	0	2	7232		
%	1.0%	1.3%	3.0%	8.2%	21.6%	31.9%	24.3%	7.7%	1.0%	0.1%	0.0%	0.0%	0.0%			
AM Peak	06:00	07:00	07:00	08:00	09:00	09:00	07:00	10:00	04:00	09:00			02:00	07:00		
Vol.	7	19	28	37	74	116	104	51	9	2			1	387		
PM Peak	17:00	12:00	15:00	18:00	17:00	17:00	16:00	13:00	14:00	15:00	12:00		13:00	17:00		
Vol.	9	14	22	78	277	306	165	51	7	1	1		1	779		

Stats

15th Percentile :	29 MPH
50th Percentile :	36 MPH
85th Percentile :	42 MPH
95th Percentile :	46 MPH

Mean Speed(Average) :	36 MPH
10 MPH Pace Speed :	35-44 MPH
Number in Pace :	4065
Percent in Pace :	56.2%
Number of Vehicles > 40 MPH :	2039
Percent of Vehicles > 40 MPH :	28.2%

Willow Road
north of Ayer Road (Route 2A/110)
City, State: Littleton, MA
Client: Green International/ J. Sobel



154787 C Volume
Site Code: TBA

Start Time	NB		SB		Combined		10-Nov-15 Tue
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	3	23	4	18	7	41	
12:15	10	34	1	46	11	80	
12:30	2	30	2	25	4	55	
12:45	1	35	0	7	1	63	239
01:00	1	27	0	22	1	49	
01:15	0	34	0	17	0	51	
01:30	2	25	4	23	6	48	
01:45	0	3	1	5	1	47	195
02:00	3	30	2	28	5	58	
02:15	0	23	2	38	2	61	
02:30	1	34	1	25	2	59	
02:45	1	5	1	6	2	76	254
03:00	2	33	0	37	2	70	
03:15	1	53	3	29	4	82	
03:30	4	56	2	50	6	106	
03:45	1	8	2	7	3	90	348
04:00	2	47	6	35	8	82	
04:15	4	67	1	40	5	107	
04:30	6	61	11	38	17	99	
04:45	17	29	7	25	37	150	389
05:00	6	87	11	34	17	121	
05:15	6	88	23	28	29	116	
05:30	16	79	24	20	40	99	
05:45	21	49	25	83	40	122	427
06:00	24	63	31	24	55	87	
06:15	33	44	33	23	66	67	
06:30	26	48	49	19	75	67	
06:45	40	123	56	169	96	292	290
07:00	31	45	57	11	88	56	
07:15	35	33	54	8	89	41	
07:30	37	29	61	9	98	38	
07:45	34	137	65	237	14	42	163
08:00	35	19	52	11	87	30	
08:15	19	20	58	6	77	26	
08:30	32	15	44	11	76	26	
08:45	39	125	43	197	5	33	105
09:00	30	11	45	4	75	15	
09:15	24	15	34	3	58	18	
09:30	30	13	47	5	77	18	
09:45	21	105	30	156	7	19	66
10:00	19	9	23	1	42	10	
10:15	20	6	20	4	40	10	
10:30	24	8	24	2	48	10	
10:45	22	85	24	91	1	8	34
11:00	34	7	27	4	61	11	
11:15	18	0	35	1	53	1	
11:30	29	3	33	5	62	8	
11:45	30	111	27	122	2	12	25
Total	796	1578	1105	957	1901	2535	
Percent	41.9%	62.2%	58.1%	37.8%			
Day Total	2374		2062		4436		
Peak	06:45	-	04:45	-	07:00	-	04:30
Vol.	143	-	318	-	237	-	437
P.H.F.	0.894	-	0.903	-	0.912	-	0.903

Willow Road
north of Ayer Road (Route 2A/110)
City, State: Littleton, MA
Client: Green International/ J. Sobel



PRECISION
D A T A
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154787 C Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/10/1														
5	2	5	5	1	0	1	0	1	1	0	0	0	0	16
01:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
02:00	1	3	0	1	0	0	0	0	0	0	0	0	0	5
03:00	1	1	3	2	1	0	0	0	0	0	0	0	0	8
04:00	1	12	6	1	4	1	0	1	3	0	0	0	0	29
05:00	4	21	7	3	12	1	0	0	1	0	0	0	0	49
06:00	3	53	28	5	22	5	0	1	6	0	0	0	0	123
07:00	3	60	30	10	23	5	0	3	3	0	0	0	0	137
08:00	3	44	32	10	20	9	1	1	5	0	0	0	0	125
09:00	4	32	23	8	18	8	1	2	9	0	0	0	0	105
10:00	4	27	23	5	11	5	0	2	8	0	0	0	0	85
11:00	4	33	26	11	16	10	1	2	8	0	0	0	0	111
12 PM	2	56	33	3	18	3	0	1	6	0	0	0	0	122
13:00	3	36	37	3	17	2	0	2	7	0	0	0	0	107
14:00	4	63	36	3	21	4	1	1	3	0	0	0	0	136
15:00	4	108	42	5	28	3	0	3	7	0	0	0	0	200
16:00	4	145	57	1	28	2	0	1	1	0	0	0	0	239
17:00	3	181	80	2	37	0	0	2	0	0	0	0	0	305
18:00	2	111	57	2	16	1	0	0	1	0	0	0	0	190
19:00	1	83	30	0	6	1	0	0	0	0	0	0	0	121
20:00	1	52	12	1	3	1	0	0	2	0	0	0	0	72
21:00	0	33	7	0	6	0	0	1	0	0	0	0	0	47
22:00	0	18	7	0	1	0	0	0	0	0	0	0	0	26
23:00	0	10	2	0	0	0	0	0	1	0	0	0	0	13
Total	54	1189	584	77	308	62	4	24	72	0	0	0	0	2374
Percent	2.3%	50.1%	24.6%	3.2%	13.0%	2.6%	0.2%	1.0%	3.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	05:00	07:00	08:00	11:00	07:00	11:00	08:00	07:00	09:00					07:00
Vol.	4	60	32	11	23	10	1	3	9					137
PM Peak	14:00	17:00	17:00	15:00	17:00	14:00	14:00	15:00	13:00					17:00
Vol.	4	181	80	5	37	4	1	3	7					305

Willow Road
north of Ayer Road (Route 2A/110)
City, State: Littleton, MA
Client: Green International/ J. Sobel



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154787 C Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/10/1														
5	1	1	3	1	1	0	0	0	0	0	0	0	0	7
01:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
02:00	1	1	2	1	0	0	0	0	1	0	0	0	0	6
03:00	0	2	1	1	1	0	0	0	2	0	0	0	0	7
04:00	1	6	5	2	1	5	0	0	5	0	0	0	0	25
05:00	6	31	23	3	14	1	1	0	4	0	0	0	0	83
06:00	3	92	45	0	22	1	1	0	5	0	0	0	0	169
07:00	7	113	58	5	45	0	5	1	3	0	0	0	0	237
08:00	8	70	72	9	21	4	3	4	6	0	0	0	0	197
09:00	2	55	47	11	27	8	4	1	1	0	0	0	0	156
10:00	3	19	32	7	15	2	1	3	9	0	0	0	0	91
11:00	5	33	39	9	23	3	2	1	7	0	0	0	0	122
12 PM	6	42	31	4	25	2	0	2	5	0	0	0	0	117
13:00	3	33	28	5	12	2	0	0	5	0	0	0	0	88
14:00	5	44	29	5	28	0	0	0	7	0	0	0	0	118
15:00	6	56	36	8	38	3	0	0	1	0	0	0	0	148
16:00	3	62	53	3	24	2	0	0	3	0	0	0	0	150
17:00	2	60	47	1	11	0	0	0	1	0	0	0	0	122
18:00	2	52	34	3	8	0	0	0	1	0	0	0	0	100
19:00	1	18	15	0	6	0	0	0	2	0	0	0	0	42
20:00	2	15	10	0	4	2	0	0	0	0	0	0	0	33
21:00	0	9	9	0	1	0	0	0	0	0	0	0	0	19
22:00	0	3	3	0	2	0	0	0	0	0	0	0	0	8
23:00	1	5	4	0	1	1	0	0	0	0	0	0	0	12
Total	68	825	628	78	330	36	17	12	68	0	0	0	0	2062
Percent	3.3%	40.0%	30.5%	3.8%	16.0%	1.7%	0.8%	0.6%	3.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	08:00	09:00	07:00	09:00	07:00	08:00	10:00					07:00
Vol.	8	113	72	11	45	8	5	4	9					237
PM Peak	12:00	16:00	16:00	15:00	15:00	15:00		12:00	14:00					16:00
Vol.	6	62	53	8	38	3		2	7					150

Willow Road
north of Ayer Road (Route 2A/110)
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154787 C Speed
Site Code: TBA

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/10/																
15	0	4	0	2	1	2	4	2	1	0	0	0	0	16	45	34
01:00	0	0	0	0	1	2	0	0	0	0	0	0	0	3	37	35
02:00	0	0	0	0	2	3	0	0	0	0	0	0	0	5	37	35
03:00	0	0	0	0	2	4	2	0	0	0	0	0	0	8	41	37
04:00	0	1	1	3	4	6	10	2	2	0	0	0	0	29	43	38
05:00	0	0	0	1	14	21	11	2	0	0	0	0	0	49	41	37
06:00	2	3	0	2	26	44	34	12	0	0	0	0	0	123	43	37
07:00	0	0	2	8	25	44	43	15	0	0	0	0	0	137	43	38
08:00	1	0	1	6	29	52	33	3	0	0	0	0	0	125	41	37
09:00	1	0	0	6	26	44	22	6	0	0	0	0	0	105	41	37
10:00	0	0	0	3	26	30	18	7	1	0	0	0	0	85	42	37
11:00	0	0	0	5	21	46	27	9	3	0	0	0	0	111	43	38
12 PM	0	0	0	3	20	56	31	12	0	0	0	0	0	122	42	38
13:00	0	0	0	2	21	37	35	12	0	0	0	0	0	107	43	39
14:00	0	0	2	3	20	59	41	9	2	0	0	0	0	136	42	38
15:00	0	0	1	6	27	76	68	18	3	0	0	0	1	200	43	39
16:00	1	0	1	4	18	101	93	17	3	1	0	0	0	239	43	39
17:00	1	1	4	6	27	103	138	22	3	0	0	0	0	305	43	39
18:00	0	0	3	8	16	86	70	7	0	0	0	0	0	190	42	38
19:00	0	0	1	7	15	39	50	8	1	0	0	0	0	121	43	39
20:00	0	2	1	2	10	28	27	2	0	0	0	0	0	72	42	37
21:00	0	0	1	3	7	20	13	2	0	1	0	0	0	47	42	38
22:00	0	0	0	1	6	10	6	3	0	0	0	0	0	26	43	38
23:00	0	0	0	1	3	8	1	0	0	0	0	0	0	13	38	35
Total	6	11	18	82	367	921	777	170	19	2	0	0	1	2374		
%	0.3%	0.5%	0.8%	3.5%	15.5%	38.8%	32.7%	7.2%	0.8%	0.1%	0.0%	0.0%	0.0%			
AM Peak	06:00	00:00	07:00	07:00	08:00	08:00	07:00	07:00	11:00					07:00		
Vol.	2	4	2	8	29	52	43	15	3					137		
PM Peak	16:00	20:00	17:00	18:00	15:00	17:00	17:00	17:00	15:00	16:00			15:00	17:00		
Vol.	1	2	4	8	27	103	138	22	3	1			1	305		

Stats

15th Percentile :	32 MPH
50th Percentile :	37 MPH
85th Percentile :	42 MPH
95th Percentile :	46 MPH

Mean Speed(Average) :	38 MPH
10 MPH Pace Speed :	35-44 MPH
Number in Pace :	1698
Percent in Pace :	71.5%
Number of Vehicles > 35 MPH :	1706
Percent of Vehicles > 35 MPH :	71.9%

Willow Road
north of Ayer Road (Route 2A/110)
City, State: Littleton, MA
Client: Green International/ J. Sobel



PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154787 C Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/10/																
15	0	0	0	2	0	1	4	0	0	0	0	0	0	7	42	37
01:00	0	0	0	0	0	1	4	0	0	0	0	0	0	5	43	41
02:00	0	0	0	0	4	0	2	0	0	0	0	0	0	6	41	35
03:00	0	0	0	0	1	2	2	1	1	0	0	0	0	7	48	41
04:00	0	0	0	2	4	9	8	2	0	0	0	0	0	25	42	38
05:00	0	0	1	7	19	22	19	11	4	0	0	0	0	83	45	38
06:00	5	6	11	16	25	51	46	9	0	0	0	0	0	169	42	35
07:00	35	16	31	33	43	52	24	3	0	0	0	0	0	237	38	28
08:00	3	2	11	27	48	56	39	11	0	0	0	0	0	197	41	34
09:00	2	1	7	11	37	54	29	14	1	0	0	0	0	156	42	36
10:00	0	0	0	5	12	45	23	5	1	0	0	0	0	91	42	38
11:00	0	0	2	3	35	45	27	9	1	0	0	0	0	122	42	37
12 PM	1	0	0	4	19	38	42	11	2	0	0	0	0	117	43	39
13:00	0	0	5	3	18	25	24	11	2	0	0	0	0	88	43	38
14:00	5	0	4	4	13	36	39	14	3	0	0	0	0	118	43	38
15:00	0	0	3	7	25	52	49	12	0	0	0	0	0	148	42	38
16:00	0	0	4	13	22	44	55	10	1	1	0	0	0	150	43	38
17:00	2	0	1	6	19	48	34	12	0	0	0	0	0	122	43	37
18:00	0	3	4	8	16	29	27	12	1	0	0	0	0	100	43	37
19:00	0	0	0	1	4	18	16	3	0	0	0	0	0	42	42	39
20:00	0	0	4	0	2	12	12	3	0	0	0	0	0	33	43	38
21:00	0	0	0	0	3	8	7	0	1	0	0	0	0	19	42	39
22:00	0	0	0	0	2	3	3	0	0	0	0	0	0	8	42	38
23:00	0	0	0	3	2	2	3	2	0	0	0	0	0	12	44	37
Total	53	28	88	155	373	653	538	155	18	1	0	0	0	2062		
%	2.6%	1.4%	4.3%	7.5%	18.1%	31.7%	26.1%	7.5%	0.9%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	07:00	07:00	07:00	08:00	08:00	06:00	09:00	05:00					07:00		
Vol.	35	16	31	33	48	56	46	14	4					237		
PM Peak	14:00	18:00	13:00	16:00	15:00	15:00	16:00	14:00	14:00	16:00				16:00		
Vol.	5	3	5	13	25	52	55	14	3	1				150		

Stats
15th Percentile : 28 MPH
50th Percentile : 36 MPH
85th Percentile : 42 MPH
95th Percentile : 46 MPH

Mean Speed(Average) : 36 MPH
10 MPH Pace Speed : 35-44 MPH
Number in Pace : 1191
Percent in Pace : 57.8%
Number of Vehicles > 35 MPH : 1234
Percent of Vehicles > 35 MPH : 59.9%

[illegible]

1546

1491

1390
1390

1260

File Name: 154787_AA
Start Date: 11/10/2015
Start Time: 4:00:00 PM
Site Code: TBA
Comment 1: N/S/SW: Willow Rd/ Bruce St/ Gas Station
Comment 2: E/W: Ayer Road (Route 2A/110)
Comment 3: City, State: Littleton, MA
Comment 4: Client: Green International/ J. Sobel

***APPENDIX 2 – SEASONAL ADJUSTMENT
CALCULATION DATA***

STATION 34 - LANCASTER - RTE. 2 - WEST OF RTE. 70

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
2009	46,402	48,675	49,997	51,012	51,078	52,833	52,515	52,576	52,517	52,015	48,899	47,068	50,466
	-1.53%	-3.00%	1.31%	2.75%	2.09%	2.28%	-0.30%	1.81%	1.14%	2.32%	4.19%	-2.10%	0.96%
2010	45,691	47,217	50,653	52,414	52,148	54,040	52,355	53,529	53,116	53,223	50,950	46,079	50,951
	-4.61%	-5.80%	-2.28%	-5.32%	-1.68%	-2.70%	-3.34%	-4.14%	-3.54%	-5.38%	-2.38%	5.08%	-3.06%
2011	43,585	44,477	49,496	49,624	51,274	52,580	50,607	51,313	51,234	50,358	49,736	48,419	49,392
	4.34%	7.65%	-1.78%	0.50%	0.91%	-0.25%	0.12%	3.92%	-1.47%	2.81%	0.44%	-3.54%	1.05%
2012	45,478	47,880	48,616	49,871	51,743	52,449	50,669	53,325	50,481	51,772	49,955	46,705	49,912
	2.16%	1.02%	1.44%	1.93%	1.64%	0.29%	2.46%	1.60%	3.46%	3.32%	-0.23%	-2.98%	1.37%
2013	46,462	48,370	49,315	50,835	52,594	52,602	51,914	54,179	52,227	53,491	49,838	45,311	50,595
	4.08%	-6.19%	-1.90%	1.43%	0.44%	3.28%	1.18%	-1.64%	0.93%	3.49%			1.73%
2014	48,357	45,375	48,378	51,562	52,823	54,328	52,526	53,293	52,714	55,358			51,471
		10.84%	3.37%	3.54%	2.94%	4.02%	4.74%	5.12%	5.92%	3.24%			5.82%
2015		50,295	50,009	53,385	54,376	56,511	55,014	56,019	55,835	57,153	53,211	57,351	54,469
Average	45,996	47,470	49,495	51,243	52,291	53,620	52,229	53,462	52,589	53,339	50,432	48,489	51,037
Seasonal Adjustment Factor	1.11	1.08	1.03	1.00	0.98	0.95	0.98	0.95	0.97	0.96	1.01	1.05	
												Growth	1.31%

APPENDIX 3 – 2017 TRAFFIC DATA

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE
Starting: 12/13/2017

Page: 3

STA. 1
TOTAL

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction: ROAD TOTAL

File: LCS17-049-158-01.prn
City: LITTLETON
County: CLASS EB&WB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				79	103	91			91	182
02:00				44	51	47			47	95
03:00				49	49	49			49	98
04:00				67	85	76			76	152
05:00				155	151	153			153	306
06:00				391	414	402			402	805
07:00				906	896	901			901	1802
08:00				1055	963	1009			1009	2018
09:00				981	981	981			981	1962
10:00				731	700	715			715	1431
11:00			686	689		687			687	1375
12:00			709	722		715			715	1431
13:00			839	768		803			803	1607
14:00			802	702		752			752	1504
15:00			825	897		861			861	1722
16:00			1061	1058		1059			1059	2119
17:00			1048	1028		1038			1038	2076
18:00			1065	1060		1062			1062	2125
19:00			806	791		798			798	1597
20:00			492	551		521			521	1043
21:00			383	439		411			411	822
22:00			254	289		271			271	543
23:00			196	257		226			226	453
24:00			136	157		146			146	293

TOTALS	0	0	9302	13866	4393	13774	0	0	13774	27561
% AVG WKDY			67.5	100.6	31.8					
% AVG WEEK			67.5	100.6	31.8					
AM Times			12:00	08:00	09:00	08:00			08:00	
AM Peaks			709	1055	981	1009			1009	
PM Times			18:00	18:00		18:00			18:00	
PM Peaks			1065	1060		1062			1062	

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COMB AWD 13774

FAC .97

COMB ADT 13,400

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 1
Starting: 12/13/2017

Page: 1

STA. 1 EB

Site Reference: 170490000400

Site ID: 000000000103

Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.

Direction:

File: LCS17-049-158-01.prn

City: LITTLETON

County: CLASS EB&WB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				47	49	48			48	96
02:00				25	27	26			26	52
03:00				28	31	29			29	59
04:00				44	48	46			46	92
05:00				87	84	85			85	171
06:00				270	255	262			262	525
07:00				624	595	609			609	1219
08:00				762	678	720			720	1440
09:00				662	634	648			648	1296
10:00				437	414	425			425	851
11:00			373	400		386			386	773
12:00			379	394		386			386	773
13:00			419	386		402			402	805
14:00			401	378		389			389	779
15:00			379	430		404			404	809
16:00			478	501		489			489	979
17:00			423	423		423			423	846
18:00			364	364		364			364	728
19:00			262	283		272			272	545
20:00			169	203		186			186	372
21:00			135	164		149			149	299
22:00			80	114		97			97	194
23:00			67	83		75			75	150
24:00			50	53		51			51	103

TOTALS	0	0	3979	7162	2815	6971	0	0	6971	13956
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% AVG WKDY	57	102.7	40.3
% AVG WEEK	57	102.7	40.3

AM Times	12:00	08:00	08:00	08:00	08:00
AM Peaks	379	762	678	720	720

PM Times	16:00	16:00	16:00	16:00
PM Peaks	478	501	489	489

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 2
Starting: 12/13/2017

Page: 2

STA. 1 WB

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction:

File: LCS17-049-158-01.prn
City: LITTLETON
County: CLASS EB&WB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				32	54	43			43	86
02:00				19	24	21			21	43
03:00				21	18	19			19	39
04:00				23	37	30			30	60
05:00				68	67	67			67	135
06:00				121	159	140			140	280
07:00				282	301	291			291	583
08:00				293	285	289			289	578
09:00				319	347	333			333	666
10:00				294	286	290			290	580
11:00			313	289		301			301	602
12:00			330	328		329			329	658
13:00			420	382		401			401	802
14:00			401	324		362			362	725
15:00			446	467		456			456	913
16:00			583	557		570			570	1140
17:00			625	605		615			615	1230
18:00			701	696		698			698	1397
19:00			544	508		526			526	1052
20:00			323	348		335			335	671
21:00			248	275		261			261	523
22:00			174	175		174			174	349
23:00			129	174		151			151	303
24:00			86	104		95			95	190
TOTALS	0	0	5323	6704	1578	6797	0	0	6797	13605
% AVG WKDY			78.3	98.6	23.2					
% AVG WEEK			78.3	98.6	23.2					
AM Times			12:00	12:00	09:00	09:00			09:00	
AM Peaks			330	328	347	333			333	
PM Times			18:00	18:00		18:00			18:00	
PM Peaks			701	696		698			698	

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE
Starting: 12/13/2017

Page: 3

STA. 2

TOTAL

Site Reference: 170490000822

Site ID: 000000000203

Location: RTE 2A WEST OF WILLOW RD/BRUCE ST

Direction: ROAD TOTAL

File: LCS17-049-158-02.prn

City: LITTLETON

County: CLASS EB&WB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				76	91	83			83	167
02:00				44	40	42			42	84
03:00				51	45	48			48	96
04:00				90	88	89			89	178
05:00				143	136	139			139	279
06:00				345	314	329			329	659
07:00				737	736	736			736	1473
08:00				830	756	793			793	1586
09:00				781	766	773			773	1547
10:00				633	576	604			604	1209
11:00			573	576		574			574	1149
12:00			582	591		586			586	1173
13:00			765	657		711			711	1422
14:00			670	597		633			633	1267
15:00			713	749		731			731	1462
16:00			909	917		913			913	1826
17:00			852	852		852			852	1704
18:00			826	836		831			831	1662
19:00			643	683		663			663	1326
20:00			410	423		416			416	833
21:00			298	373		335			335	671
22:00			217	255		236			236	472
23:00			158	205		181			181	363
24:00			112	132		122			122	244

TOTALS	0	0	7728	11576	3548	11420	0	0	11420	22852
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% AVG WKDY			67.6	101.3	31					
% AVG WEEK			67.6	101.3	31					

AM Times			12:00	08:00	09:00	08:00			08:00	
AM Peaks			582	830	766	793			793	

PM Times			16:00	16:00		16:00			16:00	
PM Peaks			909	917		913			913	

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COMB AWD 11420

FAC 197

COMB ADT 11,100

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 1
Starting: 12/13/2017

Page: 1

STA. 2 EB

Site Reference: 170490000822
Site ID: 000000000203
Location: RTE 2A WEST OF WILLOW RD/BRUCE ST
Direction:

File: LCS17-049-158-02.prn
City: LITTLETON
County: CLASS EB&WB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				41	42	41			41	83
02:00				21	18	19			19	39
03:00				28	28	28			28	56
04:00				44	44	44			44	88
05:00				74	73	73			73	147
06:00				221	192	206			206	413
07:00				516	484	500			500	1000
08:00				590	541	565			565	1131
09:00				508	487	497			497	995
10:00				360	340	350			350	700
11:00			294	337		315			315	631
12:00			306	313		309			309	619
13:00			372	327		349			349	699
14:00			332	314		323			323	646
15:00			324	359		341			341	683
16:00			409	434		421			421	843
17:00			347	347		347			347	694
18:00			278	280		279			279	558
19:00			217	251		234			234	468
20:00			148	160		154			154	308
21:00			108	146		127			127	254
22:00			65	102		83			83	167
23:00			57	77		67			67	134
24:00			49	46		47			47	95

TOTALS	0	0	3306	5896	2249	5719	0	0	5719	11451
% AVG WKDY			57.8	103	39.3					
% AVG WEEK			57.8	103	39.3					
AM Times			12:00	08:00	08:00	08:00			08:00	
AM Peaks			306	590	541	565			565	
PM Times			16:00	16:00		16:00			16:00	
PM Peaks			409	434		421			421	

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 2
Starting: 12/13/2017

Page: 2

STA. 2 WB

Site Reference: 170490000822
Site ID: 000000000203
Location: RTE 2A WEST OF WILLOW RD/BRUCE ST
Direction:

File: LCS17-049-158-02.prn
City: LITTLETON
County: CLASS EB&WB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				35	49	42			42	84
02:00				23	22	22			22	45
03:00				23	17	20			20	40
04:00				46	44	45			45	90
05:00				69	63	66			66	132
06:00				124	122	123			123	246
07:00				221	252	236			236	473
08:00				240	215	227			227	455
09:00				273	279	276			276	552
10:00				273	236	254			254	509
11:00			279	239		259			259	518
12:00			276	278		277			277	554
13:00			393	330		361			361	723
14:00			338	283		310			310	621
15:00			389	390		389			389	779
16:00			500	483		491			491	983
17:00			505	505		505			505	1010
18:00			548	556		552			552	1104
19:00			426	432		429			429	858
20:00			262	263		262			262	525
21:00			190	227		208			208	417
22:00			152	153		152			152	305
23:00			101	128		114			114	229
24:00			63	86		74			74	149
TOTALS	0	0	4422	5680	1299	5694	0	0	5694	11401
% AVG WKDY			77.6	99.7	22.8					
% AVG WEEK			77.6	99.7	22.8					
AM Times			11:00	12:00	09:00	12:00			12:00	
AM Peaks			279	278	279	277			277	
PM Times			18:00	18:00		18:00			18:00	
PM Peaks			548	556		552			552	

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE
Starting: 12/13/2017

Page: 3

STA. 3

TOTAL

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction: ROAD TOTAL

File: LCS17-049-158-03.prn
City: LITTLETON
County: CLASS NB&SB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				15	18	16			16	33
02:00				15	16	15			15	31
03:00				8	8	8			8	16
04:00				21	21	21			21	42
05:00				46	37	41			41	83
06:00				118	127	122			122	245
07:00				296	282	289			289	578
08:00				446	383	414			414	829
09:00				367	318	342			342	685
10:00				266	242	254			254	508
11:00			218	216		217			217	434
12:00			225	239		232			232	464
13:00			252	305		278			278	557
14:00			250	247		248			248	497
15:00			261	306		283			283	567
16:00			333	311		322			322	644
17:00			389	371		380			380	760
18:00			440	419		429			429	859
19:00			274	276		275			275	550
20:00			172	187		179			179	359
21:00			147	123		135			135	270
22:00			83	88		85			85	171
23:00			58	73		65			65	131
24:00			38	44		41			41	82

TOTALS	0	0	3140	4803	1452	4691	0	0	4691	9395
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% AVG WKDY			66.9	102.3	30.9					
% AVG WEEK			66.9	102.3	30.9					

AM Times			12:00	08:00	08:00	08:00			08:00	
AM Peaks			225	446	383	414			414	

PM Times			18:00	18:00		18:00			18:00	
PM Peaks			440	419		429			429	

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COMB AWD 4691

FAC .96

COMB ADT 4,500

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 1
Starting: 12/13/2017

Page: 1

STA. 3 NB

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction:

File: LCS17-049-158-03.prn
City: LITTLETON
County: CLASS NB&SB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				8	15	11			11	23
02:00				5	7	6			6	12
03:00				3	6	4			4	9
04:00				12	10	11			11	22
05:00				24	16	20			20	40
06:00				35	47	41			41	82
07:00				103	86	94			94	189
08:00				112	112	112			112	224
09:00				117	107	112			112	224
10:00				104	106	105			105	210
11:00			91	100		95			95	191
12:00			101	109		105			105	210
13:00			127	149		138			138	276
14:00			125	121		123			123	246
15:00			136	174		155			155	310
16:00			184	175		179			179	359
17:00			243	232		237			237	475
18:00			302	285		293			293	587
19:00			191	187		189			189	378
20:00			119	119		119			119	238
21:00			94	83		88			88	177
22:00			58	54		56			56	112
23:00			35	49		42			42	84
24:00			28	29		28			28	57

TOTALS	0	0	1834	2389	512	2363	0	0	2363	4735
--------	---	---	------	------	-----	------	---	---	------	------

% AVG WKDY			77.6	101.1	21.6					
% AVG WEEK			77.6	101.1	21.6					

AM Times			12:00	09:00	08:00	08:00			08:00	
AM Peaks			101	117	112	112			112	

PM Times			18:00	18:00		18:00			18:00	
PM Peaks			302	285		293			293	

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 2
Starting: 12/13/2017

Page: 2

STA. 3 SB

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction: SOUTH

File: LCS17-049-158-03.prn
City: LITTLETON
County: CLASS NB&SB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				7	3	5			5	10
02:00				10	9	9			9	19
03:00				5	2	3			3	7
04:00				9	11	10			10	20
05:00				22	21	21			21	43
06:00				83	80	81			81	163
07:00				193	196	194			194	389
08:00				334	271	302			302	605
09:00				250	211	230			230	461
10:00				162	136	149			149	298
11:00			127	116		121			121	243
12:00			124	130		127			127	254
13:00			125	156		140			140	281
14:00			125	126		125			125	251
15:00			125	132		128			128	257
16:00			149	136		142			142	285
17:00			146	139		142			142	285
18:00			138	134		136			136	272
19:00			83	89		86			86	172
20:00			53	68		60			60	121
21:00			53	40		46			46	93
22:00			25	34		29			29	59
23:00			23	24		23			23	47
24:00			10	15		12			12	25

TOTALS	0	0	1306	2414	940	2321	0	0	2321	4660
--------	---	---	------	------	-----	------	---	---	------	------

% AVG WKDY	56.2	104	40.4
% AVG WEEK	56.2	104	40.4

AM Times	11:00	08:00	08:00	08:00	08:00
AM Peaks	127	334	271	302	302

PM Times	16:00	13:00	16:00	16:00
PM Peaks	149	156	142	142

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE
Starting: 12/13/2017

Page: 3

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction: ROAD TOTAL

STA. 4
TOTAL

File: LCS17-049-158-04.prn
City: LITTLETON
County: CLASS NB&SB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				4	4	4			4	8
02:00				0	0	0			0	0
03:00				1	1	1			1	2
04:00				2	1	1			1	3
05:00				2	3	2			2	5
06:00				17	13	15			15	30
07:00				87	61	74			74	148
08:00				158	129	143			143	287
09:00				92	79	85			85	171
10:00				53	42	47			47	95
11:00			55	35		45			45	90
12:00			56	52		54			54	108
13:00			51	47		49			49	98
14:00			47	50		48			48	97
15:00			60	53		56			56	113
16:00			76	74		75			75	150
17:00			116	128		122			122	244
18:00			120	115		117			117	235
19:00			69	77		73			73	146
20:00			46	36		41			41	82
21:00			30	36		33			33	66
22:00			27	14		20			20	41
23:00			10	20		15			15	30
24:00			8	8		8			8	16

TOTALS	0	0	771	1161	333	1128	0	0	1128	2265
--------	---	---	-----	------	-----	------	---	---	------	------

% AVG WKDY			68.3	102.9	29.5					
% AVG WEEK			68.3	102.9	29.5					

AM Times		12:00	08:00	08:00	08:00			08:00		
AM Peaks		56	158	129	143			143		

PM Times		18:00	17:00		17:00			17:00		
PM Peaks		120	128		122			122		

46
COMB AND 1128
FAC .96
COMB ADT 1,100

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 1
Starting: 12/13/2017

Page: 1

STA 4 NB

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction:

File: LCS17-049-158-04.prn
City: LITTLETON
County: CLASS NB&SB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				3	3	3			3	6
02:00				0	0	0			0	0
03:00				0	1	0			0	1
04:00				2	1	1			1	3
05:00				2	1	1			1	3
06:00				2	2	2			2	4
07:00				17	8	12			12	25
08:00				23	18	20			20	41
09:00				26	23	24			24	49
10:00				19	15	17			17	34
11:00			21	10		15			15	31
12:00			30	25		27			27	55
13:00			27	25		26			26	52
14:00			22	21		21			21	43
15:00			29	38		33			33	67
16:00			43	43		43			43	86
17:00			79	89		84			84	168
18:00			94	100		97			97	194
19:00			45	47		46			46	92
20:00			29	24		26			26	53
21:00			10	23		16			16	33
22:00			9	5		7			7	14
23:00			3	8		5			5	11
24:00			3	5		4			4	8
TOTALS	0	0	444	557	72	530	0	0	530	1073
% AVG WKDY			83.7	105	13.5					
% AVG WEEK			83.7	105	13.5					
AM Times			12:00	09:00	09:00	12:00			12:00	
AM Peaks			30	26	23	27			27	
PM Times			18:00	18:00		18:00			18:00	
PM Peaks			94	100		97			97	

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 2
Starting: 12/13/2017

Page: 2

STA 4 SB

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction: SOUTH

File: LCS17-049-158-04.prn
City: LITTLETON
County: CLASS NB&SB

TIME	MON	TUE	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00				1	1	1			1	2
02:00				0	0	0			0	0
03:00				1	0	0			0	1
04:00				0	0	0			0	0
05:00				0	2	1			1	2
06:00				15	11	13			13	26
07:00				70	53	61			61	123
08:00				135	111	123			123	246
09:00				66	56	61			61	122
10:00				34	27	30			30	61
11:00			34	25		29			29	59
12:00			26	27		26			26	53
13:00			24	22		23			23	46
14:00			25	29		27			27	54
15:00			31	15		23			23	46
16:00			33	31		32			32	64
17:00			37	39		38			38	76
18:00			26	15		20			20	41
19:00			24	30		27			27	54
20:00			17	12		14			14	29
21:00			20	13		16			16	33
22:00			18	9		13			13	27
23:00			7	12		9			9	19
24:00			5	3		4			4	8

TOTALS	0	0	327	604	261	591	0	0	591	1192
% AVG WKDY			55.3	102.1	44.1					
% AVG WEEK			55.3	102.1	44.1					
AM Times			11:00	08:00	08:00	08:00			08:00	
AM Peaks			34	135	111	123			123	
PM Times			17:00	17:00		17:00			17:00	
PM Peaks			37	39		38			38	

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 1

STA. 1 EB

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction:
Lane: 1

File: LCS17-049-158-01.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	0	4	23	61	145	106	26	7	1	0	0	0	0	0	0	373
12:00	0	1	18	56	128	140	32	3	1	0	0	0	0	0	0	379
13:00	0	3	19	69	159	138	28	1	2	0	0	0	0	0	0	419
14:00	2	6	18	54	169	125	23	4	0	0	0	0	0	0	0	401
15:00	4	2	26	57	134	115	37	3	1	0	0	0	0	0	0	379
16:00	0	0	10	50	196	186	35	1	0	0	0	0	0	0	0	478
17:00	6	18	30	57	164	114	27	5	2	0	0	0	0	0	0	423
18:00	7	11	27	86	137	86	10	0	0	0	0	0	0	0	0	364
19:00	0	1	14	49	83	82	31	2	0	0	0	0	0	0	0	262
20:00	0	1	6	27	39	60	30	6	0	0	0	0	0	0	0	169
21:00	0	0	1	22	37	49	24	1	1	0	0	0	0	0	0	135
22:00	0	0	3	6	18	39	14	0	0	0	0	0	0	0	0	80
23:00	0	0	1	2	18	29	15	2	0	0	0	0	0	0	0	67
24:00	0	0	1	3	7	14	19	5	1	0	0	0	0	0	0	50
DAY TOTAL	19	47	197	599	1434	1283	351	40	9	0	0	0	0	0	0	3979
PERCENTS	0.5%	1.2%	5.0%	15.1%	36.0%	32.2%	8.8%	1.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
31.8 mph

85th Percentile Speed
43.2 mph

Median Speed
37.9 mph

Average Speed
37.6 mph

10 MPH Pace Speed
34 mph to 44 mph
2717 vehicles in pace
Representing 68.2% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 2

STA. 1 EB

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction:
Lane: 1

File: LCS17-049-158-01.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	1	10	20	15	1	0	0	0	0	0	0	0	47
02:00	0	1	1	0	7	9	5	0	1	0	1	0	0	0	0	25
03:00	0	0	0	3	6	10	7	2	0	0	0	0	0	0	0	28
04:00	0	0	2	0	4	19	13	5	1	0	0	0	0	0	0	44
05:00	0	1	8	7	16	28	24	3	0	0	0	0	0	0	0	87
06:00	0	1	9	6	70	128	48	7	1	0	0	0	0	0	0	270
07:00	1	9	23	116	233	206	32	4	0	0	0	0	0	0	0	624
08:00	3	4	17	112	296	290	37	3	0	0	0	0	0	0	0	762
09:00	0	1	25	103	280	207	42	3	1	0	0	0	0	0	0	662
10:00	0	1	11	82	164	151	28	0	0	0	0	0	0	0	0	437
11:00	1	4	22	75	120	137	39	2	0	0	0	0	0	0	0	400
12:00	0	0	12	66	117	136	52	10	1	0	0	0	0	0	0	394
13:00	2	3	15	75	127	125	33	6	0	0	0	0	0	0	0	386
14:00	6	3	16	38	143	127	39	5	1	0	0	0	0	0	0	378
15:00	3	6	25	110	159	94	30	2	1	0	0	0	0	0	0	430
16:00	2	8	8	68	192	171	43	9	0	0	0	0	0	0	0	501
17:00	0	0	17	67	176	130	31	2	0	0	0	0	0	0	0	423
18:00	0	7	12	62	162	97	21	3	0	0	0	0	0	0	0	364
19:00	0	2	15	54	115	70	25	1	1	0	0	0	0	0	0	283
20:00	0	2	7	22	58	86	24	4	0	0	0	0	0	0	0	203
21:00	0	0	0	15	63	71	13	1	1	0	0	0	0	0	0	164
22:00	0	0	5	16	29	43	18	3	0	0	0	0	0	0	0	114
23:00	0	0	1	4	21	34	21	2	0	0	0	0	0	0	0	83
24:00	0	2	0	3	11	20	13	3	0	0	1	0	0	0	0	53
DAY TOTAL	18	55	251	1105	2579	2409	653	81	9	0	2	0	0	0	0	7162
PERCENTS	0.3%	0.8%	3.6%	15.4%	36.0%	33.6%	9.1%	1.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
32.4 mph

85th Percentile Speed
43.3 mph

Median Speed
38.2 mph

Average Speed
38.0 mph

10 MPH Pace Speed
34 mph to 44 mph
4988 vehicles in pace
Representing 69.6% of the total vehicles

Vehicles > 65 MPH
2
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 3

STA-1 EB

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction:
Lane: 1

File: LCS17-049-158-01.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	2	4	7	21	13	2	0	0	0	0	0	0	0	49
02:00	0	1	1	5	2	9	7	2	0	0	0	0	0	0	0	27
03:00	0	0	0	0	7	8	10	6	0	0	0	0	0	0	0	31
04:00	0	1	3	1	9	20	9	4	0	1	0	0	0	0	0	48
05:00	0	1	3	4	15	31	23	4	1	2	0	0	0	0	0	84
06:00	0	1	5	20	56	122	43	8	0	0	0	0	0	0	0	255
07:00	2	2	23	89	222	221	34	2	0	0	0	0	0	0	0	595
08:00	1	1	22	106	259	229	60	0	0	0	0	0	0	0	0	678
09:00	0	0	10	105	243	235	39	2	0	0	0	0	0	0	0	634
10:00	0	0	16	53	159	143	40	3	0	0	0	0	0	0	0	414
DAY TOTAL	3	7	85	387	979	1039	278	33	1	3	0	0	0	0	0	2815
PERCENTS	0.2%	0.3%	3.1%	13.8%	34.7%	36.9%	9.8%	1.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
33.2 mph

85th Percentile Speed
43.5 mph

Median Speed
38.7 mph

Average Speed
38.5 mph

10 MPH Pace Speed
34 mph to 44 mph
2018 vehicles in pace
Representing 71.6% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 4

STAIL WB

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction:
Lane: 2

File: LCS17-049-158-01.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	4	12	46	112	103	28	7	0	1	0	0	0	0	0	0	313
12:00	11	19	41	104	116	33	6	0	0	0	0	0	0	0	0	330
13:00	49	17	49	93	154	48	10	0	0	0	0	0	0	0	0	420
14:00	19	34	71	103	137	32	5	0	0	0	0	0	0	0	0	401
15:00	20	23	66	163	129	39	6	0	0	0	0	0	0	0	0	446
16:00	65	60	117	168	133	39	1	0	0	0	0	0	0	0	0	583
17:00	96	71	137	177	126	16	2	0	0	0	0	0	0	0	0	625
18:00	198	141	157	137	61	5	0	0	2	0	0	0	0	0	0	701
19:00	58	62	96	141	133	48	6	0	0	0	0	0	0	0	0	544
20:00	10	10	32	93	127	48	3	0	0	0	0	0	0	0	0	323
21:00	1	5	15	53	102	67	5	0	0	0	0	0	0	0	0	248
22:00	1	1	6	25	78	56	6	0	1	0	0	0	0	0	0	174
23:00	1	2	3	21	51	34	14	3	0	0	0	0	0	0	0	129
24:00	0	3	4	11	27	26	13	2	0	0	0	0	0	0	0	86
DAY TOTAL	533	460	840	1401	1477	519	84	5	4	0	0	0	0	0	0	5323
PERCENTS	10.1%	8.7%	15.8%	26.4%	27.8%	9.7%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
21.9 mph

85th Percentile Speed
38.4 mph

Median Speed
32.0 mph

Average Speed
30.3 mph

10 MPH Pace Speed
29 mph to 39 mph
2878 vehicles in pace
Representing 54.0% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 5

STA. 1WB

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction:
Lane: 2

File: LCS17-049-158-01.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	1	0	1	12	12	5	1	0	0	0	0	0	0	0	32
02:00	0	0	0	1	7	5	6	0	0	0	0	0	0	0	0	19
03:00	0	0	0	3	5	6	4	3	0	0	0	0	0	0	0	21
04:00	0	0	0	1	9	10	3	0	0	0	0	0	0	0	0	23
05:00	0	0	2	6	14	27	16	1	2	0	0	0	0	0	0	68
06:00	0	1	10	14	41	46	8	1	0	0	0	0	0	0	0	121
07:00	24	10	21	80	96	48	3	0	0	0	0	0	0	0	0	282
08:00	9	13	30	61	107	66	6	1	0	0	0	0	0	0	0	293
09:00	7	17	48	101	116	28	2	0	0	0	0	0	0	0	0	319
10:00	16	14	19	88	116	36	4	1	0	0	0	0	0	0	0	294
11:00	1	5	37	88	103	43	12	0	0	0	0	0	0	0	0	289
12:00	5	12	24	89	129	55	14	0	0	0	0	0	0	0	0	328
13:00	13	15	43	105	142	58	6	0	0	0	0	0	0	0	0	382
14:00	7	10	15	60	165	54	13	0	0	0	0	0	0	0	0	324
15:00	36	33	65	110	150	64	9	0	0	0	0	0	0	0	0	467
16:00	38	48	88	170	156	52	5	0	0	0	0	0	0	0	0	557
17:00	82	82	99	167	142	31	2	0	0	0	0	0	0	0	0	605
18:00	115	105	155	231	77	12	1	0	0	0	0	0	0	0	0	696
19:00	33	42	100	173	120	36	4	0	0	0	0	0	0	0	0	508
20:00	5	3	29	101	139	65	6	0	0	0	0	0	0	0	0	348
21:00	3	4	26	55	121	58	7	1	0	0	0	0	0	0	0	275
22:00	3	1	5	34	89	40	3	0	0	0	0	0	0	0	0	175
23:00	3	7	5	22	74	49	13	0	0	0	0	1	0	0	0	174
24:00	0	0	2	9	39	36	18	0	0	0	0	0	0	0	0	104
DAY TOTAL	400	423	823	1770	2169	937	170	9	2	0	0	1	0	0	0	6704
PERCENTS	6.0%	6.4%	12.3%	26.5%	32.3%	13.9%	2.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
25.1 mph

85th Percentile Speed
39.6 mph

Median Speed
33.8 mph

Average Speed
32.4 mph

10 MPH Pace Speed
29 mph to 39 mph
3939 vehicles in pace
Representing 58.7% of the total vehicles

Vehicles > 65 MPH
1
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 6

STA. 1WB

Site Reference: 170490000400
Site ID: 000000000103
Location: RTE 2A EAST OF WILLOW RD/BRUCE ST.
Direction:
Lane: 2

File: LCS17-049-158-01.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	7	24	19	4	0	0	0	0	0	0	0	0	54
02:00	0	0	0	0	4	10	7	3	0	0	0	0	0	0	0	24
03:00	0	0	1	1	9	4	3	0	0	0	0	0	0	0	0	18
04:00	1	0	0	3	9	12	12	0	0	0	0	0	0	0	0	37
05:00	1	2	3	5	15	27	11	3	0	0	0	0	0	0	0	67
06:00	1	0	3	30	47	61	13	2	2	0	0	0	0	0	0	159
07:00	10	19	56	81	82	45	5	3	0	0	0	0	0	0	0	301
08:00	17	11	21	74	109	44	9	0	0	0	0	0	0	0	0	285
09:00	15	11	37	86	129	61	8	0	0	0	0	0	0	0	0	347
10:00	9	10	22	84	97	54	10	0	0	0	0	0	0	0	0	286
DAY TOTAL	54	53	143	371	525	337	82	11	2	0	0	0	0	0	0	1578
PERCENTS	3.5%	3.4%	9.1%	23.6%	33.3%	21.3%	5.1%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
28.5 mph

85th Percentile Speed
41.9 mph

Median Speed
35.6 mph

Average Speed
34.7 mph

10 MPH Pace Speed
29 mph to 39 mph
896 vehicles in pace
Representing 56.7% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 1

Site Reference: 170490000822

Site ID: 000000000203

Location: RTE 2A WEST OF WILLOW RD/BRUCE ST

Direction:

Lane: 1

STA. 2 EB

File: LCS17-049-158-02.prn

City: LITTLETON

County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	1	12	7	24	122	99	26	3	0	0	0	0	0	0	0	294
12:00	0	0	2	16	105	151	28	4	0	0	0	0	0	0	0	306
13:00	0	1	2	39	170	136	22	1	0	1	0	0	0	0	0	372
14:00	0	0	1	29	143	131	26	2	0	0	0	0	0	0	0	332
15:00	0	6	7	17	133	119	40	2	0	0	0	0	0	0	0	324
16:00	0	0	5	36	170	170	27	1	0	0	0	0	0	0	0	409
17:00	0	0	0	18	156	152	19	2	0	0	0	0	0	0	0	347
18:00	0	1	14	36	117	97	13	0	0	0	0	0	0	0	0	278
19:00	0	0	7	21	107	71	11	0	0	0	0	0	0	0	0	217
20:00	0	0	0	14	49	66	17	2	0	0	0	0	0	0	0	148
21:00	0	0	0	14	37	40	14	3	0	0	0	0	0	0	0	108
22:00	0	0	0	2	20	36	7	0	0	0	0	0	0	0	0	65
23:00	0	0	2	0	18	23	10	2	1	1	0	0	0	0	0	57
24:00	0	0	0	2	8	22	14	3	0	0	0	0	0	0	0	49
DAY TOTAL	1	20	47	268	1355	1313	274	25	1	2	0	0	0	0	0	3306
PERCENTS	0.1%	0.7%	1.5%	8.2%	40.9%	39.7%	8.2%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
34.6 mph

85th Percentile Speed
43.3 mph

Median Speed
38.9 mph

Average Speed
38.8 mph

10 MPH Pace Speed
34 mph to 44 mph
2668 vehicles in pace
Representing 80.7% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 2

Site Reference: 170490000822

Site ID: 000000000203

Location: RTE 2A WEST OF WILLOW RD/BRUCE ST

Direction:

Lane: 1

STA. 2EB

File: LCS17-049-158-02.prn

City: LITTLETON

County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	0	13	23	3	2	0	0	0	0	0	0	0	41
02:00	0	0	0	0	8	9	1	2	0	1	0	0	0	0	0	21
03:00	0	0	0	1	7	16	4	0	0	0	0	0	0	0	0	28
04:00	0	0	0	0	9	14	20	1	0	0	0	0	0	0	0	44
05:00	0	0	0	3	18	34	18	1	0	0	0	0	0	0	0	74
06:00	0	0	0	11	80	105	24	0	1	0	0	0	0	0	0	221
07:00	0	6	10	101	232	150	16	1	0	0	0	0	0	0	0	516
08:00	30	25	72	128	221	101	13	0	0	0	0	0	0	0	0	590
09:00	2	5	20	64	226	163	25	2	1	0	0	0	0	0	0	508
10:00	3	13	3	33	159	122	26	1	0	0	0	0	0	0	0	360
11:00	0	0	3	16	132	151	32	3	0	0	0	0	0	0	0	337
12:00	0	1	1	18	120	127	42	4	0	0	0	0	0	0	0	313
13:00	0	3	9	17	122	147	28	1	0	0	0	0	0	0	0	327
14:00	0	0	0	17	94	161	41	1	0	0	0	0	0	0	0	314
15:00	0	0	0	24	160	144	29	2	0	0	0	0	0	0	0	359
16:00	0	1	5	40	173	180	34	1	0	0	0	0	0	0	0	434
17:00	0	0	1	11	149	152	30	4	0	0	0	0	0	0	0	347
18:00	0	4	4	48	108	98	17	1	0	0	0	0	0	0	0	280
19:00	0	0	1	27	131	83	9	0	0	0	0	0	0	0	0	251
20:00	0	0	0	11	66	63	16	4	0	0	0	0	0	0	0	160
21:00	0	0	0	9	53	66	18	0	0	0	0	0	0	0	0	146
22:00	0	0	1	7	33	49	11	1	0	0	0	0	0	0	0	102
23:00	0	4	0	16	19	29	8	1	0	0	0	0	0	0	0	77
24:00	0	0	0	2	15	19	9	0	1	0	0	0	0	0	0	46

DAY TOTAL	35	62	130	604	2348	2206	474	33	3	1	0	0	0	0	0	5896
PERCENTS	0.6%	1.1%	2.3%	10.3%	39.8%	37.4%	8.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
34.1 mph

85th Percentile Speed
43.2 mph

Median Speed
38.5 mph

Average Speed
38.2 mph

10 MPH Pace Speed
34 mph to 44 mph
4554 vehicles in pace
Representing 77.2% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 3

Site Reference: 170490000822
Site ID: 000000000203
Location: RTE 2A WEST OF WILLOW RD/BRUCE ST
Direction:
Lane: 1

STA. 2EB

File: LCS17-049-158-02.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	1	7	26	8	0	0	0	0	0	0	0	0	42
02:00	0	0	0	0	6	7	4	1	0	0	0	0	0	0	0	18
03:00	0	0	0	0	5	15	7	1	0	0	0	0	0	0	0	28
04:00	0	0	0	1	9	24	9	0	1	0	0	0	0	0	0	44
05:00	0	0	0	0	19	39	10	5	0	0	0	0	0	0	0	73
06:00	0	2	6	5	60	91	27	1	0	0	0	0	0	0	0	192
07:00	0	0	9	67	243	152	13	0	0	0	0	0	0	0	0	484
08:00	6	9	36	94	207	174	15	0	0	0	0	0	0	0	0	541
09:00	2	0	14	71	228	148	22	2	0	0	0	0	0	0	0	487
10:00	0	5	3	16	145	147	22	2	0	0	0	0	0	0	0	340
DAY TOTAL	8	16	68	255	929	823	137	12	1	0	0	0	0	0	0	2249
PERCENTS	0.4%	0.8%	3.1%	11.4%	41.3%	36.5%	6.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
33.8 mph

85th Percentile Speed
42.9 mph

Median Speed
38.2 mph

Average Speed
38.0 mph

10 MPH Pace Speed
34 mph to 44 mph
1752 vehicles in pace
Representing 77.9% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 4

STA. 2 WB

Site Reference: 170490000822
Site ID: 000000000203
Location: RTE 2A WEST OF WILLOW RD/BRUCE ST
Direction:
Lane: 2

File: LCS17-049-158-02.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	0	0	0	13	87	123	47	8	1	0	0	0	0	0	0	279
12:00	0	0	5	15	77	130	43	6	0	0	0	0	0	0	0	276
13:00	0	0	2	51	111	171	54	4	0	0	0	0	0	0	0	393
14:00	0	2	0	21	109	148	52	5	1	0	0	0	0	0	0	338
15:00	2	0	2	13	122	195	50	4	0	1	0	0	0	0	0	389
16:00	0	0	8	18	139	230	96	9	0	0	0	0	0	0	0	500
17:00	0	1	0	33	171	215	80	5	0	0	0	0	0	0	0	505
18:00	1	1	5	39	159	276	63	4	0	0	0	0	0	0	0	548
19:00	0	0	0	17	112	224	67	6	0	0	0	0	0	0	0	426
20:00	4	3	0	8	36	138	66	6	1	0	0	0	0	0	0	262
21:00	0	0	0	8	28	90	55	9	0	0	0	0	0	0	0	190
22:00	0	0	0	3	22	70	48	8	1	0	0	0	0	0	0	152
23:00	0	0	0	2	13	46	31	8	1	0	0	0	0	0	0	101
24:00	2	0	0	0	7	22	25	6	1	0	0	0	0	0	0	63
DAY TOTAL	9	7	22	241	1193	2078	777	88	6	1	0	0	0	0	0	4422
PERCENTS	0.3%	0.2%	0.5%	5.5%	27.0%	47.0%	17.5%	1.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
35.6 mph

85th Percentile Speed
45.4 mph

Median Speed
40.8 mph

Average Speed
40.5 mph

10 MPH Pace Speed
34 mph to 44 mph
3271 vehicles in pace
Representing 73.9% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 5

STA. 2 WB

Site Reference: 170490000822
Site ID: 000000000203
Location: RTE 2A WEST OF WILLOW RD/BRUCE ST
Direction:
Lane: 2

File: LCS17-049-158-02.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	1	0	5	13	13	3	0	0	0	0	0	0	0	35
02:00	0	0	0	0	0	9	11	2	1	0	0	0	0	0	0	23
03:00	0	0	0	0	5	1	14	1	2	0	0	0	0	0	0	23
04:00	0	0	1	1	8	13	16	6	1	0	0	0	0	0	0	46
05:00	1	0	0	1	8	18	27	14	0	0	0	0	0	0	0	69
06:00	0	0	0	3	29	54	32	4	0	0	2	0	0	0	0	124
07:00	0	0	0	17	66	101	34	3	0	0	0	0	0	0	0	221
08:00	2	0	2	15	57	99	55	10	0	0	0	0	0	0	0	240
09:00	1	5	1	18	74	127	44	3	0	0	0	0	0	0	0	273
10:00	0	1	1	18	88	126	37	2	0	0	0	0	0	0	0	273
11:00	0	3	1	8	62	107	55	3	0	0	0	0	0	0	0	239
12:00	0	4	2	7	82	114	57	11	1	0	0	0	0	0	0	278
13:00	0	0	8	31	83	142	54	10	2	0	0	0	0	0	0	330
14:00	2	0	0	6	96	121	53	5	0	0	0	0	0	0	0	283
15:00	0	0	1	27	131	161	63	7	0	0	0	0	0	0	0	390
16:00	1	2	0	15	120	238	96	11	0	0	0	0	0	0	0	483
17:00	0	0	2	21	153	248	74	7	0	0	0	0	0	0	0	505
18:00	0	0	0	43	185	270	56	2	0	0	0	0	0	0	0	556
19:00	0	4	7	15	144	208	49	5	0	0	0	0	0	0	0	432
20:00	0	2	0	7	50	138	59	6	1	0	0	0	0	0	0	263
21:00	0	0	0	5	48	115	55	4	0	0	0	0	0	0	0	227
22:00	0	0	0	6	23	80	38	6	0	0	0	0	0	0	0	153
23:00	10	7	15	4	13	42	29	7	0	1	0	0	0	0	0	128
24:00	0	0	0	0	11	35	32	6	2	0	0	0	0	0	0	86
DAY TOTAL	17	28	42	268	1541	2580	1053	138	10	1	2	0	0	0	0	5680
PERCENTS	0.3%	0.5%	0.8%	4.8%	27.2%	45.4%	18.5%	2.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
35.6 mph

85th Percentile Speed
45.7 mph

Median Speed
40.8 mph

Average Speed
40.6 mph

10 MPH Pace Speed
34 mph to 44 mph
4121 vehicles in pace
Representing 72.5% of the total vehicles

Vehicles > 65 MPH
2
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 6

STA 2WB

Site Reference: 170490000822
Site ID: 000000000203
Location: RTE 2A WEST OF WILLOW RD/BRUCE ST
Direction:
Lane: 2

File: LCS17-049-158-02.prn
City: LITTLETON
County: SPEED EB&WB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	2	7	17	20	3	0	0	0	0	0	0	0	49
02:00	0	0	0	0	3	3	10	6	0	0	0	0	0	0	0	22
03:00	0	0	0	0	1	6	10	0	0	0	0	0	0	0	0	17
04:00	0	0	0	3	3	11	21	6	0	0	0	0	0	0	0	44
05:00	0	0	0	0	10	15	22	16	0	0	0	0	0	0	0	63
06:00	0	0	0	2	19	64	33	3	1	0	0	0	0	0	0	122
07:00	0	0	1	19	62	120	44	5	1	0	0	0	0	0	0	252
08:00	0	0	2	4	58	93	50	8	0	0	0	0	0	0	0	215
09:00	0	2	2	15	83	120	50	6	0	0	1	0	0	0	0	279
10:00	4	2	1	11	56	105	51	6	0	0	0	0	0	0	0	236
DAY TOTAL	4	4	6	56	302	554	311	59	2	0	1	0	0	0	0	1299
PERCENTS	0.4%	0.4%	0.5%	4.4%	23.2%	42.6%	23.9%	4.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
36.1 mph

85th Percentile Speed
46.9 mph

Median Speed
41.5 mph

Average Speed
41.4 mph

10 MPH Pace Speed
39 mph to 49 mph
865 vehicles in pace
Representing 66.5% of the total vehicles

Vehicles > 65 MPH
1
0.1%

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 1

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction:
Lane: 1

STA. 3 NB

File: LCS17-049-158-03.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	1	7	9	32	33	7	1	0	1	0	0	0	0	0	0	91
12:00	1	5	21	33	27	10	4	0	0	0	0	0	0	0	0	101
13:00	2	1	17	37	51	18	0	1	0	0	0	0	0	0	0	127
14:00	2	4	13	48	40	17	1	0	0	0	0	0	0	0	0	125
15:00	0	1	16	51	49	19	0	0	0	0	0	0	0	0	0	136
16:00	2	3	12	54	84	28	0	1	0	0	0	0	0	0	0	184
17:00	0	4	20	82	108	27	2	0	0	0	0	0	0	0	0	243
18:00	0	2	18	105	145	28	4	0	0	0	0	0	0	0	0	302
19:00	0	2	22	59	74	32	2	0	0	0	0	0	0	0	0	191
20:00	0	2	12	40	48	12	4	1	0	0	0	0	0	0	0	119
21:00	5	0	8	23	50	6	2	0	0	0	0	0	0	0	0	94
22:00	0	1	2	17	31	4	3	0	0	0	0	0	0	0	0	58
23:00	0	1	0	9	14	6	4	1	0	0	0	0	0	0	0	35
24:00	0	1	2	5	19	1	0	0	0	0	0	0	0	0	0	28
DAY TOTAL	13	34	172	595	773	215	27	4	1	0	0	0	0	0	0	1834
PERCENTS	0.8%	1.9%	9.4%	32.5%	42.1%	11.7%	1.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
29.5 mph

85th Percentile Speed
38.8 mph

Median Speed
34.7 mph

Average Speed
34.3 mph

10 MPH Pace Speed
29 mph to 39 mph
1368 vehicles in pace
Representing 74.5% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 2

STA. 3 NB

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction:
Lane: 1

File: LCS17-049-158-03.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0	8
02:00	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	5
03:00	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	3
04:00	0	0	1	4	5	1	1	0	0	0	0	0	0	0	0	12
05:00	0	0	2	11	10	1	0	0	0	0	0	0	0	0	0	24
06:00	0	1	4	11	12	5	2	0	0	0	0	0	0	0	0	35
07:00	0	0	7	46	41	8	1	0	0	0	0	0	0	0	0	103
08:00	3	1	19	38	39	10	2	0	0	0	0	0	0	0	0	112
09:00	0	3	16	41	40	17	0	0	0	0	0	0	0	0	0	117
10:00	2	4	15	39	39	5	0	0	0	0	0	0	0	0	0	104
11:00	0	1	18	35	34	11	1	0	0	0	0	0	0	0	0	100
12:00	2	4	12	27	46	14	4	0	0	0	0	0	0	0	0	109
13:00	0	5	9	56	59	17	3	0	0	0	0	0	0	0	0	149
14:00	3	3	13	38	49	13	1	1	0	0	0	0	0	0	0	121
15:00	1	0	14	57	70	31	1	0	0	0	0	0	0	0	0	174
16:00	0	0	11	53	79	24	7	1	0	0	0	0	0	0	0	175
17:00	1	1	18	76	97	35	4	0	0	0	0	0	0	0	0	232
18:00	2	4	12	94	142	26	5	0	0	0	0	0	0	0	0	285
19:00	0	6	17	72	72	20	0	0	0	0	0	0	0	0	0	187
20:00	0	0	20	37	42	14	6	0	0	0	0	0	0	0	0	119
21:00	0	0	5	30	35	8	5	0	0	0	0	0	0	0	0	83
22:00	0	0	9	17	17	9	2	0	0	0	0	0	0	0	0	54
23:00	0	0	1	16	23	5	4	0	0	0	0	0	0	0	0	49
24:00	0	0	1	8	15	3	1	0	1	0	0	0	0	0	0	29

DAY TOTAL	14	33	225	810	976	278	50	2	1	0	0	0	0	0	0	2389
PERCENTS	0.6%	1.4%	9.5%	34.0%	40.9%	11.6%	2.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
29.5 mph

85th Percentile Speed
38.9 mph

Median Speed
34.6 mph

Average Speed
34.3 mph

10 MPH Pace Speed
29 mph to 39 mph
1786 vehicles in pace
Representing 74.7% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 3

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction:
Lane: 1

STA. 3 NB

File: LCS17-049-158-03.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	2	4	5	4	0	0	0	0	0	0	0	0	0	15
02:00	0	0	1	3	0	1	1	1	0	0	0	0	0	0	0	7
03:00	3	0	1	1	1	0	0	0	0	0	0	0	0	0	0	6
04:00	0	0	1	5	2	2	0	0	0	0	0	0	0	0	0	10
05:00	0	1	1	7	7	0	0	0	0	0	0	0	0	0	0	16
06:00	0	1	0	11	26	6	3	0	0	0	0	0	0	0	0	47
07:00	0	0	14	34	28	9	1	0	0	0	0	0	0	0	0	86
08:00	0	1	12	43	45	11	0	0	0	0	0	0	0	0	0	112
09:00	1	1	18	38	38	10	1	0	0	0	0	0	0	0	0	107
10:00	4	3	12	27	45	12	2	0	0	0	0	0	0	0	0	105
DAY TOTAL	8	7	62	173	197	55	8	1	0	0	0	0	0	0	0	511
PERCENTS	1.6%	1.4%	12.2%	33.9%	38.6%	10.7%	1.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
29.0 mph

85th Percentile Speed
38.7 mph

Median Speed
34.1 mph

Average Speed
33.7 mph

10 MPH Pace Speed
29 mph to 39 mph
370 vehicles in pace
Representing 72.4% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 4

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction: SOUTH
Lane: 2

STA. 3 SB

File: LCS17-049-158-03.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	4	13	10	33	52	12	3	0	0	0	0	0	0	0	0	127
12:00	2	6	20	43	40	10	3	0	0	0	0	0	0	0	0	124
13:00	3	5	19	51	38	9	0	0	0	0	0	0	0	0	0	125
14:00	0	2	17	59	36	11	0	0	0	0	0	0	0	0	0	125
15:00	8	5	7	42	47	11	5	0	0	0	0	0	0	0	0	125
16:00	8	6	20	38	60	14	3	0	0	0	0	0	0	0	0	149
17:00	5	6	31	55	31	17	1	0	0	0	0	0	0	0	0	146
18:00	2	9	24	52	45	6	0	0	0	0	0	0	0	0	0	138
19:00	2	5	5	23	37	11	0	0	0	0	0	0	0	0	0	83
20:00	1	5	4	14	20	9	0	0	0	0	0	0	0	0	0	53
21:00	0	0	6	18	25	3	1	0	0	0	0	0	0	0	0	53
22:00	0	1	3	3	9	6	2	1	0	0	0	0	0	0	0	25
23:00	1	1	2	5	10	3	1	0	0	0	0	0	0	0	0	23
24:00	0	1	0	4	4	1	0	0	0	0	0	0	0	0	0	10
DAY TOTAL	36	65	168	440	454	123	19	1	0	0	0	0	0	0	0	1306
PERCENTS	2.8%	5.0%	12.9%	33.7%	34.8%	9.4%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
26.8 mph

85th Percentile Speed
38.4 mph

Median Speed
33.4 mph

Average Speed
32.7 mph

10 MPH Pace Speed
29 mph to 39 mph
894 vehicles in pace
Representing 68.4% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 5

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction: SOUTH
Lane: 2

STA. 35B

File: LCS17-049-158-03.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	1	2	4	0	0	0	0	0	0	0	0	0	0	7
02:00	0	1	1	1	2	5	0	0	0	0	0	0	0	0	0	10
03:00	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	5
04:00	0	0	0	4	3	0	2	0	0	0	0	0	0	0	0	9
05:00	0	1	2	8	8	2	1	0	0	0	0	0	0	0	0	22
06:00	0	2	4	29	34	12	1	0	1	0	0	0	0	0	0	83
07:00	11	8	36	67	57	13	1	0	0	0	0	0	0	0	0	193
08:00	70	40	76	106	39	3	0	0	0	0	0	0	0	0	0	334
09:00	12	21	50	85	50	27	2	3	0	0	0	0	0	0	0	250
10:00	8	18	29	47	45	14	1	0	0	0	0	0	0	0	0	162
11:00	1	9	19	46	33	6	2	0	0	0	0	0	0	0	0	116
12:00	1	10	15	44	42	15	2	1	0	0	0	0	0	0	0	130
13:00	3	21	25	39	51	16	1	0	0	0	0	0	0	0	0	156
14:00	1	5	12	48	46	9	4	1	0	0	0	0	0	0	0	126
15:00	0	7	21	42	47	13	2	0	0	0	0	0	0	0	0	132
16:00	0	4	18	48	48	16	2	0	0	0	0	0	0	0	0	136
17:00	0	3	21	55	48	10	2	0	0	0	0	0	0	0	0	139
18:00	5	6	21	42	48	10	2	0	0	0	0	0	0	0	0	134
19:00	1	0	8	39	30	10	0	0	1	0	0	0	0	0	0	89
20:00	0	0	5	28	22	10	3	0	0	0	0	0	0	0	0	68
21:00	0	3	4	12	14	7	0	0	0	0	0	0	0	0	0	40
22:00	0	0	1	12	18	3	0	0	0	0	0	0	0	0	0	34
23:00	0	0	3	6	9	4	0	2	0	0	0	0	0	0	0	24
24:00	0	1	1	5	6	2	0	0	0	0	0	0	0	0	0	15
DAY TOTAL	113	160	373	819	705	207	28	7	2	0	0	0	0	0	0	2414
PERCENTS	4.7%	6.7%	15.5%	34.0%	29.3%	8.5%	1.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
25.2 mph

85th Percentile Speed
38.2 mph

Median Speed
32.4 mph

Average Speed
31.6 mph

10 MPH Pace Speed
29 mph to 39 mph
1524 vehicles in pace
Representing 63.1% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 6

Site Reference: 170490000698
Site ID: 000000000301
Location: WILLOW RD. NORTH OF RTE 2A
Direction: SOUTH
Lane: 2

STA. 3 SB

File: LCS17-049-158-03.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	3
02:00	0	0	1	3	2	3	0	0	0	0	0	0	0	0	0	9
03:00	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
04:00	0	0	4	3	4	0	0	0	0	0	0	0	0	0	0	11
05:00	0	1	2	7	7	3	0	1	0	0	0	0	0	0	0	21
06:00	0	1	6	22	43	6	1	1	0	0	0	0	0	0	0	80
07:00	11	17	51	65	41	7	3	1	0	0	0	0	0	0	0	196
08:00	33	26	47	89	55	17	4	0	0	0	0	0	0	0	0	271
09:00	4	10	36	86	58	17	0	0	0	0	0	0	0	0	0	211
10:00	4	4	25	35	50	13	1	1	0	0	0	0	0	1	0	134
DAY TOTAL	52	59	172	310	264	67	9	4	0	0	0	0	0	1	0	938
PERCENTS	5.6%	6.3%	18.4%	33.1%	28.1%	7.1%	0.9%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	100%

Statistical Information...

15th Percentile Speed
24.9 mph

85th Percentile Speed
37.9 mph

Median Speed
32.0 mph

Average Speed
31.1 mph

10 MPH Pace Speed
29 mph to 39 mph
574 vehicles in pace
Representing 61.1% of the total vehicles

Vehicles > 65 MPH
1
0.1%

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 1

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction:
Lane: 1

STA. 4 NB

File: LCS17-049-158-04.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	7	0	0	7	3	1	0	0	0	0	0	0	0	0	0	18
12:00	0	3	6	11	9	1	0	0	0	0	0	0	0	0	0	30
13:00	0	1	6	16	3	1	0	0	0	0	0	0	0	0	0	27
14:00	1	1	7	10	3	0	0	0	0	0	0	0	0	0	0	22
15:00	0	2	10	5	9	3	0	0	0	0	0	0	0	0	0	29
16:00	0	1	5	19	13	3	0	0	0	0	0	2	0	0	0	43
17:00	0	2	15	45	16	1	0	0	0	0	0	0	0	0	0	79
18:00	3	4	28	41	17	1	0	0	0	0	0	0	0	0	0	94
19:00	1	2	8	26	8	0	0	0	0	0	0	0	0	0	0	45
20:00	0	1	10	12	5	1	0	0	0	0	0	0	0	0	0	29
21:00	0	2	3	2	2	1	0	0	0	0	0	0	0	0	0	10
22:00	1	0	3	3	2	0	0	0	0	0	0	0	0	0	0	9
23:00	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
24:00	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	3
DAY TOTAL	13	19	101	200	93	13	0	0	0	0	0	2	0	0	0	441
PERCENTS	3.0%	4.4%	23.0%	45.3%	21.0%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
25.7 mph

85th Percentile Speed
36.3 mph

Median Speed
31.2 mph

Average Speed
30.8 mph

10 MPH Pace Speed
24 mph to 34 mph
301 vehicles in pace
Representing 68.2% of the total vehicles

Vehicles > 65 MPH
2
0.5%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 2

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction:
Lane: 1

STA. 4 NB

File: LCS17-049-158-04.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
05:00	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
06:00	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	2
07:00	0	0	5	8	3	1	0	0	0	0	0	0	0	0	0	17
08:00	0	3	4	6	8	2	0	0	0	0	0	0	0	0	0	23
09:00	0	0	3	12	9	2	0	0	0	0	0	0	0	0	0	26
10:00	0	0	2	8	8	1	0	0	0	0	0	0	0	0	0	19
11:00	0	1	2	3	4	0	0	0	0	0	0	0	0	0	0	10
12:00	0	1	0	16	5	3	0	0	0	0	0	0	0	0	0	25
13:00	0	1	5	8	10	1	0	0	0	0	0	0	0	0	0	25
14:00	0	3	6	8	4	0	0	0	0	0	0	0	0	0	0	21
15:00	1	1	8	14	12	2	0	0	0	0	0	0	0	0	0	38
16:00	0	1	2	23	15	2	0	0	0	0	0	0	0	0	0	43
17:00	0	0	15	51	21	2	0	0	0	0	0	0	0	0	0	89
18:00	0	0	30	51	18	0	1	0	0	0	0	0	0	0	0	100
19:00	0	2	13	25	5	2	0	0	0	0	0	0	0	0	0	47
20:00	2	0	5	10	6	1	0	0	0	0	0	0	0	0	0	24
21:00	0	1	3	7	11	1	0	0	0	0	0	0	0	0	0	23
22:00	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	5
23:00	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	8
24:00	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	5
DAY TOTAL	3	14	106	265	146	22	1	0	0	0	0	0	0	0	0	557
PERCENTS	0.6%	2.6%	19.1%	47.5%	26.2%	3.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
27.1 mph

85th Percentile Speed
36.9 mph

Median Speed
31.9 mph

Average Speed
31.9 mph

10 MPH Pace Speed
29 mph to 39 mph
411 vehicles in pace
Representing 73.7% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 3

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction:
Lane: 1

STA. 4 NB

File: LCS17-049-158-04.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
05:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
06:00	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
07:00	0	0	3	3	2	0	0	0	0	0	0	0	0	0	0	8
08:00	0	0	0	11	6	1	0	0	0	0	0	0	0	0	0	18
09:00	0	2	3	12	4	1	0	1	0	0	0	0	0	0	0	23
10:00	0	1	2	7	4	1	0	0	0	0	0	0	0	0	0	15
DAY TOTAL	0	3	9	37	19	3	0	1	0	0	0	0	0	0	0	72
PERCENTS	0.0%	4.2%	12.6%	51.4%	26.4%	4.1%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
28.3 mph

85th Percentile Speed
37.2 mph

Median Speed
32.3 mph

Average Speed
32.5 mph

10 MPH Pace Speed
29 mph to 39 mph
56 vehicles in pace
Representing 77.7% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Wed 12/13/2017

Page: 4

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction: SOUTH
Lane: 2

STA. 4 SB

File: LCS17-049-158-04.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
11:00	4	4	4	8	8	0	0	0	0	0	0	0	0	0	0	28
12:00	0	1	9	8	6	2	0	0	0	0	0	0	0	0	0	26
13:00	0	0	3	12	9	0	0	0	0	0	0	0	0	0	0	24
14:00	0	0	11	9	5	0	0	0	0	0	0	0	0	0	0	25
15:00	1	0	10	13	6	1	0	0	0	0	0	0	0	0	0	31
16:00	0	3	9	11	10	0	0	0	0	0	0	0	0	0	0	33
17:00	2	0	3	18	13	1	0	0	0	0	0	0	0	0	0	37
18:00	2	1	4	10	9	0	0	0	0	0	0	0	0	0	0	26
19:00	3	5	4	8	3	1	0	0	0	0	0	0	0	0	0	24
20:00	0	7	3	6	1	0	0	0	0	0	0	0	0	0	0	17
21:00	1	0	17	0	0	2	0	0	0	0	0	0	0	0	0	20
22:00	3	0	12	3	0	0	0	0	0	0	0	0	0	0	0	18
23:00	2	0	2	1	0	1	1	0	0	0	0	0	0	0	0	7
24:00	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	5
DAY TOTAL	18	21	92	108	72	9	1	0	0	0	0	0	0	0	0	321
PERCENTS	5.7%	6.6%	28.6%	33.6%	22.4%	2.8%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
24.5 mph

85th Percentile Speed
36.4 mph

Median Speed
30.4 mph

Average Speed
29.6 mph

10 MPH Pace Speed
24 mph to 34 mph
200 vehicles in pace
Representing 62.3% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Thu 12/14/2017

Page: 5

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction: SOUTH
Lane: 2

STA. 4SB

File: LCS17-049-158-04.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00	1	1	2	1	3	2	5	0	0	0	0	0	0	0	0	15
07:00	4	1	9	35	15	5	1	0	0	0	0	0	0	0	0	70
08:00	13	3	3	48	66	2	0	0	0	0	0	0	0	0	0	135
09:00	1	2	11	31	16	5	0	0	0	0	0	0	0	0	0	66
10:00	1	2	6	15	9	1	0	0	0	0	0	0	0	0	0	34
11:00	0	1	4	11	8	1	0	0	0	0	0	0	0	0	0	25
12:00	0	4	6	6	10	0	0	1	0	0	0	0	0	0	0	27
13:00	1	2	5	7	7	0	0	0	0	0	0	0	0	0	0	22
14:00	0	0	3	16	10	0	0	0	0	0	0	0	0	0	0	29
15:00	0	0	6	6	3	0	0	0	0	0	0	0	0	0	0	15
16:00	0	0	4	20	7	0	0	0	0	0	0	0	0	0	0	31
17:00	1	1	13	15	9	0	0	0	0	0	0	0	0	0	0	39
18:00	0	1	3	7	4	0	0	0	0	0	0	0	0	0	0	15
19:00	0	0	8	12	10	0	0	0	0	0	0	0	0	0	0	30
20:00	0	2	5	3	2	0	0	0	0	0	0	0	0	0	0	12
21:00	0	1	1	9	2	0	0	0	0	0	0	0	0	0	0	13
22:00	0	1	2	4	2	0	0	0	0	0	0	0	0	0	0	9
23:00	0	0	4	7	1	0	0	0	0	0	0	0	0	0	0	12
24:00	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
DAY TOTAL	22	23	95	255	186	16	6	1	0	0	0	0	0	0	0	604
PERCENTS	3.7%	3.9%	15.8%	42.3%	30.7%	2.6%	0.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
26.4 mph

85th Percentile Speed
37.2 mph

Median Speed
32.2 mph

Average Speed
31.5 mph

10 MPH Pace Speed
29 mph to 39 mph
441 vehicles in pace
Representing 73.0% of the total vehicles

Vehicles > 65 MPH
0
0.0%

MassDOT Highway Division
SPEED SUMMARY
Fri 12/15/2017

Page: 6

Site Reference: 170490000836
Site ID: 000000000401
Location: BRUCE ST SOUTH OF RTE 2A
Direction: SOUTH
Lane: 2

STA 4 SB

File: LCS17-049-158-04.prn
City: LITTLETON
County: SPEED NB&SB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
06:00	0	2	1	3	4	1	0	0	0	0	0	0	0	0	0	11
07:00	1	1	5	25	19	2	0	0	0	0	0	0	0	0	0	53
08:00	1	0	6	54	43	6	1	0	0	0	0	0	0	0	0	111
09:00	0	1	13	23	17	2	0	0	0	0	0	0	0	0	0	56
10:00	2	1	2	16	6	0	0	0	0	0	0	0	0	0	0	27
DAY TOTAL	4	5	27	121	92	11	1	0	0	0	0	0	0	0	0	261
PERCENTS	1.6%	2.0%	10.4%	46.3%	35.2%	4.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
29.1 mph

85th Percentile Speed
37.5 mph

Median Speed
32.9 mph

Average Speed
32.7 mph

10 MPH Pace Speed
29 mph to 39 mph
213 vehicles in pace
Representing 81.6% of the total vehicles

Vehicles > 65 MPH
0
0.0%

Study Name	Littleton - Route 2A at Willow Road, Bruce Street, Gas Station and Residential Driveways TMC
Start Date	Wednesday, December 13, 2017 6:00 AM
End Date	Wednesday, December 13, 2017 6:00 PM
Site Code	

Report Summary

		Willow Road SB								Residential Driveway SWB								Route 2A WB								Bruce Street NB								Gas Station Driveway NEB								Route 2A EB								Crosswalk			
Time Period	Class.	R	BR	T	L	HL	U	I	O	HR	BR	T	BL	HL	U	I	O	HR	R	T	BL	L	U	I	O	R	BR	T	L	HL	U	I	O	HR	BR	T	BL	HL	U	I	O	HR	R	T	BL	L	U	I	O	Total	Pedestrians	Total	
Peak 1	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0		
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
6:00 AM - 9:00 AM	Cars	10	12	76	177	0	0	275	83	0	0	0	0	0	0	0	0	0	53	176	2	2	0	233	627	4	0	18	3	0	0	25	120	6	14	0	2	0	0	22	14	0	36	432	0	10	0	478	189	1033	NE	0	0
One Hour Peak	%	77%	86%	94%	77%	0%	0%	82%	74%	0%	0%	0%	0%	0%	0%	0%	0%	0%	71%	76%	100%	50%	0%	75%	82%	50%	0%	100%	43%	0%	0%	76%	92%	86%	70%	0%	50%	0%	0%	71%	88%	0%	95%	85%	0%	67%	0%	85%	75%	81%	0%	0%	0%
6:45 AM - 7:45 AM	Light Goods Vehicles	2	2	5	33	0	0	42	20	0	0	0	0	0	0	0	0	0	13	25	0	1	0	39	87	3	0	0	3	0	0	6	8	0	4	0	2	0	0	6	2	0	2	47	0	5	0	54	30	147	E	0	0
	%	15%	14%	6%	14%	0%	0%	12%	18%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17%	11%	0%	25%	0%	13%	11%	38%	0%	0%	43%	0%	0%	18%	6%	0%	20%	0%	50%	0%	0%	19%	13%	0%	5%	9%	0%	33%	0%	10%	12%	12%	0%	0%	0%
	Buses	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	2	1	4	S	0	0	
	%	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	Single-Unit Trucks	0	0	0	8	0	0	8	4	0	0	0	0	0	0	0	0	0	4	9	0	0	0	13	18	1	0	0	1	0	0	2	0	0	0	0	0	2	0	0	0	7	0	0	0	7	10	32	SW	0	0		
	%	0%	0%	0%	3%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	4%	0%	0%	0%	4%	2%	13%	0%	0%	14%	0%	0%	6%	0%	0%	10%	0%	0%	0%	6%	0%	0%	0%	1%	0%	0%	1%	4%	3%	0%	0%	0%	0%	
	Articulated Trucks	0	0	0	11	0	0	11	5	0	0	0	0	0	0	0	0	0	5	21	0	0	0	26	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	19	21	56	W	0	0	
	%	0%	0%	0%	5%	0%	0%	3%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%	9%	0%	0%	0%	8%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	3%	8%	4%	0%	0%	0%	0%	0%	
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Total	13	14	81	229	0	0	337	112	0	0	0	0	0	0	0	0	0	75	231	2	4	0	312	764	8	0	18	7	0	0	33	130	7	20	0	4	0	0	31	16	0	38	507	0	15	0	560	251	1273			
	PHF	0.81	0.58	0.78	0.95	0	0	0.89	0.88	0	0	0	0	0	0	0	0	0	0.69	0.89	0.5	0.5	0	0.85	0.96	0.67	0	0.64	0.58	0	0	0.82	0.83	0.44	0.83	0	0.25	0	0	0.65	0.57	0	0.73	0.96	0	0.54	0	0.95	0.87	0.94			
	Approach %							26%	9%															25%	60%							3%	10%							2%	1%					44%	20%						
Peak 2	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0		
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
3:00 PM - 6:00 PM	Cars	24	4	9	97	0	0	134	280	0	0	0	0	1	0	1	0	0	210	437	2	3	0	652	386	2	0	56	26	1	0	85	17	2	9	0	6	0	0	17	8	1	3	277	0	8	0	289	487	1178	NE	0	0
One Hour Peak	%	89%	100%	100%	88%	0%	0%	89%	92%	0%	0%	0%	0%	100%	0%	100%	0%	89%	92%	91%	50%	100%	0%	91%	89%	100%	0%	95%	90%	100%	0%	93%	100%	100%	90%	0%	75%	0%	0%	85%	80%	100%	100%	89%	0%	100%	0%	90%	91%	91%	0%	0%	0%
4:30 PM - 5:30 PM	Light Goods Vehicles	1	0	0	8	0	0	9	10	0	0	0	0	0	0	0	0	0	7	23	2	0	0	32	23	0	0	2	3	0	0	5	0	0	1	0	1	0	0	2	2	0	0	14	0	0	0	14	27	62	E	0	0
	%	4%	0%	0%	7%	0%	0%	6%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	5%	50%	0%	0%	4%	5%	0%	0%	3%	10%	0%	0%	5%	0%	0%	10%	0%	13%	0%	0%	10%	20%	0%	5%	0%	0%	0%	4%	5%	5%	0%	0%	0%	
	Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	S	0	0	
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	Single-Unit Trucks	1	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	2	9	0	0	0	11	7	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	7	0	0	0	7	10	21	SW	0	0	
	%	4%	0%	0%	0%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	0%	2%	2%	0%	0%	2%	0%	0%	0%	1%	0%	0%	0%	0%	1%	0%	0%	0%	5%	0%	0%	2%	0%	0%	2%	2%	2%	0%	0%	0%	
	Articulated Trucks	1	0	0	5	0	0	6	9	0	0	0	0	0	0	0	0	0	9	11	0	0	0	20	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	12	12	38	W	0	0	
	%	4%	0%	0%	5%	0%	0%	4%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	2%	0%	0%	0%	3%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	4%	2%	3%	0%	0%	0%	0%	0%	
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Total	27	4	9	110	0	0	150	303	0	0	0	0	1	0	1	0	0	228	481	4	3	0	716	433	2	0	59	29	1	0	91	17	2	10	0	8	0	0	20	10	1	3	310	0	8	0	322	537	1300			
	PHF	0.75	1	0.45	0.71	0	0	0.85	0.88	0	0	0	0	0.25	0	0.25	0	0	0.77	0.95	0.5	0.38	0	0.91	0.85	0.5	0	0.78	0.72	0.25	0	0.76	0.53	0.5	0.62	0	0.5	0	0	0.83	0.62	0.25	0.38	0.87	0	0.67	0	0.87	0.94	0.93			
	Approach %							12%	23%															55%	33%							7%	1%							2%	1%				25%	41%							

Turns:
R=right
HR=hard right
BR=bear right
T=thru
L=left
HL=hard left
BL=bear left
U=u-turn

APPENDIX 4 – SIGNAL WARRANT ANALYSIS

Green International Affiliates, Inc.

Ayer Rd (Route 2A/110) / Willow Road

Littleton, MA

Traffic Counts from November 2015

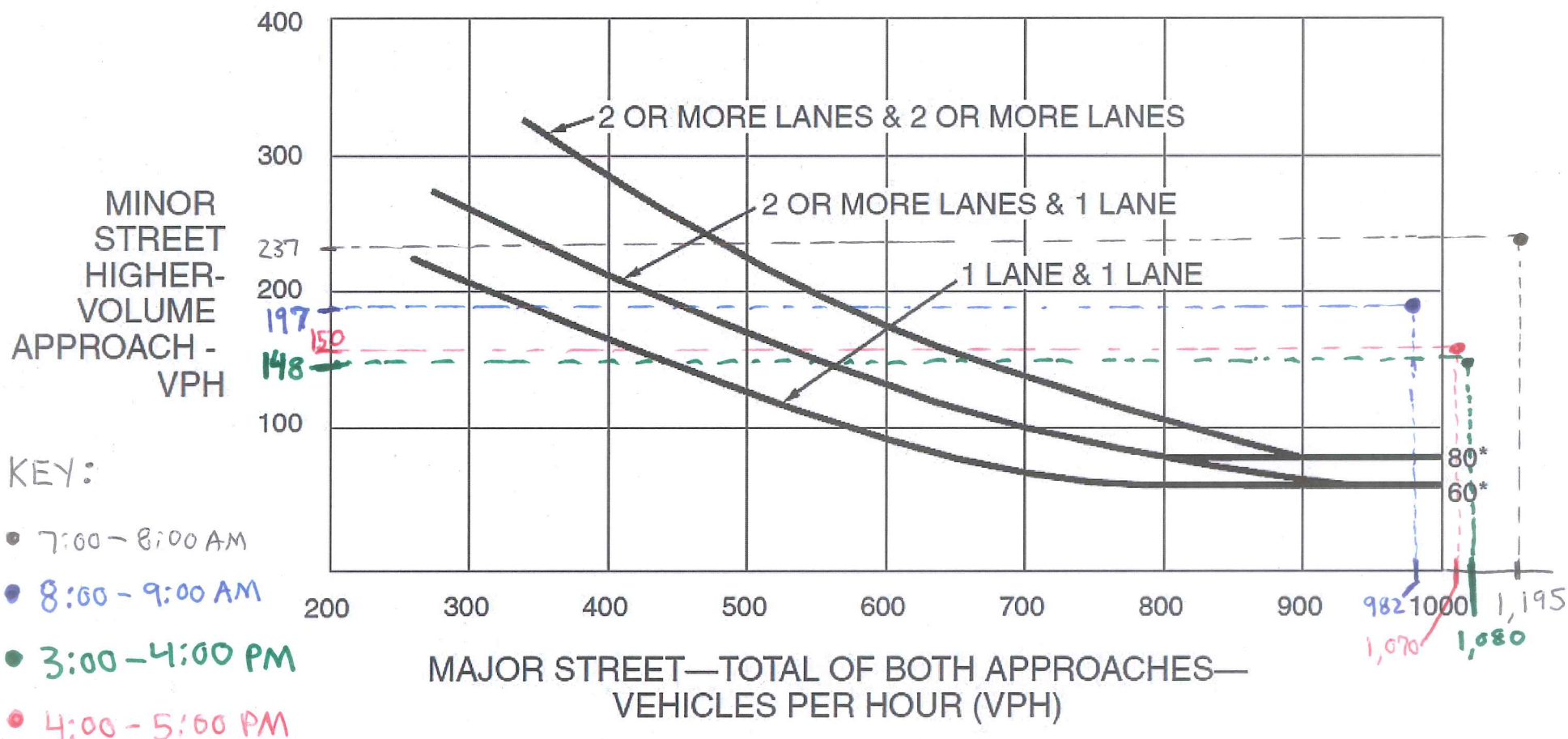
2015 Existing Traffic Volumes

	Condition A Thresholds	Condition B Thresholds
Vehicles per hour on major street (total of both approaches)	350	525
Vehicles per hour on higher-volume minor-street approach (one direction only)	105	53

	Ayer Road (Route 2A/110)		Willow Rd	Bruce St	Ayer Rd	Willow/Bruce	condition A met?	condition B met?
	EB approach	WB approach	SB approach	NB approach	Total of Both Approaches	Higher of two approaches		
12:00 AM to 01:00 AM	22	49	7		71	7	no	no
01:00 AM to 02:00 AM	56	15	5		71	5	no	no
02:00 AM to 03:00 AM	16	23	6		39	6	no	no
03:00 AM to 04:00 AM	48	31	7		79	7	no	no
04:00 AM to 05:00 AM	71	61	25		132	25	no	no
05:00 AM to 06:00 AM	246	156	83		402	83	no	no
06:00 AM to 07:00 AM	604	333	169		937	169	yes	yes
07:00 AM to 08:00 AM	808	387	237		1195	237	yes	yes
08:00 AM to 09:00 AM	630	352	197		982	197	yes	yes
09:00 AM to 10:00 AM	353	364	156		717	156	yes	yes
10:00 AM to 11:00 AM	300	324	91		624	91	no	yes
11:00 AM to 12:00 PM	327	327	122		654	122	yes	yes
12:00 PM to 01:00 PM	344	406	117		750	117	yes	yes
01:00 PM to 02:00 PM	329	358	88		687	88	no	yes
02:00 PM to 03:00 PM	356	423	118		779	118	yes	yes
03:00 PM to 04:00 PM	464	616	148		1080	148	yes	yes
04:00 PM to 05:00 PM	374	696	150		1070	150	yes	yes
05:00 PM to 06:00 PM	312	779	122		1091	122	yes	yes
06:00 PM to 07:00 PM	236	551	100		787	100	no	yes
07:00 PM to 08:00 PM	136	336	42		472	42	no	no
08:00 PM to 09:00 PM	81	249	33		330	33	no	no
09:00 PM to 10:00 PM	81	180	19		261	19	no	no
10:00 PM to 11:00 PM	58	133	8		191	8	no	no
11:00 PM to 12:00 AM	40	83	12		123	12	no	no
Number of Hours in which Condition is met							10	13
Warrant 1 satisfied?							yes	

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

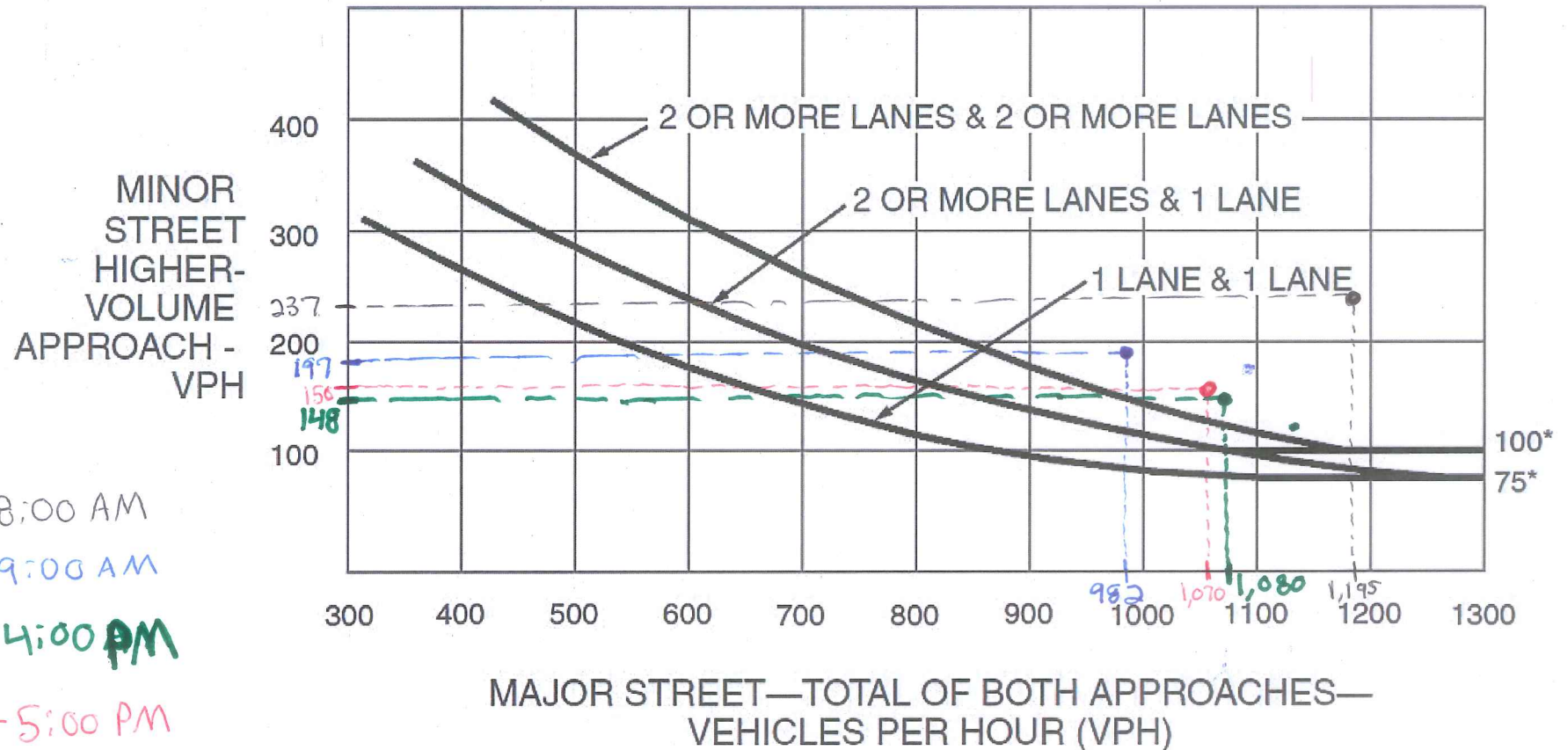
(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*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 for a minor-street approach with one lane.

Note: Warrant 2 Met

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)
 (COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



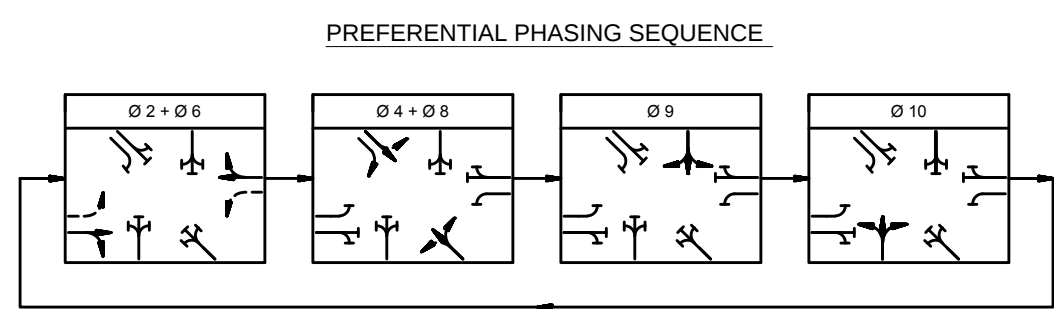
KEY:

- 7:00 - 8:00 AM
- 8:00 - 9:00 AM
- 3:00 - 4:00 PM
- 4:00 - 5:00 PM

*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 for a minor-street approach with one lane.

Note: Warrant 3 Met

APPENDIX 5 – CONCEPTUAL DESIGNS



ROUTE 2A (AYER RD) GEOMETRY

	EXIST	PROP
RADIUS	2100±	1720'
INSIDE SUPERELEVATION	5.6%	4.8%
OUTSIDE SUPERELEVATION	0.0%	4.8%

NOTES

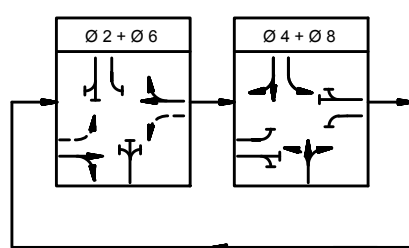
- 1) SINGLE SKEWED INTERSECTION WITH TRAFFIC SIGNAL CONTROL
- 2) 11' TRAVEL LANES, 11' TURN LANES, 5' SHOULDERS
- 3) LEFT TURN LANE TAPER (155' OF 165' AASHTO PREFERRED)
- 4) SEPTIC SYSTEM LOCATION SHOWN ON THIS PLAN IS APPROXIMATE AND WAS COMPILED FROM AN AS-BUILT PLAN PROVIDED BY THE TOWN OF LITTLETON

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CONCEPT 1
SIGNAL AT WILLOW - SKEWED INTERSECTION

PREFERENTIAL PHASING SEQUENCE



ROUTE 2A (AYER RD) GEOMETRY

	EXIST	PROP
RADIUS	2100±	1720'
INSIDE SUPERELEVATION	5.6%	4.8%
OUTSIDE SUPERELEVATION	0.0%	4.8%

NOTES

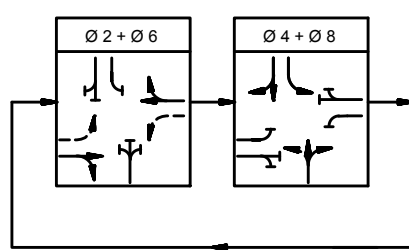
- 1) WILLOW ROAD INTERSECTION UNDER TRAFFIC SIGNAL CONTROL
- 2) 11' TRAVEL LANES, 11' TURN LANES, 5' SHOULDERS
- 3) LEFT TURN LANE TAPER (135' OF 165' AASHTO PREFERRED)
- 4) SEPTIC SYSTEM LOCATION SHOWN ON THIS PLAN IS APPROXIMATE AND WAS COMPILED FROM AN AS-BUILT PLAN PROVIDED BY THE TOWN OF LITTLETON

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CONCEPT 2A
SIGNAL AT WILLOW - 3 LANE SECTION

PREFERENTIAL PHASING SEQUENCE



ROUTE 2A (AYER RD) GEOMETRY

	EXIST	PROP
RADIUS	2100±	1720'
INSIDE SUPERELEVATION	5.6%	4.8%
OUTSIDE SUPERELEVATION	0.0%	4.8%

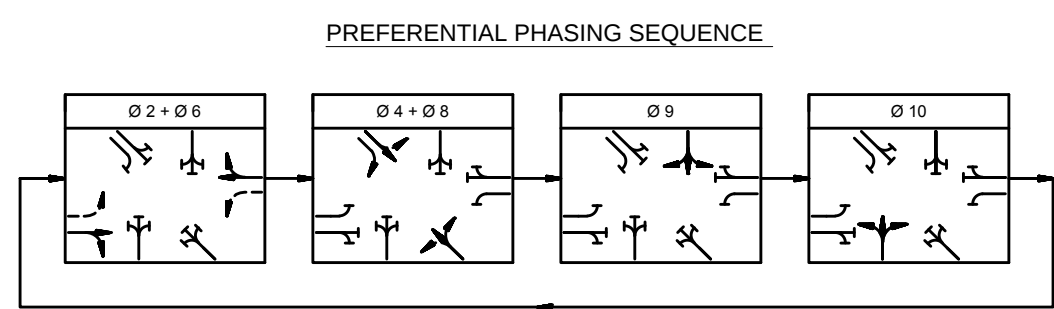
NOTES

- 1) WILLOW ROAD INTERSECTION UNDER TRAFFIC SIGNAL CONTROL
- 2) 11' TRAVEL LANES, 11' TURN LANES, 5' SHOULDERS
- 3) LEFT TURN LANE TAPER (135' OF 165' AASHTO PREFERRED)
- 4) RIGHT TURN LANE TAPER (175' OF 165' AASHTO PREFERRED)
- 5) SEPTIC SYSTEM LOCATION SHOWN ON THIS PLAN IS APPROXIMATE AND WAS COMPILED FROM AN AS-BUILT PLAN PROVIDED BY THE TOWN OF LITTLETON

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CONCEPT 2B
SIGNAL AT WILLOW - 4 LANE SECTION



ROUTE 2A (AYER RD) GEOMETRY

	EXIST	PROP
RADIUS	2100'±	1720'
INSIDE SUPERELEVATION	5.6%	4.8%
OUTSIDE SUPERELEVATION	0.0%	4.8%

NOTES

- 1) SINGLE SKEWED INTERSECTION WITH TRAFFIC SIGNAL CONTROL
- 2) 11' TRAVEL LANES, 11' TURN LANES, 5' SHOULDERS
- 3) LEFT TURN LANE TAPER (155' OF 165' AASHTO PREFERRED)
- 4) SEPTIC SYSTEM LOCATION SHOWN ON THIS PLAN IS APPROXIMATE AND WAS COMPILED FROM AN AS-BUILT PLAN PROVIDED BY THE TOWN OF LITTLETON

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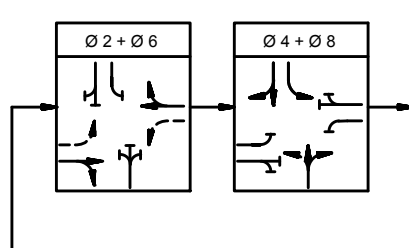
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CONCEPT 1
SIGNAL AT WILLOW - SKEWED INTERSECTION

SCALE: 1" = 20'

PREFERENTIAL PHASING SEQUENCE



ROUTE 2A (AYER RD) GEOMETRY

	EXIST	PROP
RADIUS	2100'±	1720'
INSIDE SUPERELEVATION	5.6%	4.8%
OUTSIDE SUPERELEVATION	0.0%	4.8%

NOTES

- 1) WILLOW ROAD INTERSECTION UNDER TRAFFIC SIGNAL CONTROL
- 2) 11' TRAVEL LANES, 11' TURN LANES, 5' SHOULDERS
- 3) LEFT TURN LANE TAPER (135' OF 165' AASHTO PREFERRED)
- 4) SEPTIC SYSTEM LOCATION SHOWN ON THIS PLAN IS APPROXIMATE AND WAS COMPILED FROM AN AS-BUILT PLAN PROVIDED BY THE TOWN OF LITTLETON

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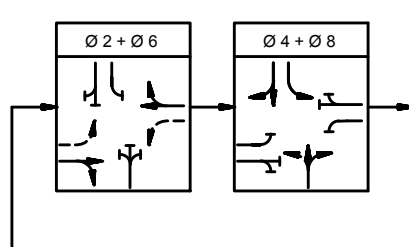
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CONCEPT 2A
SIGNAL AT WILLOW - 3 LANE SECTION

SCALE: 1" = 20'

PREFERENTIAL PHASING SEQUENCE



ROUTE 2A (AYER RD) GEOMETRY

	EXIST	PROP
RADIUS	2100'±	1720'
INSIDE SUPERELEVATION	5.6%	4.8%
OUTSIDE SUPERELEVATION	0.0%	4.8%

NOTES

- 1) WILLOW ROAD INTERSECTION UNDER TRAFFIC SIGNAL CONTROL
- 2) 11' TRAVEL LANES, 11' TURN LANES, 5' SHOULDERS
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- 5) SEPTIC SYSTEM LOCATION SHOWN ON THIS PLAN IS APPROXIMATE AND WAS COMPILED FROM AN AS-BUILT PLAN PROVIDED BY THE TOWN OF LITTLETON

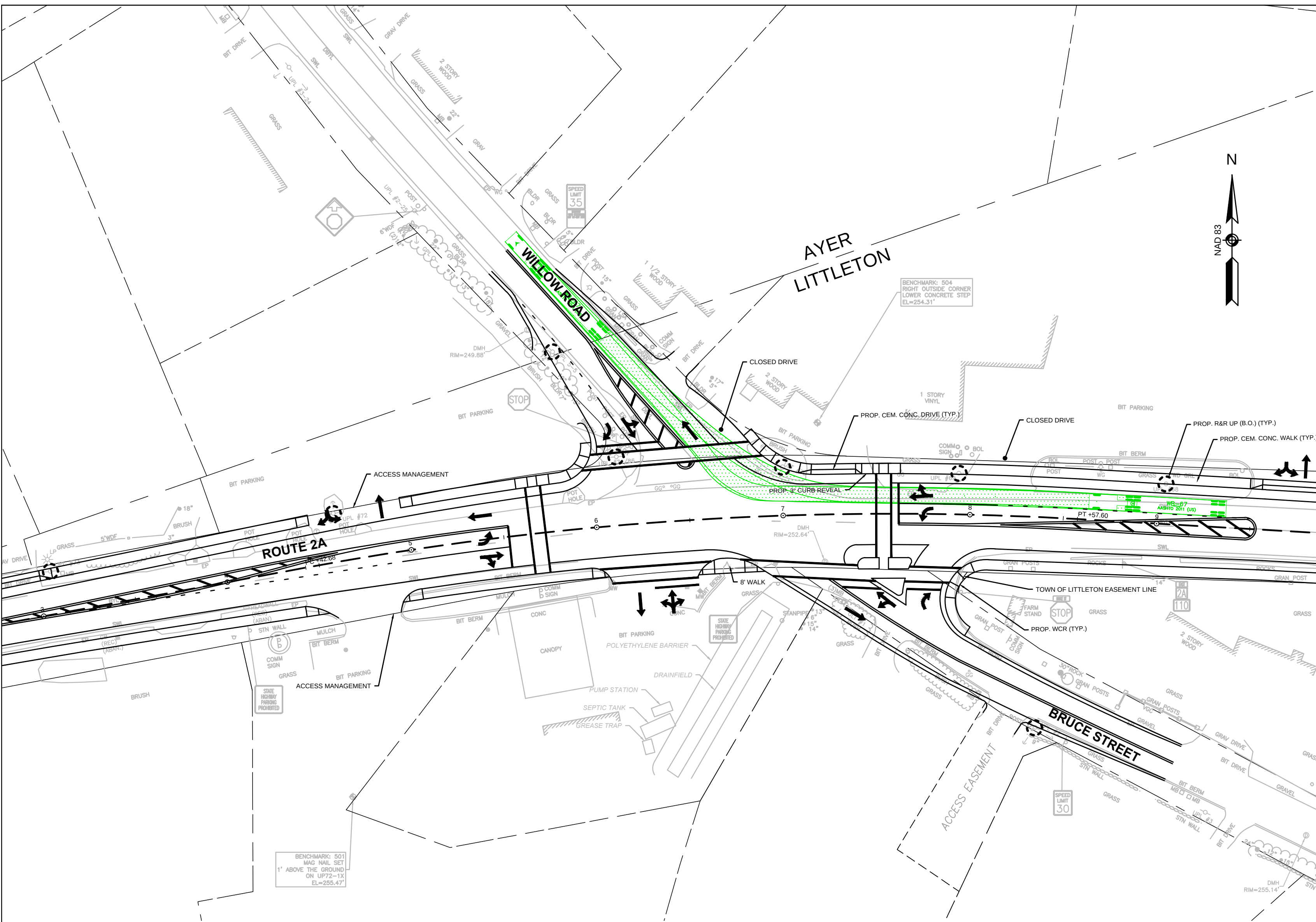
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CONCEPT 2B
SIGNAL AT WILLOW - 4 LANE SECTION

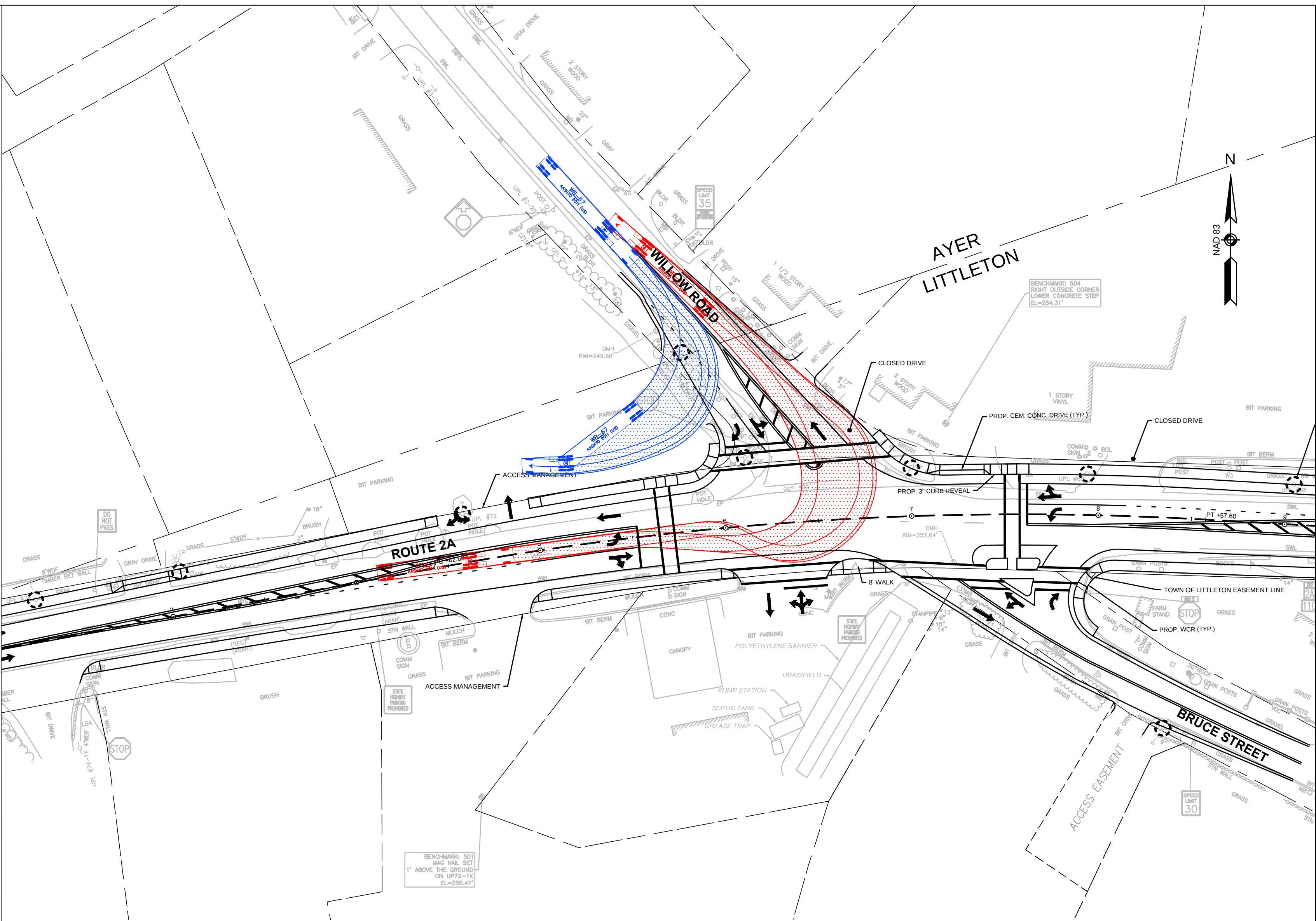
SCALE: 1" = 20'



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CONCEPT 1
SIGNAL AT WILLOW - SKEWED INTERSECTION
WB-67 RIGHT TURN ENTERING WILLOW ROAD

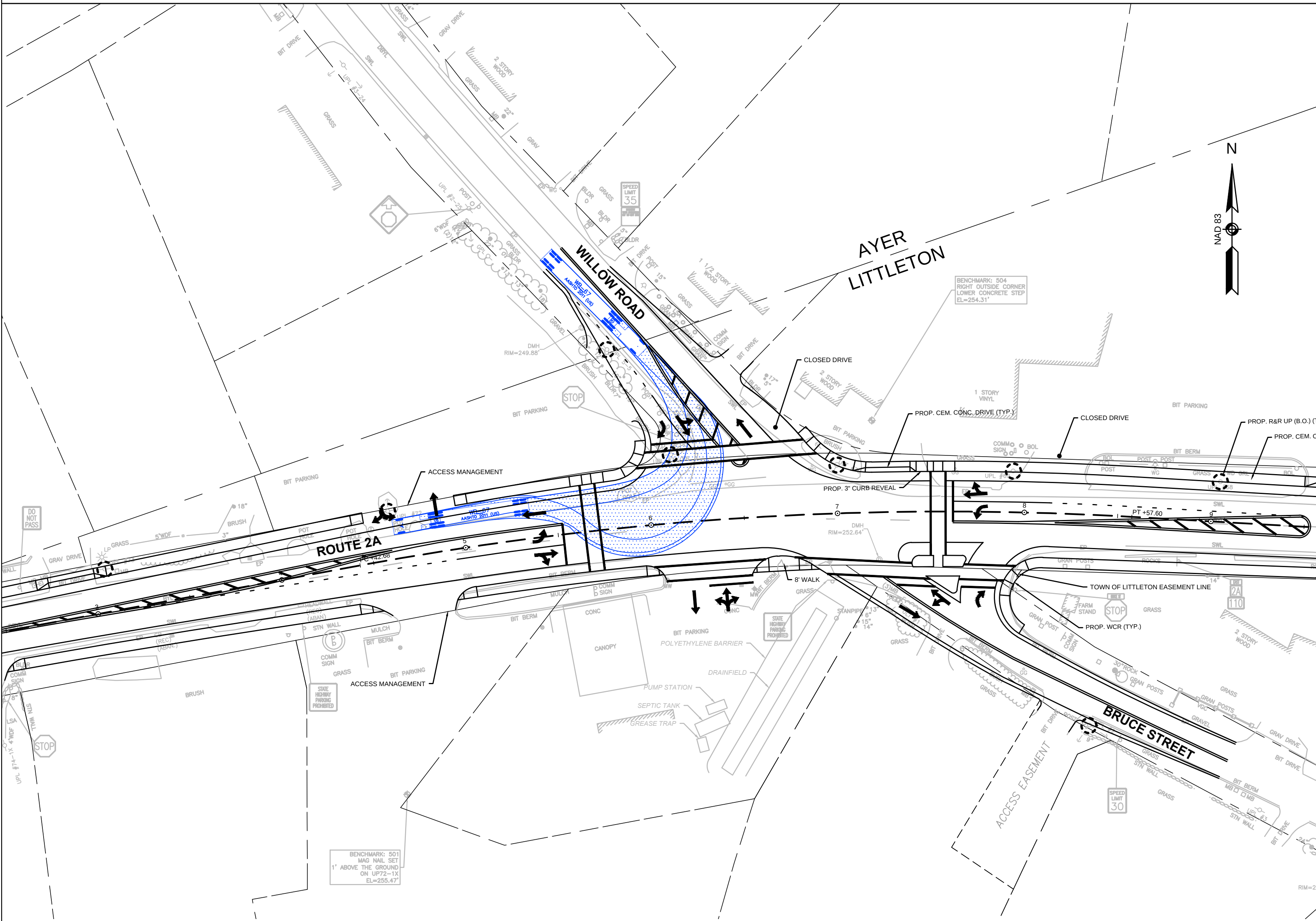
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WB-67 LEFT TURN ENTERING WILLOW ROAD

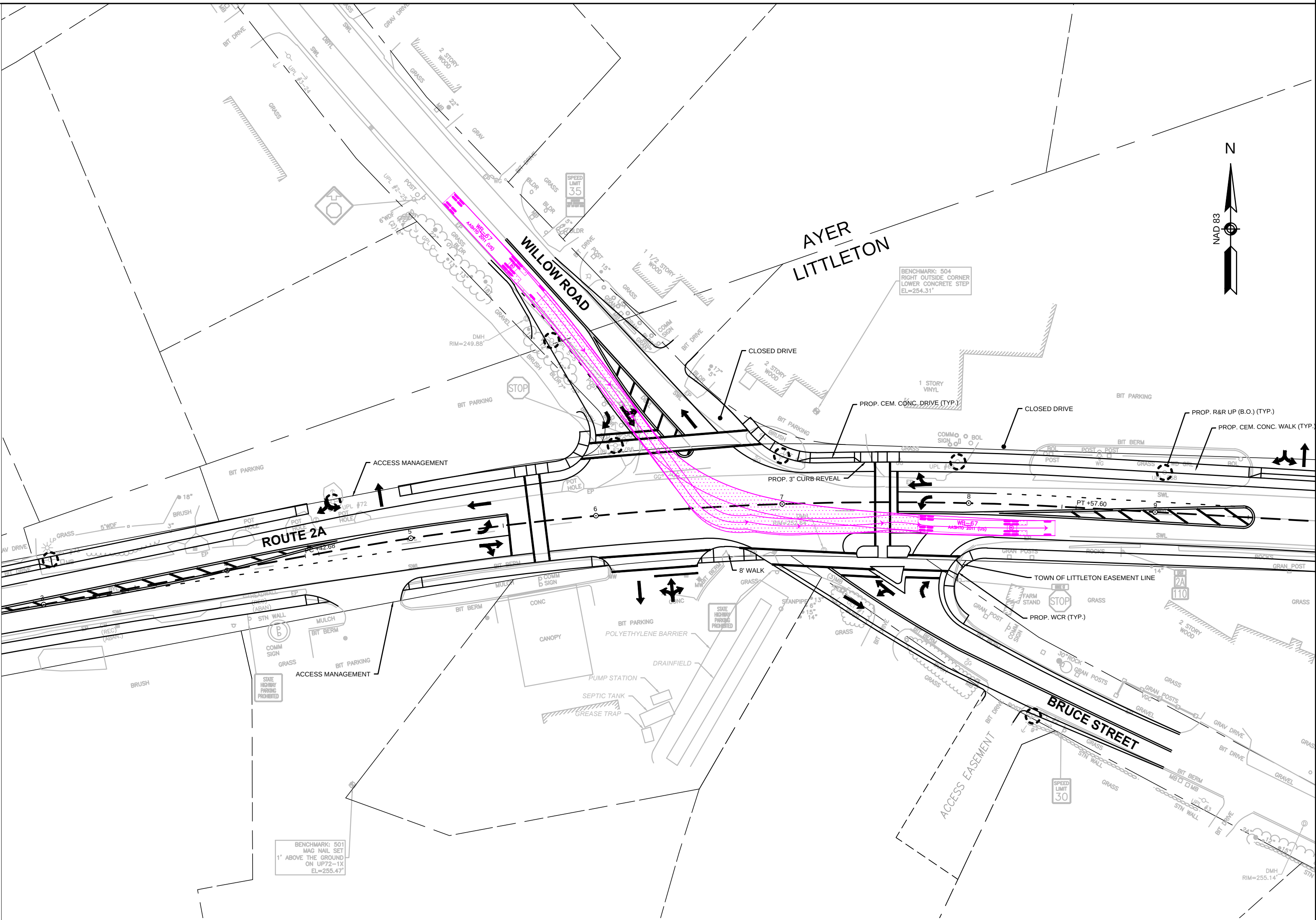
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CONCEPT 1
SIGNAL AT WILLOW - SKEWED INTERSECTION
WB-67 RIGHT TURN EXITING WILLOW ROAD

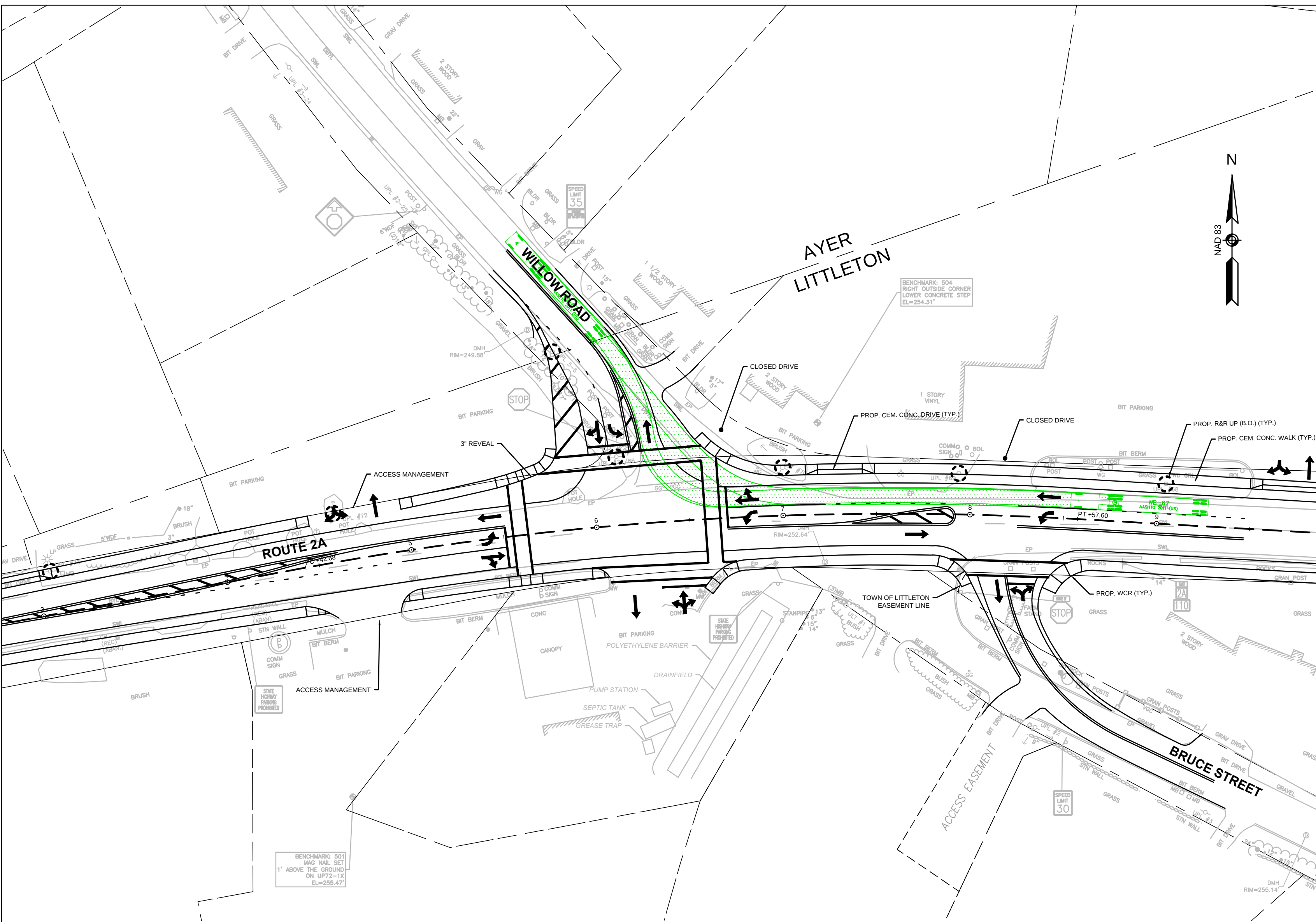
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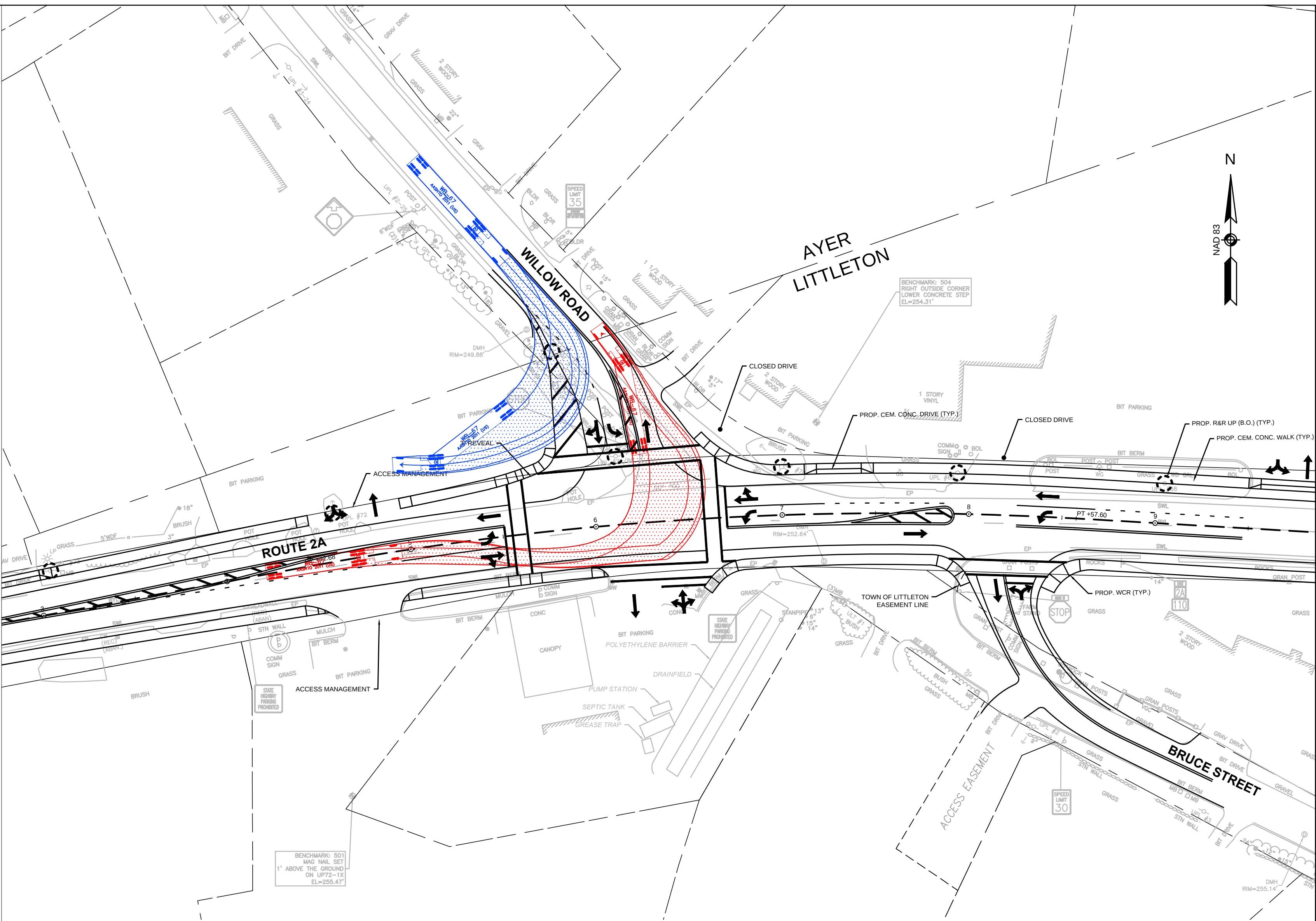
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WB-67 RIGHT TURN ENTERING WILLOW ROAD

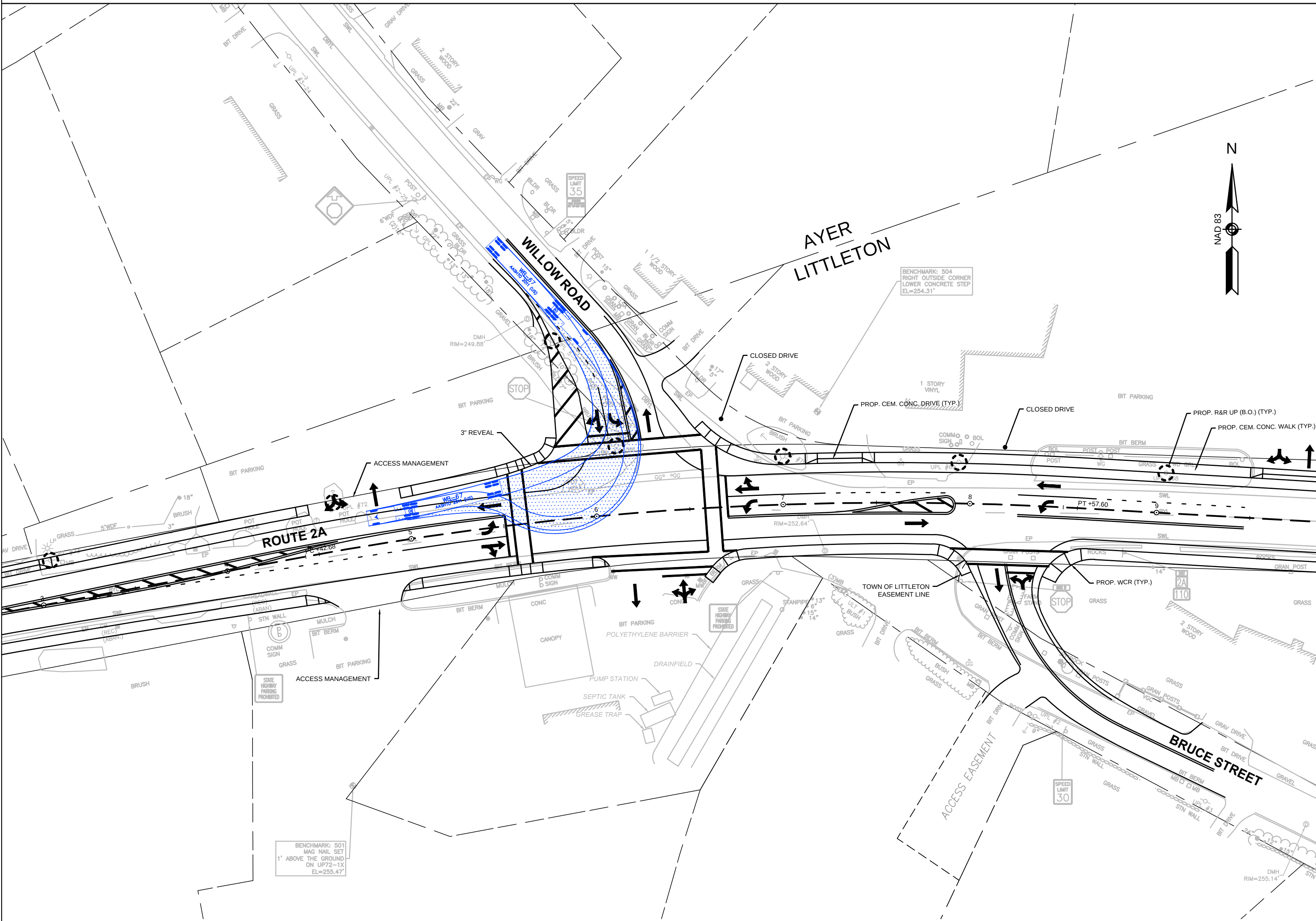
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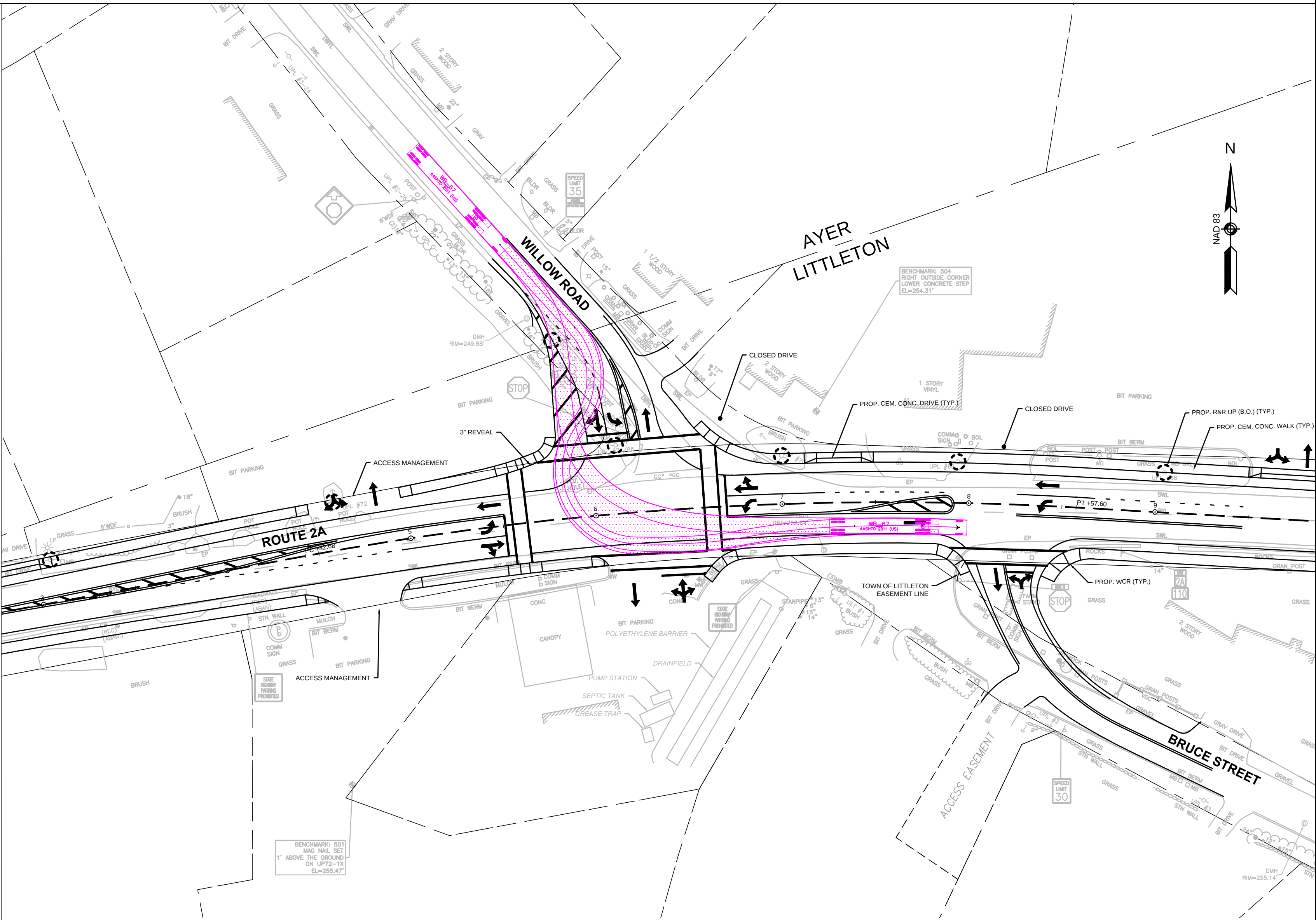
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SIGNAL AT WILLOW - 3 LANE SECTION
WB-67 RIGHT TURN EXITING WILLOW ROAD

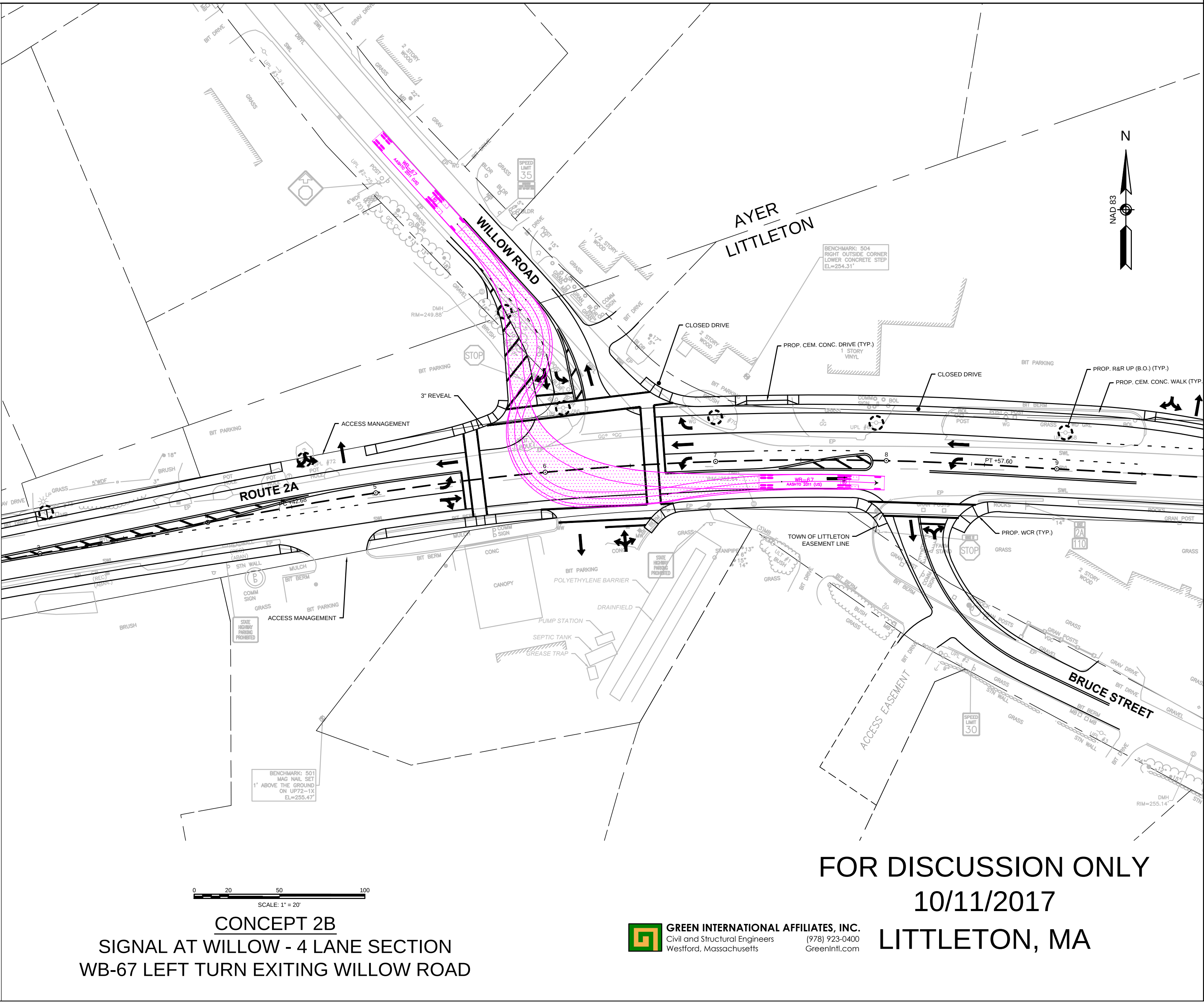
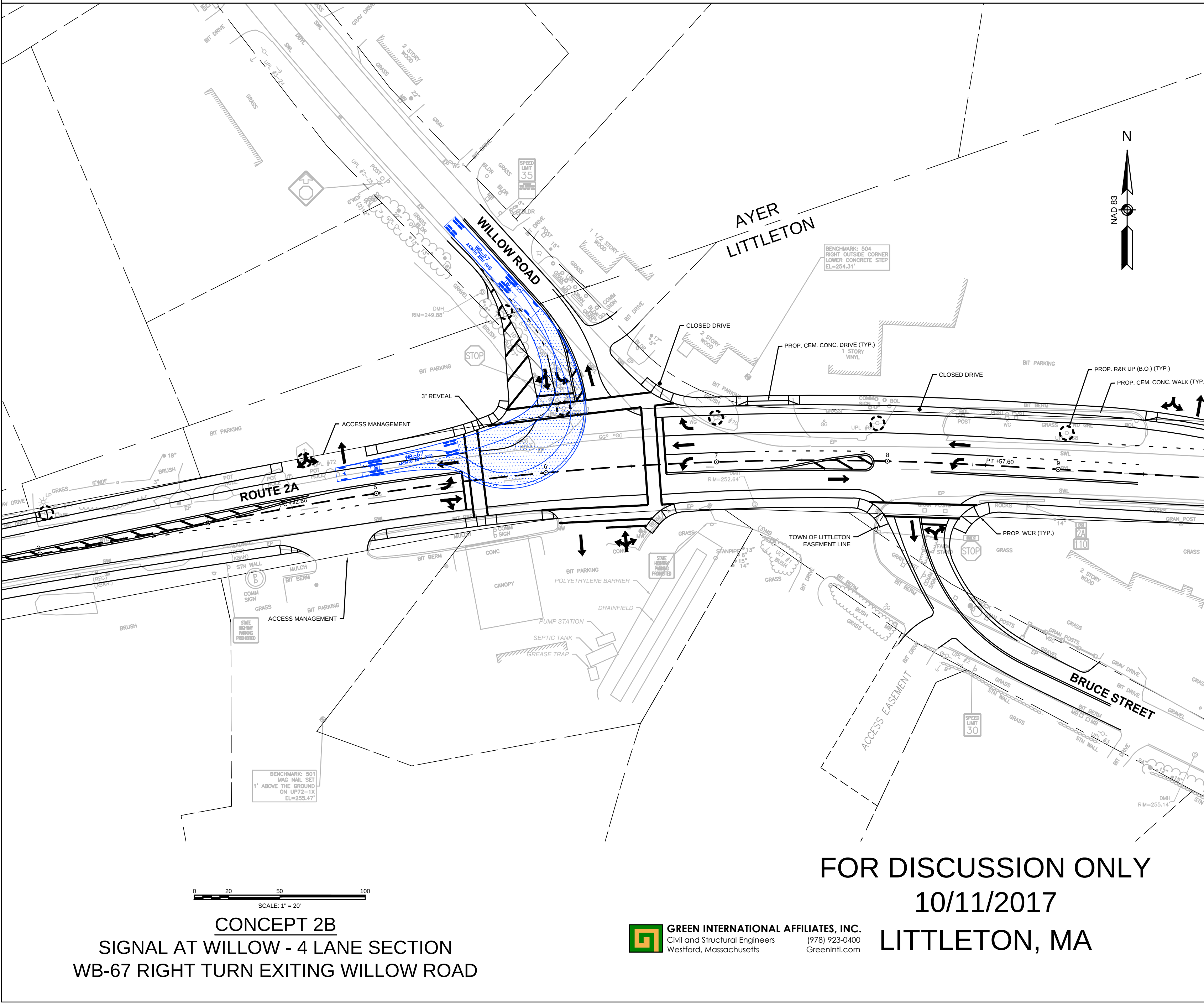
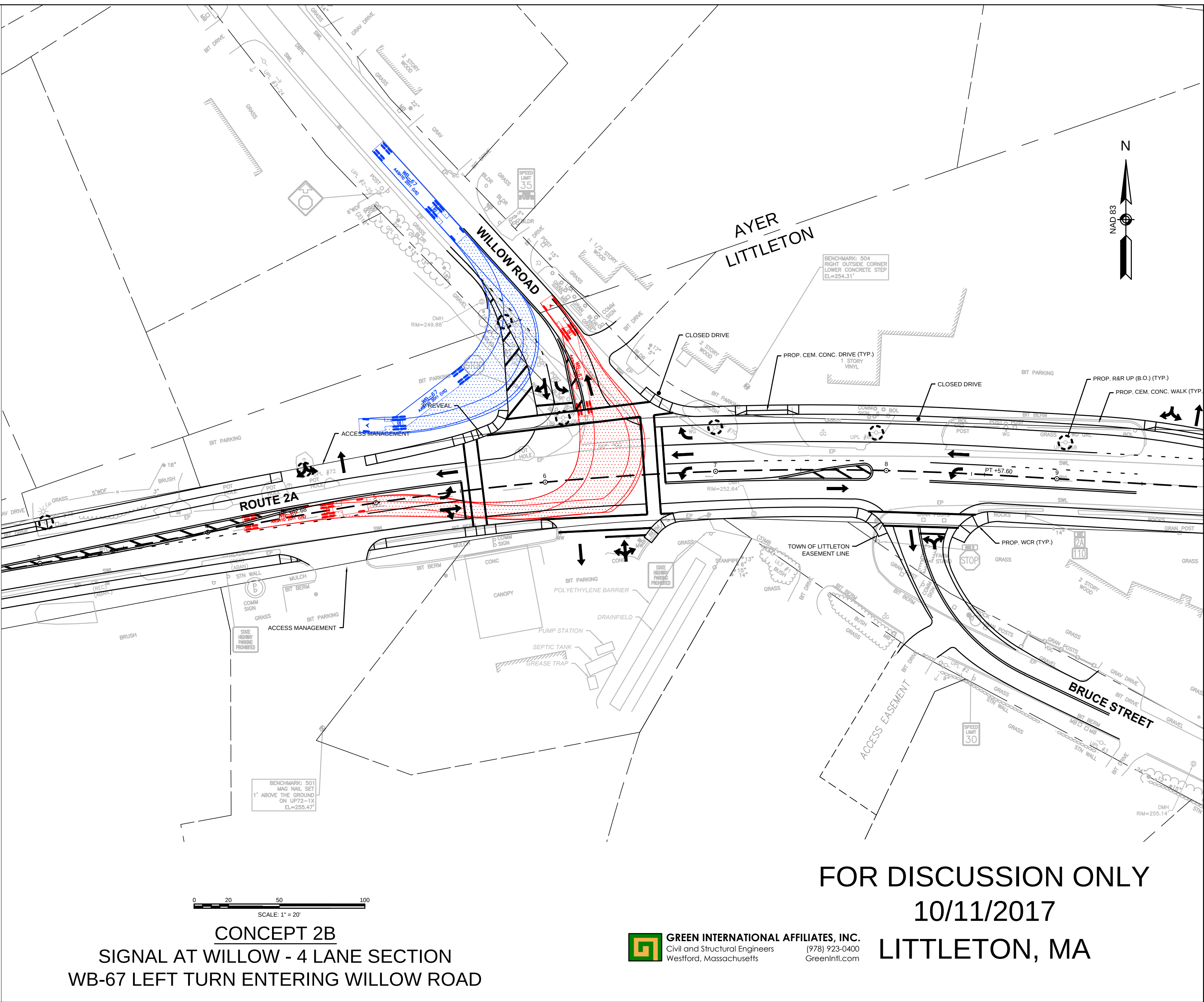
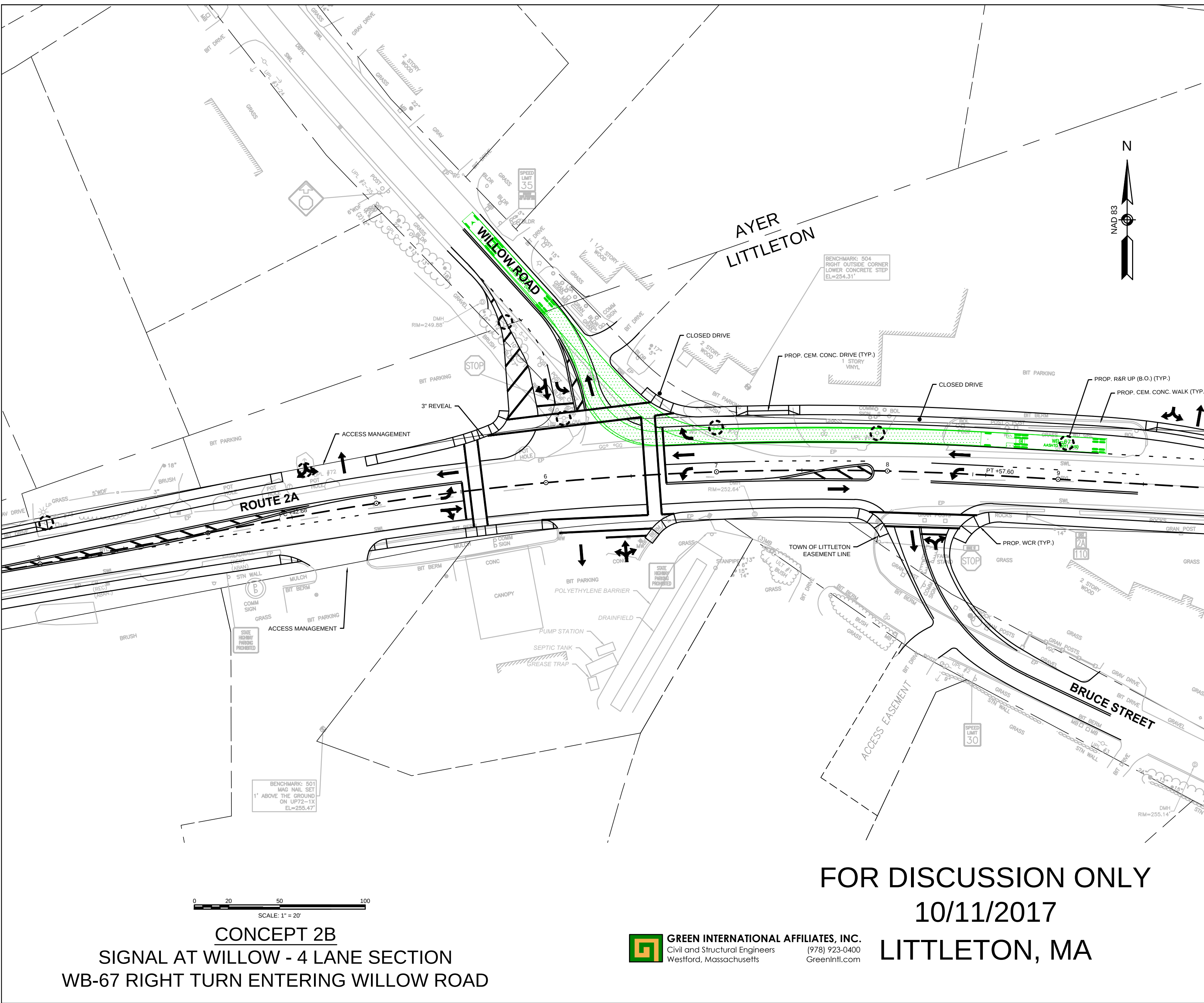
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CONCEPT 2A
SIGNAL AT WILLOW - 3 LANE SECTION
WB-67 LEFT TURN EXITING WILLOW ROAD

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APPENDIX 6 – INTERSECTION CAPACITY ANALYSIS



												
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR2	SBT	SEL
Lane Configurations												
Traffic Volume (vph)	16	534	40	4	2	243	79	4	0	7	0	241
Future Volume (vph)	16	534	40	4	2	243	79	4	0	7	0	241
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	12	11	11	12	12	12	12	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991				0.968			0.914			
Flt Protected		0.999				0.999			0.982			
Satd. Flow (prot)	0	1796	0	0	0	1575	0	0	1705	0	1900	0
Flt Permitted		0.985				0.989			0.950			
Satd. Flow (perm)	0	1771	0	0	0	1559	0	0	1650	0	1900	0
Right Turn on Red										Yes		
Satd. Flow (RTOR)									182			
Link Speed (mph)		45				45			15		15	
Link Distance (ft)		527				802			231		145	
Travel Time (s)		8.0				12.2			10.5		6.6	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	8%	5%	0%	0%	0%	13%	13%	0%	0%	0%	0%	10%
Adj. Flow (vph)	17	568	43	4	2	259	84	4	0	7	0	256
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	628	0	0	0	349	0	0	11	0	0	0
Turn Type	Perm	NA		Perm	Perm	NA		Perm	NA			Perm
Protected Phases		2				6			10		9	
Permitted Phases	2			6	6			10				4
Detector Phase	2	2		6	6	6		10	10		9	4
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
Minimum Split (s)	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0
Total Split (s)	48.0	48.0		48.0	48.0	48.0		10.0	10.0		10.0	22.0
Total Split (%)	53.3%	53.3%		53.3%	53.3%	53.3%		11.1%	11.1%		11.1%	24.4%
Maximum Green (s)	42.0	42.0		42.0	42.0	42.0		4.0	4.0		4.0	16.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0		2.0	2.0		2.0	2.0
Lost Time Adjust (s)		0.0				0.0			0.0		0.0	
Total Lost Time (s)		6.0				6.0			6.0		6.0	
Lead/Lag								Lag	Lag		Lead	
Lead-Lag Optimize?								Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0		3.0	3.0
Recall Mode	Min	Min		Min	Min	Min		None	None		None	None
Act Effct Green (s)		24.6				24.6			4.2			
Actuated g/C Ratio		0.44				0.44			0.08			
v/c Ratio		0.80				0.50			0.04			
Control Delay		21.5				13.5			0.2			
Queue Delay		0.0				0.0			0.0			
Total Delay		21.5				13.5			0.2			
LOS		C				B			A			
Approach Delay		21.5				13.5			0.2			
Approach LOS		C				B			A			
Queue Length 50th (ft)		149				69			0			

						
Lane Group	SET	SER	SER2	NWL	NWT	NWR2
Lane Configurations						
Traffic Volume (vph)	85	15	14	7	19	8
Future Volume (vph)	85	15	14	7	19	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	9	9	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.989				0.966	
Flt Protected	0.967				0.990	
Satd. Flow (prot)	1639	0	0	0	1572	0
Flt Permitted	0.774				0.919	
Satd. Flow (perm)	1312	0	0	0	1460	0
Right Turn on Red			Yes			Yes
Satd. Flow (RTOR)	2				182	
Link Speed (mph)	35				30	
Link Distance (ft)	530				455	
Travel Time (s)	10.3				10.3	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	10%	9%	0%	9%
Adj. Flow (vph)	90	16	15	7	20	9
Shared Lane Traffic (%)						
Lane Group Flow (vph)	377	0	0	0	36	0
Turn Type	NA			Perm	NA	
Protected Phases	4				8	
Permitted Phases				8		
Detector Phase	4			8	8	
Switch Phase						
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	10.0			10.0	10.0	
Total Split (s)	22.0			22.0	22.0	
Total Split (%)	24.4%			24.4%	24.4%	
Maximum Green (s)	16.0			16.0	16.0	
Yellow Time (s)	4.0			4.0	4.0	
All-Red Time (s)	2.0			2.0	2.0	
Lost Time Adjust (s)	0.0				0.0	
Total Lost Time (s)	6.0				6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0			3.0	3.0	
Recall Mode	None			None	None	
Act Effct Green (s)	16.7				16.7	
Actuated g/C Ratio	0.30				0.30	
v/c Ratio	0.95				0.06	
Control Delay	60.2				0.2	
Queue Delay	0.0				0.0	
Total Delay	60.2				0.2	
LOS	E				A	
Approach Delay	60.2				0.2	
Approach LOS	E				A	
Queue Length 50th (ft)	107				0	

												
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR2	SBT	SEL
Queue Length 95th (ft)		335				164			0			
Internal Link Dist (ft)		447				722			151		65	
Turn Bay Length (ft)												
Base Capacity (vph)		1407				1239			293			
Starvation Cap Reductn		0				0			0			
Spillback Cap Reductn		0				0			0			
Storage Cap Reductn		0				0			0			
Reduced v/c Ratio		0.45				0.28			0.04			

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 55.3

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 29.2

Intersection LOS: C

Intersection Capacity Utilization 83.6%

ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/Resid Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4	 Ø9	 Ø10
48 s	22 s	10 s	10 s
 Ø6	 Ø8		
48 s	22 s		



Lane Group	SET	SER	SER2	NWL	NWT	NWR2
Queue Length 95th (ft)	#429				0	
Internal Link Dist (ft)	450				375	
Turn Bay Length (ft)						
Base Capacity (vph)	398				568	
Starvation Cap Reductn	0				0	
Spillback Cap Reductn	0				0	
Storage Cap Reductn	0				0	
Reduced v/c Ratio	0.95				0.06	
Intersection Summary						

Intersection												
Int Delay, s/veh	7.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Vol, veh/h	18	313	6	7	535	280	10	9	5	104	9	30
Future Vol, veh/h	18	313	6	7	535	280	10	9	5	104	9	30
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	3	3	0	0	3	3	0	0	0	3	0	3
Mvmt Flow	19	329	6	7	563	295	11	9	5	109	9	32
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	858	0	0	336	0	0	1117	1244	333	1103	1099	711
Stage 1	-	-	-	-	-	-	371	371	-	725	725	-
Stage 2	-	-	-	-	-	-	746	873	-	378	374	-
Critical Hdwy	4.13	-	-	4.1	-	-	7.1	6.5	6.2	7.13	6.5	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.13	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.13	5.5	-
Follow-up Hdwy	2.227	-	-	2.2	-	-	3.5	4	3.3	3.527	4	3.327
Pot Cap-1 Maneuver	779	-	-	1235	-	-	186	176	713	188	214	431
Stage 1	-	-	-	-	-	-	653	623	-	415	433	-
Stage 2	-	-	-	-	-	-	409	370	-	642	621	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	779	-	-	1235	-	-	161	169	713	173	205	431
Mov Cap-2 Maneuver	-	-	-	-	-	-	161	169	-	173	205	
Stage 1	-	-	-	-	-	-	633	604	-	403	428	-
Stage 2	-	-	-	-	-	-	366	366	-	608	602	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.5			0.1			26.1			63.2		
HCM LOS							D			F		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	196	779	-	-	1235	-	-	200				
HCM Lane V/C Ratio	0.129	0.024	-	-	0.006	-	-	0.753				
HCM Control Delay (s)	26.1	9.7	0	-	7.9	0	-	63.2				
HCM Lane LOS	D	A	A	-	A	A	-	F				
HCM 95th %tile O(veh)	0.4	0.1	-	-	0	-	-	5				

												
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR2	SBT	SEL
Lane Configurations												
Traffic Volume (vph)	16	534	40	4	2	243	79	4	0	7	0	241
Future Volume (vph)	16	534	40	4	2	243	79	4	0	7	0	241
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	12	11	11	12	12	12	12	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991				0.968			0.914			
Flt Protected		0.999				0.999			0.982			
Satd. Flow (prot)	0	1796	0	0	0	1575	0	0	1705	0	1900	0
Flt Permitted		0.985				0.989			0.950			
Satd. Flow (perm)	0	1771	0	0	0	1559	0	0	1650	0	1900	0
Right Turn on Red										Yes		
Satd. Flow (RTOR)									182			
Link Speed (mph)		45				45			15		15	
Link Distance (ft)		527				802			231		145	
Travel Time (s)		8.0				12.2			10.5		6.6	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	8%	5%	0%	0%	0%	13%	13%	0%	0%	0%	0%	10%
Adj. Flow (vph)	17	568	43	4	2	259	84	4	0	7	0	256
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	628	0	0	0	349	0	0	11	0	0	0
Turn Type	Perm	NA		Perm	Perm	NA		Perm	NA			Perm
Protected Phases		2				6			10		9	
Permitted Phases	2			6	6			10				4
Detector Phase	2	2		6	6	6		10	10		9	4
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
Minimum Split (s)	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0
Total Split (s)	48.0	48.0		48.0	48.0	48.0		10.0	10.0		10.0	22.0
Total Split (%)	53.3%	53.3%		53.3%	53.3%	53.3%		11.1%	11.1%		11.1%	24.4%
Maximum Green (s)	42.0	42.0		42.0	42.0	42.0		4.0	4.0		4.0	16.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0		2.0	2.0		2.0	2.0
Lost Time Adjust (s)		0.0				0.0			0.0		0.0	
Total Lost Time (s)		6.0				6.0			6.0		6.0	
Lead/Lag								Lag	Lag		Lead	
Lead-Lag Optimize?								Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0		3.0	3.0
Recall Mode	Min	Min		Min	Min	Min		None	None		None	None
Act Effct Green (s)		24.6				24.6			4.2			
Actuated g/C Ratio		0.44				0.44			0.08			
v/c Ratio		0.80				0.50			0.04			
Control Delay		21.5				13.5			0.2			
Queue Delay		0.0				0.0			0.0			
Total Delay		21.5				13.5			0.2			
LOS		C				B			A			
Approach Delay		21.5				13.5			0.2			
Approach LOS		C				B			A			
Queue Length 50th (ft)		149				69			0			

						
Lane Group	SET	SER	SER2	NWL	NWT	NWR2
Lane Configurations						
Traffic Volume (vph)	85	15	14	7	19	8
Future Volume (vph)	85	15	14	7	19	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	9	9	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.989				0.966	
Flt Protected	0.967				0.990	
Satd. Flow (prot)	1639	0	0	0	1572	0
Flt Permitted	0.774				0.919	
Satd. Flow (perm)	1312	0	0	0	1460	0
Right Turn on Red			Yes			Yes
Satd. Flow (RTOR)	2				182	
Link Speed (mph)	35				30	
Link Distance (ft)	530				455	
Travel Time (s)	10.3				10.3	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	10%	9%	0%	9%
Adj. Flow (vph)	90	16	15	7	20	9
Shared Lane Traffic (%)						
Lane Group Flow (vph)	377	0	0	0	36	0
Turn Type	NA			Perm	NA	
Protected Phases	4				8	
Permitted Phases				8		
Detector Phase	4			8	8	
Switch Phase						
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	10.0			10.0	10.0	
Total Split (s)	22.0			22.0	22.0	
Total Split (%)	24.4%			24.4%	24.4%	
Maximum Green (s)	16.0			16.0	16.0	
Yellow Time (s)	4.0			4.0	4.0	
All-Red Time (s)	2.0			2.0	2.0	
Lost Time Adjust (s)	0.0				0.0	
Total Lost Time (s)	6.0				6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0			3.0	3.0	
Recall Mode	None			None	None	
Act Effct Green (s)	16.7				16.7	
Actuated g/C Ratio	0.30				0.30	
v/c Ratio	0.95				0.06	
Control Delay	60.2				0.2	
Queue Delay	0.0				0.0	
Total Delay	60.2				0.2	
LOS	E				A	
Approach Delay	60.2				0.2	
Approach LOS	E				A	
Queue Length 50th (ft)	107				0	

												
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR2	SBT	SEL
Queue Length 95th (ft)		335				164			0			
Internal Link Dist (ft)		447				722			151		65	
Turn Bay Length (ft)												
Base Capacity (vph)		1407				1239			293			
Starvation Cap Reductn		0				0			0			
Spillback Cap Reductn		0				0			0			
Storage Cap Reductn		0				0			0			
Reduced v/c Ratio		0.45				0.28			0.04			

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 55.3

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 29.2

Intersection LOS: C

Intersection Capacity Utilization 83.6%

ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/Resid Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4	 Ø9	 Ø10
48 s	22 s	10 s	10 s
 Ø6	 Ø8		
48 s	22 s		



Lane Group	SET	SER	SER2	NWL	NWT	NWR2
Queue Length 95th (ft)	#429				0	
Internal Link Dist (ft)	450				375	
Turn Bay Length (ft)						
Base Capacity (vph)	398				568	
Starvation Cap Reductn	0				0	
Spillback Cap Reductn	0				0	
Storage Cap Reductn	0				0	
Reduced v/c Ratio	0.95				0.06	
Intersection Summary						

												
Lane Group	EBL2	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR2	SBL
Lane Configurations												
Traffic Volume (vph)	8	326	3	1	3	4	506	240	8	0	2	1
Future Volume (vph)	8	326	3	1	3	4	506	240	8	0	2	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	11	12	11	11	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999					0.957			0.975		
Flt Protected		0.999								0.961		
Satd. Flow (prot)	0	1896	0	0	0	0	1629	0	0	1780	0	0
Flt Permitted		0.980					0.997					
Satd. Flow (perm)	0	1860	0	0	0	0	1624	0	0	1852	0	0
Right Turn on Red				Yes							Yes	
Satd. Flow (RTOR)										182		
Link Speed (mph)		45					45			15		
Link Distance (ft)		527					802			231		
Travel Time (s)		8.0					12.2			10.5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%	8%	8%	0%	0%	0%	3%
Adj. Flow (vph)	9	354	3	1	3	4	550	261	9	0	2	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	367	0	0	0	0	818	0	0	11	0	0
Turn Type	Perm	NA			Perm	Perm	NA		Perm	NA		Perm
Protected Phases		2					6			10		
Permitted Phases	2				6	6			10			9
Detector Phase	2	2			6	6	6		10	10		9
Switch Phase												
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0		4.0	4.0		4.0
Minimum Split (s)	10.0	10.0			10.0	10.0	10.0		10.0	10.0		10.0
Total Split (s)	55.0	55.0			55.0	55.0	55.0		10.0	10.0		10.0
Total Split (%)	61.1%	61.1%			61.1%	61.1%	61.1%		11.1%	11.1%		11.1%
Maximum Green (s)	49.0	49.0			49.0	49.0	49.0		4.0	4.0		4.0
Yellow Time (s)	4.0	4.0			4.0	4.0	4.0		4.0	4.0		4.0
All-Red Time (s)	2.0	2.0			2.0	2.0	2.0		2.0	2.0		2.0
Lost Time Adjust (s)		0.0					0.0			0.0		
Total Lost Time (s)		6.0					6.0			6.0		
Lead/Lag									Lag	Lag		Lead
Lead-Lag Optimize?									Yes	Yes		Yes
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0	3.0		3.0
Recall Mode	Min	Min			Min	Min	Min		None	None		None
Act Effct Green (s)		41.0					41.0			4.1		
Actuated g/C Ratio		0.62					0.62			0.06		
v/c Ratio		0.32					0.81			0.04		
Control Delay		7.7					19.1			0.3		
Queue Delay		0.0					0.0			0.0		
Total Delay		7.7					19.1			0.3		
LOS		A					B			A		
Approach Delay		7.7					19.1			0.3		
Approach LOS		A					B			A		
Queue Length 50th (ft)		48					172			0		

	↓	↘	↙	↘	↙	↘	↙	↘	↙
Lane Group	SBT	SEL	SET	SER	SER2	NWL2	NWL	NWT	NWR2
Lane Configurations	↕		↕					↕	
Traffic Volume (vph)	0	116	9	4	28	1	31	62	2
Future Volume (vph)	0	116	9	4	28	1	31	62	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	11	11	12	11	12	9	9	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.973					0.997	
Flt Protected	0.950		0.964					0.983	
Satd. Flow (prot)	1752	0	1677	0	0	0	0	1655	0
Flt Permitted			0.783					0.869	
Satd. Flow (perm)	1845	0	1362	0	0	0	0	1463	0
Right Turn on Red					Yes				Yes
Satd. Flow (RTOR)			10					182	
Link Speed (mph)	15		35					30	
Link Distance (ft)	145		530					455	
Travel Time (s)	6.6		10.3					10.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	3%	0%	0%	3%	0%	0%	2%	0%
Adj. Flow (vph)	0	126	10	4	30	1	34	67	2
Shared Lane Traffic (%)									
Lane Group Flow (vph)	1	0	170	0	0	0	0	104	0
Turn Type	NA	Perm	NA			Perm	Perm	NA	
Protected Phases	9		4					8	
Permitted Phases		4				8	8		
Detector Phase	9	4	4			8	8	8	
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0			4.0	4.0	4.0	
Minimum Split (s)	10.0	10.0	10.0			10.0	10.0	10.0	
Total Split (s)	10.0	15.0	15.0			15.0	15.0	15.0	
Total Split (%)	11.1%	16.7%	16.7%			16.7%	16.7%	16.7%	
Maximum Green (s)	4.0	9.0	9.0			9.0	9.0	9.0	
Yellow Time (s)	4.0	4.0	4.0			4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0			2.0	2.0	2.0	
Lost Time Adjust (s)	0.0		0.0					0.0	
Total Lost Time (s)	6.0		6.0					6.0	
Lead/Lag	Lead								
Lead-Lag Optimize?	Yes								
Vehicle Extension (s)	3.0	3.0	3.0			3.0	3.0	3.0	
Recall Mode	None	None	None			None	None	None	
Act Effct Green (s)	4.1		9.3					9.3	
Actuated g/C Ratio	0.06		0.14					0.14	
v/c Ratio	0.01		0.85					0.29	
Control Delay	36.0		65.4					2.3	
Queue Delay	0.0		0.0					0.0	
Total Delay	36.0		65.4					2.3	
LOS	D		E					A	
Approach Delay	36.0		65.4					2.3	
Approach LOS	D		E					A	
Queue Length 50th (ft)	0		56					0	

												
Lane Group	EBL2	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR2	SBL
Queue Length 95th (ft)		171					#672			0		
Internal Link Dist (ft)		447					722			151		
Turn Bay Length (ft)												
Base Capacity (vph)		1432					1250			287		
Starvation Cap Reductn		0					0			0		
Spillback Cap Reductn		0					0			0		
Storage Cap Reductn		0					0			0		
Reduced v/c Ratio		0.26					0.65			0.04		

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 65.6

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.85

Intersection Signal Delay: 20.3

Intersection LOS: C

Intersection Capacity Utilization 78.5%

ICU Level of Service D

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4	 Ø9	 Ø10
55 s	15 s	10 s	10 s
 Ø6	 Ø8		
55 s	15 s		

									
Lane Group	SBT	SEL	SET	SER	SER2	NWL2	NWL	NWT	NWR2
Queue Length 95th (ft)	6		#240					4	
Internal Link Dist (ft)	65		450					375	
Turn Bay Length (ft)									
Base Capacity (vph)	116		201					363	
Starvation Cap Reductn	0		0					0	
Spillback Cap Reductn	0		0					0	
Storage Cap Reductn	0		0					0	
Reduced v/c Ratio	0.01		0.85					0.29	
Intersection Summary									

													
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2	SBT	
Lane Configurations													
Traffic Volume (vph)	18	590	44	4	2	268	87	4	0	23	8	0	
Future Volume (vph)	18	590	44	4	2	268	87	4	0	23	8	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	12	12	11	12	11	11	12	12	12	12	12	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		0.991				0.967			0.880				
Flt Protected		0.999				0.999			0.995				
Satd. Flow (prot)	0	1750	0	0	0	1587	0	0	1664	0	0	1900	
Flt Permitted		0.984				0.990			0.950				
Satd. Flow (perm)	0	1724	0	0	0	1573	0	0	1588	0	0	1900	
Right Turn on Red											Yes		
Satd. Flow (RTOR)									173				
Link Speed (mph)		45				45			15			15	
Link Distance (ft)		527				802			231			145	
Travel Time (s)		8.0				12.2			10.5			6.6	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	
Heavy Vehicles (%)	8%	8%	0%	0%	0%	12%	12%	0%	0%	0%	0%	0%	
Adj. Flow (vph)	19	628	47	4	2	285	93	4	0	24	9	0	
Shared Lane Traffic (%)													
Lane Group Flow (vph)	0	694	0	0	0	384	0	0	37	0	0	0	
Turn Type	Perm	NA		Perm	Perm	NA		Perm	NA				
Protected Phases		2				6			10			9	
Permitted Phases	2			6	6			10					
Detector Phase	2	2		6	6	6		10	10			9	
Switch Phase													
Minimum Initial (s)	8.0	8.0		8.0	8.0	8.0		6.0	6.0			6.0	
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0		12.0	12.0			12.0	
Total Split (s)	53.0	53.0		53.0	53.0	53.0		12.0	12.0			12.0	
Total Split (%)	44.2%	44.2%		44.2%	44.2%	44.2%		10.0%	10.0%			10.0%	
Maximum Green (s)	47.0	47.0		47.0	47.0	47.0		6.0	6.0			6.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0			4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0		2.0	2.0			2.0	
Lost Time Adjust (s)		0.0				0.0			0.0			0.0	
Total Lost Time (s)		6.0				6.0			6.0			6.0	
Lead/Lag								Lag	Lag			Lead	
Lead-Lag Optimize?								Yes	Yes			Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0			3.0	
Recall Mode	Min	Min		Min	Min	Min		None	None			None	
Act Effct Green (s)		47.2				47.2			6.0				
Actuated g/C Ratio		0.46				0.46			0.06				
v/c Ratio		0.88				0.53			0.15				
Control Delay		41.3				24.6			1.2				
Queue Delay		0.0				0.0			0.0				
Total Delay		41.3				24.6			1.2				
LOS		D				C			A				
Approach Delay		41.3				24.6			1.2				
Approach LOS		D				C			A				
Queue Length 50th (ft)		444				194			0				



Lane Group	SEL	SET	SER	SER2	NWL	NWT	NWR2
Lane Configurations		↕				↕	
Traffic Volume (vph)	266	94	17	15	8	21	9
Future Volume (vph)	266	94	17	15	8	21	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	9	9	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.989				0.967	
Flt Protected		0.967				0.989	
Satd. Flow (prot)	0	1639	0	0	0	1635	0
Flt Permitted		0.771				0.907	
Satd. Flow (perm)	0	1307	0	0	0	1500	0
Right Turn on Red				Yes			Yes
Satd. Flow (RTOR)		2				173	
Link Speed (mph)		35				30	
Link Distance (ft)		530				455	
Travel Time (s)		10.3				10.3	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	10%	0%	0%	10%	0%	0%	0%
Adj. Flow (vph)	283	100	18	16	9	22	10
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	417	0	0	0	41	0
Turn Type	pm+pt	NA			Perm	NA	
Protected Phases	7	4				8	
Permitted Phases	4				8		
Detector Phase	7	4			8	8	
Switch Phase							
Minimum Initial (s)	6.0	6.0			6.0	6.0	
Minimum Split (s)	10.0	12.0			12.0	12.0	
Total Split (s)	13.0	43.0			30.0	30.0	
Total Split (%)	10.8%	35.8%			25.0%	25.0%	
Maximum Green (s)	9.0	37.0			24.0	24.0	
Yellow Time (s)	3.5	4.0			4.0	4.0	
All-Red Time (s)	0.5	2.0			2.0	2.0	
Lost Time Adjust (s)		0.0				0.0	
Total Lost Time (s)		6.0				6.0	
Lead/Lag	Lead				Lag	Lag	
Lead-Lag Optimize?	Yes				Yes	Yes	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	
Recall Mode	None	None			None	None	
Act Effct Green (s)		37.1				37.1	
Actuated g/C Ratio		0.36				0.36	
v/c Ratio		0.89				0.06	
Control Delay		54.4				0.2	
Queue Delay		0.0				0.0	
Total Delay		54.4				0.2	
LOS		D				A	
Approach Delay		54.4				0.2	
Approach LOS		D				A	
Queue Length 50th (ft)		275				0	

													
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2	SBT	
Queue Length 95th (ft)		#686				291			0				
Internal Link Dist (ft)		447				722			151			65	
Turn Bay Length (ft)													
Base Capacity (vph)		788				718			255				
Starvation Cap Reductn		0				0			0				
Spillback Cap Reductn		0				0			0				
Storage Cap Reductn		0				0			0				
Reduced v/c Ratio		0.88				0.53			0.15				

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 103.2

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.89

Intersection Signal Delay: 38.7

Intersection LOS: D

Intersection Capacity Utilization 91.9%

ICU Level of Service F

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4	 Ø9	 Ø10
53 s	43 s	12 s	12 s
 Ø6	 Ø7	 Ø8	
53 s	13 s	30 s	



Lane Group	SEL	SET	SER	SER2	NWL	NWT	NWR2
Queue Length 95th (ft)		#472				0	
Internal Link Dist (ft)		450				375	
Turn Bay Length (ft)							
Base Capacity (vph)		471				650	
Starvation Cap Reductn		0				0	
Spillback Cap Reductn		0				0	
Storage Cap Reductn		0				0	
Reduced v/c Ratio		0.89				0.06	
Intersection Summary							

												
Lane Group	EBL2	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2
Lane Configurations												
Traffic Volume (vph)	9	360	3	1	3	4	559	265	9	0	12	2
Future Volume (vph)	9	360	3	1	3	4	559	265	9	0	12	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	11	12	11	11	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999					0.957			0.919		
Flt Protected		0.999								0.980		
Satd. Flow (prot)	0	1878	0	0	0	0	1675	0	0	1711	0	0
Flt Permitted		0.976					0.997			0.869		
Satd. Flow (perm)	0	1834	0	0	0	0	1670	0	0	1517	0	0
Right Turn on Red				Yes								Yes
Satd. Flow (RTOR)										191		
Link Speed (mph)		45					45			15		
Link Distance (ft)		527					802			231		
Travel Time (s)		8.0					12.2			10.5		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	1%	0%	0%	0%	0%	5%	5%	0%	0%	0%	0%
Adj. Flow (vph)	10	396	3	1	3	4	614	291	10	0	13	2
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	410	0	0	0	0	912	0	0	25	0	0
Turn Type	Perm	NA			Perm	Perm	NA		Perm	NA		
Protected Phases		2					6			10		
Permitted Phases	2				6	6			10			
Detector Phase	2	2			6	6	6		10	10		
Switch Phase												
Minimum Initial (s)	8.0	8.0			8.0	8.0	8.0		6.0	6.0		
Minimum Split (s)	14.0	14.0			14.0	14.0	14.0		12.0	12.0		
Total Split (s)	66.0	66.0			66.0	66.0	66.0		12.0	12.0		
Total Split (%)	55.0%	55.0%			55.0%	55.0%	55.0%		10.0%	10.0%		
Maximum Green (s)	60.0	60.0			60.0	60.0	60.0		6.0	6.0		
Yellow Time (s)	4.0	4.0			4.0	4.0	4.0		4.0	4.0		
All-Red Time (s)	2.0	2.0			2.0	2.0	2.0		2.0	2.0		
Lost Time Adjust (s)		0.0					0.0			0.0		
Total Lost Time (s)		6.0					6.0			6.0		
Lead/Lag									Lag	Lag		
Lead-Lag Optimize?									Yes	Yes		
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0	3.0		
Recall Mode	Min	Min			Min	Min	Min		None	None		
Act Effct Green (s)		61.1					61.1			6.1		
Actuated g/C Ratio		0.58					0.58			0.06		
v/c Ratio		0.38					0.94			0.09		
Control Delay		15.1					40.5			0.7		
Queue Delay		0.0					0.0			0.0		
Total Delay		15.1					40.5			0.7		
LOS		B					D			A		
Approach Delay		15.1					40.5			0.7		
Approach LOS		B					D			A		
Queue Length 50th (ft)		154					586			0		

										
Lane Group	SBL2	SBT	SEL	SET	SER	SER2	NWL2	NWL	NWT	NWR2
Lane Configurations										
Traffic Volume (vph)	1	0	128	10	4	31	1	34	69	2
Future Volume (vph)	1	0	128	10	4	31	1	34	69	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	11	11	12	11	12	9	9	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt				0.973					0.998	
Flt Protected		0.950		0.964					0.984	
Satd. Flow (prot)	0	1805	0	1692	0	0	0	0	1679	0
Flt Permitted				0.694					0.863	
Satd. Flow (perm)	0	1900	0	1218	0	0	0	0	1473	0
Right Turn on Red						Yes				Yes
Satd. Flow (RTOR)				8					191	
Link Speed (mph)		15		35					30	
Link Distance (ft)		145		530					455	
Travel Time (s)		6.6		10.3					10.3	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	2%	0%	0%	2%	0%	0%	0%	0%
Adj. Flow (vph)	1	0	141	11	4	34	1	37	76	2
Shared Lane Traffic (%)										
Lane Group Flow (vph)	0	1	0	190	0	0	0	0	116	0
Turn Type	Perm	NA	pm+pt	NA			Perm	Perm	NA	
Protected Phases		9	7	4					8	
Permitted Phases	9		4				8	8		
Detector Phase	9	9	7	4			8	8	8	
Switch Phase										
Minimum Initial (s)	6.0	6.0	6.0	6.0			6.0	6.0	6.0	
Minimum Split (s)	12.0	12.0	12.0	12.0			12.0	12.0	12.0	
Total Split (s)	12.0	12.0	16.0	30.0			14.0	14.0	14.0	
Total Split (%)	10.0%	10.0%	13.3%	25.0%			11.7%	11.7%	11.7%	
Maximum Green (s)	6.0	6.0	10.0	24.0			8.0	8.0	8.0	
Yellow Time (s)	4.0	4.0	4.0	4.0			4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0			2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0					0.0	
Total Lost Time (s)		6.0		6.0					6.0	
Lead/Lag	Lead	Lead	Lead				Lag	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes				Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0			3.0	3.0	3.0	
Recall Mode	None	None	None	None			None	None	None	
Act Effct Green (s)		6.1		22.6					22.6	
Actuated g/C Ratio		0.06		0.22					0.22	
v/c Ratio		0.01		0.71					0.25	
Control Delay		52.0		53.4					1.3	
Queue Delay		0.0		0.0					0.0	
Total Delay		52.0		53.4					1.3	
LOS		D		D					A	
Approach Delay		52.0		53.4					1.3	
Approach LOS		D		D					A	
Queue Length 50th (ft)		1		116					0	



Lane Group	EBL2	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2
Queue Length 95th (ft)		282					#1045			0		
Internal Link Dist (ft)		447					722			151		
Turn Bay Length (ft)												
Base Capacity (vph)		1070					974			267		
Starvation Cap Reductn		0					0			0		
Spillback Cap Reductn		0					0			0		
Storage Cap Reductn		0					0			0		
Reduced v/c Ratio		0.38					0.94			0.09		

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 104.7

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 32.3

Intersection LOS: C

Intersection Capacity Utilization 85.4%

ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

Ø2	Ø4	Ø9	Ø10
66 s	30 s	12 s	12 s
Ø6	Ø7	Ø8	
66 s	16 s	14 s	

											
Lane Group	SBL2	SBT	SEL	SET	SER	SER2	NWL2	NWL	NWT	NWR2	
Queue Length 95th (ft)		7		#250					1		
Internal Link Dist (ft)		65		450					375		
Turn Bay Length (ft)											
Base Capacity (vph)		109		287					468		
Starvation Cap Reductn		0		0					0		
Spillback Cap Reductn		0		0					0		
Storage Cap Reductn		0		0					0		
Reduced v/c Ratio		0.01		0.66					0.25		
Intersection Summary											

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018

												
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2	SBT
Lane Configurations												
Traffic Volume (vph)	18	590	44	4	2	268	87	4	0	23	8	0
Future Volume (vph)	18	590	44	4	2	268	87	4	0	23	8	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	12	11	11	12	12	12	12	12
Storage Length (ft)			0		40		0	0		0		
Storage Lanes			0		1		0	0		0		
Taper Length (ft)					150			25				
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.990				0.963			0.880			
Flt Protected	0.950				0.950				0.995			
Satd. Flow (prot)	1805	1797	0	0	1805	1565	0	0	1664	0	0	1900
Flt Permitted	0.442				0.165				0.950			
Satd. Flow (perm)	840	1797	0	0	314	1565	0	0	1588	0	0	1900
Right Turn on Red												Yes
Satd. Flow (RTOR)									149			
Link Speed (mph)		45				45			25			25
Link Distance (ft)		527				802			231			145
Travel Time (s)		8.0				12.2			6.3			4.0
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	5%	0%	0%	0%	13%	13%	0%	0%	0%	0%	0%
Adj. Flow (vph)	19	628	47	4	2	285	93	4	0	24	9	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	19	675	0	0	6	378	0	0	37	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Left	Right	Left	Left	Right	Right	Left
Median Width(ft)		12				12			0			0
Link Offset(ft)		5				5			-35			-45
Crosswalk Width(ft)		50				25			16			15
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.04	1.00	1.04	1.04	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15	15		9	15		9	9	
Turn Type	Perm	NA		Perm	Perm	NA		Perm	NA			
Protected Phases		2				6			10			9
Permitted Phases	2			6	6			10				
Detector Phase	2	2		6	6	6		10	10			9
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0	8.0		6.0	6.0			6.0
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0		13.0	13.0			13.0
Total Split (s)	52.0	52.0		52.0	52.0	52.0		13.0	13.0			13.0
Total Split (%)	34.7%	34.7%		34.7%	34.7%	34.7%		8.7%	8.7%			8.7%
Maximum Green (s)	45.0	45.0		45.0	45.0	45.0		6.0	6.0			6.0
Yellow Time (s)	5.0	5.0		5.0	5.0	5.0		3.0	3.0			3.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0		4.0	4.0			4.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0			0.0			0.0
Total Lost Time (s)	7.0	7.0			7.0	7.0			7.0			7.0
Lead/Lag								Lag	Lag			Lead
Lead-Lag Optimize?								Yes	Yes			Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0			3.0

Reconstruction of Rt 2A at Willow Rd/Bruce St 08/22/2018 2037 AM Peak Hr-Skewed Intersection
YC

Synchro 10 Report
Page 1

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018

								
Lane Group	SEL	SET	SER	SER2	NWL	NWT	NWR2	Ø11
Lane Configurations								
Traffic Volume (vph)	266	94	17	15	8	21	9	
Future Volume (vph)	266	94	17	15	8	21	9	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	11	12	11	9	9	9	
Storage Length (ft)	0		25		0			
Storage Lanes	0		1		0			
Taper Length (ft)	25				25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt			0.850				0.850	
Flt Protected		0.964				0.986		
Satd. Flow (prot)	0	1695	1571	0	0	1643	1333	
Flt Permitted		0.762				0.883		
Satd. Flow (perm)	0	1340	1571	0	0	1471	1333	
Right Turn on Red				Yes			Yes	
Satd. Flow (RTOR)			153				153	
Link Speed (mph)		35				30		
Link Distance (ft)		530				455		
Travel Time (s)		10.3				10.3		
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	
Heavy Vehicles (%)	6%	0%	0%	6%	9%	0%	9%	
Adj. Flow (vph)	283	100	18	16	9	22	10	
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	383	34	0	0	31	10	
Enter Blocked Intersection	No	No	No	No	No	No	No	
Lane Alignment	Left	Left	Right	Right	Left	Left	Right	
Median Width(ft)		0				0		
Link Offset(ft)		0				5		
Crosswalk Width(ft)		15				15		
Two way Left Turn Lane								
Headway Factor	1.04	1.04	1.00	1.04	1.14	1.14	1.14	
Turning Speed (mph)	15		9	9	15		9	
Turn Type	Perm	NA	Perm		Perm	NA	Perm	
Protected Phases		4				8		11
Permitted Phases	4		4		8		8	
Detector Phase	4	4	4		8	8	8	
Switch Phase								
Minimum Initial (s)	6.0	6.0	6.0		6.0	6.0	6.0	4.0
Minimum Split (s)	13.0	13.0	13.0		13.0	13.0	13.0	33.0
Total Split (s)	39.0	39.0	39.0		39.0	39.0	39.0	33.0
Total Split (%)	26.0%	26.0%	26.0%		26.0%	26.0%	26.0%	22%
Maximum Green (s)	32.5	32.5	32.5		32.5	32.5	32.5	30.0
Yellow Time (s)	3.5	3.5	3.5		3.0	3.0	3.0	2.0
All-Red Time (s)	3.0	3.0	3.0		3.5	3.5	3.5	1.0
Lost Time Adjust (s)		0.0	0.0			0.0	0.0	
Total Lost Time (s)		6.5	6.5			6.5	6.5	
Lead/Lag								
Lead-Lag Optimize?								
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0

Reconstruction of Rt 2A at Willow Rd/Bruce St 08/22/2018 2037 AM Peak Hr-Skewed Intersection
YC

Synchro 10 Report
Page 2

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018

														
Lane Group	EBL2	EBT	EBR	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2	SBT		
Recall Mode	Min	Min		Min	Min	Min		None	None			None		
Walk Time (s)														
Flash Dont Walk (s)														
Pedestrian Calls (#/hr)														
Act Effct Green (s)	45.2	45.2			45.2	45.2			6.0					
Actuated g/C Ratio	0.46	0.46			0.46	0.46			0.06					
v/c Ratio	0.05	0.82			0.04	0.53			0.16					
Control Delay	17.5	34.7			18.3	23.7			1.4					
Queue Delay	0.0	0.0			0.0	0.0			0.0					
Total Delay	17.5	34.7			18.3	23.7			1.4					
LOS	B	C			B	C			A					
Approach Delay		34.2				23.6			1.4					
Approach LOS		C				C			A					
Queue Length 50th (ft)	7	398			2	183			0					
Queue Length 95th (ft)	22	#617			11	278			0					
Internal Link Dist (ft)		447				722			151			65		
Turn Bay Length (ft)	50				40									
Base Capacity (vph)	384	821			143	715			236					
Starvation Cap Reductn	0	0			0	0			0					
Spillback Cap Reductn	0	0			0	0			0					
Storage Cap Reductn	0	0			0	0			0					
Reduced v/c Ratio	0.05	0.82			0.04	0.53			0.16					

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 98.8

Natural Cycle: 150

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.87

Intersection Signal Delay: 34.5

Intersection LOS: C

Intersection Capacity Utilization 85.9%

ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4	 Ø9	 Ø10	 Ø11
52 s	39 s	13 s	13 s	33 s
 Ø6	 Ø8			
52 s	39 s			

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018



Lane Group	SEL	SET	SER	SER2	NWL	NWT	NWR2	Ø11
Recall Mode	None	None	None		None	None	None	None
Walk Time (s)								7.0
Flash Dont Walk (s)								23.0
Pedestrian Calls (#/hr)								0
Act Effct Green (s)		32.6	32.6			32.6	32.6	
Actuated g/C Ratio		0.33	0.33			0.33	0.33	
v/c Ratio		0.87	0.05			0.06	0.02	
Control Delay		53.7	0.2			25.3	0.1	
Queue Delay		0.0	0.0			0.0	0.0	
Total Delay		53.7	0.2			25.3	0.1	
LOS		D	A			C	A	
Approach Delay		49.3				19.1		
Approach LOS		D				B		
Queue Length 50th (ft)		244	0			14	0	
Queue Length 95th (ft)		#425	0			37	0	
Internal Link Dist (ft)		450				375		
Turn Bay Length (ft)			25				25	
Base Capacity (vph)		442	621			485	542	
Starvation Cap Reductn		0	0			0	0	
Spillback Cap Reductn		0	0			0	0	
Storage Cap Reductn		0	0			0	0	
Reduced v/c Ratio		0.87	0.05			0.06	0.02	

Intersection Summary

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018

												
Lane Group	EBL2	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2
Lane Configurations												
Traffic Volume (vph)	9	360	3	1	3	4	559	265	9	0	12	2
Future Volume (vph)	9	360	3	1	3	4	559	265	9	0	12	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	11	12	11	11	12	12	12	12
Storage Length (ft)			0			40		0	0		0	
Storage Lanes			0			1		0	0		0	
Taper Length (ft)						150			25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998					0.952			0.919		
Flt Protected	0.950					0.950				0.980		
Satd. Flow (prot)	1787	1859	0	0	0	1805	1619	0	0	1711	0	0
Flt Permitted	0.086					0.462				0.869		
Satd. Flow (perm)	162	1859	0	0	0	878	1619	0	0	1517	0	0
Right Turn on Red				Yes								Yes
Satd. Flow (RTOR)										149		
Link Speed (mph)		45					45			25		
Link Distance (ft)		527					802			231		
Travel Time (s)		8.0					12.2			6.3		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	8%	8%	0%	0%	0%	0%
Adj. Flow (vph)	10	391	3	1	3	4	608	288	10	0	13	2
Shared Lane Traffic (%)												
Lane Group Flow (vph)	10	395	0	0	0	7	896	0	0	25	0	0
Turn Type	Perm	NA			Perm	Perm	NA		Perm	NA		
Protected Phases		2					6			10		
Permitted Phases	2				6	6			10			
Detector Phase	2	2			6	6	6		10	10		
Switch Phase												
Minimum Initial (s)	8.0	8.0			8.0	8.0	8.0		6.0	6.0		
Minimum Split (s)	15.0	15.0			15.0	15.0	15.0		13.0	13.0		
Total Split (s)	65.0	65.0			65.0	65.0	65.0		13.0	13.0		
Total Split (%)	43.3%	43.3%			43.3%	43.3%	43.3%		8.7%	8.7%		
Maximum Green (s)	58.0	58.0			58.0	58.0	58.0		6.0	6.0		
Yellow Time (s)	5.0	5.0			5.0	5.0	5.0		3.0	3.0		
All-Red Time (s)	2.0	2.0			2.0	2.0	2.0		4.0	4.0		
Lost Time Adjust (s)	0.0	0.0				0.0	0.0			0.0		
Total Lost Time (s)	7.0	7.0				7.0	7.0			7.0		
Lead/Lag									Lag	Lag		
Lead-Lag Optimize?									Yes	Yes		
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0	3.0		
Recall Mode	Min	Min			Min	Min	Min		None	None		
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	59.4	59.4				59.4	59.4			6.0		
Actuated g/C Ratio	0.58	0.58				0.58	0.58			0.06		
v/c Ratio	0.11	0.37				0.01	0.95			0.11		
Control Delay	17.3	14.5				13.2	43.6			1.0		

Reconstruction of Rt 2A at Willow Rd/Bruce St 08/22/2018 2037 PM Peak Hr Skewed Intersection
YC

Synchro 10 Report
Page 1

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018

											
Lane Group	SBL2	SBT	SEL	SET	SER	SER2	NWL2	NWL	NWT	NWR2	Ø11
Lane Configurations											
Traffic Volume (vph)	1	0	128	10	4	31	1	34	69	2	
Future Volume (vph)	1	0	128	10	4	31	1	34	69	2	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	12	12	11	11	12	11	12	9	9	9	
Storage Length (ft)			0		25			0			
Storage Lanes			0		1			0			
Taper Length (ft)			25					25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt					0.850					0.850	
Flt Protected		0.950		0.956					0.983		
Satd. Flow (prot)	0	1805	0	1708	1573	0	0	0	1659	1454	
Flt Permitted				0.662					0.808		
Satd. Flow (perm)	0	1900	0	1183	1573	0	0	0	1364	1454	
Right Turn on Red						Yes				Yes	
Satd. Flow (RTOR)					153					153	
Link Speed (mph)		25		35					30		
Link Distance (ft)		145		530					455		
Travel Time (s)		4.0		10.3					10.3		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	0%	0%	3%	0%	0%	3%	0%	0%	2%	0%	
Adj. Flow (vph)	1	0	139	11	4	34	1	37	75	2	
Shared Lane Traffic (%)											
Lane Group Flow (vph)	0	1	0	150	38	0	0	0	113	2	
Turn Type	Perm	NA	Perm	NA	Perm		Perm	Perm	NA	Perm	
Protected Phases		9		4					8		11
Permitted Phases	9		4		4		8	8		8	
Detector Phase	9	9	4	4	4		8	8	8	8	
Switch Phase											
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	4.0
Minimum Split (s)	13.0	13.0	13.0	13.0	13.0		13.0	13.0	13.0	13.0	33.0
Total Split (s)	13.0	13.0	26.0	26.0	26.0		26.0	26.0	26.0	26.0	33.0
Total Split (%)	8.7%	8.7%	17.3%	17.3%	17.3%		17.3%	17.3%	17.3%	17.3%	22%
Maximum Green (s)	6.0	6.0	19.5	19.5	19.5		19.5	19.5	19.5	19.5	30.0
Yellow Time (s)	3.0	3.0	3.5	3.5	3.5		3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	4.0	4.0	3.0	3.0	3.0		3.5	3.5	3.5	3.5	1.0
Lost Time Adjust (s)		0.0		0.0	0.0				0.0	0.0	
Total Lost Time (s)		7.0		6.5	6.5				6.5	6.5	
Lead/Lag	Lead	Lead									
Lead-Lag Optimize?	Yes	Yes									
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	None	None	None	None
Walk Time (s)											7.0
Flash Dont Walk (s)											23.0
Pedestrian Calls (#/hr)											0
Act Effct Green (s)		6.0		19.7	19.7				19.7	19.7	
Actuated g/C Ratio		0.06		0.19	0.19				0.19	0.19	
v/c Ratio		0.01		0.66	0.09				0.43	0.00	
Control Delay		50.0		55.7	0.4				44.7	0.0	

Reconstruction of Rt 2A at Willow Rd/Bruce St 08/22/2018 2037 PM Peak Hr Skewed Intersection
YC

Synchro 10 Report
Page 2

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018

												
Lane Group	EBL2	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	NBR2
Queue Delay	0.0	0.0				0.0	0.0			0.0		
Total Delay	17.3	14.5				13.2	43.6			1.0		
LOS	B	B				B	D			A		
Approach Delay		14.5					43.3			1.0		
Approach LOS		B					D			A		
Queue Length 50th (ft)	3	140				2	558			0		
Queue Length 95th (ft)	16	264				11	#1022			0		
Internal Link Dist (ft)		447					722			151		
Turn Bay Length (ft)	50					40						
Base Capacity (vph)	94	1078				509	939			229		
Starvation Cap Reductn	0	0				0	0			0		
Spillback Cap Reductn	0	0				0	0			0		
Storage Cap Reductn	0	0				0	0			0		
Reduced v/c Ratio	0.11	0.37				0.01	0.95			0.11		

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 102.3

Natural Cycle: 150

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 35.7

Intersection LOS: D

Intersection Capacity Utilization 83.6%

ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4	 Ø9	 Ø10	 Ø11
65 s	26 s	13 s	13 s	33 s
 Ø6	 Ø8			
65 s	26 s			

Lanes, Volumes, Timings

1: Gas Sta Drwy/House Drwy & Bruce St/Willow Rd & Ayer Rd (Rt 2A)

08/22/2018

												
Lane Group	SBL2	SBT	SEL	SET	SER	SER2	NWL2	NWL	NWT	NWR2	Ø11	
Queue Delay		0.0		0.0	0.0				0.0	0.0		
Total Delay		50.0		55.7	0.4				44.7	0.0		
LOS		D		E	A				D	A		
Approach Delay		50.0		44.5					43.9			
Approach LOS		D		D					D			
Queue Length 50th (ft)		1		94	0				67	0		
Queue Length 95th (ft)		7		#216	0				139	0		
Internal Link Dist (ft)		65		450					375			
Turn Bay Length (ft)					25					25		
Base Capacity (vph)		112		227	425				262	402		
Starvation Cap Reductn		0		0	0				0	0		
Spillback Cap Reductn		0		0	0				0	0		
Storage Cap Reductn		0		0	0				0	0		
Reduced v/c Ratio		0.01		0.66	0.09				0.43	0.00		
Intersection Summary												

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	633	0	2	278	108	0	4	31	361	17	15
Future Volume (vph)	15	633	0	2	278	108	0	4	31	361	17	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	11	11	12	12	12	11	12	11
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	40		0	0		0	0		0	0		30
Storage Lanes	1		0	1		0	0		0	1		1
Taper Length (ft)	100			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt					0.958			0.880			0.929	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1770	1810	0	1805	1571	0	0	1672	0	1646	1717	0
Flt Permitted	0.442			0.196						0.733		
Satd. Flow (perm)	823	1810	0	372	1571	0	0	1672	0	1270	1717	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					44			33			16	
Link Speed (mph)		45			30			25			35	
Link Distance (ft)		527			176			231			535	
Travel Time (s)		8.0			4.0			6.3			10.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	5%	0%	0%	12%	12%	0%	0%	0%	6%	0%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	16	666	0	2	293	114	0	4	33	380	18	16
Shared Lane Traffic (%)												
Lane Group Flow (vph)	16	666	0	2	407	0	0	37	0	380	34	0
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	14.0	14.0		14.0	14.0		20.0	20.0		12.0	12.0	
Total Split (s)	33.0	33.0		33.0	33.0		27.0	27.0		27.0	27.0	
Total Split (%)	55.0%	55.0%		55.0%	55.0%		45.0%	45.0%		45.0%	45.0%	
Maximum Green (s)	28.0	28.0		28.0	28.0		22.0	22.0		21.5	21.5	
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0			5.0		5.5	5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)	23.8	23.8		23.8	23.8			19.7		19.2	19.2	
Actuated g/C Ratio	0.44	0.44		0.44	0.44			0.37		0.36	0.36	
v/c Ratio	0.04	0.83		0.01	0.57			0.06		0.84	0.05	
Control Delay	9.2	24.8		9.0	13.7			6.0		36.7	9.2	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	9.2	24.8		9.0	13.7			6.0		36.7	9.2	
LOS	A	C		A	B			A		D	A	
Approach Delay		24.4			13.7			6.0			34.4	
Approach LOS		C			B			A			C	
Queue Length 50th (ft)	3	191		0	86			1		121	4	
Queue Length 95th (ft)	12	#369		3	159			17		#263	19	
Internal Link Dist (ft)		447			96			151			455	
Turn Bay Length (ft)	40											
Base Capacity (vph)	441	971		199	863			724		523	716	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	0.04	0.69		0.01	0.47			0.05		0.73	0.05	

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 53.9

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 23.8

Intersection LOS: C

Intersection Capacity Utilization 68.7%

ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4
33 s	27 s
 Ø6	 Ø8
33 s	27 s

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	633	0	2	278	108	0	4	31	361	17	15
Future Volume (veh/h)	15	633	0	2	278	108	0	4	31	361	17	15
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Lanes Open During Work Zone												
Adj Sat Flow, veh/h/ln	1870	1826	1826	1900	1722	1722	1900	1900	1900	1811	1900	1900
Adj Flow Rate, veh/h	16	666	0	2	293	114	0	4	33	380	18	16
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	5	5	0	12	12	0	0	0	6	0	0
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	394	792	0	238	512	199	0	61	501	588	318	283
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.43	0.43	0.00	0.43	0.43	0.43	0.00	0.34	0.34	0.34	0.34	0.34
Unsig. Movement Delay												
Ln Grp Delay, s/veh	13.6	16.3	0.0	18.8	0.0	10.8	0.0	0.0	10.4	16.2	0.0	10.4
Ln Grp LOS	B	B	A	B	A	B	A	A	B	B	A	B
Approach Vol, veh/h	682			409			37			414		
Approach Delay, s/veh	16.3			10.8			10.4			15.7		
Approach LOS	B			B			B			B		
Timer:	1	2	3	4	5	6	7	8				
Assigned Phs	2		4		6		8					
Case No	6.0		6.0		6.0		8.0					
Phs Duration (G+Y+Rc), s	25.4		21.7		25.4		21.7					
Change Period (Y+Rc), s	5.0		5.5		5.0		*5.5					
Max Green (Gmax), s	28.0		21.5		28.0		*22					
Max Allow Headway (MAH), s	4.9		4.0		5.4		5.7					
Max Q Clear (g_c+I1), s	17.3		15.4		17.4		2.7					
Green Ext Time (g_e), s	3.1		0.8		1.9		0.1					
Prob of Phs Call (p_c)	1.00		1.00		1.00		1.00					
Prob of Max Out (p_x)	0.33		0.38		0.23		0.00					
Left-Turn Movement Data												
Assigned Mvmt	5		7		1		3					
Mvmt Sat Flow, veh/h	978		1327		782		0					
Through Movement Data												
Assigned Mvmt	2		4		6		8					
Mvmt Sat Flow, veh/h	1826		927		1180		177					
Right-Turn Movement Data												
Assigned Mvmt	12		14		16		18					
Mvmt Sat Flow, veh/h	0		824		459		1460					
Left Lane Group Data												
Assigned Mvmt	0		5		0		7		0		3	
Lane Assignment			L		L		L					

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

Lanes in Grp	0	1	0	1	0	1	0	0
Grp Vol (v), veh/h	0	16	0	380	0	2	0	0
Grp Sat Flow (s), veh/h/ln	0	978	0	1327	0	782	0	0
Q Serve Time (g_s), s	0.0	0.6	0.0	12.7	0.0	0.1	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	9.4	0.0	13.4	0.0	15.4	0.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	978	0	1327	0	782	0	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	20.4	0.0	16.2	0.0	20.4	0.0	0.0
Perm LT Serve Time (g_u), s	0.0	11.6	0.0	15.4	0.0	5.1	0.0	0.0
Perm LT Q Serve Time (g_ps), s	0.0	0.6	0.0	12.7	0.0	0.1	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Lane Grp Cap (c), veh/h	0	394	0	588	0	238	0	0
V/C Ratio (X)	0.00	0.04	0.00	0.65	0.00	0.01	0.00	0.00
Avail Cap (c_a), veh/h	0	552	0	739	0	364	0	0
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	13.6	0.0	14.9	0.0	18.8	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	13.6	0.0	16.2	0.0	18.8	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.1	0.0	3.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.1	0.0	3.2	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.07	0.00	0.18	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle Lane Group Data								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment	T							
Lanes in Grp	0	1	0	0	0	0	0	0
Grp Vol (v), veh/h	0	666	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	1826	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	792	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	1086	0	0	0	0	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	11.9	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	16.3	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Right Lane Group Data

Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R			T+R			T+R	
Lanes in Grp	0	0	0	1	0	1	0	1
Grp Vol (v), veh/h	0	0	0	34	0	407	0	37
Grp Sat Flow (s), veh/h/ln	0	0	0	1752	0	1640	0	1637
Q Serve Time (g_s), s	0.0	0.0	0.0	0.6	0.0	8.8	0.0	0.7
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.6	0.0	8.8	0.0	0.7
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.00	0.00	0.47	0.00	0.28	0.00	0.89
Lane Grp Cap (c), veh/h	0	0	0	601	0	711	0	562
V/C Ratio (X)	0.00	0.00	0.00	0.06	0.00	0.57	0.00	0.07
Avail Cap (c_a), veh/h	0	0	0	800	0	975	0	765
Upstream Filter (I)	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	10.4	0.0	10.0	0.0	10.4
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	10.4	0.0	10.8	0.0	10.4
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.2	0.0	2.4	0.0	0.2
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.2	0.0	2.6	0.0	0.2
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.01	0.00	0.56	0.00	0.03
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary

HCM 6th Ctrl Delay	14.5
HCM 6th LOS	B

Notes

* HCM 6th Edition computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
3: Bruce St & Ayer Rd (Rt 2A)

03/12/2018

Intersection						
Int Delay, s/veh	0.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	872	153	4	358	29	9
Future Vol, veh/h	872	153	4	358	29	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	40	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	6	0	0	13	6	6
Mvmt Flow	908	159	4	373	30	9
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1067	0	1369	988
Stage 1	-	-	-	-	988	-
Stage 2	-	-	-	-	381	-
Critical Hdwy	-	-	4.1	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	-	-	2.2	-	3.554	3.354
Pot Cap-1 Maneuver	-	-	661	-	158	295
Stage 1	-	-	-	-	354	-
Stage 2	-	-	-	-	682	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	661	-	157	295
Mov Cap-2 Maneuver	-	-	-	-	157	-
Stage 1	-	-	-	-	352	-
Stage 2	-	-	-	-	682	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.1		31.1	
HCM LOS	D					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	177	-	-	661	-	
HCM Lane V/C Ratio	0.224	-	-	0.006	-	
HCM Control Delay (s)	31.1	-	-	10.5	-	
HCM Lane LOS	D	-	-	B	-	
HCM 95th %tile Q(veh)	0.8	-	-	0	-	

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	363	1	6	595	334	0	9	14	138	4	31
Future Volume (vph)	9	363	1	6	595	334	0	9	14	138	4	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	11	11	12	12	12	11	12	11
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	40		0	0		0	0		0	0		30
Storage Lanes	1		0	1		0	0		0	1		1
Taper Length (ft)	100			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt					0.946			0.919			0.866	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1703	1793	0	1805	1671	0	0	1732	0	1662	1572	0
Flt Permitted	0.157			0.520						0.741		
Satd. Flow (perm)	281	1793	0	988	1671	0	0	1732	0	1296	1572	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					81			15			34	
Link Speed (mph)		45			30			25			35	
Link Distance (ft)		527			176			231			535	
Travel Time (s)		8.0			4.0			6.3			10.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	6%	2%	0%	4%	4%	2%	2%	0%	5%	2%	5%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	10	395	1	7	647	363	0	10	15	150	4	34
Shared Lane Traffic (%)												
Lane Group Flow (vph)	10	396	0	7	1010	0	0	25	0	150	38	0
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	14.0	14.0		14.0	14.0		20.0	20.0		12.0	12.0	
Total Split (s)	50.0	50.0		50.0	50.0		20.0	20.0		20.0	20.0	
Total Split (%)	71.4%	71.4%		71.4%	71.4%		28.6%	28.6%		28.6%	28.6%	
Maximum Green (s)	45.0	45.0		45.0	45.0		15.0	15.0		14.5	14.5	
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0			5.0		5.5	5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)	45.5	45.5		45.5	45.5		12.0			11.8	11.8	
Actuated g/C Ratio	0.72	0.72		0.72	0.72		0.19			0.19	0.19	
v/c Ratio	0.05	0.31		0.01	0.82		0.07			0.61	0.12	
Control Delay	5.3	5.8		4.5	17.0		14.9			37.4	10.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Total Delay	5.3	5.8		4.5	17.0		14.9			37.4	10.8	
LOS	A	A		A	B		B			D	B	
Approach Delay		5.8			16.9		14.9				32.0	
Approach LOS		A			B		B				C	
Queue Length 50th (ft)	1	62		1	278		3			58	1	
Queue Length 95th (ft)	7	110		5	#628		22			115	24	
Internal Link Dist (ft)		447			96		151				455	
Turn Bay Length (ft)	40											
Base Capacity (vph)	203	1298		715	1232		447			315	408	
Starvation Cap Reductn	0	0		0	0		0			0	0	
Spillback Cap Reductn	0	0		0	0		0			0	0	
Storage Cap Reductn	0	0		0	0		0			0	0	
Reduced v/c Ratio	0.05	0.31		0.01	0.82		0.06			0.48	0.09	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 62.8

Natural Cycle: 70

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.82

Intersection Signal Delay: 15.9

Intersection LOS: B

Intersection Capacity Utilization 74.7%

ICU Level of Service D

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4
50 s	20 s
 Ø6	 Ø8
50 s	20 s

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	363	1	6	595	334	0	9	14	138	4	31
Future Volume (veh/h)	9	363	1	6	595	334	0	9	14	138	4	31
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Lanes Open During Work Zone												
Adj Sat Flow, veh/h/ln	1811	1811	1811	1900	1841	1841	1870	1870	1870	1826	1870	1870
Adj Flow Rate, veh/h	10	395	1	7	647	363	0	10	15	150	4	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	6	6	6	0	4	4	2	2	2	5	2	2
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	224	1187	3	693	728	409	0	104	157	321	26	223
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.66	0.66	0.66	0.66	0.66	0.66	0.00	0.15	0.15	0.15	0.15	0.15
Unsig. Movement Delay												
Ln Grp Delay, s/veh	19.4	0.0	4.4	5.4	0.0	14.3	0.0	0.0	20.4	24.2	0.0	20.7
Ln Grp LOS	B	A	A	A	A	B	A	A	C	C	A	C
Approach Vol, veh/h	406			1017			25			188		
Approach Delay, s/veh	4.7			14.2			20.4			23.5		
Approach LOS	A			B			C			C		
Timer:	1	2	3	4	5	6	7	8				
Assigned Phs	2		4		6		8					
Case No	6.0		6.0		6.0		8.0					
Phs Duration (G+Y+Rc), s	41.8		14.2		41.8		14.2					
Change Period (Y+Rc), s	5.0		5.5		5.0		*5.5					
Max Green (Gmax), s	45.0		14.5		45.0		*15					
Max Allow Headway (MAH), s	5.0		4.2		5.4		5.6					
Max Q Clear (g_c+I1), s	29.8		8.7		28.9		2.7					
Green Ext Time (g_e), s	2.0		0.3		7.9		0.0					
Prob of Phs Call (p_c)	1.00		0.96		1.00		0.96					
Prob of Max Out (p_x)	0.04		0.31		0.44		0.00					
Left-Turn Movement Data												
Assigned Mvmt	5		7		1		3					
Mvmt Sat Flow, veh/h	540		1353		1004		0					
Through Movement Data												
Assigned Mvmt	2		4		6		8					
Mvmt Sat Flow, veh/h	1806		170		1108		675					
Right-Turn Movement Data												
Assigned Mvmt	12		14		16		18					
Mvmt Sat Flow, veh/h	5		1441		621		1013					
Left Lane Group Data												
Assigned Mvmt	0		5		0		1		0		3	
Lane Assignment			L		L		L					

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

Lanes in Grp	0	1	0	1	0	1	0	0
Grp Vol (v), veh/h	0	10	0	150	0	7	0	0
Grp Sat Flow (s), veh/h/ln	0	540	0	1353	0	1004	0	0
Q Serve Time (g_s), s	0.0	0.9	0.0	6.0	0.0	0.2	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	27.8	0.0	6.7	0.0	5.5	0.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	540	0	1353	0	1004	0	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	36.8	0.0	8.7	0.0	36.8	0.0	0.0
Perm LT Serve Time (g_u), s	0.0	9.9	0.0	7.9	0.0	31.4	0.0	0.0
Perm LT Q Serve Time (g_ps), s	0.0	0.9	0.0	6.0	0.0	0.2	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Lane Grp Cap (c), veh/h	0	224	0	321	0	693	0	0
V/C Ratio (X)	0.00	0.04	0.00	0.47	0.00	0.01	0.00	0.00
Avail Cap (c_a), veh/h	0	304	0	462	0	840	0	0
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	19.3	0.0	23.2	0.0	5.4	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.1	0.0	1.1	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	19.4	0.0	24.2	0.0	5.4	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.1	0.0	1.7	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.1	0.0	1.8	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.06	0.00	0.10	0.00	0.01	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Middle Lane Group Data

Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Right Lane Group Data

Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R		T+R		T+R		T+R	
Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	396	0	38	0	1010	0	25
Grp Sat Flow (s), veh/h/ln	0	1810	0	1611	0	1729	0	1688
Q Serve Time (g_s), s	0.0	5.4	0.0	1.1	0.0	26.9	0.0	0.7
Cycle Q Clear Time (g_c), s	0.0	5.4	0.0	1.1	0.0	26.9	0.0	0.7
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.00	0.00	0.89	0.00	0.36	0.00	0.60
Lane Grp Cap (c), veh/h	0	1190	0	249	0	1137	0	261
V/C Ratio (X)	0.00	0.33	0.00	0.15	0.00	0.89	0.00	0.10
Avail Cap (c_a), veh/h	0	1456	0	418	0	1391	0	453
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	4.2	0.0	20.5	0.0	7.9	0.0	20.3
Incr Delay (d2), s/veh	0.0	0.2	0.0	0.3	0.0	6.4	0.0	0.2
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	4.4	0.0	20.7	0.0	14.3	0.0	20.4
1st-Term Q (Q1), veh/ln	0.0	0.9	0.0	0.4	0.0	5.9	0.0	0.3
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	2.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.9	0.0	0.4	0.0	7.9	0.0	0.3
%ile Storage Ratio (RQ%)	0.00	0.05	0.00	0.02	0.00	1.62	0.00	0.04
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary

HCM 6th Ctrl Delay	13.0
HCM 6th LOS	B

Notes

* HCM 6th Edition computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
3: Bruce St & Ayer Rd (Rt 2A)

03/12/2018

Intersection						
Int Delay, s/veh	6.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	498	17	3	830	104	2
Future Vol, veh/h	498	17	3	830	104	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	40	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	5	0	0	4	0	0
Mvmt Flow	547	19	3	912	114	2
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	566	0	1475	557
Stage 1	-	-	-	-	557	-
Stage 2	-	-	-	-	918	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1016	-	141	534
Stage 1	-	-	-	-	578	-
Stage 2	-	-	-	-	392	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1016	-	141	534
Mov Cap-2 Maneuver	-	-	-	-	141	-
Stage 1	-	-	-	-	576	-
Stage 2	-	-	-	-	392	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0		93.2	
HCM LOS					F	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	143	-	-	1016	-	
HCM Lane V/C Ratio	0.815	-	-	0.003	-	
HCM Control Delay (s)	93.2	-	-	8.6	-	
HCM Lane LOS	F	-	-	A	-	
HCM 95th %tile Q(veh)	5.2	-	-	0	-	

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	633	0	2	278	108	0	4	31	361	17	15
Future Volume (vph)	15	633	0	2	278	108	0	4	31	361	17	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	11	11	12	12	12	11	12	11
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	40		0	0		0	0		0	0		30
Storage Lanes	1		0	1		1	0		0	1		1
Taper Length (ft)	100			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt						0.850		0.880			0.929	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1770	1810	0	1805	1640	1394	0	1672	0	1646	1717	0
Flt Permitted	0.562			0.196						0.733		
Satd. Flow (perm)	1047	1810	0	372	1640	1394	0	1672	0	1270	1717	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						114		33			16	
Link Speed (mph)		45			30			25			35	
Link Distance (ft)		527			176			231			535	
Travel Time (s)		8.0			4.0			6.3			10.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	5%	0%	0%	12%	12%	0%	0%	0%	6%	0%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	16	666	0	2	293	114	0	4	33	380	18	16
Shared Lane Traffic (%)												
Lane Group Flow (vph)	16	666	0	2	293	114	0	37	0	380	34	0
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Detector Phase	2	2		6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0	8.0	6.0	6.0		6.0	6.0	
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	20.0	20.0		12.0	12.0	
Total Split (s)	33.0	33.0		33.0	33.0	33.0	27.0	27.0		27.0	27.0	
Total Split (%)	55.0%	55.0%		55.0%	55.0%	55.0%	45.0%	45.0%		45.0%	45.0%	
Maximum Green (s)	28.0	28.0		28.0	28.0	28.0	22.0	22.0		21.5	21.5	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	3.0		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0		5.0		5.5	5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Gap (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Time Before Reduce (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Time To Reduce (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)	23.8	23.8		23.8	23.8	23.8		19.7		19.2	19.2	
Actuated g/C Ratio	0.44	0.44		0.44	0.44	0.44		0.37		0.36	0.36	
v/c Ratio	0.03	0.83		0.01	0.40	0.17		0.06		0.84	0.05	
Control Delay	9.1	24.8		9.0	12.4	3.0		6.0		36.7	9.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	9.1	24.8		9.0	12.4	3.0		6.0		36.7	9.2	
LOS	A	C		A	B	A		A		D	A	
Approach Delay		24.4			9.8			6.0			34.4	
Approach LOS		C			A			A			C	
Queue Length 50th (ft)	3	191		0	64	0		1		121	4	
Queue Length 95th (ft)	11	#369		3	116	22		17		#263	19	
Internal Link Dist (ft)		447			96			151			455	
Turn Bay Length (ft)	40											
Base Capacity (vph)	561	971		199	880	800		724		523	716	
Starvation Cap Reductn	0	0		0	0	0		0		0	0	
Spillback Cap Reductn	0	0		0	0	0		0		0	0	
Storage Cap Reductn	0	0		0	0	0		0		0	0	
Reduced v/c Ratio	0.03	0.69		0.01	0.33	0.14		0.05		0.73	0.05	

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 53.9

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 22.8

Intersection LOS: C

Intersection Capacity Utilization 68.7%

ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

 Ø2	 Ø4
33 s	27 s
 Ø6	 Ø8
33 s	27 s

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	633	0	2	278	108	0	4	31	361	17	15
Future Volume (veh/h)	15	633	0	2	278	108	0	4	31	361	17	15
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Lanes Open During Work Zone												
Adj Sat Flow, veh/h/ln	1870	1826	1826	1900	1722	1722	1900	1900	1900	1811	1900	1900
Adj Flow Rate, veh/h	16	666	0	2	293	114	0	4	33	380	18	16
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	5	5	0	12	12	0	0	0	6	0	0
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	464	792	0	238	747	633	0	61	501	588	318	283
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.43	0.43	0.00	0.43	0.43	0.43	0.00	0.34	0.34	0.34	0.34	0.34
Unsig. Movement Delay												
Ln Grp Delay, s/veh	11.2	16.3	0.0	18.8	9.4	8.3	0.0	0.0	10.4	16.2	0.0	10.4
Ln Grp LOS	B	B	A	B	A	A	A	A	B	B	A	B
Approach Vol, veh/h	682			409			37			414		
Approach Delay, s/veh	16.2			9.2			10.4			15.7		
Approach LOS	B			A			B			B		
Timer:	1	2	3	4	5	6	7	8				
Assigned Phs	2		4		6		8					
Case No	6.0		6.0		5.0		8.0					
Phs Duration (G+Y+Rc), s	25.4		21.7		25.4		21.7					
Change Period (Y+Rc), s	5.0		5.5		5.0		*5.5					
Max Green (Gmax), s	28.0		21.5		28.0		*22					
Max Allow Headway (MAH), s	4.9		4.0		5.0		5.7					
Max Q Clear (g_c+I1), s	17.3		15.4		17.4		2.7					
Green Ext Time (g_e), s	3.1		0.8		1.6		0.1					
Prob of Phs Call (p_c)	1.00		1.00		1.00		1.00					
Prob of Max Out (p_x)	0.33		0.38		0.15		0.00					
Left-Turn Movement Data												
Assigned Mvmt	5		7		1		3					
Mvmt Sat Flow, veh/h	978		1327		782		0					
Through Movement Data												
Assigned Mvmt	2		4		6		8					
Mvmt Sat Flow, veh/h	1826		927		1722		177					
Right-Turn Movement Data												
Assigned Mvmt	12		14		16		18					
Mvmt Sat Flow, veh/h	0		824		1459		1460					
Left Lane Group Data												
Assigned Mvmt	0	5	0	7	0	1	0	3				
Lane Assignment		L		L		L						

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

Lanes in Grp	0	1	0	1	0	1	0	0
Grp Vol (v), veh/h	0	16	0	380	0	2	0	0
Grp Sat Flow (s), veh/h/ln	0	978	0	1327	0	782	0	0
Q Serve Time (g_s), s	0.0	0.5	0.0	12.7	0.0	0.1	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	6.0	0.0	13.4	0.0	15.4	0.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	978	0	1327	0	782	0	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	20.4	0.0	16.2	0.0	20.4	0.0	0.0
Perm LT Serve Time (g_u), s	0.0	14.9	0.0	15.4	0.0	5.1	0.0	0.0
Perm LT Q Serve Time (g_ps), s	0.0	0.5	0.0	12.7	0.0	0.1	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Lane Grp Cap (c), veh/h	0	464	0	588	0	238	0	0
V/C Ratio (X)	0.00	0.03	0.00	0.65	0.00	0.01	0.00	0.00
Avail Cap (c_a), veh/h	0	621	0	739	0	364	0	0
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	11.1	0.0	14.9	0.0	18.8	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	11.2	0.0	16.2	0.0	18.8	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.1	0.0	3.0	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.1	0.0	3.2	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.06	0.00	0.18	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle Lane Group Data								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment	T				T			
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	666	0	0	0	293	0	0
Grp Sat Flow (s), veh/h/ln	0	1826	0	0	0	1722	0	0
Q Serve Time (g_s), s	0.0	15.3	0.0	0.0	0.0	5.5	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	15.3	0.0	0.0	0.0	5.5	0.0	0.0
Lane Grp Cap (c), veh/h	0	792	0	0	0	747	0	0
V/C Ratio (X)	0.00	0.84	0.00	0.00	0.00	0.39	0.00	0.00
Avail Cap (c_a), veh/h	0	1086	0	0	0	1025	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	11.9	0.0	0.0	0.0	9.1	0.0	0.0
Incr Delay (d2), s/veh	0.0	4.5	0.0	0.0	0.0	0.3	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	16.3	0.0	0.0	0.0	9.4	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	4.0	0.0	0.0	0.0	1.6	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	1.0	0.0	0.0	0.0	0.1	0.0	0.0

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	5.0	0.0	0.0	0.0	1.7	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.29	0.00	0.00	0.00	0.36	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Right Lane Group Data

Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R			R			T+R	
Lanes in Grp	0	0	0	1	0	1	0	1
Grp Vol (v), veh/h	0	0	0	34	0	114	0	37
Grp Sat Flow (s), veh/h/ln	0	0	0	1752	0	1459	0	1637
Q Serve Time (g_s), s	0.0	0.0	0.0	0.6	0.0	2.3	0.0	0.7
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.6	0.0	2.3	0.0	0.7
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.00	0.00	0.47	0.00	1.00	0.00	0.89
Lane Grp Cap (c), veh/h	0	0	0	601	0	633	0	562
V/C Ratio (X)	0.00	0.00	0.00	0.06	0.00	0.18	0.00	0.07
Avail Cap (c_a), veh/h	0	0	0	800	0	868	0	765
Upstream Filter (I)	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	10.4	0.0	8.2	0.0	10.4
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	10.4	0.0	8.3	0.0	10.4
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.2	0.0	0.6	0.0	0.2
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.2	0.0	0.6	0.0	0.2
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.01	0.00	0.13	0.00	0.03
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary

HCM 6th Ctrl Delay	14.1
HCM 6th LOS	B

Notes

* HCM 6th Edition computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
3: Bruce St & Ayer Rd (Rt 2A)

03/12/2018

Intersection						
Int Delay, s/veh	0.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	872	153	4	358	29	9
Future Vol, veh/h	872	153	4	358	29	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	40	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	6	0	0	13	6	6
Mvmt Flow	908	159	4	373	30	9
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1067	0	1183	988
Stage 1	-	-	-	-	988	-
Stage 2	-	-	-	-	195	-
Critical Hdwy	-	-	4.1	-	6.69	6.29
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.89	-
Follow-up Hdwy	-	-	2.2	-	3.557	3.357
Pot Cap-1 Maneuver	-	-	661	-	190	292
Stage 1	-	-	-	-	351	-
Stage 2	-	-	-	-	809	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	661	-	189	292
Mov Cap-2 Maneuver	-	-	-	-	189	-
Stage 1	-	-	-	-	349	-
Stage 2	-	-	-	-	809	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.1		26.6	
HCM LOS					D	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	206	-	-	661	-	
HCM Lane V/C Ratio	0.192	-	-	0.006	-	
HCM Control Delay (s)	26.6	-	-	10.5	-	
HCM Lane LOS	D	-	-	B	-	
HCM 95th %tile Q(veh)	0.7	-	-	0	-	

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	363	1	6	595	334	0	9	14	138	4	31
Future Volume (vph)	9	363	1	6	595	334	0	9	14	138	4	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	11	11	12	12	12	11	12	11
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	40		0	0		0	0		0	0		30
Storage Lanes	1		0	1		1	0		0	1		1
Taper Length (ft)	100			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt						0.850		0.919				0.866
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1703	1793	0	1805	1766	1501	0	1732	0	1662	1572	0
Flt Permitted	0.333			0.521						0.741		
Satd. Flow (perm)	597	1793	0	990	1766	1501	0	1732	0	1296	1572	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						363		15			34	
Link Speed (mph)		45			30			25			35	
Link Distance (ft)		527			176			231			535	
Travel Time (s)		8.0			4.0			6.3			10.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	6%	2%	0%	4%	4%	2%	2%	0%	5%	2%	5%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	10	395	1	7	647	363	0	10	15	150	4	34
Shared Lane Traffic (%)												
Lane Group Flow (vph)	10	396	0	7	647	363	0	25	0	150	38	0
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Detector Phase	2	2		6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0	8.0	6.0	6.0		6.0	6.0	
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	20.0	20.0		12.0	12.0	
Total Split (s)	35.0	35.0		35.0	35.0	35.0	20.0	20.0		20.0	20.0	
Total Split (%)	63.6%	63.6%		63.6%	63.6%	63.6%	36.4%	36.4%		36.4%	36.4%	
Maximum Green (s)	30.0	30.0		30.0	30.0	30.0	15.0	15.0		14.5	14.5	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	3.0		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0		5.0		5.5	5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	

Lanes, Volumes, Timings

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

	↖	→	↗	↖	←	↖	↗	↑	↖	↗	↓	↖
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Gap (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Time Before Reduce (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Time To Reduce (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)	29.3	29.3		29.3	29.3	29.3		10.8		10.5	10.5	
Actuated g/C Ratio	0.64	0.64		0.64	0.64	0.64		0.24		0.23	0.23	
v/c Ratio	0.03	0.34		0.01	0.57	0.33		0.06		0.51	0.10	
Control Delay	5.9	7.3		5.7	10.2	1.8		10.5		23.5	7.9	
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	5.9	7.3		5.7	10.2	1.8		10.5		23.5	7.9	
LOS	A	A		A	B	A		B		C	A	
Approach Delay		7.3			7.2			10.5			20.3	
Approach LOS		A			A			B			C	
Queue Length 50th (ft)	1	53		1	107	0		2		34	1	
Queue Length 95th (ft)	7	118		5	236	29		17		86	19	
Internal Link Dist (ft)		447			96			151			455	
Turn Bay Length (ft)	40											
Base Capacity (vph)	409	1229		679	1210	1143		610		434	549	
Starvation Cap Reductn	0	0		0	0	0		0		0	0	
Spillback Cap Reductn	0	0		0	0	0		0		0	0	
Storage Cap Reductn	0	0		0	0	0		0		0	0	
Reduced v/c Ratio	0.02	0.32		0.01	0.53	0.32		0.04		0.35	0.07	

Intersection Summary

Area Type: Other

Cycle Length: 55

Actuated Cycle Length: 45.6

Natural Cycle: 50

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.57

Intersection Signal Delay: 8.8

Intersection LOS: A

Intersection Capacity Utilization 54.4%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

↖ Ø2	↘ Ø4
35 s	20 s
↖ Ø6	↘ Ø8
35 s	20 s

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	363	1	6	595	334	0	9	14	138	4	31
Future Volume (veh/h)	9	363	1	6	595	334	0	9	14	138	4	31
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Lanes Open During Work Zone												
Adj Sat Flow, veh/h/ln	1811	1811	1811	1900	1841	1841	1870	1870	1870	1826	1870	1870
Adj Flow Rate, veh/h	10	395	1	7	647	363	0	10	15	150	4	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	6	6	6	0	4	4	2	2	2	5	2	2
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	356	921	2	598	938	795	0	111	166	428	28	236
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.51	0.51	0.51	0.51	0.51	0.51	0.00	0.16	0.16	0.16	0.16	0.16
Unsig. Movement Delay												
Ln Grp Delay, s/veh	9.4	0.0	5.3	6.4	6.9	5.4	0.0	0.0	11.6	13.5	0.0	11.8
Ln Grp LOS	A	A	A	A	A	A	A	A	B	B	A	B
Approach Vol, veh/h	406			1017			25			188		
Approach Delay, s/veh	5.4			6.4			11.6			13.2		
Approach LOS	A			A			B			B		
Timer:	1	2	3	4	5	6	7	8				
Assigned Phs		2		4		6		8				
Case No		6.0		6.0		5.0		8.0				
Phs Duration (G+Y+Rc), s		21.4		10.8		21.4		10.8				
Change Period (Y+Rc), s		5.0		5.5		5.0		*5.5				
Max Green (Gmax), s		30.0		14.5		30.0		*15				
Max Allow Headway (MAH), s		5.0		4.2		4.8		5.6				
Max Q Clear (g_c+I1), s		11.0		5.8		10.5		2.4				
Green Ext Time (g_e), s		2.1		0.4		5.9		0.0				
Prob of Phs Call (p_c)		1.00		0.85		1.00		0.85				
Prob of Max Out (p_x)		0.01		0.04		0.16		0.00				
Left-Turn Movement Data												
Assigned Mvmt		5		7		1		3				
Mvmt Sat Flow, veh/h		540		1353		1004		0				
Through Movement Data												
Assigned Mvmt		2		4		6		8				
Mvmt Sat Flow, veh/h		1806		170		1841		675				
Right-Turn Movement Data												
Assigned Mvmt		12		14		16		18				
Mvmt Sat Flow, veh/h		5		1441		1560		1013				
Left Lane Group Data												
Assigned Mvmt		0	5	0	7	0	1	0	3			
Lane Assignment			L		L		L					

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

Lanes in Grp	0	1	0	1	0	1	0	0
Grp Vol (v), veh/h	0	10	0	150	0	7	0	0
Grp Sat Flow (s), veh/h/ln	0	540	0	1353	0	1004	0	0
Q Serve Time (g_s), s	0.0	0.5	0.0	3.4	0.0	0.1	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	9.0	0.0	3.8	0.0	4.6	0.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	540	0	1353	0	1004	0	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	16.4	0.0	5.3	0.0	16.4	0.0	0.0
Perm LT Serve Time (g_u), s	0.0	7.9	0.0	4.9	0.0	12.0	0.0	0.0
Perm LT Q Serve Time (g_ps), s	0.0	0.5	0.0	3.4	0.0	0.1	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Lane Grp Cap (c), veh/h	0	356	0	428	0	598	0	0
V/C Ratio (X)	0.00	0.03	0.00	0.35	0.00	0.01	0.00	0.00
Avail Cap (c_a), veh/h	0	584	0	817	0	1023	0	0
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	9.4	0.0	13.0	0.0	6.4	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	9.4	0.0	13.5	0.0	6.4	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.02	0.00	0.04	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Middle Lane Group Data

Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment	T							
Lanes in Grp	0	0	0	0	0	1	0	0
Grp Vol (v), veh/h	0	0	0	0	0	647	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	1841	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	8.5	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	8.5	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	938	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	1717	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0

HCM 6th Signalized Intersection Capacity Analysis

1: Gas Sta Drwy/Willow Rd & Ayer Rd (Rt 2A)

03/12/2018

3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Right Lane Group Data

Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R		T+R		R		T+R	
Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	396	0	38	0	363	0	25
Grp Sat Flow (s), veh/h/ln	0	1810	0	1611	0	1560	0	1688
Q Serve Time (g_s), s	0.0	4.4	0.0	0.6	0.0	4.8	0.0	0.4
Cycle Q Clear Time (g_c), s	0.0	4.4	0.0	0.6	0.0	4.8	0.0	0.4
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.00	0.00	0.89	0.00	1.00	0.00	0.60
Lane Grp Cap (c), veh/h	0	923	0	264	0	795	0	276
V/C Ratio (X)	0.00	0.43	0.00	0.14	0.00	0.46	0.00	0.09
Avail Cap (c_a), veh/h	0	1689	0	726	0	1455	0	787
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	4.9	0.0	11.5	0.0	5.0	0.0	11.4
Incr Delay (d2), s/veh	0.0	0.3	0.0	0.2	0.0	0.4	0.0	0.1
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	5.3	0.0	11.8	0.0	5.4	0.0	11.6
1st-Term Q (Q1), veh/ln	0.0	0.4	0.0	0.2	0.0	0.7	0.0	0.1
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.5	0.0	0.2	0.0	0.8	0.0	0.1
%ile Storage Ratio (RQ%)	0.00	0.03	0.00	0.01	0.00	0.16	0.00	0.02
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary

HCM 6th Ctrl Delay	7.0
HCM 6th LOS	A

Notes

* HCM 6th Edition computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
3: Bruce St & Ayer Rd (Rt 2A)

03/12/2018

Intersection						
Int Delay, s/veh	2.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	498	17	3	830	104	2
Future Vol, veh/h	498	17	3	830	104	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	40	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	5	0	0	4	0	0
Mvmt Flow	547	19	3	912	114	2
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	566	0	1019	557
Stage 1	-	-	-	-	557	-
Stage 2	-	-	-	-	462	-
Critical Hdwy	-	-	4.1	-	6.6	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.8	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1016	-	250	534
Stage 1	-	-	-	-	578	-
Stage 2	-	-	-	-	607	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1016	-	249	534
Mov Cap-2 Maneuver	-	-	-	-	249	-
Stage 1	-	-	-	-	576	-
Stage 2	-	-	-	-	607	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0		31	
HCM LOS					D	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	252	-	-	1016	-	
HCM Lane V/C Ratio	0.462	-	-	0.003	-	
HCM Control Delay (s)	31	-	-	8.6	-	
HCM Lane LOS	D	-	-	A	-	
HCM 95th %tile Q(veh)	2.3	-	-	0	-	