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OF HARTFORD
COLLEGE OF ENGINEERING,
TECHNOLOGY, AND ARCHITECTURE

Traffic Operations Modeling of Connecticut Roundabouts

FINAL REPORT

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16. Abstract

The Connecticut Department of Transportation (ConnDOT) has constructed four roundabouts in the State of Connecticut within the past ten years. VISSIM, a microscopic traffic simulation software program was utilized to analyze roundabout during their design phase. This project has collected a variety of traffic data at the roundabouts using Miovision Technologies. A large sample size of field data was analyzed to achieve accurate and statistically significant results. The research investigated a series of simulation parameters as calibration factors for describing driver behaviors at roundabouts. A VISSIM simulation of existing roundabouts was built to compare both queue length and travel time as predicted from simulation with measured field data. In the end, this project identified VISSIM input variables most critical to accurate modeling; summarized the recommended parameter values; and, provided recommendations for roundabout traffic operations modeling.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

DISCLAIMER

This report does not constitute a standard, specification or regulation. The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the views of the Connecticut Department of Transportation or the Federal Highway Administration.

ACKNOWLEDGEMENTS

This report was prepared by the University of Hartford, in cooperation with the University of Connecticut, the Connecticut Department of Transportation, the United States Department of Transportation, and Federal Highway Administration. The opinions, findings and conclusions expressed in the publication are those of the author(s) and not necessarily those of the Connecticut Department of Transportation or the Federal Highway Administration.

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CHAPTER 1 INTRODUCTION

1.1. BACKGROUND

The Connecticut Department of Transportation (ConnDOT) has constructed four roundabouts in the State of Connecticut within the past ten years at the following locations:

- Ellington, CT. The Ellington roundabout, locally known as “Five Corners”, was the first five-leg roundabout on a State-maintained road (Route 74 and Route 286).
- Killingworth, CT, located at the intersection of Route 80 and Route 81.
- Salem, CT, located at the intersection of Route 85 and Route 82.
- West Haven, CT, located at the intersection of Route 162 and Route 705 (Ocean Avenue and Jones Hill Road).

ConnDOT utilized VISSIM traffic simulation software when designing these roundabouts. VISSIM is a microscopic simulation model designed by PTV AG, Germany to study traffic operations of freeways, surface streets and basic transit systems. Traffic flow at all four roundabouts has been satisfactory. Indeed, queue lengths appear to be much lower than predicted by the VISSIM model.

The levels of service (LOS) at these four intersections appear to be better than predicted by the VISSIM model. It is necessary to investigate whether the parameters (default values) used by ConnDOT are too conservative and possibly resulting in an overdesigned roundabout. To make a direct comparison of actual and modeled performance, traffic characteristics and geometric features of the roundabouts need to be collected. Then, VISSIM are calibrated by refining inputs and parameters to attain agreement between observed and modeled conditions.

1.2. OBJECTIVES OF THIS PROJECT

The objectives of this project are two-fold. The first is to understand traffic operational and geometric characteristics of roundabouts, particularly on how driver behavior affect roundabout performance. Second, the project is aimed to improve planning and design of roundabouts in Connecticut by refining operational analyses with VISSIM. Specifically, “this study will identify VISSIM input variables most critical to accurate modeling and recommend VISSIM calibration factors as well as provide other recommendations for roundabout traffic operations modeling.”

1.3. RESEARCH RESULTS AND IMPLEMENTATION

The results of the study can be implemented in the following ways:

- Improved traffic operations modeling by using more accurate parameters in the model.
- Improved roundabout design by using more accurate model results.

The data and analysis of the project provides better understanding of roundabout traffic operations modeling. The results will improve the design of future roundabouts in Connecticut

and provide decision makers with insights on the relationship between various choices (e.g., number of lanes) and future performance.

The results of the study are in the form of: (1) an interim report that describes the findings to date; and, (2) a final report that summarizes the finding of the data collection and analysis. The researchers are aware of ConnDOT's need for transfer value to other intersections where roundabouts may be utilized and will provide recommendations for roundabout traffic operations modeling. Drafts of the interim and final reports were submitted to ConnDOT and the research team has addressed any comments received from ConnDOT. These results are available for ConnDOT to use in future roundabout design projects.

The results of the study will be used by ConnDOT in the VISSIM modeling for future roundabout design in the State of Connecticut.

1.4. TASKS AND REPORT ORGANIZATION

The research was conducted in seven tasks. Detailed descriptions of each task are provided in the remainder of this section.

Task 1 – Collect and Process Data (Completed)

In this task, the University of Hartford (UofH) research team developed a data collection plan and conducted the field measurements (video recording and observations) on all four study sites. A variety of traffic operational characteristics are extracted from video footages. Data analysis are also performed to achieve statistical significance.

Task 2 – Simulate Geometric and Traffic Conditions (Completed)

The research team built a VISSIM simulation network of existing roundabouts and modeled operations using observed vehicle traffic characteristics including geometry, volumes, vehicle composition, driver critical gaps, speed etc.

Task 3 – Compare Simulated and Observed Performance (Completed)

In this task, two performance measures – queue length and travel time of vehicles from simulation were compared with field data. Based on it, the research team investigated the sensitivities of some calibration parameters and studied how calibration factors representing driver behavior can affect roundabout performance. The factors considered in this study include the driver critical gap, approach speed, min. headway distance, circulating speed and reduced speed on an entering approach.

Task 4 – Prepare Interim Report and Convene Review Meeting (Completed)

During this task the PI prepared an interim report summarizing the work conducted for the study to state. The PI presented the research process and findings to the ConnDOT project

panel and solicit their inputs. The research team continued to work on the remaining tasks after completion of this task with the ConnDOT's approval.

Task 5 – Recommendations for Applying VISSIM to Connecticut Roundabouts (Completed)

In this task, the research team identified VISSIM input variables most critical to accurate modeling, recommend VISSIM calibration factors and provide other recommendations for roundabout traffic operational modeling. A table summarizing the recommended parameter values for simulation modeling of Connecticut roundabouts was also provided.

Task 6 – Prepare Final Report (Completed)

In task 6 the PI prepared the final report of the report, which documented the entire research efforts. The report summarized research method and results and contained necessary appendices of traffic data, analysis and results. The PI has revised the report to address the comments received, and submitted the final version before the completion date of the contract.

The report is organized as follows. Chapter 2 describes the data collection effort while Chapter 3 summarizes the data analysis procedures and results. Chapter 4 discusses the simulation of geometric and traffic conditions of roundabouts, and compare the simulation results with field measurements. Chapter 5 presents the calibration of simulation parameters. Conclusions and recommendations are provided in Chapter 6.

CHAPTER 2 DATA COLLECTION

The preliminary data collection plan was discussed among key members of the project team including Connecticut Department of Transportation (ConnDOT) members and the Principal Investigator (PI) in early May 2013. In developing the data collection plan, the research team applied principles of experimental design to obtain a representative sample of data to the extent possible. The main data source of this project is the videos recorded in the field to capture traffic movements at roundabouts using Miovision Technologies (Miovsion, 2013). The research team solicited the assistance of the ConnDOT Policy and Planning/Roadway Information Systems Unit in the field data collection and processing. Practical field constraints (such as the feasibility of placing video cameras at a particular site) were considered as well.

The data collection methods, the types of data collected, and the number and type of data collection sites are discussed in the remainder of this chapter.

2.1. STUDY SITES

This project considered the data collection on all four roundabouts located in the state of Connecticut, as shown in Figure 2-1. Each roundabout has its own unique geometric and traffic operational characteristics and was designed and built for difference reasons. Figure 2-1 provides a list of the roundabout sites along with their general information and characteristics. The West Haven roundabout, located at the intersection of Route 162 and S.R. 705 (Ocean Avenue and Jones Hill Road), was installed, in part, due to several pedestrian incidents and one fatal accident involving a motorcyclist which had previously occurred at the intersection. The roundabout was, therefore, chosen for safety enhancement and capacity improvement. The Killingworth roundabout, located at the intersection of Route 80 and Route 81, had excess pavement which allowed higher speeds and conflicts between entering and circulating traffic. A truck apron was installed so the vehicles with a large turning radius could properly maneuver. The Ellington roundabout, locally known as “Five Corners”, was the first five-leg roundabout on a State-maintained road (Route 74 and Route 286). The roundabout was chosen to reduce congestion and improve the flow of traffic during peak hours. The Salem roundabout was recently built to improve safety at the junction of Route 85 and Route 82. There were a large number of head-on turning accidents at the intersection and at the driveway just east of the intersection on Route 85, including one fatal accident at this intersection. The roundabout would eliminate this type of maneuver.

	Salem Roundabout	West Haven Roundabout
		
Type	**4-leg multi-lane Roundabout**	**3-leg Small Roundabout**
Co-ordinates	**41.476615, -72.264749**	**41.236, -72.986083**
Address	**Intersection of Route 85 and Route 82 1 Hartford Road, Salem, CT 06420**	**Intersection Route 162 and S.R. 705 (Ocean Ave and Jones Hill Road) 65 Ocean Ave, West Haven, CT 06516**
Google Map Link	**https://www.google.com/maps/place/Connecticut+85/@41.4764257,-72.26396,302m/data=!3m1!1e3!4m2!3m1!1s0x89e6699922cdb123:0xe3a361e376f32df7**	**https://www.google.com/maps/place/Connecticut+162/@41.2361573,-72.9856071,225m/data=!3m1!1e3!4m2!3m1!1s0x89e875b577d07bf3:0x813a41305663e96e**

	Ellington Roundabout	Killingworth Roundabout
		
Type	**5-leg Roundabout**	**4-leg Roundabout**
Co-ordinates	**41.867391, -72.492664**	**41.358036, -72.565106**
Address	**Intersection of Route 74 and Route 286 1 Wappingwood Road, Vernon, CT 06066**	**intersection of Route 80 and Route 81 Killingworth, CT**
Google Map Link	**https://www.google.com/maps/place/Connecticut+74/@41.8673354,-72.491893,382m/data=!3m1!1e3!4m2!3m1!1s0x89e6f4ed572c6dc5:0xed420d2ac46586f7**	**https://www.google.com/maps/@41.3579236,-72.5657045,302m/data=!3m1!1e3**

Figure 2-1. Study Sites of Connecticut Roundabouts

2.3. DATA REQUIREMENTS

The project aims to evaluate traffic operations at existing roundabouts in Connecticut and use field data to improve modeling with the VISSIM traffic simulation software. To achieve this objective, certain traffic operational characteristics and geometric features of roundabouts need to be gathered. The data obtained at each site includes variables used as input in the analysis (such as demand, geometry), variables to be used for calibration purposes (such as driver critical gap, speed and follow-up headway) and performance measures (such as vehicle queues and travel time. The values of the calibration variables were compared to model outputs to assess the quality of the models and re-calibrate them when necessary. Table 2-1 summarizes the data requirements of the project.

Table 2-1. Data Requirements

Traffic Demand		- Vehicle volumes from originating to departing legs for each approach during a peak hour (vph) - % heavy vehicles by each approach during a peak hour - Pedestrian crossing on each approach during a peak hour
Calibration Factors	Driver Behavior – Critical Gap	- Statistics (mean and standard deviation) of a representative sample of critical gaps at a roundabout
	Speed	- Average travel speed of circulating vehicles (mph)
	Saturation Flow Rate	- Average discharge saturation flow rate on an entering approach (v/h/ln)
Performance Measures		- Vehicle travel time from entry to exit (seconds) - Vehicle queue length (# of vehicles)
Geometric Characteristics		- Number of lanes for each approach - Channelization - Lane widths - Presence of left and right turn pockets along with their length - Grades - Circle radius
Traffic Control Devices		- Stop control on each approach, if any - Yield control on each approach, if any

2.2. DATA COLLECTION

On a regular four-leg intersection, turning movements (left, right and through) are usually easily identified on the entering approaches where each movement is classified by different lanes. However, at a roundabout, identifying trajectories of vehicles including entry point and exit point is necessary to understand different turning movements. It becomes obvious that the measurement of such trajectories (or trace of vehicles entering and exiting on different approaches at the same time) in the field can be time consuming and labor intensive.

The research team conducted a video recording of traffic movements at roundabouts during typical weekdays, from which turning movements can be extracted using an automated software service or by manual review. Miovision Technologies is a vendor to provide the required digital video collection equipment and data processing service. Miovision uses integrated camera hardware called a Scout Video Collection Unit (SVCU). As shown in Figure 2-1, the SVCU is mounted on existing poles on the side the road to capture a wide-angle view of traffic movements, which are then processed into traffic data using proprietary algorithms. The SCVU can be extended to 25' above the roadway for full view of a roundabout. The bottom-left picture on Figure 2-2 illustrates a typical SVCU video camera setup during data collection.

Working with the engineers of ConnDOT Policy and Planning/Roadway Information Systems Unit, the research team deployed SVCU technology and collect data at all four roundabouts in the summer of 2014. The data collection activities were firstly held on **Tuesday, May 20, 2014** and **Wednesday, May 21, 2014** mainly for acquiring traffic volume at all roundabouts. Each roundabout was recorded continuously for 36 to 48 hrs. Cameras were also set up at study sites to capture queue conditions in the beginning of June. In addition, cameras were deployed in a summer weekend – Saturday, July 19 and Sunday, July 20, 2014 at Salem roundabout to understand busy weekend traffic patterns. To minimize the distractions that could affect driver behaviors, the installation of SVCU technology were completed at least eight hours prior to the data collection period. No personnel and their vehicles were present within a visible distance of a roundabout while cameras are recording. It is reasonably expected that SVCU does not cause a distraction to drivers.

Figures 2-3, 2-4, 2-5, and 2-6 have shown the camera locations at each roundabout. The two black dots in the map indicated the camera positions, which were suggested by Miovision and also re-adjusted in the field to get a proper view of the roundabout. The location of cameras were also carefully chosen to minimize the number of cameras needed for a roundabout. Typically one camera was set up to capture the circulating activity of a roundabout and the other for entry activities of busy legs.

The video was recorded for about 2 days and only the peak hours are analyzed in this study. The videos of four peak hours (**7 a.m. to 9 a.m. & 4 p.m. to 6 p.m.**) of each roundabout for both days were processed by Miovision. For the purpose of validation of the Miovision traffic data results particularly on left turns, the research team manually measured turning movements from video footages on some approaches. Details are provided in Chapter 3 Data Analysis.

Figure 2-2. Miovision Camera and Video Setup for Data Collection

Figure 2-3. Miovision Camera Setup at Salem Roundabout

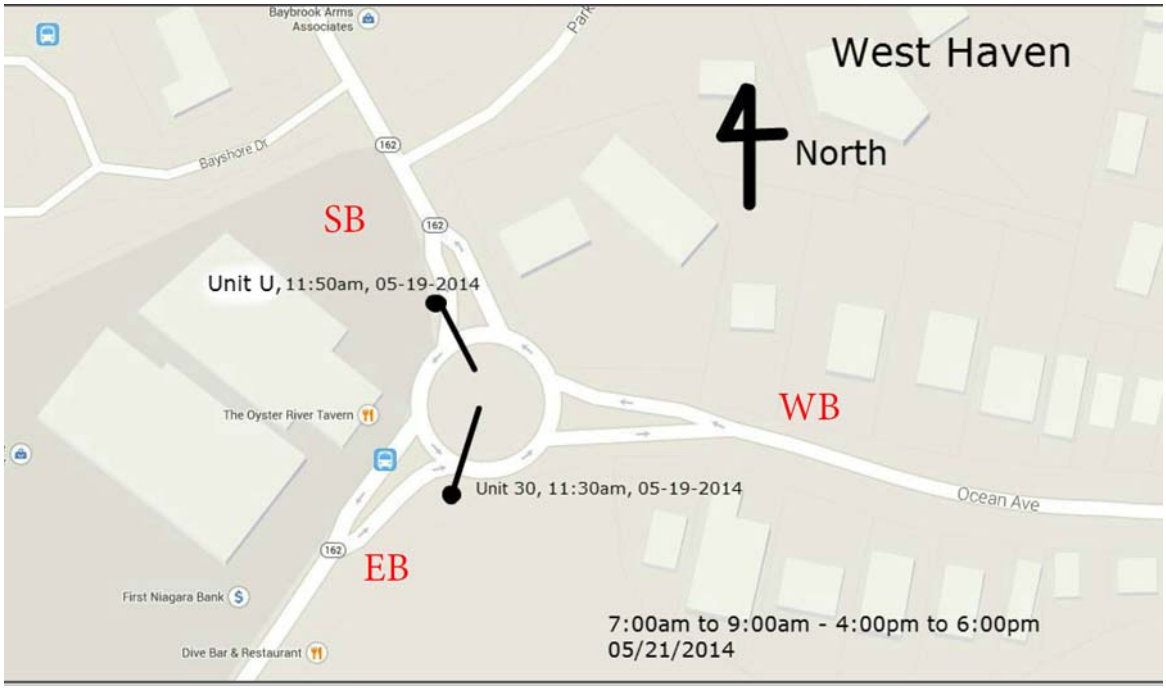

Figure 2-4. Miovision Camera Setup at West Haven Roundabout

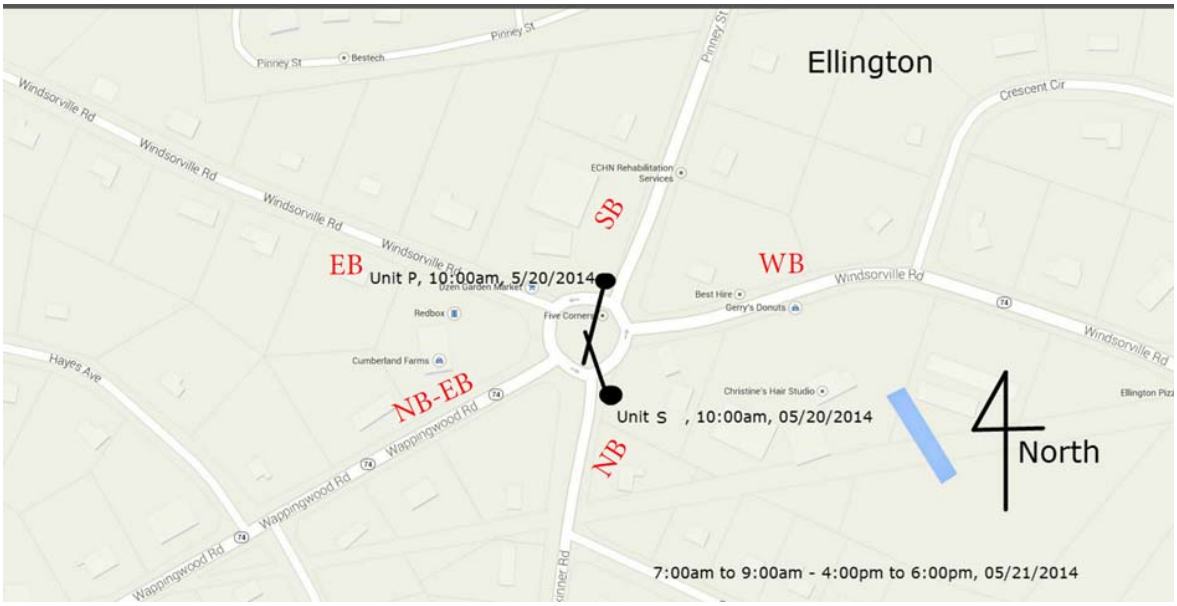

Figure 2-5. Ellington Roundabout Camera Setup

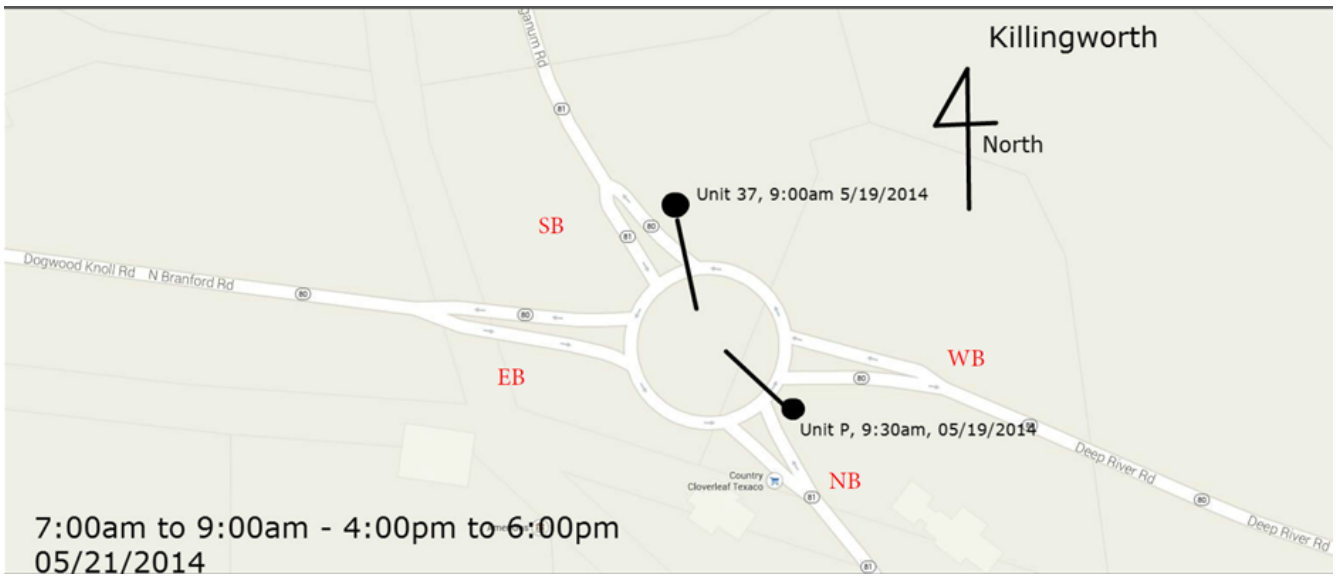

Figure 2-6. Killingworth Roundabout Camera Setup

and provide decision makers with insights on the relationship between various choices (e.g., number of lanes) and future performance.

The results of the study are in the form of: (1) an interim report that describes the findings to date; and, (2) a final report that summarizes the finding of the data collection and analysis. The researchers are aware of ConnDOT's need for transfer value to other intersections where roundabouts may be utilized and will provide recommendations for roundabout traffic operations modeling. Drafts of the interim and final reports will be submitted to ConnDOT and the research team will address any comments received from ConnDOT. These results will be available for ConnDOT to use in future roundabout design projects.

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Google Map Link	**https://www.google.com/maps/place/Connecticut+85/@41.4764257,-72.26396,302m/data=!3m1!1e3!4m2!3m1!1s0x89e6699922cdb123:0xe3a361e376f32df7**	**https://www.google.com/maps/place/Connecticut+162/@41.2361573,-72.9856071,225m/data=!3m1!1e3!4m2!3m1!1s0x89e875b577d07bf3:0x813a41305663e96e**

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Google Map Link	**https://www.google.com/maps/place/Connecticut+74/@41.8673354,-72.491893,382m/data=!3m1!1e3!4m2!3m1!1s0x89e6f4ed572c6dc5:0xed420d2ac46586f7**	**https://www.google.com/maps/@41.3579236,-72.5657045,302m/data=!3m1!1e3**

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2.3. DATA COLLECTION

On a regular four-leg intersection, turning movements (left, right and through) are usually easily identified on the entering approaches where each movement is classified by different lanes. However, at a roundabout, identifying trajectories of vehicles including entry point and exit point is necessary to understand different turning movements. It becomes obvious that the measurement of such trajectories (or trace of vehicles entering and exiting on different approaches at the same time) in the field can be time consuming and labor intensive.

The research team conducted a video recording of traffic movements at roundabouts during typical weekdays, from which turning movements can be extracted using an automated software service or by manual review. Miovision Technologies is a vendor to provide the required digital video collection equipment and data processing service. Miovision uses integrated camera hardware called a Scout Video Collection Unit (SVCU). As shown in Figure 2-1, the SVCU is mounted on existing poles on the side the road to capture a wide-angle view of traffic movements, which are then processed into traffic data using proprietary algorithms. The SCVU can be extended to 25' above the roadway for full view of a roundabout. The bottom-left picture on Figure 2-2 illustrates a typical SVCU video camera setup during data collection.

Working with the engineers of ConnDOT Policy and Planning/Roadway Information Systems Unit, the research team deployed SVCU technology and collect data at all four roundabouts in the summer of 2014. The data collection activities were firstly held on **Tuesday, May 20, 2014** and **Wednesday, May 21, 2014** mainly for acquiring traffic volume at all roundabouts. Each roundabout was recorded continuously for 36 to 48 hrs. Cameras were also set up at study sites to capture queue conditions in the beginning of June. In addition, cameras were deployed in a summer weekend – Saturday, July 19 and Sunday, July 20, 2014 at Salem roundabout to understand busy weekend traffic patterns. To minimize the distractions that could affect driver behaviors, the installation of SVCU technology were completed at least eight hours prior to the data collection period. No personnel and their vehicles were present within a visible distance of a roundabout while cameras are recording. It is reasonably expected that SVCU does not cause a distraction to drivers.

Figures 2-3, 2-4, 2-5, and 2-6 have shown the camera locations at each roundabout. The two black dots in the map indicated the camera positions, which were suggested by Miovision and also re-adjusted in the field to get a proper view of the roundabout. The location of cameras were also carefully chosen to minimize the number of cameras needed for a roundabout. Typically one camera was set up to capture the circulating activity of a roundabout and the other for entry activities of busy legs.

The video was recorded for about 2 days and only the peak hours are analyzed in this study. The videos of four peak hours (**7 a.m. to 9 a.m. & 4 p.m. to 6 p.m.**) of each roundabout for both days were processed by Miovision. For the purpose of validation of the Miovision traffic data results particularly on left turns, the research team manually measured turning movements from video footages on some approaches. Details are provided in Chapter 3 Data Analysis.

Figure 2-2. Miovision Camera and Video Setup for Data Collection

Figure 2-3. Miovision Camera Setup at Salem Roundabout

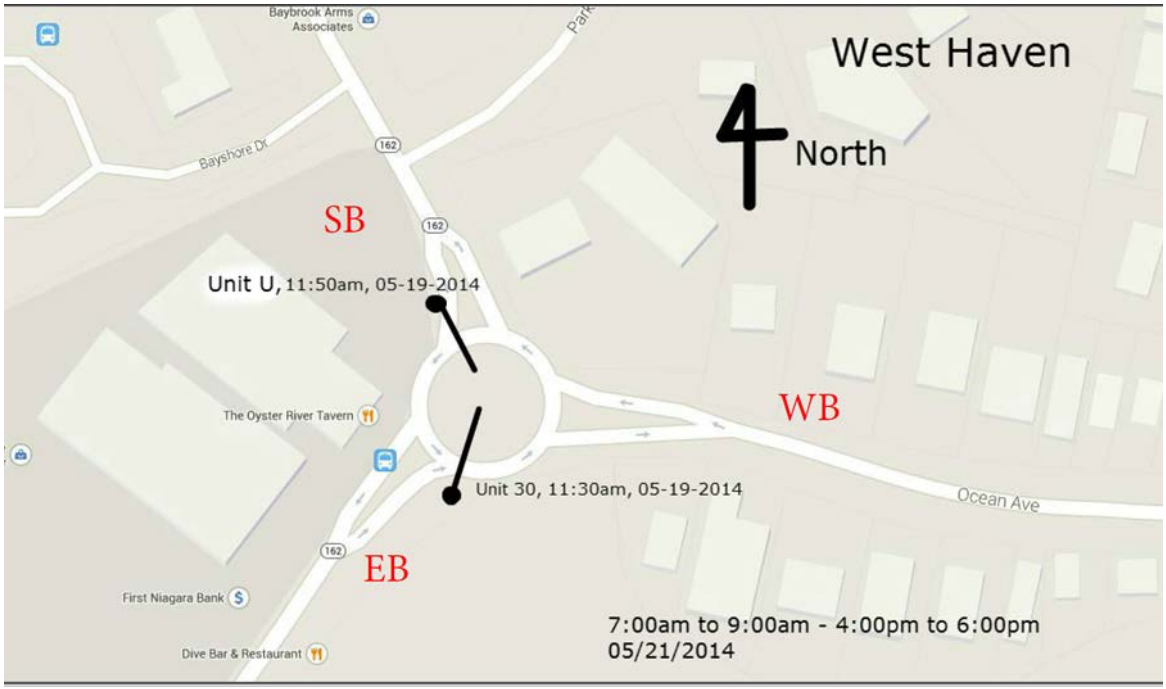


Figure 2-4. Miovision Camera Setup at West Haven Roundabout

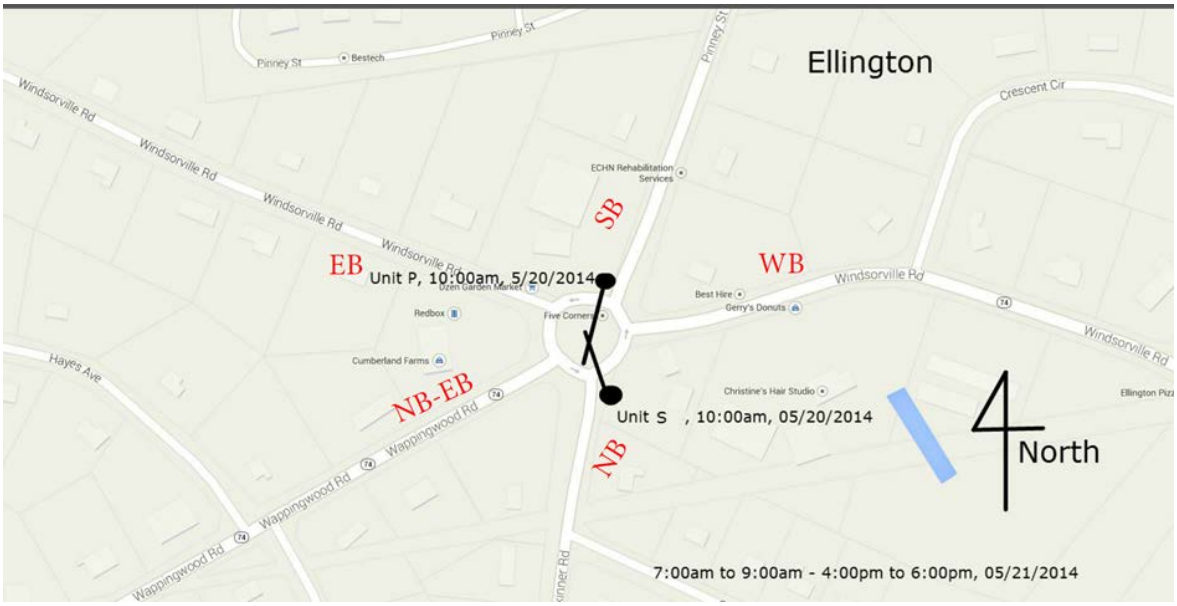


Figure 2-5. Ellington Roundabout Camera Setup

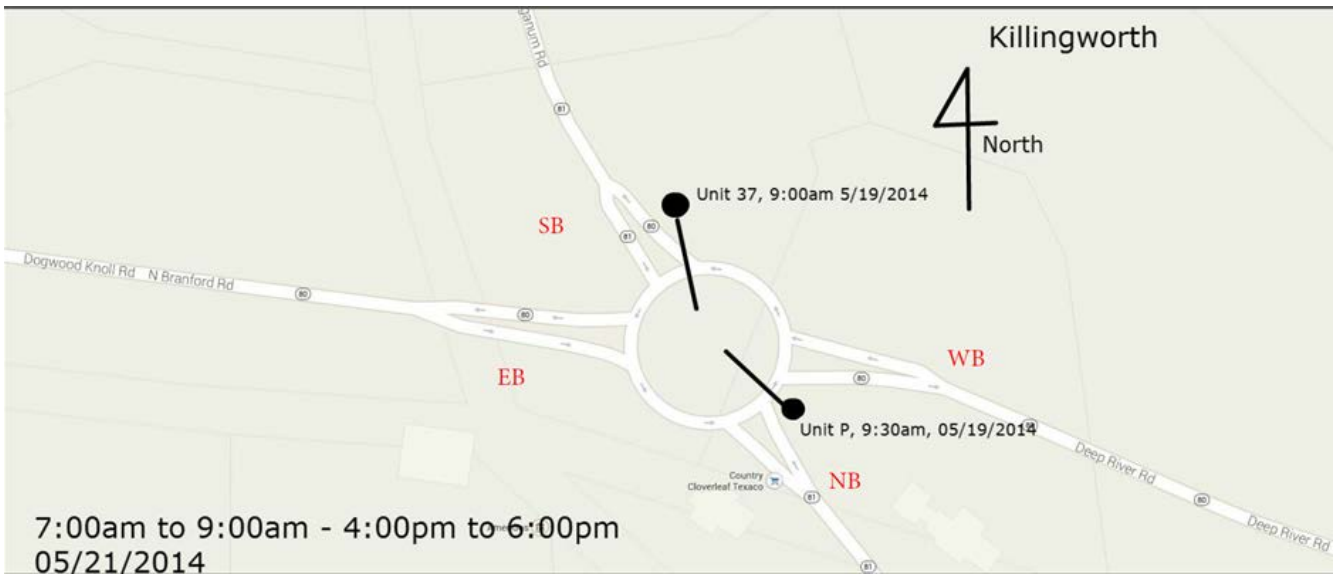


Figure 2-6. Killingworth Roundabout Camera Setup

Additional Camera Deployment for Capturing Queues

After viewing video of each roundabout from week one data collection (May 20 and May 21, 2014), it was determined that specific legs of each roundabout with longer queues are needed to be further monitored. Figure 2-7 presents a summary of additional camera deployment at Salem, West Have and Ellington roundabouts during the week of June 2, 2014. The video footages of Killingworth roundabout have already provided a good resolution of queue development on northbound and southbound, so the Killingworth was excluded from secondary monitoring.

At West Haven roundabout, Camera #1 was placed on the same utility pole located near Jones Hills road as originally placed during week one monitoring, however instead of focusing on viewing entire roundabout camera was focused on the west bound Ocean Ave. approach as to capture queue. Camera #2 was placed at proposed location, utility in front of gas station, also located on Jones Hill Road. Camera was orientated as to capture North Bound New Haven Ave. approach. Recording was set to begin at 12 noon 6/2/14 and record for 48 hours.

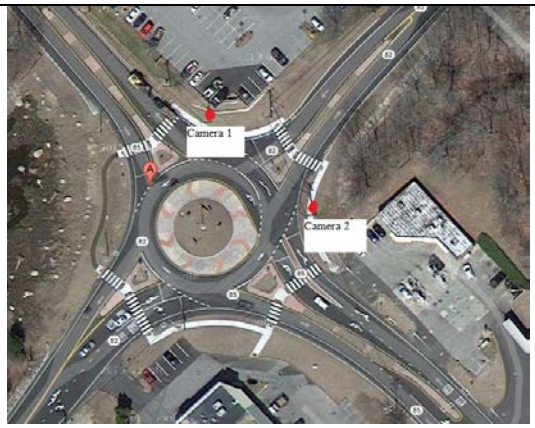
At the study site of Ellington roundabout, camera #1 was set up on utility pole near Skinner Road, approximately 20 ft in front of initial location, to capture the queue of the south bound approach piney street. Cameras 2 and 3 were set on town signage located in the center of roundabout. Camera #2 was orientated as to capture queues of both north-west bound Wappingwood Road and north bound Skinner street. The final camera was focused on capturing queue of west bound Windsorville Road. (Due to the weather condition, one of cameras changed its position, but with the other two surviving cameras, we still had the data needed.)

It was initially proposed that three cameras be used to monitor Salem roundabout, however due to technical difficulties only two cameras were usable. Camera #1 was set up near East Bound Route 85 to capture the queue of both northbound route 82 and westbound Route 85. The view of both approaches from this location was very good. Camera #2 was set up as a secondary view of northbound Route 82.

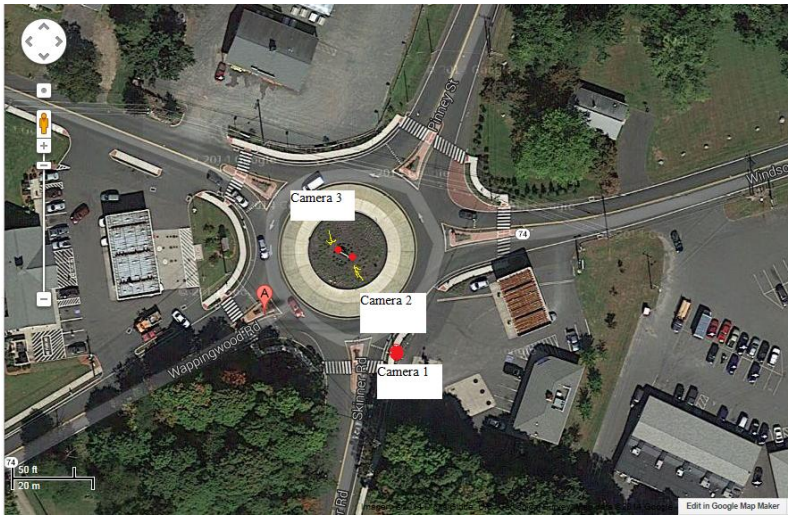
Geometric Characteristics

The geometric characteristics of each site were collected using a combination of aerial photographs and field measurements. Microstation CAD design of each roundabout was also obtained from the ConnDOT. Figures 2-9, 2-10, 2-11 and 2-12 presents the geometry of each roundabout with the name of each approach and direction marked.

West Haven Roundabout



Salem Roundabout



Ellington Roundabout

Figure 2-7. Additional Camera Deployment for Capturing Queues

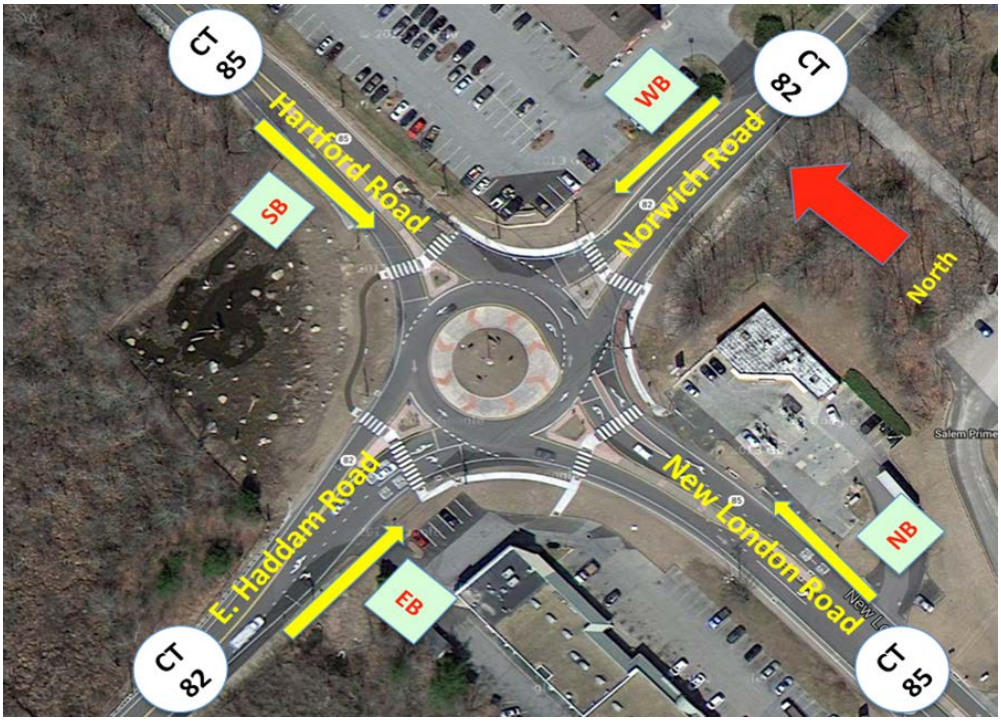


Figure 2-8. Salem Roundabout (Courtesy of Google Maps)

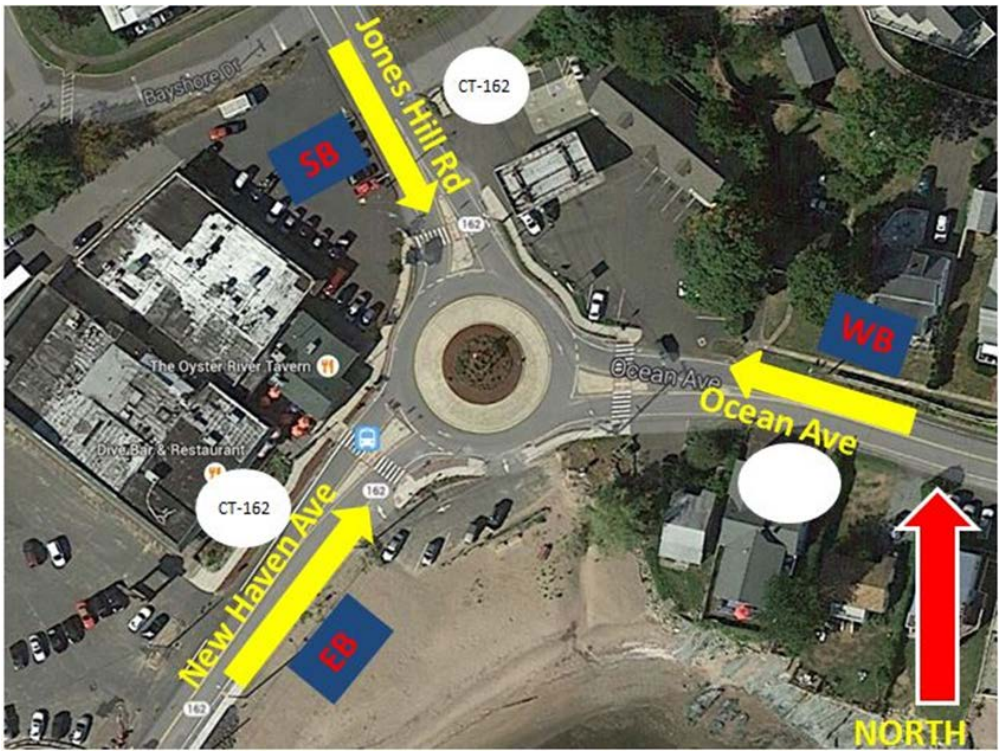


Figure 2-9. West Haven Roundabout (Courtesy of Google Maps)

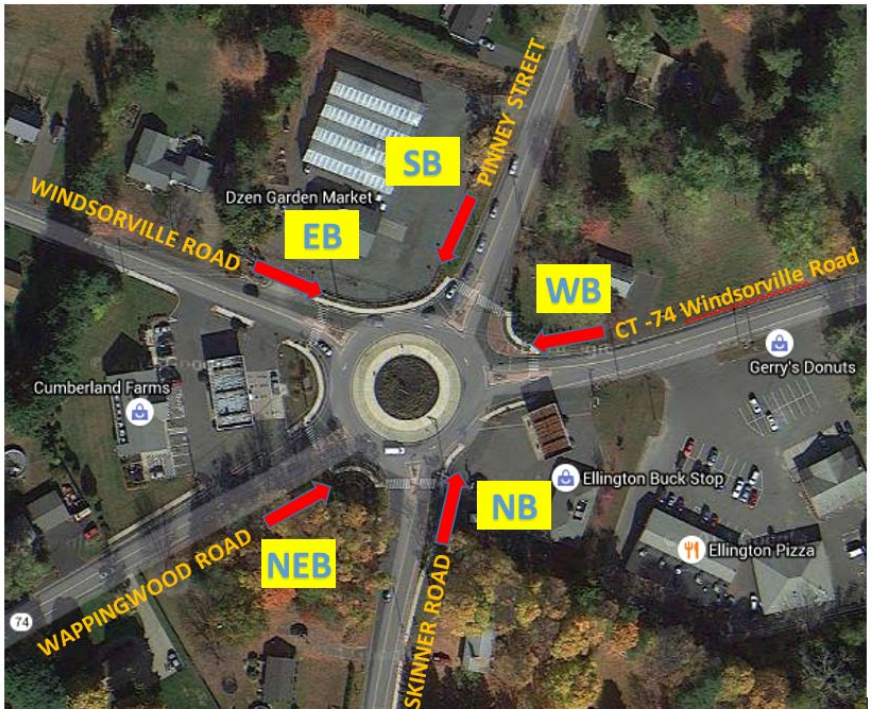


Figure 2-10. Ellington Roundabout (Courtesy of Google Maps)

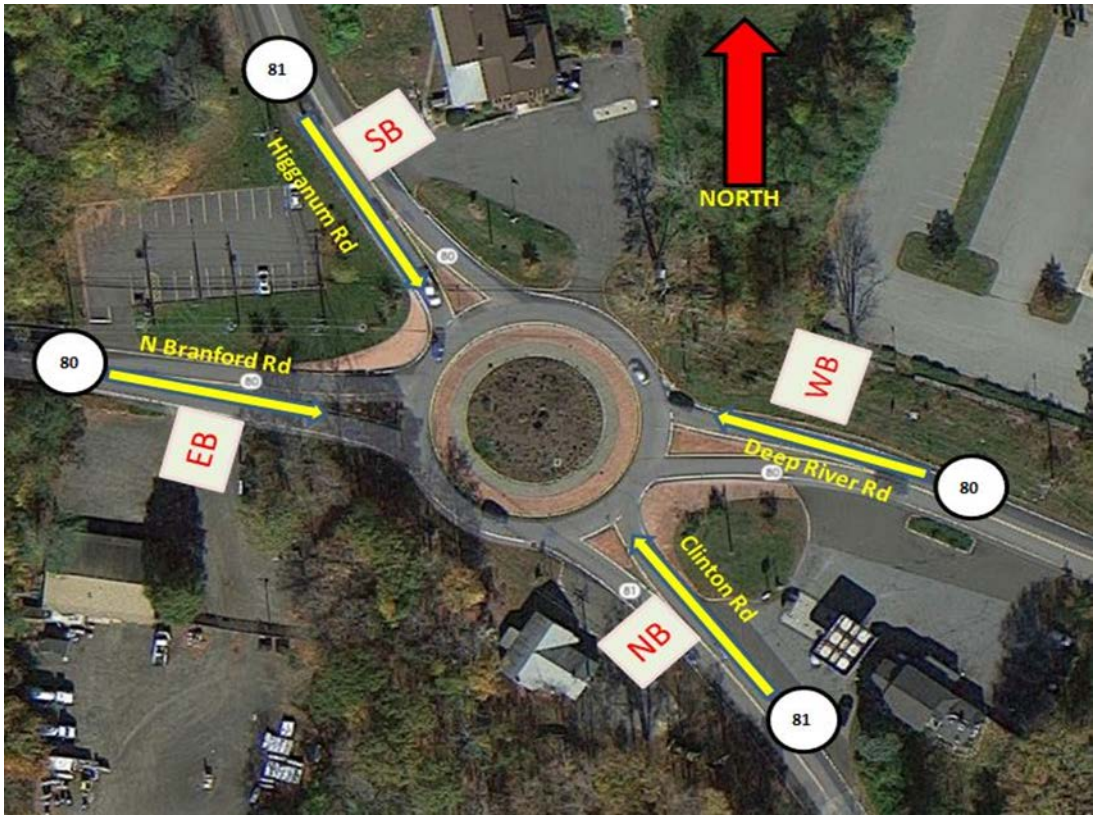


Figure 2-11. Killingworth Roundabout (Courtesy of Google Maps)

CHAPTER 3 DATA ANALYSIS

This chapter discusses the traffic operational data collected from the field, provides an overview of the data analysis process, and describes the methods used to extract the selected performance measures from the field data.

At each roundabout, videos of four peak hours were used for the data analysis purpose. They are two hours in the morning peak hour (7:00 a.m. – 8:00 a.m.) and two hours in the afternoon peak hour (4 a.m. – 6:00 p.m.) during a weekday (Tuesday, May 20, 2014 or Wednesday, May 21, 2014). The research team consisting of the PI and a group of graduate and undergraduate students of University of Hartford (UofH) observed the video footages and conducted data analysis in the UofH civil engineering computer laboratory during the summer and fall of 2014. Four (4) data analysis worksheets were designed in MS Excel to capture the vehicle activities and extract them into the traffic data needed for the project. They are "Vehicle Arrival and Exit Time Tracking Worksheet" (Table 3-1), "Driver Gap Acceptance Worksheet" (Table 3-12), "Follow-up Headway Worksheet" (Table 3-17)" and "Queue Worksheet" (Table 3-21). The function and results of each worksheets are discussed in the corresponding sections of the Chapter. A computational engine in MS Excel was also developed to estimate the critical gap. This research applied an extensive large sample size of data to achieve accurate results and statistical significance. In a total, more than 20,000 vehicles at all four roundabouts were tracked and studied to comprehend their driver behavior.

This Chapter is organized as follows. Section 3.1 describes the total number of vehicles tracked and peak hour volumes of turning movements at four roundabouts. The results of Miovision data and laboratory manually measured data are also compared. Section 3.2 illustrates the calculation of vehicle circulating speed. Section 3.3 and 3.4 discuss the estimation of two important driver behavior calibration factors - critical gap and follow-up time. Two methods (Maximum Likelihood and Raff method) are presented to determine the minimum gap. This is followed by the analysis of two performance measures – travel time and vehicle queues in the Section 3.5 and Section 3.6, respectively.

3.1. VEHICLE ARRIVAL AND EXIT TIME TRACKING

The "Vehicle Arrival and Exit Time Tracking" worksheet was firstly designed to capture the activity of each vehicle during two (2) traffic peak hours in the morning and two (2) peak hours in the afternoon. As presented in Table 3-1, each vehicle is tracked and recorded its arrival time at the stop-line of an entering approach of a roundabout and leaving time at the exit leg. The turning direction of each vehicle is recorded. Vehicle travel distance in terms of left turn, through and right turn were measured along the circulating trajectory of a roundabout using Google map and later Microstation CAD design plan provided by ConnDOT. The latter was selected to give more accurate measurement. Travel time and vehicle circulating speed are subsequently calculated in the worksheet for each vehicle. The number of turning movement are also sorted in the worksheet. Their results are further discussed in the corresponding sections of this Chapter.

The research team performed an extensive data retrieval from the videos and applied a substantial large sample size of data to achieve accurate results and statistical significance. In a total, more than 20,000 vehicles at all four roundabouts were tracked and studied to comprehend their driver behavior at roundabouts. Table 3-2 shows the number of vehicles captured at each roundabout during the four (4) peak hour period of time. “5 Corners” Ellington roundabout has the largest volume (> 6000) while the smaller West Haven roundabout accommodates (about 3600) vehicles. Salem and Killingworth each carries more than 5,000 vehicles.

Table 3-1. Vehicle Arrival and Exit Time Tracking Worksheet

Date of Recording	Salem - NB (New London Road)					Google Based Data			Microstation Based Data		
		Movement	Arrival	Exit	Travel Time	Distance (ft)	Speed (sec/ft)	Speed (m/h)	Distance (ft)	Speed (sec/ft)	Speed (m/h)
May 21st (7 a.m. - 9 a.m.) & May 20th (4p.m. - 6 p.m.)	1	left	7:00:16	7:00:27	0:00:11	294	26.73	18.22	251	22.82	15.56
	2	left	7:00:23	7:00:33	0:00:10	294	29.40	20.04	251	25.10	17.11
	3	left	7:00:26	7:00:36	0:00:10	294	29.40	20.04	251	25.10	17.11
	4	left	7:00:46	7:00:59	0:00:13	294	22.62	15.42	251	19.31	13.16
	5	left	7:00:51	7:01:01	0:00:10	294	29.40	20.04	251	25.10	17.11
	6	left	7:00:55	7:01:04	0:00:09	294	32.67	22.27	251	27.89	19.01
	7	left	7:00:57	7:01:06	0:00:09	294	32.67	22.27	251	27.89	19.01
	8	left	7:00:59	7:01:10	0:00:11	294	26.73	18.22	251	22.82	15.56
	9	left	7:01:09	7:01:19	0:00:10	294	29.40	20.04	251	25.10	17.11
	10	left	7:01:10	7:01:21	0:00:11	294	26.73	18.22	251	22.82	15.56
	11	right	7:01:21	7:01:23	0:00:02	85	42.50	28.98	55	27.50	18.75
	12	left	7:01:36	7:01:45	0:00:09	294	32.67	22.27	251	27.89	19.01
	13	left	7:02:17	7:02:25	0:00:08	294	36.75	25.06	251	31.38	21.39
	14	left	7:02:20	7:02:29	0:00:09	294	32.67	22.27	251	27.89	19.01
	15	left	7:02:24	7:02:34	0:00:10	294	29.40	20.04	251	25.10	17.11
	16	right	7:02:37	7:02:40	0:00:03	85	28.33	19.32	55	18.33	12.50
	17	right	7:02:45	7:02:48	0:00:03	85	28.33	19.32	55	18.33	12.50
	18	left	7:03:41	7:03:50	0:00:09	294	32.67	22.27	251	27.89	19.01
	19	left	7:03:43	7:03:50	0:00:07	294	42.00	28.64	251	35.86	24.45
	20	left	7:03:46	7:03:56	0:00:10	294	29.40	20.04	251	25.10	17.11
	21	left	7:03:49	7:03:58	0:00:09	294	32.67	22.27	251	27.89	19.01
	22	left	7:03:50	7:04:00	0:00:10	294	29.40	20.04	251	25.10	17.11
	23	left	7:04:08	7:04:17	0:00:09	294	32.67	22.27	251	27.89	19.01
	24	left	7:04:46	7:04:54	0:00:08	294	36.75	25.06	251	31.38	21.39
	25	left	7:05:14	7:05:24	0:00:10	294	29.40	20.04	251	25.10	17.11
	26	through	7:05:16	7:05:21	0:00:05	141	28.20	19.23	149	29.80	20.32
	27	through	7:05:19	7:05:24	0:00:05	141	28.20	19.23	149	29.80	20.32

28	left	7:05:22	7:05:30	0:00:08	294	36.75	25.06	251	31.38	21.39
29	through	7:05:24	7:05:27	0:00:03	141	47.00	32.04	149	49.67	33.86
30	left	7:05:25	7:05:32	0:00:07	294	42.00	28.64	251	35.86	24.45
31	through	7:05:27	7:05:31	0:00:04	141	35.25	24.03	149	37.25	25.40
32	left	7:05:30	7:05:37	0:00:07	294	42.00	28.64	251	35.86	24.45
33	right	7:06:02	7:06:06	0:00:04	85	21.25	14.49	55	13.75	9.37
34	through	7:06:05	7:06:10	0:00:05	141	28.20	19.23	149	29.80	20.32
35	right	7:06:07	7:06:09	0:00:02	85	42.50	28.98	55	27.50	18.75
36	right	7:06:13	7:06:14	0:00:01	85	85.00	57.95	55	55.00	37.50
37	left	7:06:16	7:06:24	0:00:08	294	36.75	25.06	251	31.38	21.39
38	left	7:06:19	7:06:27	0:00:08	294	36.75	25.06	251	31.38	21.39
39	left	7:06:21	7:06:29	0:00:08	294	36.75	25.06	251	31.38	21.39
40	left	7:06:49	7:06:58	0:00:09	294	32.67	22.27	251	27.89	19.01
41	left	7:06:53	7:07:01	0:00:08	294	36.75	25.06	251	31.38	21.39
….										
…										
2309	through	5:56:45	5:56:51	0:00:06	141	23.50	16.02	149	24.83	16.93
2310	left	5:57:19	5:57:28	0:00:09	294	32.67	22.27	251	27.89	19.01
2311	through	5:57:56	5:58:04	0:00:08	141	17.63	12.02	149	18.63	12.70
2312	left	5:58:20	5:58:29	0:00:09	294	32.67	22.27	251	27.89	19.01
2313	through	5:58:40	5:58:48	0:00:08	141	17.63	12.02	149	18.63	12.70
2314	right	5:59:18	5:59:21	0:00:03	85	28.33	19.32	55	18.33	12.50
2315	right	5:59:45	5:59:48	0:00:03	85	28.33	19.32	55	18.33	12.50

Table 3-2. Total Number of Vehicles Tracked in Video Footages

Salem		
Wednesday, May 21st, 2014 (7 a.m. - 9 a.m.) & **Tuesday, May 20th, 2014** (4 p.m. - 6 p.m.)	Sum of Right	1918
	Sum of Left	1840
	Sum of Through	1780
	Total	**5538**

West Haven		
Tuesday, May 20th, 2014 (7 a.m. - 9 a.m.) & **Tuesday, May 20th, 2014** (4 p.m. - 6 p.m.)	Sum of Right	1822
	Sum of Left	1773
	Total	**3595**

Ellington		
Wednesday, May 21st, 2014 (7 a.m. - 9 a.m.) & **Tuesday, May 20th, 2014** (4 p.m. - 6 p.m.)	Sum of Right	1117
	Sum of Left	965
	Sum of Through	2069
	Sum of Bear Right	961
	Sum of Hard Right	224
	Sum of Bear Left	718
	Sum of Hard Left	67
	Total	**6121**

Killingworth		
Tuesday, May 20th, 2014 (7 a.m. - 9 a.m.) & **Tuesday, May 20th, 2014** (4 p.m. - 6 p.m.)	Sum of Right	1010
	Sum of Left	849
	Sum of Through	3221
	Total	**5080**

3.2. PEAK HOUR VOLUME

The peak hour videos were processed by Miovision to retrieve turning movement volumes. To validate their results, roundabouts and their approaches at either AM or PM peak hours were randomly chosen for this purpose. Their data were sorted in Vehicle Arrival and Exit Time Tracking Worksheet to determine the turning movements of each 15-minute time interval. AM and PM peak hours were also identified for each roundabout, as shown in Table 3-1.

Table 3-3. Peak Hours of Data Collection and Analysis

	Salem		**West Haven**	
	Data Collection Period	Peak Hour	Data Collection Period	Peak Hour
AM	7 – 9 am Wed., May 21, 2014	7 – 8 am Wed., May 21, 2014	7 – 9 am Tue., May 20, 2014	7 – 8 am Tue., May 20, 2014
PM	4 – 6 pm Tue. May 20, 2014	4:30 – 5:30 pm Tue. May 20, 2014	7 – 9 am Tue., May 20, 2014	4:45 – 5:45 pm Tue., May 20, 2014
	Ellington		**Killingworth**	
	Data Collection Period	Peak Hour	Data Collection Period	Peak Hour
AM	7 – 9 am Wed., May 21, 2014	7 – 8 am Wed., May 21, 2014	7 – 9 am Tue., May 20, 2014	7 – 8 am Tue., May 20, 2014
PM	4 – 6 pm Wed. May 21, 2014	4:30 – 5:30 pm Wed. May 21, 2014	7 – 9 am Tue., May 20, 2014	4:30 – 5:30 pm Tue., May 20, 2014

Table 3-4 and Table 3-5 present the AM peak hour volume of Salem roundabout measured in our lab and determined by the Miovision algorithm, respectively. Both tables have shown similar results although the left turn movement presents a small discrepancy. The comparisons on some approaches on Killingworth and West Haven Roundabout have also exhibited the differences are also small. With this validation, the research team decided to apply Miovision data as the traffic demand for this project to reduce potential human error in field data collection.

The details of turning movement volumes at each 15-min interval during the AM peak hour and PM peak hour and percentage of heavy vehicles of each roundabout are presented in Appendix A. The data from Mivision and our lab (if available) are also provided in the Appendix.

Table 3-4. A.M. Peak Hour Traffic Volume – Field Data (Salem Roundabout)

Date of Recording	Time (a.m.)	Salem											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	69	18	13	4	43	4	35	12	8	1	10	90
	7:15 – 7:30	50	14	12	3	46	3	31	16	1	5	20	91
	7:30 – 7:45	58	26	9	0	39	3	21	13	6	1	9	115
	7:45 – 8:00	56	19	0	0	41	2	17	11	0	4	18	101
	Total	233	77	34	7	169	12	104	52	15	11	57	397

Table 3-5. A.M. Peak Hour Traffic Volume – Miovision Data (Salem Roundabout)

Date of Recording	Time (a.m.)	Salem											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	72	19	9	4	45	3	39	11	7	1	10	92
	7:15 – 7:30	65	16	10	4	45	3	29	16	1	4	20	96
	7:30 – 7:45	79	28	13	0	41	3	21	13	7	1	10	115
	7:45 – 8:00	72	25	8	0	40	2	17	11	0	4	24	96
	Total	288	88	40	8	171	11	106	51	15	10	64	399

Note: Percentage of Heavy vehicles observed in MIOVISION is NB (6%), SB (3%), WB (3%), EB (5%).

The traffic volume data also identified the percentage of heavy vehicles for each roundabout as presented below. The percentage of heavy vehicles is no more than 6% for all roundabouts.

Salem:
AM: 3-6% NB (6%), SB (3%), WB (3%), EB (5%)
PM: 1-3% NB (1%), SB (2%), WB (3%), EB (2%)

Ellington:
AM: 3-5% NB (3%), SB (3%), WB (5%), EB (4%), NEB (3%)
PM: 1-3% NB (0%), SB (1%), WB (3%), EB (1%), NEB (1%)

West Haven:
AM: 2% SB (2%), WB (2%), EB (2%)
PM: 0-2% SB (0%), WB (2%), EB (1%)

Killingworth:
AM: 1-6% NB (5%), SB (6%), WB (6%), EB (4%)
PM: 2-3% NB (3%), SB (2%), WB (3%), EB (2%)

The following table highlights some critical movements of each roundabout which carry higher volumes and experience more queues and often congestion during peak hours.

Table 3-6. A Summary of Critical Approaches and Turning Movements

Roundabout	AM	PM
Salem	NB left + through, EB right + through	NB left + through, EB right + through
Ellington	SB through + left +bear right EB through	NB left +through SB through + left + bear right NEB bear left
West Haven	WB	EB WB
Killingworth	NB left + through SB left + through	NB left + through SB left + through

3.3. CIRCULATING SPEED

Based on the Worksheet of Vehicle Arrival and Exit Time Tracking, each vehicle's arrival and exit times are observed and gathered from the video footages. Vehicle travel distance is measured on the circulating path in terms of left, through and right turning movement of each approach at each roundabout. Circulating speed of each vehicle is calculated from travel time and travel distance. Instead of using simple arithmetic mean of speeds, the circulating speed of each turning movement is calculated as a volume-weighted average value of all approaches. The more traffic an approach carries, the greater its contribution to the average speed.

Tables 3-7, 3-8, 3-9 and 3-10 presents minimum, maximum and average circulating speed of each turn movement at each roundabouts. All roundabouts have shown their circulating speed is at or lower than 20 mph. Salem roundabout has a slightly higher circulating speed on average than other roundabouts. Ellington, West Have and Killingworth roundabout all have an average speed about 15 mph with the lowest 13 mph and the highest 18 mph. There is no clear pattern on which movement travels faster or slower than others. It is believed that a combination of geometry and volume of a roundabout can have a good impact to the circulating speed.

Left, through and right turning movements are usually easily identified at an entering approach of a roundabout. However, Ellington roundabout is a 5-leg intersection and the naming of each turning movement can be obscure. In this research, we defined a turning movement based on whether the turn is geometrically acute or obtuse when viewed on a campus. Hard right or hard left turning movement is defined when the turn is an acute angle ($<90^0$). Bear right or bear left turning movement is when the turn is an obtuse angel ($>90^0$). Table 3-11 illustrates the turning movement designation of Ellington.

Table 3-7. Salem Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Wednesday, May 21st, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	17.28	23.27	20.27	458
		Left	17.77	19.77	18.77	355
		Through	18.58	24.46	21.52	355
		Combined (R+L+TH)	17.82	22.57	**20.20**	**1168**
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. - 5:30 p.m.	Right	10.94	15.81	13.37	478
		Left	17.00	18.77	17.89	248
		Through	16.74	21.95	19.35	357
		Combined (R+L+TH)	14.24	18.51	**16.38**	**1083**

Table 3-8. Ellington Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Wednesday, May 21st, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	13.70	18.91	16.30	655
		Left	13.82	20.76	17.29	390
		Through	14.44	19.79	17.11	433
		Combined (R+L+TH)	13.95	19.65	**16.80**	**1478**
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. - 5:30 p.m.	Right	12.29	17.55	14.92	560
		Left	15.76	20.33	18.04	479
		Through	12.54	18.16	15.35	544
		Combined (R+L+TH)	13.43	18.60	**16.01**	**1583**

Note:

- Right movement is based on the turning movement of right, bear right and hard right
- Left movement is based on the turning movement of left, bear left and hard left

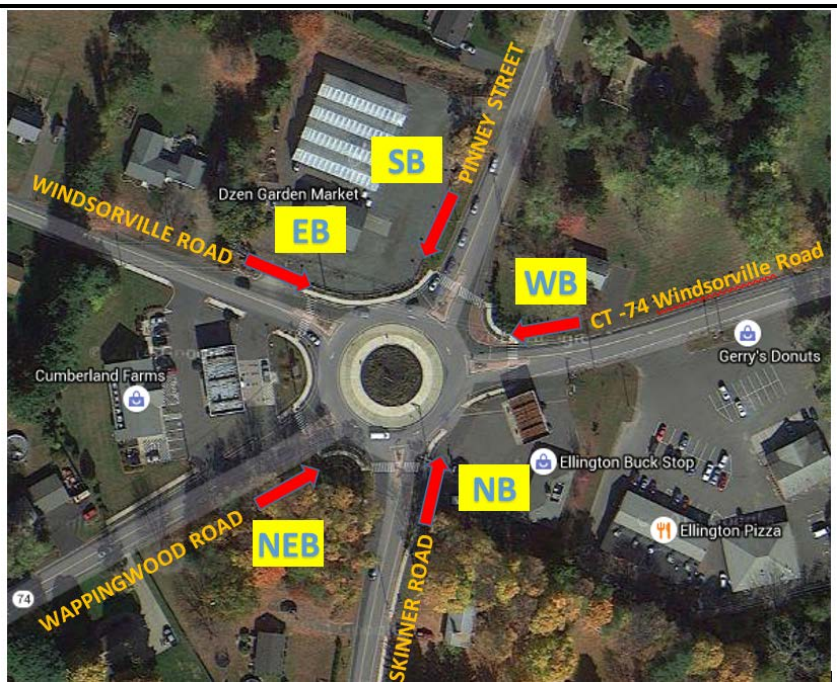
Table 3-9. West Haven Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Tuesday, May 20th, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	13.51	18.66	16.08	310
		Left	13.68	15.76	14.72	314
		Combined (R+L)	13.04	17.20	**15.40**	**624**
Tuesday, May 20th, 2014 (4:45 p.m. - 5:45 p.m.)	4:45 p.m. - 5:45 p.m.	Right	14.21	18.95	16.58	619
		Left	13.80	15.64	14.72	577
		Combined (R+L)	14.01	17.35	**15.68**	**1196**

Table 3-10. Killingworth Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Tuesday, May 20th, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	12.68	19.47	16.07	219
		Left	12.93	17.97	15.45	198
		Through	12.48	15.09	13.78	799
		Combined (R+L+TH)	12.59	16.35	**14.47**	**1216**
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. - 5:30 p.m.	Right	12.67	16.26	14.46	284
		Left	14.16	19.76	16.96	250
		Through	12.88	18.78	15.83	900
		Combined (R+L+TH)	13.06	18.45	**15.76**	**1434**

Table 3-11. Ellington Roundabout Turning Movement Designation



Approach	Movement	Designation
NB	NB - WB	Right
	NB - SB	Through
	NB - EB	Left
	NB - NEB	Hard Left
NEB	NEB - NB	Hard Right
	NEB - WB	Bear Right
	NEB – SB	Bear Left
	NEB - EB	Hard Left
WB	WB - SB	Right
	WB - EB	Through
	WB - (NB - EB)	Bear Left
	WB - NB	Left
SB	SB - EB	Right
	SB - (NB - EB)	Bear Right
	SB - NB	Through
	SB - WB	Left
EB	EB (NB - EB)	Hard Right
	EB - NB	Right
	EB - WB	Through
	EB - SB	Left

3.4. CRITICAL GAP

The **critical gap**, or **critical headway**, is defined in HCM (2010) as the minimum time interval in the major-street traffic stream that allows intersection entry for one minor street vehicle. The same term is also used in this research to analyze traffic operations of roundabouts where yield signs are present. The critical gap is the minimum headway that provides a gap in circulating traffic that would allow one vehicle to enter the roundabout flow. Together with follow-up headway, they are the two most important parameters used in traffic modeling of roundabouts according to HCM.

a) Data Extraction, Driver Gap Behavior Scenario and Sample Size

The recorded videos provide four (4) peak hour analysis period for each roundabout. A MS Excel Worksheet of Driver Gap Acceptance was developed to record driver behaviors at the entrance of a roundabout, as shown in Table 3-12. The subject vehicle's arriving time, direction of turning and type of vehicle are entered to the worksheet. The object vehicles if present on circulating lane are also recorded. The available gaps and decisions of the subject vehicle (YES to merge to the roundabout, or NO to wait for the next gap) are required in the worksheet. Additionally, if an upstream entering vehicle affected the subject vehicle's decision, then its information is also recorded.

Generally speaking, drive gap acceptance behavior at a roundabout is divided into three scenarios:

Scenario A: The subject vehicle accepted an infinite gap without rejecting any gap. This usually occurs when there is no vehicle present on the circulating path and the subject vehicle entered the roundabout easily.

Scenario B: The subject vehicle accepted a large gap available without rejecting any gap. The situation often occurs when there is few vehicles present on the circulating path or vehicles exit from the upstream leg to create large time headways.

Scenario C: The subject vehicle accepted a gap after having at least rejected one gap.

The snapshots in Figure 3-1 demonstrate a Scenarios C case on Salem southbound during a.m. peak hour period. The subject vehicle (red arrow pointed) is at the stopline of southbound entrance at 8:20:48am. The vehicle continuously rejected gaps and let 6 vehicles passing through till he/she perceived an available gap (produced by a white light truck in Figure 3-1(g)) is sufficient large and safe to allow him/her to merge. He/she made a Yes decision and entered the roundabout at 8:21:21am, as shown on Figure 3-1 (h).

This research and many other studies in the topic of gap acceptance assume that a single driver's headway ranges between his or her rejected headway and the accept headway. Therefore, the data from Scenario C are the most important resource for gap analysis. In the following sections, two method – Maximum Likelihood and Raff method are applied to estimate

critical gaps. Nevertheless, this project still collected the data of Scenarios A and Scenario B as supplementary information of gap acceptance behavior.

For all four roundabouts, there are 3259 drivers (18 percent of the total number of vehicles) who were observed in Scenario C. A large number of data were collected for Scenario A – 8566 vehicles (47%) and followed with 6567 vehicles (46%) obtained for Scenarios B. In spite of the fact that Scenario C occurred less frequently in all roundabout, our study has collected and maintained an extensive data pool to achieve more accurate estimation. The details of statistics of field gap data of each approach at each roundabout during a.m. peak period and p.m. peak period are presented in Table 3-13.

Table 3-12. Driver Gap Acceptance Worksheet

Salem Roundabout - EB												
Scenario	Subject Vehicle					Driver Gap Acceptance						
						Circulating Vehicle Present		Upstream Entering Vehicle		Object Vehicle		
	# Veh	Arrival	Movement	# Veh	Veh Type	Veh	Circ Veh Type	Upstream	Upstream Veh Type	Exit	Gap (sec)	Decision
A (Infinite Gap)	1	7:00:18	right		Bus/Truck	No		No			INF	Yes
	2	7:00:42	right		Bus/Truck	No		No			INF	Yes
	3	7:01:18	right		Pick-up/SUV/Van	No		No			INF	Yes
	4	7:01:24	left		Pick-up/SUV/Van	No		No			INF	Yes
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
B (Large Gap)	1	7:00:07	right			Yes	Pick-up/SUV/Van			7:00:14	0:00:07	Yes
	2	7:00:29	right		Bus/Truck	Early Exit	Passenger Car			7:00:33	0:00:04	Yes
	3	7:01:00	right		Bus/Truck	Yes	Passenger Car			7:01:04	0:00:04	Yes
	4	7:01:03	right		Passenger Car	Yes	Passenger Car			7:01:06	0:00:03	Yes
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
C (Critical Gap) At least One Rejection	1	7:00:48	right		Pick-up/SUV/Van	Yes	Pick-up/SUV/Van			7:00:50	0:00:02	No
		7:00:50				Yes	Pick-up/SUV/Van			7:00:51	0:00:01	No
		7:00:51				No		No			INF	Yes
	2	7:01:58	right		Pick-up/SUV/Van	Yes	Passenger Car			7:02:01	0:00:03	No
		7:02:01				Yes	Passenger Car			7:02:06	0:00:05	Yes
	3	7:02:07	right		Pick-up/SUV/Van	Yes	Pick-up/SUV/Van			7:02:10	0:00:03	No
		7:02:10				Yes	Passenger Car			7:02:12	0:00:02	No
		7:02:12				Yes	Pick-up/SUV/Van			7:02:14	0:00:02	No
		7:02:14				Yes	Passenger Car			7:02:17	0:00:03	No
		7:02:17				Yes	Passenger Car			7:02:19	0:00:02	No
		7:02:19				Yes	Passenger Car			7:02:21	0:00:02	No
		7:02:21				Early Exit	Passenger Car			7:02:25	0:00:04	Yes
	4	7:03:36	left		Passenger Car	Yes	Pick-up/SUV/Van			7:03:37	0:00:01	No
		7:03:37				Yes	Passenger Car			7:03:39	0:00:02	No
		7:03:39				No		No			INF	Yes
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

a) Subject Vehicle (Red Arrow) Reject 1st Gap

b) Subject Vehicle (Red Arrow) Reject 2nd Gap

c) Subject Vehicle (Red Arrow) Reject 3rd Gap

d) Subject Vehicle (Red Arrow) Reject 4th Gap

Figure 3-1. Gap Acceptance Behavior (Scenario C)

e) Subject Vehicle (Red Arrow) Reject 5th Gap

f) Subject Vehicle (Red Arrow) Reject 6th Gap

g) Subject Vehicle (Red Arrow) Accepts the Gap

h) Subject Vehicle (Red Arrow) Merged to the Roundabout

Figure 3-1. Gap Acceptance Behavior (Scenario C) (cont'd)

Table 3-13. Summary of Field Gap Data
Salem Roundabout

Scenario	Driver Gap Acceptance Behaviors	EB		NB		SB		WB	
		AM May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)
C (Critical Gap) At least One Rejection	# of Drivers Accept an Infinite Gap	**69**	**34**	**15**	**16**	**44**	**51**	**55**	**57**
	# of Drivers Accept a Specific Gap	**22**	**48**	**5**	**4**	**21**	**48**	**5**	**48**
	# of Drivers Accept an Early Exits Gap	**37**	**40**	**22**	**34**	**4**	**11**	**0**	**27**
	# of Drivers	**128**	**122**	**42**	**54**	**69**	**110**	**60**	**132**
	# of Decision Points	**218**	**165**	**47**	**69**	**163**	**284**	**124**	**397**
A (Infinite Gap)	# of Drivers Accept an Infinite Gap	**372**	**120**	**282**	**444**	**208**	**140**	**197**	**130**
B (Large Gap)	# of Drivers Accept a Large Gap	**372**	**729**	**391**	**376**	**79**	**88**	**58**	**126**

Table 3-13. Summary of Field Gap Data (cont')
Ellington Roundabout

Scenario	Driver Gap Acceptance Behaviors	EB		NB		SB		WB		NEB	
		AM May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 21st, Wednesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)
C (Critical Gap) At least One Rejection	# of Drivers Accept an Infinite Gap	**51**	**135**	**21**	**37**	**132**	**174**	**17**	**7**	**32**	**15**
	# of Drivers Accept a Specific Gap	**50**	**45**	**30**	**107**	**15**	**33**	**27**	**43**	**63**	**35**
	# of Drivers Accept an Early Exits Gap	**40**	**2**	**21**	**67**	**19**	**15**	**26**	**39**	**49**	**13**
	# of Drivers	**141**	**182**	**72**	**211**	**166**	**222**	**70**	**89**	**144**	**63**
	# of Decision Points	**329**	**391**	**106**	**474**	**247**	**317**	**111**	**195**	**312**	**136**
A (Infinite Gap)	# of Drivers Accept an Infinite Gap	**107**	**312**	**110**	**232**	**764**	**563**	**173**	**159**	**91**	**165**
B (Large Gap)	# of Drivers Accept a Large Gap	**125**	**14**	**131**	**275**	**125**	**45**	**259**	**410**	**125**	**88**

Table 3-13. Summary of Field Gap Data (cont')
West Haven Roundabout

Scenario	Driver Gap Acceptance Behaviors	EB		SB		WB	
		AM May 20th, Tuesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 20th, Tuesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 20th, Tuesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)
C (Critical Gap) At least One Rejection	# of Drivers Accept an Infinite Gap	**6**	**13**	**42**	**39**	**31**	**31**
	# of Drivers Accept a Specific Gap	**0**	**4**	**7**	**9**	**2**	**27**
	# of Drivers Accept an Early Exits Gap	**4**	**11**	**3**	**21**	**1**	**37**
	# of Drivers	**10**	**28**	**52**	**69**	**34**	**95**
	# of Decision Points	**13**	**33**	**91**	**125**	**37**	**150**
A (Infinite Gap)	# of Drivers Accept an Infinite Gap	**233**	**430**	**231**	**348**	**453**	**237**
B (Large Gap)	# of Drivers Accept a Large Gap	**115**	**144**	**44**	**114**	**48**	**266**

Table 3-13. Summary of Field Gap Data
Killingworth Roundabout

Scenario	Driver Gap Acceptance Behaviors	EB		NB		SB		WB	
		AM May 20th, Tuesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 20th, Tuesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 20th, Tuesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)	**AM** May 20th, Tuesday, 2014 (7 – 9 a.m.)	**PM** May 20th, Tuesday, 2014 (4 – 6 p.m.)
C (Critical Gap) At least One Rejection	# of Drivers Accept an Infinite Gap	**16**	**8**	**25**	**20**	**37**	**31**	**56**	**93**
	# of Drivers Accept a Specific Gap	**20**	**66**	**21**	**10**	**27**	**49**	**23**	**32**
	# of Drivers Accept an Early Exits Gap	**32**	**64**	**17**	**33**	**57**	**137**	**12**	**8**
	# of Drivers	**68**	**138**	**63**	**63**	**121**	**217**	**91**	**133**
	# of Decision Points	**145**	**267**	**116**	**136**	**194**	**404**	**180**	**268**
A (Infinite Gap)	# of Drivers Accept an Infinite Gap	**171**	**209**	**354**	**420**	**207**	**137**	**243**	**324**
B (Large Gap)	# of Drivers Accept a Large Gap	**83**	**141**	**274**	**410**	**416**	**599**	**48**	**49**

b) Critical Gap Estimation

The critical gap or headway cannot be obtained directly from the recorded video time events. It is a stochastically distributed value and can only be determined by mathematical tools. The estimation of critical gaps at unsignalized intersections or roundabouts from traffic observation is one of the most difficult tasks in traffic engineering science. For estimating the critical gaps, statistical models or procedures are required. There exist many different models for estimating critical gaps. Among them, the maximum likelihood method by Troutbeck (1992) gives the best results according to Brilon and König (1997) and other researchers. This model is recommended for estimating the critical gaps in standard manuals for traffic engineering (e.g., HCM 2000). In practice, the most common models are that of Raff et al. (1950) and Troutbeck (1992).

This study employs two methods: the maximum likelihood methodology and Raff method to estimate the critical gap/headway. The concept, implementation and results of either method are presented in the following sections.

c) Maximum Likelihood Method

The maximum likelihood method is based on the fact that a driver's critical gap is greater than his or her largest rejected gap and smaller than his or her accepted gap. Troutbeck (1992) gave a procedure for estimating critical gaps based on the maximum likelihood techniques. For an accepted gap *a*, there is only a corresponding rejected gap *r* under consideration. The likelihood of a sample of n drivers' critical gap is between *a* and *r* is given by *F(a) –F(r)*.

$$L = \prod_{i=1}^{n} [F(a) - F(r)] \qquad (1)$$

F(a) and *F(r)* are the probability distribution functions of rejected and accepted gaps, respectively.

In the practice, the log-normal distribution is often used as the probability distribution function of the critical gaps. The maximization of the likelihood *L* can only be done using numerical and iteration techniques.

A computation engine in MS Excel was designed to apply the equation (1) in this rearch. The SOLVE function is used to estimate the statistics mean μ and standard deviation σ of the critical gap. As shown in Table 3-14 using Salem roundabout eastbound right turn as an example, the gap accepted and the largest rejected gap values of each driver were entered to the engine. The engine output mean critical gap μ and standard deviation σ of the critical gap.

The critical gaps were estimated for each turning movement of each approach at roundabouts. A summary of results of critical headway at four roundabout is presented in Table 3-15. For all four roundabouts, the values of critical headway is ranged 3.1 to 4.7 seconds. There is no clear trend on how the critical gap varies among left, through or right. The approaches with higher volume do show slighter smaller critical headway, such as Salem eastbound and Ellington northbound. The approaches with fewer volumes, but facing higher conflicting volume demonstrated the need of larger critical gap, such as Killingworth eastbound and westbound. Smaller roundabouts i.e., West Haven exhibited consistently larger critical gaps than other roundabouts. In addition, the conflicting circulating speed might have a negative correlation with critical headway. The increased circulating speed tends to decrease the critical headway as demonstrated in Salem roundabout. It means drivers tend to be more aggressive to accept smaller gaps when the circulating speed is higher.

Appendix E presents the data and estimation results of the critical gap in terms of each turning movement of each approach of all four roundabouts using maximum likelihood method.

Table 3-14. Critical Gap Computational Engine
Based on Maximum Likelihood Method
Salem Roundabout – EB – Right Turn Movement

A	B	C	D
Driver No.	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	5	3	-0.312966
2	4	3	-0.771753
3	4	2	-0.445201
4	4	3	-0.771753
5	4	3	-0.771753
6	6	5	-2.633083
7	5	3	-0.312966
8	5	3	-0.312966
9	4	2	-0.445201
10	4	2	-0.445201
11	7	2	-0.005544
12	5	3	-0.312966
13	5	3	-0.312966
14	4	2	-0.445201
15	7	3	-0.203368
16	4	3	-0.771753
17	6	4	-1.076080
18	10	4	-1.033034
19	5	2	-0.094565
20	4	2	-0.445201
…..			
…..			
…..			
…..			
68	5	3	-0.312966
69	4	3	-0.771753
70	5	1	-0.090863
71	5	3	-0.312966
80	6	3	-0.219237
81	5	3	-0.312966
82	10	1	-0.000005
83	2	1	-5.691522
84	8	2	-0.003664
85	10	3	-0.200737
86	5	2	-0.094565
87	3	2	-1.723203
88	4	2	-0.445201
Sum			-69.421780
Mean Critical Gap			**3.77528775**
Standard Deviation of the Critical Gap			**0.86096633**
Mean of the log of the Critical Gap			1.30312613
Standard Deviation of the log of the Critical Gap			0.22516872

Table 3-15. Critical Gap Results of Roundabouts
Based on Maximum Likelihood Method

Roundabout		Movement	Mean Critical Gap (Seconds)	Standard Deviation of the Critical Gap	Sample Size
Salem	EB	Right	3.775	0.861	88
		Left	3.069	0.154	6
		Through	3.848	1.082	22
	WB	Right	3.800	0.810	11
		Left	3.790	1.126	39
		Through	3.925	0.791	22
	NB	Right	3.698	0.200	9
		Left	3.612	1.182	33
		Through	3.848	1.009	14
	SB	Right	4.004	0.175	11
		Left	3.612	1.182	33
		Through	3.756	0.958	14
Ellington	EB	Hard Right	3.864	0.993	13
		Right	4.235	0.834	34
		Through	3.987	0.963	64
		Left	4.002	0.133	17
	WB	Right	3.190	0.958	47
		Through	3.349	1.074	42
		Bear Left	3.350	1.409	33
		Left	3.564	0.580	11
	NB	Right	3.770	0.859	26
		Through	3.724	0.996	143
		Left	4.067	0.866	51
	SB	Right	4.282	0.581	11
		Bear Right	4.185	0.759	29
		Through	3.746	0.485	22
		Left	4.114	0.611	16
	NEB	Hard Right	3.854	0.599	15
		Bear Right	4.051	0.911	51
		Bear Left	4.319	1.069	79
		Hard Left	3.484	0.897	5

Table 3-15. Critical Gap Results of Roundabouts (cont'd)
Based on Maximum Likelihood Method

Roundabout		Movement	Mean Critical Gap (Seconds)	Standard Deviation of the Critical Gap	Sample Size
West Haven	WB	Left	4.770	1.104	52
		Right	4.030	1.053	13
	EB	Left	3.454	0.540	8
		Right	4.078	1.138	11
	SB	Left	4.737	0.721	18
		Right	4.005	1.519	20
Killingworth	NB	Right	3.526	0.930	13
		Left	3.869	1.316	10
		Through	3.283	0.832	56
	SB	Right	4.043	0.844	38
		Left	3.920	0.813	33
		Through	4.038	1.081	168
	EB	Right	4.770	1.104	65
		Left	4.770	1.104	49
		Through	4.770	1.104	65
	WB	Right	4.234	0.800	24
		Left	4.025	0.156	10
		Through	3.854	0.710	25

d) **Raff Method**

Compared to maximum likelihood method, Raff method is easier to implement. Greenshields (1947) made early reference to critical gap referring to it as the "acceptable average minimum gap". His definition of the critical gap is the gap that is accepted by 50 percent of drivers. This interpretation of critical gap was popularized by Raff in the late 1950's. His method of analysis of gap acceptance data, as shown below, is still one of the most common.

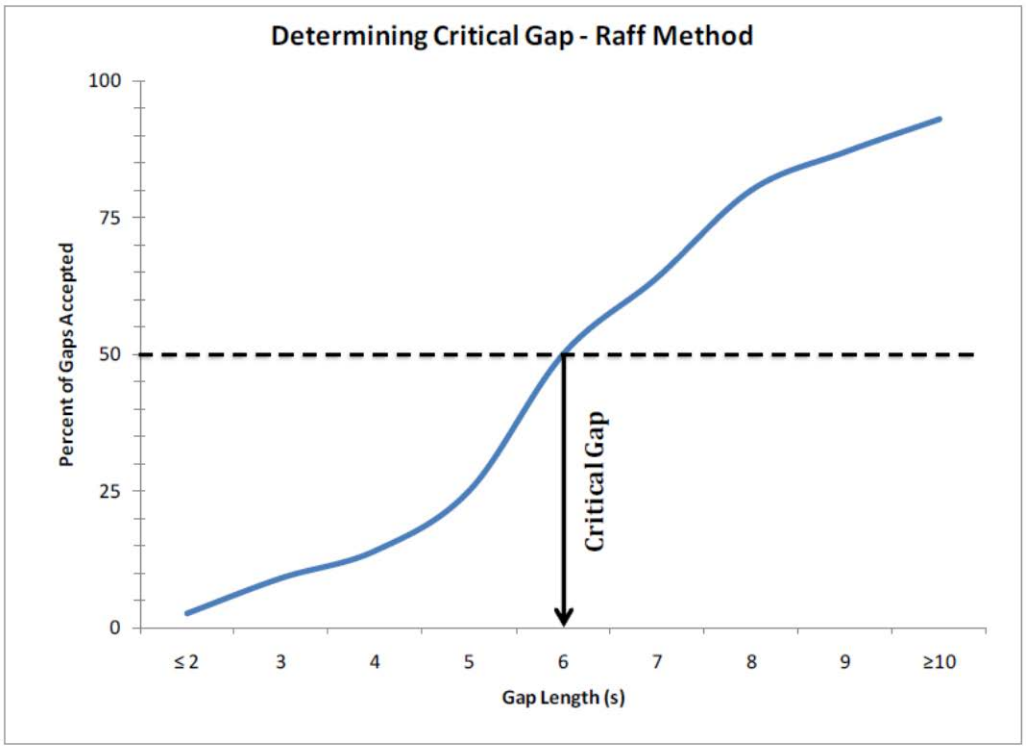


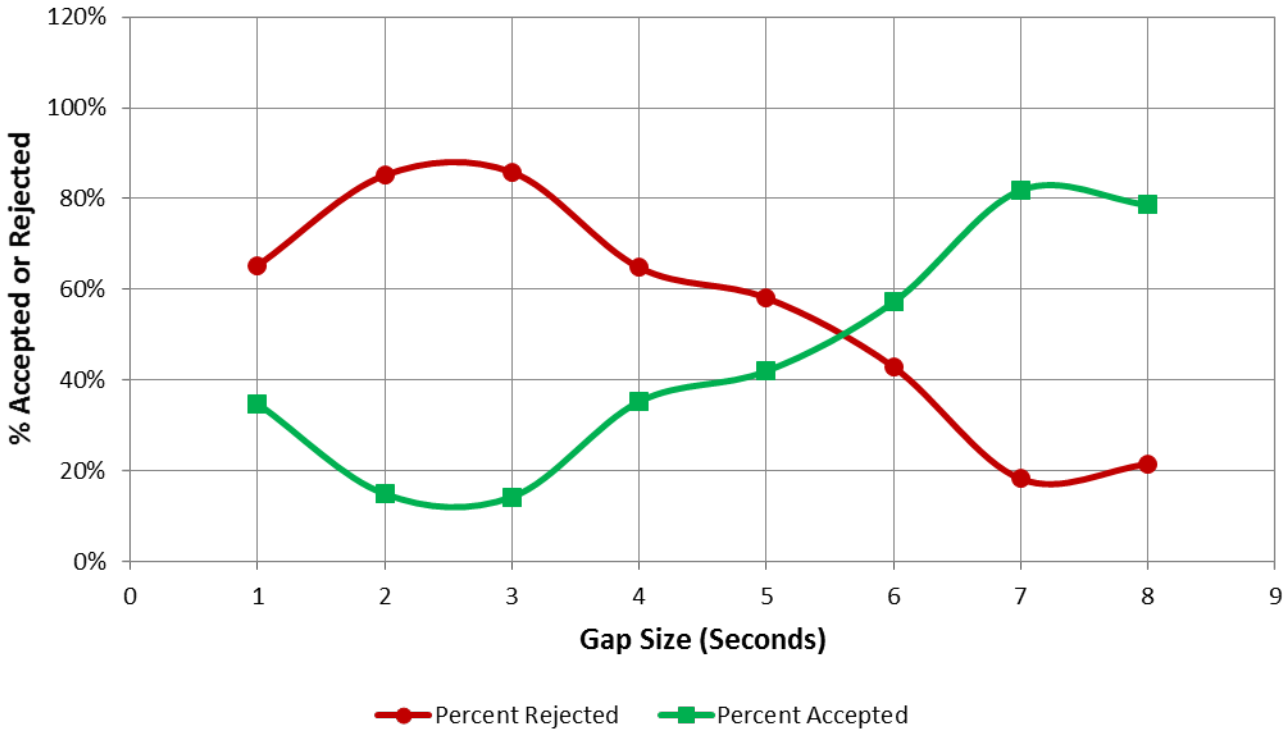
Figure 3-2. Determining Critical Gap Using the Raff Method (Tupper, 2011)

Figure 3-3 shows Salem roundabout eastbound analysis of critical gap using Raff method. For each gap size, the number of gaps rejected, number of gaps accepted, percent of gaps rejected and percent of gaps accepted must be tabulated. For instance, when the available gaps on conflicting flow are 3 seconds, the gaps were rejected 127 (86 percent) times by the subject vehicles on eastbound and accepted 21 (14 percent) times. It is refereed as when a subject driver perceives a 3-sec gap on circulating path, there is a 14 percent probability he/she would accept the gap, and 86 percent probability he/she would reject the gap.

By graphing the resulting percent accept and percent rejected, the critical gap can be determined as shown in Figure 3-3. By the Raff definition, the gap length where the percent of gap rejected equals to the percent of gap accepted is the critical gap. This corresponds to the point on the graph where 50 percent of gaps are rejected and 50 percent of gaps are rejected. Assuming the sample is representative of the driving population this would also be gap length where a driver has 50 percent probability of accepting the gap. For Salem eastbound, according to the graph, the critical gap is estimated to be 5.6 or so. The research team applied the Raff method for each movement of each approach at roundabouts. However, the results have shown there is no clear pattern among different turning movements. In the end, a combination of turning movements are applied to estimate the critical gap.

Appendix D provides the graphs and tables of the implementation of the Raff method for each approach (a combination of left, through and right and other turning movements) of roundabouts. The results of Raff method generally are higher than the values from the maximum likelihood method. The critical gap values of Raff method is about 5~6 seconds with the highest value of 7.6 and lowest of 4.0.

Figure 3-3. Critical Gap Estimation Based on Raff Method
Salem Roundabout – EB



Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + L + TH	<=1	45	24	65%	35%
	2	126	22	85%	15%
	3	127	21	86%	14%
	4	57	31	65%	35%
	5	18	13	58%	42%
	6	9	12	43%	57%
	7	2	9	18%	82%
	>=8	3	11	21%	79%

Table 3-16. Critical Gap Results of Roundabouts Based on Raff Method

Roundabout		Movement	Estimated Critical Gap (Seconds)
Salem	EB	R + L + TH	5.6
	WB	R + L + TH	6.6
	NB	R + L + TH	7.6
	SB	R + L + TH	5.0
Ellington	NB	R + TH + L + HL	4.6
	SB	R + BR + TH + L	5.4
	EB	HR + R + TH + L	5.4
	WB	R + TH + BL + L	4.0
	NEB	HR + BR + BL + HL	4.7
West Haven	WB	L + R	5.3
	SB	L + R	5.5
	EB	L + R	5.0
Killingworth	EB	R + L + TH	4.0
	WB	R + L + TH	5.0
	NB	R + L + TH	4.3
	SB	R + L + TH	4.8

3.5. FOLLOW-UP HEADWAY

Headway is the time between successive vehicles as they pass a point on a lane or roadway (e.g., roundabout entering stop line), also measured from the same point on each vehicle (e.g., front bumper). In HCM (2010) the time between the departure of one vehicle from the minor street and the departure of the next vehicle using the same major-street headway, under a condition of continuous queuing on the minor street is called the **follow-up headway**. Thus, follow-up headway, or **saturation discharge headway** is the also headway that defines the saturation flow rate for the approach if there were no conflicting vehicles on movements of higher rank.

In order to get reasonable values for the discharge rate, the flows that are measured need to be saturated (i.e., at least as many vehicles queuing as can pass at a given gap). Follow-up headway or saturation discharge headway is measured from the 2nd queued vehicles on the entering approach. A Follow-up Headway Worksheet, as shown in Table 3-17, was developed in this research to exam the queues and estimate the follow-up headway. The saturation flow rate is then computed based upon the corresponding headway. If there is no queue accumulated during peak hours on any entering approach, then this calibration factor is forfeit.

Table 3-18 presents the results of follow-ups headway and saturation discharge follow rate. Since follow-up headway can only be collected on a congested approaches, the following approaches are used to measure follow-up headway for each roundabout:

Salem: EB and NB
West Haven: EB and WB
Ellington: NB and SB
Killingworth: NB and SB

The results have shown that the average headway is generally ranged between 2.5 seconds to 3.3 seconds across all the approaches. Two approaches exhibited higher values with 4.3 seconds on Ellington southbound and 3.92 seconds on West Haven eastbound. Compared to other roundabouts, Salem roundabout has the lowest follow-up time which is correlated to the higher circulating speed. The results have indicated that correlation between speed and follow-up time is negative which means that with an increase in conflicting speed, the follow-up headway tends to decrease.

Table 3-17. Follow-up Headway Worksheet

Average Follow-up Headway (sec/veh) on Killingworth - NB					
Date : May 20th for both 7 a.m. to 9 a.m. and 4 p.m. to 6 p.m.					
	Departure	Circulating Gap	Headway (sec)	Ave Headway (sec)	Sat. Flow Rate (v/h)
1	7:00:17	Infinite		0:00:03	1200.00
2	7:00:19		0:00:02		
3	7:00:22		0:00:03		
4	7:00:24		0:00:02		
5	7:00:27		0:00:03		
5	7:00:31		0:00:04		
5	7:00:34		0:00:03		
1	7:00:39	Infinite			
2	7:00:42		0:00:03		
1	7:00:56	Infinite			
2	7:00:58		0:00:02		
1	7:02:09	Infinite			
2	7:02:15		0:00:06		
3	7:02:18		0:00:03		
4	7:02:22		0:00:04		
5	7:02:24		0:00:02		
6	7:02:27		0:00:03		
7	7:02:31		0:00:04		
1	7:03:51	Infinite			
2	7:03:54		0:00:03		
3	7:03:57		0:00:03		
4 ….. …	7:04:00		0:00:03		
1	5:59:03		0:00:03		
2	5:59:06		0:00:03		
3	5:59:08		0:00:02		
1	5:59:26	Infinite			
2	5:59:32		0:00:06		
1	5:59:38	Infinite			
2	5:59:40		0:00:02		

Table 3-18. Summary of Follow-up Headway Results

Roundabout		Average Headway (Seconds)	Saturation Flow Rate (v/h)
Salem	EB	2.58	1396.55
	NB	2.58	1398.06
	Average	2.58	1397.30
Ellington	NB	2.44	1474.54
	SB	4.33	831.28
	Average	3.39	1152.91
West Haven	EB	3.92	918.72
	WB	2.85	1265.04
	Average	3.38	1091.88
Killingworth	NB	3.09	1164.22
	SB	2.93	1226.98
	Average	3.01	1195.60

3.6. TRAVEL TIME

Travel Time, as a performance measure, will be applied later for the comparison of simulated and field measured results. Travel time of a vehicle from the entering leg (origin) to the exiting leg (destination) is measured from the video footages. The data inquisition of vehicle travel times is directly from the Vehicle Arrival and Exit Time Tracking Worksheet as shown in Table 3-1.

Each vehicle's travel time is computed in the worksheet. All the data are then sorted based on their turning movements. As an example, the travel time of Salem roundabout during a.m. peak period are presented in Table 3-19, and that of p.m. peak period are summarized in Table 3-20.

The travel time results have indicated that left turn and through vehicles spent more time on the circulating path than right turns which is consistent with the fact that the longer travel distance is, the more travel time tends to be. There is no clear difference between a.m. and p.m. peak period since all roundabouts have the similar busy approaches in a.m. and p.m. West Haven roundabout exhibited smaller values of travel time because of its smaller size and shorter travel distance. All left turns have a travel time of 10 - 14 seconds from entering to exit a roundabout. The through movements takes about 6 - 10 seconds to exit a roundabout except West Haven.

The results in terms of each turning movement of each approach of roundabouts is presented in Appendix C.

Table 3-19. Salem Roundabout: A.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach			
			EB	NB	SB	WB
Wednesday, May 21st, 2014 (7 a.m. - 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	4	3	3	2
		Left	14	10	10	10
		Through	7	6	6	7
	7:15 a.m. to 7:30 a.m.	Right	4	2	3	2
		Left	12	10	10	10
		Through	10	5	6	6
	7:30 a.m. to 7:45 a.m.	Right	4	2	3	2
		Left	8	9	10	10
		Through	10	7	8	5
	7:45 a.m. to 8:00 a.m.	Right	4	3	3	2
		Left	12	10	13	10
		Through	8	5	7	6

Table 3-20. Salem Roundabout: P.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach			
			EB	NB	SB	WB
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. to 4:45 a.m.	Right	4	3	3	2
		Left	12	11	13	10
		Through	7	7	9	6
	4:45 p.m. to 5:00 p.m.	Right	5	2	4	2
		Left	12	11	12	10
		Through	10	8	8	6
	5:00 p.m. to 5:15 p.m.	Right	5	3	3	2
		Left	13	12	13	11
		Through	10	8	8	6
	5:15 p.m. to 5:30 p.m.	Right	5	3	3	2
		Left	14	11	10	10
		Through	9	7	7	5

3.7. VEHICLES QUEUE LENGTH

Vehicle queue length on entering approaches is an important performance measure used in simulation comparison and calibration. Critical approaches of each roundabout were selected to measure the minimum, maximum and average queues during 7-9 a.m. peak period and 4-6 p.m. peak period.

Table 3-21 presents an example of Queue Worksheet where queues are observed for each 5-min time interval on critical approaches of each roundabout. Minimum queues, Maximum queues and average queues are observed and recorded. For each 15-min time interval, average values of queues are aggregated upon three 5-min time intervals. For each peak hour, average values of queues are also aggregated upon four 15-min time intervals.

The detailed queue length measurement and analysis of each critical approach on all four roundabouts are presented in Appendix F.

Salem and Ellington roundabouts usually hold up a maximum number of queues of 9~14 vehicles. Occasionally Salem eastbound and Ellington southbound experience a queue surge up to about 20 vehicles during p.m. peak hour. Compared to them, Killingworth and West Have roundabouts maintain a shorter queue length condition, fewer than 10 vehicles at most cases.

Table 3-21. Queue Worksheet (Salem Roundabout – EB / E Hadda.m. Rd)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Wednesday, May 21st, 2014 (7 a.m. – 9 a.m.)	**7 – 8 a.m.**	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	2	8	2	5.00	4.33	4.38
			7:05 a.m.	7:10 a.m.	1	9	2	5.00		
			7:10 a.m.	7:15 a.m.	1	5	3	3.00		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	1	13	7	7.00	5.83	
			7:20 a.m.	7:25 a.m.	2	5	2	3.50		
			7:25 a.m.	7:30 a.m.	2	12	2	7.00		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	1	10	2	5.50	4.00	
			7:35 a.m.	7:40 a.m.	1	4	4	2.50		
			7:40 a.m.	7:45 a.m.	1	7	3	4.00		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	1	5	2	3.00	3.33	
			7:50 a.m.	7:55 a.m.	1	9		5.00		
			7:55 a.m.	8:00 a.m.	1	3	2	2.00		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	1	4	2	2.50	4.83	3.50
			8:05 a.m.	8:10 a.m.	1	16	3	8.50		
			8:10 a.m.	8:15 a.m.	2	5	2	3.50		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	2	4	3	3.00	3.67	
			8:20 a.m.	8:25 a.m.	2	4	3	3.00		
			8:25 a.m.	8:30 a.m.	2	8	5	5.00		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	2	3	2	2.50	2.83	
			8:35 a.m.	8:40 a.m.	2	6	2	4.00		
			8:40 a.m.	8:45 a.m.	1	3	3	2.00		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	1	6	3	3.50	2.67	
			8:50 a.m.	8:55 a.m.	1	4	2	2.50		
			8:55 a.m.	9:00 a.m.	1	3	2	2.00		

CHAPTER 4 SIMULATION OF EXISTING CONDITION AND RESULTS COMPARISON

This Chapter presents an overview of computer simulation of existing conditions of all four roundabouts. A variety of simulation inputs such as geometry, volume, approach speed, circulating speed, reduce speed and vehicle critical gaps are discussed. The study also investigated how these variables are defined in VISSIM simulation model. Two performance measures - queue length and travel time as simulation outputs are described. The last part of the chapter discusses the performance measure comparison between simulated and field measured.

4.1. BUILD A VISSIM SIMULATION NETWORK OF EXISTING CONDITION

VISSIM is a microscopic simulation program by PTV AG, Germany (2015) to study traffic operations of freeways, surface streets and basic transit systems. VISSIM is commonly used to simulate traffic operations at roundabouts. VISSIM 6.0 version is used in this study. The geometry for each roundabout in the study is coded in VISSIM. Special geometric features of each roundabout are noted in the modeling process. For instance, the Ellington Roundabout has five entering approaches, additional pavement was built for trucks at the Killingworth roundabout and northbound approach has a designated two-lane entry at the Salem roundabout. All roundabouts are simulated during a.m. and p.m. peak hours. The research team modeled operations using observed vehicle traffic characteristics including geometry, volumes, vehicle composition, and driver behaviors. The traffic operational activities in simulation is compared with that of the actual roundabout.

Figure 4-1(a) ~ (d) presents a VISSIM network of each roundabout. VISSIM built-in Bing map is used as background for building West Haven roundabout and Killingworth roundabout network. Salem roundabout and Ellington roundabouts were provided with the Google map image scaled to match with the real-world dimension since their Bing map in VISSIM is not update to date.

Figure 4-1(a). VISSIM Simulation of Salem Roundabout

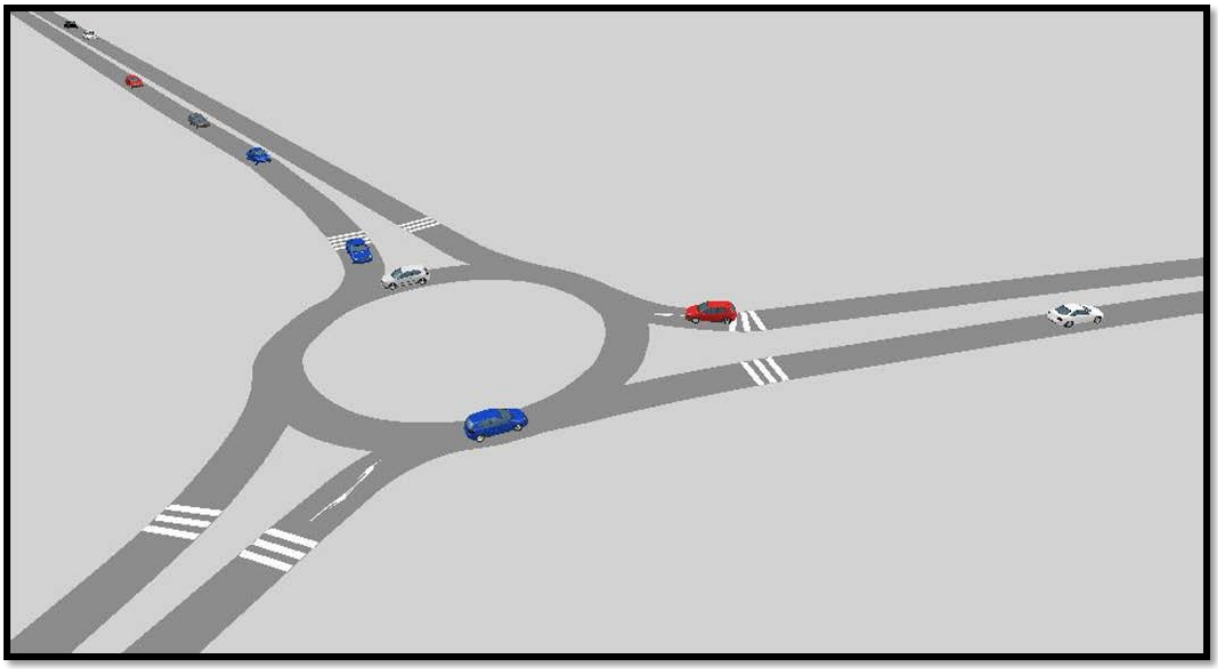


Figure 4-1(b). VISSIM Simulation of West Haven Roundabout

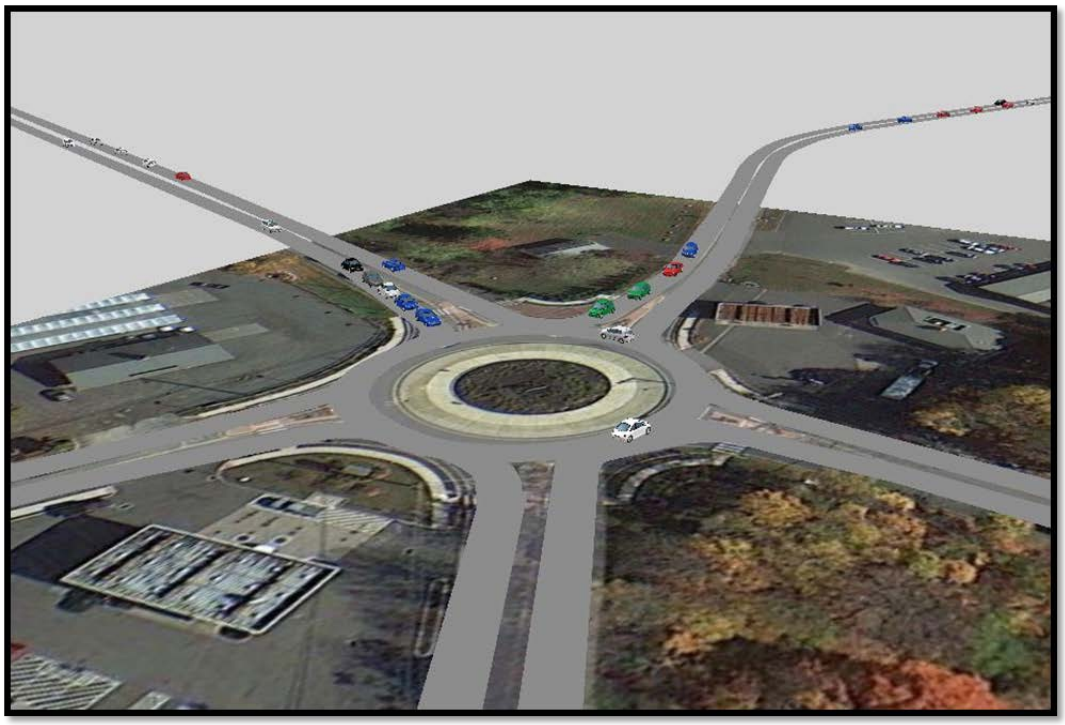


Figure 4-1(c). VISSIM Simulation of Ellington Roundabout

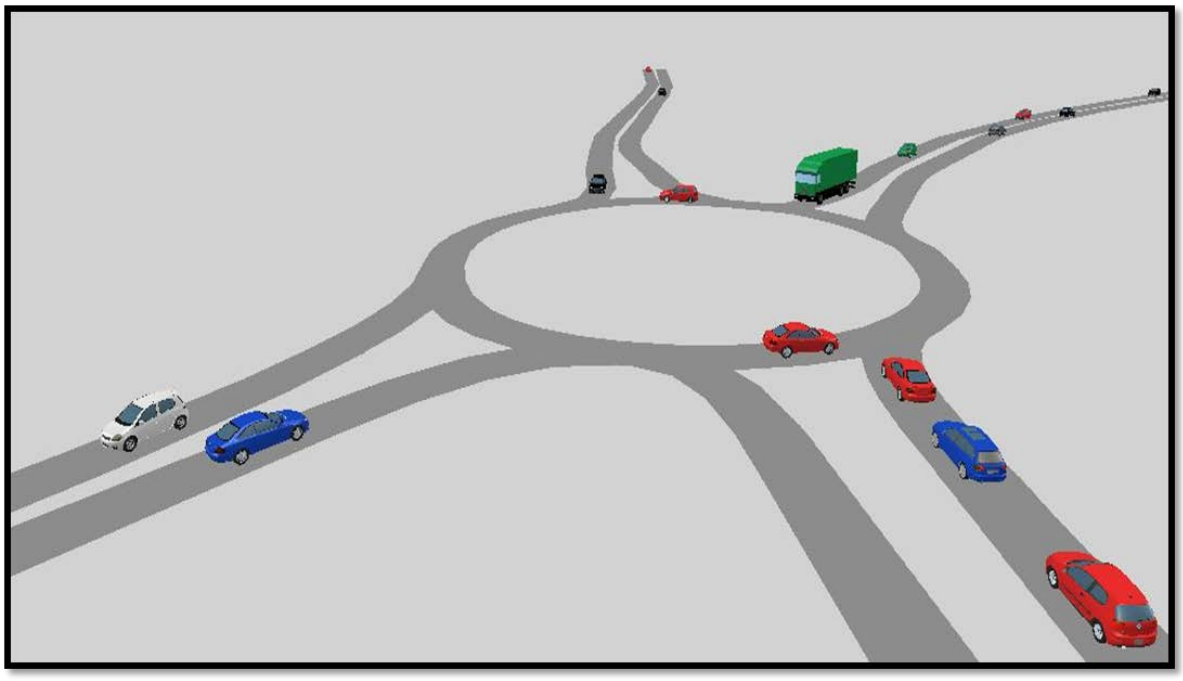


Figure 4-1(d). VISSIM Simulation of Killingworth Roundabout

4.2. SIMULATION INPUTS

The section gives an overview of some input variables and their definitions in VISSIM.

a) Traffic Demand

Each roundabout is simulated during one a.m. peak hour and one p.m. peak hour. Their peak hour volumes were discussed in details in Chapter 3. The data from Miovsion are used as simulation inputs and presented in Appendix A. Heavy vehicles are also modelled accordingly.

b) Approach Speed

The speed of a vehicle is one of the important parameters in the simulation. The desired speed values are considered according to each vehicle characteristics. The desired speed of each vehicle type is assigned default values according to the vehicle characteristics and the vehicle classification. This project considers Light vehicles (Car) and Heavy vehicles (Truck, Bus etc.).

Decision Point

A vehicle in the simulation usually maintains its own desired speed, and subject to change its speed based on decision point enforcement on an approach. The decision point (starting point) is placed on an approach where the vehicle speed changes according to given speed distribution. The vehicle remains at the new speed assigned until the next decision point or reduced area/point. The decision point also known as the starting point is placed on the approach where the desired speed change is necessary. Figure 4-2 explains the placement of decision point on an approach. The yellow line marked indicates the decision point for an approach and the vehicle remain at the same speed from the yellow marker up to the red line where the decision point ends and the vehicles change their speed as they enter reduced speed zone for the circulating path. In this study, the decision point is considered approximately 800 feet from the next decision point where the reduced speed area begins. It is an approximate distance from the roundabout entrance to hold a large queue of vehicles if observed.

Figure 4-2. Decision Point in VISSIM Network

Speed Distribution

The speed limit on most entering approaches is 40 mph, which was obtained from field observation. This research assumed 85 percent of vehicles travel at 45 mph and 15 percent of vehicles at 35 mph. (note: Most traffic analysis would use 85th percentile speed as speed limit, but we consider 5 miles higher to account for the fact that most drivers tend to driver higher than the speed limit). There might be drivers who would travel less than 35 mph and more than 45 mph, so we established a range of minimum speed and maximum speed in the speed graph**,** and considered the lower speed to be as low as 25 mph and maximum speed of 55 mph and this would be the range of speed in which all vehicles travel.

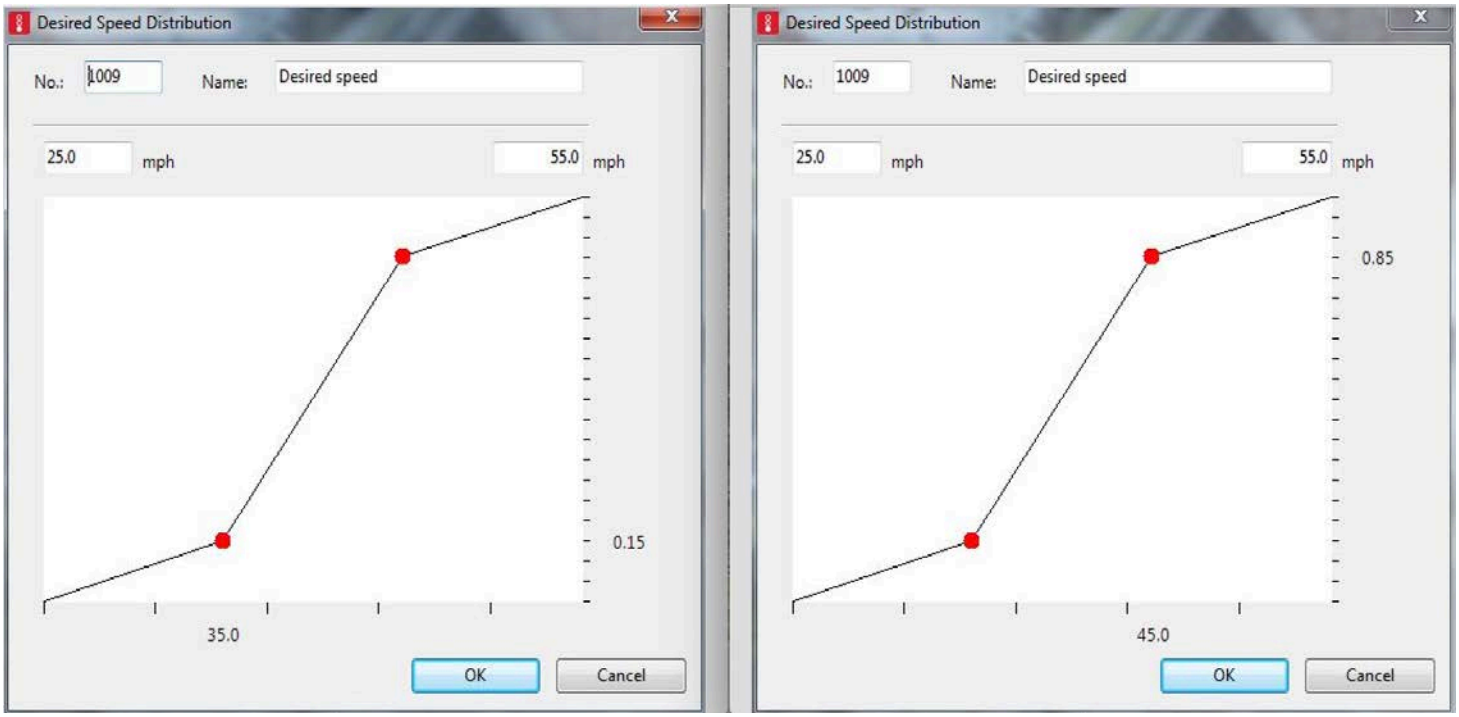


Figure 4-3. Speed Distribution (85th Percentile and 15th Percentile Speed)

As shown in Figure 4-3, the graph allows us to set up the range of speed: 25 mph as the minimum and 55 mph as the maximum. The horizontal axis depicts the desired speed and the vertical axis depicts the percentile range from 0 to 1. The curve is maintained in almost an "S" shape to achieve best results from simulation. For example, the speed distribution on the figure left indicates that 15 percent vehicles travel at a speed of 35 mph or less. The speed distribution on the figure right represents that 85 percent vehicles travels at a speed of 45 mph or more.

Table 4-1 presents how the speed distribution is developed and applied in the simulation of existing condition and calibration process.

Table 4-1. Determining 85th and 15th Percentile Speed

Approach Speed					Note
Speed Limit	85 Percentile	15 Percentile	Min	Max	apply the posted speed limit, then follow the table about its distribution
25	30	20	15	40	
30	35	25	15	45	
35	40	30	20	50	
40	45	35	25	55	
45	50	40	30	60	
50	55	45	35	65	
55	60	50	40	70	
Circulating Speed					apply the field data, min, max and average as 50 percentile
Speed	50 Percentile		Min	Max	
10	12.5		10	15	
15	17.5		15	20	
20	22.5		20	25	
25	27.5		25	30	
30	32.5		30	35	
Reduced Speed on the Entering Approach					
Speed	50 Percentile		Min	Max	
25	20		17.5	22.5	
30	25		22.5	27.5	
35	25		22.5	27.5	
40	30		27.5	32.5	
45	35		32.5	37.5	
50	40		37.5	42.5	
55	45		42.5	47.5	

c) Circulating Speed

Reduced speed is assigned on the circulating path of a roundabout. As shown on Figure 4-4, the yellow circular and straight path in the roundabout is referred to as reduced speed area. The driver behavior changes when they are approaching the reduced speed zone. The vehicle automatically decelerates while travelling in the reduced speed area/zone and accelerates back to the default desired speed of the approach after leaving the reduced speed zone. In this research, field measured circulating speed (as described in Chapter 3) of each roundabout was adopted in the reduced zone. However, the speed cannot be implemented according to different turning movements. Reduced speed zone enforces all the vehicle follow the same speed distribution in spite of their origins and destinations.

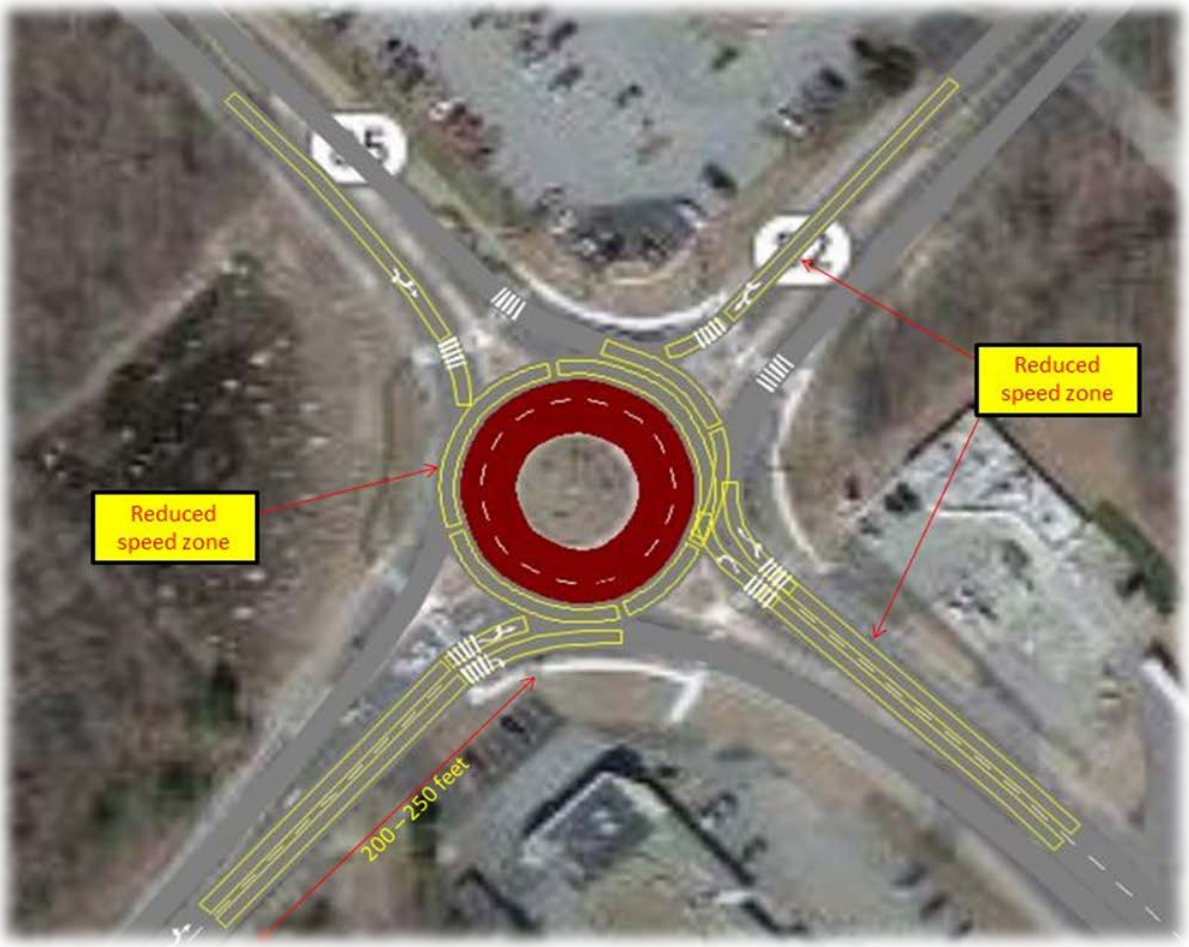


Figure 4-4. Reduced Speed Area on Entering Approaches and Circulating Paths

d) Reduced Speed on an Entering Approach

This study assumed there would be gradually decrease of speed around 10 – 15 mph at about 200 – 250 feet from the roundabout entrance. As shown Figure 4-4, a reduced speed is assigned in this area to observe realistic driver behavior.

e) Critical Gap and Minimum Headway Distance

In VISSIM, critical gap time is the minimum gap in the circulating traffic stream needed by an entering vehicle to merge into the circulatory road of the roundabout. The Highway Capacity Manual (HCM 2010) defines the critical gap as the "minimum length time interval that allows intersection entry of one minor street vehicle". Both definitions use different language but convey similar meanings. These definitions may seem simple but are difficult to apply in practice.

The key to model drive gap acceptance behavior in VISSIM simulation is through assigning a priority rule. The priority rule controls the decision of subject vehicles to merge to the roundabout or not. VISSIM employs three (3) simulation variables in this process where users can modify their values for the purpose of calibration, as shown in Figure 4-5. They are Min. Headway, Min. Gap Time and Maximum Speed.

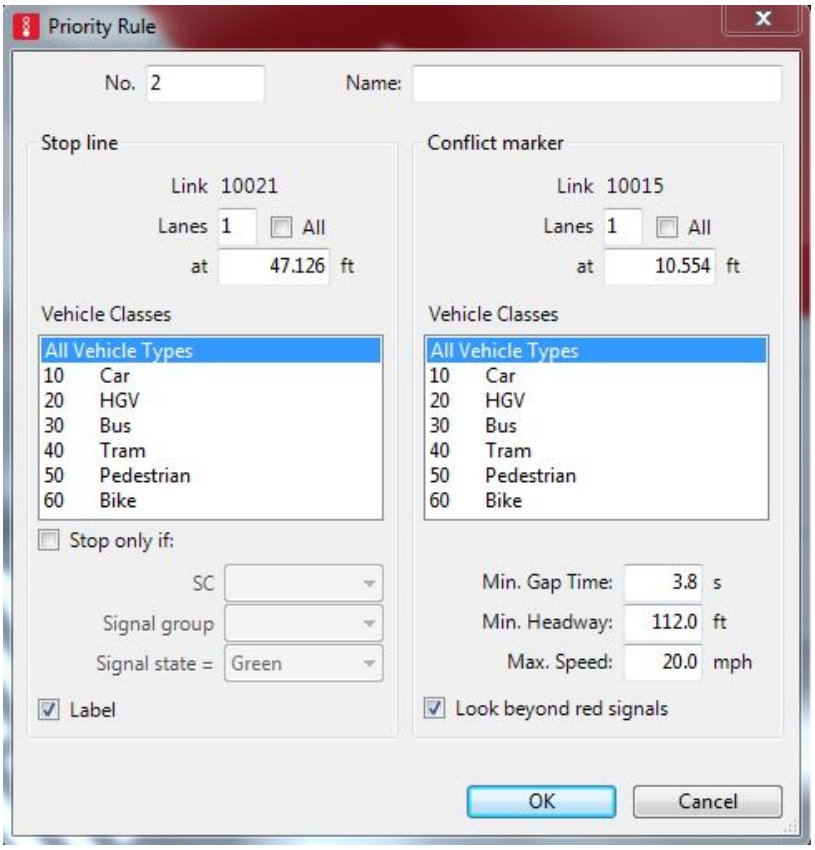


Figure 4-5. Priority Rule in VISSIM Simulation

The following figure depicts the concept of critical gap in simulation:

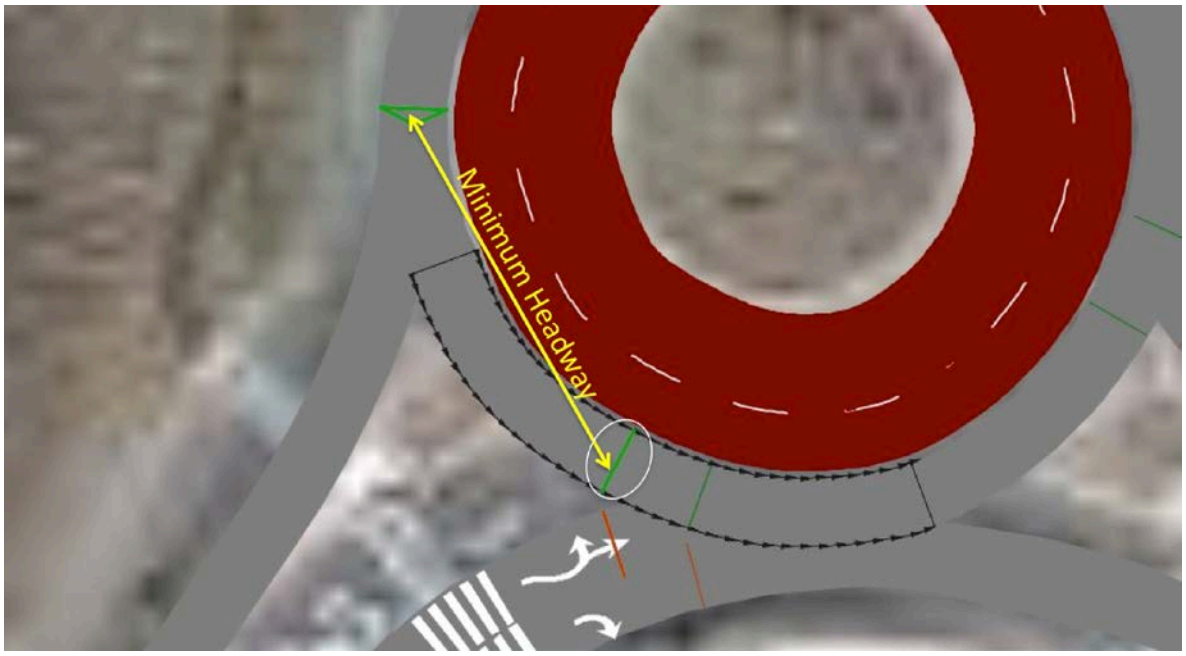


Figure 4-6. Assigning Priority Rule

As shown in Figure 4-6, the red line acts as the stop line or yield line on an entering approach where the subject vehicles are about to merge to the roundabout. The VISSIM allows users to define a priority rule where the conflict marker (green line) is circled on Figure 4-6. Three variables control the setup of the priority rule: Min. Gap Time, Min. Headway Distance and Max Speed.

In this study, the value of Min. Gap Time is obtained from the numerical analysis and estimated by the maximum likelihood method based on field data. The details of this method and comparison with Raff method for critical gaps are provided in Chapter 2 Data Analysis.

Max. Circulating Speed is the maximum circulating speed based on the field measurement.

Min. Headway Distance is defined as the headway distance between the conflict marker and the next vehicle traveling upwards. The Min. Headway Distance is calculated as Min. Gap Time multiple Maximum Speed of the Vehicle.

The VISSIM priority rule indicates that a subject vehicle at stopline or yield line must wait if the current time gap is less than the specified critical gap (the value which has been entered) or if there is a vehicle present within the min. headway distance.

All three priority rule control variables - Min. Gap Time, Min. Headway Distance, and Maximum Speed can be assigned for each lane at each approach but not with respect to each turning movements of the vehicles.

4.3 SIMULATION OUTPUTS AND SAMPLE SIZE

In VISSIM, the output of performance measures can be flexible compared to other software programs. Queue counters were setup on critical approaches of each roundabout in this study. Travel time is measured between a From Section and a To Section in the network. It is calculated as the time from traversing the From Section up to the Traversing the To Section, including the waiting time and/or holding time.

The following table provides an example of the data for Queues obtained from VISSIM simulation. Queue lengths can be determined with queue counters at any point in the VISSIM network and evaluated for any time interval. The Maximum Queue Length, Average Queue Length and Number of Stops are the outputs of queue counter.

Table 4-2: VISSIM Simulation Results of Queue Length

Salem Simulation Queue Results (7 a.m. – 8 a.m.)						
Sl. No	Simulation Run	Time Interval	Queue Counter	Queue Length	Queue Maximum Length	Queue Stops
1	1	0-900	EB (Right)	5.57	177.89	32
2	1	0-900	EB (Th & L)	2.04	174.48	9
3	1	0-900	NB (L)	0.08	33.28	2
4	1	0-900	NB (R & Th)	0.14	33.50	2
5	2	0-900	EB (Right)	8.50	172.65	43
6	2	0-900	EB (Th & L)	3.00	169.24	27
7	2	0-900	NB (L)	0.93	112.20	11
8	2	0-900	NB (R & Th)	0.63	116.45	6
9	3	0-900	EB (Right)	13.12	159.85	50
10	3	0-900	EB (Th & L)	6.03	156.43	21
11	3	0-900	NB (L)	0.63	52.56	5
12	3	0-900	NB (R & Th)	0.15	33.50	2
13	4	0-900	EB (Right)	5.50	146.41	28
14	4	0-900	EB (Th & L)	1.16	142.99	8
15	4	0-900	NB (L)	0.80	74.57	4
16	4	0-900	NB (R & Th)	0.63	78.82	3

Simulation run: *Shows the difference in number of times the simulation runs.*
Time interval: *[0-900 sec = 15 min], splitting of simulation time interval into different number of intervals.*
Queue Counter: *Name of the approach.*
Queue Length: *Average Queue Length.*
Queue Length Max: *Maximum Queue Length.*
Queue Stops: *Number of vehicle stops in that time interval.*

Sample Size Determination

VISSIM is a microscopic, time step and behavior based simulation model. Random seeds are used to model stochastic behavior of drivers. Simulation runs with identical input files and random seeds generate identical results. Using a different random seed represents a stochastic variation of input flow arrival times.

This study has conducted a statistical analysis of simulation output to determine the sample size, or the number of simulation runs. A margin of error of 2 vehicles in queue and 1 sec in travel time is allowed. Various random seeds are applied for the analysis. With 95% confidence interval, the sample size is determined to be 10 runs. That is, 10 runs with different random seems will be used in VISSIM simulation to achieve 95% confidence interval on the results.

4.4 COMPARE SIMULATED AND FIELD MEASURED PERFORMANCE

Comparisons between the simulated and field measured results were conducted for all data collection sites. This process is to examine whether or not the VISSIM model using as-built plans and observed traffic characteristics (e.g, volumes, composition, driver gap acceptance behavior) can be used to simulate roundabouts realistically.

a) Queue Length Comparison

The field data of queue length were obtained already through data extraction from Miovision video footages. The results are described in Chapter 3 Data Analysis. The average values of 10 simulation runs are used as the final simulation results. Two peak hours: 7:00 a.m. – 8:00 a.m. and 4:30 p.m. – 5:30 p.m. (4:45 pm – 5:45 pm in West Haven) are used for the comparison. The maximum likelihood results of critical gaps are used in the simulation. The comparisons are done on critical approaches of each roundabout where traffic experience congestions and queues accumulate.

Table 3-4 and 3-5 presents the comparison of vehicle length for Killingworth roundabout as an example. The difference in the table is the queue length value between field measured and VISSIM simulated. All roundabout have shown the differences on average queue length and minimum queue length are lesser than on maximum queue length. Northbound and southbound in Killingworth are two critical approaches. Their differences in the morning peak hour are smaller than in the p.m. peak hour. The comparison also indicated that the southbound queue prediction in simulation is well matched with the real-life condition during a.m. peak hour. However, VISSIM overestimates the maximum queue length in the afternoon by 4-12 vehicles. Generally speaking, VISSIM tends to overestimate the maximum queue length in the afternoon when the volumes are higher. Particularly West Haven roundabout is resulted in a significant overestimation of VISSIM with a difference of up to 26 vehicles. When queues are lower than 10 vehicles, VISSIM seems to be able to better handle the results. Among all four roundabouts,

Salem and Killingworth exhibited better results with smaller difference. Ellington southbound and West Haven have appeared to be more congested in VISSIM than in the real-world.

Appendix H provides the detailed comparison of queue length for all four roundabouts during both a.m. peak hour and p.m. peak hour.

Table 4-3. Comparison of Vehicle Queue Length
Killingworth Roundabout – SB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	2	**1.7**	2	**1.7**	6	**-1**
		Simulation	0.3		0.3		7	
	7:15 a.m. to 7:30 a.m.	Field	1	**0.7**	1	**0.7**	6	**0**
		Simulation	0.3		0.3		6	
	7:30 a.m. to 7:45 a.m.	Field	1	**0.8**	1	**0.8**	6	**0**
		Simulation	0.2		0.2		6	
	7:45 a.m. to 8:00 a.m.	Field	1	**0.8**	1	**0.8**	7	**-1**
		Simulation	0.2		0.2		6	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	2	**-0.7**	3	**0.3**	6	**-11**
		Simulation	2.7		2.7		17	
	4:45 p.m. to 5:00 p.m.	Field	1	**-0.6**	2	**0.4**	9	**-4**
		Simulation	1.6		1.6		13	
	5:00 p.m. to 5:15 p.m.	Field	2	**0.4**	3	**1.4**	8	**-4**
		Simulation	1.6		1.6		12	
	5:15 p.m. to 5:30 p.m.	Field	2	**-0.4**	2	**-0.4**	10	**-5**
		Simulation	2.4		2.4		15	

Table 4-4. Comparison of Vehicle Queue Length
Killingworth Roundabout – NB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	1	**0.6**	1	**0.6**	9	**2**
		Simulation	0.4		0.4		7	
	7:15 a.m. to 7:30 a.m.	Field	2	**1.6**	2	**1.6**	12	**4**
		Simulation	0.4		0.4		8	
	7:30 a.m. to 7:45 a.m.	Field	1	**0.6**	2	**1.6**	10	**3**
		Simulation	0.4		0.4		7	
	7:45 a.m. to 8:00 a.m.	Field	2	**1.6**	2	**1.6**	9	**1**
		Simulation	0.4		0.4		8	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	3	**1.3**	3	**1.3**	7	**-7**
		Simulation	1.7		1.7		14	
	4:45 p.m. to 5:00 p.m.	Field	2	**-1**	2	**-1**	9	**-8**
		Simulation	3		3		17	
	5:00 p.m. to 5:15 p.m.	Field	1	**-2.2**	2	**-1.2**	5	**-12**
		Simulation	3.2		3.2		17	
	5:15 p.m. to 5:30 p.m.	Field	2	**0.7**	2	**0.7**	20	**9**
		Simulation	1.3		1.3		11	

b) **Travel Time Comparison**

Travel time comparison examines how accurately VISSIM models the trajectory of vehicles through the curves of the roundabout and if the speed distribution used in the VISSIM is appropriate. The travel time is measured from an entry point of a vehicle to the exit point, as shown in Figure 4-7, the original and destination of turning movements are presented. The travel time is measured along the travel path of vehicles. In VISSIM, the difference of exit and entrance time gives us the vehicle travel time. The travel time measurement in VISSIM is almost identical to the one used in field data collection process, as shown in Figure 4-8.

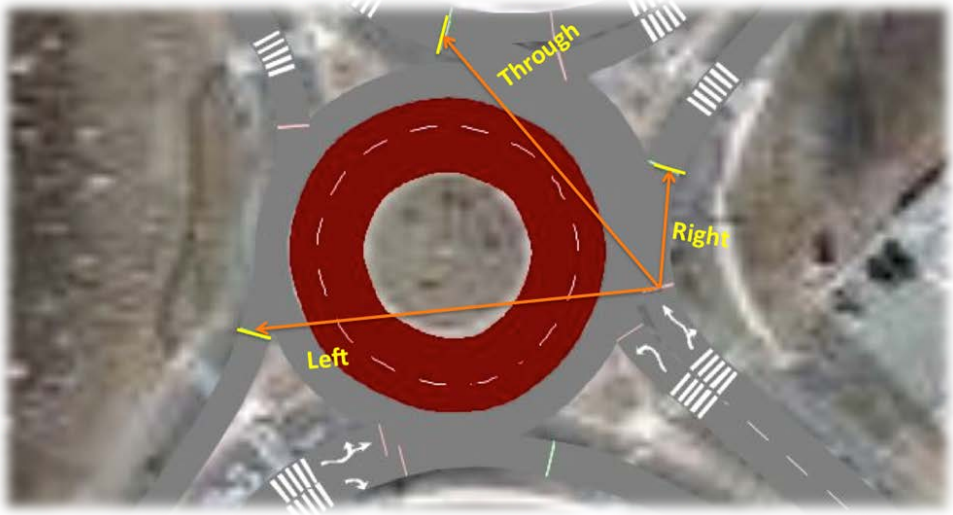


Figure 4-7. Travel Time in Simulation

Figure 4-8. Travel Time in the Field

The travel time is conducted for all the approaches of roundabout. Overall the comparison results between field and simulation are in the reasonable range. The study has shown that the difference of travel time between field and simulated in West Haven and Killingworth roundabouts and Salem roundabout northbound and southbound are much smaller (less than 5 or seconds in most cases) than Ellington and other approaches of Salem roundabout. The difference in left turn is consistently larger than through and right turns. Some hard lefts in Ellington have exhibited more than 10 seconds in difference. VISSIM tends to overestimate the approaches with lower volume but facing higher conflicting circulating traffic flow such as Salem westbound and Ellington eastbound. Nevertheless, overall, there is no consistent or clear trend on overestimation or underestimation of VISSIM.

Table 4-5 describes Travel Time comparison on the Salem roundabout west bound as an example.

Appendix I provides a comparison of travel time for all the approaches of four roundabouts.

Table 4-5. Comparison of Travel Time
Salem Roundabout – WB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	2	1	**1**
		Left	10	11	**-1**
		Through	7	7	**0**
	7:15 a.m. to 7:30 a.m.	Right	2	1	**1**
		Left	10	11	**-1**
		Through	6	7	**-1**
	7:30 a.m. to 7:45 a.m.	Right	2	2	**0**
		Left	10	10	**0**
		Through	5	7	**-2**
	7:45 a.m. to 8:00 a.m.	Right	2	1	**1**
		Left	10	11	**-1**
		Through	6	7	**-1**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	2	3	**-1**
		Left	10	14	**-4**
		Through	6	8	**-2**
	4:45 p.m. to 5:00 p.m.	Right	2	4	**-2**
		Left	10	14	**-4**
		Through	6	14	**-8**
	5:00 p.m. to 5:15 p.m.	Right	2	3	**-1**
		Left	11	13	**-2**
		Through	6	13	**-7**
	5:15 p.m. to 5:30 p.m.	Right	2	2	**0**
		Left	10	13	**-3**
		Through	5	14	**-9**

CHAPTER 5 CALIBRATION OF SIMULATION PARAMETERS

This Chapter investigates a variety of simulation parameters as calibration factors for describing driver behaviors at roundabouts. How each of these variables affects queue length and vehicle travel time are presented. A pattern or trend of each relation is illustrated. Finally the Chapter also discusses how the understanding of these patterns can facilitate the calibration process.

5.1. INDENTIFY THE PATTERNS OF CALIBRATION PARAMETERS

VISSIM cannot be expected to perfectly match all possible real-world conditions and situations. For the convenience of the analyst, VISSIM provides default values for the model parameters. However, only under rare circumstances will the model be able to produce accurate results for a specific area using only the default parameter values. Without calibration, there is no assurance that the model will correctly predict traffic performance for the project. Calibration is the adjustment of model parameters to improve the model's ability to reproduce local traffic conditions. Therefore, the importance of calibration cannot be overemphasized.

VISSIM comes with a set of user-adjustable driver behavior parameters for the purpose of calibrating the model to local conditions. Before we determine the set of parameter values for the model that best reproduce local traffic condition, it is critical important to understand what these parameters are, how they are defined in simulation and how they affect the performance measures.

In this task, the research team has identified the following important calibration parameters as described below:

- **Critical Gap.** Critical Gap represents driver gap acceptance behavior.

- **Min. Headway Distance.** It is another important factor in modeling the priority rule of driver gap acceptance.

- **Speed**: To reflect the stochastic nature of traffic speed, VISSIM requires a probabilistic distribution of traffic speeds. Three types of speeds are investigated: **Approach Speed, Circulating Speed and Reduce Speed on an Entering Approach**.

- **Saturation Flow Rate** (or the inverse of **Follow-up Headway**). It is used for modeling the discharge efficiency of queued vehicles and one of the important factors affecting roundabout operations. Unfortunately the research team was not able to identify a model parameter in the VISSIM which can directly model this behavior.

Finally the research team decided on five calibration factors as described in Figure 5-1. How each of these parameters affects queue length and travel time is further examined in this study. The range of values of each of these parameters is experimented in simulation and their results of queue and travel time are also presented in order to identify their patterns. The subsequent sections present the results of sensitivity analysis of each relation.

a) Approach Speed (mph) vs. Queue Length (# of vehicles)
b) Circulating Speed (mph) vs. Queue Length (# of vehicles)
c) Critical Gap (seconds) vs. Queue Length (# of Vehicles)
d) Min Headway Distance (ft) vs. Queue Length (# of vehicles)
e) Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles)
f) Approach Speed (mph) vs. Travel Time (seconds)
g) Circulating Speed (mph) vs. Travel Time (seconds)
h) Gap (seconds) vs. Travel Time (seconds)
i) Min Headway Distance (ft) vs. Travel Time (seconds)
j) Reduced Speed of Approach (mph) vs. Travel Time (seconds)

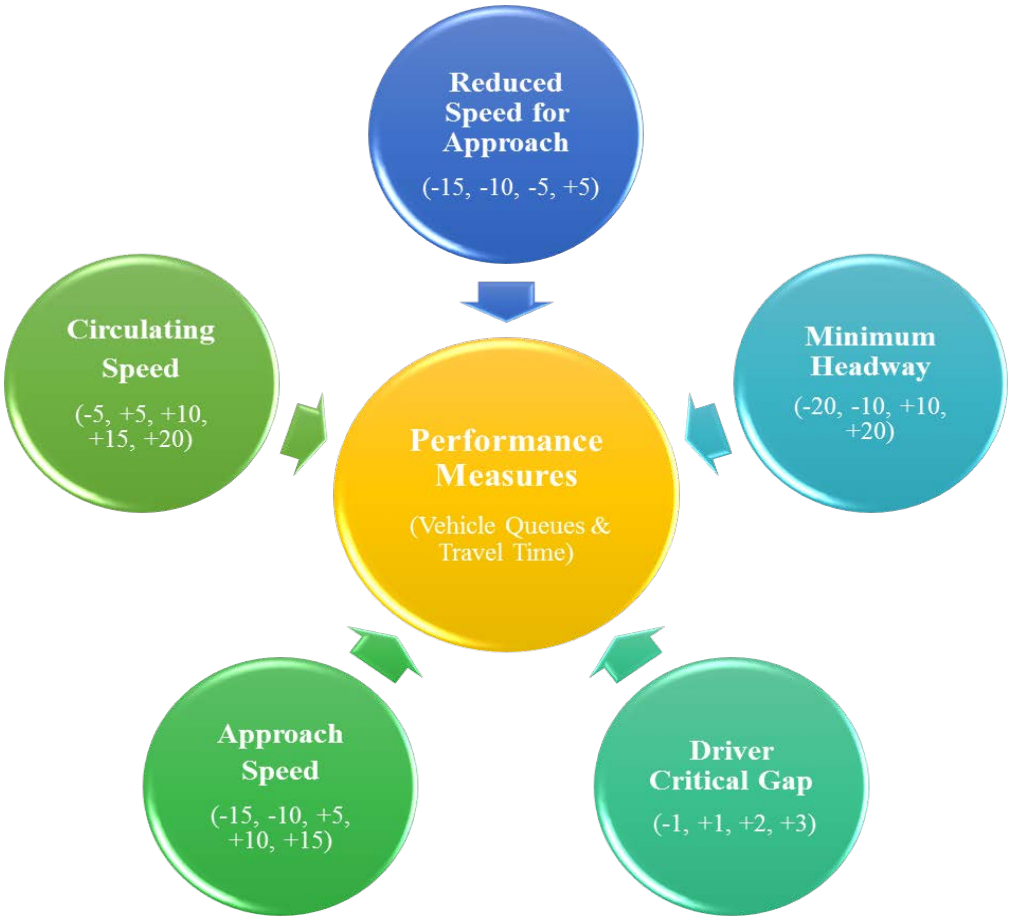


Figure 5-1. Calibration Parameters

5.2. CALIBRATION PARAMETERS VS. QUEUE LENGTH

The sensitivity analysis were conducted for all roundabouts during both a.m. and p.m. peak hours. Due to the limitation of the report, this section only includes the data for Salem roundabout during a.m. for the purpose of demonstration. Table 5-1 to Table 5-5 present how these five calibration factors affect queue length, while Table 5-6 to Table 5-10 depict how these variables impact the travel time of vehicles.

The complete set of results are contained in the Appendix J-Q as follows.

APPENDIX J	Salem Roundabout: Calibration Variables vs. Queues
APPENDIX K	Salem Roundabout: Calibration Variables vs. Travel Time
APPENDIX L	Ellington Roundabout: Calibration Variables vs. Queues
APPENDIX M	Ellington Roundabout: Calibration Variables vs. Travel Time
APPENDIX N	West Haven Roundabout: Calibration Variables vs. Queues
APPENDIX O	West Haven Roundabout: Calibration Variables vs. Travel
APPENDIX P	Killingworth Roundabout: Calibration Variables vs. Queues
APPENDIX Q	Killingworth Roundabout: Calibration Variables vs. Travel Time

a) Approach Speed (mph) vs. Queue Length (# of vehicles)

The sensitivity analysis has exhibited that a change on approach speed has a small impact on the queues at all study sites. Queue length is evaluated when the approach speed is varied from 15mph to 55 mph. Overall the number of queues drops when the speed increases. It implies that vehicles move up quickly when the speed increases and potentially queues be discharged quickly. On Ellington roundabout p.m. peak hour, a queue of 40 vehicles is reduced to 20 vehicles when the speed is increased from 15 mph to 55 mph. A higher number of queues may imply traffic flow is unstable so when there is even a small change on this behavior such as speed, the impact could be larger than expected. When an approaches is less congested the change is smaller compared to more congested approaches.

In a summary, approach speed has a small impact on the queues. Its impact on more congested approaches can be higher than that of the less congested approaches.

b) Circulating Speed (mph) vs. Queue Length (# of vehicles)

All roundabouts have shown that the changes in circulating speed do not impact queues on entering approaches except at very low speed range of 10 to 15 mph. When circulating speed is over than 20 mph, queues are practically not affected.

In a summary, circulating speed is not effective for queue calibration in simulation.

c) Critical Gap (seconds) vs. Queue Length (# of Vehicles)

All roundabouts have shown that the critical gap affects the queues drastically. When the size of the gap is changed by -1, +1, +2, +3 from the existing condition in this study, queue length has demonstrated an impressive change in the simulation. The number of queued vehicles increase with the increase of the gap size. This becomes more evident when the approach volume is high. For instance, at northbound of Salem roundabout (833 veh/h), the queues on northbound increase from 6.4 at -1 sec in gap to 11.7 at +3 sec. gap considering the existing condition of 3.8 seconds. The change is smaller when the volume is lower such as during West Have a.m. peak hour. The relation of critical gap and queue length is consistent with the driver behavior in theory. Larger the size of a critical gap is, the less aggressive of a vehicle and longer of queues can be predicted.

In a summary, critical gap play a major role in traffic operational modeling of roundabouts. It has a significant impact to queue length compared to other parameters, particularly when the volume is higher.

d) Min Headway Distance (ft) vs. Queue Length (# of vehicles)

The change in min. headway distance affects queue length in a moderate way. For a reduction of 30, 20, 10 ft from the existing condition, the queue value remains approximately the same. On the opposite direction, when the min. headway is increased 10 or 20 feet from the existing headway distance, queue length would have a small change. When queues are fewer than 10 vehicles, the change is about 2~3 vehicles in the case of Salem roundabout. When the queues are greater than 10 vehicles, the change increases to 4~5 vehicles. At Ellington roundabout, min. headway distance does demonstrate a significant effect once the increase reaches to +35 ft or more. The results have shown that there is a jump on queue length resulted (e.g., from 3~4 vehicles to 12~19 vehicles on southbound) and then remains unchanged. This is due to the close proximity of entering approaches at this 5-leg roundabout. The queue prediction in simulation would reach to a saturation point when the min. headway distance is greater than the distance to upstream approach. The entries of vehicles from the upstream approach would affect the decision making of the subject approach. It tends to slow down the vehicles to enter the roundabout. We define this distance as saturated headway distance. As shown on Figure 5-2, on Ellington roundabout, a saturated minimum headway distance of NB approach is the distance between NB entering and NEB entrance.

In a summary, the effect of min. headway distance to queue length is moderate. However, if this min. headway distance is greater than the distance to the upstream approach, the effect can be elevated. Min. headway distance becomes to be an important calibration factor when entering approaches of a roundabout are closely spaced.

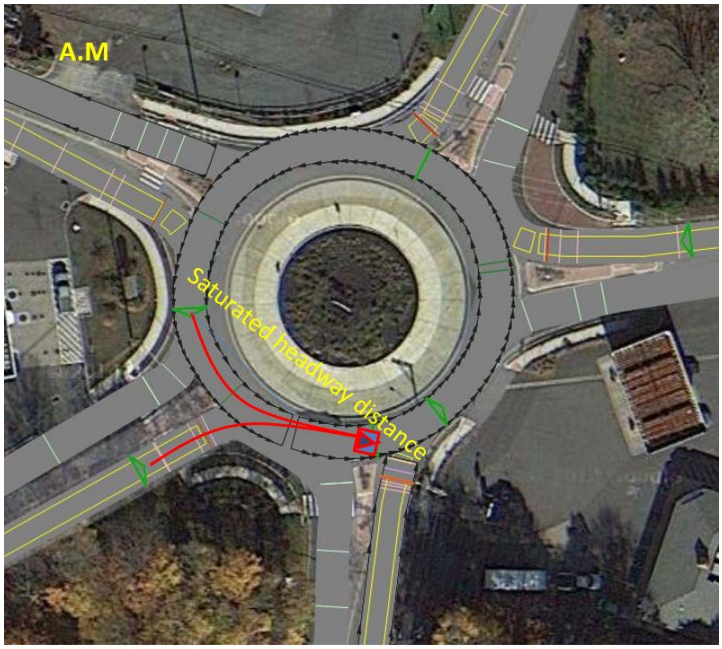


Figure 5-2. Saturated Minimum Headway Distance

e) Reduced Speed on an Approach (mph) vs. Queue Length (# of vehicles)

Calibration was performed for speed of 25,30,35,40,45,50,55 mph for the reduced speed on an approach. There are good effects on queues when the maximum queues on an approach is greater than 10 vehicles. Salem roundabout demonstrated the queues can drop from 12 to 7 vehicles when the reduce speed increases from 25 to 50 mph. The higher this speed is, the fewer queues occur. It is also noted that in some case, the results do show random behavior, such as at Ellington, the queue reduces and then increases when the speed is increasing from 25 to 50. When the speed on the reduced zone becomes larger than the speed an approaches, it can cause complications on the queue results.

In a summary, reduced speed on an approach is a good calibration factor for queue length. The lower the reduced speed is, the more sensitive to the queue. The reduced speed is not recommended to be higher than the approach speed.

5.3. CALIBRATION PARAMETERS VS. TRAVEL TIME

f) Approach Speed (mph) vs. Travel Time (seconds)

All roundabouts during both a.m. and p.m. analysis peak hours demonstrated the change in approach speed does not seem to have some impacts on travel time.

g) Circulating Speed (mph) vs. Travel Time (seconds)

The change of circulating speed does affect travel time considerably particularly on left turns. The lower the speed is, the longer the travel time is, and vice versa. For example, on Salem eastbound, when the speed is increased from 10 to 30 mph, the travel time of left turns is cut almost half from 13.6 sec. to 6.2 seconds. The same trend also occurs the less congested approach, westbound. Its travel time decreased from 16.9 sec. to 7.4 sec.

h) Critical Gap (seconds) vs. Travel Time (seconds)

The change in critical gap does not have much effect on travel time on many approaches. However, the impact is evident when an approach is challenged with high conflicting traffic flow on circulating path. For example, on Salem westbound, the travel time increases from 7.2 seconds at the gap size of -1 sec (from the existing condition) to 12.5 seconds at the gap size of +3 sec. The same trend occurred on Ellington westbound. The travel time of its bear left turn increases from 9.5 seconds to 19.8 seconds when the gap size increased 4 seconds.

i) Min Headway Distance (ft) vs. Travel Time (seconds)

The change in min headway has a minimum effect on travel time as long as this min. headway distance is less than the saturated level.

j) Reduced Speed of Approach (mph) vs. Travel Time (seconds)

The change in reduced speed for approach do not have a good effect on travel time which is evident by the results of all study sites.

Table 5-1. Salem Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) – AM

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	15 to 40	7:00 - 7:15	1	0.3	0.7	9	8.1	0.9	2	0.1	1.9	6	4.5	1.5
		7:15 - 7:30	2	0.2	1.8	12	7.0	5.0	1	0.0	1.0	6	3.2	2.8
		7:30 - 7:45	1	0.2	0.8	10	6.8	3.2	1	0.1	0.9	6	4.4	1.6
		7:45 - 8:00	2	0.2	1.8	9	6.7	2.3	1	0.0	1.0	7	3.2	3.8
30	15 to 45	7:00 - 7:15	1	0.3	0.7	9	7.1	1.9	2	0.0	2.0	6	4.0	2.0
		7:15 - 7:30	2	0.3	1.7	12	7.2	4.8	1	0.0	1.0	6	3.5	2.5
		7:30 - 7:45	1	0.3	0.7	10	7.0	3.0	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.3	1.7	9	7.4	1.6	1	0.1	0.9	7	4.1	2.9
35	20 to 50	7:00 - 7:15	1	0.3	0.7	9	7.0	2.0	2	0.1	1.9	6	5.0	1.0
		7:15 - 7:30	2	0.2	1.8	12	7.0	5.0	1	0.1	0.9	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	6.0	4.0	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.2	1.8	9	6.0	3.0	1	0.0	1.0	7	3.0	4.0
40 (Existing Condition)	25 to 55	7:00 - 7:15	1	0.3	0.7	9	6.3	2.7	2	0.1	1.9	6	4.2	1.8
		7:15 - 7:30	2	0.2	1.8	12	7.1	4.9	1	0.0	1.0	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	5.7	4.3	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.2	1.8	9	6.1	2.9	1	0.0	1.0	7	3.5	3.5
45	30 to 60	7:00 - 7:15	1	0.2	0.8	9	6.6	2.4	2	0.1	1.9	6	4.1	1.9
		7:15 - 7:30	2	0.2	1.8	12	6.8	5.2	1	0.0	1.0	6	3.9	2.1
		7:30 - 7:45	1	0.2	0.8	10	6.1	3.9	1	0.0	1.0	6	3.2	2.8
		7:45 - 8:00	2	0.2	1.8	9	6.1	2.9	1	0.0	1.0	7	3.9	3.1

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	35 to 65	7:00 - 7:15	1	0.3	0.7	9	8.0	1.0	2	0.1	1.9	6	4.0	2.0
		7:15 - 7:30	2	0.2	1.8	12	6.7	5.3	1	0.0	1.0	6	3.7	2.3
		7:30 - 7:45	1	0.2	0.8	10	5.8	4.2	1	0.0	1.0	6	3.6	2.4
		7:45 - 8:00	2	0.2	1.8	9	6.0	3.0	1	0.0	1.0	7	3.7	3.3
55	40 to 70	7:00 - 7:15	1	0.3	0.7	9	7.3	1.7	2	0.0	2.0	6	4.3	1.7
		7:15 - 7:30	2	0.2	1.8	12	6.5	5.5	1	0.0	1.0	6	3.8	2.2
		7:30 - 7:45	1	0.2	0.8	10	5.5	4.5	1	0.0	1.0	6	3.8	2.2
		7:45 - 8:00	2	0.2	1.8	9	6.2	2.8	1	0.0	1.0	7	3.9	3.1

Note:

- Circulating Speed = 16 – 22 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table 5-2. Salem Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) – AM

Circulating	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15	7:00 - 7:15	1	1.0	0.0	9	11.1	-2.1	2	0.4	1.6	6	8.5	-2.5
		7:15 - 7:30	2	0.8	1.2	12	8.7	3.3	1	0.4	0.6	6	9.0	-3.0
		7:30 - 7:45	1	0.9	0.1	10	9.7	0.3	1	0.4	0.6	6	8.3	-2.3
		7:45 - 8:00	2	0.6	1.4	9	7.7	1.3	1	0.3	0.7	7	8.4	-1.4
15	15 to 20 **(16 to 22 existing condition)**	7:00 - 7:15	1	0.4	0.6	9	7.5	1.5	2	0.1	1.9	6	6.4	-0.4
		7:15 - 7:30	2	0.3	1.7	12	7.3	4.7	1	0.0	1.0	6	4.5	1.5
		7:30 - 7:45	1	0.3	0.7	10	7.2	2.8	1	0.0	1.0	6	3.7	2.3
		7:45 - 8:00	2	0.3	1.7	9	6.3	2.7	1	0.1	0.9	7	4.8	2.2
20	20 to 25	7:00 - 7:15	1	0.2	0.8	9	6.0	3.0	2	0.0	2.0	6	3.6	2.4
		7:15 - 7:30	2	0.2	1.8	12	6.7	5.3	1	0.0	1.0	6	3.3	2.7
		7:30 - 7:45	1	0.2	0.8	10	5.6	4.4	1	0.0	1.0	6	3.7	2.3
		7:45 - 8:00	2	0.1	1.9	9	5.2	3.8	1	0.0	1.0	7	3.0	4.0
25	25 to 30	7:00 - 7:15	1	0.2	0.8	9	6.5	2.5	2	0.0	2.0	6	3.5	2.5
		7:15 - 7:30	2	0.2	1.8	12	6.7	5.3	1	0.0	1.0	6	3.0	3.0
		7:30 - 7:45	1	0.2	0.8	10	5.0	5.0	1	0.0	1.0	6	3.1	2.9
		7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.4	3.6
30	30 to 35	7:00 - 7:15	1	0.2	0.8	9	6.1	2.9	2	0.0	2.0	6	3.6	2.4
		7:15 - 7:30	2	0.3	1.7	12	6.7	5.3	1	0.0	1.0	6	2.3	3.7
		7:30 - 7:45	1	0.2	0.8	10	6.6	3.4	1	0.0	1.0	6	2.2	3.8
		7:45 - 8:00	2	0.2	1.8	9	5.7	3.3	1	0.0	1.0	7	2.6	4.4

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table 5-3. Salem Roundabout – Critical Gap (seconds) vs. Queue Length (# of Vehicles) – AM

Gap	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
(seconds)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-1	7:00 - 7:15	1	0.2	0.8	9	6.1	2.9	2	0.1	1.9	6	4.2	1.8
	7:15 - 7:30	2	0.2	1.8	12	6.8	5.2	1	0.0	1.0	6	4.1	1.9
	7:30 - 7:45	1	0.2	0.8	10	5.9	4.1	1	0.0	1.0	6	4.1	1.9
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.5	3.5
+1	7:00 - 7:15	1	0.5	0.5	9	8.2	0.8	2	0.1	1.9	6	4.4	1.6
	7:15 - 7:30	2	0.4	1.6	12	8.0	4.0	1	0.1	0.9	6	4.9	1.1
	7:30 - 7:45	1	0.4	0.6	10	6.8	3.2	1	0.1	0.9	6	4.4	1.6
	7:45 - 8:00	2	0.3	1.7	9	7.1	1.9	1	0.1	0.9	7	4.5	2.5
+2	7:00 - 7:15	1	1.6	-0.6	9	11.8	-2.8	2	0.3	1.7	6	7.2	-1.2
	7:15 - 7:30	2	1.1	0.9	12	9.4	2.6	1	0.2	0.8	6	6.0	0.0
	7:30 - 7:45	1	1.4	-0.4	10	10.6	-0.6	1	0.2	0.8	6	6.2	-0.2
	7:45 - 8:00	2	0.8	1.2	9	9.1	-0.1	1	0.2	0.8	7	5.6	1.4
+3	7:00 - 7:15	1	5.5	-4.5	9	17.8	-8.8	2	0.4	1.6	6	7.6	-1.6
	7:15 - 7:30	2	2.9	-0.9	12	14.2	-2.2	1	0.3	0.7	6	6.9	-0.9
	7:30 - 7:45	1	3.4	-2.4	10	15.4	-5.4	1	0.3	0.7	6	6.7	-0.7
	7:45 - 8:00	2	1.9	0.1	9	11.3	-2.3	1	0.3	0.7	7	5.9	1.1

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table 5-4. Salem Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) – AM

Min Headway	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Distance (ft)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-30	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.0	2.0	6	4.0	2.0
	7:15 - 7:30	2	0.2	1.8	12	6.6	5.4	1	0.0	1.0	6	3.4	2.6
	7:30 - 7:45	1	0.2	0.8	10	6.2	3.8	1	0.0	1.0	6	2.9	3.1
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.0	4.0
-20	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.0	2.0	6	4.0	2.0
	7:15 - 7:30	2	0.2	1.8	12	6.6	5.4	1	0.0	1.0	6	3.4	2.6
	7:30 - 7:45	1	0.2	0.8	10	6.2	3.8	1	0.0	1.0	6	2.9	3.1
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.0	4.0
-10	7:00 - 7:15	1	0.2	0.8	9	6.5	2.5	2	0.0	2.0	6	4.0	2.0
	7:15 - 7:30	2	0.2	1.8	12	6.6	5.4	1	0.0	1.0	6	3.7	2.3
	7:30 - 7:45	1	0.2	0.8	10	5.7	4.3	1	0.0	1.0	6	2.9	3.1
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.1	3.9
+10	7:00 - 7:15	1	0.3	0.7	9	7.1	1.9	2	0.1	1.9	6	4.7	1.3
	7:15 - 7:30	2	0.3	1.7	12	7.2	4.8	1	0.0	1.0	6	4.2	1.8
	7:30 - 7:45	1	0.3	0.7	10	6.4	3.6	1	0.1	0.9	6	4.6	1.4
	7:45 - 8:00	2	0.2	1.8	9	6.3	2.7	1	0.1	0.9	7	4.1	2.9
+20	7:00 - 7:15	1	0.4	0.6	9	8.0	1.0	2	0.1	1.9	6	5.1	0.9
	7:15 - 7:30	2	0.3	1.7	12	7.8	4.2	1	0.1	0.9	6	4.8	1.2
	7:30 - 7:45	1	0.3	0.7	10	6.5	3.5	1	0.1	0.9	6	5.0	1.0
	7:45 - 8:00	2	0.3	1.7	9	6.7	2.3	1	0.1	0.9	7	4.8	2.2

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table 5-5. Salem Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) – AM

Reduced Speed of	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	17.5 to 22.5	7:00 - 7:15	1	0.4	0.6	9	8.5	0.5	2	0.1	1.9	6	4.9	1.1
		7:15 - 7:30	2	0.4	1.6	12	8.6	3.4	1	0.0	1.0	6	4.1	1.9
		7:30 - 7:45	1	0.3	0.7	10	8.1	1.9	1	0.0	1.0	6	3.8	2.2
		7:45 - 8:00	2	0.3	1.7	9	8.0	1.0	1	0.0	1.0	7	4.0	3.0
30 (Existing Condition)	22.5 to 27.5	7:00 - 7:15	1	0.4	0.6	9	8.1	0.9	2	0.1	1.9	6	4.0	2.0
		7:15 - 7:30	2	0.3	1.7	12	7.4	4.6	1	0.0	1.0	6	4.1	1.9
		7:30 - 7:45	1	0.3	0.7	10	6.9	3.1	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.3	1.7	9	6.3	2.7	1	0.0	1.0	7	4.1	2.9
35	22.5 to 27.5	7:00 - 7:15	1	0.4	0.6	9	8.1	0.9	2	0.1	1.9	6	4.0	2.0
		7:15 - 7:30	2	0.3	1.7	12	7.4	4.6	1	0.0	1.0	6	4.1	1.9
		7:30 - 7:45	1	0.3	0.7	10	6.9	3.1	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.3	1.7	9	6.3	2.7	1	0.0	1.0	7	4.1	2.9
40	27.5 to 32.5	7:00 - 7:15	1	0.3	0.7	9	6.3	2.7	2	0.1	1.9	6	4.2	1.8
		7:15 - 7:30	2	0.2	1.8	12	7.1	4.9	1	0.0	1.0	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	5.7	4.3	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.2	1.8	9	6.1	2.9	1	0.0	1.0	7	3.5	3.5
45	32.5 to 37.5	7:00 - 7:15	1	0.2	0.8	9	6.2	2.8	2	0.1	1.9	6	4.9	1.1
		7:15 - 7:30	2	0.2	1.8	12	5.7	6.3	1	0.0	1.0	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	5.2	4.8	1	0.0	1.0	6	4.3	1.7
		7:45 - 8:00	2	0.2	1.8	9	5.9	3.1	1	0.0	1.0	7	3.5	3.5

Reduced Speed of	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	37.5 to 42.5	7:00 - 7:15	1	0.2	0.8	9	6.2	2.8	2	0.0	2.0	6	4.1	1.9
		7:15 - 7:30	2	0.2	1.8	12	6.3	5.7	1	0.0	1.0	6	4.5	1.5
		7:30 - 7:45	1	0.2	0.8	10	5.4	4.6	1	0.1	0.9	6	4.5	1.5
		7:45 - 8:00	2	0.2	1.8	9	6.0	3.0	1	0.0	1.0	7	3.3	3.7
55	42.5 to 47.5	7:00 - 7:15	1	0.2	0.8	9	6.3	2.7	2	0.1	1.9	6	4.7	1.3
		7:15 - 7:30	2	0.2	1.8	12	6.3	5.7	1	0.0	1.0	6	4.6	1.4
		7:30 - 7:45	1	0.2	0.8	10	5.4	4.6	1	0.1	0.9	6	4.6	1.4
		7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.4	3.6

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table 5-6. Salem Roundabout EB - Approach Speed (mph) vs. Travel Time (seconds) – AM

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	4	7	14	2.0	5.6	7.8	2.0	1.4	6.2
		7:15 - 7:30	4	10	12	2.0	5.5	9.0	2.0	4.5	3.0
		7:30 - 7:45	4	10	0	2.0	5.4	8.5	2.0	4.6	-8.5
		7:45 - 8:00	4	8	12	2.0	5.5	9.0	2.0	2.5	3.0
30	15 to 35	7:00 - 7:15	4	7	14	1.9	5.2	7.9	2.1	1.8	6.1
		7:15 - 7:30	4	10	12	1.9	5.1	8.8	2.1	4.9	3.2
		7:30 - 7:45	4	10	0	1.9	5.0	8.4	2.1	5.0	-8.4
		7:45 - 8:00	4	8	12	1.9	5.1	8.9	2.1	2.9	3.1
35	20 to 40	7:00 - 7:15	4	7	14	1.9	4.7	7.7	2.1	2.3	6.3
		7:15 - 7:30	4	10	12	1.8	4.6	8.7	2.2	5.4	3.3
		7:30 - 7:45	4	10	0	1.8	4.5	8.1	2.2	5.5	-8.1
		7:45 - 8:00	4	8	12	1.8	4.6	8.8	2.2	3.4	3.2
40 (Existing condition)	25 to 45	7:00 - 7:15	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
		7:15 - 7:30	4	10	12	1.8	4.3	8.7	2.2	5.7	3.3
		7:30 - 7:45	4	10	0	1.8	4.3	8.3	2.2	5.7	-8.3
		7:45 - 8:00	4	8	12	1.7	4.3	8.9	2.3	3.7	3.1
45	30 to 50	7:00 - 7:15	4	7	14	1.8	4.2	7.8	2.2	2.8	6.2
		7:15 - 7:30	4	10	12	1.8	4.2	8.5	2.2	5.8	3.5
		7:30 - 7:45	4	10	0	1.8	4.2	8.2	2.2	5.8	-8.2
		7:45 - 8:00	4	8	12	1.7	4.2	8.6	2.3	3.8	3.4

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	4	7	14	1.8	4.2	7.8	2.2	2.8	6.2
		7:15 - 7:30	4	10	12	1.8	4.3	8.8	2.2	5.7	3.2
		7:30 - 7:45	4	10	0	1.7	4.1	8.2	2.3	5.9	-8.2
		7:45 - 8:00	4	8	12	1.7	4.1	8.7	2.3	3.9	3.3
55	30 to 50	7:00 - 7:15	4	7	14	1.8	4.2	7.8	2.2	2.8	6.2
		7:15 - 7:30	4	10	12	1.8	4.2	8.5	2.2	5.8	3.5
		7:30 - 7:45	4	10	0	1.7	4.2	8.3	2.3	5.8	-8.3
		7:45 - 8:00	4	8	12	1.7	4.1	8.6	2.3	3.9	3.4

Note:

- Circulating Speed = 16 - 22 mph
- EB Volume = 1260 vph

Table 5-7. Salem Roundabout EB - Circulating Speed (mph) vs. Travel Time (seconds) – AM

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15	7:00 - 7:15	4	7	14	1.9	5.0	11.7	2.1	2.0	2.3
		7:15 - 7:30	4	10	12	2.0	4.9	13.6	2.0	5.1	-1.6
		7:30 - 7:45	4	10	0	1.9	5.0	12.9	2.1	5.0	-12.9
		7:45 - 8:00	4	8	12	1.9	4.9	13.6	2.1	3.1	-1.6
15	15 to 20 **(16 to 22 existing condition)**	7:00 - 7:15	4	7	14	1.8	4.5	8.7	2.2	2.5	5.3
		7:15 - 7:30	4	10	12	1.8	4.6	9.8	2.2	5.4	2.2
		7:30 - 7:45	4	10	0	1.7	4.5	9.2	2.3	5.5	-9.2
		7:45 - 8:00	4	8	12	1.8	4.5	9.9	2.2	3.5	2.1
20	20 to 25	7:00 - 7:15	4	7	14	1.8	4.4	7.1	2.2	2.6	6.9
		7:15 - 7:30	4	10	12	1.8	4.3	8.0	2.2	5.7	4.0
		7:30 - 7:45	4	10	0	1.7	4.3	7.3	2.3	5.7	-7.3
		7:45 - 8:00	4	8	12	1.8	4.3	8.4	2.2	3.7	3.6
25	25 to 30	7:00 - 7:15	4	7	14	1.9	4.5	6.1	2.1	2.5	7.9
		7:15 - 7:30	4	10	12	1.8	4.4	7.2	2.2	5.6	4.8
		7:30 - 7:45	4	10	0	1.8	4.2	6.4	2.2	5.8	-6.4
		7:45 - 8:00	4	8	12	1.8	4.2	6.8	2.2	3.8	5.2
30	30 to 35	7:00 - 7:15	4	7	14	1.8	4.5	5.6	2.2	2.5	8.4
		7:15 - 7:30	4	10	12	1.8	4.4	6.3	2.2	5.6	5.7
		7:30 - 7:45	4	10	0	1.8	4.3	5.7	2.2	5.7	-5.7
		7:45 - 8:00	4	8	12	1.8	4.4	6.2	2.2	3.6	5.8

Note:

- Approach Speed = 40 mph EB Volume = 1260 vph

Table 5-8. Salem Roundabout EB – Critical Gap (seconds) vs. Travel Time (seconds) – AM

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	4	7	14	1.8	4.3	7.9	2.2	2.7	6.1
	7:15 - 7:30	4	10	12	1.8	4.4	8.8	2.2	5.6	3.2
	7:30 - 7:45	4	10	0	1.7	4.3	8.4	2.3	5.7	-8.4
	7:45 - 8:00	4	8	12	1.8	4.3	8.7	2.2	3.7	3.3
1	7:00 - 7:15	4	7	14	1.9	4.6	8.1	2.1	2.4	5.9
	7:15 - 7:30	4	10	12	1.9	4.6	8.9	2.1	5.4	3.1
	7:30 - 7:45	4	10	0	1.9	4.7	8.4	2.1	5.3	-8.4
	7:45 - 8:00	4	8	12	1.9	4.5	9.0	2.1	3.5	3.0
2	7:00 - 7:15	4	7	14	2.1	5.1	8.2	1.9	1.9	5.8
	7:15 - 7:30	4	10	12	2.1	5.1	9.2	1.9	4.9	2.8
	7:30 - 7:45	4	10	0	2.1	5.0	8.4	1.9	5.0	-8.4
	7:45 - 8:00	4	8	12	2.0	4.8	9.3	2.0	3.2	2.7
3	7:00 - 7:15	4	7	14	2.2	5.1	8.1	1.8	1.9	5.9
	7:15 - 7:30	4	10	12	2.2	5.2	9.3	1.8	4.8	2.7
	7:30 - 7:45	4	10	0	2.1	5.1	8.5	1.9	4.9	-8.5
	7:45 - 8:00	4	8	12	2.2	5.0	9.4	1.8	3.0	2.6

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- EB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table 5-9. Salem Roundabout EB - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	4	7	14	1.8	4.3	7.8	2.2	2.7	6.2
	7:15 - 7:30	4	10	12	1.8	4.4	8.9	2.2	5.6	3.1
	7:30 - 7:45	4	10	0	1.7	4.2	8.5	2.3	5.8	-8.5
	7:45 - 8:00	4	8	12	1.7	4.2	8.9	2.3	3.8	3.1
-20	7:00 - 7:15	4	7	14	1.8	4.3	7.8	2.2	2.7	6.2
	7:15 - 7:30	4	10	12	1.8	4.4	8.9	2.2	5.6	3.1
	7:30 - 7:45	4	10	0	1.7	4.2	8.5	2.3	5.8	-8.5
	7:45 - 8:00	4	8	12	1.7	4.2	9.0	2.3	3.8	3.0
-10	7:00 - 7:15	4	7	14	1.8	4.3	7.9	2.2	2.7	6.1
	7:15 - 7:30	4	10	12	1.8	4.3	8.8	2.2	5.7	3.2
	7:30 - 7:45	4	10	0	1.7	4.2	8.3	2.3	5.8	-8.3
	7:45 - 8:00	4	8	12	1.7	4.2	8.9	2.3	3.8	3.1
+10	7:00 - 7:15	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
	7:15 - 7:30	4	10	12	1.8	4.4	8.8	2.2	5.6	3.2
	7:30 - 7:45	4	10	0	1.7	4.3	8.4	2.3	5.7	-8.4
	7:45 - 8:00	4	8	12	1.7	4.4	8.8	2.3	3.6	3.2
+20	7:00 - 7:15	4	7	14	1.8	4.5	8.0	2.2	2.5	6.0
	7:15 - 7:30	4	10	12	1.9	4.5	8.9	2.1	5.5	3.1
	7:30 - 7:45	4	10	0	1.8	4.4	8.4	2.2	5.6	-8.4
	7:45 - 8:00	4	8	12	1.8	4.5	9.0	2.2	3.5	3.0

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- EB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table 5-10. Salem Roundabout EB - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	4	7	14	2.1	5.0	8.0	1.9	2.0	6.0
		7:15 - 7:30	4	10	12	2.1	4.9	9.0	1.9	5.1	3.0
		7:30 - 7:45	4	10	0	2.1	4.8	8.4	1.9	5.2	-8.4
		7:45 - 8:00	4	8	12	2.1	4.7	9.2	1.9	3.3	2.8
30 (Existing condition)	15 to 35	7:00 - 7:15	4	7	14	1.9	4.7	7.9	2.1	2.3	6.1
		7:15 - 7:30	4	10	12	1.9	4.5	9.1	2.1	5.5	2.9
		7:30 - 7:45	4	10	0	1.9	4.6	8.3	2.1	5.4	-8.3
		7:45 - 8:00	4	8	12	1.9	4.5	9.2	2.1	3.5	2.8
35	20 to 40	7:00 - 7:15	4	7	14	1.9	4.7	7.9	2.1	2.3	6.1
		7:15 - 7:30	4	10	12	1.9	4.5	9.1	2.1	5.5	2.9
		7:30 - 7:45	4	10	0	1.9	4.6	8.3	2.1	5.4	-8.3
		7:45 - 8:00	4	8	12	1.9	4.5	9.2	2.1	3.5	2.8
40	25 to 45	7:00 - 7:15	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
		7:15 - 7:30	4	10	12	1.8	4.3	8.7	2.2	5.7	3.3
		7:30 - 7:45	4	10	0	1.8	4.3	8.3	2.2	5.7	-8.3
		7:45 - 8:00	4	8	12	1.7	4.3	8.9	2.3	3.7	3.1
45	30 to 50	7:00 - 7:15	4	7	14	1.7	4.2	7.8	2.3	2.8	6.2
		7:15 - 7:30	4	10	12	1.7	4.3	8.6	2.3	5.7	3.4
		7:30 - 7:45	4	10	0	1.6	4.1	8.0	2.4	5.9	-8.0
		7:45 - 8:00	4	8	12	1.6	4.1	8.6	2.4	3.9	3.4

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	4	7	14	1.6	4.1	7.6	2.4	2.9	6.4
		7:15 - 7:30	4	10	12	1.7	4.2	8.4	2.3	5.8	3.6
		7:30 - 7:45	4	10	0	1.5	4.0	7.9	2.5	6.0	-7.9
		7:45 - 8:00	4	8	12	1.6	3.9	8.1	2.4	4.1	3.9
55	30 to 50	7:00 - 7:15	4	7	14	1.6	3.9	7.7	2.4	3.1	6.3
		7:15 - 7:30	4	10	12	1.6	4.1	8.4	2.4	5.9	3.6
		7:30 - 7:45	4	10	0	1.5	3.8	7.6	2.5	6.2	-7.6
		7:45 - 8:00	4	8	12	1.5	3.7	8.0	2.5	4.3	4.0

Note:

- Approach Speed = 40 mph
- Circulating Speed = 16 – 22 mph
- EB Volume = 1260 vph

5.4. FINAL CALIBRATION

The sensitivity analyses of these simulation calibration parameters have demonstrated that driver critical gap, min. headway distance and reduced speed on an approach are the vital factors for calibrating queue length. Circulating speed and critical gaps contribute significantly to the travel time calibration, as shown in Figure 5-3.

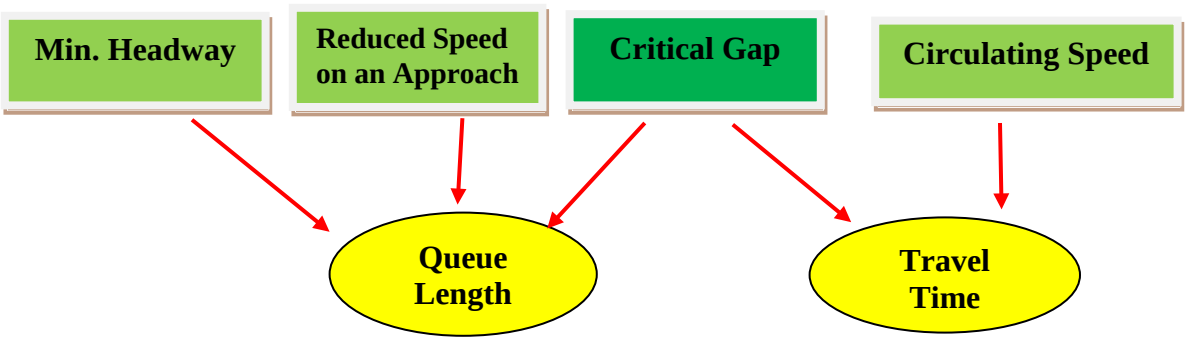


Figure 5-3. Critical Calibration Factors

In this section, Salem roundabout is used as an experiment site to calibrate its queue length and travel time by applying the recommendations drawn from the previous section on calibration patterns and their relations to performance measures.

Four experiments were conducted to calibration queues and travel time as described below.

Experiment 1: Modify Critical Gap only (Queue Length Calibration)

The simulation of existing condition of Salem roundabout has shown that the average queue difference in AM peak hour period is about 1~2 vehicles in both EB and NB, and the maximum queue difference is about 2~5 vehicles. In this calibration process, the critical gaps were modified by increasing 1.5 sec. on northbound and 2 sec. on the other three appraoches in the a.m. peak hour, and 2.4 sec. on northbound and 1.5~1.7 sec. on the other three approaches during the p.m. peak hour. The improved results are quickly obtained as shown in Table 5-11 and 5-12. The difference btween simulation and field obversation is under 1 vehicle or a little over 1 vehicle.

In a summary, the critical gap is effective and sensitive towards vehicle queues and also can be controlled relatively easily.

Experiment 2: Modify Min. Headway Distance only (Queue Length Calibration)

Min. headway distance is modified by increasing 20 ft to 36ft from the existing one. The results in a.m. peak hour do appear to be closer to the field condition, as shown in Table 5-13 and 5-14, however, in the p.m. condition, the difference of maximum queue on both EB and NB remain about 2.6 and 4.8 vehicles at one 15-time interval. The min. headway distance can affect queues but not as effective as critical gap. In addition, min. headway distance presents some challenging and could be time consuming efforts in the calibration process. It also requires a special attention to the saturation point of its value. If the min. headway distance reaches to this point, then by increasing distance only with 1 foot can completely overestimates the queue results.

Experiment 3: Modify both Reduced Speed on an Approach and Critical Gap (Queue Length Calibration)

The reduced speed on the Salem roundabout approaches is decreased further by 5 to 15 mph from 30 mph (the existing condition). Critical gap is increased about 2.5 to 3 seconds in the a.m. peak hour and 0.5 to 1 sec in the PM peak hour. As described in Table 5-15 and 5-16, the results have shown the difference between field and simulated is minimum. The effect of this calibration factor is accompanied with a smaller modification on critical gaps.

Experiment 4: Modify Circulating Speed (Travel Time Calibration)

As shown in Table 5-17, with the increase of 5 mph circulating speed, it is expected that travel time should be reduced. However the change is only effective on certain approaches. A reduction of 2 mph on circulating speed does has slightly better impact on less congested approach of WB. The research team has also done other trial and error. In the end, it became obvious that it can be challenging to calibration travel time, particularly when a roundabout has some approaches overestimated and others underestimated. This is because the circulating speed must be applied to all turning movements in VISSIM through the reduced speed zone function and therefore cannot be implemented with different values on different approaches. For example, it is difficult to choose a circulating speed or identify the calibration direction if the intention here is to increase the EB travel time but at the same time to decrease the WB travel time so that in end both results will be close to 0.

Table 5-11. Queue Length Calibration based on Critical Gap (Salem Roundabout, AM Peak Hour)

Critical Gap: EB = 5.6 sec., WB = 5.8 sec., NB = 5.3 sec., and SB = 5.8 sec.

Peak Period (A.M)	Field EB Ave	Simulation EB Ave	Diff.	Field EB Max	Simulation EB Max	Diff.	Field NB Ave	Simulation NB Ave	Diff.	Field NB Max	Simulation NB Max	Diff.
7:00 - 7:15	1	1.5	-0.5	9.0	10.4	-1.4	2	0.2	1.8	6.0	6.4	-0.4
7:15 - 7:30	2	1.7	0.3	12.0	12.2	-0.2	1	0.2	0.8	6.0	5.7	0.3
7:30 - 7:45	1	1.0	0.0	10.0	9.8	0.2	1	0.2	0.8	6.0	5.6	0.4
7:45 - 8:00	2	1.8	0.2	9.0	10.2	-1.2	1	0.2	0.8	7.0	7.1	-0.1

Table 5-12. Queue Length Calibration based on Critical Gap (Salem Roundabout, PM Peak Hour)

Critical Gap: EB = 5.3 sec., WB = 5.3 sec., NB = 6.2 sec., and SB = 5.3 sec.

Peak Period (P.M)	Field EB Average	Simulation EB Average	Diff.	Field EB Max	Simulation EB Max	Diff.	Field NB Average	Simulation NB Average	Diff.	Field NB Max	Simulation NB Max	Diff.
4:00 - 4:15	1	1.0	0.0	9.0	9.6	-0.6	2	0.8	1.2	10.0	9.8	0.2
4:15 - 4:30	2	0.5	1.5	8.0	7.2	0.8	1	0.9	0.1	9.0	9.5	-0.5
4:30 - 4:45	1	0.7	0.3	11.0	9.8	1.2	1	0.9	0.1	13.0	11.7	1.3
4:45 - 5:00	2	0.8	1.2	8.0	8.3	-0.3	1	0.9	0.1	11.0	10.9	0.1

Note: EB = 3.6 sec, WB = 3.8 sec., NB = 3.8 sec., and SB = 3.8 sec (existing critical gaps)

Table 5-13. Queue Length Calibration based on Min. Headway Distance (Salem Roundabout, AM Peak Hour)

EB: + 36 ft, WB: +25 ft, NB: +25 ft, SB: +25 ft

Peak Period (A.M)	Field EB Ave.	Simulation EB Ave.	Diff.	Field EB Max	Simulation EB Max	Diff.	Field NB Ave.	Simulation NB Ave.	Diff.	Field NB Max	Simulation NB Max	Diff.
7:00 - 7:15	1.0	0.7	0.3	9.0	9.7	-0.7	2.0	0.5	1.5	6.0	6.3	-0.3
7:15 - 7:30	2.0	0.5	1.5	12.0	10.3	1.7	1.0	0.2	0.8	6.0	5.8	0.2
7:30 - 7:45	1.0	0.5	0.5	10.0	8.0	2.0	1.0	0.4	0.6	6.0	5.4	0.6
7:45 - 8:00	2.0	0.4	1.6	9.0	9.5	-0.5	1.0	0.2	0.8	7.0	6.8	0.2

Table 5-14. Queue Length Calibration based on Min. Headway Distance (Salem Roundabout, PM Peak Hour)

EB: + 24 ft, WB: +20 ft, NB: +34 ft, SB: +20 ft

Peak Period (P.M)	Field EB Ave	Simulation EB Ave	Diff.	Field EB Max	Simulation EB Max	Diff.	Field NB Ave	Simulation NB Ave	Diff.	Field NB Max	Simulation NB Max	Diff.
4:30 - 4:45	1	0.5	0.5	9.0	7.5	1.5	2	0.6	1.4	10.0	9.0	1.0
4:45 - 5:00	2	0.4	1.6	8.0	6.1	1.9	1	0.6	0.4	9.0	8.9	0.1
5:00 - 5:15	1	0.5	0.5	11.0	8.4	2.6	1	0.6	0.4	13.0	8.2	4.8
5:15 - 5:30	2	0.6	1.4	8.0	8.4	-0.4	1	0.6	0.4	11.0	10.1	0.9

Note: Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)

Table 5-15. Queue Length Calibration based on Reduced Speed on an Approach & Critical Gap (Salem Roundabout, AM Peak Hour)

EB = 20 mph, WB = 20 mph, NB = 15 mph, SB = 20 mph & EB = 5.3 sec., WB = 5.3 sec., NB = 6.8 sec., SB = 5.3 sec.

Peak Period (A.M)	Field EB Ave.	Simulation EB Ave.	Diff.	Field EB Max	Simulation EB Max	Diff.	Field NB Ave.	Simulation NB Ave.	Diff.	Field NB Max	Simulation NB Max	Diff.
7:00 - 7:15	1	1.2	-0.2	9.0	10.8	-1.8	2	0.2	1.8	6.0	6.0	0.0
7:15 - 7:30	2	1.3	0.7	12.0	11.8	0.2	1	0.2	0.8	6.0	5.8	0.2
7:30 - 7:45	1	0.9	0.1	10.0	10.4	-0.4	1	0.2	0.8	6.0	6.1	-0.1
7:45 - 8:00	2	1.5	0.5	9.0	11.6	-2.6	1	0.3	0.7	7.0	6.8	0.2

Table 5-16. Queue Length Calibration based on Reduced Speed on an Approach & Critical Gap (Salem Roundabout, PM Peak Hour)

EB = 25 mph, WB = 25 mph, NB = 25 mph, SB = 25 mph & EB = 4.8 sec., WB = 4.3 sec., NB = 4.3 sec., SB = 4.3 sec.

Peak Period (A.M)	Field EB Ave.	Simulation EB Ave.	Diff.	Field EB Max	Simulation EB Max	Diff.	Field NB Ave	Simulation NB Ave	Diff.	Field NB Max	Simulation NB Max	Diff.
4:30 - 4:45	1	0.7	0.3	9.0	8.8	0.2	2	0.4	1.6	10.0	10.0	0.0
4:45 - 5:00	2	0.4	1.6	8.0	7.2	0.8	1	0.5	0.5	9.0	9.4	-0.4
4:45 - 5:00	1	0.7	0.3	11.0	9.9	1.1	1	0.5	0.5	13.0	10.9	2.1
5:15 - 5:30	2	0.7	1.3	8.0	8.9	-0.9	1	0.5	0.5	11.0	9.6	1.4

Note: Reduced Speed on an Approach = 30 mph (Existing condition)

Table 5-17 Travel Time Calibration based on Circulating Speed (Salem Roundabout, PM Peak Hour)

EB (Differences)			NB (Differences)			SB (Differences)			WB (Differences)		
R	TH	L	R	TH	L	R	TH	L	R	TH	L
2	3	6	2	1	1	1	-1	0	1	0	-1
2	6	3	1	0	1	1	-1	1	1	-1	-1
2	6	4	1	2	0	1	1	1	0	-2	0
2	4	3	2	0	1	1	0	5	1	-1	-1

Existing

EB (Differences)			NB (Differences)			SB (Differences)			WB (Differences)		
R	TH	L	R	TH	L	R	TH	L	R	TH	L
2	3	7	2	1	1	1	0	1	1	1	0
2	6	4	1	0	2	1	0	2	1	-1	0
2	6	4	1	2	1	1	2	2	0	-2	0
2	4	4	2	0	2	1	1	5	1	-1	0

Increased +5mph

EB (Differences)			NB (Differences)			SB (Differences)			WB (Differences)		
R	TH	L	R	TH	L	R	TH	L	R	TH	L
2	2	5	1	0	0	0	-2	0	1	-1	-2
2	5	2	0	-1	0	0	-2	0	1	-3	-2
2	5	3	0	1	-1	0	0	1	0	-5	-2
2	3	2	1	-1	0	1	-1	4	1	-4	-2

Decreased 2mph

CHAPTER 6 RECOMMENDATIONS

6.1 RECOMMENDATIONS FOR ANALYZING TRAFFIC AND DRIVE BEHAVIOR DATA

This study has performed an extensive data collection and analysis to understand traffic characteristics and driver behavior at Connecticut roundabouts. A large sample size of field data was analyzed to achieve accurate and statistically significant results. This research recommends, at the minimum, the following traffic data be evaluated properly to ensure their quality for better modeling of roundabouts in simulation:

- Critical Gap, or Critical Headway: The critical gap cannot be obtained directly from the recorded time events. This research has applied two methods to estimate the critical gap. The maximum likelihood model assumes that a single driver's critical headway ranges between his or her largest rejected headway and the accepted headway. The implementation of the method requires a probabilistic iteration technique and computational efforts. Compared to maximum likelihood method, Raff method is easier to implement. The gap length where the percent of gap rejected equals to the percent of gap accepted is defined as the critical gap. In this study, the critical gap estimated by the maximum likelihood method resulted in a slightly smaller value than that of the raff method, as discussed in Chapter 3. With the circumstance that VISSIM tends to overestimate some traffic conditions, the critical gap of Raff method could produce better results in simulating queue length. Nevertheless, the maximum likelihood method is recommended for estimating the critical gaps by Highway Capacity Manual (2010). Either method should be suitable for future projects.

- Circulating Speed: It is necessary to obtain the distribution of the circulating speed including three basic statistics - minimum, maximum and average speed as simulation inputs. The circulating speed can be calculated as volume-weighted average values to allow the movements with higher flow contribute more to the final results. This research has demonstrated all roundabouts have a circulating speed at or lower than 20 mph. It is believed that a combination of geometry and volume of a roundabout can have a good impact to the circulating speed.

- Turning Movement Volume: Miovision technology has demonstrated its accuracy in measuring turning movements. Only left turn movements show a small discrepancy compared to manually collected data from video footages. It is recommended to validate some left turn volumes at large roundabouts where multiple cameras and image synchronization required for data collection and process. This research does not involve the data collection of multi-lane roundabouts (except Salem roundabout northbound) which can present more challenges.

- Queue length: In this study, queue length is evaluated through obserserving video footages manually at every 5-min interval. Minimum, average and maximum queues are recorded and aggregated to each 15-min interval. The measurement of queue length usually requires to deploy separate cameras in the field for capturing queues. When the queue gets longer, the cameras are required to be positioned properly to seize the end of the queue.

6.2 RECOMMENDATIONS FOR APPLYING VISSIM TO ROUNDABOUTS

The research team has identified the following five factors as the most critical to calibrate and modeling a roundabout in VISSIM:

- Critical Gap;
- Circulating Speed;
- Reduced Speed of Approach;
- Min. Headway Distance
- and Approach Speed.

This study provides the following recommendations on the use of calibration factors for roundabout traffic operations modeling in VISSIM:

- When the volume for all approaches was low (< 500 veh/h), the effect of calibration factors such as approach speed, reduced speed for approach, minimum headway and circulating speed on vehicle queues is minimum.

- When the volumes for all approaches are high (> 700 vphpl), all calibration factors affect vehicle queues in some extent but variation in its pattern for circulating speed, approach speed was not uniform.

- In particular, sensitivity of VISSIM overestimation seems to increase when the flow increases. The roundabout or the approaches with higher traffic flow would be more sensitive to the change of these variables.

- Among all the calibration factors, critical gap is the most effective and powerful variable affecting vehicle queues regardless the volumes of all approaches are low or high.

- When the nearby legs are closer (<60 feet), minimum headway distance becomes sensitive to queue results. Minimum headway distance does affect queue but up to a saturation point. Higher the distance, longer will be the queue and once it reaches the saturation point the impact of minimum headway distance on queues is very minimum. The saturation point is the distance between subject approach entering and the upstream entrance, as shown in Figure 5-2.

- When the geometry of a roundabout is small such as at West Haven roundabout (radius about 200 feet), if the vehicle volume is higher, VISSIM tends to completely overestimate queue results, however, travel time is not affected.

- The study has shown that travel time (the time different between enter and exit the roundabout) cannot be calibrated properly, as we were not able to assign different circulating speed with respect to each turning movements.

- Approach speed is not effective in affecting queue compared to the reduced speed of an approach. Any change in the approach speed can be again controlled by the reduced speed area when the vehicles approach to the stopline of a roundabout. If a reduced area is not assigned to an approach, then approach speed should be promoted to be a reasonable factor in determining queue length.

In a summary, the analyses of these simulation calibration parameters have demonstrated that driver critical gap, min. headway distance and reduced speed on an approach are the vital factors for calibrating queue length. Circulating speed and critical gaps contribute significantly to the travel time calibration.

6.3 RECOMMENDED PARAMETER VALUES FOR ANALYZING CONNECTICUT ROUNDABOUTS

This study summarizes the recommended parameter values for simulating and modeling Connecticut roundabouts. The recommendations are based on data analysis of 20,000 vehicles at all four roundabouts, simulation results and past research.

There are five key simulation parameters that are used for calibrating driver behavior at roundabouts. They are driver critical gap, circulating speed, minimum headway distance, reduced speed on an entering approach and follow-up headway. The definition of each parameter has been presented in various chapters of the report. They are also summarized here for readers' convenience.

- **Driver Critical Gap**: The critical gap, or critical headway, is defined in HCM (2010) as the minimum time interval in the major-street traffic stream that allows intersection entry for one minor street vehicle. The same term is also used in this research to analyze traffic operations of roundabouts where yield signs are present. The critical gap is the minimum headway that provides a gap in circulating traffic that would allow one vehicle to enter the roundabout flow.
- **Circulating Speed**: Vehicle travel distance is measured on the circulating path in terms of left, through and right turning movement of each approach at each roundabout. Circulating speed of each vehicle is calculated from travel time and travel distance. Instead of using simple arithmetic mean of speeds, the circulating speed of each turning movement is calculated as a volume-weighted average value of all approaches. The more traffic an approach carries, the greater its contribution to the average speed.

- **Minimum Headway Distance**: Minimum Headway Distance is defined as the headway distance between the conflict marker and the next vehicle traveling upwards (as shown in Figure 4-6). The Minimum Headway Distance is calculated as Minimum Gap Time multiple Maximum Speed of Circulating Vehicle.
- **Reduced Speed on an Entering Approach**: This study assumed there would be gradually decrease of speed around 10 – 15 mph at about 200 – 250 feet from the roundabout entrance. A reduced speed is assigned in this area to observe realistic driver behavior.
- **Follow-up Headway**: Headway is the time between successive vehicles as they pass a point on a lane or roadway (e.g., roundabout entering stop line), also measured from the same point on each vehicle (e.g., front bumper). In HCM (2010) the time between the departure of one vehicle from the minor street and the departure of the next vehicle using the same major-street headway, under a condition of continuous queuing on the minor street is called the follow-up headway. Thus, follow-up headway, or saturation discharge headway is the also headway that defines the saturation flow rate for the approach if there were no conflicting vehicles on movements of higher rank.

Four types of roundabouts are classified in this study: Hybrid Roundabout (roundabout with a mixed single-lane and multi-lane on the circulation), Four-Leg Roundabout, Small Roundabout (with diameter < 150 ft) and Roundabouts with Closely-Spaced Legs.

Table 6-1 gives an overview of the recommended values of these five calibration parameters for each type of roundabout. Details on how these values are determined and their results are presented in Section 6.3.1 through Section 6.3.4.

Table 6-1. Recommended Calibration Parameter Values for Analyzing Connecticut Roundabouts

	Hybrid Roundabout	**Four-Leg Roundabout**	**Small Roundabout**	**Roundabout with Closely-Spaced Legs**
Critical Gap (sec)	Refer to Table 6-2	Refer to Table 6-2	Refer to Table 6-2	Refer to Table 6-2
Circulating Speed [Mean Value] (mph)	17.8 – 22.2 [20]	13 – 18 [15.5]	13 – 18 [15.5]	13.7 – 18.8 [16.3]
Reduced Speed on an Entering Approach (mph)	Refer to Table 6-3	Refer to Table 6-3	Refer to Table 6-3	Refer to Table 6-3
Min. Headway Distance (ft)	Calculated as the product of the Critical Gap and Maximum Circulating Speed. However, its value cannot exceed the distance to the upstream entering approach. See Figure 6-2 and Table 6-4 for details.			
Follow-up Headway (sec)	2.58	2.99	3.38	3.39

6.3.1 Driver Critical Gap

The data analysis of driver behavior in this study has indicated that drivers are willing to accept smaller gaps when volumes increase and/or in more congested conditions. Table 6-2 presents the recommended critical gap values for each type of roundabout at different circulating and approach flow conditions. There are totally four scenarios applied considering a combination of high and low traffic volumes on circulating (conflicting) and entering. Troutbeck (1989) established the relationships between circulating flow and entry flow, as shown in Figure 6-1. When Vc (circulating or conflicting flow) reaches 1000 veh/h and V_A (approach or entry flow) rises to 500 veh/h, a single lane roundabout would operate at its capacity and a 2-lane roundabout is suggested to better accommodate traffic flow. Thus, this study follows the same idea of using these values as boundaries to identify high or low flow condition for circulating and entering, respectively.

The entry lanes are also classified as dominant or sub-dominant. The dominant one has the greatest entry flow and the other lanes carry sub-dominant streams. This is based on the assumption that the drivers on the dominant lane tend to influence the behavior of drives in other entry lanes at the approach (Troutbeck, 1989).

Table 6-2. Recommended Critical Gap Values for Analyzing Connecticut Roundabouts

Circulating Flow (V_C)	Approach Flow (V_A)	Hybrid Roundabout		4-Leg Roundabout	Small Roundabout	Closely-Spaced Leg Roundabout
		Single-Lane Entering Approach	Multi-lane Entering Approach			
V_C < 1000 veh/h	**V_A** < 500 veh/h	3.8	3.8 (dominant) 4.0 (sub-dominant)	3.9	4.2	3.7
	V_A > 500 veh/h	3.1	3.1 (dominant) 3.8 (sub-dominant)	3.2	3.5	3.0
V_C > 1000 veh/h	**V_A** < 500 veh/h	3.7	3.4 (dominant) 4.1 (sub-dominant)	4.0	4.4	4.0
	V_A > 500 veh/h	3.0	2.7 (dominant) 3.4 (sub-dominant)	3.3	3.7	3.3

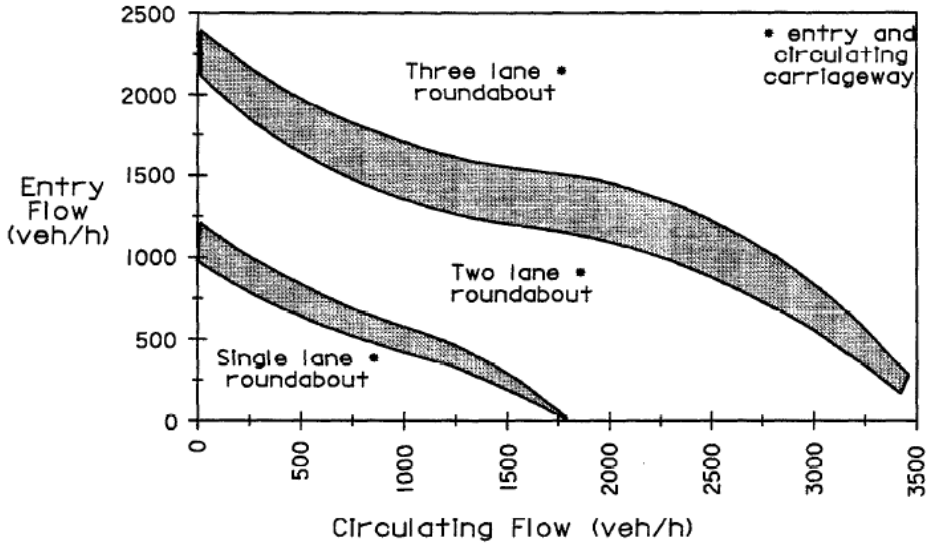


Figure 6-1. Required Number of Entry and Circulating Lanes (Troutbeck, 1989)

When V_C < 1000 veh/h and V_A < 500 veh/h, critical gaps were primarily estimated based on Maximum Likelihood method using the field data gathered in this study (see Section 3.4 for details). Each gap value is summarized based upon the appropriate roundabout characteristics. For instance, the values of Hybrid Roundabouts are from the Salem roundabout. 4-Leg Roundabout is represented by a combination of data from Salem and Killingworth and a Roundabout with Closely-spaced Leg is characterized by various approaches from Ellington and Killingworth. The West Haven roundabout is set for Small Roundabout.

When V_C < 1000 veh/h and V_A > 500 veh/h or When V_C > 1000 veh/h and V_A < 500 veh/h, field data were mainly not available. Simulation study was then used to identify driver reactions under this condition, or to find how drivers would react differently when traffic volume increases. Both northbound and southbound approaches of the Ellington roundabout were modeled. For example, the existing southbound condition has driver reaction time 3.7seconds and traffic volume 411 veh/h. When the volume rises to 500 veh/h and higher, driver reaction is reduced to 2.9 seconds to produce the similar queue length performance.

The field data were not available for the condition when V_C > 1000 veh/h and V_A > 500 veh/h, critical gap was then estimated based upon some results from Troutbeck's study (1989, 1990). The study recommends the critical gap based on its relations to follow-up headway under various circulating flows, the number of circulating lanes and entry lane width conditions. The critical acceptance gap values for each approach are given by the product of the follow-up headway in Table 6-2b and the ratios in Table 6-2a. As shown on both tables, when circulating flow increases, follow-up headway reduces and so does its ratio with critical gap.

Below presents an example on how critical gap is calculated. In the case of a hybrid roundabout with single lane approach, critical acceptance gap (3.0 sec) is first calculated as the product of follow-up time from Table 6-2a and the ratio in Table 6-2b, and then adjusted using an average value of one lane circulating (1.67 x 1.96 = 3.27 sec) and more than one lane

circulating (1.39 x 1.96 = 2.7 sec). Inscribed diameter, circulating flow and average entry lane width were 230 ft, 1,000 veh/h and 13 ft respectively.

Table 6-2a Ratio of the Critical Acceptance Gap to the Follow-up Headway (Troutbeck, 1989)

Number of circulating lanes	one			more than one		
Ave. entry lane width (ft)	10	13	16	10	13	16
Circulating flow (veh/h)						
0	2.32	1.98	1.64	2.04	1.70	1.36
200	2.26	1.92	1.58	1.98	1.64	1.30
400	2.19	1.85	1.52	1.92	1.58	1.24
600	2.13	1.79	1.45	1.85	1.51	1.18
800	2.07	1.73	1.39	1.79	1.45	1.11
1000	2.01	**1.67**	1.33	1.73	**1.39**	1.10
1200	1.94	1.60	1.26	1.67	1.33	1.10
1400	1.88	1.54	1.20	1.60	1.26	1.10
1600	1.82	1.48	1.14	1.54	1.20	1.10
1800				1.48	1.14	1.10
2000				1.41	1.10	1.10
2200				1.35	1.10	1.10
2400				1.29	1.10	1.10
2600				1.23	1.10	1.10

Table 6-2b. Dominant Stream Follow-up Headways (Troutbeck, 1989)

Inscribed Diameter (ft)	**Circulating Flow (veh/h)**					
	0	500	1000	1500	2000	2500
66	2.99	2.79	2.60	2.40	2.20	2.00
82	2.91	2.71	2.51	2.31	2.12	1.92
98	2.83	2.63	2.43	2.24	2.04	1.84
115	2.75	2.55	2.36	2.16	1.96	1.77
131	2.68	2.48	2.29	2.09	1.89	1.70
148	2.61	2.42	2.22	2.02	1.83	1.63
164	2.55	2.36	2.16	1.96	1.76	1.57
180	2.49	2.30	2.10	1.90	1.71	1.51
197	2.44	2.25	2.05	1.85	1.65	1.46
213	2.39	2.20	2.00	1.80	1.61	1.41
230	2.35	2.15	**1.96**	1.76	1.56	1.36
246	2.31	2.11	1.92	1.72	1.52	1.33
262	2.27	2.08	1.88	1.68	1.49	1.29

6.3.2 Reduced Speed on an Entering Approach

This study assumed there would be a gradual decrease of speed around 10 – 15 mph at about 200 – 250 feet from the roundabout entrance. Table 6-3 illustrates the distribution of reduced speed, average (50th percentile), minimum and maximum values at various speed limits.

Table 6-3. Recommended Reduced Speed on an Entering Approach

Speed Limit of an Approach	Distribution of Reduced Speed		
	50 Percentile	Min.	Max.
25	20	17.5	22.5
30	25	22.5	27.5
35	25	22.5	27.5
40	30	27.5	32.5
45	35	32.5	37.5
50	40	37.5	42.5
55	45	42.5	47.5

6.3.3 Minimum Headway Distance

Minimum Headway Distance is an important and often negligent concept in VISSIM simulation. It is calculated as the product of the Critical Gap and Maximum Circulating Speed. However, its value cannot exceed the distance to the upstream entering approach. If there is a vehicle present within the distance, it will block the action of vehicles on the subject approach and these vehicles will not be able to depart. As shown on Figure 6-2, its recommended (accepted) value is measured from the subject approach to the upstream approaches, and marked as green. The accepted limit of the Minimum Headway Distance is defined when the queue suddenly increases to about 8-10 vehicles.

This study also investigated the sensitivity within this distance in VISSIM simulation. The sensitive zone (marked as yellow) shows small changes on the queue about 0.5 ~ 2 vehicles while the rest of the distance (non-sensitive zone) does not exhibit any change. As shown in Table 6-4, using Ellington and Killingworth as examples, their recommended distances are determined. The ratios of sensitivity (or non-sensitivity zone) to the accepted distance are also calculated although there is no clear pattern revealed. It is suggested that future study with more sample data from simulation could uncover the trend of Minimum Headway Distance and its sensitivity.

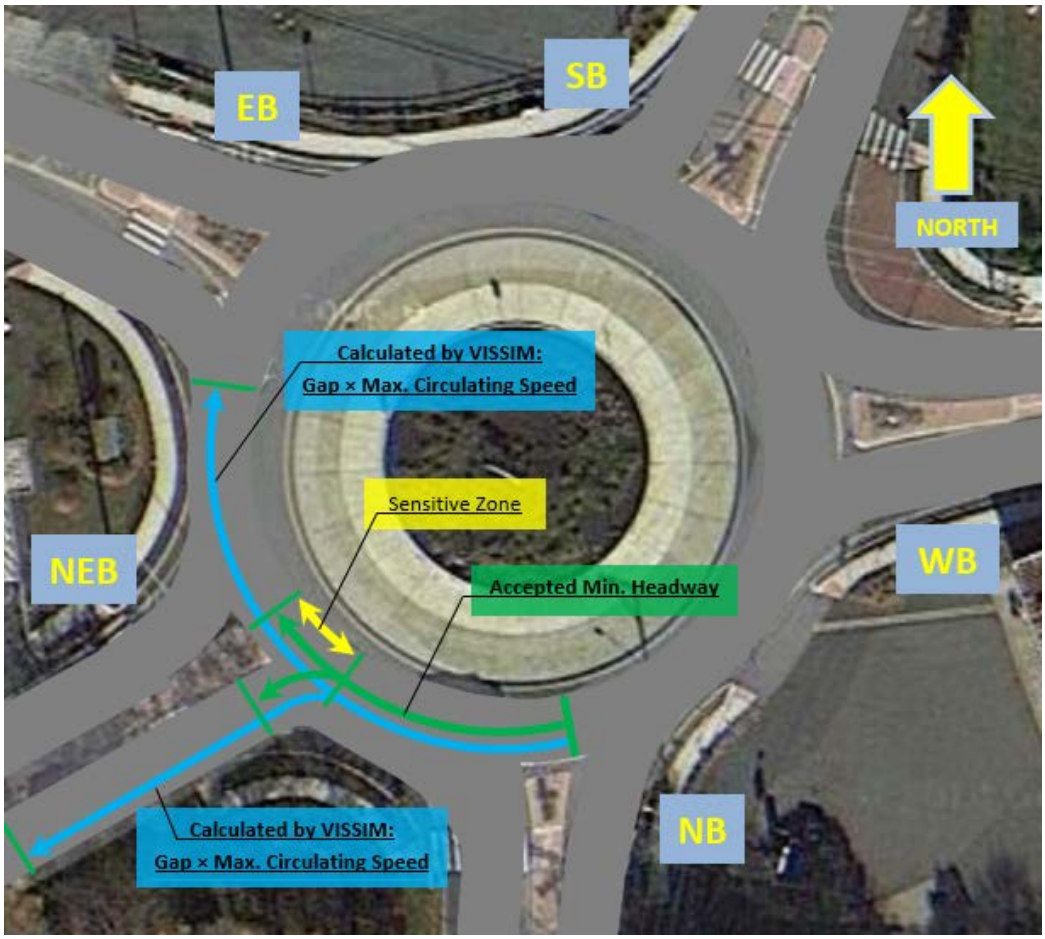


Figure 6-2. Recommended Minimum Headway Distance.

Table 6-4. Minimum Headway Distance

Roundabout Approach		Calculated (ft)	**Accepted (Recommended) (ft)**	Sensitive (ft)	Non-Sensitive (ft)	Ratio of Accepted and Calculated	Ratio of Sensitive and Accepted	Ratio of Non-Sensitive and Accepted
Ellington	NB	107.5	**62.4**	10.4	52.0	58%	17%	83%
	SB	110.3	**70.0**	14.0	56.0	63%	20%	80%
Killingworth	SB	105.6	**95.4**	31.8	63.6	90%	33%	67%
					Average	71%	23%	77%

6.3.4 Follow-up Headway

Follow-up headway is used to describe the driver behavior at departure under the same available circulating gap. Follow-up headway, however, is not employed by VISSIM simulation. The term is used in other modeling procedures such as SITRA roundabout simulation and HCM

analysis. Together with critical gap, they are the two most important parameters used in traffic modeling of roundabouts according to HCM.

Table 6-5 presents the recommend values of follow-up headway and saturated discharge rates. They were analyzed based on the field data collected in this study.

Table 6-5. Recommend Follow-up Headway

Roundabout		Average Follow-up Headway (Seconds)	Saturation Discharge Rate (veh/h)
Salem	EB	2.58	1396.55
	NB	2.58	1398.06
	Average	2.58	1397.30
Ellington	NB	2.44	1474.54
	SB	4.33	831.28
	Average	3.39	1152.91
West Haven	EB	3.92	918.72
	WB	2.85	1265.04
	Average	3.38	1091.88
Killingworth	NB	3.09	1164.22
	SB	2.93	1226.98
	Average	3.01	1195.60

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APPENDIX A

PEAK HOUR VOLUME OF ROUNDABOUTS

APPENDIX A – PEAK HOUR VOLUME OF ROUNDABOUTS

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Table A-1. Salem Roundabout: A.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (a.m.)	Salem											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	72	19	9	4	45	3	39	11	7	1	10	92
	7:15 – 7:30	65	16	10	4	45	3	29	16	1	4	20	96
	7:30 – 7:45	59	28	13	0	41	3	21	13	7	1	10	115
	7:45 – 8:00	72	25	8	0	40	2	17	11	0	4	24	96
	Total	268	88	40	8	171	11	106	51	15	10	64	399

Table A-1a. Salem Roundabout: A.M. Peak Hour Traffic Volume – Field Data

Date of Recording	Time (a.m.)	Salem											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	69	18	13	4	43	4	35	12	8	1	10	90
	7:15 – 7:30	50	14	12	3	46	3	31	16	1	5	20	91
	7:30 – 7:45	58	26	9	0	39	3	21	13	6	1	9	115
	7:45 – 8:00	56	19	0	0	41	2	17	11	0	4	18	101
	Total	233	77	34	7	169	12	104	52	15	11	57	397

Note: Percentage of Heavy vehicles observed in MIOVISION is NB (6%), SB (3%), WB (3%), EB (5%).

Table A-2. Salem Roundabout: P.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (p.m.)	Salem											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 – 4:45	89	59	29	7	37	1	23	15	5	6	23	102
	4:45 – 5:00	104	57	27	6	50	3	19	11	6	6	30	91
	5:00 – 5:15	128	70	26	2	29	2	15	13	2	3	21	103
	5:15 – 5:30	97	69	28	3	32	2	13	13	5	5	23	72
	Total	418	255	110	18	148	8	70	52	18	20	97	368

Table A-2a. Salem Roundabout: P.M. Peak Hour Traffic Volume – Field Data

Date of Recording	Time (p.m.)	Salem											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 – 4:45				3	37	7	26	12	5	4	28	113
	4:45 – 5:00				4	41	1	20	10	7	2	22	107
	5:00 – 5:15				4	35	3	16	14	7	3	19	89
	5:15 – 5:30				4	46	9	15	14	6	3	22	101
	Total				15	159	20	77	50	25	12	91	410

Note: Percentage of Heavy vehicles observed in MIOVISION is NB (1%), SB (2%), WB (3%), EB (2%).

Table A-3. Ellington Roundabout: A.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (a.m.)	Ellington																			
		NB				NEB				WB				SB				EB			
		L	HL	TH	R	BL	HL	BR	R	BL	L	TH	R	TH	L	BR	R	TH	L	R	HR
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	22	2	9	23	33	0	12	12	7	7	9	30	40	48	34	12	24	6	14	2
	7:15 – 7:30	14	6	17	12	19	1	13	13	12	12	22	28	45	47	57	22	25	16	12	3
	7:30 – 7:45	20	0	11	14	37	0	13	13	13	13	33	26	58	35	42	15	23	5	15	3
	7:45 – 8:00	20	0	11	9	33	0	16	16	22	22	29	22	48	26	49	13	37	9	20	4
	Total	76	8	48	58	122	1	54	54	54	54	93	106	191	156	182	62	109	36	61	12

Note: Percentage of Heavy vehicles observed in MIOVISION is NB (3%), SB (3%), WB (5%), EB (4%), NEB (3%).

Note:

- **L**-LEFT
- **BL**- BARE LEFT
- **HL**-HARD LEFT
- **TH**-THROUGH
- **R**- RIGHT
- **BR**- BARE RIGHT
- **HR**-HARD RIGHT

Table A-4. Ellington Roundabout: P.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (p.m.)	Ellington																			
		NB				NEB				WB				SB				EB			
		L	HL	TH	R	BL	HL	BR	R	BL	L	TH	R	TH	L	BR	R	TH	L	R	HR
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 – 4:45	66	0	14	20	86	0	1	0	20	20	1	61	24	27	33	3	34	6	17	4
	4:45 – 5:00	32	2	54	13	78	0	8	4	12	12	22	48	32	33	29	5	40	9	21	4
	5:00 – 5:15	37	4	41	13	57	0	19	3	20	20	38	50	32	26	30	6	26	15	14	0
	5:15 – 5:30	37	0	51	19	59	0	20	8	25	25	42	48	55	22	36	14	24	13	8	1
	Total	172	6	160	65	280	0	48	15	77	77	103	207	143	108	128	28	124	43	60	9

Note: Percentage of Heavy vehicles observed in MIOVISION is NB (0%), SB (1%), WB (3%), EB (1%), NEB (1%).

Note:

- **L**-LEFT
- **BL**- BARE LEFT
- **HL**-HARD LEFT
- **TH**-THROUGH
- **R**- RIGHT
- **BR**- BARE RIGHT
- **HR**-HARD RIGHT

Table A-5. West Haven Roundabout: A.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (a.m.)	West Haven					
		SB		WB		EB	
		L	R	L	R	L	R
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	7	26	53	19	11	34
	7:15 – 7:30	10	23	49	26	15	24
	7:30 – 7:45	14	30	63	24	24	25
	7:45 – 8:00	9	36	42	22	15	28
	Total	40	115	207	91	65	111

Note: Percentage of Heavy vehicles observed in MIOVISION is SB (2%), WB (2%), EB (2%).

Table A-6. West Haven Roundabout: P.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (p.m.)	West Haven					
		SB		WB		EB	
		L	R	L	R	L	R
Tuesday, May 20th, 2014 (4:45 p.m. – 5:45 p.m.)	4:45 – 5:00	22	47	70	17	45	107
	5:00 – 5:15	32	43	62	20	48	102
	5:15 – 5:30	41	41	78	12	42	100
	5:30 – 5:45	27	35	75	23	46	102
	Total	122	166	285	72	181	411

Table A- 6a. West Haven Roundabout: P.M. Peak Hour Traffic Volume – Field Data

Date of Recording	Time (p.m.)	West Haven					
		SB		WB		EB	
		L	R	L	R	L	R
Tuesday, May 20th, 2014 (4:45 p.m. – 5:45 p.m.)	4:45 – 5:00	22	49	73	16	44	105
	5:00 – 5:15	33	47	64	15	49	103
	5:15 – 5:30	42	40	76	12	42	99
	5:30 – 5:45	27	33	75	21	44	119
	Total	124	169	288	64	179	426

Note: Percentage of Heavy vehicles observed in MIOVISION is SB (0%), WB (2%), EB (1%).

Table A-7. Killingworth Roundabout: A.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (a.m.)	Killingworth											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	12	94	6	18	47	6	6	27	24	14	22	7
	7:15 – 7:30	18	60	5	21	59	21	8	27	16	15	20	13
	7:30 – 7:45	16	72	11	15	73	7	7	22	30	11	15	17
	7:45 – 8:00	18	90	6	23	71	20	19	20	21	18	14	11
	Total	64	316	28	77	250	54	40	96	91	58	71	48

Table A-7a. Killingworth Roundabout: A.M. Peak Hour Traffic Volume – Field Data

Date of Recording	Time (a.m.)	Killingworth											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 – 7:15	11	96	5	17	51	7	5	26	24	8	20	7
	7:15 – 7:30	8	74	4	20	68	21	7	27	16	18	15	14
	7:30 – 7:45	14	87	5	14	75	7	6	23	31	14	15	17
	7:45 – 8:00	6	99	5	21	76	20	15	22	21	14	25	15
	Total	39	356	19	72	270	55	33	98	92	54	75	53

Note: Percentage of Heavy vehicles observed in MIOVISION is NB (5%), SB (6%), WB (6%), EB (4%).

Table A-8. Killingworth Roundabout: P.M. Peak Hour Traffic Volume – Miovision Data

Date of Recording	Time (p.m.)	Killingworth											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 – 4:45	15	90	18	14	87	16	22	21	27	22	32	25
	4:45 – 5:00	21	90	15	19	88	13	21	34	26	31	23	17
	5:00 – 5:15	24	89	16	15	114	21	16	24	23	13	31	33
	5:15 – 5:30	20	82	13	17	91	18	15	29	26	17	25	19
	Total	80	351	62	65	380	68	74	108	102	83	111	94

Table A-8a. Killingworth Roundabout: P.M. Peak Hour Traffic Volume – Field Data

Date of Recording	Time (p.m.)	Killingworth											
		NB			SB			WB			EB		
		L	TH	R	L	TH	R	L	TH	R	L	TH	R
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 – 4:45	12	94	15	17	87	16	21	22	26	13	15	23
	4:45 – 5:00	14	100	10	17	89	13	18	35	28	25	27	25
	5:00 – 5:15	20	95	11	14	111	22	13	25	23	17	23	26
	5:15 – 5:30	8	92	10	17	87	16	13	33	27	10	29	27
	Total	54	381	37	65	374	67	75	115	104	65	94	101

Note: Percentage of Heavy vehicles observed in MIOVISION is NB (3%), SB (2%), WB (3%), EB (2%).

APPENDIX B

CIRCULATING SPEED OF ROUNDABOUTS

APPENDIX B – CIRCULATING SPEED OF ROUNDABOUTS

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Table B-1. Salem Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Wednesday, May 21st, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	17.28	23.27	20.27	458
		Left	17.77	19.77	18.77	355
		Through	18.58	24.46	21.52	355
		Combined (R+L+TH)	17.82	22.57	**20.20**	**1168**
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. - 5:30 p.m.	Right	10.94	15.81	13.37	478
		Left	17.00	18.77	17.89	248
		Through	16.74	21.95	19.35	357
		Combined (R+L+TH)	14.24	18.51	**16.38**	**1083**

Note:

- Average based upon the turning movement of each bound.

Table B-2. Ellington Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Wednesday, May 21st, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	13.70	18.91	16.30	655
		Left	13.82	20.76	17.29	390
		Through	14.44	19.79	17.11	433
		Combined (R+L+TH)	13.95	19.65	**16.80**	**1478**
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. - 5:30 p.m.	Right	12.29	17.55	14.92	560
		Left	15.76	20.33	18.04	479
		Through	12.54	18.16	15.35	544
		Combined (R+L+TH)	13.43	18.60	**16.01**	**1583**

Note:

- Right movement is based on the turning movement of right, bear right and hard right
- Left movement is based on the turning movement of left, bear left and hard left
- Average based upon the turning movement of each bound.

Table B-3. West Haven Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Tuesday, May 20th, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	13.51	18.66	16.08	310
		Left	13.68	15.76	14.72	314
		Combined (R+L)	13.04	17.20	**15.40**	**624**
Tuesday, May 20th, 2014 (4:45 p.m. - 5:45 p.m.)	4:45 p.m. - 5:45 p.m.	Right	14.21	18.95	16.58	619
		Left	13.80	15.64	14.72	577
		Combined (R+L)	14.01	17.35	**15.68**	**1196**

Note:

- Average based upon the turning movement of each bound.

Table B-4. Killingworth Roundabout: Circulating Speed – Field Data

Date of Recording	Time	Movement	Min Speed (mph)	Max Speed (mph)	Average Circulating Speed (mph)	Volume (v/h)
Tuesday, May 20th, 2014 (7 a.m. - 8 a.m.)	7 a.m. - 8 a.m.	Right	12.68	19.47	16.07	219
		Left	12.93	17.97	15.45	198
		Through	12.48	15.09	13.78	799
		Combined (R+L+TH)	12.59	16.35	**14.47**	**1216**
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. - 5:30 p.m.	Right	12.67	16.26	14.46	284
		Left	14.16	19.76	16.96	250
		Through	12.88	18.78	15.83	900
		Combined (R+L+TH)	13.06	18.45	**15.76**	**1434**

Note:

- Average based upon the turning movement of each bound.

APPENDIX C

TRAVEL TIME OF ROUNDABOUTS

APPENDIX C – TRAVEL TIME OF ROUNDABOUTS

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Table C-1.1. Salem Roundabout: A.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach			
			EB	NB	SB	WB
Wednesday, May 21st, 2014 (7 a.m. - 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	4	3	3	2
		Left	14	10	10	10
		Through	7	6	6	7
	7:15 a.m. to 7:30 a.m.	Right	4	2	3	2
		Left	12	10	10	10
		Through	10	5	6	6
	7:30 a.m. to 7:45 a.m.	Right	4	2	3	2
		Left	0	9	10	10
		Through	10	7	8	5
	7:45 a.m. to 8:00 a.m.	Right	4	3	3	2
		Left	12	10	13	10
		Through	8	5	7	6

Table C-1.2. Salem Roundabout: P.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach			
			EB	NB	SB	WB
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. to 4:45 a.m.	Right	4	3	3	2
		Left	12	11	13	10
		Through	7	7	9	6
	4:45 p.m. to 5:00 p.m.	Right	5	2	4	2
		Left	12	11	12	10
		Through	10	8	8	6
	5:00 p.m. to 5:15 p.m.	Right	5	3	3	2
		Left	13	12	13	11
		Through	10	8	8	6
	5:15 p.m. to 5:30 p.m.	Right	5	3	3	2
		Left	14	11	10	10
		Through	9	7	7	5

Table C-2.1. Ellington Roundabout: A.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Approach									
		Movement	NB	Movement	WB	Movement	NEB	Movement	SB	Movement	EB
Wednesday, May 21st, 2014 (7 a.m. - 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	5	Right	2	Hard Right	2	Right	4	Through	3
		Through	6	Through	6	Bare Right	5	Bare Right	8	Hard Right	6
		Left	11	Bare Left	13	Bare Left	9	Through	13	Left	11
		Hard Left	0	Left	14	Hard Left	14	Left	15	Right	12
	7:15 a.m. to 7:30 a.m.	Right	5	Right	3	Hard Right	2	Right	4	Through	4
		Through	6	Through	7	Bare Right	5	Bare Right	9	Hard Right	6
		Left	12	Bare Left	12	Bare Left	11	Through	11	Left	11
		Hard Left	0	Left	23	Hard Left	15	Left	17	Right	13
	7:30 a.m. to 7:45 a.m.	Right	6	Right	4	Hard Right	2	Right	4	Through	7
		Through	7	Through	7	Bare Right	6	Bare Right	8	Hard Right	7
		Left	14	Bare Left	12	Bare Left	8	Through	11	Left	10
		Hard Left	14	Left	15	Hard Left	16	Left	16	Right	14
	7:45 a.m. to 8:00 a.m.	Right	5	Right	4	Hard Right	2	Right	4	Through	3
		Through	7	Through	10	Bare Right	6	Bare Right	9	Hard Right	7
		Left	13	Bare Left	13	Bare Left	8	Through	11	Left	11
		Hard Left	0	Left	16	Hard Left	15	Left	15	Right	12

Table C-2.2. Ellington Roundabout: P.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Approach									
		Movement	NB	Movement	WB	Movement	NEB	Movement	SB	Movement	EB
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 a.m.	Right	5	Right	2	Hard Right	2	Right	4	Through	3
		Through	6	Through	6	Bare Right	5	Bare Right	8	Hard Right	6
		Left	11	Bare Left	13	Bare Left	9	Through	13	Left	11
		Hard Left	13	Left	14	Hard Left	14	Left	15	Right	12
	4:45 p.m. to 5:00 p.m.	Right	4	Right	3	Hard Right	2	Right	4	Through	4
		Through	6	Through	7	Bare Right	5	Bare Right	9	Hard Right	6
		Left	12	Bare Left	12	Bare Left	11	Through	11	Left	11
		Hard Left	16	Left	23	Hard Left	15	Left	17	Right	13
	5:00 p.m. to 5:15 p.m.	Right	6	Right	4	Hard Right	2	Right	4	Through	7
		Through	7	Through	7	Bare Right	6	Bare Right	8	Hard Right	7
		Left	14	Bare Left	12	Bare Left	8	Through	11	Left	10
		Hard Left	15	Left	15	Hard Left	16	Left	16	Right	14
	5:15 p.m. to 5:30 p.m.	Right	5	Right	4	Hard Right	2	Right	4	Through	3
		Through	7	Through	10	Bare Right	6	Bare Right	9	Hard Right	7
		Left	13	Bare Left	13	Bare Left	8	Through	11	Left	11
		Hard Left	13	Left	16	Hard Left	15	Left	15	Right	12

Table C-3.1. West Haven Roundabout: A.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach		
			EB	WB	SB
Tuesday, May 20th, 2014 (7 a.m. - 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	3	3	4
		Left	8	7	10
	7:15 a.m. to 7:30 a.m.	Right	3	3	3
		Left	7	8	8
	7:30 a.m. to 7:45 a.m.	Right	3	3	3
		Left	7	8	8
	7:45 a.m. to 8:00 a.m.	Right	3	2	3
		Left	8	8	8

Table C-3.2. West Haven Roundabout: P.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach		
			EB	WB	SB
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. to 4:45 a.m.	Right	4	3	5
		Left	8	7	8
	4:45 p.m. to 5:00 p.m.	Right	4	3	5
		Left	9	7	10
	5:00 p.m. to 5:15 p.m.	Right	4	3	4
		Left	8	8	10
	5:15 p.m. to 5:30 p.m.	Right	4	3	3
		Left	9	8	10

Table C-4.1. Killingworth Roundabout: A.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach			
			EB	NB	SB	WB
Tuesday, May 20th, 2014 (7 a.m. - 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	4	3	3	2
		Left	14	10	10	10
		Through	7	6	6	6
	7:15 a.m. to 7:30 a.m.	Right	4	2	3	2
		Left	12	10	10	10
		Through	10	5	6	6
	7:30 a.m. to 7:45 a.m.	Right	4	2	3	2
		Left	12	9	10	10
		Through	10	7	8	5
	7:45 a.m. to 8:00 a.m.	Right	4	3	3	2
		Left	12	10	13	10
		Through	8	5	7	6

Table C-4.2. Killingworth Roundabout: P.M. Peak Hour Travel Time – Field Data

Date of Recording	Time	Movement	Approach			
			EB	NB	SB	WB
Tuesday, May 20th, 2014 (4:30 p.m. - 5:30 p.m.)	4:30 p.m. to 4:45 a.m.	Right	4	3	3	3
		Left	14	11	10	11
		Through	7	6	6	8
	4:45 p.m. to 5:00 p.m.	Right	4	2	3	2
		Left	13	11	10	10
		Through	10	7	6	7
	5:00 p.m. to 5:15 p.m.	Right	4	2	3	2
		Left	14	9	10	10
		Through	10	7	7	9
	5:15 p.m. to 5:30 p.m.	Right	4	3	3	3
		Left	13	11	13	12
		Through	8	6	7	6

APPENDIX D

ESTIMATION OF CRITICAL GAP OF RAOUNDABOUTS USING RAFF METHOD

APPENDIX D – ESTIMATION OF CRITICAL GAP OF ROUNDABOUTS USING RAFF METHOD

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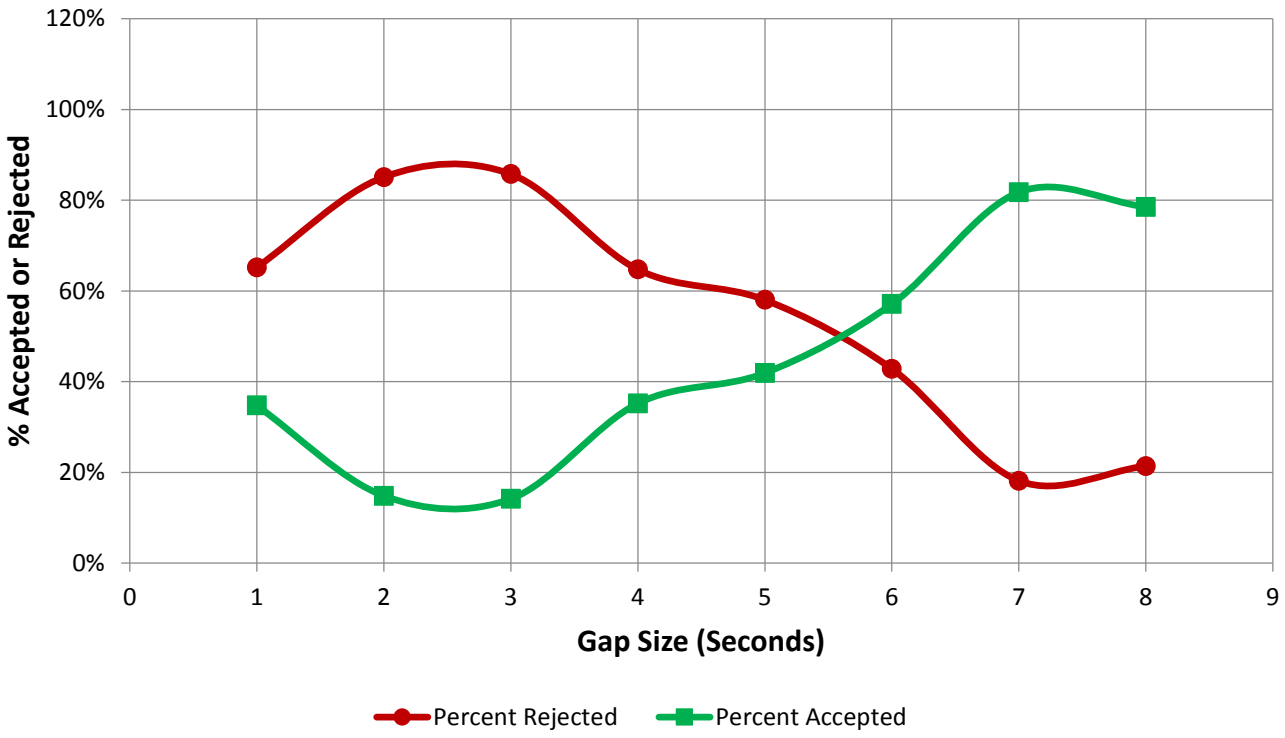
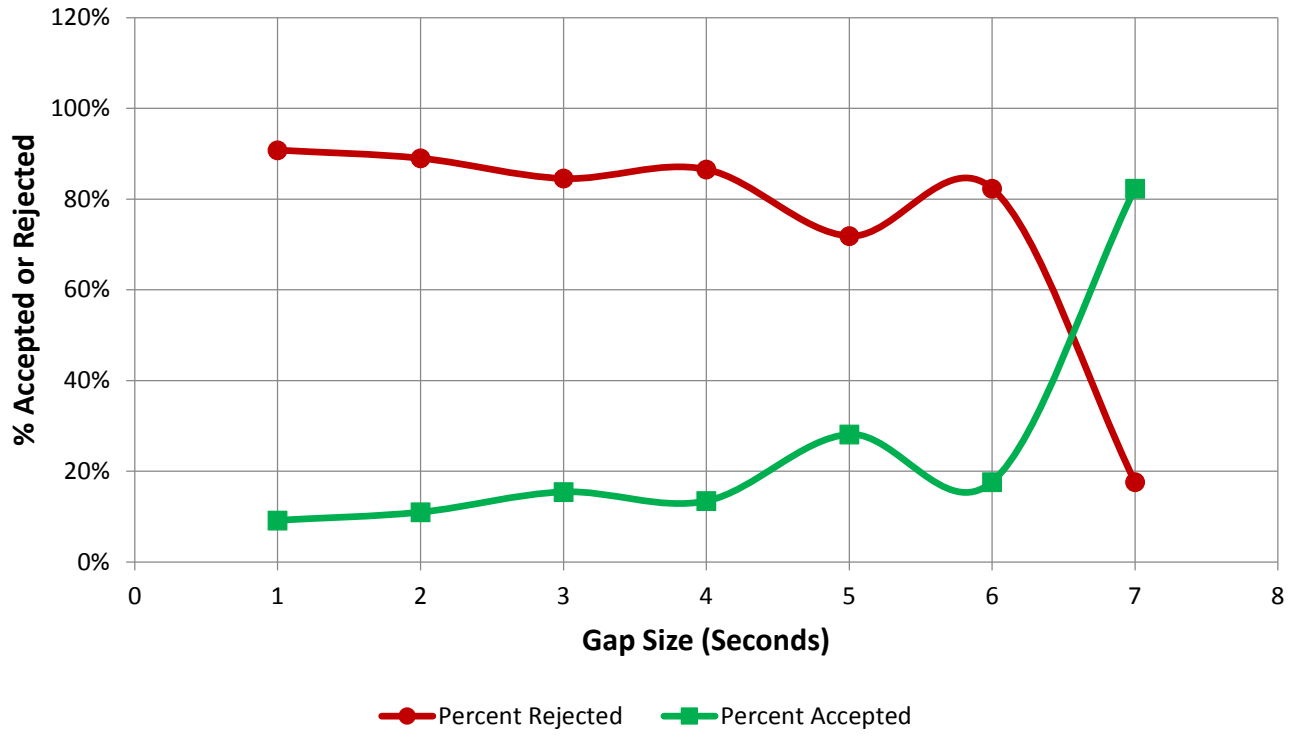
Figure D-1.1. Critical Gap Analysis Based on Raff Method
Salem Roundabout – EB



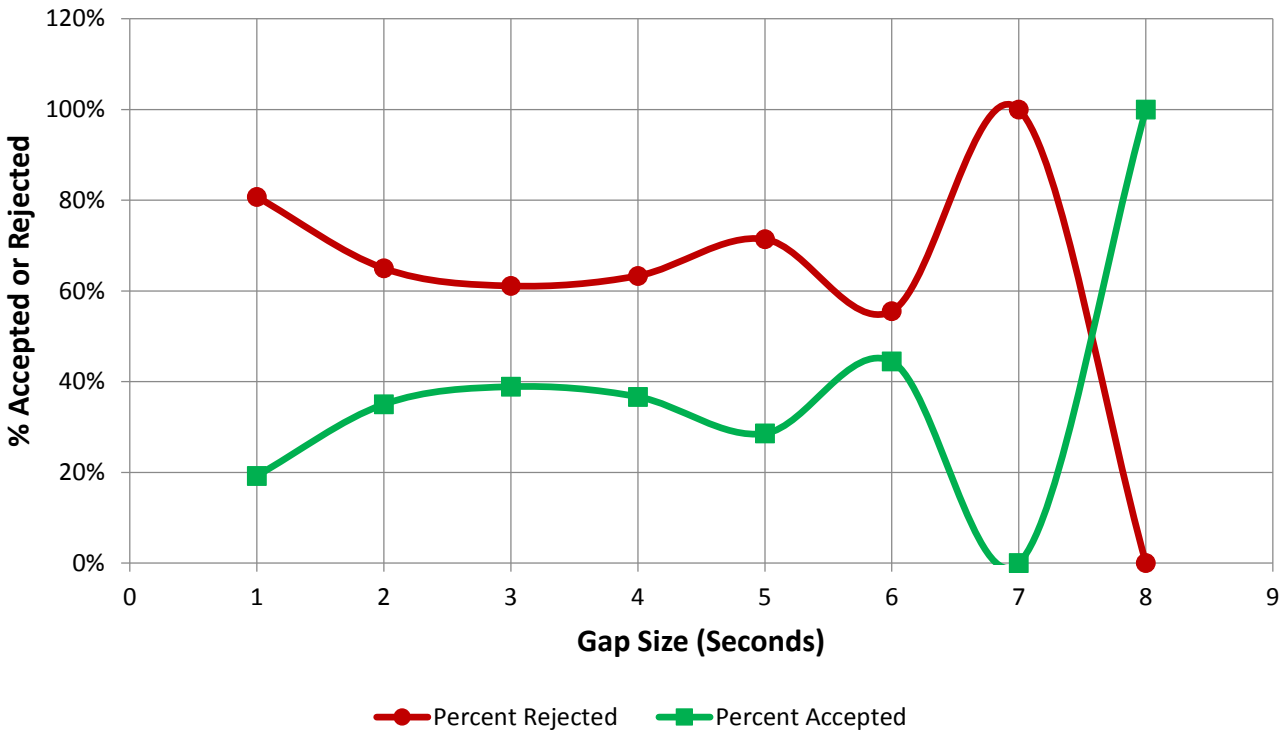
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + L + TH	1	45	24	65%	35%
	2	126	22	85%	15%
	3	127	21	86%	14%
	4	57	31	65%	35%
	5	18	13	58%	42%
	6	9	12	43%	57%
	7	2	9	18%	82%
	8	3	11	21%	79%

Figure D-1.2. Critical Gap Analysis Based on Raff Method
Salem Roundabout – WB



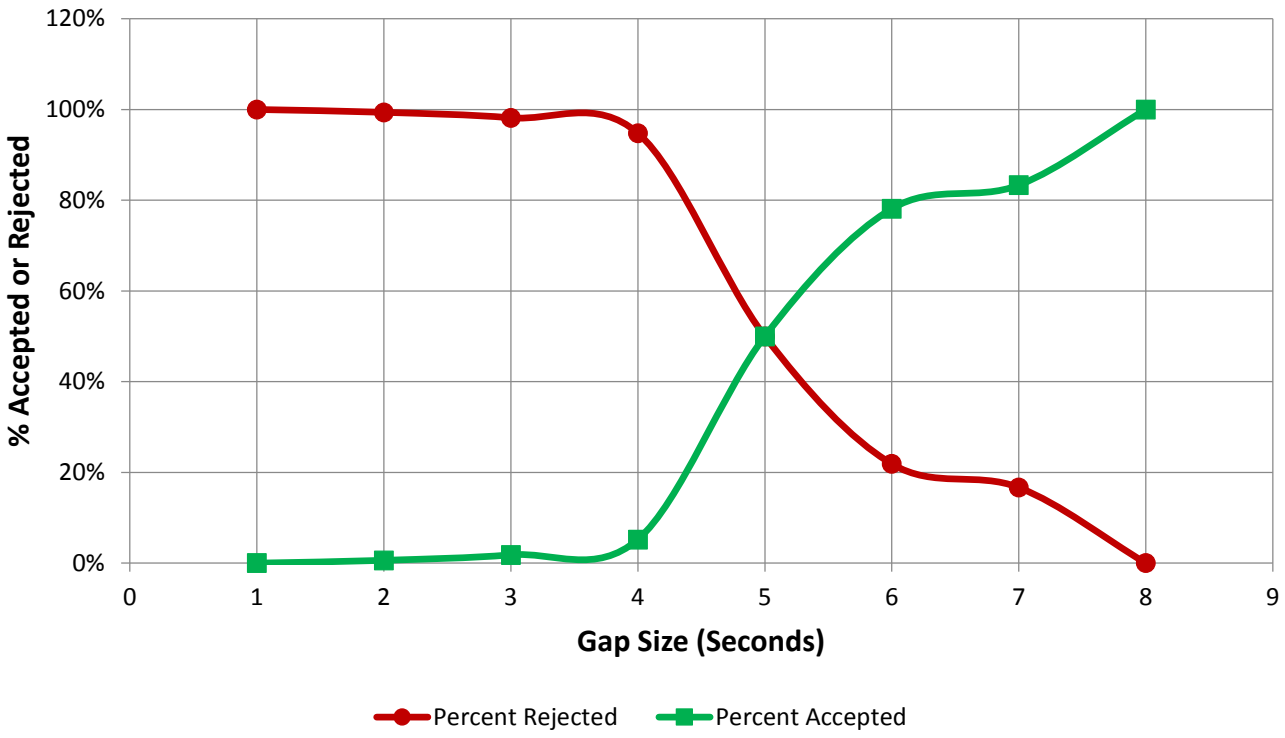
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + L + TH	1	89	9	91%	9%
	2	219	27	89%	11%
	3	115	21	85%	15%
	4	58	9	87%	13%
	5	23	9	72%	28%
	6	14	3	82%	18%
	7	3	14	18%	82%

Figure D-1.3. Critical Gap Analysis Based on Raff Method
Salem Roundabout – NB



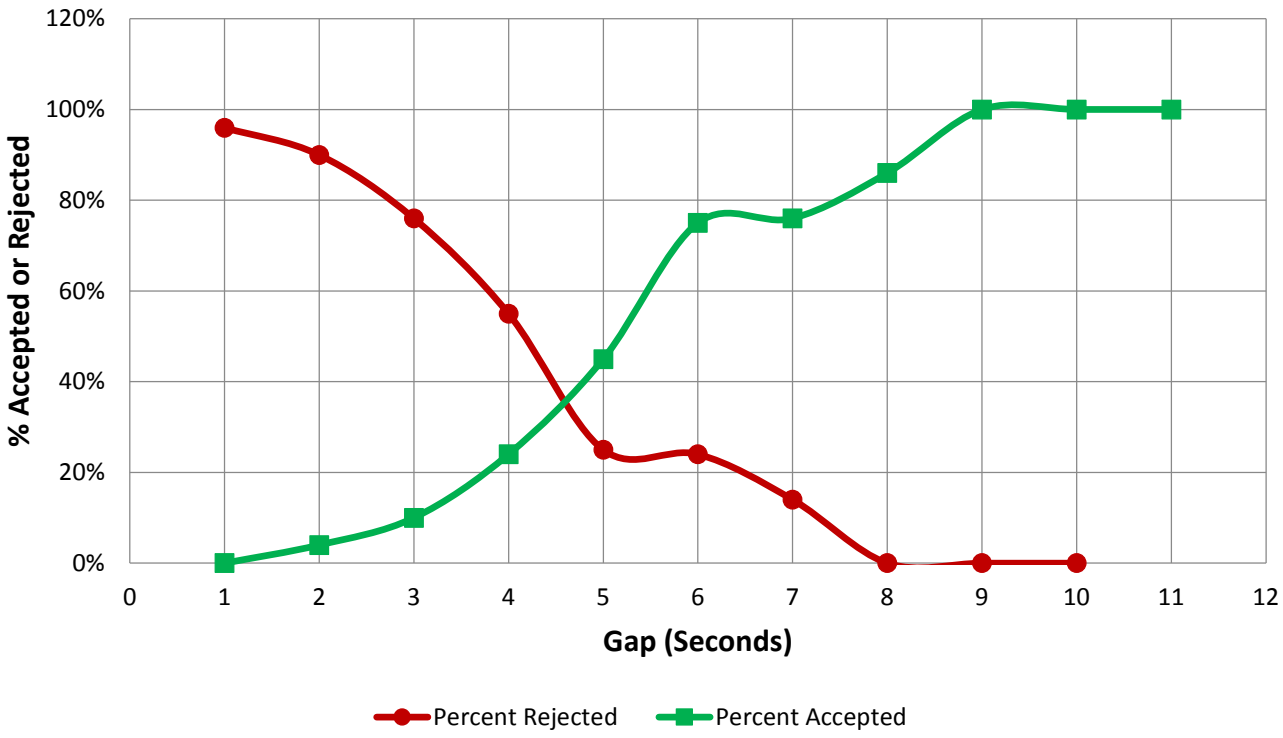
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + L + TH	1	21	5	81%	19%
	2	26	14	65%	35%
	3	33	21	61%	39%
	4	19	11	63%	37%
	5	10	4	71%	29%
	6	5	4	56%	44%
	7	2	0	100%	0%
	8	0	2	0%	100%

Figure D-1.4. Critical Gap Analysis Based on Raff Method
Salem Roundabout – SB



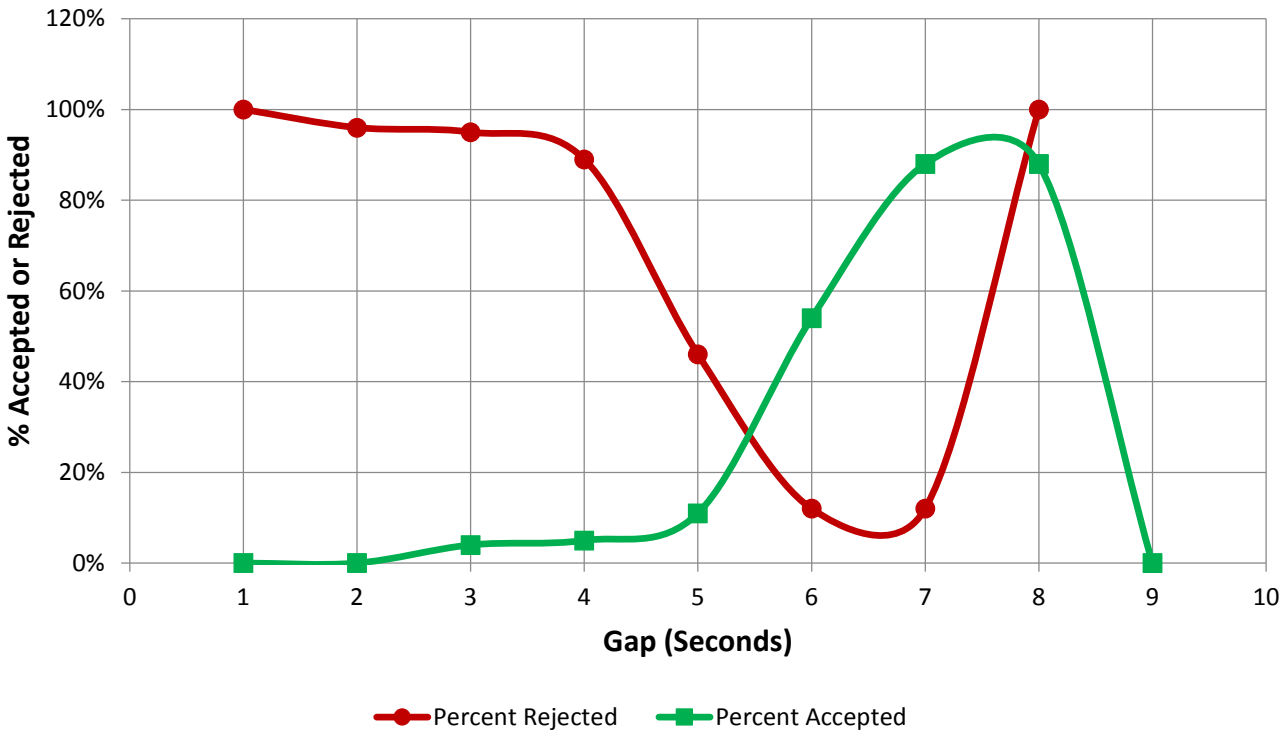
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + L + TH	1	25	0	100%	0%
	2	160	1	99%	1%
	3	161	3	98%	2%
	4	73	4	95%	5%
	5	21	21	50%	50%
	6	7	25	22%	78%
	7	2	10	17%	83%
	8	0	6	0%	100%

Figure D-2.1. Critical Gap Analysis Based on Raff Method
Ellington Roundabout – NB



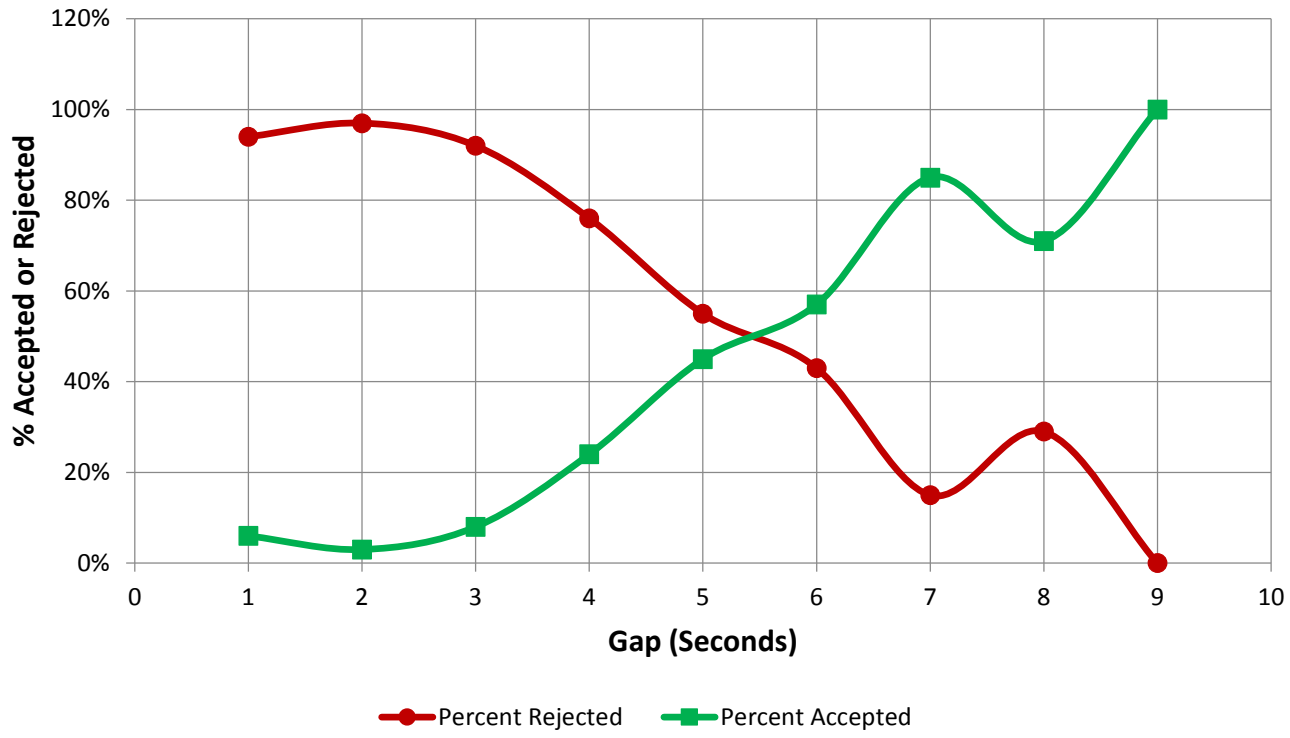
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + TH + L + HL	1	67	3	96%	4%
	2	236	26	90%	10%
	3	186	60	76%	24%
	4	65	53	55%	45%
	5	13	38	25%	75%
	6	8	26	24%	76%
	7	2	12	14%	86%
	8	0	10	0%	100%
	9	0	4	0%	100%
	10	0	2	0%	100%

Figure D-2.2. Critical Gap Analysis Based on Raff Method
Ellington Roundabout – SB



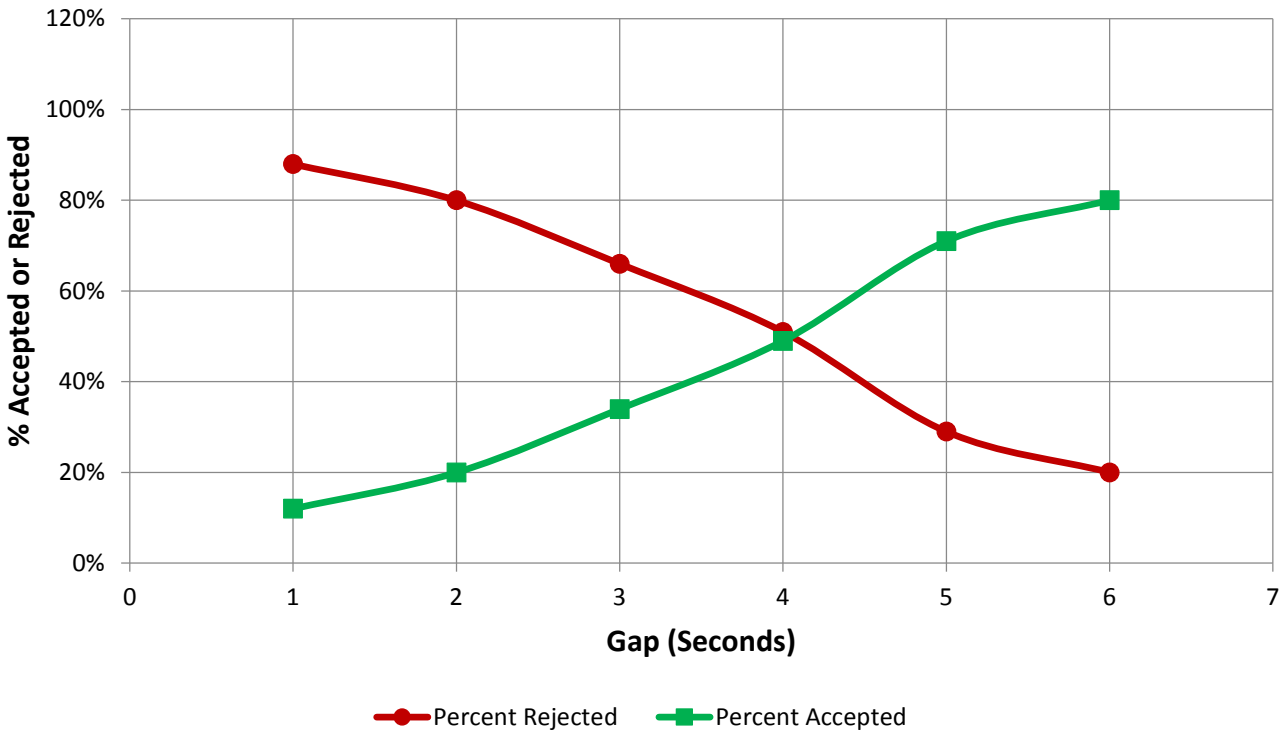
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + BR + TH + L	1	15	0	100%	0%
	2	162	6	96%	4%
	3	235	13	95%	5%
	4	105	13	89%	11%
	5	37	43	46%	54%
	6	6	45	12%	88%
	7	2	15	12%	88%
	8	1	0	100%	0%

Figure D-2.3. Critical Gap Analysis Based on Raff Method
Ellington Roundabout – EB



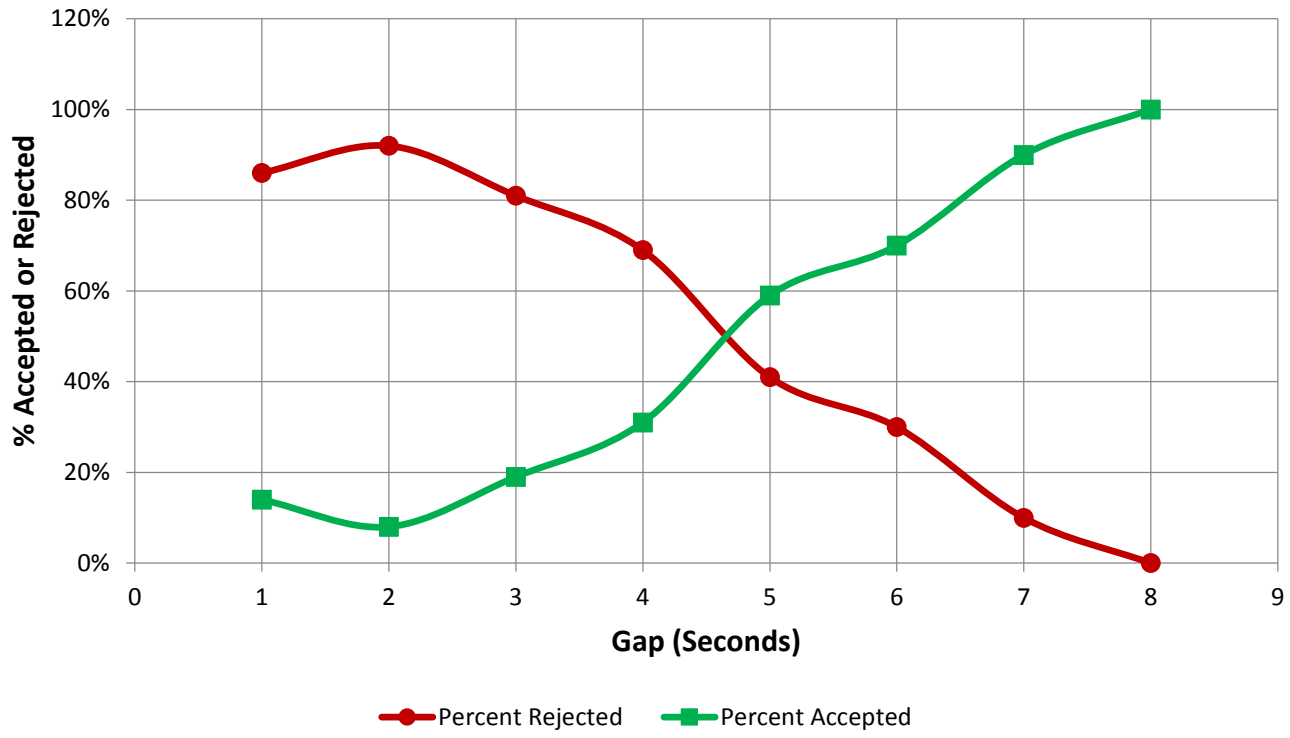
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
HR+ R + TH + L	1	33	2	94%	6%
	2	256	9	97%	3%
	3	240	20	92%	8%
	4	107	34	76%	24%
	5	42	34	55%	45%
	6	15	20	43%	57%
	7	2	11	15%	85%
	8	2	5	29%	71%
	9	0	2	0%	100%

Figure D-2.4. Critical Gap Analysis Based on Raff Method
Ellington Roundabout – WB



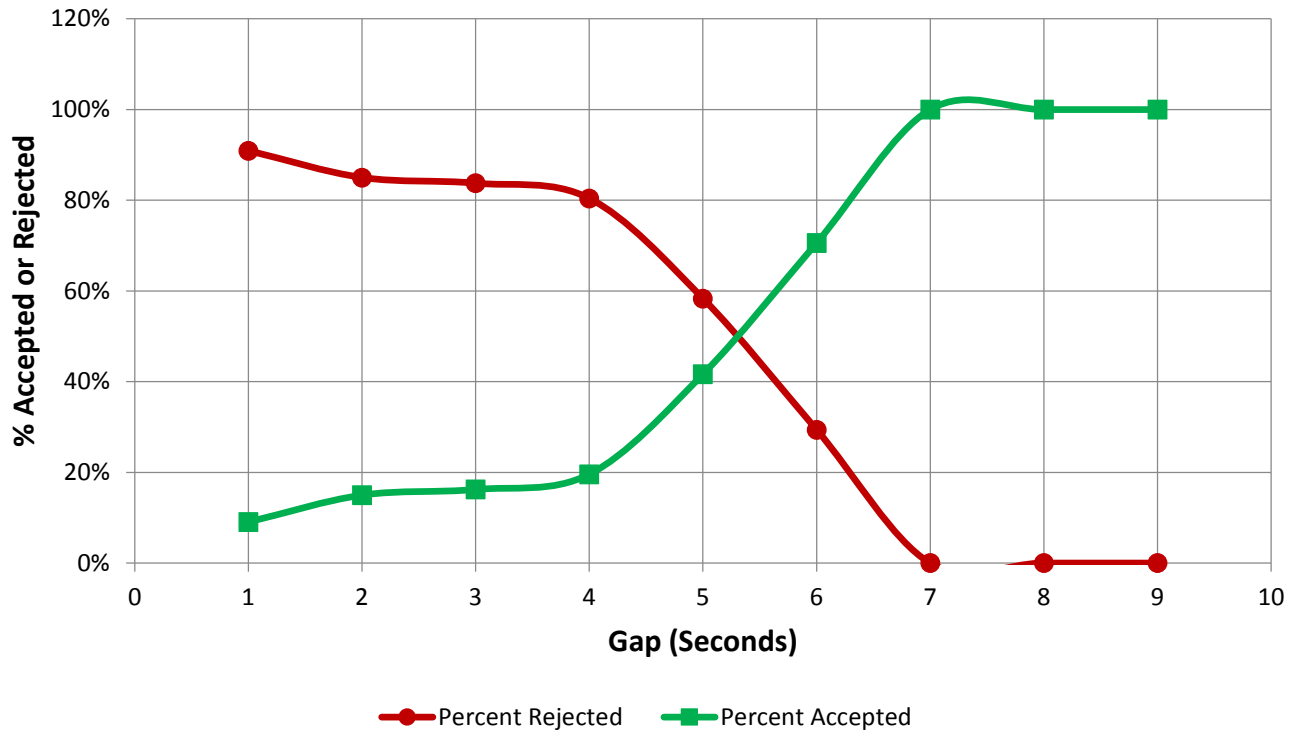
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
R + TH + BL + L	1	102	14	88%	12%
	2	107	27	80%	20%
	3	59	31	66%	34%
	4	19	18	51%	49%
	5	10	24	29%	71%
	6	2	8	20%	80%

Figure D-2.5. Critical Gap Analysis Based on Raff Method
Ellington Roundabout – NEB



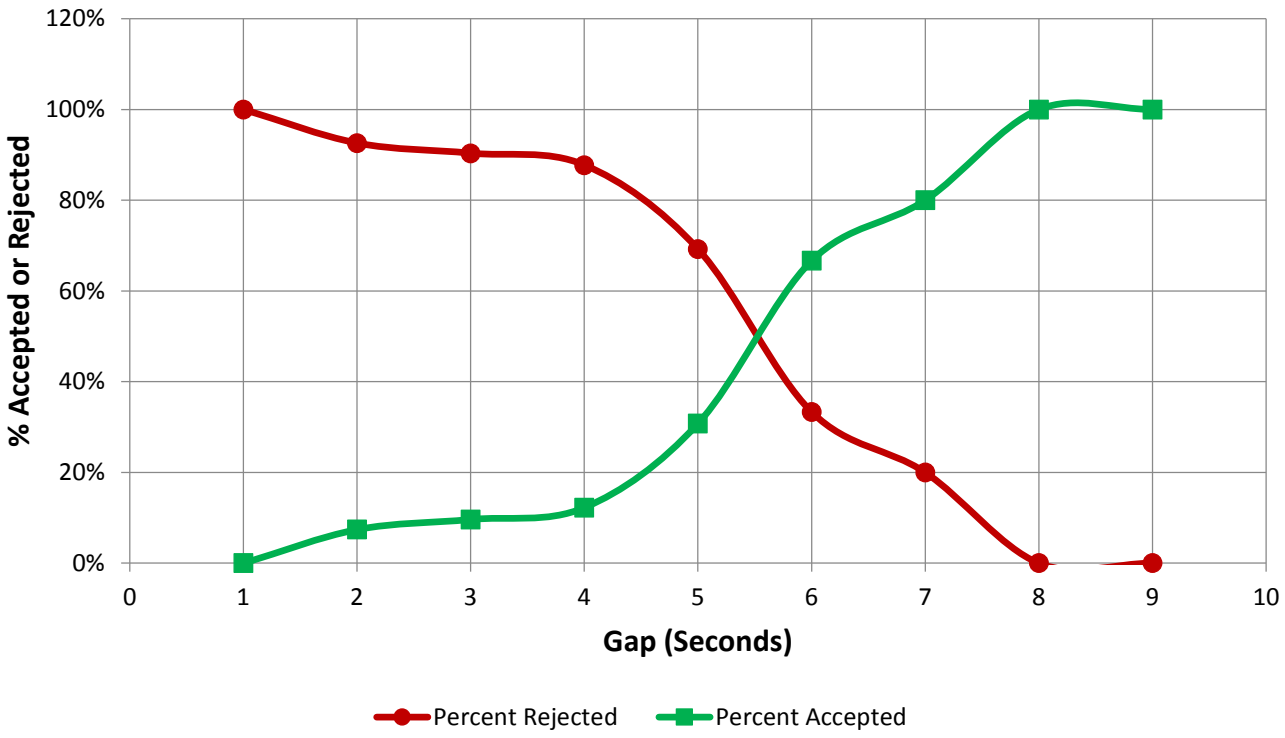
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
HR + BR + BL + HL	1	49	8	86%	14%
	2	163	14	92%	8%
	3	145	33	81%	19%
	4	59	26	69%	31%
	5	21	30	41%	59%
	6	9	21	30%	70%
	7	2	19	10%	90%
	8	0	5	0%	100%

Figure D-3.1. Critical Gap Analysis Based on Raff Method
West Haven Roundabout – WB



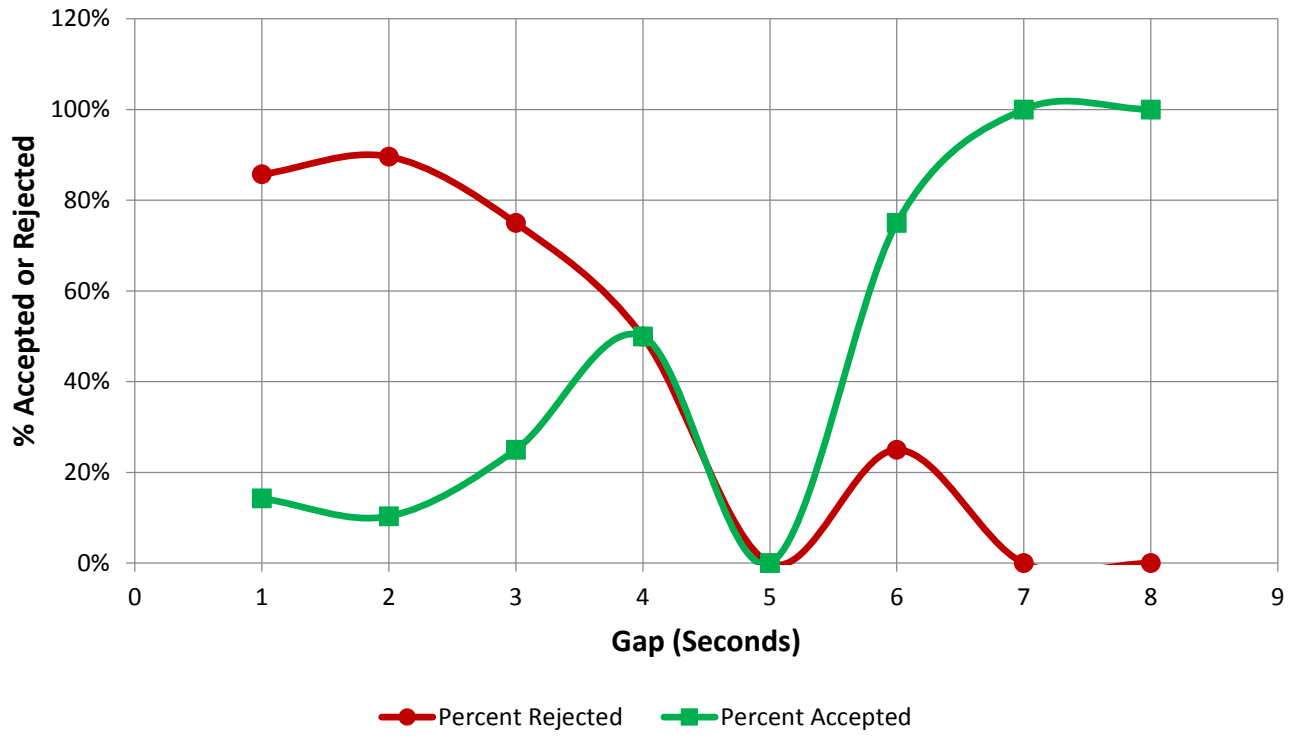
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
L + R	1	10	1	91%	9%
	2	51	9	85%	15%
	3	67	13	84%	16%
	4	41	10	80%	20%
	5	14	10	58%	42%
	6	5	12	29%	71%
	7	0	6	0%	100%
	8	0	4	0%	100%
	9	0	2	0%	100%

Figure D-3.2. Critical Gap Analysis Based on Raff Method
West Haven Roundabout – SB



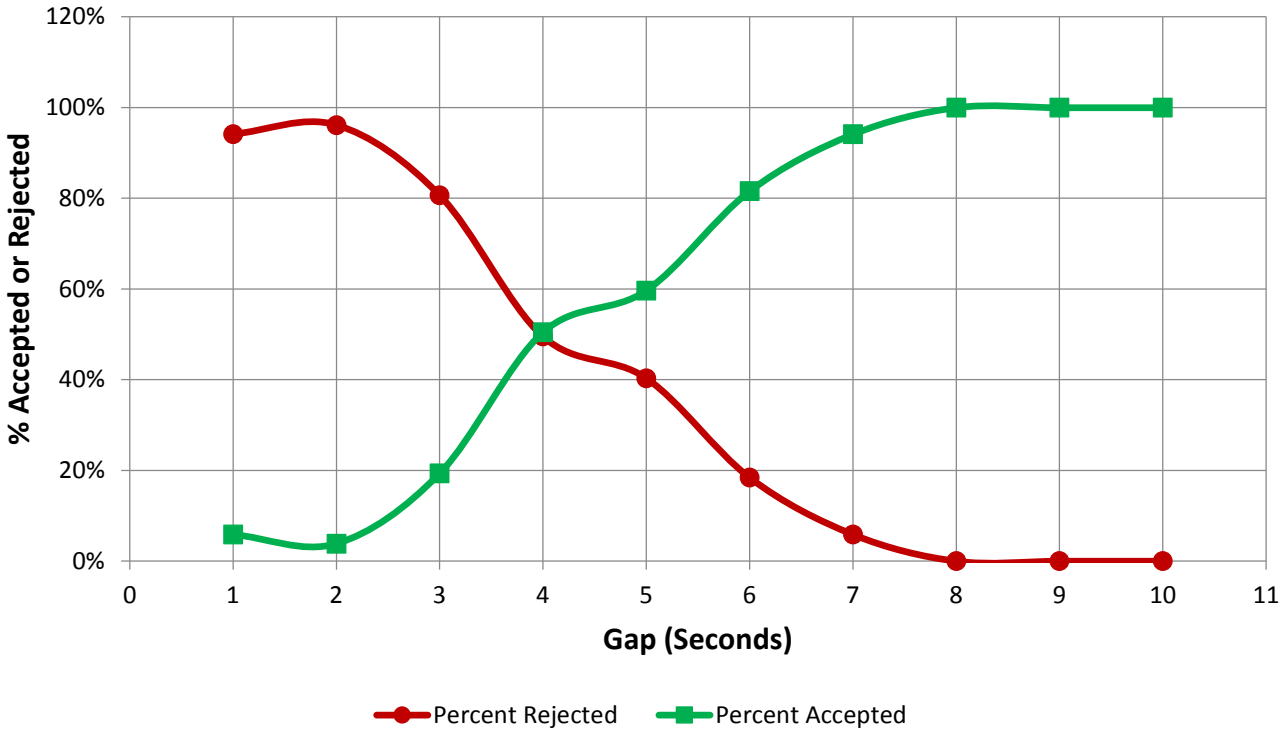
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
L + R	1	2	0	100%	0%
	2	75	6	93%	7%
	3	75	8	90%	10%
	4	43	6	88%	12%
	5	9	4	69%	31%
	6	4	8	33%	67%
	7	1	4	20%	80%
	8	0	1	0%	100%
	9	0	3	0%	100%

Figure D-3.3. Critical Gap Analysis Based on Raff Method
West Haven Roundabout – EB



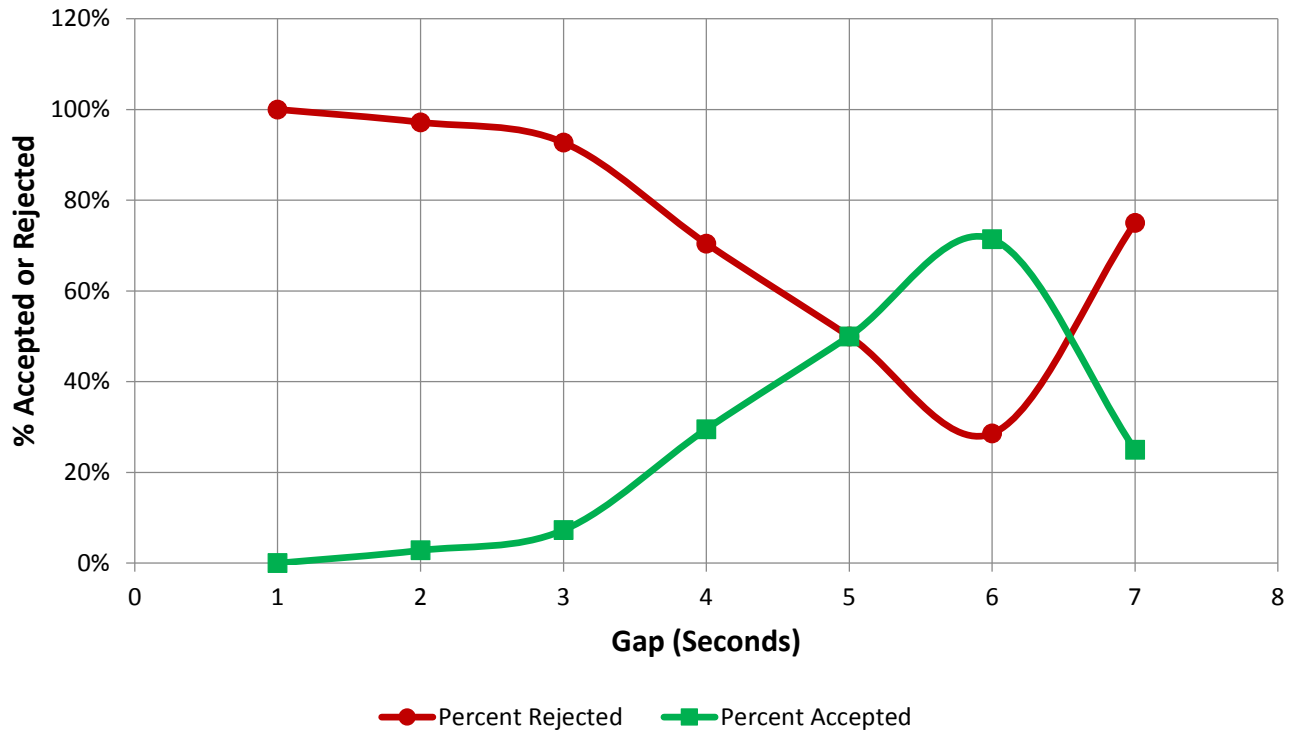
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
L + R	1	6	1	86%	14%
	2	26	3	90%	10%
	3	12	4	75%	25%
	4	2	2	50%	50%
	5	0	0	0%	0%
	6	1	3	25%	75%
	7	0	1	0%	100%
	8	0	1	0%	100%

Figure D-4.1. Critical Gap Analysis Based on Raff Method
Killingworth Roundabout – EB



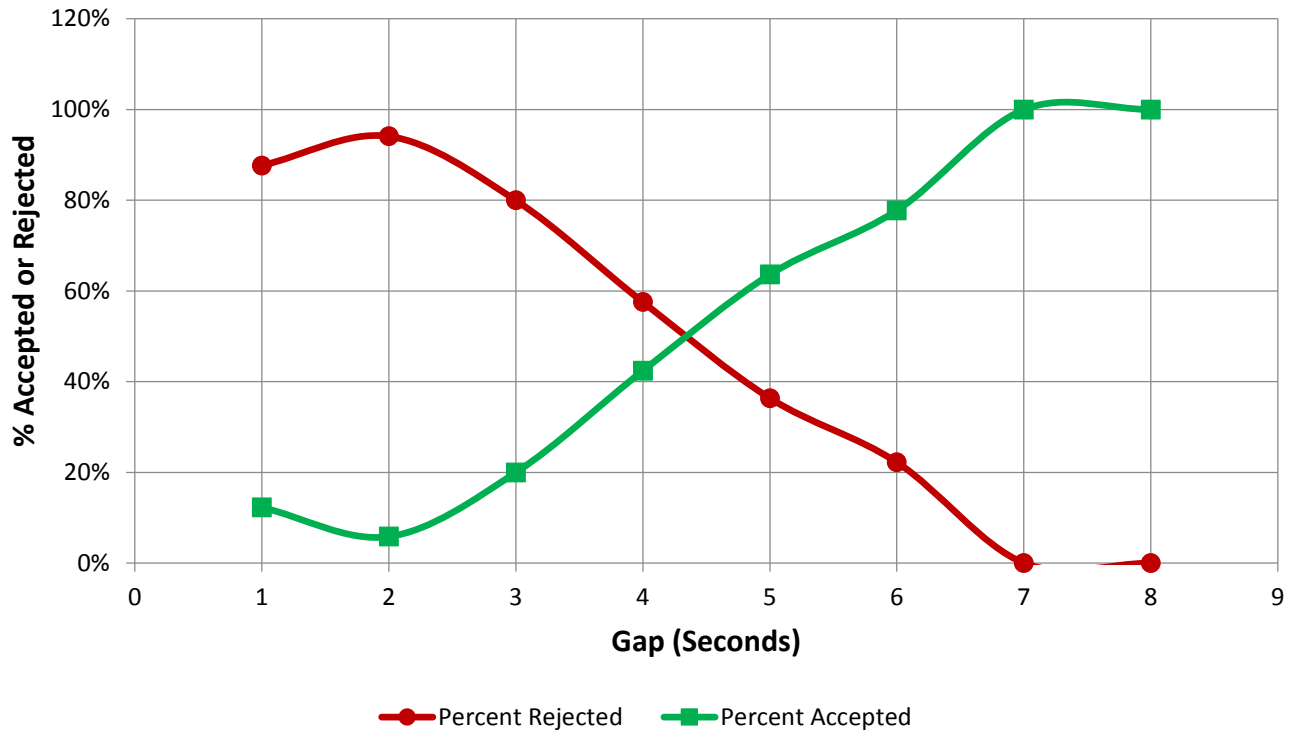
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
L + R + T	1	32	2	94%	6%
	2	174	7	96%	4%
	3	125	30	81%	19%
	4	52	53	50%	50%
	5	25	37	40%	60%
	6	7	31	18%	82%
	7	1	16	6%	94%
	8	0	3	0%	100%
	9	0	4	0%	100%
	10	0	2	0%	100%

Figure D-4.2. Critical Gap Analysis Based on Raff Method
Killingworth Roundabout – WB



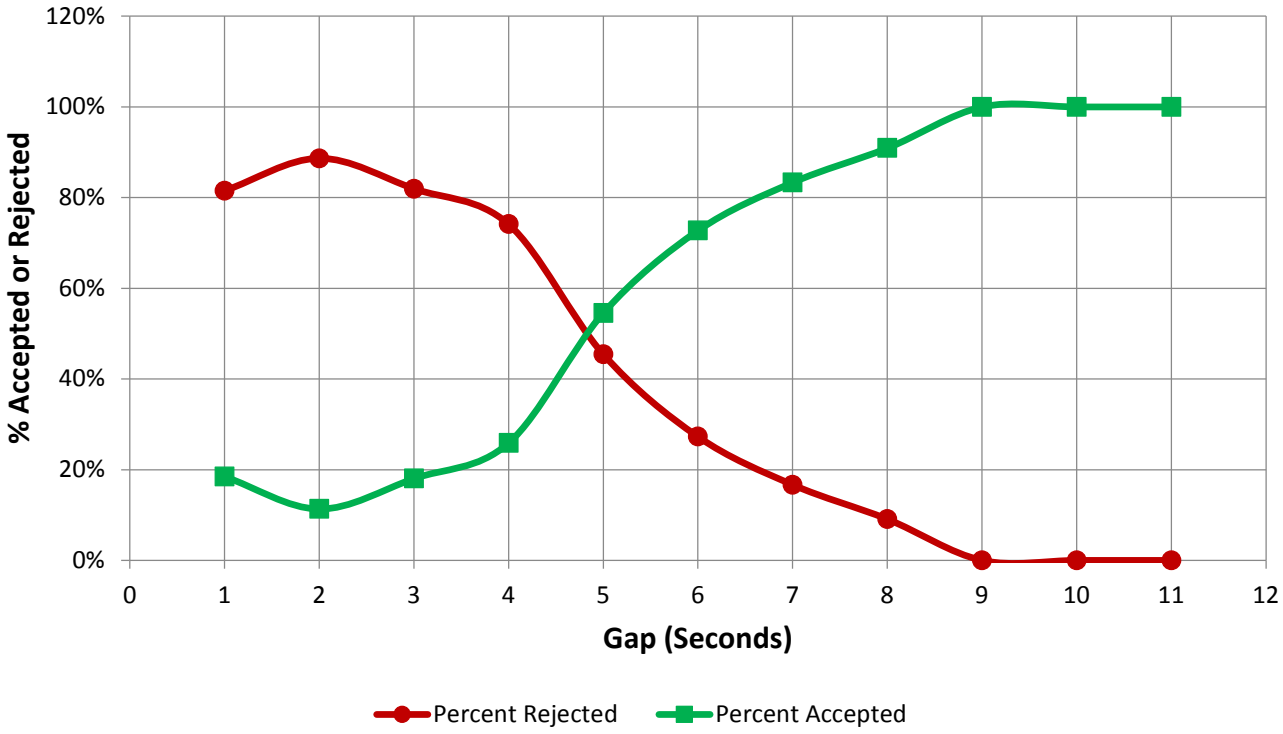
Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
L + R + T	1	11	0	100%	0%
	2	172	5	97%	3%
	3	178	14	93%	7%
	4	62	26	70%	30%
	5	17	17	50%	50%
	6	4	10	29%	71%
	7	3	1	75%	25%

Figure D-4.3. Critical Gap Analysis Based on Raff Method
Killingworth Roundabout – NB



Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
L + R + T	1	64	9	88%	12%
	2	96	6	94%	6%
	3	60	15	80%	20%
	4	19	14	58%	42%
	5	8	14	36%	64%
	6	2	7	22%	78%
	7	0	7	0%	100%
	8	0	7	0%	100%

Figure D-4.4. Critical Gap Analysis Based on Raff Method
Killingworth Roundabout – SB



Movement	Gap Size (Seconds)	Count Rejected	Count Accepted	Percent Rejected	Percent Accepted
L + R + T	1	22	5	81%	19%
	2	117	15	89%	11%
	3	118	26	82%	18%
	4	63	22	74%	26%
	5	15	18	45%	55%
	6	9	24	27%	73%
	7	2	10	17%	83%
	8	1	10	9%	91%
	9	2	0	0%	100%
	10	0	2	0%	100%
	11	0	1	0%	100%

APPENDIX E

ESTIMATION OF CRITICAL GAP OF RAOUNDABOUTS USING MAXIMUM LIKELIHOOD METHOD

APPENDIX E – ESTIMATION OF CRITICAL GAP OF ROUNDABOUTS USING MAXIMUM LIKELIHOOD METHOD

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Table E-1.1.a. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – EB – Right Turn Movement

A	B	C	D
Driver No.	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	3	-0.312966
2	4	3	-0.771753
3	4	2	-0.445201
4	4	3	-0.771753
5	4	3	-0.771753
6	6	5	-2.633083
7	5	3	-0.312966
8	5	3	-0.312966
9	4	2	-0.445201
10	4	2	-0.445201
11	7	2	-0.005544
12	5	3	-0.312966
13	5	3	-0.312966
14	4	2	-0.445201
15	7	3	-0.203368
16	4	3	-0.771753
17	6	4	-1.076080
18	10	4	-1.033034
19	5	2	-0.094565
20	4	2	-0.445201
21	6	3	-0.219237
22	8	3	-0.201077
23	4	3	-0.771753
24	5	3	-0.312966
25	8	4	-1.033816
26	6	4	-1.076080
27	4	3	-0.771753
28	5	4	-1.312774
29	7	6	-4.354684
30	7	2	-0.005544

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
31	4	1	-0.439948
32	6	3	-0.219237
33	4	3	-0.771753
34	4	3	-0.771753
35	5	3	-0.312966
36	5	3	-0.312966
37	4	2	-0.445201
38	5	2	-0.094565
39	5	4	-1.312774
40	4	3	-0.771753
41	7	2	-0.005544
42	5	3	-0.312966
43	5	4	-1.312774
44	4	3	-0.771753
45	6	5	-2.633083
46	7	1	-0.002156
47	12	4	-1.033022
48	4	3	-0.771753
49	4	3	-0.771753
50	6	3	-0.219237
51	3	2	-1.723203
52	5	2	-0.094565
53	4	3	-0.771753
54	3	1	-1.704474
55	4	3	-0.771753
56	6	4	-1.076080
57	6	1	-0.015114
58	6	5	-2.633083
59	4	3	-0.771753
60	8	2	-0.003664
61	7	3	-0.203368
62	2	1	-5.691522
63	4	3	-0.771753

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
64	4	2	-0.445201
65	5	4	-1.312774
66	6	3	-0.219237
67	6	4	-1.076080
68	5	3	-0.312966
69	4	3	-0.771753
70	5	1	-0.090863
71	5	3	-0.312966
72	4	3	-0.771753
73	3	2	-1.723203
74	4	3	-0.771753
75	6	2	-0.018546
76	5	3	-0.312966
77	5	3	-0.312966
78	4	3	-0.771753
79	8	2	-0.003664
80	6	3	-0.219237
81	5	3	-0.312966
82	10	1	-0.000005
83	2	1	-5.691522
84	8	2	-0.003664
85	10	3	-0.200737
86	5	2	-0.094565
87	3	2	-1.723203
88	4	2	-0.445201
Sum			-69.421780
Mean Critical Gap			**3.77528775**
Standard Deviation of the Critical Gap			**0.86096633**
Mean of the log of the Critical Gap			1.30312613
Standard Deviation of the log of the Critical Gap			0.22516872

Table E-1.1.b. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – EB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	8	3	-0.405558
2	8	2	0.000000
3	5	2	0.000000
4	4	3	-0.405558
5	10	2	0.000000
6	3	2	-1.098426
Sum			-1.909543
Mean Critical Gap			**3.06944262**
Standard Deviation of the Critical Gap			**0.15424539**
Mean of the log of the Critical Gap			1.12023495
Standard Deviation of the log of the Critical Gap			0.05022024

Table E-1.1.c. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – EB – Through Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	5	3	-0.447817
2	6	4	-1.049823
3	5	3	-0.447817
4	4	3	-0.948702
5	4	3	-0.948702
6	5	2	-0.163978
7	4	2	-0.515868
8	4	2	-0.515868
9	7	3	-0.265345
10	6	1	-0.041074
11	7	5	-2.056349
12	2	1	-4.360198
13	8	4	-0.947761
14	10	4	-0.941401
15	6	2	-0.054475
16	3	2	-1.561891
17	5	3	-0.447817
18	4	3	-0.948702
19	5	3	-0.447817
20	4	2	-0.515868
21	6	4	-1.049823
22	5	4	-1.379208
Sum			-20.056305
Mean Critical Gap			**3.84765365**
Standard Deviation of the Critical Gap			**1.08240463**
Mean of the log of the Critical Gap			1.30938204
Standard Deviation of the log of the Critical Gap			0.27597637

Table E-1.2.a. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – WB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	4	3	-0.730473
2	4	2	-0.454823
3	5	1	-0.082987
4	6	5	-2.686446
5	4	3	-0.730473
6	5	1	-0.082987
7	5	4	-1.258174
8	6	1	-0.011581
9	5	4	-1.258174
10	3	1	-1.867499
11	4	3	-0.730473
Sum			-9.894088
Mean Critical Gap			**3.80041508**
Standard Deviation of the Critical Gap			**0.80958758**
Mean of the log of the Critical Gap			1.31292001
Standard Deviation of the log of the Critical Gap			0.21066696

Table E-1.2.b. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – WB – Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	2	-0.169691
2	6	3	-0.352854
3	6	5	-2.366517
4	10	5	-1.996627
5	7	4	-1.026294
6	5	2	-0.169691
7	5	4	-1.450970
8	5	3	-0.496146
9	4	2	-0.494981
10	4	2	-0.494981
11	4	2	-0.494981
12	7	2	-0.032611
13	6	2	-0.064291
14	3	2	-1.447946
15	6	2	-0.064291
16	4	2	-0.494981
17	6	4	-1.114286
18	7	1	-0.012129
19	8	3	-0.298949
20	9	3	-0.295702
21	8	3	-0.298949
22	3	1	-1.366172
23	7	6	-3.500478
24	5	3	-0.496146
25	9	5	-2.001471
26	3	2	-1.447946
27	4	2	-0.494981
28	5	4	-1.450970
29	3	1	-1.366172
30	5	3	-0.496146

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
31	7	4	-1.026294
32	4	3	-0.982084
33	3	2	-1.447946
34	3	2	-1.447946
35	5	2	-0.169691
36	4	3	-0.982084
37	4	1	-0.462652
38	4	3	-0.982084
39	3	2	-1.447946
Sum			-35.207074
Mean Critical Gap			**3.79001863**
Standard Deviation of the Critical Gap			**1.12570179**
Mean of the log of the Critical Gap			1.29009955
Standard Deviation of the log of the Critical Gap			0.29076239

Table E-1.2.c. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – WB – Through Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	6	5	-2.506077
2	7	3	-0.113911
3	5	3	-0.224246
4	3	2	-2.246343
5	6	4	-0.892340
6	6	3	-0.127031
7	4	3	-0.752875
8	4	2	-0.550267
9	4	3	-0.752875
10	5	4	-1.114412
11	5	3	-0.224246
12	3	2	-2.246343
13	4	3	-0.752875
14	5	3	-0.224246
15	7	5	-2.372802
16	4	2	-0.550267
17	5	4	-1.114412
18	5	4	-1.114412
19	4	3	-0.752875
20	5	4	-1.114412
21	4	3	-0.752875
22	4	3	-0.752875
Sum			-21.253020
Mean Critical gap			**3.92467992**
Standard Deviation of the Critical Gap			**0.79115025**
Mean of the log of the Critical Gap			1.34736883
Standard Deviation of the log of the Critical Gap			0.19957938

Table E-1.3.a. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – NB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	8	3	-0.000060
2	4	2	-0.072289
3	6	4	-2.663008
4	6	3	-0.000060
5	4	3	-0.072354
6	5	4	-2.663009
7	6	4	-2.663008
8	5	3	-0.000060
9	5	4	-2.663009
Sum			-10.796857
Mean Critical Gap			**3.69839927**
Standard Deviation of the Critical Gap			**0.2**
Mean of the log of the Critical Gap			1.30644004
Standard Deviation of the log of the Critical Gap			0.05403798

Table E-1.3.b. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – NB – Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	3	-0.608167
2	4	2	-0.447752
3	4	3	-1.056141
4	5	3	-0.608167
5	5	4	-1.626826
6	5	3	-0.608167
7	3	2	-1.233511
8	4	3	-1.056141
9	6	4	-1.288390
10	2	1	-3.097356
11	6	3	-0.472391
12	10	3	-0.410819
13	3	1	-1.089346
14	4	3	-1.056141
15	4	2	-0.447752
16	6	5	-2.536258
17	3	2	-1.233511
18	5	4	-1.626826
19	3	2	-1.233511
20	5	4	-1.626826
21	3	2	-1.233511
22	5	4	-1.626826
23	5	3	-0.608167
24	4	2	-0.447752
25	3	1	-1.089346
26	4	2	-0.447752
27	5	4	-1.626826
28	5	3	-0.608167
29	6	5	-2.536258
30	6	5	-2.536258

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
31	2	1	-3.097356
32	5	4	-1.626826
33	3	2	-1.233511
Sum			-42.082555
Mean Critical Gap			**3.61156449**
Standard Deviation of the Critical Gap			**1.18209386**
Mean of the log of the Critical Gap			1.23325528
Standard Deviation of the log of the Critical Gap			0.31901652

Table E-1.3.c. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – NB – Through Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	3	2	-1.643881
2	4	2	-0.507846
3	3	1	-1.603468
4	6	4	-1.026654
5	4	3	-0.895112
6	6	3	-0.265574
7	8	3	-0.226522
8	5	3	-0.396655
9	5	4	-1.331792
10	6	4	-1.026654
11	7	5	-2.127897
12	5	3	-0.396655
13	3	2	-1.643881
14	5	3	-0.396655
Sum			-13.489247
Mean Critical Gap			**3.84848044**
Standard Deviation of the Critical Gap			**1.0087305**
Mean of the log of the Critical Gap			1.31445579
Standard Deviation of the log of the Critical Gap			0.25776962

Table E-1.4.a. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – SB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	8	3	0.000000
2	4	2	-0.693308
3	6	4	-0.692986
4	6	3	0.000000
5	4	3	-0.693308
6	4	3	-0.693308
7	5	4	-0.692986
8	4	3	-0.693308
9	6	4	-0.692986
10	5	3	0.000000
11	5	4	-0.692986
Sum			-5.545178
Mean Critical Gap			**4.0038592**
Standard Deviation of the Critical Gap			**0.17511304**
Mean of the log of the Critical Gap			1.38630319
Standard Deviation of the log of the Critical Gap			0.04371517

Table E-1.4.b. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – SB – Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	3	-0.608167
2	4	2	-0.447752
3	4	3	-1.056141
4	5	3	-0.608167
5	5	4	-1.626826
6	5	3	-0.608167
7	3	2	-1.233511
8	4	3	-1.056141
9	6	4	-1.288390
10	2	1	-3.097356
11	6	3	-0.472391
12	10	3	-0.410819
13	3	1	-1.089346
14	4	3	-1.056141
15	4	2	-0.447752
16	6	5	-2.536258
17	3	2	-1.233511
18	5	4	-1.626826
19	3	2	-1.233511
20	5	4	-1.626826
21	3	2	-1.233511
22	5	4	-1.626826
23	5	3	-0.608167
24	4	2	-0.447752
25	3	1	-1.089346
26	4	2	-0.447752
27	5	4	-1.626826
28	5	3	-0.608167
29	6	5	-2.536258

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	6	5	-2.536258
31	2	1	-3.097356
32	5	4	-1.626826
33	3	2	-1.233511
Sum			-42.082555
Mean Critical Gap			**3.61156449**
Standard Deviation of the Critical Gap			**1.18209386**
Mean of the log of the Critical Gap			1.23325528
Standard Deviation of the log of the Critical Gap			0.31901652

Table E-1.4.c. Critical Gap Analysis Based on Maximum Likelihood Method
Salem Roundabout – SB – Through Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	3	2	-1.550950
2	4	2	-0.449371
3	4	3	-0.853357
4	3	1	-1.511563
5	6	4	-1.107914
6	4	3	-0.853357
7	6	3	-0.279410
8	8	3	-0.250278
9	5	3	-0.390782
10	6	4	-1.107914
11	7	5	-2.319473
12	5	3	-0.390782
13	3	2	-1.550950
14	5	3	-0.390782
Sum			-13.006884
Mean Critical Gap			**3.75624259**
Standard Deviation of the Critical Gap			**0.95772628**
Mean of the log of the Critical Gap			1.29192738
Standard Deviation of the log of the Critical Gap			0.25096522

Table E-2.1.a. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – EB – Hard Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	3	2	-1.691604
2	4	2	-0.515638
3	8	3	-0.213377
4	4	3	-0.884561
5	5	3	-0.380978
6	3	2	-1.691604
7	6	3	-0.250760
8	4	3	-0.884561
9	5	3	-0.380978
10	9	2	-0.006878
11	5	3	-0.380978
12	7	5	-2.125676
13	6	5	-2.353713
Sum			-11.761305
Mean Critical Gap			**3.864253352**
Standard Deviation of the Critical Gap			**0.992814942**
Mean of the log of the Critical Gap			1.319807435
Standard Deviation of the log of the Critical Gap			0.252828188

Table E-2.1.b. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – EB – Right Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	3	-0.246978
2	5	3	-0.246978
3	6	2	-0.030364
4	6	4	-0.602516
5	4	2	-0.861189
6	4	3	-0.980199
7	5	3	-0.246978
8	8	4	-0.550157
9	4	3	-0.980199
10	4	1	-0.860978
11	5	4	-0.901596
12	4	2	-0.861189
13	3	1	-3.046766
14	4	2	-0.861189
15	8	2	-0.000482
16	6	3	-0.080485
17	5	3	-0.246978
18	7	4	-0.555998
19	5	3	-0.246978
20	7	3	-0.052625
21	7	2	-0.003849
22	5	3	-0.246978
23	6	4	-0.602516
24	5	3	-0.246978
25	5	2	-0.188041
26	7	5	-1.786306
27	6	4	-0.602516
28	6	4	-0.602516
29	8	3	-0.049090

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	4	3	-0.980199
31	6	5	-1.955375
32	7	3	-0.052625
33	7	5	-1.786306
34	6	5	-1.955375
Sum			-23.519491
Mean Critical Gap			**4.234823094**
Standard Deviation of the Critical Gap			**0.834101741**
Mean of the log of the Critical Gap			1.424311216
Standard Deviation of the log of the Critical Gap			0.195091462

Table E-2.1.c. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – EB – Through Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	8	2	-0.003911
2	4	2	-0.597799
3	7	2	-0.009297
4	6	3	-0.191543
5	6	5	-2.215016
6	5	3	-0.333332
7	4	2	-0.597799
8	5	4	-1.187890
9	5	3	-0.333332
10	4	1	-0.592841
11	3	2	-1.977949
12	5	3	-0.333332
13	5	1	-0.153596
14	4	3	-0.887537
15	5	3	-0.333332
16	5	3	-0.333332
17	7	4	-0.819335
18	5	3	-0.333332
19	4	3	-0.887537
20	3	2	-1.977949
21	2	1	-5.902154
22	4	3	-0.887537
23	4	2	-0.597799
24	3	1	-1.958384
25	3	2	-1.977949
26	6	3	-0.191543
27	6	4	-0.881852
28	5	3	-0.333332
29	5	3	-0.333332

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
30	6	4	-0.881852
31	6	2	-0.036626
32	5	3	-0.333332
33	5	2	-0.156788
34	4	3	-0.887537
35	5	2	-0.156788
36	5	2	-0.156788
37	5	3	-0.333332
38	5	4	-1.187890
39	4	2	-0.597799
40	4	3	-0.887537
41	7	2	-0.009297
42	6	3	-0.191543
43	5	3	-0.333332
44	4	3	-0.887537
45	5	2	-0.156788
46	6	4	-0.881852
47	6	4	-0.881852
48	5	3	-0.333332
49	6	5	-2.215016
50	6	5	-2.215016
51	5	3	-0.333332
52	4	3	-0.887537
53	6	4	-0.881852
54	6	5	-2.215016
55	5	4	-1.187890
56	6	4	-0.881852
57	6	5	-2.215016
58	4	3	-0.887537
59	5	4	-1.187890
60	7	4	-0.819335
61	5	3	-0.333332

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
62	4	3	-0.887537
63	5	2	-0.156788
64	8	6	-3.440143
Sum			-57.200764
Mean Critical Gap			**3.987106552**
Standard Deviation of the Critical Gap			**0.963079992**
Mean of the log of the Critical Gap			1.354712267
Standard Deviation of the log of the Critical Gap			0.238132425

Table E-2.1.d. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – EB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	9	3	0.000000
2	6	4	-0.693147
3	5	3	0.000000
4	5	4	-0.693147
5	5	3	0.000000
6	6	2	0.000000
7	5	2	0.000000
8	7	3	0.000000
9	4	2	-0.693147
10	7	3	0.000000
11	6	3	0.000000
12	5	3	0.000000
13	5	2	0.000000
14	4	3	-0.693147
15	5	3	0.000000
16	6	2	0.000000
17	6	3	0.000000
Sum			-2.772589
Mean Critical Gap			**4.002194983**
Standard Deviation of the Critical Gap			**0.132604685**
Mean of the log of the Critical Gap			1.38629436
Standard Deviation of the log of the Critical Gap			0.033123902

Table E-2.2.a. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – WB – Right Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	3	1	-0.744167
2	3	1	-0.744167
3	4	1	-0.197927
4	4	3	-1.063343
5	5	1	-0.047974
6	7	5	-3.114793
7	5	3	-0.738084
8	4	1	-0.197927
9	6	1	-0.010918
10	4	2	-0.293099
11	3	2	-0.914670
12	3	2	-0.914670
13	5	1	-0.047974
14	3	1	-0.744167
15	4	2	-0.293099
16	3	2	-0.914670
17	3	1	-0.744167
18	5	1	-0.047974
19	3	2	-0.914670
20	4	2	-0.293099
21	5	4	-2.019443
22	11	2	-0.077485
23	6	5	-3.324735
24	4	2	-0.293099
25	5	3	-0.738084
26	2	1	-2.597205
27	3	1	-0.744167
28	4	3	-1.063343
29	4	2	-0.293099

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	3	2	-0.914670
31	4	2	-0.293099
32	3	1	-0.744167
33	5	3	-0.738084
34	5	2	-0.129337
35	5	3	-0.738084
36	6	3	-0.665511
37	6	1	-0.010918
38	5	3	-0.738084
39	5	3	-0.738084
40	2	1	-2.597205
41	4	2	-0.293099
42	6	4	-1.779566
43	6	2	-0.089203
44	5	4	-2.019443
45	5	3	-0.738084
46	5	2	-0.129337
47	5	2	-0.129337
Sum			-37.617533
Mean Critical Gap			**3.18997738**
Standard Deviation of the Critical Gap			**0.95750151**
Mean of the log of the Critical Gap			1.11688111
Standard Deviation of the log of the Critical Gap			0.29370977

Table E-2.2.b. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – WB – Through Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	4	3	-1.069753
2	2	1	-2.692357
3	5	1	-0.078368
4	4	1	-0.267356
5	4	3	-1.069753
6	5	2	-0.154431
7	5	3	-0.688525
8	4	3	-1.069753
9	4	2	-0.359996
10	5	3	-0.688525
11	4	3	-1.069753
12	6	5	-2.926018
13	5	3	-0.688525
14	2	1	-2.692357
15	6	2	-0.093747
16	4	1	-0.267356
17	4	1	-0.267356
18	3	2	-1.036804
19	3	2	-1.036804
20	2	1	-2.692357
21	8	3	-0.551735
22	3	2	-1.036804
23	3	2	-1.036804
24	5	4	-1.837447
25	4	2	-0.359996
26	3	2	-1.036804
27	5	4	-1.837447
28	8	2	-0.071995
29	4	3	-1.069753

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	4	3	-1.069753
31	9	4	-1.452262
32	4	3	-1.069753
33	3	1	-0.862022
34	3	1	-0.862022
35	11	4	-1.450481
36	3	2	-1.036804
37	5	3	-0.688525
38	7	5	-2.669393
39	5	4	-1.837447
40	4	2	-0.359996
41	6	3	-0.587119
42	4	2	-0.359996
Sum			-44.054246
Mean Critical Gap			**3.34923453**
Standard Deviation of the Critical Gap			**1.07361205**
Mean of the log of the Critical Gap			1.15982595
Standard Deviation of the log of the Critical Gap			0.31274868

Table E-2.2.c. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – WB – Bear Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	3	2	-1.106938
2	12	1	-0.003002
3	5	3	-0.886223
4	3	2	-1.106938
5	5	4	-1.934964
6	4	2	-0.513579
7	3	2	-1.106938
8	3	1	-0.757194
9	5	3	-0.886223
10	10	1	-0.004421
11	3	1	-0.757194
12	7	3	-0.679017
13	8	1	-0.011855
14	2	1	-1.977528
15	10	8	-4.909841
16	4	2	-0.513579
17	5	4	-1.934964
18	5	1	-0.126482
19	3	2	-1.106938
20	5	3	-0.886223
21	4	2	-0.513579
22	4	2	-0.513579
23	4	2	-0.513579
24	3	2	-1.106938
25	4	2	-0.513579
26	9	1	-0.006655
27	3	1	-0.757194
28	4	2	-0.513579
29	8	6	-3.201007

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$\boldsymbol{ln\,[F(a) - F(r)]}$
30	7	1	-0.024195
31	9	4	-1.360211
32	2	1	-1.977528
33	5	2	-0.297356
Sum			-32.509023
Mean Critical Gap			**3.34963555**
Standard Deviation of the Critical Gap			**1.40911608**
Mean of the log of the Critical Gap			1.12738009
Standard Deviation of the log of the Critical Gap			0.40366188

Table E-2.2.d. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – WB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	3	1	-1.817033
2	5	3	-0.195270
3	5	3	-0.195270
4	5	1	-0.014992
5	5	2	-0.015237
6	4	1	-0.240292
7	8	2	-0.000241
8	4	2	-0.240599
9	5	4	-1.615851
10	5	3	-0.195270
11	6	3	-0.177919
Sum			-4.707976
Mean Critical Gap			**3.56415691**
Standard Deviation of the Critical Gap			**0.58041558**
Mean of the log of the Critical Gap			1.25784058
Standard Deviation of the log of the Critical Gap			0.16178351

Table E-2.3.a. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – NB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	5	3	-0.313247
2	2	1	-5.681795
3	5	4	-1.316972
4	5	2	-0.093439
5	4	3	-0.769760
6	8	3	-0.202613
7	8	2	-0.003688
8	4	2	-0.441846
9	6	5	-2.643993
10	4	2	-0.441846
11	7	3	-0.204852
12	4	2	-0.441846
13	6	3	-0.220464
14	6	2	-0.018296
15	5	4	-1.316972
16	5	2	-0.093439
17	5	3	-0.313247
18	4	3	-0.769760
19	4	3	-0.769760
20	4	3	-0.769760
21	6	2	-0.018296
22	4	3	-0.769760
23	5	3	-0.313247
24	5	4	-1.316972
25	4	3	-0.769760
26	6	4	-1.081690
Sum			-21.097320
Mean Critical Gap			**3.77040869**
Standard Deviation of the Critical Gap			**0.85909706**
Mean of the log of the Critical Gap			1.30187641
Standard Deviation of the log of the Critical Gap			0.22497553

Table E-2.3.b. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – NB – Through Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	4	3	-0.887164
2	5	4	-1.434806
3	4	3	-0.887164
4	7	3	-0.288157
5	4	3	-0.887164
6	4	2	-0.440452
7	6	3	-0.315469
8	2	1	-4.361927
9	15	2	-0.012836
10	6	4	-1.146884
11	2	1	-4.361927
12	6	2	-0.039395
13	4	3	-0.887164
14	3	2	-1.461347
15	5	3	-0.430808
16	5	4	-1.434806
17	5	3	-0.430808
18	4	2	-0.440452
19	7	1	-0.005695
20	8	3	-0.282181
21	4	2	-0.440452
22	6	2	-0.039395
23	4	2	-0.440452
24	5	3	-0.430808
25	7	3	-0.288157
26	7	3	-0.288157
27	6	5	-2.532458
28	4	2	-0.440452
29	5	2	-0.125669

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
30	7	2	-0.018604
31	7	4	-1.085236
32	5	3	-0.430808
33	5	3	-0.430808
34	4	2	-0.440452
35	10	3	-0.280678
36	5	3	-0.430808
37	6	2	-0.039395
38	7	4	-1.085236
39	3	2	-1.461347
40	3	2	-1.461347
41	3	2	-1.461347
42	4	3	-0.887164
43	4	2	-0.440452
44	6	4	-1.146884
45	4	2	-0.440452
46	5	3	-0.430808
47	7	4	-1.085236
48	5	3	-0.430808
49	4	3	-0.887164
50	4	3	-0.887164
51	4	3	-0.887164
52	3	2	-1.461347
53	5	3	-0.430808
54	6	4	-1.146884
55	4	2	-0.440452
56	5	4	-1.434806
57	5	2	-0.125669
58	7	5	-2.305985
59	4	3	-0.887164
60	2	1	-4.361927
61	9	4	-1.069278

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
62	9	4	-1.069278
63	11	2	-0.012847
64	5	3	-0.430808
65	5	3	-0.430808
66	8	6	-3.701354
67	4	3	-0.887164
68	7	5	-2.305985
69	4	2	-0.440452
70	6	4	-1.146884
71	6	4	-1.146884
72	5	3	-0.430808
73	5	2	-0.125669
74	4	3	-0.887164
75	5	3	-0.430808
76	5	3	-0.430808
77	6	2	-0.039395
78	8	2	-0.014037
79	9	2	-0.013083
80	8	2	-0.014037
81	4	3	-0.887164
82	6	3	-0.315469
83	5	3	-0.430808
84	6	4	-1.146884
85	6	3	-0.315469
86	5	3	-0.430808
87	6	4	-1.146884
88	6	3	-0.315469
89	5	3	-0.430808
90	5	3	-0.430808
91	4	2	-0.440452
92	4	2	-0.440452
93	5	4	-1.434806

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
94	6	2	-0.039395
95	5	4	-1.434806
96	5	4	-1.434806
97	5	4	-1.434806
98	6	2	-0.039395
99	4	2	-0.440452
100	3	1	-1.407815
101	3	2	-1.461347
102	5	2	-0.125669
103	5	3	-0.430808
104	6	3	-0.315469
105	4	3	-0.887164
106	5	3	-0.430808
107	5	3	-0.430808
108	3	2	-1.461347
109	3	2	-1.461347
110	3	1	-1.407815
111	5	3	-0.430808
112	6	3	-0.315469
113	4	2	-0.440452
114	3	2	-1.461347
115	6	3	-0.315469
116	6	3	-0.315469
117	3	2	-1.461347
118	5	4	-1.434806
119	7	6	-3.902215
120	5	3	-0.430808
121	4	2	-0.440452
122	4	2	-0.440452
123	4	3	-0.887164
124	6	3	-0.315469
125	4	2	-0.440452

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
126	3	2	-1.461347
127	3	2	-1.461347
128	4	3	-0.887164
129	7	5	-2.305985
130	4	3	-0.887164
131	6	2	-0.039395
132	6	5	-2.532458
133	5	3	-0.430808
134	5	2	-0.125669
135	4	2	-0.440452
136	3	2	-1.461347
137	4	3	-0.887164
138	9	3	-0.280934
139	5	3	-0.430808
140	5	3	-0.430808
141	2	1	-4.361927
142	4	2	-0.440452
143	5	3	-0.430808
Sum			-123.942306
Mean Critical Gap			**3.72446189**
Standard Deviation of the Critical Gap			**0.99632733**
Mean of the log of the Critical Gap			1.2803641
Standard Deviation of the log of the Critical Gap			0.26290028

Table E-2.3.c. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – NB – Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	6	4	-0.767381
2	4	2	-0.673782
3	5	4	-1.047107
4	6	3	-0.122646
5	4	3	-0.866669
6	3	1	-2.408272
7	4	3	-0.866669
8	6	4	-0.767381
9	3	2	-2.414324
10	6	4	-0.767381
11	7	3	-0.098275
12	4	3	-0.866669
13	7	5	-2.001751
14	4	3	-0.866669
15	4	3	-0.866669
16	3	2	-2.414324
17	8	3	-0.094775
18	6	2	-0.026339
19	4	2	-0.673782
20	5	4	-1.047107
21	4	2	-0.673782
22	8	3	-0.094775
23	4	2	-0.673782
24	4	3	-0.866669
25	5	3	-0.259677
26	5	3	-0.259677
27	5	3	-0.259677
28	5	3	-0.259677
29	4	3	-0.866669

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	8	4	-0.714926
31	6	4	-0.767381
32	5	3	-0.259677
33	5	4	-1.047107
34	6	4	-0.767381
35	6	4	-0.767381
36	5	3	-0.259677
37	7	3	-0.098275
38	7	5	-2.001751
39	10	4	-0.714015
40	8	2	-0.000995
41	5	3	-0.259677
42	5	3	-0.259677
43	3	2	-2.414324
44	4	3	-0.866669
45	5	4	-1.047107
46	4	2	-0.673782
47	7	5	-2.001751
48	5	4	-1.047107
49	6	2	-0.026339
50	7	5	-2.001751
51	6	4	-0.767381
Sum			-42.636488
Mean Critical Gap			**4.06738172**
Standard Deviation of the Critical Gap			**0.86566169**
Mean of the log of the Critical Gap			1.3808491
Standard Deviation of the log of the Critical Gap			0.21047747

Table E-2.4.a. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – SB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	4	2	-1.106260
2	5	4	-0.584985
3	4	2	-1.106260
4	6	2	-0.005154
5	5	4	-0.584985
6	5	4	-0.584985
7	7	5	-2.189367
8	4	3	-1.121793
9	5	3	-0.124646
10	5	4	-0.584985
11	7	4	-0.401819
Sum			-8.395239
Mean Critical Gap			**4.28228201**
Standard Deviation of the Critical Gap			**0.58065112**
Mean of the log of the Critical Gap			1.44537669
Standard Deviation of the log of the Critical Gap			0.13497674

Table E-2.4.b. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – SB – Bear Right Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	4	3	-0.924385
2	5	3	-0.197698
3	4	3	-0.924385
4	5	3	-0.197698
5	7	5	-1.975816
6	5	4	-0.858393
7	5	3	-0.197698
8	6	4	-0.605319
9	6	5	-2.103263
10	6	3	-0.059033
11	5	2	-0.151134
12	5	3	-0.197698
13	5	4	-0.858393
14	6	5	-2.103263
15	5	3	-0.197698
16	4	3	-0.924385
17	3	1	-3.240496
18	5	3	-0.197698
19	5	4	-0.858393
20	5	3	-0.197698
21	4	2	-0.830366
22	5	3	-0.197698
23	5	2	-0.151134
24	5	4	-0.858393
25	6	4	-0.605319
26	4	3	-0.924385
27	4	3	-0.924385
28	7	5	-1.975816

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
29	5	3	-0.197698
Sum			-23.635736
Mean Critical Gap			**4.18492356**
Standard Deviation of the Critical Gap			**0.75887656**
Mean of the log of the Critical Gap			1.41531163
Standard Deviation of the log of the Critical Gap			0.1798711

Table E-2.4.c. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – SB – Through Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	5	3	-0.061103
2	4	2	-0.332648
3	5	3	-0.061103
4	5	3	-0.061103
5	3	2	-3.022252
6	4	3	-0.402972
7	4	2	-0.332648
8	6	4	-1.262743
9	5	3	-0.061103
10	5	3	-0.061103
11	4	3	-0.402972
12	6	3	-0.050023
13	5	3	-0.061103
14	4	3	-0.402972
15	6	3	-0.050023
16	4	3	-0.402972
17	5	4	-1.300502
18	6	3	-0.050023
19	5	3	-0.061103
20	5	3	-0.061103
21	5	2	-0.010639
22	6	4	-1.262743
Sum			-9.774958
Mean Critical Gap			**3.74569516**
Standard Deviation of the Critical Gap			**0.48486207**
Mean of the log of the Critical Gap			1.31229862
Standard Deviation of the log of the Critical Gap			0.12890777

Table E-2.4.d. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – SB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	5	4	-0.766234
2	3	2	-3.937367
3	4	2	-0.790553
4	5	4	-0.766234
5	6	3	-0.024077
6	5	2	-0.085172
7	5	4	-0.766234
8	5	4	-0.766234
9	5	4	-0.766234
10	5	4	-0.766234
11	5	3	-0.106634
12	6	4	-0.612276
13	5	3	-0.106634
14	5	3	-0.106634
15	4	3	-0.834493
16	6	4	-0.612276
Sum			-11.813521
Mean Critical Gap			**4.11411792**
Standard Deviation of the Critical Gap			**0.61103141**
Mean of the log of the Critical Gap			1.40351515
Standard Deviation of the log of the Critical Gap			0.14771125

Table E-2.5.a. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – NEB – Hard Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	4	3	-0.573238
2	5	4	-1.090196
3	4	1	-0.470102
4	7	3	-0.063239
5	4	3	-0.573238
6	6	1	-0.001621
7	4	3	-0.573238
8	4	2	-0.470126
9	4	2	-0.470126
10	5	2	-0.039704
11	6	2	-0.001636
12	7	5	-3.247519
13	5	3	-0.105529
14	5	3	-0.105529
15	5	3	-0.105529
Sum			-7.890571
Mean Critical Gap			**3.85371248**
Standard Deviation of the Critical Gap			**0.59867772**
Mean of the log of the Critical Gap			1.33711332
Standard Deviation of the log of the Critical Gap			0.15442566

Table E-2.5.b. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – NEB – Bear Right Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	4	3	-0.881018
2	5	4	-1.097790
3	5	3	-0.290394
4	4	2	-0.652920
5	6	5	-2.165083
6	6	3	-0.147678
7	5	4	-1.097790
8	4	2	-0.652920
9	6	3	-0.147678
10	5	3	-0.290394
11	4	2	-0.652920
12	7	1	-0.005035
13	7	4	-0.747871
14	5	4	-1.097790
15	7	4	-0.747871
16	4	3	-0.881018
17	5	4	-1.097790
18	6	4	-0.802185
19	5	4	-1.097790
20	5	3	-0.290394
21	3	1	-2.232658
22	3	1	-2.232658
23	5	4	-1.097790
24	3	2	-2.242782
25	6	4	-0.802185
26	6	5	-2.165083
27	11	2	-0.001083
28	6	5	-2.165083
29	3	2	-2.242782

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	5	3	-0.290394
31	6	5	-2.165083
32	13	3	-0.113441
33	5	4	-1.097790
34	5	3	-0.290394
35	5	4	-1.097790
36	6	3	-0.147678
37	3	2	-2.242782
38	6	4	-0.802185
39	6	1	-0.030509
40	9	4	-0.737537
41	7	4	-0.747871
42	5	3	-0.290394
43	5	4	-1.097790
44	5	3	-0.290394
45	6	3	-0.147678
46	3	1	-2.232658
47	4	3	-0.881018
48	7	2	-0.006122
49	4	3	-0.881018
50	4	2	-0.652920
51	4	3	-0.881018
Sum			-47.150890
Mean Critical Gap			**4.05081799**
Standard Deviation of the Critical Gap			**0.91073633**
Mean of the log of the Critical Gap			1.37426309
Standard Deviation of the log of the Critical Gap			0.22206188

Table E-2.5.c. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – NEB – Bear Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	3	1	-2.464993
2	8	2	-0.005240
3	6	3	-0.169293
4	8	1	-0.004031
5	6	5	-1.806654
6	5	2	-0.269364
7	5	3	-0.385576
8	6	3	-0.169293
9	6	4	-0.682105
10	6	2	-0.074650
11	6	5	-1.806654
12	4	3	-1.082611
13	4	2	-0.861527
14	6	4	-0.682105
15	7	6	-2.937919
16	5	3	-0.385576
17	7	3	-0.108435
18	5	3	-0.385576
19	5	3	-0.385576
20	3	2	-2.479246
21	8	7	-4.288170
22	5	3	-0.385576
23	4	2	-0.861527
24	7	3	-0.108435
25	4	2	-0.861527
26	5	3	-0.385576
27	6	4	-0.682105
28	4	2	-0.861527
29	5	3	-0.385576

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
30	6	4	-0.682105
31	6	1	-0.073355
32	5	3	-0.385576
33	5	3	-0.385576
34	4	2	-0.861527
35	5	4	-1.074849
36	7	2	-0.019138
37	7	6	-2.937919
38	8	4	-0.558166
39	5	3	-0.385576
40	5	4	-1.074849
41	5	3	-0.385576
42	7	3	-0.108435
43	5	3	-0.385576
44	4	3	-1.082611
45	5	3	-0.385576
46	6	4	-0.682105
47	6	3	-0.169293
48	5	2	-0.269364
49	5	2	-0.269364
50	6	4	-0.682105
51	7	2	-0.019138
52	5	4	-1.074849
53	6	4	-0.682105
54	7	2	-0.019138
55	2	1	-6.722925
56	5	3	-0.385576
57	6	2	-0.074650
58	7	6	-2.937919
59	9	3	-0.089787
60	5	2	-0.269364
61	7	4	-0.582451

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$\boldsymbol{ln\,[F(a) - F(r)]}$
62	6	5	-1.806654
63	4	3	-1.082611
64	5	3	-0.385576
65	5	3	-0.385576
66	5	4	-1.074849
67	7	3	-0.108435
68	6	5	-1.806654
69	6	5	-1.806654
70	5	4	-1.074849
71	4	2	-0.861527
72	5	3	-0.385576
73	5	4	-1.074849
74	7	3	-0.108435
75	8	2	-0.005240
76	4	3	-1.082611
77	5	3	-0.385576
78	5	3	-0.385576
79	7	6	-2.937919
Sum			-68.442140
Mean Critical Gap			**4.31863336**
Standard Deviation of the Critical Gap			**1.06894444**
Mean of the log of the Critical Gap			1.43320786
Standard Deviation of the log of the Critical Gap			0.24384888

Table E-2.5.d. Critical Gap Analysis Based on Maximum Likelihood Method
Ellington Roundabout – NEB – Hard Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	6	3	-0.404544
2	8	3	-0.387891
3	3	2	-1.198194
4	3	2	-1.198194
5	5	4	-1.657108
Sum			-4.845931
Mean Critical Gap			**3.48442058**
Standard Deviation of the Critical Gap			**0.89685556**
Mean of the log of the Critical Gap			1.216228
Standard Deviation of the log of the Critical Gap			0.25327363

Table E-3.1.a. Critical Gap Analysis Based on Maximum Likelihood Method
West Haven Roundabout – WB – Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	6	4	-0.490023
2	8	6	-2.096556
3	5	3	-0.513994
4	6	5	-1.416177
5	10	3	-0.028488
6	5	4	-0.994327
7	8	3	-0.037058
8	7	4	-0.345637
9	8	4	-0.307217
10	6	5	-1.416177
11	7	6	-2.352225
12	7	3	-0.066248
13	5	4	-0.994327
14	6	5	-1.416177
15	9	8	-4.992419
16	7	6	-2.352225
17	7	4	-0.345637
18	5	2	-0.468916
19	6	4	-0.490023
20	5	3	-0.513994
21	6	4	-0.490023
22	6	5	-1.416177
23	6	3	-0.173471
24	6	3	-0.173471
25	5	4	-0.994327
26	6	2	-0.141195
27	7	3	-0.066248
28	4	2	-1.363719
29	6	4	-0.490023
30	5	3	-0.513994

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
31	3	2	-3.590717
32	5	4	-0.994327
33	5	3	-0.513994
34	6	3	-0.173471
35	5	3	-0.513994
36	5	4	-0.994327
37	6	5	-1.416177
38	6	4	-0.490023
39	5	4	-0.994327
40	5	4	-0.994327
41	6	3	-0.173471
42	8	5	-1.006438
43	3	2	-3.590717
44	5	4	-0.994327
45	6	4	-0.490023
46	4	2	-1.363719
47	6	3	-0.173471
48	4	3	-1.477842
49	6	4	-0.490023
50	7	3	-0.066248
51	4	2	-1.363719
52	7	6	-2.352225
Sum			-51.678397
Mean Critical Gap			**4.769623744**
Standard Deviation of the Critical Gap			**1.103709669**
Mean of the log of the Critical Gap			1.53618577
Standard Deviation of the log of the Critical Gap			0.228392874

Table E-3.1.b. Critical Gap Analysis Based on Maximum Likelihood Method
West Haven Roundabout – WB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	6	3	-0.224068
2	5	3	-0.386583
3	6	2	-0.052903
4	7	4	-0.800621
5	5	3	-0.386583
6	6	5	-2.121212
7	6	1	-0.047958
8	5	3	-0.386583
9	7	5	-1.862455
10	4	3	-0.952916
11	3	2	-1.902391
12	3	2	-1.902391
13	5	3	-0.386583
Sum			-11.413247
Mean Critical Gap			**4.030236405**
Standard Deviation of the Critical Gap			**1.053449403**
Mean of the log of the Critical Gap			1.360780016
Standard Deviation of the log of the Critical Gap			0.257079831

Table E-3.2.a. Critical Gap Analysis Based on Maximum Likelihood Method
West Haven Roundabout – EB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	5	1	-0.006965
2	4	2	-0.166533
3	5	3	-0.236111
4	4	3	-0.440805
5	4	2	-0.166533
6	4	3	-0.440805
7	3	2	-1.594173
8	5	4	-1.922952
Sum			-4.974876
Mean Critical Gap			**3.453833549**
Standard Deviation of the Critical Gap			**0.539514972**
Mean of the log of the Critical Gap			1.227430856
Standard Deviation of the log of the Critical Gap			0.155267071

Table E-3.2.b. Critical Gap Analysis Based on Maximum Likelihood Method
West Haven Roundabout – EB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	6	1	-0.062773
2	3	2	-1.860013
3	6	3	-0.252779
4	4	2	-0.654446
5	5	3	-0.433049
6	8	6	-2.879502
7	4	3	-1.010438
8	8	3	-0.182959
9	5	2	-0.217908
10	5	3	-0.433049
11	7	4	-0.785199
Sum			-8.772115
Mean Critical Gap			**4.077635248**
Standard Deviation of the Critical Gap			**1.137563854**
Mean of the log of the Critical Gap			1.368043359
Standard Deviation of the log of the Critical Gap			0.273765831

Table E-3.3.a. Critical Gap Analysis Based on Maximum Likelihood Method
West Haven Roundabout – SB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	5	3	-0.406878
2	8	3	-0.001835
3	4	3	-1.915886
4	7	6	-3.060739
5	6	4	-0.222716
6	6	4	-0.222716
7	6	3	-0.053872
8	6	4	-0.222716
9	6	4	-0.222716
10	9	3	-0.001641
11	7	2	-0.003970
12	7	3	-0.005609
13	6	3	-0.053872
14	5	4	-0.656788
15	6	4	-0.222716
16	6	2	-0.052152
17	7	2	-0.003970
18	6	3	-0.053872
Sum			-7.384668
Mean Critical Gap			**4.737000116**
Standard Deviation of the Critical Gap			**0.721228362**
Mean of the log of the Critical Gap			1.543945674
Standard Deviation of the log of the Critical Gap			0.151382787

Table E-3.3.b. Critical Gap Analysis Based on Maximum Likelihood Method
West Haven Roundabout – SB – Right Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	2	-0.299507
2	4	3	-1.208354
3	4	2	-0.639112
4	9	5	-1.575738
5	7	6	-2.895180
6	2	1	-3.137021
7	6	4	-1.110550
8	4	2	-0.639112
9	6	3	-0.465110
10	9	4	-0.866840
11	5	4	-1.544479
12	5	4	-1.544479
13	3	2	-1.473718
14	3	2	-1.473718
15	3	2	-1.473718
16	6	2	-0.154156
17	4	2	-0.639112
18	5	3	-0.669213
19	7	6	-2.895180
20	5	4	-1.544479
Sum			-26.248777
Mean Critical Gap			**4.005232917**
Standard Deviation of the Critical Gap			**1.519322821**
Mean of the log of the Critical Gap			1.320382347
Standard Deviation of the log of the Critical Gap			0.366658938

Table E-4.1.a. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – NB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	7	5	-2.701580
2	4	1	-0.313326
3	7	3	-0.375971
4	5	4	-1.613804
5	6	3	-0.393392
6	3	2	-1.234953
7	3	2	-1.234953
8	5	3	-0.478806
9	4	2	-0.340742
10	3	2	-1.234953
11	5	1	-0.072420
12	4	3	-0.866562
13	5	2	-0.093903
Sum			-10.955368
Mean Critical Gap			**3.5263339**
Standard Deviation of the Critical Gap			**0.92951528**
Mean of the log of the Critical Gap			1.22667202
Standard Deviation of the log of the Critical Gap			0.25917852

Table E-4.1.b. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – NB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	6	1	-0.070456
2	6	1	-0.070456
3	7	2	-0.060708
4	3	1	-1.298231
5	7	3	-0.354173
6	3	2	-1.429852
7	4	3	-1.103480
8	8	2	-0.043790
9	7	6	-3.151223
10	5	4	-1.506786
Sum			-9.089155
Mean Critical Gap			**3.86946756**
Standard Deviation of the Critical Gap			**1.31640069**
Mean of the log of the Critical Gap			1.29835914
Standard Deviation of the log of the Critical Gap			0.33093133

Table E-4.1.c. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – NB – Through Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	2	-0.068781
2	5	1	-0.035787
3	3	2	-0.980816
4	7	2	-0.032637
5	4	2	-0.237255
6	3	2	-0.980816
7	4	2	-0.237255
8	7	2	-0.032637
9	6	1	-0.005551
10	8	4	-1.716007
11	5	2	-0.068781
12	4	2	-0.237255
13	4	2	-0.237255
14	3	1	-0.900614
15	5	2	-0.068781
16	2	1	-3.463653
17	3	2	-0.980816
18	6	4	-1.746638
19	6	3	-0.530783
20	7	2	-0.032637
21	9	3	-0.521444
22	8	3	-0.521604
23	3	2	-0.980816
24	4	3	-0.882409
25	6	4	-1.746638
26	3	2	-0.980816
27	4	2	-0.237255
28	3	2	-0.980816
29	4	2	-0.237255

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	5	2	-0.068781
31	3	2	-0.980816
32	5	3	-0.582454
33	3	2	-0.980816
34	4	3	-0.882409
35	4	3	-0.882409
36	5	3	-0.582454
37	7	2	-0.032637
38	6	4	-1.746638
39	4	3	-0.882409
40	5	2	-0.068781
41	5	3	-0.582454
42	5	2	-0.068781
43	3	2	-0.980816
44	4	2	-0.237255
45	3	2	-0.980816
46	4	3	-0.882409
47	8	5	-3.351222
48	3	2	-0.980816
49	4	2	-0.237255
50	4	3	-0.882409
51	6	2	-0.037547
52	3	2	-0.980816
53	8	3	-0.521604
54	3	1	-0.900614
55	6	3	-0.530783
56	8	4	-1.716007
Sum			-41.246026
Mean Critical Gap			**3.28346414**
Standard Deviation of the Critical Gap			**0.83232296**
Mean of the log of the Critical Gap			1.15776064
Standard Deviation of the log of the Critical Gap			0.24955306

Table E-4.2.a. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – SB – Right Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	4	2	-0.653993
2	4	2	-0.653993
3	5	2	-0.138648
4	4	2	-0.653993
5	7	3	-0.097453
6	9	3	-0.094306
7	4	2	-0.653993
8	5	3	-0.247115
9	5	3	-0.247115
10	5	3	-0.247115
11	6	3	-0.118772
12	10	3	-0.094272
13	5	3	-0.247115
14	6	4	-0.781917
15	5	4	-1.048199
16	5	3	-0.247115
17	7	5	-2.070726
18	6	4	-0.781917
19	9	6	-3.817010
20	5	3	-0.247115
21	7	5	-2.070726
22	4	2	-0.653993
23	5	2	-0.138648
24	5	1	-0.138100
25	5	4	-1.048199
26	5	3	-0.247115
27	4	3	-0.842849
28	6	2	-0.022763
29	4	2	-0.653993

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$\boldsymbol{ln\,[F(a) - F(r)]}$
30	8	3	-0.094630
31	4	3	-0.842849
32	3	2	-2.413703
33	6	4	-0.781917
34	4	2	-0.653993
35	7	2	-0.003377
36	5	3	-0.247115
37	5	2	-0.138648
38	8	1	-0.000330
Sum			-24.134831
Mean Critical Gap			**4.043251214**
Standard Deviation of the Critical Gap			**0.844452175**
Mean of the log of the Critical Gap			1.37570126
Standard Deviation of the log of the Critical Gap			0.206629445

Table E-4.2.b. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – SB – Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	4	3	-0.766167
2	4	2	-0.546212
3	3	2	-2.168508
4	8	3	-0.122473
5	8	2	-0.000922
6	6	3	-0.139081
7	4	3	-0.766167
8	4	3	-0.766167
9	5	3	-0.240612
10	6	2	-0.015616
11	5	3	-0.240612
12	6	3	-0.139081
13	4	2	-0.546212
14	6	4	-0.902964
15	10	3	-0.122279
16	5	4	-1.135208
17	7	6	-4.339837
18	6	4	-0.902964
19	6	4	-0.902964
20	4	3	-0.766167
21	11	3	-0.122277
22	5	3	-0.240612
23	5	1	-0.103980
24	5	3	-0.240612
25	5	3	-0.240612
26	3	2	-2.168508
27	4	2	-0.546212
28	5	3	-0.240612
29	5	4	-1.135208

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	5	3	-0.240612
31	5	4	-1.135208
32	5	4	-1.135208
33	3	2	-2.168508
Sum			-25.248383
Mean Critical Gap			**3.919555829**
Standard Deviation of the Critical Gap			**0.813126206**
Mean of the log of the Critical Gap			1.344910003
Standard Deviation of the log of the Critical Gap			0.205272186

Table E-4.2.c. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – SB – Through Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	7	5	-1.835486
2	5	2	-0.196214
3	5	3	-0.402850
4	9	2	-0.006291
5	5	3	-0.402850
6	4	3	-0.970264
7	4	3	-0.970264
8	8	6	-3.044002
9	4	3	-0.970264
10	4	3	-0.970264
11	4	3	-0.970264
12	7	3	-0.188805
13	2	1	-5.197214
14	5	2	-0.196214
15	6	3	-0.235413
16	7	4	-0.800810
17	3	1	-1.839130
18	14	1	-0.000001
19	5	2	-0.196214
20	5	3	-0.402850
21	8	1	-0.003161
22	5	4	-1.239845
23	8	4	-0.778911
24	10	5	-1.757591
25	4	2	-0.630347
26	6	4	-0.888526
27	4	2	-0.630347
28	3	2	-1.874552
29	4	3	-0.970264

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
30	7	3	-0.188805
31	2	1	-5.197214
32	4	3	-0.970264
33	10	4	-0.772431
34	7	3	-0.188805
35	5	3	-0.402850
36	7	4	-0.800810
37	3	2	-1.874552
38	4	3	-0.970264
39	6	5	-2.105109
40	5	3	-0.402850
41	7	5	-1.835486
42	5	4	-1.239845
43	4	2	-0.630347
44	7	5	-1.835486
45	5	3	-0.402850
46	11	5	-1.756828
47	8	2	-0.008726
48	7	5	-1.835486
49	6	4	-0.888526
50	5	2	-0.196214
51	8	4	-0.778911
52	7	3	-0.188805
53	7	3	-0.188805
54	5	4	-1.239845
55	5	3	-0.402850
56	6	4	-0.888526
57	4	3	-0.970264
58	4	3	-0.970264
59	6	3	-0.235413
60	5	3	-0.402850
61	6	3	-0.235413

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
62	6	3	-0.235413
63	4	3	-0.970264
64	6	3	-0.235413
65	6	3	-0.235413
66	6	4	-0.888526
67	10	2	-0.005720
68	6	3	-0.235413
69	6	4	-0.888526
70	4	3	-0.970264
71	9	7	-4.393525
72	4	2	-0.630347
73	6	4	-0.888526
74	5	3	-0.402850
75	7	5	-1.835486
76	5	3	-0.402850
77	5	4	-1.239845
78	5	4	-1.239845
79	6	5	-2.105109
80	5	3	-0.402850
81	4	3	-0.970264
82	6	4	-0.888526
83	5	4	-1.239845
84	8	3	-0.176870
85	4	3	-0.970264
86	3	2	-1.874552
87	4	3	-0.970264
88	6	3	-0.235413
89	6	3	-0.235413
90	7	3	-0.188805
91	7	5	-1.835486
92	4	3	-0.970264
93	4	3	-0.970264

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
94	4	3	-0.970264
95	6	4	-0.888526
96	5	4	-1.239845
97	4	3	-0.970264
98	3	2	-1.874552
99	6	5	-2.105109
100	4	3	-0.970264
101	5	3	-0.402850
102	3	2	-1.874552
103	7	3	-0.188805
104	4	2	-0.630347
105	6	5	-2.105109
106	3	2	-1.874552
107	5	4	-1.239845
108	5	4	-1.239845
109	4	3	-0.970264
110	3	2	-1.874552
111	6	3	-0.235413
112	5	3	-0.402850
113	13	4	-0.772063
114	2	1	-5.197214
115	5	3	-0.402850
116	4	3	-0.970264
117	5	3	-0.402850
118	3	1	-1.839130
119	6	3	-0.235413
120	5	4	-1.239845
121	6	4	-0.888526
122	6	3	-0.235413
123	3	2	-1.874552
124	4	3	-0.970264
125	3	2	-1.874552

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
126	3	2	-1.874552
127	6	4	-0.888526
128	4	2	-0.630347
129	10	3	-0.173316
130	8	6	-3.044002
131	5	4	-1.239845
132	6	4	-0.888526
133	4	3	-0.970264
134	7	5	-1.835486
135	7	3	-0.188805
136	4	3	-0.970264
137	4	3	-0.970264
138	7	1	-0.013182
139	9	4	-0.773658
140	4	2	-0.630347
141	4	3	-0.970264
142	6	2	-0.057980
143	8	2	-0.008726
144	4	2	-0.630347
145	4	2	-0.630347
146	5	3	-0.402850
147	4	3	-0.970264
148	6	5	-2.105109
149	4	3	-0.970264
150	6	4	-0.888526
151	5	4	-1.239845
152	6	4	-0.888526
153	3	2	-1.874552
154	9	4	-0.773658
155	4	3	-0.970264
156	4	3	-0.970264
157	5	3	-0.402850

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
158	5	3	-0.402850
159	4	3	-0.970264
160	5	3	-0.402850
161	4	3	-0.970264
162	4	3	-0.970264
163	3	1	-1.839130
164	3	2	-1.874552
165	4	3	-0.970264
166	5	4	-1.239845
167	9	4	-0.773658
168	5	3	-0.402850
Sum			-168.930842
Mean Critical Gap			**4.038300274**
Standard Deviation of the Critical Gap			**1.080549557**
Mean of the log of the Critical Gap			1.361249054
Standard Deviation of the log of the Critical Gap			0.262963209

Table E-4.3.a. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – EB – Right Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	5	1	-0.468737
2	6	2	-0.141195
3	7	4	-0.345637
4	5	4	-0.994327
5	7	4	-0.345637
6	7	1	-0.037090
7	6	3	-0.173471
8	3	2	-3.590717
9	5	3	-0.513994
10	6	4	-0.490023
11	4	3	-1.477842
12	5	3	-0.513994
13	9	3	-0.030037
14	5	3	-0.513994
15	4	3	-1.477842
16	6	3	-0.173471
17	4	3	-1.477842
18	5	3	-0.513994
19	5	4	-0.994327
20	5	2	-0.468916
21	5	4	-0.994327
22	6	3	-0.173471
23	5	1	-0.468737
24	4	2	-1.363719
25	6	5	-1.416177
26	4	3	-1.477842
27	7	4	-0.345637
28	5	3	-0.513994
29	4	2	-1.363719

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
30	5	3	-0.513994
31	3	2	-3.590717
32	6	3	-0.173471
33	4	3	-1.477842
34	5	2	-0.468916
35	5	1	-0.468737
36	6	1	-0.141066
37	6	5	-1.416177
38	5	4	-0.994327
39	4	2	-1.363719
40	6	2	-0.141195
41	4	3	-1.477842
42	5	3	-0.513994
43	5	3	-0.513994
44	5	2	-0.468916
45	6	3	-0.173471
46	5	3	-0.513994
47	5	4	-0.994327
48	6	3	-0.173471
49	6	3	-0.173471
50	4	2	-1.363719
51	6	5	-1.416177
52	6	5	-1.416177
53	3	1	-3.586679
54	9	4	-0.298028
55	5	3	-0.513994
56	4	2	-1.363719
57	4	2	-1.363719
58	5	3	-0.513994
59	6	5	-1.416177
60	4	2	-1.363719
61	6	4	-0.490023

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
62	5	3	-0.513994
63	5	3	-0.513994
64	3	1	-3.586679
65	5	4	-0.994327
Sum			-59.329472
Mean Critical Gap			**4.76962374**
Standard Deviation of the Critical Gap			**1.10370967**
Mean of the log of the Critical Gap			1.53618577
Standard Deviation of the log of the Critical Gap			0.22839287

Table E-4.3.b. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – EB – Left Turn Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	9	2	-0.002014
2	4	2	-1.363719
3	4	3	-1.477842
4	4	2	-1.363719
5	5	3	-0.513994
6	7	3	-0.066248
7	4	3	-1.477842
8	6	2	-0.141195
9	6	3	-0.173471
10	5	2	-0.468916
11	8	5	-1.006438
12	7	4	-0.345637
13	5	2	-0.468916
14	5	3	-0.513994
15	7	2	-0.037206
16	5	3	-0.513994
17	7	2	-0.037206
18	7	2	-0.037206
19	4	3	-1.477842
20	4	3	-1.477842
21	4	2	-1.363719
22	4	2	-1.363719
23	5	3	-0.513994
24	4	2	-1.363719
25	5	3	-0.513994
26	6	3	-0.173471
27	6	4	-0.490023
28	6	4	-0.490023
29	6	2	-0.141195

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
30	5	3	-0.513994
31	7	5	-1.085310
32	3	2	-3.590717
33	3	2	-3.590717
34	4	3	-1.477842
35	7	6	-2.352225
36	4	2	-1.363719
37	4	3	-1.477842
38	6	3	-0.173471
39	4	2	-1.363719
40	4	3	-1.477842
41	6	3	-0.173471
42	5	3	-0.513994
43	5	2	-0.468916
44	6	4	-0.490023
45	4	3	-1.477842
46	6	4	-0.490023
47	4	2	-1.363719
48	9	2	-0.002014
49	6	4	-0.490023
Sum			-43.316524
Mean Critical Gap			4.76962374
Standard Deviation of the Critical Gap			1.10370967
Mean of the log of the Critical Gap			1.53618577
Standard Deviation of the log of the Critical Gap			0.22839287

Table E-4.3.c. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – EB – Through Movement

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
1	3	2	-3.590717
2	6	2	-0.141195
3	3	2	-3.590717
4	5	3	-0.513994
5	6	1	-0.141066
6	7	3	-0.066248
7	5	1	-0.468737
8	7	5	-1.085310
9	6	5	-1.416177
10	6	4	-0.490023
11	6	4	-0.490023
12	6	3	-0.173471
13	6	2	-0.141195
14	5	3	-0.513994
15	5	3	-0.513994
16	4	2	-1.363719
17	7	3	-0.066248
18	6	3	-0.173471
19	7	2	-0.037206
20	6	5	-1.416177
21	7	2	-0.037206
22	8	2	-0.008840
23	5	3	-0.513994
24	6	3	-0.173471
25	10	4	-0.296004
26	3	1	-3.586679
27	5	4	-0.994327
28	4	3	-1.477842
29	8	6	-2.096556

A	B	C	D
Driver	Accepted Gap, a (Seconds)	Largest Rejected gap, r (Seconds)	$ln\,[F(a) - F(r)]$
30	4	2	-1.363719
31	3	2	-3.590717
32	4	2	-1.363719
33	5	3	-0.513994
34	7	5	-1.085310
35	6	4	-0.490023
36	5	4	-0.994327
37	7	3	-0.066248
38	4	1	-1.363283
39	6	5	-1.416177
40	4	2	-1.363719
41	4	3	-1.477842
42	6	5	-1.416177
43	6	3	-0.173471
44	4	2	-1.363719
45	8	2	-0.008840
46	5	4	-0.994327
47	5	4	-0.994327
48	8	6	-2.096556
49	10	3	-0.028488
50	6	4	-0.490023
51	5	2	-0.468916
52	6	4	-0.490023
53	4	3	-1.477842
54	6	4	-0.490023
55	5	4	-0.994327
56	5	1	-0.468737
57	4	3	-1.477842
58	5	3	-0.513994
59	7	3	-0.066248
60	7	5	-1.085310
61	3	1	-3.586679

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$\boldsymbol{ln\,[F(a) - F(r)]}$
62	4	3	-1.477842
63	6	5	-1.416177
64	6	4	-0.490023
65	5	3	-0.513994
Sum			-63.251585
Mean Critical Gap			**4.76962374**
Standard Deviation of the Critical Gap			**1.10370967**
Mean of the log of the Critical Gap			1.53618577
Standard Deviation of the log of the Critical Gap			0.22839287

Table E-4.4.a. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – WB – Right Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	8	3	-0.041528
2	4	3	-0.976789
3	5	4	-0.867695
4	4	3	-0.976789
5	5	4	-0.867695
6	5	4	-0.867695
7	5	3	-0.227608
8	6	4	-0.583825
9	6	2	-0.025657
10	5	4	-0.867695
11	5	3	-0.227608
12	4	3	-0.976789
13	4	3	-0.976789
14	3	2	-3.209162
15	6	5	-1.981645
16	7	4	-0.544190
17	4	2	-0.874889
18	4	2	-0.874889
19	6	4	-0.583825
20	7	5	-1.830124
21	5	3	-0.227608
22	6	5	-1.981645
23	6	4	-0.583825
24	5	3	-0.227608
Sum			-21.403576
Mean Critical Gap			**4.23384109**
Standard Deviation of the Critical Gap			**0.79999942**
Mean of the log of the Critical Gap			1.42556921
Standard Deviation of the log of the Critical Gap			0.18729886

Table E-4.4.b. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – WB – Left Turn Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	6	4	-0.587957
2	4	3	-0.810718
3	4	3	-0.810718
4	6	4	-0.587957
5	4	3	-0.810718
6	5	3	0.000000
7	4	2	-0.810718
8	5	4	-0.587957
9	6	4	-0.587957
10	5	4	-0.587957
Sum			-6.182654
Mean Critical Gap			**4.02470235**
Standard Deviation of the Critical Gap			**0.15604532**
Mean of the log of the Critical Gap			1.39169989
Standard Deviation of the log of the Critical Gap			0.03875733

Table E-4.4.c. Critical Gap Analysis Based on Maximum Likelihood Method
Killingworth Roundabout – WB – Through Movement

A	B	C	D
Driver	**Accepted Gap, a (Seconds)**	**Largest Rejected gap, r (Seconds)**	$ln\,[F(a) - F(r)]$
1	6	4	-0.972392
2	4	3	-0.662736
3	5	4	-1.141552
4	5	4	-1.141552
5	5	3	-0.180608
6	5	2	-0.067292
7	6	2	-0.006243
8	4	3	-0.662736
9	4	2	-0.485160
10	5	2	-0.067292
11	4	3	-0.662736
12	5	3	-0.180608
13	6	5	-2.832692
14	6	2	-0.006243
15	4	3	-0.662736
16	6	4	-0.972392
17	3	1	-2.298648
18	4	3	-0.662736
19	4	3	-0.662736
20	3	2	-2.300989
21	6	4	-0.972392
22	4	3	-0.662736
23	4	3	-0.662736
24	6	4	-0.972392
25	6	3	-0.112479
Sum			-20.012814
Mean Critical Gap			**3.85418207**
Standard Deviation of the Critical Gap			**0.7104209**
Mean of the log of the Critical Gap			1.33245323
Standard Deviation of the log of the Critical Gap			0.18278722

APPENDIX F

VEHICLE QUEUE LENGTH OF ROUNDABOUTS

APPENDIX F – VEHICLE QUEUE LENGHT OF ROUNDABOUTS

Table of Contents

Table F-1.1. Average Queue (# of Vehicles) on Salem Roundabout – EB (E Hadda.m. Rd)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Wednesday, May 21st, 2014 (7 a.m. – 9 a.m.)	**7 – 8 a.m.**	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	2	8	2	5.00	4.33	4.38
			7:05 a.m.	7:10 a.m.	1	9	2	5.00		
			7:10 a.m.	7:15 a.m.	1	5	3	3.00		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	1	13	7	7.00	5.83	
			7:20 a.m.	7:25 a.m.	2	5	2	3.50		
			7:25 a.m.	7:30 a.m.	2	12	2	7.00		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	1	10	2	5.50	4.00	
			7:35 a.m.	7:40 a.m.	1	4	4	2.50		
			7:40 a.m.	7:45 a.m.	1	7	3	4.00		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	1	5	2	3.00	3.33	
			7:50 a.m.	7:55 a.m.	1	9		5.00		
			7:55 a.m.	8:00 a.m.	1	3	2	2.00		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	1	4	2	2.50	4.83	3.50
			8:05 a.m.	8:10 a.m.	1	16	3	8.50		
			8:10 a.m.	8:15 a.m.	2	5	2	3.50		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	2	4	3	3.00	3.67	
			8:20 a.m.	8:25 a.m.	2	4	3	3.00		
			8:25 a.m.	8:30 a.m.	2	8	5	5.00		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	2	3	2	2.50	2.83	
			8:35 a.m.	8:40 a.m.	2	6	2	4.00		
			8:40 a.m.	8:45 a.m.	1	3	3	2.00		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	1	6	3	3.50	2.67	
			8:50 a.m.	8:55 a.m.	1	4	2	2.50		
			8:55 a.m.	9:00 a.m.	1	3	2	2.00		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	1	9	4	5.00	6.33	4.21
			4:05 p.m.	4:10 p.m.	1	21	2	11.00		
			4:10 p.m.	4:15 p.m.	1	5	2	3.00		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	1	8	2	4.50	3.00	
			4:20 p.m.	4:25 p.m.	1	5	2	3.00		
			4:25 p.m.	4:30 p.m.	1	2	2	1.50		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	1	3	2	2.00	3.50	
			4:35 p.m.	4:40 p.m.	1	9	5	5.00		
			4:40 p.m.	4:45 p.m.	2	5	2	3.50		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	1	8	4	4.50	4.00	
			4:50 p.m.	4:55 p.m.	1	6	2	3.50		
			4:55 p.m.	5:00 p.m.	2	6	3	4.00		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	1	8	2	4.50	3.83	3.08
			5:05 p.m.	5:10 p.m.	2	5	3	3.50		
			5:10 p.m.	5:15 p.m.	1	6	2	3.50		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	1	5	2	3.00	3.17	
			5:20 p.m.	5:25 p.m.	1	6	1	3.50		
			5:25 p.m.	5:30 p.m.	1	5	2	3.00		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	1	3	2	2.00	2.50	
			5:35 p.m.	5:40 p.m.	1	4	3	2.50		
			5:40 p.m.	5:45 p.m.	1	5	2	3.00		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	1	3	2	2.00	2.83	
			5:50 p.m.	5:55 p.m.	2	5	2	3.50		
			5:55 p.m.	6:00 p.m.	1	5	2	3.00		

Table F-1.2. Average Queue (# of Vehicles) on Salem Roundabout – NB (New London Rd)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Wednesday, May 21st, 2014 (7 a.m. – 9 a.m.)	**7 – 8 a.m.**	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	2	6	1 or 2	4.00	3.33	2.38
			7:05 a.m.	7:10 a.m.	2	4	2	3.00		
			7:10 a.m.	7:15 a.m.	2	4	2	3.00		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	1	2	1	1.50	2.33	
			7:20 a.m.	7:25 a.m.	2	6	2	4.00		
			7:25 a.m.	7:30 a.m.	1	2	1	1.50		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	1	2	1	1.50	2.00	
			7:35 a.m.	7:40 a.m.	2	4	2	3.00		
			7:40 a.m.	7:45 a.m.	1	2	2	1.50		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	1	2	1	1.50	1.83	
			7:50 a.m.	7:55 a.m.	1	2	1	1.50		
			7:55 a.m.	8:00 a.m.	1	4	2 or 3	2.50		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	1	4	2	2.50	2.50	2.08
			8:05 a.m.	8:10 a.m.	2	5	2 or 3	3.50		
			8:10 a.m.	8:15 a.m.	1	2	1	1.50		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	2	4	2	3.00	2.33	
			8:20 a.m.	8:25 a.m.	0	2	2	1.00		
			8:25 a.m.	8:30 a.m.	2	4	2	3.00		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	1	2	1	1.50	1.83	
			8:35 a.m.	8:40 a.m.	2	3	2	2.50		
			8:40 a.m.	8:45 a.m.	1	2	2	1.50		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	2	2	2	2.00	1.67	
			8:50 a.m.	8:55 a.m.	1	1	1	1.00		
			8:55 a.m.	9:00 a.m.	2	2	2	2.00		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	1	5	3	3.00	3.50	2.79
			4:05 p.m.	4:10 p.m.	3	6	3 or 4	4.50		
			4:10 p.m.	4:15 p.m.	2	4	3	3.00		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	1	4	2	2.50	2.50	
			4:20 p.m.	4:25 p.m.	1	3	2	2.00		
			4:25 p.m.	4:30 p.m.	1	5	2	3.00		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	2	6	2 or 3	4.00	2.67	
			4:35 p.m.	4:40 p.m.	1	4	2	2.50		
			4:40 p.m.	4:45 p.m.	1	2	2	1.50		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	1	2	1	1.50	2.50	
			4:50 p.m.	4:55 p.m.	2	4	2 or 3	3.00		
			4:55 p.m.	5:00 p.m.	1	5	3	3.00		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	1	2	2	1.50	2.17	2.29
			5:05 p.m.	5:10 p.m.	2	3	2	2.50		
			5:10 p.m.	5:15 p.m.	1	4	2 or 3	2.50		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	1	3	1	2.00	2.33	
			5:20 p.m.	5:25 p.m.	2	3	2	2.50		
			5:25 p.m.	5:30 p.m.	1	4	2 or 3	2.50		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	2	3	2	2.50	2.67	
			5:35 p.m.	5:40 p.m.	1	8	2 to 4	4.50		
			5:40 p.m.	5:45 p.m.	1	1	1	1.00		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	1	4	1 to 2	2.50	2.00	
			5:50 p.m.	5:55 p.m.	1	2	2	1.50		
			5:55 p.m.	6:00 p.m.	2	2	2	2.00		

Table F-2.1. Average Queue (# of Vehicles) on Ellington Roundabout – NB (Skinner Rd)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Wednesday, May 21st, 2014 (7 a.m. – 9 a.m.)	**7 – 8 a.m.**	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	2	10	5	6.00	4.67	7.21
			7:05 a.m.	7:10 a.m.	3	4	4	3.50		
			7:10 a.m.	7:15 a.m.	2	7	4	4.50		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	3	9	5	6.00	7.50	
			7:20 a.m.	7:25 a.m.	3	15	4	9.00		
			7:25 a.m.	7:30 a.m.	6	9	5	7.50		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	2	13	6	7.50	8.33	
			7:35 a.m.	7:40 a.m.	5	14	6	9.50		
			7:40 a.m.	7:45 a.m.	2	14	3	8.00		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	6	14	3	10.00	8.33	
			7:50 a.m.	7:55 a.m.	4	13	3	8.50		
			7:55 a.m.	8:00 a.m.	5	8	4	6.50		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	3	5	3	4.00	3.67	4.50
			8:05 a.m.	8:10 a.m.	1	3	2	2.00		
			8:10 a.m.	8:15 a.m.	1	9	3	5.00		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	4	6	1,2	5.00	6.00	
			8:20 a.m.	8:25 a.m.	5	9	3	7.00		
			8:25 a.m.	8:30 a.m.	1	11	2	6.00		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	3	13	1,3	8.00	5.17	
			8:35 a.m.	8:40 a.m.	2	6	3	4.00		
			8:40 a.m.	8:45 a.m.	3	4	1	3.50		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	4	7	2,3	5.50	3.17	
			8:50 a.m.	8:55 a.m.	1	3	2	2.00		
			8:55 a.m.	9:00 a.m.	1	3	2	2.00		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	1	4	2	2.50	4.50	4.88
			4:05 p.m.	4:10 p.m.	1	7	2	4.00		
			4:10 p.m.	4:15 p.m.	3	11	2	7.00		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	3	6	2	4.50	4.67	
			4:20 p.m.	4:25 p.m.	2	7	3	4.50		
			4:25 p.m.	4:30 p.m.	1	9	2	5.00		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	1	6	2	3.50	3.83	
			4:35 p.m.	4:40 p.m.	2	7	2	4.50		
			4:40 p.m.	4:45 p.m.	2	5	2	3.50		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	2	15	3	8.50	6.50	
			4:50 p.m.	4:55 p.m.	3	9	3	6.00		
			4:55 p.m.	5:00 p.m.	3	7	2	5.00		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	1	13	1	7.00	5.33	4.79
			5:05 p.m.	5:10 p.m.	1	10	2	5.50		
			5:10 p.m.	5:15 p.m.	1	6	2	3.50		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	2	9	3	5.50	5.50	
			5:20 p.m.	5:25 p.m.	2	12	2	7.00		
			5:25 p.m.	5:30 p.m.	3	5	2,3	4.00		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	2	7	3	4.50	4.17	
			5:35 p.m.	5:40 p.m.	4	4	2	4.00		
			5:40 p.m.	5:45 p.m.	2	6	3	4.00		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	3	8	2	5.50	4.17	
			5:50 p.m.	5:55 p.m.	4	5	2	4.50		
			5:55 p.m.	6:00 p.m.	2	3	2	2.50		

Table F-2.2. Average Queue (# of Vehicles) on Ellington Roundabout – SB (Pinney St)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Wednesday, May 21st, 2014 (7 a.m. – 9 a.m.)	**7 – 8 a.m.**	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	2	12	2	7.00	5.33	4.88
			7:05 a.m.	7:10 a.m.	2	5	3	3.50		
			7:10 a.m.	7:15 a.m.	2	9	2	5.50		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	2	9	3	5.50	6.17	
			7:20 a.m.	7:25 a.m.	2	11	4	6.50		
			7:25 a.m.	7:30 a.m.	3	10	3	6.50		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	2	9	4	5.50	5.83	
			7:35 a.m.	7:40 a.m.	2	10	3	6.00		
			7:40 a.m.	7:45 a.m.	2	10	2	6.00		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	2	17	3	9.50	9.00	
			7:50 a.m.	7:55 a.m.	2	17	3	9.50		
			7:55 a.m.	8:00 a.m.	2	14	2	8.00		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	2	5	2	3.50	4.33	4.79
			8:05 a.m.	8:10 a.m.	2	4	3	3.00		
			8:10 a.m.	8:15 a.m.	2	11	3	6.50		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	2	6	3	4.00	9.67	
			8:20 a.m.	8:25 a.m.	2	21	3	11.50		
			8:25 a.m.	8:30 a.m.	3	24	2	13.50		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	2	11	3	6.50	4.83	
			8:35 a.m.	8:40 a.m.	2	9	4	5.50		
			8:40 a.m.	8:45 a.m.	1	4	4	2.50		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	2	8	4	5.00	3.50	
			8:50 a.m.	8:55 a.m.	2	3	2	2.50		
			8:55 a.m.	9:00 a.m.	2	4	2	3.00		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	2	9	2	5.50	4.00	5.21
			4:05 p.m.	4:10 p.m.	2	5	2	3.50		
			4:10 p.m.	4:15 p.m.	1	5	2	3.00		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	1	6	2	3.50	3.83	
			4:20 p.m.	4:25 p.m.	1	9	5	5.00		
			4:25 p.m.	4:30 p.m.	1	5	2	3.00		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	1	6	2	3.50	6.00	
			4:35 p.m.	4:40 p.m.	2	22	2	12.00		
			4:40 p.m.	4:45 p.m.	1	4	4	2.50		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	2	18	2	10.00	7.00	
			4:50 p.m.	4:55 p.m.	3	10	3	6.50		
			4:55 p.m.	5:00 p.m.	1	8	2	4.50		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	1	12	2	6.50	4.33	4.92
			5:05 p.m.	5:10 p.m.	1	5	4	3.00		
			5:10 p.m.	5:15 p.m.	1	6	6	3.50		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	1	18	4	9.50	7.00	
			5:20 p.m.	5:25 p.m.	2	16	3	9.00		
			5:25 p.m.	5:30 p.m.	2	3	2	2.50		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	2	7	2	4.50	4.33	
			5:35 p.m.	5:40 p.m.	2	8	2	5.00		
			5:40 p.m.	5:45 p.m.	2	5	4	3.50		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	2	8	2	5.00	4.00	
			5:50 p.m.	5:55 p.m.	2	6	3	4.00		
			5:55 p.m.	6:00 p.m.	1	5	2	3.00		

Table F-3.1. Average Queue (# of Vehicles) on West Haven Roundabout – EB (New Haven Avenue)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (7 a.m. – 9 a.m.)	**7 – 8 a.m.**	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	2	2	2	2.00	2.33	2.46
			7:05 a.m.	7:10 a.m.	2	2	2	2.00		
			7:10 a.m.	7:15 a.m.	3	3	3	3.00		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	2	3	2	2.50	2.67	
			7:20 a.m.	7:25 a.m.	1	5	2	3.00		
			7:25 a.m.	7:30 a.m.	1	4	2	2.50		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	1	3	2	2.00	2.50	
			7:35 a.m.	7:40 a.m.	2	5	2	3.50		
			7:40 a.m.	7:45 a.m.	2	2	2	2.00		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	1	4	4	2.50	2.33	
			7:50 a.m.	7:55 a.m.	2	4	2	3.00		
			7:55 a.m.	8:00 a.m.	1	2	2	1.50		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	1	5	2	3.00	2.50	2.29
			8:05 a.m.	8:10 a.m.	2	3	2	2.50		
			8:10 a.m.	8:15 a.m.	2	2	2	2.00		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	2	2	2	2.00	1.33	
			8:20 a.m.	8:25 a.m.	0	0	0	0.00		
			8:25 a.m.	8:30 a.m.	2	2	2	2.00		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	1	2	1	1.50	2.83	
			8:35 a.m.	8:40 a.m.	2	7	2	4.50		
			8:40 a.m.	8:45 a.m.	2	3	0	2.50		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	2	4	2	3.00	2.50	
			8:50 a.m.	8:55 a.m.	1	5	2	3.00		
			8:55 a.m.	9:00 a.m.	1	2	0	1.50		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	1	4	2	2.50	5.17	4.38
			4:05 p.m.	4:10 p.m.	2	13	2	7.50		
			4:10 p.m.	4:15 p.m.	3	8	5	5.50		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	1	8	2	4.50	5.00	
			4:20 p.m.	4:25 p.m.	2	9	2	5.50		
			4:25 p.m.	4:30 p.m.	2	8	3	5.00		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	2	7	5	4.50	4.17	
			4:35 p.m.	4:40 p.m.	2	5	3	3.50		
			4:40 p.m.	4:45 p.m.	2	7	2	4.50		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	1	4	2	2.50	3.17	
			4:50 p.m.	4:55 p.m.	2	5	2	3.50		
			4:55 p.m.	5:00 p.m.	1	6	4	3.50		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	2	6	2	4.00	4.33	5.29
			5:05 p.m.	5:10 p.m.	2	8	2	5.00		
			5:10 p.m.	5:15 p.m.	2	6	2	4.00		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	2	26	2	14.00	8.67	
			5:20 p.m.	5:25 p.m.	2	12	6	7.00		
			5:25 p.m.	5:30 p.m.	2	8	5	5.00		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	1	4	3	2.50	3.83	
			5:35 p.m.	5:40 p.m.	2	9	4	5.50		
			5:40 p.m.	5:45 p.m.	1	6	4	3.50		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	2	10	3	6.00	4.33	
			5:50 p.m.	5:55 p.m.	1	5	2	3.00		
			5:55 p.m.	6:00 p.m.	2	6	6	4.00		

Table F-3.2. Average Queue (# of Vehicles) on West Haven Roundabout – WB (Ocean Avenue)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (7 a.m. – 9 a.m.)	**7 – 8 a.m.**	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	1	7	2	4.00	2.50	2.58
			7:05 a.m.	7:10 a.m.	1	2	2	1.50		
			7:10 a.m.	7:15 a.m.	1	3	3	2.00		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	1	3	2	2.00	2.50	
			7:20 a.m.	7:25 a.m.	1	3	3	2.00		
			7:25 a.m.	7:30 a.m.	1	6	2	3.50		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	1	4	3	2.50	2.83	
			7:35 a.m.	7:40 a.m.	1	3	2	2.00		
			7:40 a.m.	7:45 a.m.	1	7	2	4.00		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	1	4	1	2.50	2.50	
			7:50 a.m.	7:55 a.m.	1	4	1	2.50		
			7:55 a.m.	8:00 a.m.	1	4	1	2.50		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	1	2	1	1.50	1.67	2.33
			8:05 a.m.	8:10 a.m.	1	3	1	2.00		
			8:10 a.m.	8:15 a.m.	1	2	1	1.50		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	1	4	1	2.50	2.50	
			8:20 a.m.	8:25 a.m.	1	3	1	2.00		
			8:25 a.m.	8:30 a.m.	1	5	1	3.00		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	1	2	1	1.50	2.83	
			8:35 a.m.	8:40 a.m.	2	3	1	2.50		
			8:40 a.m.	8:45 a.m.	2	7	2	4.50		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	1	4	2	2.50	2.33	
			8:50 a.m.	8:55 a.m.	1	4	1	2.50		
			8:55 a.m.	9:00 a.m.	1	3	3	2.00		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	1	3	1	2.00	2.33	2.71
			4:05 p.m.	4:10 p.m.	2	4	2	3.00		
			4:10 p.m.	4:15 p.m.	1	3	1	2.00		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	1	5	1	3.00	3.17	
			4:20 p.m.	4:25 p.m.	1	4	2	2.50		
			4:25 p.m.	4:30 p.m.	1	7	1	4.00		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	1	4	3	2.50	2.33	
			4:35 p.m.	4:40 p.m.	1	4	2	2.50		
			4:40 p.m.	4:45 p.m.	1	3	1	2.00		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	1	6	1	3.50	3.00	
			4:50 p.m.	4:55 p.m.	1	5	2	3.00		
			4:55 p.m.	5:00 p.m.	1	4	1	2.50		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	1	13	2	7.00	5.50	3.96
			5:05 p.m.	5:10 p.m.	1	2	2	1.50		
			5:10 p.m.	5:15 p.m.	1	15	8	8.00		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	2	6	4	4.00	3.83	
			5:20 p.m.	5:25 p.m.	2	4	4	3.00		
			5:25 p.m.	5:30 p.m.	2	7	3	4.50		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	1	5	2	3.00	2.83	
			5:35 p.m.	5:40 p.m.	1	4	4	2.50		
			5:40 p.m.	5:45 p.m.	1	5	1	3.00		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	2	5	4	3.50	3.67	
			5:50 p.m.	5:55 p.m.	2	6	3	4.00		
			5:55 p.m.	6:00 p.m.	2	5	3	3.50		

Table F-4.1. Average Queue (# of Vehicles) on Killingworth Roundabout – NB (Clinton Rd)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (7 a.m. – 9 a.m.)	7 – 8 a.m.	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	2	4	3	3.00	2.83	2.92
			7:05 a.m.	7:10 a.m.	2	6	2	2.50		
			7:10 a.m.	7:15 a.m.	2	4	2 or 3	3.00		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	2	4	2 or 3	3.00	2.33	
			7:20 a.m.	7:25 a.m.	1	3	1	2.50		
			7:25 a.m.	7:30 a.m.	1	6	1	1.50		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	2	5	3	3.50	3.50	
			7:35 a.m.	7:40 a.m.	4	6	1	4.50		
			7:40 a.m.	7:45 a.m.	2	3	1	2.50		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	1	4	3	2.50	3.00	
			7:50 a.m.	7:55 a.m.	1	6	1	3.00		
			7:55 a.m.	8:00 a.m.	2	7	1	3.50		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	2	2	2	2.00	2.00	2.58
			8:05 a.m.	8:10 a.m.	2	3	2	2.50		
			8:10 a.m.	8:15 a.m.	1	2	2	1.50		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	1	3	2	2.00	3.00	
			8:20 a.m.	8:25 a.m.	3	4	3	3.50		
			8:25 a.m.	8:30 a.m.	2	5	3	3.50		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	3	5	4	4.00	2.83	
			8:35 a.m.	8:40 a.m.	1	2	2	1.50		
			8:40 a.m.	8:45 a.m.	1	5	2 or 3	3.00		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	2	4	2	3.00	2.50	
			8:50 a.m.	8:55 a.m.	2	3	2	2.50		
			8:55 a.m.	9:00 a.m.	2	2	2	2.00		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	2	4	2 or 3	3.00	4.33	4.29
			4:05 p.m.	4:10 p.m.	3	9	4 or 5	6.00		
			4:10 p.m.	4:15 p.m.	3	5	3 or 4	4.00		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	2	4	3	3.00	4.67	
			4:20 p.m.	4:25 p.m.	2	8	3	5.00		
			4:25 p.m.	4:30 p.m.	2	10	6	6.00		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	3	5	3	5.00	4.83	
			4:35 p.m.	4:40 p.m.	3	6	4 or 5	5.00		
			4:40 p.m.	4:45 p.m.	4	5	3	4.50		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	2	9	3 to 5	5.50	3.33	
			4:50 p.m.	4:55 p.m.	2	2	2	2.00		
			4:55 p.m.	5:00 p.m.	1	4	2 to 3	2.50		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	1	4	2	2.50	3.17	5.79
			5:05 p.m.	5:10 p.m.	2	8	3	3.50		
			5:10 p.m.	5:15 p.m.	2	5	3 or 4	3.50		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	3	6	2 or 3	4.50	7.00	
			5:20 p.m.	5:25 p.m.	2	10	2 or 3	11.00		
			5:25 p.m.	5:30 p.m.	2	9	3 or 4	5.50		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	1	8	4 or 5	4.50	7.67	
			5:35 p.m.	5:40 p.m.	2	23	9 to 12	12.50		
			5:40 p.m.	5:45 p.m.	2	10	6 or 7	6.00		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	2	5	3	3.50	5.33	
			5:50 p.m.	5:55 p.m.	1	19	7 to 9	10.00		
			5:55 p.m.	6:00 p.m.	2	3	2	2.50		

Table F-4.2. Average Queue (# of Vehicles) on Killingworth Roundabout – SB (Higganum Rd)

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (7 a.m. – 9 a.m.)	7 – 8 a.m.	7:00 - 7:15 a.m.	7:00 a.m.	7:05 a.m.	1	3	2	2.00	3.17	3.42
			7:05 a.m.	7:10 a.m.	2	5	1	3.50		
			7:10 a.m.	7:15 a.m.	2	6	3	4.00		
		7:15 - 7:30 a.m.	7:15 a.m.	7:20 a.m.	1	6	1	3.50	3.50	
			7:20 a.m.	7:25 a.m.	2	5	2	3.50		
			7:25 a.m.	7:30 a.m.	3	4	3	3.50		
		7:30 - 7:45 a.m.	7:30 a.m.	7:35 a.m.	1	6	3	3.50	3.17	
			7:35 a.m.	7:40 a.m.	1	6	2	3.50		
			7:40 a.m.	7:45 a.m.	1	4	1	2.50		
		7:45 - 8:00 a.m.	7:45 a.m.	7:50 a.m.	2	7	1	4.50	3.83	
			7:50 a.m.	7:55 a.m.	2	4	1	3.00		
			7:55 a.m.	8:00 a.m.	2	6	2	4.00		
	8 – 9 a.m.	8:00 - 8:15 a.m.	8:00 a.m.	8:05 a.m.	2	7	2	4.50	3.33	3.58
			8:05 a.m.	8:10 a.m.	2	3	2	2.50		
			8:10 a.m.	8:15 a.m.	1	5	2	3.00		
		8:15 - 8:30 a.m.	8:15 a.m.	8:20 a.m.	2	5	2	3.50	3.67	
			8:20 a.m.	8:25 a.m.	2	6	2	4.00		
			8:25 a.m.	8:30 a.m.	1	6	2	3.50		
		8:30 - 8:45 a.m.	8:30 a.m.	8:35 a.m.	1	6	2	3.50	4.50	
			8:35 a.m.	8:40 a.m.	2	7	1	4.50		
			8:40 a.m.	8:45 a.m.	2	9	2	5.50		
		8:45 - 9:00 a.m.	8:45 a.m.	8:50 a.m.	1	3	2	2.00	2.83	
			8:50 a.m.	8:55 a.m.	2	6	2	4.00		
			8:55 a.m.	9:00 a.m.	1	4	2	2.50		

Date of Recording	Time		Start	End	Queue (min)	Queue (max)	Ave Queue Observed	Average Queue Per 5 Min	Average Queue Per 15 Min	Average Queue Per Hour
Tuesday, May 20th, 2014 (4 p.m. - 6 p.m.)	**4 – 5 p.m.**	4:00 - 4:15 p.m.	4:00 p.m.	4:05 p.m.	1	5	2	3.00	3.00	3.08
			4:05 p.m.	4:10 p.m.	1	4	2	2.50		
			4:10 p.m.	4:15 p.m.	2	5	1	3.50		
		4:15 - 4:30 p.m.	4:15 p.m.	4:20 p.m.	1	4	2	2.50	2.50	
			4:20 p.m.	4:25 p.m.	1	5	2	3.00		
			4:25 p.m.	4:30 p.m.	1	3	1	2.00		
		4:30 - 4:45 p.m.	4:30 p.m.	4:35 p.m.	2	6	3	4.00	3.50	
			4:35 p.m.	4:40 p.m.	2	5	2	3.50		
			4:40 p.m.	4:45 p.m.	2	4	3	3.00		
		4:45 - 5:00 p.m.	4:45 p.m.	4:50 p.m.	1	4	2	2.50	3.33	
			4:50 p.m.	4:55 p.m.	1	4	2	2.50		
			4:55 p.m.	5:00 p.m.	1	9	2	5.00		
	5 – 6 p.m.	5:00 - 5:15 p.m.	5:00 p.m.	5:05 p.m.	2	8	2	5.00	4.50	4.83
			5:05 p.m.	5:10 p.m.	2	6	2	4.00		
			5:10 p.m.	5:15 p.m.	2	7	2	4.50		
		5:15 - 5:30 p.m.	5:15 p.m.	5:20 p.m.	2	8	2	5.00	5.00	
			5:20 p.m.	5:25 p.m.	2	10	2	6.00		
			5:25 p.m.	5:30 p.m.	2	6	1	4.00		
		5:30 - 5:45 p.m.	5:30 p.m.	5:35 p.m.	2	7	1	4.50	4.67	
			5:35 p.m.	5:40 p.m.	2	7	2	4.50		
			5:40 p.m.	5:45 p.m.	3	7	3	5.00		
		5:45 - 6:00 p.m.	5:45 p.m.	5:50 p.m.	2	7	3	4.50	5.17	
			5:50 p.m.	5:55 p.m.	1	8	2	4.50		
			5:55 p.m.	6:00 p.m.	3	10	3	6.50		

APPENDIX G

FOLLOW-UP HEADWAY OF ROUNDABOUTS

APPENDIX G – FOLLOW-UP HEADWAY OF ROUNDABOUTS

Table of Contents

Table G-1. Summary of Follow-Up Headway of Roundabouts

Roundabout		Average Headway (Seconds)	Saturation Flow Rate (v/h)
Salem	EB	2.58	1396.55
	NB	2.58	1398.06
	Average	2.58	1397.30
Ellington	NB	2.44	1474.54
	SB	4.33	831.28
	Average	3.39	1152.91
West Haven	EB	3.92	918.72
	WB	2.85	1265.04
	Average	3.38	1091.88
Killingworth	NB	3.09	1164.22
	SB	2.93	1226.98
	Average	3.01	1195.60

Table G-2. Follow-Up Headway Measurement on Salem -EB

Average Follow-up Headway (sec/veh) on Salem - EB					
Date : May 21st for 7 a.m. to 9 a.m. and May 20th for 4 p.m. to 6.p.m					
	Departure	**Circulating Gap**	**Headway**	**Ave Headway (sec)**	**Sat. Flow Rate (v/h)**
1	7:01:01	Infinity			
2	7:01:04		0:00:03		
1	7:01:25	Infinity			
2	7:01:27		0:00:02		
	7:01:29		0:00:02		
1	7:01:42	Infinity			
2	7:01:45		0:00:03		
1	7:02:23	Regular			
2	7:02:26		0:00:03		
1	7:02:31	Infinity			
2	7:02:34		0:00:03		
1	7:02:44	Infinity			
Motor	7:02:46		0:00:02		
1	7:04:16	Regular			
2	7:04:18		0:00:02		
3	7:04:22		0:00:04		
1	7:05:04	Regular			
2	7:05:06		0:00:02		
1	7:06:55	Infinity			
2 … … … …	7:06:57		0:00:02		
1	5:02:33	Regular			
2	5:02:34		0:00:01		
3	5:02:36		0:00:02		
1	5:04:37	Infinity			
2	5:04:39		0:00:02		
1	5:35:00	Regular			
2	5:35:04		0:00:04		

APPENDIX H

COMPARISON OF VEHICLE QUEUE LENGTH OF SIMULATED AND FIELD MEASURED

APPENDIX H – COMPARISON OF VEHICLE QUEUE LENGTH OF SIMULATED AND FIELD MEASURED

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Table H-1.1. Comparison of Vehicle Queue Length
Salem Roundabout – EB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	1	**0.70**	2	**1.7**	9	**3**
		Simulation	0.30		0.30		6	
	7:15 a.m. to 7:30 a.m.	Field	2	**1.8**	2	**1.8**	12	**5**
		Simulation	0.20		0.20		7	
	7:30 a.m. to 7:45 a.m.	Field	1	**0.8**	2	**1.8**	10	**4**
		Simulation	0.20		0.20		6	
	7:45 a.m. to 8:00 a.m.	Field	2	**1.8**	2	**1.8**	9	**3**
		Simulation	0.2		0.2		6	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	1	**0.2**	2	**1.2**	9	**0**
		Simulation	0.8		0.8		9	
	4:45 p.m. to 5:00 p.m.	Field	1	**0.3**	2	**1.3**	8	**-1**
		Simulation	0.7		0.7		9	
	5:00 p.m. to 5:15 p.m.	Field	1	**0.6**	2	**1.6**	11	**4**
		Simulation	0.4		0.4		7	
	5:15 p.m. to 5:30 p.m.	Field	1	**0.4**	2	**1.4**	8	**0**
		Simulation	0.6		0.6		8	

Table H-1.2. Comparison of Vehicle Queue Length
Salem Roundabout – NB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	2	**1.9**	2	**1.9**	6	**2**
		Simulation	0.1		0.1		4	
	7:15 a.m. to 7:30 a.m.	Field	1	**1**	1	**1**	6	**2**
		Simulation	0		0		4	
	7:30 a.m. to 7:45 a.m.	Field	1	**0**	1	**1**	6	**2**
		Simulation	0		0		4	
	7:45 a.m. to 8:00 a.m.	Field	1	**1**	1	**1**	7	**4**
		Simulation	0		0		3	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	1	**0**	3	**2**	10	**-1**
		Simulation	1		1		11	
	4:45 p.m. to 5:00 p.m.	Field	1	**0.3**	2	**1.3**	9	**0**
		Simulation	0.7		0.7		9	
	5:00 p.m. to 5:15 p.m.	Field	1	**0.3**	2	**1.3**	13	**4**
		Simulation	0.7		0.7		9	
	5:15 p.m. to 5:30 p.m.	Field	1	**0.3**	2	**1.3**	11	**2**
		Simulation	0.7		0.7		9	

Table H-2.1. Comparison of Vehicle Queue Length
Ellington Roundabout – SB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	2	**-0.5**	2	**-0.5**	12	**-2.8**
		Simulation	2.5		2.5		15	
	7:15 a.m. to 7:30 a.m.	Field	2	**0.9**	3	**0.9**	11	**-2**
		Simulation	2.1		2.1		13	
	7:30 a.m. to 7:45 a.m.	Field	2	**0.2**	3	**0.2**	10	**0**
		Simulation	2.8		2.8		17	
	7:45 a.m. to 8:00 a.m.	Field	2	**0.6**	3	**0.6**	17	**-1.7**
		Simulation	2.4		2.4		19	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	1	**-9.5**	2	**-9.5**	18	**-9**
		Simulation	11.5		11.5		27	
	4:45 p.m. to 5:00 p.m.	Field	1	**-4.9**	2	**-4.9**	18	**-3**
		Simulation	7.9		7.9		21	
	5:00 p.m. to 5:15 p.m.	Field	1	**-5.8**	4	**-5.8**	12	**-10**
		Simulation	8.8		8.8		22	
	5:15 p.m. to 5:30 p.m.	Field	1	**-3.9**	2	**-3.9**	18	**-3**
		Simulation	6.9		6.9		21	

Table H-2.2. Comparison of Vehicle Queue Length
Ellington Roundabout – NB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	2	**1.6**	4	3.6	10	**4**
		Simulation	0.4		0.4		6	
	7:15 a.m. to 7:30 a.m.	Field	6	**5.7**	5	4.7	15	**11**
		Simulation	0.3		0.3		4	
	7:30 a.m. to 7:45 a.m.	Field	5	**4.7**	6	5.7	14	**9**
		Simulation	0.3		0.3		5	
	7:45 a.m. to 8:00 a.m.	Field	6	**5.7**	3	2.7	14	**8**
		Simulation	0.3		0.3		5	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	1	0.6	2	0.4	7	-3
		Simulation	1.6		1.6		10	
	4:45 p.m. to 5:00 p.m.	Field	2	0.4	2	0.4	15	3
		Simulation	1.6		1.6		12	
	5:00 p.m. to 5:15 p.m.	Field	1	1	2	0	13	2
		Simulation	2		2		11	
	5:15 p.m. to 5:30 p.m.	Field	1	0.4	3	1.6	9	-1
		Simulation	1.4		1.4		10	

Table H-3.1. Comparison of Vehicle Queue Length
West Haven Roundabout – EB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	2	**2**	2	**2**	3	**1**
		Simulation	0		0		2	
	7:15 a.m. to 7:30 a.m.	Field	1	**1**	1	**1**	5	**4**
		Simulation	0		0		1	
	7:30 a.m. to 7:45 a.m.	Field	1	**1**	1	**1**	5	**3**
		Simulation	0		0		2	
	7:45 a.m. to 8:00 a.m.	Field	1	**1**	1	**1**	4	**3**
		Simulation	0		0		1	
Tuesday, May 20th, 2014 (4:45 p.m. – 5:45 p.m.)	4:45 p.m. to 5:00 p.m.	Field	1	**23.9**	1	**23.9**	6	**-21**
		Simulation	24.9		24.9		27	
	5:00 p.m. to 5:15 p.m.	Field	2	**23.2**	2	**23.2**	8	**-19**
		Simulation	25.2		25.2		27	
	5:15 p.m. to 5:30 p.m.	Field	2	**23.5**	2	**23.5**	26	**-1**
		Simulation	25.5		25.5		27	
	5:30 p.m. to 5:45 p.m.	Field	1	**24.3**	1	**24.3**	9	**-18**
		Simulation	25.3		25.3		27	

Table H-3.2. Comparison of Vehicle Queue Length
West Haven Roundabout – WB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	1	**1**	1	**1**	7	**5**
		Simulation	0		0		2	
	7:15 a.m. to 7:30 a.m.	Field	1	**1**	1	**1**	6	**4**
		Simulation	0		0		2	
	7:30 a.m. to 7:45 a.m.	Field	1	**1**	1	**1**	7	**5**
		Simulation	0		0		2	
	7:45 a.m. to 8:00 a.m.	Field	1	**1**	1	**1**	4	**2**
		Simulation	0		0		2	
Tuesday, May 20th, 2014 (4:45 p.m. – 5:45 p.m.)	4:45 p.m. to 5:00 p.m.	Field	1	**23.9**	1	**24.9**	6	**-27**
		Simulation	24.9		24.9		33	
	5:00 p.m. to 5:15 p.m.	Field	2	**23.2**	2	**23.2**	15	**-18**
		Simulation	25.2		25.2		33	
	5:15 p.m. to 5:30 p.m.	Field	2	**23.5**	2	**23.5**	7	**-26**
		Simulation	25.5		25.5		33	
	5:30 p.m. to 5:45 p.m.	Field	1	**24.3**	1	**24.3**	5	**-28**
		Simulation	25.3		25.3		33	

Table H-4.1. Comparison of Vehicle Queue Length
Killingworth Roundabout – SB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	2	**1.7**	2	**1.7**	6	**-1**
		Simulation	0.3		0.3		7	
	7:15 a.m. to 7:30 a.m.	Field	1	**0.7**	1	**0.7**	6	**0**
		Simulation	0.3		0.3		6	
	7:30 a.m. to 7:45 a.m.	Field	1	**0.8**	1	**0.8**	6	**0**
		Simulation	0.2		0.2		6	
	7:45 a.m. to 8:00 a.m.	Field	1	**0.8**	1	**0.8**	7	**-1**
		Simulation	0.2		0.2		6	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	2	**-0.7**	3	**0.3**	6	**-11**
		Simulation	2.7		2.7		17	
	4:45 p.m. to 5:00 p.m.	Field	1	**-0.6**	2	**0.4**	9	**4**
		Simulation	1.6		1.6		13	
	5:00 p.m. to 5:15 p.m.	Field	2	**0.4**	3	**1.4**	8	**-4**
		Simulation	1.6		1.6		12	
	5:15 p.m. to 5:30 p.m.	Field	2	**-0.4**	2	**-0.4**	10	**-5**
		Simulation	2.4		2.4		15	

Table H-4.2. Comparison of Vehicle Queue Length
Killingworth Roundabout – NB

Date of Recording	Time	Output	Minimum Queue	Difference	Average Queue	Difference	Maximum Queue	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Field	1	**0.6**	1	**0.6**	9	**2**
		Simulation	0.4		0.4		7	
	7:15 a.m. to 7:30 a.m.	Field	2	**1.6**	2	**1.6**	12	**4**
		Simulation	0.4		0.4		8	
	7:30 a.m. to 7:45 a.m.	Field	1	**0.6**	2	**1.6**	10	**3**
		Simulation	0.4		0.4		7	
	7:45 a.m. to 8:00 a.m.	Field	2	**1.6**	2	**1.6**	9	**1**
		Simulation	0.4		0.4		8	
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Field	3	**1.3**	3	**1.3**	7	**-7**
		Simulation	1.7		1.7		14	
	4:45 p.m. to 5:00 p.m.	Field	2	**-1**	2	**-1**	9	**-8**
		Simulation	3		3		17	
	5:00 p.m. to 5:15 p.m.	Field	1	**-2.2**	2	**-1.2**	5	**-12**
		Simulation	3.2		3.2		17	
	5:15 p.m. to 5:30 p.m.	Field	2	**0.7**	2	**0.7**	20	**9**
		Simulation	1.3		1.3		11	

APPENDIX I

COMPARISON OF TRAVEL TIME OF SIMULATED AND FIELD MEASURED

APPENDIX I – COMPARISON OF TRAVEL TIME OF SIMULATED AND FIELD MEASURED

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Table I-1.1. Comparison of Travel Time
Salem Roundabout – EB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	4	2	**2**
		Left	14	8	**6**
		Through	7	4	**3**
	7:15 a.m. to 7:30 a.m.	Right	4	2	**2**
		Left	12	9	**3**
		Through	10	4	**6**
	7:30 a.m. to 7:45 a.m.	Right	4	2	**2**
		Left	0	8	**8**
		Through	10	4	**6**
	7:45 a.m. to 8:00 a.m.	Right	4	2	**2**
		Left	12	9	**3**
		Through	8	4	**4**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	4	2	**2**
		Left	12	10	**2**
		Through	7	7	**0**
	4:45 p.m. to 5:00 p.m.	Right	5	2	**3**
		Left	12	11	**1**
		Through	10	7	**3**
	5:00 p.m. to 5:15 p.m.	Right	5	2	**3**
		Left	13	11	**2**
		Through	10	7	**3**
	5:15 p.m. to 5:30 p.m.	Right	5	3	**2**
		Left	14	11	**3**
		Through	9	7	**2**

Table I-1.2. Comparison of Travel Time
Salem Roundabout – NB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	3	1	**2**
		Left	10	9	**1**
		Through	6	5	**1**
	7:15 a.m. to 7:30 a.m.	Right	2	1	**1**
		Left	10	9	**0**
		Through	5	5	**1**
	7:30 a.m. to 7:45 a.m.	Right	2	1	**1**
		Left	9	9	**0**
		Through	7	5	**2**
	7:45 a.m. to 8:00 a.m.	Right	3	1	**2**
		Left	10	9	**1**
		Through	5	5	**0**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	3	2	**1**
		Left	11	11	**0**
		Through	7	6	**1**
	4:45 p.m. to 5:00 p.m.	Right	2	1	**0**
		Left	11	10	**1**
		Through	8	6	**2**
	5:00 p.m. to 5:15 p.m.	Right	3	1	**2**
		Left	12	10	**2**
		Through	8	6	**2**
	5:15 p.m. to 5:30 p.m.	Right	3	2	**1**
		Left	11	10	**1**
		Through	7	6	**1**

Table I-1.3. Comparison of Travel Time
Salem Roundabout – SB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	3	2	**1**
		Left	10	10	**0**
		Through	6	7	**-1**
	7:15 a.m. to 7:30 a.m.	Right	3	2	**1**
		Left	10	9	**1**
		Through	6	7	**-1**
	7:30 a.m. to 7:45 a.m.	Right	3	2	**1**
		Left	10	9	**1**
		Through	8	7	**1**
	7:45 a.m. to 8:00 a.m.	Right	3	2	**1**
		Left	13	8	**5**
		Through	7	7	**0**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	3	3	**0**
		Left	13	11	**2**
		Through	9	8	**1**
	4:45 p.m. to 5:00 p.m.	Right	4	3	**1**
		Left	12	10	**2**
		Through	8	8	**0**
	5:00 p.m. to 5:15 p.m.	Right	3	3	**0**
		Left	13	11	**2**
		Through	8	8	**0**
	5:15 p.m. to 5:30 p.m.	Right	3	3	**0**
		Left	10	11	**-1**
		Through	7	8	**-1**

Table I-1.4. Comparison of Travel Time
Salem Roundabout – WB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	2	1	**1**
		Left	10	11	**-1**
		Through	7	7	**0**
	7:15 a.m. to 7:30 a.m.	Right	2	1	**1**
		Left	10	11	**-1**
		Through	6	7	**-1**
	7:30 a.m. to 7:45 a.m.	Right	2	2	**0**
		Left	10	10	**0**
		Through	5	7	**-2**
	7:45 a.m. to 8:00 a.m.	Right	2	1	**1**
		Left	10	11	**-1**
		Through	6	7	**-1**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	2	3	**-1**
		Left	10	14	**-4**
		Through	6	8	**-2**
	4:45 p.m. to 5:00 p.m.	Right	2	4	**-2**
		Left	10	14	**-4**
		Through	6	14	**-8**
	5:00 p.m. to 5:15 p.m.	Right	2	3	**-1**
		Left	11	13	**-2**
		Through	6	13	**-7**
	5:15 p.m. to 5:30 p.m.	Right	2	2	**0**
		Left	10	13	**-3**
		Through	5	14	**-9**

Table I-2.1. Comparison of Travel Time
Ellington Roundabout – NB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	5	6.86	**-2**
		Through	6	7.09	**-1**
		Left	11	8.43	**3**
		Hard Left	0	8.04	**-8**
	7:15 a.m. to 7:30 a.m.	Right	5	6.21	**-2**
		Through	6	5.99	**0**
		Left	12	8.45	**4**
		Hard Left	0	7.32	**-7**
	7:30 a.m. to 7:45 a.m.	Right	6	5.78	**0**
		Through	7	6.93	**0**
		Left	14	8.61	**5**
		Hard Left	14	8.16	**6**
	7:45 a.m. to 8:00 a.m.	Right	5	7.23	**-2**
		Through	7	6.79	**0**
		Left	13	8.84	**4**
		Hard Left	0	7.42	**-7**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	5	6.41	**-1**
		Through	6	6.77	**-1**
		Left	11	8.10	**3**
		Hard Left	13	7.42	**6**
	4:45 p.m. to 5:00 p.m.	Right	4	5.87	**-2**
		Through	6	6.93	**-1**
		Left	12	8.07	**4**
		Hard Left	16	7.83	**8**
	5:00 p.m. to 5:15 p.m.	Right	6	6.89	**-1**
		Through	7	6.46	**1**
		Left	14	8.29	**6**
		Hard Left	15	8.37	**7**
	5:15 p.m. to 5:30 p.m.	Right	5	6.81	**-2**
		Through	7	6.75	**0**
		Left	13	7.94	**5**
		Hard Left	13	7.57-1	**5**

Table I-2.2. Comparison of Travel Time
Ellington Roundabout – WB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	2	2	**0**
		Through	6	6	**0**
		Bare Left	13	9	**4**
		Left	14	10	**4**
	7:15 a.m. to 7:30 a.m.	Right	3	2	**1**
		Through	7	6	**1**
		Bare Left	12	10	**2**
		Left	23	10	**13**
	7:30 a.m. to 7:45 a.m.	Right	4	2	**2**
		Through	7	6	**1**
		Bare Left	12	9	**3**
		Left	15	11	**4**
	7:45 a.m. to 8:00 a.m.	Right	4	3	**1**
		Through	10	6	**4**
		Bare Left	13	9	**4**
		Left	16	11	**6**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	2	4	**-2**
		Through	6	7	**-1**
		Bare Left	13	8	**5**
		Left	14	11	**3**
	4:45 p.m. to 5:00 p.m.	Right	3	4	**-1**
		Through	7	7	**0**
		Bare Left	12	9	**3**
		Left	23	11	**12**
	5:00 p.m. to 5:15 p.m.	Right	4	4	**0**
		Through	7	7	**0**
		Bare Left	12	9	**3**
		Left	15	13	**2**
	5:15 p.m. to 5:30 p.m.	Right	4	4	**0**
		Through	10	7	**3**
		Bare Left	13	8	**5**
		Left	16	11	**5**

Table I-2.3. Comparison of Travel Time
Ellington Roundabout – NEB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Hard Right	2	3	**-1**
		Bare Right	5	8	**-3**
		Bare Left	9	9	**0**
		Hard Left	14	3	**11**
	7:15 a.m. to 7:30 a.m.	Hard Right	2	2	**0**
		Bare Right	5	7	**-2**
		Bare Left	11	9	**2**
		Hard Left	15	5	**10**
	7:30 a.m. to 7:45 a.m.	Hard Right	2	2	**0**
		Bare Right	6	8	**-2**
		Bare Left	8	9	**-1**
		Hard Left	16	1	**15**
	7:45 a.m. to 8:00 a.m.	Hard Right	2	3	**-1**
		Bare Right	6	7	**-1**
		Bare Left	8	8	**0**
		Hard Left	15	5	**10**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Hard Right	2	3	**-1**
		Bare Right	5	8	**-3**
		Bare Left	9	9	**0**
		Hard Left	14	7	**7**
	4:45 p.m. to 5:00 p.m.	Hard Right	2	2	**0**
		Bare Right	5	6	**-1**
		Bare Left	11	9	**2**
		Hard Left	15	4	**11**
	5:00 p.m. to 5:15 p.m.	Right	2	3	**-1**
		Through	6	7	**-1**
		Bare Left	8	9	**-1**
		Left	16	6	**10**
	5:15 p.m. to 5:30 p.m.	Right	2	3	**-1**
		Through	6	6	**0**
		Bare Left	8	9	**-1**
		Left	15	7	**8**

Table I-2.4. Comparison of Travel Time
Ellington Roundabout – SB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	4	5	**-1**
		Bare Right	8	8	**0**
		Through	13	12	**1**
		Left	15	13	**2**
	7:15 a.m. to 7:30 a.m.	Right	4	5	**-1**
		Bare Right	9	8	**1**
		Through	11	12	**-1**
		Left	17	13	**4**
	7:30 a.m. to 7:45 a.m.	Right	4	5	**-1**
		Bare Right	8	8	**0**
		Through	11	12	**-1**
		Left	16	13	**3**
	7:45 a.m. to 8:00 a.m.	Right	4	6	**-2**
		Bare Right	9	7	**2**
		Through	11	12	**-1**
		Left	15	12	**3**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	4	7	**-3**
		Bare Right	8	9	**-1**
		Through	13	10	**3**
		Left	15	14	**1**
	4:45 p.m. to 5:00 p.m.	Right	4	7	**-3**
		Bare Right	9	8	**1**
		Through	11	10	**1**
		Left	17	13	**4**
	5:00 p.m. to 5:15 p.m.	Right	4	8	**-4**
		Bare Right	8	9	**-1**
		Through	11	11	**0**
		Left	16	14	**2**
	5:15 p.m. to 5:30 p.m.	Right	4	8	**-4**
		Bare Right	9	8	**1**
		Through	11	10	**1**
		Left	15	13	**2**

Table I-2.5. Comparison of Travel Time
Ellington Roundabout – EB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Wednesday, May 21st, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Through	3	8	**-5**
		Hard Right	6	11	**-5**
		Left	11	12	**-1**
		Right	12	16	**-4**
	7:15 a.m. to 7:30 a.m.	Through	4	7	**-3**
		Hard Right	6	10	**-4**
		Left	11	12	**-1**
		Right	13	15	**-2**
	7:30 a.m. to 7:45 a.m.	Through	7	11	**-4**
		Hard Right	7	12	**-5**
		Left	10	12	**-2**
		Right	14	16	**-2**
	7:45 a.m. to 8:00 a.m.	Through	3	7	**-4**
		Hard Right	7	12	**-5**
		Left	11	12	**-1**
		Right	12	15	**-3**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Through	3	3	**0**
		Hard Right	6	6	**0**
		Left	11	8	**3**
		Right	12	10	**2**
	4:45 p.m. to 5:00 p.m.	Through	4	3	**1**
		Hard Right	6	5	**1**
		Left	11	8	**3**
		Right	13	10	**3**
	5:00 p.m. to 5:15 p.m.	Through	7	3	**4**
		Hard Right	7	6	**1**
		Left	10	7	**3**
		Right	14	10	**4**
	5:15 p.m. to 5:30 p.m.	Through	3	3	**0**
		Hard Right	7	6	**1**
		Left	11	7	**4**
		Right	12	10	**2**

Table I-3.1. Comparison of Travel Time
West Haven Roundabout – EB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	3	3	**0**
		Left	8	5	**3**
	7:15 a.m. to 7:30 a.m.	Right	3	3	**0**
		Left	7	5	**2**
	7:30 a.m. to 7:45 a.m.	Right	3	3	**0**
		Left	7	5	**2**
	7:45 a.m. to 8:00 a.m.	Right	3	3	**0**
		Left	8	3	**5**
Tuesday, May 20th, 2014 (4:45 p.m. – 5:45 p.m.)	4:45 p.m. to 5:00 p.m.	Right	4	4	**0**
		Left	8	6	**2**
	5:00 p.m. to 5:15 p.m.	Right	4	4	**0**
		Left	9	6	**3**
	5:15 p.m. to 5:30 p.m.	Right	4	4	**0**
		Left	8	6	**2**
	5:30 p.m. to 5:45 p.m.	Right	4	4	**0**
		Left	9	5	**4**

Table I-3.2. Comparison of Travel Time
West Haven Roundabout – WB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	3	2	**1**
		Left	7	5	**2**
	7:15 a.m. to 7:30 a.m.	Right	3	2	**1**
		Left	8	4	**4**
	7:30 a.m. to 7:45 a.m.	Right	3	2	**1**
		Left	8	5	**3**
	7:45 a.m. to 8:00 a.m.	Right	2	2	**0**
		Left	8	5	**3**
Tuesday, May 20th, 2014 (4:45 p.m. – 5:45 p.m.)	4:45 p.m. to 5:00 p.m.	Right	3	3	**0**
		Left	7	6	**1**
	5:00 p.m. to 5:15 p.m.	Right	3	3	**0**
		Left	7	6	**1**
	5:15 p.m. to 5:30 p.m.	Right	3	3	**0**
		Left	8	6	**2**
	5:30 p.m. to 5:45 p.m.	Right	3	3	**0**
		Left	8	6	**2**

Table I-3.3. Comparison of Travel Time
West Haven Roundabout – SB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	4	3	**1**
		Left	10	6	**4**
	7:15 a.m. to 7:30 a.m.	Right	3	3	**0**
		Left	8	6	**2**
	7:30 a.m. to 7:45 a.m.	Right	3	3	**0**
		Left	8	6	**2**
	7:45 a.m. to 8:00 a.m.	Right	3	3	**0**
		Left	8	6	**2**
Tuesday, May 20th, 2014 (4:45 p.m. – 5:45 p.m.)	4:45 p.m. to 5:00 p.m.	Right	5	5	**0**
		Left	8	11	**-3**
	5:00 p.m. to 5:15 p.m.	Right	5	4	**1**
		Left	10	10	**0**
	5:15 p.m. to 5:30 p.m.	Right	4	5	**-1**
		Left	10	11	**-1**
	5:30 p.m. to 5:45 p.m.	Right	3	4	**-1**
		Left	10	10	**0**

Table I-4.1. Comparison of Travel Time
Killingworth Roundabout – EB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	4	4	**0**
		Left	14	13	**1**
		Through	7	5	**2**
	7:15 a.m. to 7:30 a.m.	Right	4	4	**0**
		Left	12	13	**-1**
		Through	10	5	**5**
	7:30 a.m. to 7:45 a.m.	Right	4	4	**0**
		Left	12	13	**-1**
		Through	10	5	**5**
	7:45 a.m. to 8:00 a.m.	Right	4	4	**0**
		Left	12	13	**-1**
		Through	8	5	**3**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	4	4	**0**
		Left	14	15	**-1**
		Through	7	6	**1**
	4:45 p.m. to 5:00 p.m.	Right	4	4	**0**
		Left	13	15	**-3**
		Through	10	6	**4**
	5:00 p.m. to 5:15 p.m.	Right	4	4	**0**
		Left	14	15	**-3**
		Through	10	6	**4**
	5:15 p.m. to 5:30 p.m.	Right	4	4	**0**
		Left	13	15	**-3**
		Through	8	6	**2**

Table I-4.2. Comparison of Travel Time
Killingworth Roundabout – NB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	3	2	**1**
		Left	10	7	**3**
		Through	6	7	**-1**
	7:15 a.m. to 7:30 a.m.	Right	2	2	**0**
		Left	10	8	**2**
		Through	5	7	**-2**
	7:30 a.m. to 7:45 a.m.	Right	2	2	**0**
		Left	9	8	**1**
		Through	7	6	**1**
	7:45 a.m. to 8:00 a.m.	Right	3	2	**1**
		Left	10	8	**2**
		Through	5	7	**-2**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	3	2	**1**
		Left	11	8	**2**
		Through	6	9	**-3**
	4:45 p.m. to 5:00 p.m.	Right	2	2	**0**
		Left	11	12	**-2**
		Through	7	9	**-4**
	5:00 p.m. to 5:15 p.m.	Right	2	2	**0**
		Left	9	12	**-3**
		Through	7	9	**-2**
	5:15 p.m. to 5:30 p.m.	Right	3	2	**1**
		Left	11	12	**-2**
		Through	6	9	**-4**

Table I-4.3. Comparison of Travel Time
Killingworth Roundabout – SB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	3	2	**1**
		Left	10	7	**3**
		Through	6	5	**1**
	7:15 a.m. to 7:30 a.m.	Right	3	2	**1**
		Left	10	7	**3**
		Through	6	5	**1**
	7:30 a.m. to 7:45 a.m.	Right	3	2	**1**
		Left	10	7	**3**
		Through	8	5	**3**
	7:45 a.m. to 8:00 a.m.	Right	3	2	**1**
		Left	13	7	**6**
		Through	7	5	**2**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	3	2	**1**
		Left	10	7	**3**
		Through	6	5	**1**
	4:45 p.m. to 5:00 p.m.	Right	3	2	**1**
		Left	10	7	**3**
		Through	6	5	**1**
	5:00 p.m. to 5:15 p.m.	Right	3	2	**1**
		Left	10	7	**3**
		Through	7	5	**3**
	5:15 p.m. to 5:30 p.m.	Right	3	2	**1**
		Left	13	7	**6**
		Through	7	5	**2**

Table I-4.4. Comparison of Travel Time
Killingworth Roundabout – WB

Date of Recording	Time	Movement	Field Time	Simulation Time	Difference
Tuesday, May 20th, 2014 (7 a.m. – 8 a.m.)	7:00 a.m. to 7:15 a.m.	Right	2	4	**-2**
		Left	10	9	**1**
		Through	6	5	**2**
	7:15 a.m. to 7:30 a.m.	Right	2	4	**-2**
		Left	10	9	**1**
		Through	6	5	**1**
	7:30 a.m. to 7:45 a.m.	Right	2	4	**-2**
		Left	10	8	**2**
		Through	5	5	**0**
	7:45 a.m. to 8:00 a.m.	Right	2	4	**-2**
		Left	10	8	**2**
		Through	6	6	**0**
Tuesday, May 20th, 2014 (4:30 p.m. – 5:30 p.m.)	4:30 p.m. to 4:45 p.m.	Right	3	4	**-2**
		Left	11	9	**1**
		Through	8	5	**2**
	4:45 p.m. to 5:00 p.m.	Right	2	5	**-3**
		Left	10	10	**0**
		Through	7	7	**-1**
	5:00 p.m. to 5:15 p.m.	Right	2	5	**-3**
		Left	10	9	**1**
		Through	9	7	**-2**
	5:15 p.m. to 5:30 p.m.	Right	3	5	**-3**
		Left	12	9	**1**
		Through	6	7	**-1**

APPENDIX J

SALEM ROUNDABOUT:

CALIBRATION VARIABLES VS. QUEUES

APPENDIX J – SALEM ROUNDABOUT: CALIBRATION VARIABLES VS. QUEUES

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Table J-1. Salem Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) - AM

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	15 to 40	7:00 - 7:15	1	0.3	0.7	9	8.1	0.9	2	0.1	1.9	6	4.5	1.5
		7:15 - 7:30	2	0.2	1.8	12	7.0	5.0	1	0.0	1.0	6	3.2	2.8
		7:30 - 7:45	1	0.2	0.8	10	6.8	3.2	1	0.1	0.9	6	4.4	1.6
		7:45 - 8:00	2	0.2	1.8	9	6.7	2.3	1	0.0	1.0	7	3.2	3.8
30	15 to 45	7:00 - 7:15	1	0.3	0.7	9	7.1	1.9	2	0.0	2.0	6	4.0	2.0
		7:15 - 7:30	2	0.3	1.7	12	7.2	4.8	1	0.0	1.0	6	3.5	2.5
		7:30 - 7:45	1	0.3	0.7	10	7.0	3.0	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.3	1.7	9	7.4	1.6	1	0.1	0.9	7	4.1	2.9
35	20 to 50	7:00 - 7:15	1	0.3	0.7	9	7.0	2.0	2	0.1	1.9	6	5.0	1.0
		7:15 - 7:30	2	0.2	1.8	12	7.0	5.0	1	0.1	0.9	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	6.0	4.0	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.2	1.8	9	6.0	3.0	1	0.0	1.0	7	3.0	4.0
40 (Existing Condition)	25 to 55	7:00 - 7:15	1	0.3	0.7	9	6.3	2.7	2	0.1	1.9	6	4.2	1.8
		7:15 - 7:30	2	0.2	1.8	12	7.1	4.9	1	0.0	1.0	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	5.7	4.3	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.2	1.8	9	6.1	2.9	1	0.0	1.0	7	3.5	3.5
45	30 to 60	7:00 - 7:15	1	0.2	0.8	9	6.6	2.4	2	0.1	1.9	6	4.1	1.9
		7:15 - 7:30	2	0.2	1.8	12	6.8	5.2	1	0.0	1.0	6	3.9	2.1
		7:30 - 7:45	1	0.2	0.8	10	6.1	3.9	1	0.0	1.0	6	3.2	2.8
		7:45 - 8:00	2	0.2	1.8	9	6.1	2.9	1	0.0	1.0	7	3.9	3.1

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	35 to 65	7:00 - 7:15	1	0.3	0.7	9	8.0	1.0	2	0.1	1.9	6	4.0	2.0
		7:15 - 7:30	2	0.2	1.8	12	6.7	5.3	1	0.0	1.0	6	3.7	2.3
		7:30 - 7:45	1	0.2	0.8	10	5.8	4.2	1	0.0	1.0	6	3.6	2.4
		7:45 - 8:00	2	0.2	1.8	9	6.0	3.0	1	0.0	1.0	7	3.7	3.3
55	40 to 70	7:00 - 7:15	1	0.3	0.7	9	7.3	1.7	2	0.0	2.0	6	4.3	1.7
		7:15 - 7:30	2	0.2	1.8	12	6.5	5.5	1	0.0	1.0	6	3.8	2.2
		7:30 - 7:45	1	0.2	0.8	10	5.5	4.5	1	0.0	1.0	6	3.8	2.2
		7:45 - 8:00	2	0.2	1.8	9	6.2	2.8	1	0.0	1.0	7	3.9	3.1

Note:

- Circulating Speed = 16 – 22 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table J-2. Salem Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) - AM

Circulating	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15	7:00 - 7:15	1	1.0	0.0	9	11.1	-2.1	2	0.4	1.6	6	8.5	-2.5
		7:15 - 7:30	2	0.8	1.2	12	8.7	3.3	1	0.4	0.6	6	9.0	-3.0
		7:30 - 7:45	1	0.9	0.1	10	9.7	0.3	1	0.4	0.6	6	8.3	-2.3
		7:45 - 8:00	2	0.6	1.4	9	7.7	1.3	1	0.3	0.7	7	8.4	-1.4
15	15 to 20 **(16 to 22 existing condition)**	7:00 - 7:15	1	0.4	0.6	9	7.5	1.5	2	0.1	1.9	6	6.4	-0.4
		7:15 - 7:30	2	0.3	1.7	12	7.3	4.7	1	0.0	1.0	6	4.5	1.5
		7:30 - 7:45	1	0.3	0.7	10	7.2	2.8	1	0.0	1.0	6	3.7	2.3
		7:45 - 8:00	2	0.3	1.7	9	6.3	2.7	1	0.1	0.9	7	4.8	2.2
20	20 to 25	7:00 - 7:15	1	0.2	0.8	9	6.0	3.0	2	0.0	2.0	6	3.6	2.4
		7:15 - 7:30	2	0.2	1.8	12	6.7	5.3	1	0.0	1.0	6	3.3	2.7
		7:30 - 7:45	1	0.2	0.8	10	5.6	4.4	1	0.0	1.0	6	3.7	2.3
		7:45 - 8:00	2	0.1	1.9	9	5.2	3.8	1	0.0	1.0	7	3.0	4.0
25	25 to 30	7:00 - 7:15	1	0.2	0.8	9	6.5	2.5	2	0.0	2.0	6	3.5	2.5
		7:15 - 7:30	2	0.2	1.8	12	6.7	5.3	1	0.0	1.0	6	3.0	3.0
		7:30 - 7:45	1	0.2	0.8	10	5.0	5.0	1	0.0	1.0	6	3.1	2.9
		7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.4	3.6
30	30 to 35	7:00 - 7:15	1	0.2	0.8	9	6.1	2.9	2	0.0	2.0	6	3.6	2.4
		7:15 - 7:30	2	0.3	1.7	12	6.7	5.3	1	0.0	1.0	6	2.3	3.7
		7:30 - 7:45	1	0.2	0.8	10	6.6	3.4	1	0.0	1.0	6	2.2	3.8
		7:45 - 8:00	2	0.2	1.8	9	5.7	3.3	1	0.0	1.0	7	2.6	4.4

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table J-3. Salem Roundabout – Critical Gap (seconds) vs. Queue Length (# of Vehicles) - AM

Gap	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
(seconds)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-1	7:00 - 7:15	1	0.2	0.8	9	6.1	2.9	2	0.1	1.9	6	4.2	1.8
	7:15 - 7:30	2	0.2	1.8	12	6.8	5.2	1	0.0	1.0	6	4.1	1.9
	7:30 - 7:45	1	0.2	0.8	10	5.9	4.1	1	0.0	1.0	6	4.1	1.9
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.5	3.5
+1	7:00 - 7:15	1	0.5	0.5	9	8.2	0.8	2	0.1	1.9	6	4.4	1.6
	7:15 - 7:30	2	0.4	1.6	12	8.0	4.0	1	0.1	0.9	6	4.9	1.1
	7:30 - 7:45	1	0.4	0.6	10	6.8	3.2	1	0.1	0.9	6	4.4	1.6
	7:45 - 8:00	2	0.3	1.7	9	7.1	1.9	1	0.1	0.9	7	4.5	2.5
+2	7:00 - 7:15	1	1.6	-0.6	9	11.8	-2.8	2	0.3	1.7	6	7.2	-1.2
	7:15 - 7:30	2	1.1	0.9	12	9.4	2.6	1	0.2	0.8	6	6.0	0.0
	7:30 - 7:45	1	1.4	-0.4	10	10.6	-0.6	1	0.2	0.8	6	6.2	-0.2
	7:45 - 8:00	2	0.8	1.2	9	9.1	-0.1	1	0.2	0.8	7	5.6	1.4
+3	7:00 - 7:15	1	5.5	-4.5	9	17.8	-8.8	2	0.4	1.6	6	7.6	-1.6
	7:15 - 7:30	2	2.9	-0.9	12	14.2	-2.2	1	0.3	0.7	6	6.9	-0.9
	7:30 - 7:45	1	3.4	-2.4	10	15.4	-5.4	1	0.3	0.7	6	6.7	-0.7
	7:45 - 8:00	2	1.9	0.1	9	11.3	-2.3	1	0.3	0.7	7	5.9	1.1

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table J-4. Salem Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) - AM

Min Headway	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Distance (ft)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-30	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.0	2.0	6	4.0	2.0
	7:15 - 7:30	2	0.2	1.8	12	6.6	5.4	1	0.0	1.0	6	3.4	2.6
	7:30 - 7:45	1	0.2	0.8	10	6.2	3.8	1	0.0	1.0	6	2.9	3.1
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.0	4.0
-20	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.0	2.0	6	4.0	2.0
	7:15 - 7:30	2	0.2	1.8	12	6.6	5.4	1	0.0	1.0	6	3.4	2.6
	7:30 - 7:45	1	0.2	0.8	10	6.2	3.8	1	0.0	1.0	6	2.9	3.1
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.0	4.0
-10	7:00 - 7:15	1	0.2	0.8	9	6.5	2.5	2	0.0	2.0	6	4.0	2.0
	7:15 - 7:30	2	0.2	1.8	12	6.6	5.4	1	0.0	1.0	6	3.7	2.3
	7:30 - 7:45	1	0.2	0.8	10	5.7	4.3	1	0.0	1.0	6	2.9	3.1
	7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.1	3.9
+10	7:00 - 7:15	1	0.3	0.7	9	7.1	1.9	2	0.1	1.9	6	4.7	1.3
	7:15 - 7:30	2	0.3	1.7	12	7.2	4.8	1	0.0	1.0	6	4.2	1.8
	7:30 - 7:45	1	0.3	0.7	10	6.4	3.6	1	0.1	0.9	6	4.6	1.4
	7:45 - 8:00	2	0.2	1.8	9	6.3	2.7	1	0.1	0.9	7	4.1	2.9
+20	7:00 - 7:15	1	0.4	0.6	9	8.0	1.0	2	0.1	1.9	6	5.1	0.9
	7:15 - 7:30	2	0.3	1.7	12	7.8	4.2	1	0.1	0.9	6	4.8	1.2
	7:30 - 7:45	1	0.3	0.7	10	6.5	3.5	1	0.1	0.9	6	5.0	1.0
	7:45 - 8:00	2	0.3	1.7	9	6.7	2.3	1	0.1	0.9	7	4.8	2.2

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table J-5. Salem Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) - AM

Reduced Speed of	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	17.5 to 22.5	7:00 - 7:15	1	0.4	0.6	9	8.5	0.5	2	0.1	1.9	6	4.9	1.1
		7:15 - 7:30	2	0.4	1.6	12	8.6	3.4	1	0.0	1.0	6	4.1	1.9
		7:30 - 7:45	1	0.3	0.7	10	8.1	1.9	1	0.0	1.0	6	3.8	2.2
		7:45 - 8:00	2	0.3	1.7	9	8.0	1.0	1	0.0	1.0	7	4.0	3.0
30 (Existing Condition)	22.5 to 27.5	7:00 - 7:15	1	0.4	0.6	9	8.1	0.9	2	0.1	1.9	6	4.0	2.0
		7:15 - 7:30	2	0.3	1.7	12	7.4	4.6	1	0.0	1.0	6	4.1	1.9
		7:30 - 7:45	1	0.3	0.7	10	6.9	3.1	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.3	1.7	9	6.3	2.7	1	0.0	1.0	7	4.1	2.9
35	22.5 to 27.5	7:00 - 7:15	1	0.4	0.6	9	8.1	0.9	2	0.1	1.9	6	4.0	2.0
		7:15 - 7:30	2	0.3	1.7	12	7.4	4.6	1	0.0	1.0	6	4.1	1.9
		7:30 - 7:45	1	0.3	0.7	10	6.9	3.1	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.3	1.7	9	6.3	2.7	1	0.0	1.0	7	4.1	2.9
40	27.5 to 32.5	7:00 - 7:15	1	0.3	0.7	9	6.3	2.7	2	0.1	1.9	6	4.2	1.8
		7:15 - 7:30	2	0.2	1.8	12	7.1	4.9	1	0.0	1.0	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	5.7	4.3	1	0.0	1.0	6	4.0	2.0
		7:45 - 8:00	2	0.2	1.8	9	6.1	2.9	1	0.0	1.0	7	3.5	3.5
45	32.5 to 37.5	7:00 - 7:15	1	0.2	0.8	9	6.2	2.8	2	0.1	1.9	6	4.9	1.1
		7:15 - 7:30	2	0.2	1.8	12	5.7	6.3	1	0.0	1.0	6	4.0	2.0
		7:30 - 7:45	1	0.2	0.8	10	5.2	4.8	1	0.0	1.0	6	4.3	1.7
		7:45 - 8:00	2	0.2	1.8	9	5.9	3.1	1	0.0	1.0	7	3.5	3.5

Reduced Speed of	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	37.5 to 42.5	7:00 - 7:15	1	0.2	0.8	9	6.2	2.8	2	0.0	2.0	6	4.1	1.9
		7:15 - 7:30	2	0.2	1.8	12	6.3	5.7	1	0.0	1.0	6	4.5	1.5
		7:30 - 7:45	1	0.2	0.8	10	5.4	4.6	1	0.1	0.9	6	4.5	1.5
		7:45 - 8:00	2	0.2	1.8	9	6.0	3.0	1	0.0	1.0	7	3.3	3.7
55	42.5 to 47.5	7:00 - 7:15	1	0.2	0.8	9	6.3	2.7	2	0.1	1.9	6	4.7	1.3
		7:15 - 7:30	2	0.2	1.8	12	6.3	5.7	1	0.0	1.0	6	4.6	1.4
		7:30 - 7:45	1	0.2	0.8	10	5.4	4.6	1	0.1	0.9	6	4.6	1.4
		7:45 - 8:00	2	0.2	1.8	9	5.8	3.2	1	0.0	1.0	7	3.4	3.6

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 420 vph
- EB Volume = 478 vph

Table J-6. Salem Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) – PM

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	10 to 30	4:30 - 4:45	1	0.6	0.4	9	8.9	0.1	2	0.8	1.2	6	11.6	-5.6
		4:45 - 5:00	2	0.5	1.5	12	8.3	3.7	1	0.4	0.6	6	8.0	-2.0
		5:00 - 5:15	1	0.4	0.6	10	7.1	2.9	1	0.6	0.4	6	9.8	-3.8
		5:15 - 5:30	2	0.5	1.5	9	9.0	0.0	1	0.7	0.3	7	11.2	-4.2
30	15 to 35	4:30 - 4:45	1	0.6	0.4	9	8.8	0.2	2	0.6	1.4	6	8.5	-2.5
		4:45 - 5:00	2	0.5	1.5	12	7.7	4.3	1	0.4	0.6	6	8.4	-2.4
		5:00 - 5:15	1	0.3	0.7	10	6.3	3.7	1	0.4	0.6	6	7.5	-1.5
		5:15 - 5:30	2	0.4	1.6	9	8.4	0.6	1	0.6	0.4	7	9.3	-2.3
35	20 to 40	4:30 - 4:45	1	0.5	0.5	9	9.0	0.0	2	0.6	1.4	6	9.3	-3.3
		4:45 - 5:00	2	0.4	1.6	12	7.1	4.9	1	0.4	0.6	6	7.9	-1.9
		5:00 - 5:15	1	0.3	0.7	10	6.1	3.9	1	0.4	0.6	6	8.0	-2.0
		5:15 - 5:30	2	0.4	1.6	9	7.3	1.7	1	0.4	0.6	7	8.6	-1.6
40 (Existing condition)	25 to 45	4:30 - 4:45	1	0.7	0.3	9	9.2	-0.2	1	0.8	0.2	10	10.3	-0.3
		4:45 - 5:00	1	0.5	0.5	8	7.7	0.3	1	0.5	0.5	9	8.3	0.7
		5:00 - 5:15	1	0.4	0.6	11	6.5	4.5	1	0.5	0.5	13	8.4	4.6
		5:15 - 5:30	1	0.4	0.6	8	8.8	-0.8	1	0.6	0.4	11	10.0	1.0
45	30 to 50	4:30 - 4:45	1	0.4	0.6	9	6.8	2.2	2	0.7	1.3	6	9.5	-3.5
		4:45 - 5:00	2	0.5	1.5	12	7.8	4.2	1	0.5	0.5	6	7.9	-1.9
		5:00 - 5:15	1	0.3	0.7	10	6.0	4.0	1	0.4	0.6	6	7.2	-1.2
		5:15 - 5:30	2	0.4	1.6	9	7.5	1.5	1	0.4	0.6	7	8.6	-1.6

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	30 to 50	4:30 - 4:45	1	0.5	0.5	9	7.7	1.3	2	0.8	1.2	6	10.1	-4.1
		4:45 - 5:00	2	0.5	1.5	12	8.1	3.9	1	0.4	0.6	6	7.8	-1.8
		5:00 - 5:15	1	0.3	0.7	10	6.1	3.9	1	0.5	0.5	6	7.7	-1.7
		5:15 - 5:30	2	0.4	1.6	9	7.4	1.6	1	0.5	0.5	7	8.5	-1.5
55	30 to 50	4:30 - 4:45	1	0.5	0.5	9	7.8	1.2	2	0.7	1.3	6	9.1	-3.1
		4:45 - 5:00	2	0.5	1.5	12	7.8	4.2	1	0.3	0.7	6	7.5	-1.5
		5:00 - 5:15	1	0.3	0.7	10	6.0	4.0	1	0.5	0.5	6	7.4	-1.4
		5:15 - 5:30	2	0.4	1.6	9	7.6	1.4	1	0.4	0.6	7	7.6	-0.6

Note:

- Circulating Speed = 16 – 22 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 833 vph
- EB Volume = 535 vph

Table J-7. Salem Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) - PM

Circulating	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15	4:30 - 4:45	1	1.8	-0.8	9	12.6	-3.6	2	2.5	-0.5	6	14.5	-8.5
		4:45 - 5:00	2	2.0	0.0	12	12.9	-0.9	1	2.3	-1.3	6	14.8	-8.8
		5:00 - 5:15	1	2.0	-1.0	10	14.8	-4.8	1	2.9	-1.9	6	15.7	-9.7
		5:15 - 5:30	2	2.2	-0.2	9	14.1	-5.1	1	2.4	-1.4	7	14.9	-7.9
15	15 to 35 **(16 to 22 Existing condition)**	4:30 - 4:45	1	0.9	0.1	9	9.3	-0.3	2	1.2	0.8	6	12.2	-6.2
		4:45 - 5:00	2	0.8	1.2	12	8.4	3.6	1	0.8	0.2	6	9.6	-3.6
		5:00 - 5:15	1	0.6	0.4	10	7.1	2.9	1	0.8	0.2	6	9.7	-3.7
		5:15 - 5:30	2	0.7	1.3	9	9.2	-0.2	1	0.9	0.1	7	11.4	-4.4
20	20 to 25	4:30 - 4:45	1	0.3	0.7	9	6.8	2.2	2	0.4	1.6	6	7.0	-1.0
		4:45 - 5:00	2	0.2	1.8	12	6.1	5.9	1	0.3	0.7	6	7.5	-1.5
		5:00 - 5:15	1	0.2	0.8	10	5.7	4.3	1	0.3	0.7	6	6.8	-0.8
		5:15 - 5:30	2	0.2	1.8	9	6.7	2.3	1	0.4	0.6	7	8.4	-1.4
25	25 to 30	4:30 - 4:45	1	0.3	0.7	9	6.1	2.9	2	0.3	1.7	6	7.3	-1.3
		4:45 - 5:00	2	0.3	1.7	12	6.2	5.8	1	0.2	0.8	6	7.3	-1.3
		5:00 - 5:15	1	0.2	0.8	10	5.9	4.1	1	0.3	0.7	6	6.8	-0.8
		5:15 - 5:30	2	0.3	1.7	9	6.5	2.5	1	0.3	0.7	7	7.6	-0.6
30	30 to 35	4:30 - 4:45	1	0.2	0.8	9	6.2	2.8	2	0.3	1.7	6	7.3	-1.3
		4:45 - 5:00	2	0.3	1.7	12	6.5	5.5	1	0.2	0.8	6	6.7	-0.7
		5:00 - 5:15	1	0.3	0.7	10	5.9	4.1	1	0.2	0.8	6	6.7	-0.7
		5:15 - 5:30	2	0.3	1.7	9	6.6	2.4	1	0.3	0.7	7	7.4	-0.4

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 833 vph
- EB Volume = 535 vph

Table J-8. Salem Roundabout – Critical Gap (seconds) vs. Queue Length (# of Vehicles) – PM

Gap	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
(seconds)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-1	4:30 - 4:45	1	0.2	0.8	9	5.6	3.4	2	0.2	1.8	6	6.4	-0.4
	4:45 - 5:00	2	0.2	1.8	12	6.2	5.8	1	0.2	0.8	6	6.3	-0.3
	5:00 - 5:15	1	0.2	0.8	10	5.7	4.3	1	0.2	0.8	6	6.2	-0.2
	5:15 - 5:30	2	0.2	1.8	9	6.5	2.5	1	0.2	0.8	7	7.2	-0.2
1	4:30 - 4:45	1	0.6	0.4	9	7.8	1.2	2	0.5	1.5	6	9.8	-3.8
	4:45 - 5:00	2	0.5	1.5	12	7.5	4.5	1	0.3	0.7	6	7.3	-1.3
	5:00 - 5:15	1	0.3	0.7	10	5.9	4.1	1	0.4	0.6	6	8.9	-2.9
	5:15 - 5:30	2	0.4	1.6	9	8.0	1.0	1	0.3	0.7	7	7.5	-0.5
2	4:30 - 4:45	1	1.6	-0.6	9	11.2	-2.2	2	1.3	0.7	6	11.7	-5.7
	4:45 - 5:00	2	1.6	0.4	12	11.7	0.3	1	0.8	0.2	6	10.7	-4.7
	5:00 - 5:15	1	1.1	-0.1	10	9.8	0.2	1	0.8	0.2	6	10.0	-4.0
	5:15 - 5:30	2	1.5	0.5	9	11.1	-2.1	1	0.8	0.2	7	10.0	-3.0
3	4:30 - 4:45	1	2.3	-1.3	9	12.5	-3.5	2	1.5	0.5	6	11.7	-5.7
	4:45 - 5:00	2	2.9	-0.9	12	13.3	-1.3	1	1.1	-0.1	6	11.4	-5.4
	5:00 - 5:15	1	2.8	-1.8	10	13.7	-3.7	1	1.6	-0.6	6	12.5	-6.5
	5:15 - 5:30	2	2.4	-0.4	9	13.0	-4.0	1	1.8	-0.8	7	13.7	-6.7

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 833 vph
- EB Volume = 535 vph

Table J-9. Salem Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) - PM

Min Headway	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Distance (ft)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-30	4:30 - 4:45	1	0.2	0.8	9	4.9	4.1	2	0.1	1.9	6	5.9	0.1
	4:45 - 5:00	2	0.2	1.8	12	5.6	6.4	1	0.1	0.9	6	5.5	0.5
	5:00 - 5:15	1	0.2	0.8	10	5.6	4.4	1	0.1	0.9	6	5.4	0.6
	5:15 - 5:30	2	0.2	1.8	9	6.9	2.1	1	0.2	0.8	7	6.5	0.5
-20	4:30 - 4:45	1	0.2	0.8	9	5.3	3.7	2	0.1	1.9	6	5.5	0.5
	4:45 - 5:00	2	0.2	1.8	12	6.0	6.0	1	0.1	0.9	6	5.7	0.3
	5:00 - 5:15	1	0.2	0.8	10	5.7	4.3	1	0.1	0.9	6	5.4	0.6
	5:15 - 5:30	2	0.2	1.8	9	7.4	1.6	1	0.1	0.9	7	6.6	0.4
-10	4:30 - 4:45	1	0.2	0.8	9	5.4	3.6	2	0.2	1.8	6	6.0	0.0
	4:45 - 5:00	2	0.2	1.8	12	6.0	6.0	1	0.1	0.9	6	5.3	0.7
	5:00 - 5:15	1	0.2	0.8	10	5.4	4.6	1	0.1	0.9	6	6.0	0.0
	5:15 - 5:30	2	0.2	1.8	9	6.6	2.4	1	0.2	0.8	7	6.8	0.2
+10	4:30 - 4:45	1	0.3	0.7	9	7.0	2.0	2	0.4	1.6	6	8.2	-2.2
	4:45 - 5:00	2	0.3	1.7	12	6.0	6.0	1	0.4	0.6	6	7.6	-1.6
	5:00 - 5:15	1	0.3	0.7	10	6.0	4.0	1	0.3	0.7	6	7.5	-1.5
	5:15 - 5:30	2	0.3	1.7	9	6.8	2.2	1	0.4	0.6	7	8.4	-1.4
+20	4:30 - 4:45	1	0.5	0.5	9	7.6	1.4	2	0.6	1.4	6	8.8	-2.8
	4:45 - 5:00	2	0.5	1.5	12	8.2	3.8	1	0.5	0.5	6	8.0	-2.0
	5:00 - 5:15	1	0.4	0.6	10	6.8	3.2	1	0.5	0.5	6	8.1	-2.1
	5:15 - 5:30	2	0.4	1.6	9	8.0	1.0	1	0.5	0.5	7	8.4	-1.4

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 833 vph
- EB Volume = 535 vph

Table J-10. Salem Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) - PM

Reduced Speed of	**Range**	**Peak Period**	**EB Queue Average**			**EB Queue Max**			**NB Queue Average**			**NB Queue Max**		
Approach (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	10 to 30	4:30 - 4:45	1	0.8	0.2	9	9.9	-0.9	2	1.1	0.9	6	12.1	-6.1
		4:45 - 5:00	2	0.6	1.4	12	8.6	3.4	1	0.7	0.3	6	9.4	-3.4
		5:00 - 5:15	1	0.4	0.6	10	6.8	3.2	1	0.7	0.3	6	10.2	-4.2
		5:15 - 5:30	2	0.6	1.4	9	9.7	-0.7	1	0.8	0.2	7	10.4	-3.4
30 (Existing condition)	15 to 35	4:30 - 4:45	1	0.5	0.5	9	7.9	1.1	2	1.0	1.0	6	10.6	-4.6
		4:45 - 5:00	2	0.5	1.5	12	8.2	3.8	1	0.6	0.4	6	8.8	-2.8
		5:00 - 5:15	1	0.3	0.7	10	6.2	3.8	1	0.5	0.5	6	8.1	-2.1
		5:15 - 5:30	2	0.4	1.6	9	8.8	0.2	1	0.7	0.3	7	10.5	-3.5
35	20 to 40	4:30 - 4:45	1	0.5	0.5	9	7.9	1.1	2	1.0	1.0	6	10.6	-4.6
		4:45 - 5:00	2	0.5	1.5	12	8.2	3.8	1	0.6	0.4	6	8.8	-2.8
		5:00 - 5:15	1	0.3	0.7	10	6.2	3.8	1	0.5	0.5	6	8.1	-2.1
		5:15 - 5:30	2	0.4	1.6	9	8.8	0.2	1	0.7	0.3	7	10.5	-3.5
40	25 to 45	4:30 - 4:45	1	0.7	0.3	9	9.2	-0.2	1	0.8	0.2	10	10.3	-0.3
		4:45 - 5:00	1	0.5	0.5	8	7.7	0.3	1	0.5	0.5	9	8.3	0.7
		5:00 - 5:15	1	0.4	0.6	11	6.5	4.5	1	0.5	0.5	13	8.4	4.6
		5:15 - 5:30	1	0.4	0.6	8	8.8	-0.8	1	0.6	0.4	11	10.0	1.0
45	30 to 50	4:30 - 4:45	1	0.4	0.6	9	6.9	2.1	2	0.5	1.5	6	7.2	-1.2
		4:45 - 5:00	2	0.4	1.6	12	7.3	4.7	1	0.3	0.7	6	7.4	-1.4
		5:00 - 5:15	1	0.3	0.7	10	5.9	4.1	1	0.3	0.7	6	7.6	-1.6
		5:15 - 5:30	2	0.3	1.7	9	7.7	1.3	1	0.6	0.4	7	10.5	-3.5

Reduced Speed of	Range	Peak Period	EB Queue Average			EB Queue Max			NB Queue Average			NB Queue Max		
Approach (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	30 to 50	4:30 - 4:45	1	0.4	0.6	9	6.5	2.5	2	0.5	1.5	6	7.7	-1.7
		4:45 - 5:00	2	0.3	1.7	12	6.2	5.8	1	0.4	0.6	6	7.8	-1.8
		5:00 - 5:15	1	0.3	0.7	10	6.4	3.6	1	0.3	0.7	6	7.1	-1.1
		5:15 - 5:30	2	0.3	1.7	9	6.9	2.1	1	0.5	0.5	7	9.4	-2.4
55	30 to 50	4:30 - 4:45	1	0.4	0.6	9	6.9	2.1	2	0.4	1.6	6	7.4	-1.4
		4:45 - 5:00	2	0.3	1.7	12	6.2	5.8	1	0.4	0.6	6	7.2	-1.2
		5:00 - 5:15	1	0.2	0.8	10	5.7	4.3	1	0.4	0.6	6	7.1	-1.1
		5:15 - 5:30	2	0.3	1.7	9	7.5	1.5	1	0.4	0.6	7	8.1	-1.1

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 833 vph
- EB Volume = 535 vph

APPENDIX K

SALEM ROUNDABOUT:

CALIBRATION VARIABLES VS. TRAVEL TIME

APPENDIX K – SALEM ROUNDABOUT: CALIBRATION VARIABLES VS. TRAVEL TIME

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Table K-1.a. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - EB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	4	7	14	2.0	5.6	7.8	2.0	1.4	6.2
		7:15 - 7:30	4	10	12	2.0	5.5	9.0	2.0	4.5	3.0
		7:30 - 7:45	4	10	0	2.0	5.4	8.5	2.0	4.6	-8.5
		7:45 - 8:00	4	8	12	2.0	5.5	9.0	2.0	2.5	3.0
30	15 to 35	7:00 - 7:15	4	7	14	1.9	5.2	7.9	2.1	1.8	6.1
		7:15 - 7:30	4	10	12	1.9	5.1	8.8	2.1	4.9	3.2
		7:30 - 7:45	4	10	0	1.9	5.0	8.4	2.1	5.0	-8.4
		7:45 - 8:00	4	8	12	1.9	5.1	8.9	2.1	2.9	3.1
35	20 to 40	7:00 - 7:15	4	7	14	1.9	4.7	7.7	2.1	2.3	6.3
		7:15 - 7:30	4	10	12	1.8	4.6	8.7	2.2	5.4	3.3
		7:30 - 7:45	4	10	0	1.8	4.5	8.1	2.2	5.5	-8.1
		7:45 - 8:00	4	8	12	1.8	4.6	8.8	2.2	3.4	3.2
40 (Existing condition)	25 to 45	7:00 - 7:15	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
		7:15 - 7:30	4	10	12	1.8	4.3	8.7	2.2	5.7	3.3
		7:30 - 7:45	4	10	0	1.8	4.3	8.3	2.2	5.7	-8.3
		7:45 - 8:00	4	8	12	1.7	4.3	8.9	2.3	3.7	3.1
45	30 to 50	7:00 - 7:15	4	7	14	1.8	4.2	7.8	2.2	2.8	6.2
		7:15 - 7:30	4	10	12	1.8	4.2	8.5	2.2	5.8	3.5
		7:30 - 7:45	4	10	0	1.8	4.2	8.2	2.2	5.8	-8.2
		7:45 - 8:00	4	8	12	1.7	4.2	8.6	2.3	3.8	3.4

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	4	7	14	1.8	4.2	7.8	2.2	2.8	6.2
		7:15 - 7:30	4	10	12	1.8	4.3	8.8	2.2	5.7	3.2
		7:30 - 7:45	4	10	0	1.7	4.1	8.2	2.3	5.9	-8.2
		7:45 - 8:00	4	8	12	1.7	4.1	8.7	2.3	3.9	3.3
55	30 to 50	7:00 - 7:15	4	7	14	1.8	4.2	7.8	2.2	2.8	6.2
		7:15 - 7:30	4	10	12	1.8	4.2	8.5	2.2	5.8	3.5
		7:30 - 7:45	4	10	0	1.7	4.2	8.3	2.3	5.8	-8.3
		7:45 - 8:00	4	8	12	1.7	4.1	8.6	2.3	3.9	3.4

Note:

- Circulating Speed = 16 - 22 mph
- EB Volume = 1260 vph

Table K-1.b. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - NB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	3	6	10	1.8	5.5	9.7	1.2	0.5	0.3
		7:15 - 7:30	2	5	10	1.7	5.5	9.5	0.3	-0.5	0.5
		7:30 - 7:45	2	7	9	1.7	5.4	9.5	0.3	1.6	-0.5
		7:45 - 8:00	3	5	10	1.7	5.4	9.5	1.3	-0.4	0.5
30	15 to 35	7:00 - 7:15	3	6	10	1.6	5.5	9.4	1.4	0.5	0.6
		7:15 - 7:30	2	5	10	1.6	5.4	9.3	0.4	-0.4	0.7
		7:30 - 7:45	2	7	9	1.6	5.5	9.2	0.4	1.5	-0.2
		7:45 - 8:00	3	5	10	1.5	5.4	9.3	1.5	-0.4	0.7
35	20 to 40	7:00 - 7:15	3	6	10	1.4	5.4	9.3	1.6	0.6	0.7
		7:15 - 7:30	2	5	10	1.5	5.4	9.1	0.5	-0.4	0.9
		7:30 - 7:45	2	7	9	1.4	5.3	9.1	0.6	1.7	-0.1
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
40 (Existing condition)	25 to 45	7:00 - 7:15	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
		7:15 - 7:30	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
		7:30 - 7:45	2	7	9	1.4	5.4	9.0	0.6	1.6	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
45	30 to 50	7:00 - 7:15	3	6	10	1.5	5.4	9.6	1.5	0.6	0.4
		7:15 - 7:30	2	5	10	1.4	5.3	9.1	0.6	-0.3	0.9
		7:30 - 7:45	2	7	9	1.5	5.3	9.0	0.5	1.7	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	3	6	10	1.4	5.4	9.4	1.6	0.6	0.6
		7:15 - 7:30	2	5	10	1.4	5.3	9.1	0.6	-0.3	0.9
		7:30 - 7:45	2	7	9	1.5	5.4	9.0	0.5	1.6	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.0	1.6	-0.3	1.0
55	30 to 50	7:00 - 7:15	3	6	10	1.4	5.4	9.3	1.6	0.6	0.7
		7:15 - 7:30	2	5	10	1.4	5.3	9.1	0.6	-0.3	0.9
		7:30 - 7:45	2	7	9	1.4	5.4	9.0	0.6	1.6	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9

Note:

- Circulating Speed = 16 - 22 mph
- NB Volume = 1260 vph

Table K-1.c. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - SB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	3	6	10	2.9	6.9	9.7	0.1	-0.9	0.3
		7:15 - 7:30	3	6	10	2.3	6.9	9.0	0.7	-0.9	1.0
		7:30 - 7:45	3	8	10	2.6	6.8	9.1	0.4	1.2	0.9
		7:45 - 8:00	3	7	13	2.1	6.8	8.4	0.9	0.2	4.6
30	15 to 35	7:00 - 7:15	3	6	10	2.9	6.8	9.4	0.1	-0.8	0.6
		7:15 - 7:30	3	6	10	2.4	6.9	9.2	0.6	-0.9	0.8
		7:30 - 7:45	3	8	10	2.4	6.8	8.6	0.6	1.2	1.4
		7:45 - 8:00	3	7	13	2.0	6.9	8.1	1.0	0.1	4.9
35	20 to 40	7:00 - 7:15	3	6	10	2.4	6.9	9.4	0.6	-0.9	0.6
		7:15 - 7:30	3	6	10	2.4	6.9	8.7	0.6	-0.9	1.3
		7:30 - 7:45	3	8	10	2.3	6.8	8.6	0.7	1.2	1.4
		7:45 - 8:00	3	7	13	1.9	6.9	8.1	1.1	0.1	4.9
40 (Existing condition)	25 to 45	7:00 - 7:15	3	6	10	2.4	6.9	9.5	0.6	-0.9	0.5
		7:15 - 7:30	3	6	10	2.4	7.0	8.6	0.6	-1.0	1.4
		7:30 - 7:45	3	8	10	2.3	6.8	8.8	0.7	1.2	1.2
		7:45 - 8:00	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
45	30 to 50	7:00 - 7:15	3	6	10	2.3	6.9	9.7	0.7	-0.9	0.3
		7:15 - 7:30	3	6	10	2.3	6.9	8.7	0.7	-0.9	1.3
		7:30 - 7:45	3	8	10	2.4	6.8	8.7	0.6	1.2	1.3
		7:45 - 8:00	3	7	13	1.9	6.9	8.3	1.1	0.1	4.7

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	3	6	10	2.3	7.0	9.4	0.7	-1.0	0.6
		7:15 - 7:30	3	6	10	2.4	6.9	8.7	0.6	-0.9	1.3
		7:30 - 7:45	3	8	10	2.5	6.8	8.8	0.5	1.2	1.2
		7:45 - 8:00	3	7	13	2.0	6.9	8.0	1.0	0.1	5.0
55	30 to 50	7:00 - 7:15	3	6	10	2.3	7.0	9.3	0.7	-1.0	0.7
		7:15 - 7:30	3	6	10	2.5	6.9	8.6	0.5	-0.9	1.4
		7:30 - 7:45	3	8	10	2.5	6.9	8.7	0.5	1.1	1.3
		7:45 - 8:00	3	7	13	2.1	6.9	8.0	0.9	0.1	5.0

Note:

- Circulating Speed = 16 - 22 mph
- SB Volume = 1260 vph

Table K-1.d. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - WB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	2	7	10	1.5	6.9	10.7	0.5	0.1	-0.7
		7:15 - 7:30	2	6	10	1.6	7.7	10.7	0.4	-1.7	-0.7
		7:30 - 7:45	2	5	10	2.3	8.0	10.5	-0.3	-3.0	-0.5
		7:45 - 8:00	2	6	10	1.7	7.3	10.6	0.3	-1.3	-0.6
30	15 to 35	7:00 - 7:15	2	7	10	1.6	6.8	10.7	0.4	0.2	-0.7
		7:15 - 7:30	2	6	10	1.5	7.6	10.6	0.5	-1.6	-0.6
		7:30 - 7:45	2	5	10	1.9	7.9	10.6	0.1	-2.9	-0.6
		7:45 - 8:00	2	6	10	1.7	7.5	10.6	0.3	-1.5	-0.6
35	20 to 40	7:00 - 7:15	2	7	10	1.3	6.9	10.6	0.7	0.1	-0.6
		7:15 - 7:30	2	6	10	1.6	7.1	10.6	0.4	-1.1	-0.6
		7:30 - 7:45	2	5	10	2.0	7.3	10.5	0.0	-2.3	-0.5
		7:45 - 8:00	2	6	10	1.2	7.3	10.6	0.8	-1.3	-0.6
40 (Existing condition)	25 to 45	7:00 - 7:15	2	7	10	1.4	6.9	10.8	0.6	0.1	-0.8
		7:15 - 7:30	2	6	10	1.4	7.5	10.9	0.6	-1.5	-0.9
		7:30 - 7:45	2	5	10	2.5	7.3	10.5	-0.5	-2.3	-0.5
		7:45 - 8:00	2	6	10	1.2	7.2	10.6	0.8	-1.2	-0.6
45	30 to 50	7:00 - 7:15	2	7	10	1.2	7.0	10.8	0.8	0.0	-0.8
		7:15 - 7:30	2	6	10	1.4	7.4	10.7	0.6	-1.4	-0.7
		7:30 - 7:45	2	5	10	2.4	7.3	10.7	-0.4	-2.3	-0.7
		7:45 - 8:00	2	6	10	1.3	7.5	10.6	0.7	-1.5	-0.6

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	2	7	10	1.2	7.0	10.6	0.8	0.0	-0.6
		7:15 - 7:30	2	6	10	1.5	7.5	10.8	0.5	-1.5	-0.8
		7:30 - 7:45	2	5	10	1.6	7.4	10.9	0.4	-2.4	-0.9
		7:45 - 8:00	2	6	10	1.3	7.4	10.8	0.7	-1.4	-0.8
55	30 to 50	7:00 - 7:15	2	7	10	1.2	7.0	10.7	0.8	0.0	-0.7
		7:15 - 7:30	2	6	10	1.6	7.5	10.6	0.4	-1.5	-0.6
		7:30 - 7:45	2	5	10	2.7	7.5	10.7	-0.7	-2.5	-0.7
		7:45 - 8:00	2	6	10	1.3	7.1	10.6	0.7	-1.1	-0.6

Note:

- Circulating Speed = 16 - 22 mph
- WB Volume = 1260 vph

Table K-2.a. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - EB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15	7:00 - 7:15	4	7	14	1.9	5.0	11.7	2.1	2.0	2.3
		7:15 - 7:30	4	10	12	2.0	4.9	13.6	2.0	5.1	-1.6
		7:30 - 7:45	4	10	0	1.9	5.0	12.9	2.1	5.0	-12.9
		7:45 - 8:00	4	8	12	1.9	4.9	13.6	2.1	3.1	-1.6
15	15 to 20 **(16 to 22 existing condition)**	7:00 - 7:15	4	7	14	1.8	4.5	8.7	2.2	2.5	5.3
		7:15 - 7:30	4	10	12	1.8	4.6	9.8	2.2	5.4	2.2
		7:30 - 7:45	4	10	0	1.7	4.5	9.2	2.3	5.5	-9.2
		7:45 - 8:00	4	8	12	1.8	4.5	9.9	2.2	3.5	2.1
20	20 to 25	7:00 - 7:15	4	7	14	1.8	4.4	7.1	2.2	2.6	6.9
		7:15 - 7:30	4	10	12	1.8	4.3	8.0	2.2	5.7	4.0
		7:30 - 7:45	4	10	0	1.7	4.3	7.3	2.3	5.7	-7.3
		7:45 - 8:00	4	8	12	1.8	4.3	8.4	2.2	3.7	3.6
25	25 to 30	7:00 - 7:15	4	7	14	1.9	4.5	6.1	2.1	2.5	7.9
		7:15 - 7:30	4	10	12	1.8	4.4	7.2	2.2	5.6	4.8
		7:30 - 7:45	4	10	0	1.8	4.2	6.4	2.2	5.8	-6.4
		7:45 - 8:00	4	8	12	1.8	4.2	6.8	2.2	3.8	5.2
30	30 to 35	7:00 - 7:15	4	7	14	1.8	4.5	5.6	2.2	2.5	8.4
		7:15 - 7:30	4	10	12	1.8	4.4	6.3	2.2	5.6	5.7
		7:30 - 7:45	4	10	0	1.8	4.3	5.7	2.2	5.7	-5.7
		7:45 - 8:00	4	8	12	1.8	4.4	6.2	2.2	3.6	5.8

Note:

- Approach Speed = 40 mph
- EB Volume = 1260 vph

Table K-2.b. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - NB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15	7:00 - 7:15	3	6	10	1.7	8.5	14.0	1.3	-2.5	-4.0
		7:15 - 7:30	2	5	10	1.7	8.6	14.5	0.3	-3.6	-4.5
		7:30 - 7:45	2	7	9	1.7	8.4	14.3	0.3	-1.4	-5.3
		7:45 - 8:00	3	5	10	1.7	8.6	14.5	1.3	-3.6	-4.5
15	15 to 20 **(16 to 22 existing condition)**	7:00 - 7:15	3	6	10	1.5	6.1	10.2	1.5	-0.1	-0.2
		7:15 - 7:30	2	5	10	1.5	6.1	10.4	0.5	-1.1	-0.4
		7:30 - 7:45	2	7	9	1.5	6.1	10.3	0.5	0.9	-1.3
		7:45 - 8:00	3	5	10	1.5	6.1	10.3	1.5	-1.1	-0.3
20	20 to 25	7:00 - 7:15	3	6	10	1.4	4.8	8.5	1.6	1.2	1.5
		7:15 - 7:30	2	5	10	1.3	4.8	8.2	0.7	0.2	1.8
		7:30 - 7:45	2	7	9	1.4	4.8	8.1	0.6	2.2	0.9
		7:45 - 8:00	3	5	10	1.3	4.8	8.2	1.7	0.2	1.8
25	25 to 30	7:00 - 7:15	3	6	10	1.2	4.1	7.4	1.8	1.9	2.6
		7:15 - 7:30	2	5	10	1.2	4.1	6.9	0.8	0.9	3.1
		7:30 - 7:45	2	7	9	1.3	4.2	6.9	0.7	2.8	2.1
		7:45 - 8:00	3	5	10	1.2	4.0	6.9	1.8	1.0	3.1
30	30 to 35	7:00 - 7:15	3	6	10	1.2	3.5	6.9	1.8	2.5	3.1
		7:15 - 7:30	2	5	10	1.1	3.5	6.0	0.9	1.5	4.0
		7:30 - 7:45	2	7	9	1.1	3.5	6.0	0.9	3.5	3.0
		7:45 - 8:00	3	5	10	1.1	3.6	6.0	1.9	1.4	4.0

Note:

- Approach Speed = 40 mph
- NB Volume = 1260 vph

Table K-2.c. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - SB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15	7:00 - 7:15	3	6	10	3.4	10.9	13.9	-0.4	-4.9	-3.9
		7:15 - 7:30	3	6	10	3.2	11.0	12.8	-0.2	-5.0	-2.8
		7:30 - 7:45	3	8	10	3.6	10.7	12.1	-0.6	-2.7	-2.1
		7:45 - 8:00	3	7	13	2.9	10.7	12.1	0.1	-3.7	0.9
15	15 to 20 **(16 to 22 existing condition)**	7:00 - 7:15	3	6	10	2.9	7.7	10.1	0.1	-1.7	-0.1
		7:15 - 7:30	3	6	10	2.6	7.8	9.5	0.4	-1.8	0.5
		7:30 - 7:45	3	8	10	2.8	7.7	9.5	0.2	0.3	0.5
		7:45 - 8:00	3	7	13	2.2	7.7	8.8	0.8	-0.7	4.2
20	20 to 25	7:00 - 7:15	3	6	10	2.4	6.3	8.7	0.6	-0.3	1.3
		7:15 - 7:30	3	6	10	2.3	6.4	7.9	0.7	-0.4	2.1
		7:30 - 7:45	3	8	10	2.3	6.3	7.9	0.7	1.7	2.1
		7:45 - 8:00	3	7	13	1.8	6.3	7.7	1.2	0.7	5.3
25	25 to 30	7:00 - 7:15	3	6	10	2.3	5.5	7.5	0.7	0.5	2.5
		7:15 - 7:30	3	6	10	2.1	5.5	7.1	0.9	0.5	2.9
		7:30 - 7:45	3	8	10	2.3	5.5	6.9	0.7	2.5	3.1
		7:45 - 8:00	3	7	13	1.8	5.5	6.9	1.2	1.5	6.1
30	30 to 35	7:00 - 7:15	3	6	10	2.3	5.1	7.0	0.7	0.9	3.0
		7:15 - 7:30	3	6	10	2.1	5.0	6.6	0.9	1.0	3.4
		7:30 - 7:45	3	8	10	2.1	5.0	6.4	0.9	3.0	3.6
		7:45 - 8:00	3	7	13	1.8	5.0	6.1	1.2	2.0	6.9

Note:

- Approach Speed = 40 mph
- SB Volume = 1260 vph

Table K-2.d. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - WB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15	7:00 - 7:15	2	7	10	1.5	11.0	16.9	0.5	-4.0	-6.9
		7:15 - 7:30	2	6	10	1.5	15.0	16.8	0.5	-9.0	-6.8
		7:30 - 7:45	2	5	10	2.7	13.1	16.6	-0.7	-8.1	-6.6
		7:45 - 8:00	2	6	10	1.3	12.6	16.8	0.7	-6.6	-6.8
15	15 to 20 **(16 to 22 existing condition)**	7:00 - 7:15	2	7	10	1.3	7.8	12.0	0.7	-0.8	-2.0
		7:15 - 7:30	2	6	10	2.0	8.3	12.0	0.0	-2.3	-2.0
		7:30 - 7:45	2	5	10	1.7	8.2	12.0	0.3	-3.2	-2.0
		7:45 - 8:00	2	6	10	1.3	8.5	12.1	0.7	-2.5	-2.1
20	20 to 25	7:00 - 7:15	2	7	10	1.2	6.2	9.7	0.8	0.8	0.3
		7:15 - 7:30	2	6	10	1.4	6.6	9.6	0.6	-0.6	0.4
		7:30 - 7:45	2	5	10	1.9	7.1	9.5	0.1	-2.1	0.5
		7:45 - 8:00	2	6	10	1.3	6.5	9.6	0.7	-0.5	0.4
25	25 to 30	7:00 - 7:15	2	7	10	1.3	5.4	8.1	0.7	1.6	1.9
		7:15 - 7:30	2	6	10	1.4	6.3	8.1	0.6	-0.3	1.9
		7:30 - 7:45	2	5	10	1.8	6.1	8.1	0.2	-1.1	1.9
		7:45 - 8:00	2	6	10	1.3	6.1	8.1	0.7	-0.1	1.9
30	30 to 35	7:00 - 7:15	2	7	10	1.3	5.0	7.4	0.7	2.0	2.6
		7:15 - 7:30	2	6	10	1.4	5.6	7.2	0.6	0.4	2.8
		7:30 - 7:45	2	5	10	1.6	5.1	7.2	0.4	-0.1	2.8
		7:45 - 8:00	2	6	10	1.4	5.1	7.3	0.6	0.9	2.7

Note:

- Approach Speed = 40 mph
- WB Volume = 1260 vph

Table K-3.a. Salem Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - EB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	4	7	14	1.8	4.3	7.9	2.2	2.7	6.1
	7:15 - 7:30	4	10	12	1.8	4.4	8.8	2.2	5.6	3.2
	7:30 - 7:45	4	10	0	1.7	4.3	8.4	2.3	5.7	-8.4
	7:45 - 8:00	4	8	12	1.8	4.3	8.7	2.2	3.7	3.3
1	7:00 - 7:15	4	7	14	1.9	4.6	8.1	2.1	2.4	5.9
	7:15 - 7:30	4	10	12	1.9	4.6	8.9	2.1	5.4	3.1
	7:30 - 7:45	4	10	0	1.9	4.7	8.4	2.1	5.3	-8.4
	7:45 - 8:00	4	8	12	1.9	4.5	9.0	2.1	3.5	3.0
2	7:00 - 7:15	4	7	14	2.1	5.1	8.2	1.9	1.9	5.8
	7:15 - 7:30	4	10	12	2.1	5.1	9.2	1.9	4.9	2.8
	7:30 - 7:45	4	10	0	2.1	5.0	8.4	1.9	5.0	-8.4
	7:45 - 8:00	4	8	12	2.0	4.8	9.3	2.0	3.2	2.7
3	7:00 - 7:15	4	7	14	2.2	5.1	8.1	1.8	1.9	5.9
	7:15 - 7:30	4	10	12	2.2	5.2	9.3	1.8	4.8	2.7
	7:30 - 7:45	4	10	0	2.1	5.1	8.5	1.9	4.9	-8.5
	7:45 - 8:00	4	8	12	2.2	5.0	9.4	1.8	3.0	2.6

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- EB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-3.b. Salem Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - NB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
	7:15 - 7:30	2	5	10	1.5	5.4	9.1	0.5	-0.4	0.9
	7:30 - 7:45	2	7	9	1.4	5.3	9.0	0.6	1.7	0.0
	7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
1	7:00 - 7:15	3	6	10	1.5	5.4	9.3	1.5	0.6	0.7
	7:15 - 7:30	2	5	10	1.5	5.4	9.1	0.5	-0.4	0.9
	7:30 - 7:45	2	7	9	1.5	5.4	9.1	0.5	1.6	-0.1
	7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
2	7:00 - 7:15	3	6	10	1.7	5.5	9.4	1.3	0.5	0.6
	7:15 - 7:30	2	5	10	1.7	5.4	9.2	0.3	-0.4	0.8
	7:30 - 7:45	2	7	9	1.7	5.5	9.2	0.3	1.5	-0.2
	7:45 - 8:00	3	5	10	1.5	5.4	9.2	1.5	-0.4	0.8
3	7:00 - 7:15	3	6	10	1.9	5.5	9.4	1.1	0.5	0.6
	7:15 - 7:30	2	5	10	1.7	5.5	9.3	0.3	-0.5	0.7
	7:30 - 7:45	2	7	9	1.7	5.6	9.2	0.3	1.4	-0.2
	7:45 - 8:00	3	5	10	1.7	5.5	9.3	1.3	-0.5	0.7

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- NB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-3.c. Salem Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - SB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	3	6	10	2.5	6.9	9.5	0.5	-0.9	0.5
	7:15 - 7:30	3	6	10	2.7	7.1	8.6	0.3	-1.1	1.4
	7:30 - 7:45	3	8	10	2.3	6.9	8.8	0.7	1.1	1.2
	7:45 - 8:00	3	7	13	1.8	7.0	8.1	1.2	0.0	4.9
1	7:00 - 7:15	3	6	10	2.5	6.9	9.3	0.5	-0.9	0.7
	7:15 - 7:30	3	6	10	2.5	7.0	8.7	0.5	-1.0	1.3
	7:30 - 7:45	3	8	10	2.4	6.8	8.7	0.6	1.2	1.3
	7:45 - 8:00	3	7	13	1.9	6.9	8.3	1.1	0.1	4.7
2	7:00 - 7:15	3	6	10	2.4	6.8	9.4	0.6	-0.8	0.6
	7:15 - 7:30	3	6	10	2.5	6.9	8.7	0.5	-0.9	1.3
	7:30 - 7:45	3	8	10	2.5	6.7	8.5	0.5	1.3	1.5
	7:45 - 8:00	3	7	13	2.0	6.9	8.4	1.0	0.1	4.6
3	7:00 - 7:15	3	6	10	2.5	6.7	9.5	0.5	-0.7	0.5
	7:15 - 7:30	3	6	10	2.4	6.7	8.7	0.6	-0.7	1.3
	7:30 - 7:45	3	8	10	2.6	6.6	8.5	0.4	1.4	1.5
	7:45 - 8:00	3	7	13	2.0	6.7	8.4	1.0	0.3	4.6

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- SB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-3.d. Salem Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - WB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	2	7	10	1.3	6.9	10.9	0.7	0.1	-0.9
	7:15 - 7:30	2	6	10	1.4	7.6	11.0	0.6	-1.6	-1.0
	7:30 - 7:45	2	5	10	2.5	7.2	10.6	-0.5	-2.2	-0.6
	7:45 - 8:00	2	6	10	1.2	7.2	10.7	0.8	-1.2	-0.7
1	7:00 - 7:15	2	7	10	1.3	6.9	10.6	0.7	0.1	-0.6
	7:15 - 7:30	2	6	10	1.5	7.9	10.6	0.5	-1.9	-0.6
	7:30 - 7:45	2	5	10	2.5	7.7	10.4	-0.5	-2.7	-0.4
	7:45 - 8:00	2	6	10	1.2	8.0	10.5	0.8	-2.0	-0.5
2	7:00 - 7:15	2	7	10	1.3	6.7	10.4	0.7	0.3	-0.4
	7:15 - 7:30	2	6	10	1.4	8.7	10.7	0.6	-2.7	-0.7
	7:30 - 7:45	2	5	10	1.9	9.0	10.4	0.1	-4.0	-0.4
	7:45 - 8:00	2	6	10	1.2	9.9	10.5	0.8	-3.9	-0.5
3	7:00 - 7:15	2	7	10	1.3	6.7	10.5	0.7	0.3	-0.5
	7:15 - 7:30	2	6	10	1.6	10.7	10.6	0.4	-4.7	-0.6
	7:30 - 7:45	2	5	10	2.0	10.7	10.4	0.0	-5.7	-0.4
	7:45 - 8:00	2	6	10	1.3	12.5	10.5	0.7	-6.5	-0.5

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- SB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-4.a. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - EB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	4	7	14	1.8	4.3	7.8	2.2	2.7	6.2
	7:15 - 7:30	4	10	12	1.8	4.4	8.9	2.2	5.6	3.1
	7:30 - 7:45	4	10	0	1.7	4.2	8.5	2.3	5.8	-8.5
	7:45 - 8:00	4	8	12	1.7	4.2	8.9	2.3	3.8	3.1
-20	7:00 - 7:15	4	7	14	1.8	4.3	7.8	2.2	2.7	6.2
	7:15 - 7:30	4	10	12	1.8	4.4	8.9	2.2	5.6	3.1
	7:30 - 7:45	4	10	0	1.7	4.2	8.5	2.3	5.8	-8.5
	7:45 - 8:00	4	8	12	1.7	4.2	9.0	2.3	3.8	3.0
-10	7:00 - 7:15	4	7	14	1.8	4.3	7.9	2.2	2.7	6.1
	7:15 - 7:30	4	10	12	1.8	4.3	8.8	2.2	5.7	3.2
	7:30 - 7:45	4	10	0	1.7	4.2	8.3	2.3	5.8	-8.3
	7:45 - 8:00	4	8	12	1.7	4.2	8.9	2.3	3.8	3.1
+10	7:00 - 7:15	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
	7:15 - 7:30	4	10	12	1.8	4.4	8.8	2.2	5.6	3.2
	7:30 - 7:45	4	10	0	1.7	4.3	8.4	2.3	5.7	-8.4
	7:45 - 8:00	4	8	12	1.7	4.4	8.8	2.3	3.6	3.2
+20	7:00 - 7:15	4	7	14	1.8	4.5	8.0	2.2	2.5	6.0
	7:15 - 7:30	4	10	12	1.9	4.5	8.9	2.1	5.5	3.1
	7:30 - 7:45	4	10	0	1.8	4.4	8.4	2.2	5.6	-8.4
	7:45 - 8:00	4	8	12	1.8	4.5	9.0	2.2	3.5	3.0

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- EB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-4.b. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - NB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
	7:15 - 7:30	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
	7:30 - 7:45	2	7	9	1.5	5.4	9.0	0.5	1.6	0.0
	7:45 - 8:00	3	5	10	1.4	5.3	9.0	1.6	-0.3	1.0
-20	7:00 - 7:15	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
	7:15 - 7:30	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
	7:30 - 7:45	2	7	9	1.5	5.4	9.0	0.5	1.6	0.0
	7:45 - 8:00	3	5	10	1.4	5.3	9.0	1.6	-0.3	1.0
-10	7:00 - 7:15	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
	7:15 - 7:30	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
	7:30 - 7:45	2	7	9	1.5	5.4	9.0	0.5	1.6	0.0
	7:45 - 8:00	3	5	10	1.4	5.3	9.0	1.6	-0.3	1.0
+10	7:00 - 7:15	3	6	10	1.6	5.4	9.5	1.4	0.6	0.5
	7:15 - 7:30	2	5	10	1.5	5.4	9.1	0.5	-0.4	0.9
	7:30 - 7:45	2	7	9	1.5	5.4	9.0	0.5	1.6	0.0
	7:45 - 8:00	3	5	10	1.4	5.4	9.1	1.6	-0.4	0.9
+20	7:00 - 7:15	3	6	10	1.6	5.4	9.7	1.4	0.6	0.3
	7:15 - 7:30	2	5	10	1.5	5.5	9.1	0.5	-0.5	0.9
	7:30 - 7:45	2	7	9	1.6	5.4	9.1	0.4	1.6	-0.1
	7:45 - 8:00	3	5	10	1.4	5.4	9.1	1.6	-0.4	0.9

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- NB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-4.c. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - SB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	3	6	10	2.7	7.0	9.5	0.3	-1.0	0.5
	7:15 - 7:30	3	6	10	2.2	7.0	8.5	0.8	-1.0	1.5
	7:30 - 7:45	3	8	10	2.2	6.8	8.8	0.8	1.2	1.2
	7:45 - 8:00	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
-20	7:00 - 7:15	3	6	10	2.7	7.0	9.5	0.3	-1.0	0.5
	7:15 - 7:30	3	6	10	2.2	7.0	8.5	0.8	-1.0	1.5
	7:30 - 7:45	3	8	10	2.2	6.8	8.8	0.8	1.2	1.2
	7:45 - 8:00	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
-10	7:00 - 7:15	3	6	10	3.1	6.9	9.5	-0.1	-0.9	0.5
	7:15 - 7:30	3	6	10	2.3	7.0	8.4	0.7	-1.0	1.6
	7:30 - 7:45	3	8	10	2.2	6.9	8.9	0.8	1.1	1.1
	7:45 - 8:00	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
+10	7:00 - 7:15	3	6	10	2.3	6.9	9.5	0.7	-0.9	0.5
	7:15 - 7:30	3	6	10	2.4	6.9	8.5	0.6	-0.9	1.5
	7:30 - 7:45	3	8	10	2.3	6.8	8.8	0.7	1.2	1.2
	7:45 - 8:00	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
+20	7:00 - 7:15	3	6	10	2.2	6.9	9.7	0.8	-0.9	0.3
	7:15 - 7:30	3	6	10	2.4	6.9	8.4	0.6	-0.9	1.6
	7:30 - 7:45	3	8	10	2.3	6.8	8.6	0.7	1.2	1.4
	7:45 - 8:00	3	7	13	1.9	6.9	8.3	1.1	0.1	4.7

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- SB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-4.d. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - WB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	2	7	10	1.3	6.9	10.8	0.7	0.1	-0.8
	7:15 - 7:30	2	6	10	1.4	7.4	11.0	0.6	-1.4	-1.0
	7:30 - 7:45	2	5	10	2.5	7.0	10.7	-0.5	-2.0	-0.7
	7:45 - 8:00	2	6	10	1.2	7.2	10.7	0.8	-1.2	-0.7
-20	7:00 - 7:15	2	7	10	1.3	6.9	10.8	0.7	0.1	-0.8
	7:15 - 7:30	2	6	10	1.4	7.4	11.0	0.6	-1.4	-1.0
	7:30 - 7:45	2	5	10	2.5	7.0	10.7	-0.5	-2.0	-0.7
	7:45 - 8:00	2	6	10	1.2	7.2	10.7	0.8	-1.2	-0.7
-10	7:00 - 7:15	2	7	10	1.3	6.9	10.8	0.7	0.1	-0.8
	7:15 - 7:30	2	6	10	1.4	7.5	10.9	0.6	-1.5	-0.9
	7:30 - 7:45	2	5	10	2.5	7.4	10.7	-0.5	-2.4	-0.7
	7:45 - 8:00	2	6	10	1.2	7.2	10.6	0.8	-1.2	-0.6
+10	7:00 - 7:15	2	7	10	1.3	6.8	10.7	0.7	0.2	-0.7
	7:15 - 7:30	2	6	10	1.4	7.7	10.8	0.6	-1.7	-0.8
	7:30 - 7:45	2	5	10	2.5	7.6	10.5	-0.5	-2.6	-0.5
	7:45 - 8:00	2	6	10	1.2	7.5	10.5	0.8	-1.5	-0.5
+20	7:00 - 7:15	2	7	10	1.3	6.8	10.7	0.7	0.2	-0.7
	7:15 - 7:30	2	6	10	1.4	8.0	10.7	0.6	-2.0	-0.7
	7:30 - 7:45	2	5	10	2.5	7.9	10.5	-0.5	-2.9	-0.5
	7:45 - 8:00	2	6	10	1.2	7.7	10.5	0.8	-1.7	-0.5

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- WB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-5.a. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - EB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	4	7	14	2.1	5.0	8.0	1.9	2.0	6.0
		7:15 - 7:30	4	10	12	2.1	4.9	9.0	1.9	5.1	3.0
		7:30 - 7:45	4	10	0	2.1	4.8	8.4	1.9	5.2	-8.4
		7:45 - 8:00	4	8	12	2.1	4.7	9.2	1.9	3.3	2.8
30 (Existing condition)	15 to 35	7:00 - 7:15	4	7	14	1.9	4.7	7.9	2.1	2.3	6.1
		7:15 - 7:30	4	10	12	1.9	4.5	9.1	2.1	5.5	2.9
		7:30 - 7:45	4	10	0	1.9	4.6	8.3	2.1	5.4	-8.3
		7:45 - 8:00	4	8	12	1.9	4.5	9.2	2.1	3.5	2.8
35	20 to 40	7:00 - 7:15	4	7	14	1.9	4.7	7.9	2.1	2.3	6.1
		7:15 - 7:30	4	10	12	1.9	4.5	9.1	2.1	5.5	2.9
		7:30 - 7:45	4	10	0	1.9	4.6	8.3	2.1	5.4	-8.3
		7:45 - 8:00	4	8	12	1.9	4.5	9.2	2.1	3.5	2.8
40	25 to 45	7:00 - 7:15	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
		7:15 - 7:30	4	10	12	1.8	4.3	8.7	2.2	5.7	3.3
		7:30 - 7:45	4	10	0	1.8	4.3	8.3	2.2	5.7	-8.3
		7:45 - 8:00	4	8	12	1.7	4.3	8.9	2.3	3.7	3.1
45	30 to 50	7:00 - 7:15	4	7	14	1.7	4.2	7.8	2.3	2.8	6.2
		7:15 - 7:30	4	10	12	1.7	4.3	8.6	2.3	5.7	3.4
		7:30 - 7:45	4	10	0	1.6	4.1	8.0	2.4	5.9	-8.0
		7:45 - 8:00	4	8	12	1.6	4.1	8.6	2.4	3.9	3.4

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	4	7	14	1.6	4.1	7.6	2.4	2.9	6.4
		7:15 - 7:30	4	10	12	1.7	4.2	8.4	2.3	5.8	3.6
		7:30 - 7:45	4	10	0	1.5	4.0	7.9	2.5	6.0	-7.9
		7:45 - 8:00	4	8	12	1.6	3.9	8.1	2.4	4.1	3.9
55	30 to 50	7:00 - 7:15	4	7	14	1.6	3.9	7.7	2.4	3.1	6.3
		7:15 - 7:30	4	10	12	1.6	4.1	8.4	2.4	5.9	3.6
		7:30 - 7:45	4	10	0	1.5	3.8	7.6	2.5	6.2	-7.6
		7:45 - 8:00	4	8	12	1.5	3.7	8.0	2.5	4.3	4.0

Note:

- Approach Speed = 40 mph
- EB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-5.b. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - NB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	3	6	10	1.4	5.3	9.6	1.6	0.7	0.4
		7:15 - 7:30	2	5	10	1.4	5.3	9.1	0.6	-0.3	0.9
		7:30 - 7:45	2	7	9	1.4	5.3	9.1	0.6	1.7	-0.1
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
30 (Existing condition)	15 to 35	7:00 - 7:15	3	6	10	1.5	5.4	9.4	1.5	0.6	0.6
		7:15 - 7:30	2	5	10	1.5	5.3	9.1	0.5	-0.3	0.9
		7:30 - 7:45	2	7	9	1.5	5.3	9.0	0.5	1.7	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
35	20 to 40	7:00 - 7:15	3	6	10	1.5	5.4	9.4	1.5	0.6	0.6
		7:15 - 7:30	2	5	10	1.5	5.3	9.1	0.5	-0.3	0.9
		7:30 - 7:45	2	7	9	1.5	5.3	9.0	0.5	1.7	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
40	25 to 45	7:00 - 7:15	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
		7:15 - 7:30	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
		7:30 - 7:45	2	7	9	1.4	5.4	9.0	0.6	1.6	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
45	30 to 50	7:00 - 7:15	3	6	10	1.4	5.4	9.4	1.6	0.6	0.6
		7:15 - 7:30	2	5	10	1.5	5.4	9.1	0.5	-0.4	0.9
		7:30 - 7:45	2	7	9	1.4	5.4	9.1	0.6	1.6	-0.1
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	3	6	10	1.5	5.3	9.3	1.5	0.7	0.7
		7:15 - 7:30	2	5	10	1.5	5.5	9.1	0.5	-0.5	0.9
		7:30 - 7:45	2	7	9	1.4	5.5	9.0	0.6	1.5	0.0
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
55	30 to 50	7:00 - 7:15	3	6	10	1.5	5.3	9.0	1.5	0.7	1.0
		7:15 - 7:30	2	5	10	1.5	5.4	9.1	0.5	-0.4	0.9
		7:30 - 7:45	2	7	9	1.4	5.4	9.1	0.6	1.6	-0.1
		7:45 - 8:00	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9

Note:

- Approach Speed = 40 mph
- NB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-5.c. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - SB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	3	6	10	3.0	7.0	9.7	0.0	-1.0	0.3
		7:15 - 7:30	3	6	10	2.5	7.0	8.9	0.5	-1.0	1.1
		7:30 - 7:45	3	8	10	2.5	7.1	8.6	0.5	0.9	1.4
		7:45 - 8:00	3	7	13	2.1	7.0	8.4	0.9	0.0	4.6
30 (Existing condition)	15 to 35	7:00 - 7:15	3	6	10	2.6	7.1	9.5	0.4	-1.1	0.5
		7:15 - 7:30	3	6	10	2.4	7.0	8.6	0.6	-1.0	1.4
		7:30 - 7:45	3	8	10	2.3	6.9	8.6	0.7	1.1	1.4
		7:45 - 8:00	3	7	13	1.9	7.0	8.4	1.1	0.0	4.6
35	20 to 40	7:00 - 7:15	3	6	10	2.6	7.1	9.5	0.4	-1.1	0.5
		7:15 - 7:30	3	6	10	2.4	7.0	8.6	0.6	-1.0	1.4
		7:30 - 7:45	3	8	10	2.3	6.9	8.6	0.7	1.1	1.4
		7:45 - 8:00	3	7	13	1.9	7.0	8.4	1.1	0.0	4.6
40	25 to 45	7:00 - 7:15	3	6	10	2.4	6.9	9.5	0.6	-0.9	0.5
		7:15 - 7:30	3	6	10	2.4	7.0	8.6	0.6	-1.0	1.4
		7:30 - 7:45	3	8	10	2.3	6.8	8.8	0.7	1.2	1.2
		7:45 - 8:00	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
45	30 to 50	7:00 - 7:15	3	6	10	2.1	6.8	9.4	0.9	-0.8	0.6
		7:15 - 7:30	3	6	10	2.4	6.8	8.4	0.6	-0.8	1.6
		7:30 - 7:45	3	8	10	2.5	6.8	8.5	0.5	1.2	1.5
		7:45 - 8:00	3	7	13	1.9	6.8	7.9	1.1	0.2	5.1

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	3	6	10	2.1	6.8	9.2	0.9	-0.8	0.8
		7:15 - 7:30	3	6	10	2.3	6.7	8.3	0.7	-0.7	1.7
		7:30 - 7:45	3	8	10	2.3	6.6	8.3	0.7	1.4	1.7
		7:45 - 8:00	3	7	13	1.9	6.7	7.7	1.1	0.3	5.3
55	30 to 50	7:00 - 7:15	3	6	10	2.1	6.8	8.9	0.9	-0.8	1.1
		7:15 - 7:30	3	6	10	2.3	6.6	8.4	0.7	-0.6	1.6
		7:30 - 7:45	3	8	10	2.3	6.6	8.2	0.7	1.4	1.8
		7:45 - 8:00	3	7	13	1.7	6.7	7.5	1.3	0.3	5.5

Note:

- Approach Speed = 40 mph
- SB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-5.d. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - WB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	7:00 - 7:15	2	7	10	1.7	6.9	10.9	0.3	0.1	-0.9
		7:15 - 7:30	2	6	10	1.6	8.2	11.0	0.4	-2.2	-1.0
		7:30 - 7:45	2	5	10	2.2	8.4	10.9	-0.2	-3.4	-0.9
		7:45 - 8:00	2	6	10	1.7	8.6	10.9	0.3	-2.6	-0.9
30 (Existing condition)	15 to 35	7:00 - 7:15	2	7	10	1.4	7.0	11.1	0.6	0.0	-1.1
		7:15 - 7:30	2	6	10	1.5	7.8	11.0	0.5	-1.8	-1.0
		7:30 - 7:45	2	5	10	2.2	8.5	10.7	-0.2	-3.5	-0.7
		7:45 - 8:00	2	6	10	1.8	7.6	10.9	0.2	-1.6	-0.9
35	20 to 40	7:00 - 7:15	2	7	10	1.4	7.0	11.1	0.6	0.0	-1.1
		7:15 - 7:30	2	6	10	1.5	7.8	11.0	0.5	-1.8	-1.0
		7:30 - 7:45	2	5	10	2.2	8.5	10.7	-0.2	-3.5	-0.7
		7:45 - 8:00	2	6	10	1.8	7.6	10.9	0.2	-1.6	-0.9
40	25 to 45	7:00 - 7:15	2	7	10	1.4	6.9	10.8	0.6	0.1	-0.8
		7:15 - 7:30	2	6	10	1.4	7.5	10.9	0.6	-1.5	-0.9
		7:30 - 7:45	2	5	10	2.5	7.3	10.5	-0.5	-2.3	-0.5
		7:45 - 8:00	2	6	10	1.2	7.2	10.6	0.8	-1.2	-0.6
45	30 to 50	7:00 - 7:15	2	7	10	1.2	6.8	10.5	0.8	0.2	-0.5
		7:15 - 7:30	2	6	10	1.2	7.2	10.6	0.8	-1.2	-0.6
		7:30 - 7:45	2	5	10	1.8	7.0	10.5	0.2	-2.0	-0.5
		7:45 - 8:00	2	6	10	1.1	7.0	10.6	0.9	-1.0	-0.6

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	7:00 - 7:15	2	7	10	1.1	6.8	10.4	0.9	0.2	-0.4
		7:15 - 7:30	2	6	10	1.5	6.7	10.2	0.5	-0.7	-0.2
		7:30 - 7:45	2	5	10	1.5	7.1	10.3	0.5	-2.1	-0.3
		7:45 - 8:00	2	6	10	1.0	6.9	10.5	1.0	-0.9	-0.5
55	30 to 50	7:00 - 7:15	2	7	10	1.1	6.8	10.5	0.9	0.2	-0.5
		7:15 - 7:30	2	6	10	1.4	6.8	10.3	0.6	-0.8	-0.3
		7:30 - 7:45	2	5	10	1.5	7.1	10.1	0.5	-2.1	-0.1
		7:45 - 8:00	2	6	10	1.0	6.9	10.4	1.0	-0.9	-0.4

Note:

- Approach Speed = 40 mph
- WB Volume = 1260 vph
- Circulating Speed = 16 - 22 mph

Table K-6.a. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - EB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	4	7	14	2.2	6.5	10.1	1.8	0.5	3.9
		4:45 - 5:00	4	10	12	2.3	6.5	9.8	1.7	3.5	2.2
		5:00 - 5:15	4	10	0	2.2	6.4	10.3	1.8	3.6	-10.3
		5:15 - 5:30	4	8	12	2.2	6.4	9.9	1.8	1.6	2.1
30	15 to 35	4:30 - 4:45	4	7	14	2.1	6.3	10.1	1.9	0.7	3.9
		4:45 - 5:00	4	10	12	2.2	6.3	10.0	1.8	3.7	2.0
		5:00 - 5:15	4	10	0	2.1	6.2	10.3	1.9	3.8	-10.3
		5:15 - 5:30	4	8	12	2.1	6.3	10.0	1.9	1.7	2.0
35	20 to 40	4:30 - 4:45	4	7	14	2.0	6.2	9.8	2.0	0.8	4.2
		4:45 - 5:00	4	10	12	2.0	6.1	9.8	2.0	3.9	2.2
		5:00 - 5:15	4	10	0	2.0	6.1	10.0	2.0	3.9	-10.0
		5:15 - 5:30	4	8	12	2.0	6.1	9.9	2.0	1.9	2.1
40 (Existing Condition)	25 to 45	4:30 - 4:45	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
		4:45 - 5:00	4	10	12	1.8	4.3	8.7	2.2	5.7	3.3
		5:00 - 5:15	4	10	0	1.8	4.3	8.3	2.2	5.7	-8.3
		5:15 - 5:30	4	8	12	1.7	4.3	8.9	2.3	3.7	3.1
45	30 to 50	4:30 - 4:45	4	7	14	1.9	6.1	9.7	2.1	0.9	4.3
		4:45 - 5:00	4	10	12	1.9	6.0	9.9	2.1	4.0	2.1
		5:00 - 5:15	4	10	0	1.9	6.1	9.9	2.1	3.9	-9.9
		5:15 - 5:30	4	8	12	2.0	6.0	9.6	2.0	2.0	2.4

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	4	7	14	2.0	6.2	9.8	2.0	0.8	4.2
		4:45 - 5:00	4	10	12	2.0	6.1	9.9	2.0	3.9	2.1
		5:00 - 5:15	4	10	0	1.9	6.1	10.0	2.1	3.9	-10.0
		5:15 - 5:30	4	8	12	1.9	6.0	10.1	2.1	2.0	1.9
55	30 to 50	4:30 - 4:45	4	7	14	2.0	6.2	9.8	2.0	0.8	4.2
		4:45 - 5:00	4	10	12	1.9	6.1	9.7	2.1	3.9	2.3
		5:00 - 5:15	4	10	0	1.9	6.1	10.0	2.1	3.9	-10.0
		5:15 - 5:30	4	8	12	1.9	6.0	10.0	2.1	2.0	2.0

Note:

- Circulating Speed = 16 - 22 mph
- EB Volume = 1759 vph

Table K-6.b. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - NB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	3	6	10	1.7	5.7	10.2	1.3	0.3	-0.2
		4:45 - 5:00	2	5	10	1.7	5.7	9.4	0.3	-0.7	0.6
		5:00 - 5:15	2	7	9	1.6	5.6	9.2	0.4	1.4	-0.2
		5:15 - 5:30	3	5	10	1.7	5.6	9.3	1.3	-0.6	0.7
30	15 to 35	4:30 - 4:45	3	6	10	1.6	5.6	10.0	1.4	0.4	0.0
		4:45 - 5:00	2	5	10	1.6	5.6	9.2	0.4	-0.6	0.8
		5:00 - 5:15	2	7	9	1.5	5.6	9.2	0.5	1.4	-0.2
		5:15 - 5:30	3	5	10	1.6	5.6	9.2	1.4	-0.6	0.8
35	20 to 40	4:30 - 4:45	3	6	10	1.5	5.5	9.8	1.5	0.5	0.2
		4:45 - 5:00	2	5	10	1.4	5.7	9.1	0.6	-0.7	0.9
		5:00 - 5:15	2	7	9	1.4	5.5	9.0	0.6	1.5	0.0
		5:15 - 5:30	3	5	10	1.5	5.6	9.0	1.5	-0.6	1.0
40 (Existing Condition)	25 to 45	4:30 - 4:45	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
		4:45 - 5:00	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
		5:00 - 5:15	2	7	9	1.4	5.4	9.0	0.6	1.6	0.0
		5:15 - 5:30	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
45	30 to 50	4:30 - 4:45	3	6	10	1.5	5.6	9.8	1.5	0.4	0.2
		4:45 - 5:00	2	5	10	1.4	5.6	9.1	0.6	-0.6	0.9
		5:00 - 5:15	2	7	9	1.4	5.5	9.0	0.6	1.5	0.0
		5:15 - 5:30	3	5	10	1.5	5.6	9.0	1.5	-0.6	1.0

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	3	6	10	1.5	5.6	9.9	1.5	0.4	0.1
		4:45 - 5:00	2	5	10	1.4	5.5	9.1	0.6	-0.5	0.9
		5:00 - 5:15	2	7	9	1.4	5.5	9.0	0.6	1.5	0.0
		5:15 - 5:30	3	5	10	1.5	5.6	9.0	1.5	-0.6	1.0
55	30 to 50	4:30 - 4:45	3	6	10	1.5	5.5	9.8	1.5	0.5	0.2
		4:45 - 5:00	2	5	10	1.4	5.5	9.1	0.6	-0.5	0.9
		5:00 - 5:15	2	7	9	1.4	5.6	9.0	0.6	1.4	0.0
		5:15 - 5:30	3	5	10	1.5	5.6	9.0	1.5	-0.6	1.0

Note:

- Circulating Speed = 16 - 22 mph
- NB Volume = 1759 vph

Table K-6.c. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - SB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	3	6	10	3.1	7.0	10.3	-0.1	-1.0	-0.3
		4:45 - 5:00	3	6	10	2.6	7.1	9.3	0.4	-1.1	0.7
		5:00 - 5:15	3	8	10	2.9	7.0	10.1	0.1	1.0	-0.1
		5:15 - 5:30	3	7	13	2.7	7.0	10.1	0.3	0.0	2.9
30	15 to 35	4:30 - 4:45	3	6	10	3.0	7.0	10.1	0.0	-1.0	-0.1
		4:45 - 5:00	3	6	10	2.5	7.1	9.2	0.5	-1.1	0.8
		5:00 - 5:15	3	8	10	2.9	7.0	9.9	0.1	1.0	0.1
		5:15 - 5:30	3	7	13	2.5	7.1	9.8	0.5	-0.1	3.2
35	20 to 40	4:30 - 4:45	3	6	10	2.7	7.0	9.9	0.3	-1.0	0.1
		4:45 - 5:00	3	6	10	2.6	7.0	9.0	0.4	-1.0	1.0
		5:00 - 5:15	3	8	10	2.7	7.0	9.9	0.3	1.0	0.1
		5:15 - 5:30	3	7	13	2.6	7.0	9.8	0.4	0.0	3.2
40 (Existing Condition)	25 to 45	4:30 - 4:45	3	6	10	2.4	6.9	9.5	0.6	-0.9	0.5
		4:45 - 5:00	3	6	10	2.4	7.0	8.6	0.6	-1.0	1.4
		5:00 - 5:15	3	8	10	2.3	6.8	8.8	0.7	1.2	1.2
		5:15 - 5:30	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
45	30 to 50	4:30 - 4:45	3	6	10	2.7	7.0	10.0	0.3	-1.0	0.0
		4:45 - 5:00	3	6	10	2.1	7.1	9.1	0.9	-1.1	0.9
		5:00 - 5:15	3	8	10	2.7	7.0	10.0	0.3	1.0	0.0
		5:15 - 5:30	3	7	13	2.5	7.1	10.0	0.5	-0.1	3.0

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	3	6	10	2.8	7.1	10.0	0.2	-1.1	0.0
		4:45 - 5:00	3	6	10	2.2	7.2	9.1	0.8	-1.2	0.9
		5:00 - 5:15	3	8	10	2.9	7.1	9.7	0.1	0.9	0.3
		5:15 - 5:30	3	7	13	2.5	7.2	10.3	0.5	-0.2	2.7
55	30 to 50	4:30 - 4:45	3	6	10	2.9	7.1	9.9	0.1	-1.1	0.1
		4:45 - 5:00	3	6	10	2.5	7.1	9.0	0.5	-1.1	1.0
		5:00 - 5:15	3	8	10	2.9	7.0	10.0	0.1	1.0	0.0
		5:15 - 5:30	3	7	13	2.5	7.0	9.9	0.5	0.0	3.1

Note:

- Circulating Speed = 16 - 22 mph
- SB Volume = 1759 vph

Table K-6.d. Salem Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - WB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	2	7	10	3.2	7.6	11.9	-1.2	-0.6	-1.9
		4:45 - 5:00	2	6	10	3.6	11.0	12.4	-1.6	-5.0	-2.4
		5:00 - 5:15	2	5	10	2.5	10.5	12.2	-0.5	-5.5	-2.2
		5:15 - 5:30	2	6	10	2.8	11.8	12.5	-0.8	-5.8	-2.5
30	15 to 35	4:30 - 4:45	2	7	10	2.9	7.8	12.3	-0.9	-0.8	-2.3
		4:45 - 5:00	2	6	10	4.0	10.3	12.8	-2.0	-4.3	-2.8
		5:00 - 5:15	2	5	10	2.2	10.5	12.4	-0.2	-5.5	-2.4
		5:15 - 5:30	2	6	10	2.9	12.5	11.6	-0.9	-6.5	-1.6
35	20 to 40	4:30 - 4:45	2	7	10	3.2	7.9	12.4	-1.2	-0.9	-2.4
		4:45 - 5:00	2	6	10	4.4	11.1	12.1	-2.4	-5.1	-2.1
		5:00 - 5:15	2	5	10	2.9	10.7	12.0	-0.9	-5.7	-2.0
		5:15 - 5:30	2	6	10	2.9	10.8	12.0	-0.9	-4.8	-2.0
40 (Existing Condition)	25 to 45	4:30 - 4:45	2	7	10	1.4	6.9	10.8	0.6	0.1	-0.8
		4:45 - 5:00	2	6	10	1.4	7.5	10.9	0.6	-1.5	-0.9
		5:00 - 5:15	2	5	10	2.5	7.3	10.5	-0.5	-2.3	-0.5
		5:15 - 5:30	2	6	10	1.2	7.2	10.6	0.8	-1.2	-0.6
45	30 to 50	4:30 - 4:45	2	7	10	3.4	7.8	12.1	-1.4	-0.8	-2.1
		4:45 - 5:00	2	6	10	3.3	12.7	12.4	-1.3	-6.7	-2.4
		5:00 - 5:15	2	5	10	3.0	10.8	11.9	-1.0	-5.8	-1.9
		5:15 - 5:30	2	6	10	2.5	11.6	12.0	-0.5	-5.6	-2.0

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	2	7	10	3.3	7.6	12.0	-1.3	-0.6	-2.0
		4:45 - 5:00	2	6	10	3.3	10.8	12.7	-1.3	-4.8	-2.7
		5:00 - 5:15	2	5	10	2.3	11.6	12.2	-0.3	-6.6	-2.2
		5:15 - 5:30	2	6	10	2.9	11.1	12.0	-0.9	-5.1	-2.0
55	30 to 50	4:30 - 4:45	2	7	10	3.0	7.7	12.1	-1.0	-0.7	-2.1
		4:45 - 5:00	2	6	10	2.9	12.3	12.3	-0.9	-6.3	-2.3
		5:00 - 5:15	2	5	10	2.2	10.9	12.4	-0.2	-5.9	-2.4
		5:15 - 5:30	2	6	10	3.1	10.9	12.1	-1.1	-4.9	-2.1

Note:

- Circulating Speed = 16 - 22 mph
- WB Volume = 1759 vph

Table K-7.a. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - EB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	5 to 25	4:30 - 4:45	4	7	14	2.0	8.8	14.1	2.0	-1.8	-0.1
		4:45 - 5:00	4	10	12	2.0	8.8	14.1	2.0	1.2	-2.1
		5:00 - 5:15	4	10	0	2.0	8.9	14.9	2.0	1.1	-14.9
		5:15 - 5:30	4	8	12	2.0	8.8	14.5	2.0	-0.8	-2.5
15	5 to 25	4:30 - 4:45	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
		4:45 - 5:00	4	10	12	1.8	4.3	8.7	2.2	5.7	3.3
		5:00 - 5:15	4	10	0	1.8	4.3	8.3	2.2	5.7	-8.3
		5:15 - 5:30	4	8	12	1.7	4.3	8.9	2.3	3.7	3.1
20	5 to 25	4:30 - 4:45	4	7	14	1.9	5.6	9.0	2.1	1.4	5.0
		4:45 - 5:00	4	10	12	1.9	5.6	9.1	2.1	4.4	2.9
		5:00 - 5:15	4	10	0	1.8	5.5	9.1	2.2	4.5	-9.1
		5:15 - 5:30	4	8	12	1.9	5.5	9.1	2.1	2.5	2.9
25	5 to 25	4:30 - 4:45	4	7	14	2.0	5.0	8.0	2.0	2.0	6.0
		4:45 - 5:00	4	10	12	1.9	5.0	7.8	2.1	5.0	4.2
		5:00 - 5:15	4	10	0	1.9	5.0	8.4	2.1	5.0	-8.4
		5:15 - 5:30	4	8	12	1.9	5.0	7.9	2.1	3.0	4.1
30	5 to 25	4:30 - 4:45	4	7	14	2.0	4.7	7.2	2.0	2.3	6.8
		4:45 - 5:00	4	10	12	2.0	4.5	7.3	2.0	5.5	4.7
		5:00 - 5:15	4	10	0	1.9	4.6	7.6	2.1	5.4	-7.6
		5:15 - 5:30	4	8	12	1.9	4.6	7.1	2.1	3.4	4.9

Note:

- Approach Speed = 40 mph
- EB Volume = 1759 vph
- **Circulating Speed: 16 to 20 mph (Existing condition)**

Table K-7.b. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - NB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	5 to 25	4:30 - 4:45	3	6	10	1.8	8.2	10.3	1.2	-2.2	-0.3
		4:45 - 5:00	2	5	10	1.8	8.4	14.8	0.2	-3.4	-4.8
		5:00 - 5:15	2	7	9	1.7	8.3	14.9	0.3	-1.3	-5.9
		5:15 - 5:30	3	5	10	1.7	8.2	14.9	1.3	-3.2	-4.9
15	5 to 25	4:30 - 4:45	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
		4:45 - 5:00	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
		5:00 - 5:15	2	7	9	1.4	5.4	9.0	0.6	1.6	0.0
		5:15 - 5:30	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
20	5 to 25	4:30 - 4:45	3	6	10	1.4	5.0	8.9	1.6	1.0	1.1
		4:45 - 5:00	2	5	10	1.4	5.1	8.2	0.6	-0.1	1.8
		5:00 - 5:15	2	7	9	1.4	5.1	8.2	0.6	1.9	0.8
		5:15 - 5:30	3	5	10	1.4	5.1	8.2	1.6	-0.1	1.8
25	5 to 25	4:30 - 4:45	3	6	10	1.4	4.4	7.6	1.6	1.6	2.4
		4:45 - 5:00	2	5	10	1.4	4.4	7.0	0.6	0.6	3.0
		5:00 - 5:15	2	7	9	1.3	4.4	6.9	0.7	2.6	2.1
		5:15 - 5:30	3	5	10	1.5	4.4	7.0	1.5	0.6	3.0
30	5 to 25	4:30 - 4:45	3	6	10	1.4	4.0	6.8	1.6	2.0	3.2
		4:45 - 5:00	2	5	10	1.3	4.0	6.3	0.7	1.0	3.7
		5:00 - 5:15	2	7	9	1.3	3.9	6.2	0.7	3.1	2.8
		5:15 - 5:30	3	5	10	1.4	4.1	6.2	1.6	0.9	3.8

Note:

- Approach Speed = 40 mph
- NB Volume = 1759 vph
- **Circulating Speed: 16 to 20 mph (Existing condition)**

Table K-7.c. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - SB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	5 to 25	4:30 - 4:45	3	6	10	3.6	11.6	10.1	-0.6	-5.6	-0.1
		4:45 - 5:00	3	6	10	2.9	11.5	15.1	0.1	-5.5	-5.1
		5:00 - 5:15	3	8	10	2.9	10.6	13.0	0.1	-2.6	-3.0
		5:15 - 5:30	3	7	13	3.2	11.6	14.3	-0.2	-4.6	-1.3
15	5 to 25	4:30 - 4:45	3	6	10	2.4	6.9	9.5	0.6	-0.9	0.5
		4:45 - 5:00	3	6	10	2.4	7.0	8.6	0.6	-1.0	1.4
		5:00 - 5:15	3	8	10	2.3	6.8	8.8	0.7	1.2	1.2
		5:15 - 5:30	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
20	5 to 25	4:30 - 4:45	3	6	10	2.7	6.6	9.0	0.3	-0.6	1.0
		4:45 - 5:00	3	6	10	2.4	6.6	8.2	0.6	-0.6	1.8
		5:00 - 5:15	3	8	10	2.7	6.3	8.8	0.3	1.7	1.2
		5:15 - 5:30	3	7	13	2.4	6.5	8.7	0.6	0.5	4.3
25	5 to 25	4:30 - 4:45	3	6	10	2.9	5.7	7.6	0.1	0.3	2.4
		4:45 - 5:00	3	6	10	2.4	5.8	7.2	0.6	0.2	2.8
		5:00 - 5:15	3	8	10	2.7	5.8	7.6	0.3	2.2	2.4
		5:15 - 5:30	3	7	13	2.4	5.6	7.6	0.6	1.4	5.4
30	5 to 25	4:30 - 4:45	3	6	10	3.0	5.2	6.9	0.0	0.8	3.1
		4:45 - 5:00	3	6	10	2.3	5.4	6.6	0.7	0.6	3.4
		5:00 - 5:15	3	8	10	2.8	5.3	7.0	0.2	2.7	3.0
		5:15 - 5:30	3	7	13	2.2	5.2	6.8	0.8	1.8	6.2

Note:

- Approach Speed = 40 mph
- SB Volume = 1759 vph
- **Circulating Speed: 16 to 20 mph (Existing condition)**

Table K-7.d. Salem Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - WB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	5 to 25	4:30 - 4:45	2	7	10	3.6	13.1	19.3	-1.6	-6.1	-9.3
		4:45 - 5:00	2	6	10	4.9	27.2	19.0	-2.9	-21.2	-9.0
		5:00 - 5:15	2	5	10	2.5	26.7	19.1	-0.5	-21.7	-9.1
		5:15 - 5:30	2	6	10	3.5	25.8	19.4	-1.5	-19.8	-9.4
15	5 to 25	4:30 - 4:45	2	7	10	1.4	6.9	10.8	0.6	0.1	-0.8
		4:45 - 5:00	2	6	10	1.4	7.5	10.9	0.6	-1.5	-0.9
		5:00 - 5:15	2	5	10	2.5	7.3	10.5	-0.5	-2.3	-0.5
		5:15 - 5:30	2	6	10	1.2	7.2	10.6	0.8	-1.2	-0.6
20	5 to 25	4:30 - 4:45	2	7	10	3.0	7.2	10.5	-1.0	-0.2	-0.5
		4:45 - 5:00	2	6	10	2.9	10.1	10.9	-0.9	-4.1	-0.9
		5:00 - 5:15	2	5	10	2.6	9.2	10.8	-0.6	-4.2	-0.8
		5:15 - 5:30	2	6	10	2.8	10.2	10.5	-0.8	-4.2	-0.5
25	5 to 25	4:30 - 4:45	2	7	10	3.1	6.1	9.2	-1.1	0.9	0.8
		4:45 - 5:00	2	6	10	2.9	8.4	9.7	-0.9	-2.4	0.3
		5:00 - 5:15	2	5	10	1.8	8.2	9.1	0.2	-3.2	0.9
		5:15 - 5:30	2	6	10	2.3	9.0	9.3	-0.3	-3.0	0.7
30	5 to 25	4:30 - 4:45	2	7	10	2.8	5.6	8.2	-0.8	1.4	1.8
		4:45 - 5:00	2	6	10	3.1	7.8	9.0	-1.1	-1.8	1.0
		5:00 - 5:15	2	5	10	2.5	7.4	8.2	-0.5	-2.4	1.8
		5:15 - 5:30	2	6	10	2.4	8.0	8.3	-0.4	-2.0	1.7

Note:

- Approach Speed = 40 mph
- WB Volume = 1759 vph
- **Circulating Speed: 16 to 20 mph (Existing condition)**

Table K-8.a. Salem Roundabout - Critical Gap (seconds) vs. Travel Time (seconds) – PM - EB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-1	4:30 - 4:45	4	7	14	1.8	6.0	10.1	2.2	1.0	3.9
	4:45 - 5:00	4	10	12	1.8	6.0	9.9	2.2	4.0	2.1
	5:00 - 5:15	4	10	0	1.8	5.9	10.0	2.2	4.1	-10.0
	5:15 - 5:30	4	8	12	1.8	5.9	10.4	2.2	2.1	1.6
1	4:30 - 4:45	4	7	14	2.0	6.1	9.9	2.0	0.9	4.1
	4:45 - 5:00	4	10	12	1.9	6.1	10.3	2.1	3.9	1.7
	5:00 - 5:15	4	10	0	1.9	6.1	10.1	2.1	3.9	-10.1
	5:15 - 5:30	4	8	12	2.0	6.1	9.8	2.0	1.9	2.2
2	4:30 - 4:45	4	7	14	2.1	6.3	10.3	1.9	0.7	3.7
	4:45 - 5:00	4	10	12	2.1	6.3	9.8	1.9	3.7	2.2
	5:00 - 5:15	4	10	0	2.1	6.2	10.0	1.9	3.8	-10.0
	5:15 - 5:30	4	8	12	2.1	6.4	10.0	1.9	1.6	2.0
3	4:30 - 4:45	4	7	14	2.1	6.3	9.5	1.9	0.7	4.5
	4:45 - 5:00	4	10	12	2.1	6.3	10.0	1.9	3.7	2.0
	5:00 - 5:15	4	10	0	2.1	6.4	9.7	1.9	3.6	-9.7
	5:15 - 5:30	4	8	12	2.1	6.3	9.8	1.9	1.7	2.2

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- EB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-8.b. Salem Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - NB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-1	4:30 - 4:45	3	6	10	1.4	5.5	9.9	1.6	0.5	0.1
	4:45 - 5:00	2	5	10	1.4	5.5	9.0	0.6	-0.5	1.0
	5:00 - 5:15	2	7	9	1.3	5.6	9.0	0.7	1.4	0.0
	5:15 - 5:30	3	5	10	1.4	5.5	9.0	1.6	-0.5	1.0
1	4:30 - 4:45	3	6	10	1.4	5.5	10.0	1.6	0.5	0.0
	4:45 - 5:00	2	5	10	1.4	5.5	9.1	0.6	-0.5	0.9
	5:00 - 5:15	2	7	9	1.4	5.5	9.0	0.6	1.5	0.0
	5:15 - 5:30	3	5	10	1.5	5.5	9.0	1.5	-0.5	1.0
2	4:30 - 4:45	3	6	10	1.6	5.5	9.9	1.4	0.5	0.1
	4:45 - 5:00	2	5	10	1.5	5.5	9.2	0.5	-0.5	0.8
	5:00 - 5:15	2	7	9	1.5	5.5	9.1	0.5	1.5	-0.1
	5:15 - 5:30	3	5	10	1.5	5.5	9.2	1.5	-0.5	0.8
3	4:30 - 4:45	3	6	10	1.7	5.5	10.0	1.3	0.5	0.0
	4:45 - 5:00	2	5	10	1.6	5.4	9.3	0.4	-0.4	0.7
	5:00 - 5:15	2	7	9	1.6	5.4	9.2	0.4	1.6	-0.2
	5:15 - 5:30	3	5	10	1.7	5.4	9.2	1.3	-0.4	0.8

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- NB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-8.c. Salem Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - SB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-1	4:30 - 4:45	3	6	10	2.8	7.3	10.0	0.2	-1.3	0.0
	4:45 - 5:00	3	6	10	2.4	7.3	9.2	0.6	-1.3	0.8
	5:00 - 5:15	3	8	10	2.5	7.1	10.0	0.5	0.9	0.0
	5:15 - 5:30	3	7	13	2.6	7.2	9.9	0.4	-0.2	3.1
1	4:30 - 4:45	3	6	10	3.0	7.1	10.1	0.0	-1.1	-0.1
	4:45 - 5:00	3	6	10	2.4	7.2	9.0	0.6	-1.2	1.0
	5:00 - 5:15	3	8	10	3.0	7.1	10.0	0.0	0.9	0.0
	5:15 - 5:30	3	7	13	2.6	7.1	10.0	0.4	-0.1	3.0
2	4:30 - 4:45	3	6	10	2.8	6.8	9.9	0.2	-0.8	0.1
	4:45 - 5:00	3	6	10	2.1	7.0	8.2	0.9	-1.0	1.8
	5:00 - 5:15	3	8	10	2.6	6.9	9.9	0.4	1.1	0.1
	5:15 - 5:30	3	7	13	2.4	7.0	9.0	0.6	0.0	4.0
3	4:30 - 4:45	3	6	10	1.9	7.0	10.0	1.1	-1.0	0.0
	4:45 - 5:00	3	6	10	1.8	6.0	8.9	1.2	0.0	1.1
	5:00 - 5:15	3	8	10	2.6	6.7	10.0	0.4	1.3	0.0
	5:15 - 5:30	3	7	13	2.2	6.9	8.9	0.8	0.1	4.1

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- SB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-8.d. Salem Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - WB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-1	4:30 - 4:45	2	7	10	3.3	7.7	11.8	-1.3	-0.7	-1.8
	4:45 - 5:00	2	6	10	4.3	10.2	12.3	-2.3	-4.2	-2.3
	5:00 - 5:15	2	5	10	2.4	9.3	11.9	-0.4	-4.3	-1.9
	5:15 - 5:30	2	6	10	2.7	10.2	11.9	-0.7	-4.2	-1.9
1	4:30 - 4:45	2	7	10	2.9	7.9	11.6	-0.9	-0.9	-1.6
	4:45 - 5:00	2	6	10	3.1	12.8	11.6	-1.1	-6.8	-1.6
	5:00 - 5:15	2	5	10	2.3	11.4	11.8	-0.3	-6.4	-1.8
	5:15 - 5:30	2	6	10	2.8	11.5	11.9	-0.8	-5.5	-1.9
2	4:30 - 4:45	2	7	10	3.6	7.8	11.4	-1.6	-0.8	-1.4
	4:45 - 5:00	2	6	10	4.0	16.7	12.0	-2.0	-10.7	-2.0
	5:00 - 5:15	2	5	10	3.1	15.2	11.8	-1.1	-10.2	-1.8
	5:15 - 5:30	2	6	10	2.9	15.2	11.7	-0.9	-9.2	-1.7
3	4:30 - 4:45	2	7	10	3.5	8.5	11.3	-1.5	-1.5	-1.3
	4:45 - 5:00	2	6	10	3.3	21.0	11.9	-1.3	-15.0	-1.9
	5:00 - 5:15	2	5	10	2.7	19.5	11.6	-0.7	-14.5	-1.6
	5:15 - 5:30	2	6	10	2.6	20.6	11.7	-0.6	-14.6	-1.7

Note:

- **Critical Gap: EB = 3.6s, WB=3.8s, SB=3.8s, NB=3.8 (Existing condition)**
- Approach Speed = 40 mph
- WB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-9.a. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - EB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-30	4:30 - 4:45	4	7	14	1.9	6.0	10.1	2.1	1.0	3.9
	4:45 - 5:00	4	10	12	1.9	5.9	10.1	2.1	4.1	1.9
	5:00 - 5:15	4	10	0	1.8	6.0	10.3	2.2	4.0	-10.3
	5:15 - 5:30	4	8	12	1.8	6.0	10.4	2.2	2.0	1.6
-20	4:30 - 4:45	4	7	14	1.9	6.0	10.0	2.1	1.0	4.0
	4:45 - 5:00	4	10	12	1.9	6.0	10.0	2.1	4.0	2.0
	5:00 - 5:15	4	10	0	1.8	6.0	10.2	2.2	4.0	-10.2
	5:15 - 5:30	4	8	12	1.8	5.9	10.3	2.2	2.1	1.7
-10	4:30 - 4:45	4	7	14	1.9	6.0	10.1	2.1	1.0	3.9
	4:45 - 5:00	4	10	12	1.9	6.0	9.9	2.1	4.0	2.1
	5:00 - 5:15	4	10	0	1.8	6.0	10.3	2.2	4.0	-10.3
	5:15 - 5:30	4	8	12	1.8	5.9	10.2	2.2	2.1	1.8
+10	4:30 - 4:45	4	7	14	1.9	6.1	9.9	2.1	0.9	4.1
	4:45 - 5:00	4	10	12	1.8	6.1	10.0	2.2	3.9	2.0
	5:00 - 5:15	4	10	0	1.8	6.0	9.9	2.2	4.0	-9.9
	5:15 - 5:30	4	8	12	1.8	6.0	9.9	2.2	2.0	2.1
+20	4:30 - 4:45	4	7	14	2.0	6.2	9.8	2.0	0.8	4.2
	4:45 - 5:00	4	10	12	1.9	6.1	10.0	2.1	3.9	2.0
	5:00 - 5:15	4	10	0	1.9	6.1	10.0	2.1	3.9	-10.0
	5:15 - 5:30	4	8	12	1.9	6.0	9.7	2.1	2.0	2.3

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- EB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-9.b. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - NB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-30	4:30 - 4:45	3	6	10	1.3	5.5	9.9	1.7	0.5	0.1
	4:45 - 5:00	2	5	10	1.3	5.6	9.0	0.7	-0.6	1.0
	5:00 - 5:15	2	7	9	1.3	5.5	9.0	0.7	1.5	0.0
	5:15 - 5:30	3	5	10	1.4	5.5	8.9	1.6	-0.5	1.1
-20	4:30 - 4:45	3	6	10	1.3	5.5	10.0	1.7	0.5	0.0
	4:45 - 5:00	2	5	10	1.4	5.6	9.0	0.6	-0.6	1.0
	5:00 - 5:15	2	7	9	1.4	5.5	8.9	0.6	1.5	0.1
	5:15 - 5:30	3	5	10	1.4	5.4	9.0	1.6	-0.4	1.0
-10	4:30 - 4:45	3	6	10	1.3	5.5	9.9	1.7	0.5	0.1
	4:45 - 5:00	2	5	10	1.3	5.6	9.0	0.7	-0.6	1.0
	5:00 - 5:15	2	7	9	1.3	5.5	9.0	0.7	1.5	0.0
	5:15 - 5:30	3	5	10	1.4	5.4	9.0	1.6	-0.4	1.0
+10	4:30 - 4:45	3	6	10	1.5	5.5	10.0	1.5	0.5	0.0
	4:45 - 5:00	2	5	10	1.4	5.6	9.1	0.6	-0.6	0.9
	5:00 - 5:15	2	7	9	1.4	5.6	9.0	0.6	1.4	0.0
	5:15 - 5:30	3	5	10	1.5	5.5	9.0	1.5	-0.5	1.0
+20	4:30 - 4:45	3	6	10	1.5	5.6	10.0	1.5	0.4	0.0
	4:45 - 5:00	2	5	10	1.5	5.6	9.1	0.5	-0.6	0.9
	5:00 - 5:15	2	7	9	1.4	5.6	9.0	0.6	1.4	0.0
	5:15 - 5:30	3	5	10	1.5	5.5	9.0	1.5	-0.5	1.0

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- NB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-9.c. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - SB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-30	4:30 - 4:45	3	6	10	2.8	7.2	10.0	0.2	-1.2	0.0
	4:45 - 5:00	3	6	10	2.3	7.3	9.0	0.7	-1.3	1.0
	5:00 - 5:15	3	8	10	2.8	7.0	9.9	0.2	1.0	0.1
	5:15 - 5:30	3	7	13	2.5	7.3	10.0	0.5	-0.3	3.0
-20	4:30 - 4:45	3	6	10	2.8	7.2	10.1	0.2	-1.2	-0.1
	4:45 - 5:00	3	6	10	2.2	7.3	9.0	0.8	-1.3	1.0
	5:00 - 5:15	3	8	10	2.8	7.0	9.8	0.2	1.0	0.2
	5:15 - 5:30	3	7	13	2.5	7.3	9.9	0.5	-0.3	3.1
-10	4:30 - 4:45	3	6	10	2.8	7.3	10.0	0.2	-1.3	0.0
	4:45 - 5:00	3	6	10	2.4	7.3	9.0	0.6	-1.3	1.0
	5:00 - 5:15	3	8	10	2.8	7.0	9.8	0.2	1.0	0.2
	5:15 - 5:30	3	7	13	2.6	7.3	9.9	0.4	-0.3	3.1
+10	4:30 - 4:45	3	6	10	3.0	7.1	10.1	0.0	-1.1	-0.1
	4:45 - 5:00	3	6	10	2.5	7.2	9.0	0.5	-1.2	1.0
	5:00 - 5:15	3	8	10	2.8	7.0	10.1	0.2	1.0	-0.1
	5:15 - 5:30	3	7	13	2.5	7.1	9.9	0.5	-0.1	3.1
+20	4:30 - 4:45	3	6	10	2.7	7.0	10.1	0.3	-1.0	-0.1
	4:45 - 5:00	3	6	10	2.3	7.1	9.0	0.7	-1.1	1.0
	5:00 - 5:15	3	8	10	2.8	6.9	9.8	0.2	1.1	0.2
	5:15 - 5:30	3	7	13	2.7	7.1	9.9	0.3	-0.1	3.1

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- SB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-9.d. Salem Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - WB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-30	4:30 - 4:45	2	7	10	3.3	7.3	11.4	-1.3	-0.3	-1.4
	4:45 - 5:00	2	6	10	3.7	9.1	11.5	-1.7	-3.1	-1.5
	5:00 - 5:15	2	5	10	2.3	8.9	11.7	-0.3	-3.9	-1.7
	5:15 - 5:30	2	6	10	2.9	9.6	11.5	-0.9	-3.6	-1.5
-20	4:30 - 4:45	2	7	10	3.6	7.4	11.5	-1.6	-0.4	-1.5
	4:45 - 5:00	2	6	10	3.6	9.2	11.4	-1.6	-3.2	-1.4
	5:00 - 5:15	2	5	10	2.2	8.6	11.7	-0.2	-3.6	-1.7
	5:15 - 5:30	2	6	10	2.9	9.9	11.4	-0.9	-3.9	-1.4
-10	4:30 - 4:45	2	7	10	3.2	7.4	11.6	-1.2	-0.4	-1.6
	4:45 - 5:00	2	6	10	3.6	9.6	11.6	-1.6	-3.6	-1.6
	5:00 - 5:15	2	5	10	2.3	8.9	11.5	-0.3	-3.9	-1.5
	5:15 - 5:30	2	6	10	2.8	10.0	11.6	-0.8	-4.0	-1.6
+10	4:30 - 4:45	2	7	10	3.4	7.6	11.9	-1.4	-0.6	-1.9
	4:45 - 5:00	2	6	10	3.7	11.5	11.9	-1.7	-5.5	-1.9
	5:00 - 5:15	2	5	10	2.4	10.0	11.7	-0.4	-5.0	-1.7
	5:15 - 5:30	2	6	10	2.7	11.5	11.7	-0.7	-5.5	-1.7
+20	4:30 - 4:45	2	7	10	3.8	7.8	12.1	-1.8	-0.8	-2.1
	4:45 - 5:00	2	6	10	3.9	12.4	12.0	-1.9	-6.4	-2.0
	5:00 - 5:15	2	5	10	2.4	11.2	11.7	-0.4	-6.2	-1.7
	5:15 - 5:30	2	6	10	2.9	11.9	12.4	-0.9	-5.9	-2.4

Note:

- **Min Headway Distance: EB=112 ft, WB=106 ft, SB=106 ft, NB=106 ft (Existing condition)**
- Approach Speed = 40 mph
- WB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-10.a. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - EB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	4	7	14	2.1	6.4	10.1	1.9	0.6	3.9
		4:45 - 5:00	4	10	12	2.1	6.3	9.7	1.9	3.7	2.3
		5:00 - 5:15	4	10	0	2.1	6.3	9.8	1.9	3.7	-9.8
		5:15 - 5:30	4	8	12	2.1	6.3	9.7	1.9	1.7	2.3
30 (Existing condition)	15 to 35	4:30 - 4:45	4	7	14	2.0	6.2	9.9	2.0	0.8	4.1
		4:45 - 5:00	4	10	12	2.1	6.2	9.8	1.9	3.8	2.2
		5:00 - 5:15	4	10	0	2.0	6.2	10.1	2.0	3.8	-10.1
		5:15 - 5:30	4	8	12	2.0	6.2	9.8	2.0	1.8	2.2
35	20 to 40	4:30 - 4:45	4	7	14	2.0	6.2	9.9	2.0	0.8	4.1
		4:45 - 5:00	4	10	12	2.1	6.2	9.8	1.9	3.8	2.2
		5:00 - 5:15	4	10	0	2.0	6.2	10.1	2.0	3.8	-10.1
		5:15 - 5:30	4	8	12	2.0	6.2	9.8	2.0	1.8	2.2
40	25 to 45	4:30 - 4:45	4	7	14	1.8	4.4	7.9	2.2	2.6	6.1
		4:45 - 5:00	4	10	12	1.8	4.3	8.7	2.2	5.7	3.3
		5:00 - 5:15	4	10	0	1.8	4.3	8.3	2.2	5.7	-8.3
		5:15 - 5:30	4	8	12	1.7	4.3	8.9	2.3	3.7	3.1
45	30 to 50	4:30 - 4:45	4	7	14	1.8	6.0	10.4	2.2	1.0	3.6
		4:45 - 5:00	4	10	12	1.8	6.0	9.8	2.2	4.0	2.2
		5:00 - 5:15	4	10	0	1.8	5.9	9.9	2.2	4.1	-9.9
		5:15 - 5:30	4	8	12	1.8	6.0	10.1	2.2	2.0	1.9

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	4	7	14	1.8	5.9	9.6	2.2	1.1	4.4
		4:45 - 5:00	4	10	12	1.8	5.9	9.6	2.2	4.1	2.4
		5:00 - 5:15	4	10	0	1.7	5.8	9.8	2.3	4.2	-9.8
		5:15 - 5:30	4	8	12	1.7	5.9	10.1	2.3	2.1	1.9
55	30 to 50	4:30 - 4:45	4	7	14	1.7	5.9	9.5	2.3	1.1	4.5
		4:45 - 5:00	4	10	12	1.7	5.7	9.6	2.3	4.3	2.4
		5:00 - 5:15	4	10	0	1.7	5.8	9.7	2.3	4.2	-9.7
		5:15 - 5:30	4	8	12	1.7	5.8	9.7	2.3	2.2	2.3

Note:

- Approach Speed = 40 mph
- EB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-10.b. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - NB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	3	6	10	1.7	5.6	10.2	1.3	0.4	-0.2
		4:45 - 5:00	2	5	10	1.7	5.5	9.3	0.3	-0.5	0.7
		5:00 - 5:15	2	7	9	1.6	5.5	9.2	0.4	1.5	-0.2
		5:15 - 5:30	3	5	10	1.7	5.5	9.2	1.3	-0.5	0.8
30 (Existing condition)	15 to 35	4:30 - 4:45	3	6	10	1.6	5.6	9.9	1.4	0.4	0.1
		4:45 - 5:00	2	5	10	1.5	5.7	9.3	0.5	-0.7	0.7
		5:00 - 5:15	2	7	9	1.5	5.6	9.3	0.5	1.4	-0.3
		5:15 - 5:30	3	5	10	1.5	5.6	9.3	1.5	-0.6	0.7
35	20 to 40	4:30 - 4:45	3	6	10	1.6	5.6	9.9	1.4	0.4	0.1
		4:45 - 5:00	2	5	10	1.5	5.7	9.3	0.5	-0.7	0.7
		5:00 - 5:15	2	7	9	1.5	5.6	9.3	0.5	1.4	-0.3
		5:15 - 5:30	3	5	10	1.5	5.6	9.3	1.5	-0.6	0.7
40	25 to 45	4:30 - 4:45	3	6	10	1.4	5.4	9.5	1.6	0.6	0.5
		4:45 - 5:00	2	5	10	1.4	5.4	9.1	0.6	-0.4	0.9
		5:00 - 5:15	2	7	9	1.4	5.4	9.0	0.6	1.6	0.0
		5:15 - 5:30	3	5	10	1.4	5.3	9.1	1.6	-0.3	0.9
45	30 to 50	4:30 - 4:45	3	6	10	1.4	5.4	9.8	1.6	0.6	0.2
		4:45 - 5:00	2	5	10	1.3	5.5	8.9	0.7	-0.5	1.1
		5:00 - 5:15	2	7	9	1.3	5.4	8.8	0.7	1.6	0.2
		5:15 - 5:30	3	5	10	1.4	5.5	8.9	1.6	-0.5	1.1

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	3	6	10	1.3	5.4	9.8	1.7	0.6	0.2
		4:45 - 5:00	2	5	10	1.3	5.4	8.8	0.7	-0.4	1.2
		5:00 - 5:15	2	7	9	1.2	5.3	8.7	0.8	1.7	0.3
		5:15 - 5:30	3	5	10	1.5	5.3	8.8	1.5	-0.3	1.2
55	30 to 50	4:30 - 4:45	3	6	10	1.3	5.2	9.5	1.7	0.8	0.5
		4:45 - 5:00	2	5	10	1.3	5.3	8.8	0.7	-0.3	1.2
		5:00 - 5:15	2	7	9	1.2	5.2	8.7	0.8	1.8	0.3
		5:15 - 5:30	3	5	10	1.3	5.2	8.8	1.7	-0.2	1.2

Note:

- Approach Speed = 40 mph
- NB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-10.c. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - SB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	3	6	10	3.0	7.2	10.3	0.0	-1.2	-0.3
		4:45 - 5:00	3	6	10	2.5	7.1	9.4	0.5	-1.1	0.6
		5:00 - 5:15	3	8	10	2.9	7.0	10.0	0.1	1.0	0.0
		5:15 - 5:30	3	7	13	2.6	7.1	10.1	0.4	-0.1	2.9
30 (Existing condition)	15 to 35	4:30 - 4:45	3	6	10	3.0	7.0	10.0	0.0	-1.0	0.0
		4:45 - 5:00	3	6	10	2.7	7.2	9.2	0.3	-1.2	0.8
		5:00 - 5:15	3	8	10	2.9	7.0	9.9	0.1	1.0	0.1
		5:15 - 5:30	3	7	13	2.5	7.0	10.0	0.5	0.0	3.0
35	20 to 40	4:30 - 4:45	3	6	10	3.0	7.0	10.0	0.0	-1.0	0.0
		4:45 - 5:00	3	6	10	2.7	7.2	9.2	0.3	-1.2	0.8
		5:00 - 5:15	3	8	10	2.9	7.0	9.9	0.1	1.0	0.1
		5:15 - 5:30	3	7	13	2.5	7.0	10.0	0.5	0.0	3.0
40	25 to 45	4:30 - 4:45	3	6	10	2.4	6.9	9.5	0.6	-0.9	0.5
		4:45 - 5:00	3	6	10	2.4	7.0	8.6	0.6	-1.0	1.4
		5:00 - 5:15	3	8	10	2.3	6.8	8.8	0.7	1.2	1.2
		5:15 - 5:30	3	7	13	1.9	6.9	8.2	1.1	0.1	4.8
45	30 to 50	4:30 - 4:45	3	6	10	2.7	7.0	10.0	0.3	-1.0	0.0
		4:45 - 5:00	3	6	10	2.0	7.1	8.9	1.0	-1.1	1.1
		5:00 - 5:15	3	8	10	2.9	6.9	9.9	0.1	1.1	0.1
		5:15 - 5:30	3	7	13	2.6	7.0	9.9	0.4	0.0	3.1

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	3	6	10	2.9	7.1	9.9	0.1	-1.1	0.1
		4:45 - 5:00	3	6	10	2.7	7.1	9.1	0.3	-1.1	0.9
		5:00 - 5:15	3	8	10	2.8	6.8	9.7	0.2	1.2	0.3
		5:15 - 5:30	3	7	13	2.6	6.9	9.8	0.4	0.1	3.2
55	30 to 50	4:30 - 4:45	3	6	10	2.9	7.0	9.6	0.1	-1.0	0.4
		4:45 - 5:00	3	6	10	2.4	7.1	9.0	0.6	-1.1	1.0
		5:00 - 5:15	3	8	10	2.8	6.9	9.7	0.2	1.1	0.3
		5:15 - 5:30	3	7	13	2.7	7.0	9.8	0.3	0.0	3.2

Note:

- Approach Speed = 40 mph
- SB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

Table K-10.d. Salem Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - WB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	10 to 30	4:30 - 4:45	2	7	10	3.8	7.9	13.1	-1.8	-0.9	-3.1
		4:45 - 5:00	2	6	10	4.0	13.9	13.4	-2.0	-7.9	-3.4
		5:00 - 5:15	2	5	10	3.0	12.0	13.1	-1.0	-7.0	-3.1
		5:15 - 5:30	2	6	10	3.5	13.9	13.0	-1.5	-7.9	-3.0
30 (Existing condition)	15 to 35	4:30 - 4:45	2	7	10	3.2	7.7	13.0	-1.2	-0.7	-3.0
		4:45 - 5:00	2	6	10	3.8	12.6	12.3	-1.8	-6.6	-2.3
		5:00 - 5:15	2	5	10	2.3	10.9	12.0	-0.3	-5.9	-2.0
		5:15 - 5:30	2	6	10	2.5	12.8	12.1	-0.5	-6.8	-2.1
35	20 to 40	4:30 - 4:45	2	7	10	3.2	7.7	13.0	-1.2	-0.7	-3.0
		4:45 - 5:00	2	6	10	3.8	12.6	12.3	-1.8	-6.6	-2.3
		5:00 - 5:15	2	5	10	2.3	10.9	12.0	-0.3	-5.9	-2.0
		5:15 - 5:30	2	6	10	2.5	12.8	12.1	-0.5	-6.8	-2.1
40	25 to 45	4:30 - 4:45	2	7	10	1.4	6.9	10.8	0.6	0.1	-0.8
		4:45 - 5:00	2	6	10	1.4	7.5	10.9	0.6	-1.5	-0.9
		5:00 - 5:15	2	5	10	2.5	7.3	10.5	-0.5	-2.3	-0.5
		5:15 - 5:30	2	6	10	1.2	7.2	10.6	0.8	-1.2	-0.6
45	30 to 50	4:30 - 4:45	2	7	10	3.0	7.6	11.4	-1.0	-0.6	-1.4
		4:45 - 5:00	2	6	10	3.4	11.3	12.1	-1.4	-5.3	-2.1
		5:00 - 5:15	2	5	10	2.7	10.1	11.7	-0.7	-5.1	-1.7
		5:15 - 5:30	2	6	10	2.5	11.4	11.9	-0.5	-5.4	-1.9

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	30 to 50	4:30 - 4:45	2	7	10	2.7	7.5	12.0	-0.7	-0.5	-2.0
		4:45 - 5:00	2	6	10	2.9	11.5	12.2	-0.9	-5.5	-2.2
		5:00 - 5:15	2	5	10	2.0	9.9	11.4	0.0	-4.9	-1.4
		5:15 - 5:30	2	6	10	2.0	11.8	12.0	0.0	-5.8	-2.0
55	30 to 50	4:30 - 4:45	2	7	10	2.4	7.5	12.2	-0.4	-0.5	-2.2
		4:45 - 5:00	2	6	10	2.8	11.2	12.5	-0.8	-5.2	-2.5
		5:00 - 5:15	2	5	10	2.0	10.1	11.5	0.0	-5.1	-1.5
		5:15 - 5:30	2	6	10	1.9	11.8	11.8	0.1	-5.8	-1.8

Note:

- Approach Speed = 40 mph
- WB Volume = 1759 vph
- Circulating Speed = 16 - 22 mph

APPENDIX L

ELLINGTON ROUNDABOUT:

CALIBRATION VARIABLES VS. QUEUES

APPENDIX L – ELLINGTON ROUNDABOUT: CALIBRATION VARIABLES VS. QUEUES

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Table L-1. Ellington Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) – AM

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
15	10 to 30	7:00 - 7:15	1	0.6	0.4	6	6.9	-0.9	2	3.6	-1.6	12	18.2	-6.2
		7:15 - 7:30	2	0.4	1.1	9	4.9	4.1	3	2.8	0.2	18	15.8	2.2
		7:30 - 7:45	2	0.4	1.1	17	5.3	11.2	3	3.5	-0.5	33	19.4	13.6
		7:45 - 8:00	2	0.4	1.1	9	5.7	2.8	3	3.0	0.0	17	18.0	-1.0
20	10 to 35	7:00 - 7:15	1	0.5	0.5	6	6.4	-0.4	2	3.2	-1.2	12	17.1	-5.1
		7:15 - 7:30	2	0.4	1.1	9	5.2	3.8	3	2.5	0.5	18	15.4	2.6
		7:30 - 7:45	2	0.3	1.2	17	5.2	11.3	3	3.6	-0.6	33	20.2	12.8
		7:45 - 8:00	2	0.4	1.1	9	5.7	2.8	3	3.1	-0.1	17	18.5	-1.5
25	15 to 40	7:00 - 7:15	1	0.5	0.5	6	6.5	-0.5	2	2.7	-0.7	12	16.4	-4.4
		7:15 - 7:30	2	0.3	1.2	9	4.6	4.4	3	1.7	1.3	18	13.8	4.2
		7:30 - 7:45	2	0.3	1.2	17	4.9	11.6	3	3.5	-0.5	33	18.3	14.7
		7:45 - 8:00	2	0.4	1.1	9	5.5	3.0	3	2.5	0.5	17	19.9	-2.9
30	15 to 45	7:00 - 7:15	1	0.4	0.6	6	5.9	0.1	2	2.4	-0.4	12	15.9	-3.9
		7:15 - 7:30	2	0.3	1.2	9	3.9	5.1	3	2.0	1.0	18	12.7	5.3
		7:30 - 7:45	2	0.3	1.2	17	5.5	11.0	3	2.5	0.5	33	16.5	16.5
		7:45 - 8:00	2	0.4	1.1	9	5.4	3.1	3	2.6	0.4	17	17.7	-0.7
35	20 to 50	7:00 - 7:15	1	0.3	0.7	6	5.4	0.6	2	2.5	-0.5	12	15.0	-3.0
		7:15 - 7:30	2	0.3	1.2	9	4.3	4.7	3	1.9	1.1	18	12.3	5.7
		7:30 - 7:45	2	0.2	1.3	17	5.1	11.4	3	3.4	-0.4	33	18.0	15.0
		7:45 - 8:00	2	0.3	1.2	9	4.5	4.0	3	2.8	0.2	17	19.3	-2.3

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
40 (Existing condition)	25 to 55	7:00 - 7:15	1	0.3	0.7	6	5.5	0.5	2	2.5	-0.5	12	13.7	-1.7
		7:15 - 7:30	2	0.2	1.3	9	4.1	4.9	3	2.0	1.0	18	12.0	6.0
		7:30 - 7:45	2	0.2	1.3	17	5.0	11.5	3	4.1	-1.1	33	18.2	14.8
		7:45 - 8:00	2	0.3	1.2	9	5.2	3.3	3	2.9	0.1	17	18.6	-1.6
45	30 to 60	7:00 - 7:15	1	0.3	0.7	6	5.0	1.0	2	3.1	-1.1	12	15.2	-3.2
		7:15 - 7:30	2	0.3	1.2	9	4.0	5.0	3	2.1	0.9	18	11.8	6.2
		7:30 - 7:45	2	0.2	1.3	17	5.0	11.5	3	3.3	-0.3	33	17.1	15.9
		7:45 - 8:00	2	0.3	1.2	9	4.5	4.0	3	2.9	0.1	17	16.4	0.6
50	35 to 65	7:00 - 7:15	1	0.3	0.7	6	5.5	0.5	2	3.2	-1.2	12	14.5	-2.5
		7:15 - 7:30	2	0.3	1.2	9	3.9	5.1	3	2.4	0.6	18	12.8	5.2
		7:30 - 7:45	2	0.2	1.3	17	4.4	12.1	3	2.7	0.3	33	16.7	16.3
		7:45 - 8:00	2	0.2	1.3	9	4.5	4.0	3	2.7	0.3	17	16.8	0.2
55	40 to 70	7:00 - 7:15	1	0.3	0.7	6	5.2	0.8	2	3.4	-1.4	12	14.2	-2.2
		7:15 - 7:30	2	0.2	1.3	9	4.2	4.8	3	2.3	0.7	18	13.1	4.9
		7:30 - 7:45	2	0.2	1.3	17	5.1	11.4	3	3.2	-0.2	33	17.3	15.7
		7:45 - 8:00	2	0.2	1.3	9	4.5	4.0	3	3.0	0.0	17	17.9	-0.9

Note:

- Circulating Speed = 13.7 – 18.8 mph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9
- NB Volume = 190 vph
- SB Volume = 591 vph

Table L-2. Ellington Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) – AM

Circulating	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15	7:00 - 7:15	1	0.4	0.6	6	5.5	0.5	2	2.8	-0.8	12	15.1	-3.1
		7:15 - 7:30	2	0.3	1.2	9	4.3	4.7	3	1.8	1.2	18	12.6	5.4
		7:30 - 7:45	2	0.2	1.3	17	4.7	11.8	3	2.6	0.4	33	17.3	15.7
		7:45 - 8:00	2	0.3	1.2	9	4.9	3.6	3	2.7	0.3	17	17.6	-0.6
15	15 to 20 **(16 to 20 Existing condition)**	7:00 - 7:15	1	0.4	0.6	6	5.5	0.5	2	2.8	-0.8	12	15.1	-3.1
		7:15 - 7:30	2	0.3	1.2	9	4.3	4.7	3	1.8	1.2	18	12.6	5.4
		7:30 - 7:45	2	0.2	1.3	17	4.7	11.8	3	2.6	0.4	33	17.3	15.7
		7:45 - 8:00	2	0.3	1.2	9	4.9	3.6	3	2.7	0.3	17	17.6	-0.6
20	20 to 25	7:00 - 7:15	1	0.4	0.6	6	5.5	0.5	2	2.8	-0.8	12	15.1	-3.1
		7:15 - 7:30	2	0.3	1.2	9	4.3	4.7	3	1.8	1.2	18	12.6	5.4
		7:30 - 7:45	2	0.2	1.3	17	4.7	11.8	3	2.6	0.4	33	17.3	15.7
		7:45 - 8:00	2	0.3	1.2	9	4.9	3.6	3	2.7	0.3	17	17.6	-0.6
25	25 to 30	7:00 - 7:15	1	0.4	0.6	6	5.5	0.5	2	2.8	-0.8	12	15.1	-3.1
		7:15 - 7:30	2	0.3	1.2	9	4.3	4.7	3	1.8	1.2	18	12.6	5.4
		7:30 - 7:45	2	0.2	1.3	17	4.7	11.8	3	2.6	0.4	33	17.3	15.7
		7:45 - 8:00	2	0.3	1.2	9	4.9	3.6	3	2.7	0.3	17	17.6	-0.6
30	30 to 35	7:00 - 7:15	1	0.4	0.6	6	5.5	0.5	2	2.8	-0.8	12	15.1	-3.1
		7:15 - 7:30	2	0.3	1.2	9	4.3	4.7	3	1.8	1.2	18	12.6	5.4
		7:30 - 7:45	2	0.2	1.3	17	4.7	11.8	3	2.6	0.4	33	17.3	15.7
		7:45 - 8:00	2	0.3	1.2	9	4.9	3.6	3	2.7	0.3	17	17.6	-0.6

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 191 vph
- SB Volume = 591 vph

Table L-3. Ellington Roundabout – Critical Gap (seconds) vs. Queue Length (# of vehicles) – AM

Gap	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
(seconds)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-1	7:00 - 7:15	1	0.2	0.8	6	4.6	1.4	2	0.4	1.6	12	9.4	2.6
	7:15 - 7:30	2	0.1	1.4	9	4.0	5.0	3	0.4	2.6	18	7.2	10.8
	7:30 - 7:45	2	0.2	1.3	17	4.1	12.4	3	0.6	2.4	33	9.7	23.3
	7:45 - 8:00	2	0.2	1.3	9	4.4	4.1	3	0.6	2.4	17	9.6	7.4
-0.5	7:00 - 7:15	1	0.2	0.8	6	4.9	1.1	2	1.2	0.8	12	12.2	-0.2
	7:15 - 7:30	2	0.2	1.3	9	4.5	4.5	3	0.9	2.1	18	10.2	7.8
	7:30 - 7:45	2	0.2	1.3	17	4.9	11.6	3	1.2	1.8	33	13.0	20.0
	7:45 - 8:00	2	0.2	1.3	9	4.6	3.9	3	1.3	1.7	17	13.9	3.1
0.5	7:00 - 7:15	1	0.5	0.5	6	6.0	0.0	2	7.4	-5.4	12	19.1	-7.1
	7:15 - 7:30	2	0.4	1.1	9	4.3	4.7	3	5.3	-2.3	18	18.5	-0.5
	7:30 - 7:45	2	0.4	1.1	17	5.7	10.8	3	7.4	-4.4	33	23.0	10.0
	7:45 - 8:00	2	0.5	1.0	9	5.5	3.0	3	6.6	-3.6	17	21.8	-4.8
1	7:00 - 7:15	1	0.6	0.4	6	5.9	0.1	2	19.4	-17.4	12	23.7	-11.7
	7:15 - 7:30	2	0.6	0.9	9	5.5	3.5	3	22.0	-19.0	18	25.7	-7.7
	7:30 - 7:45	2	0.5	1.0	17	6.0	10.5	3	23.2	-20.2	33	25.9	7.1
	7:45 - 8:00	2	0.6	0.9	9	5.8	2.7	3	23.0	-20.0	17	25.9	-8.9
2	7:00 - 7:15	1	0.7	0.3	6	6.6	-0.6	2	24.3	-22.3	12	24.0	-12.0
	7:15 - 7:30	2	0.7	0.8	9	5.2	3.8	3	24.3	-21.3	18	25.9	-7.9
	7:30 - 7:45	2	0.6	0.9	17	5.8	10.7	3	24.2	-21.2	33	25.7	7.3
	7:45 - 8:00	2	0.7	0.8	9	6.7	1.8	3	24.1	-21.1	17	25.8	-8.8

Gap	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
(seconds)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
3	7:00 - 7:15	1	1.0	0.0	6	6.6	-0.6	2	24.4	-22.4	12	24.0	-12.0
	7:15 - 7:30	2	1.0	0.5	9	6.0	3.0	3	24.4	-21.4	18	25.8	-7.8
	7:30 - 7:45	2	0.7	0.8	17	6.2	10.3	3	24.4	-21.4	33	25.8	7.2
	7:45 - 8:00	2	1.2	0.3	9	7.8	0.7	3	24.4	-21.4	17	25.8	-8.8

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 191 vph
- SB Volume = 591 vph

Table L-4. Ellington Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) – AM

Min Headway	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Distance (ft)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-30	7:00 - 7:15	1	0.4	0.6	6	5.6	0.4	2	1.5	0.5	12	13.2	-1.2
	7:15 - 7:30	2	0.3	1.2	9	4.2	4.8	3	1.0	2.0	18	9.8	8.2
	7:30 - 7:45	2	0.3	1.2	17	4.9	11.6	3	1.6	1.4	33	12.7	20.3
	7:45 - 8:00	2	0.3	1.2	9	5.3	3.2	3	1.5	1.5	17	13.1	3.9
-20	7:00 - 7:15	1	0.4	0.6	6	5.7	0.3	2	2.1	-0.1	12	14.8	-2.8
	7:15 - 7:30	2	0.3	1.2	9	4.6	4.4	3	1.2	1.8	18	9.9	8.1
	7:30 - 7:45	2	0.3	1.2	17	4.7	11.8	3	1.9	1.1	33	14.4	18.6
	7:45 - 8:00	2	0.3	1.2	9	5.0	3.5	3	1.9	1.1	17	15.0	2.0
-10	7:00 - 7:15	1	0.3	0.7	6	5.8	0.2	2	2.6	-0.6	12	15.1	-3.1
	7:15 - 7:30	2	0.3	1.2	9	4.5	4.5	3	1.8	1.2	18	13.0	5.0
	7:30 - 7:45	2	0.3	1.2	17	4.6	11.9	3	2.4	0.6	33	17.4	15.6
	7:45 - 8:00	2	0.4	1.1	9	5.1	3.4	3	2.4	0.6	17	16.9	0.1
10	7:00 - 7:15	1	0.5	0.5	6	6.3	-0.3	2	2.6	-0.6	12	14.8	-2.8
	7:15 - 7:30	2	0.3	1.2	9	4.5	4.5	3	1.9	1.1	18	13.0	5.0
	7:30 - 7:45	2	0.4	1.1	17	5.5	11.0	3	2.6	0.4	33	16.9	16.1
	7:45 - 8:00	2	0.4	1.1	9	4.6	3.9	3	2.6	0.4	17	18.4	-1.4
20	7:00 - 7:15	1	1.8	-0.8	6	9.8	-3.8	2	3.0	-1.0	12	16.7	-4.7
	7:15 - 7:30	2	1.1	0.4	9	7.6	1.4	3	2.7	0.3	18	14.5	3.5
	7:30 - 7:45	2	1.6	-0.1	17	9.3	7.2	3	3.1	-0.1	33	18.6	14.4
	7:45 - 8:00	2	1.1	0.4	9	8.6	-0.1	3	2.9	0.1	17	17.7	-0.7

Min Headway	**Peak Period**	**NB Queue Average**			**NB Queue Max**			**SB Queue Average**			**SB Queue Max**		
Distance (ft)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	7:00 - 7:15	1	1.4	-0.4	6	8.7	-2.7	2	3.5	-1.5	12	17.1	-5.1
	7:15 - 7:30	2	1.1	0.4	9	7.0	2.0	3	3.2	-0.2	18	14.9	3.1
	7:30 - 7:45	2	1.4	0.1	17	8.5	8.0	3	3.6	-0.6	33	19.0	14.0
	7:45 - 8:00	2	1.4	0.1	9	9.3	-0.8	3	2.9	0.1	17	19.2	-2.2
30	7:00 - 7:15	1	1.9	-0.9	6	9.6	-3.6	2	3.4	-1.4	12	16.2	-4.2
	7:15 - 7:30	2	1.5	0.0	9	8.4	0.6	3	2.9	0.1	18	16.0	2.0
	7:30 - 7:45	2	1.7	-0.2	17	10.0	6.5	3	4.7	-1.7	33	19.0	14.0
	7:45 - 8:00	2	1.4	0.1	9	10.0	-1.5	3	3.8	-0.8	17	19.5	-2.5
35	7:00 - 7:15	1	1.8	-0.8	6	9.7	-3.7	2	3.8	-1.8	12	18.1	-6.1
	7:15 - 7:30	2	1.4	0.1	9	8.7	0.3	3	3.4	-0.4	18	18.0	0.0
	7:30 - 7:45	2	1.8	-0.3	17	10.3	6.2	3	4.5	-1.5	33	19.1	13.9
	7:45 - 8:00	2	1.6	-0.1	9	10.2	-1.7	3	4.0	-1.0	17	19.5	-2.5
36	7:00 - 7:15	1	0.7	0.3	6	7.1	-1.1	2	12.4	-10.4	12	23.4	-11.4
	7:15 - 7:30	2	0.6	0.9	9	5.6	3.4	3	15.2	-12.2	18	25.2	-7.2
	7:30 - 7:45	2	0.7	0.8	17	6.0	10.5	3	17.9	-14.9	33	25.4	7.6
	7:45 - 8:00	2	0.7	0.8	9	6.4	2.1	3	19.4	-16.4	17	25.3	-8.3
37	7:00 - 7:15	1	0.7	0.3	6	7.0	-1.0	2	13.1	-11.1	12	22.8	-10.8
	7:15 - 7:30	2	0.7	0.8	9	6.2	2.8	3	16.1	-13.1	18	25.3	-7.3
	7:30 - 7:45	2	0.7	0.8	17	6.8	9.7	3	18.5	-15.5	33	25.6	7.4
	7:45 - 8:00	2	0.7	0.8	9	6.9	1.6	3	17.7	-14.7	17	24.8	-7.8

Min Headway	**Peak Period**	**NB Queue Average**			**NB Queue Max**			**SB Queue Average**			**SB Queue Max**		
Distance (ft)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
40	7:00 - 7:15	1	0.7	0.3	6	7.2	-1.2	2	13.9	-11.9	12	23.6	-11.6
	7:15 - 7:30	2	0.7	0.8	9	6.2	2.8	3	17.2	-14.2	18	25.2	-7.2
	7:30 - 7:45	2	0.7	0.8	17	6.4	10.1	3	19.8	-16.8	33	25.5	7.5
	7:45 - 8:00	2	0.8	0.7	9	6.9	1.6	3	19.6	-16.6	17	25.1	-8.1

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 191 vph
- SB Volume = 591 vph

Table L-5. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) – AM

Reduced speed of	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	7.5 to 12.5	7:00 - 7:15	1	1.1	-0.1	6	10.2	-4.2	2	15.7	-13.7	12	23.9	-11.9
		7:15 - 7:30	2	1.0	0.5	9	8.7	0.3	3	18.6	-15.6	18	25.4	-7.4
		7:30 - 7:45	2	0.9	0.6	17	9.5	7.0	3	19.8	-16.8	33	25.7	7.3
		7:45 - 8:00	2	1.0	0.5	9	9.4	-0.9	3	19.6	-16.6	17	25.5	-8.5
15	7.5 to 12.5	7:00 - 7:15	1	1.1	-0.1	6	10.2	-4.2	2	15.7	-13.7	12	23.9	-11.9
		7:15 - 7:30	2	1.0	0.5	9	8.7	0.3	3	18.6	-15.6	18	25.4	-7.4
		7:30 - 7:45	2	0.9	0.6	17	9.5	7.0	3	19.8	-16.8	33	25.7	7.3
		7:45 - 8:00	2	1.0	0.5	9	9.4	-0.9	3	19.6	-16.6	17	25.5	-8.5
20	12.5 to 17.5	7:00 - 7:15	1	0.5	0.5	6	7.3	-1.3	2	4.0	-2.0	12	16.4	-4.4
		7:15 - 7:30	2	0.4	1.1	9	6.0	3.0	3	3.3	-0.3	18	15.7	2.3
		7:30 - 7:45	2	0.4	1.1	17	6.9	9.6	3	4.2	-1.2	33	20.6	12.4
		7:45 - 8:00	2	0.4	1.1	9	6.2	2.3	3	4.0	-1.0	17	20.5	-3.5
25	17.5 to 22.5	7:00 - 7:15	1	0.4	0.6	6	5.8	0.2	2	2.8	-0.8	12	15.8	-3.8
		7:15 - 7:30	2	0.3	1.2	9	4.5	4.5	3	2.0	1.0	18	13.2	4.8
		7:30 - 7:45	2	0.3	1.2	17	5.5	11.0	3	2.9	0.1	33	17.0	16.0
		7:45 - 8:00	2	0.4	1.1	9	5.4	3.1	3	2.8	0.2	17	17.2	-0.2
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	1	0.4	0.6	6	5.9	0.1	2	2.4	-0.4	12	15.3	-3.3
		7:15 - 7:30	2	0.3	1.2	9	4.6	4.4	3	1.8	1.2	18	12.5	5.5
		7:30 - 7:45	2	0.3	1.2	17	5.2	11.3	3	2.5	0.5	33	16.5	16.5
		7:45 - 8:00	2	0.4	1.1	9	5.8	2.7	3	2.5	0.5	17	17.5	-0.5

Reduced speed of	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
35	22.5 to 27.5	7:00 - 7:15	1	0.4	0.6	6	5.9	0.1	2	2.4	-0.4	12	15.3	-3.3
		7:15 - 7:30	2	0.3	1.2	9	4.6	4.4	3	1.8	1.2	18	12.5	5.5
		7:30 - 7:45	2	0.3	1.2	17	5.2	11.3	3	2.5	0.5	33	16.5	16.5
		7:45 - 8:00	2	0.4	1.1	9	5.8	2.7	3	2.5	0.5	17	17.5	-0.5
40	27.5 to 32.5	7:00 - 7:15	1	0.5	0.5	6	6.0	0.0	2	2.2	-0.2	12	14.4	-2.4
		7:15 - 7:30	2	0.3	1.2	9	4.0	5.0	3	1.9	1.1	18	12.5	5.5
		7:30 - 7:45	2	0.3	1.2	17	4.9	11.6	3	2.8	0.2	33	17.8	15.2
		7:45 - 8:00	2	0.3	1.2	9	4.9	3.6	3	2.3	0.7	17	17.1	-0.1
45	32.5 to 37.5	7:00 - 7:15	1	0.4	0.6	6	5.4	0.6	2	2.7	-0.7	12	14.1	-2.1
		7:15 - 7:30	2	0.3	1.2	9	4.7	4.3	3	2.3	0.7	18	13.9	4.1
		7:30 - 7:45	2	0.3	1.2	17	5.1	11.4	3	2.7	0.3	33	17.9	15.1
		7:45 - 8:00	2	0.4	1.1	9	5.3	3.2	3	2.4	0.6	17	18.5	-1.5
50	37.5 to 42.5	7:00 - 7:15	1	0.4	0.6	6	5.4	0.6	2	2.6	-0.6	12	15.1	-3.1
		7:15 - 7:30	2	0.4	1.1	9	4.4	4.6	3	2.4	0.6	18	14.8	3.2
		7:30 - 7:45	2	0.2	1.3	17	4.5	12.0	3	2.7	0.3	33	17.8	15.2
		7:45 - 8:00	2	0.3	1.2	9	5.0	3.5	3	2.5	0.5	17	18.5	-1.5
55	42.5 to 47.5	7:00 - 7:15	1	0.3	0.7	6	4.8	1.2	2	2.6	-0.6	12	15.3	-3.3
		7:15 - 7:30	2	0.3	1.2	9	4.3	4.7	3	1.8	1.2	18	13.7	4.3
		7:30 - 7:45	2	0.2	1.3	17	5.1	11.4	3	2.8	0.2	33	18.0	15.0
		7:45 - 8:00	2	0.3	1.2	9	4.9	3.6	3	2.5	0.5	17	17.2	-0.2

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 190 vph
- SB Volume = 591 vph

Table L-6. Ellington Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) – PM

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference
15	10 to 30	4:30-4:45	1	3.3	-2.3	11	16.0	-5.0	2	26.2	-24.2	22	44.8	-22.8
		4:45-5:00	2	2.9	-1.4	14	15.9	-2.4	3	32.4	-29.4	27	49.8	-22.8
		5:00-5:15	2	4.5	-3.0	6	17.8	-11.8	3	35.0	-32.0	12	50.5	-38.5
		5:15-5:30	2	2.6	-1.1	9	14.6	-5.6	3	44.4	-41.4	18	57.3	-39.3
20	10 to 35	4:30-4:45	1	3.2	-2.2	11	15.2	-4.2	2	23.8	-21.8	22	40.3	-18.3
		4:45-5:00	2	2.4	-0.9	14	14.6	-1.1	3	27.8	-24.8	27	48.3	-21.3
		5:00-5:15	2	4.3	-2.8	6	17.5	-11.5	3	29.2	-26.2	12	44.0	-32.0
		5:15-5:30	2	2.4	-0.9	9	13.8	-4.8	3	35.4	-32.4	18	52.9	-34.9
25	15 to 40	4:30-4:45	1	2.2	-1.2	11	12.2	-1.2	2	19.5	-17.5	22	34.8	-12.8
		4:45-5:00	2	1.8	-0.3	14	11.6	1.9	3	18.0	-15.0	27	35.8	-8.8
		5:00-5:15	2	3.1	-1.6	6	13.5	-7.5	3	15.5	-12.5	12	29.8	-17.8
		5:15-5:30	2	1.5	0.0	9	10.7	-1.7	3	20.7	-17.7	18	38.2	-20.2
30	15 to 45	4:30-4:45	1	1.9	-0.9	11	11.5	-0.5	2	13.0	-11.0	22	26.7	-4.7
		4:45-5:00	2	1.5	0.0	14	10.7	2.8	3	10.4	-7.4	27	27.2	-0.2
		5:00-5:15	2	2.8	-1.3	6	12.3	-6.3	3	6.8	-3.8	12	19.5	-7.5
		5:15-5:30	2	1.3	0.2	9	10.1	-1.1	3	11.0	-8.0	18	26.2	-8.2
35	20 to 50	4:30-4:45	1	1.6	-0.6	11	11.1	-0.1	2	10.2	-8.2	22	23.1	-1.1
		4:45-5:00	2	1.5	0.0	14	10.8	2.7	3	8.0	-5.0	27	21.2	5.8
		5:00-5:15	2	2.6	-1.1	6	11.9	-5.9	3	6.1	-3.1	12	18.0	-6.0
		5:15-5:30	2	1.1	0.4	9	8.8	0.2	3	10.4	-7.4	18	26.2	-8.2

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
40 (Existing condition)	25 to 55	4:30-4:45	1	1.4	-0.4	11	9.8	1.2	2	8.3	-6.3	22	19.9	2.1
		4:45-5:00	2	1.4	0.1	14	9.9	3.6	3	6.8	-3.8	27	20.2	6.8
		5:00-5:15	2	1.8	-0.3	6	9.8	-3.8	3	5.9	-2.9	12	17.5	-5.5
		5:15-5:30	2	1.0	0.5	9	9.2	-0.2	3	7.9	-4.9	18	21.0	-3.0
45	30 to 60	4:30-4:45	1	1.4	-0.4	11	10.4	0.6	2	9.2	-7.2	22	21.1	0.9
		4:45-5:00	2	1.1	0.4	14	9.3	4.2	3	7.5	-4.5	27	20.8	6.2
		5:00-5:15	2	2.3	-0.8	6	11.1	-5.1	3	7.4	-4.4	12	19.7	-7.7
		5:15-5:30	2	1.0	0.5	9	9.2	-0.2	3	10.4	-7.4	18	24.4	-6.4
50	35 to 65	4:30-4:45	1	1.4	-0.4	11	10.0	1.0	2	7.6	-5.6	22	18.1	3.9
		4:45-5:00	2	1.2	0.3	14	9.0	4.5	3	6.5	-3.5	27	20.1	6.9
		5:00-5:15	2	1.8	-0.3	6	9.9	-3.9	3	5.8	-2.8	12	16.7	-4.7
		5:15-5:30	2	1.1	0.4	9	9.4	-0.4	3	8.9	-5.9	18	23.1	-5.1
55	40 to 70	4:30-4:45	1	1.6	-0.6	11	10.3	0.7	2	8.8	-6.8	22	20.4	1.6
		4:45-5:00	2	1.2	0.3	14	8.4	5.1	3	7.1	-4.1	27	19.9	7.1
		5:00-5:15	2	1.8	-0.3	6	9.7	-3.7	3	6.0	-3.0	12	15.6	-3.6
		5:15-5:30	2	1.1	0.4	9	9.8	-0.8	3	9.2	-6.2	18	22.6	-4.6

Note:

- Circulating Speed = 13.7 – 18.8 mph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9
- NB Volume = 404 vph
- SB Volume = 411 vph

Table L-7. Ellington Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) – PM

Circulating	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15	4:30-4:45	1	2.1	-1.1	11	11.2	-0.2	2	10.2	-8.2	22	25.8	-3.8
		4:45-5:00	2	1.4	0.1	14	10.4	3.1	3	9.3	-6.3	27	25.8	1.2
		5:00-5:15	2	2.1	-0.6	6	11.9	-5.9	3	6.5	-3.5	12	18.2	-6.2
		5:15-5:30	2	1.2	0.3	9	9.7	-0.7	3	10.4	-7.4	18	25.0	-7.0
15	15 to 20 **(16 to 20 Existing condition)**	4:30-4:45	1	2.1	-1.1	11	11.2	-0.2	2	10.2	-8.2	22	25.8	-3.8
		4:45-5:00	2	1.4	0.1	14	10.4	3.1	3	9.3	-6.3	27	25.8	1.2
		5:00-5:15	2	2.1	-0.6	6	11.9	-5.9	3	6.5	-3.5	12	18.2	-6.2
		5:15-5:30	2	1.2	0.3	9	9.7	-0.7	3	10.4	-7.4	18	25.0	-7.0
20	20 to 25	4:30-4:45	1	2.0	-1.0	11	11.1	-0.1	2	10.2	-8.2	22	25.8	-3.8
		4:45-5:00	2	1.4	0.1	14	10.4	3.1	3	9.3	-6.3	27	25.8	1.2
		5:00-5:15	2	2.0	-0.5	6	11.8	-5.8	3	6.5	-3.5	12	18.2	-6.2
		5:15-5:30	2	1.2	0.3	9	9.6	-0.6	3	10.4	-7.4	18	25.0	-7.0
25	25 to 30	4:30-4:45	1	2.0	-1.0	11	11.1	-0.1	2	10.2	-8.2	22	25.8	-3.8
		4:45-5:00	2	1.4	0.1	14	10.4	3.1	3	9.3	-6.3	27	25.8	1.2
		5:00-5:15	2	2.0	-0.5	6	11.8	-5.8	3	6.5	-3.5	12	18.2	-6.2
		5:15-5:30	2	1.2	0.3	9	9.6	-0.6	3	10.4	-7.4	18	25.0	-7.0
30	30 to 35	4:30-4:45	1	2.0	-1.0	11	11.1	-0.1	2	10.2	-8.2	22	25.8	-3.8
		4:45-5:00	2	1.4	0.1	14	10.4	3.1	3	9.3	-6.3	27	25.8	1.2
		5:00-5:15	2	2.0	-0.5	6	11.8	-5.8	3	6.5	-3.5	12	18.2	-6.2
		5:15-5:30	2	1.2	0.3	9	9.6	-0.6	3	10.4	-7.4	18	25.0	-7.0

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 404 vph
- SB Volume = 411 vph

Table L-8. Ellington Roundabout – Critical Gap (seconds) vs. Queue Length (# of vehicles) – PM

Gap	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
(seconds)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-1	4:30-4:45	1	0.6	0.4	11	8.3	2.7	2	1.0	1.0	22	10.2	11.8
	4:45-5:00	2	0.4	1.1	14	6.9	6.6	3	1.3	1.7	27	11.0	16.0
	5:00-5:15	2	0.6	0.9	6	7.9	-1.9	3	0.8	2.2	12	9.7	2.3
	5:15-5:30	2	0.5	1.0	9	8.5	0.5	3	0.9	2.1	18	9.3	8.7
-0.5	4:30-4:45	1	1.0	0.0	11	9.6	1.4	2	3.3	-1.3	22	17.0	5.0
	4:45-5:00	2	0.9	0.6	14	8.8	4.7	3	2.9	0.1	27	14.8	12.2
	5:00-5:15	2	1.4	0.1	6	11.0	-5.0	3	1.9	1.1	12	11.6	0.4
	5:15-5:30	2	0.8	0.7	9	8.5	0.5	3	2.5	0.5	18	15.1	2.9
0.5	4:30-4:45	1	1.5	-0.5	11	11.5	-0.5	2	34.3	-32.3	22	47.3	-25.3
	4:45-5:00	2	1.3	0.2	14	10.1	3.4	3	47.0	-44.0	27	57.2	-30.2
	5:00-5:15	2	1.5	0.0	6	10.3	-4.3	3	52.7	-49.7	12	61.1	-49.1
	5:15-5:30	2	1.0	0.5	9	9.9	-0.9	3	61.8	-58.8	18	66.2	-48.2
1	4:30-4:45	1	4.3	-3.3	11	15.9	-4.9	2	60.2	-58.2	22	61.2	-39.2
	4:45-5:00	2	3.3	-1.8	14	15.8	-2.3	3	65.7	-62.7	27	66.5	-39.5
	5:00-5:15	2	6.1	-4.6	6	16.4	-10.4	3	65.7	-62.7	12	66.7	-54.7
	5:15-5:30	2	3.8	-2.3	9	15.1	-6.1	3	65.7	-62.7	18	66.5	-48.5
2	4:30-4:45	1	20.0	-19.0	11	31.7	-20.7	2	62.8	-60.8	22	61.3	-39.3
	4:45-5:00	2	21.5	-20.0	14	32.1	-18.6	3	65.7	-62.7	27	66.4	-39.4
	5:00-5:15	2	25.6	-24.1	6	31.7	-25.7	3	65.7	-62.7	12	66.7	-54.7
	5:15-5:30	2	21.0	-19.5	9	30.5	-21.5	3	65.7	-62.7	18	66.7	-48.7

Gap	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
(seconds)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
3	4:30-4:45	1	35.5	-34.5	11	38.9	-27.9	2	64.0	-62.0	22	63.8	-41.8
	4:45-5:00	2	37.6	-36.1	14	39.1	-25.6	3	65.7	-62.7	27	66.3	-39.3
	5:00-5:15	2	37.6	-36.1	6	39.0	-33.0	3	65.7	-62.7	12	66.7	-54.7
	5:15-5:30	2	37.7	-36.2	9	38.9	-29.9	3	65.7	-62.7	18	66.6	-48.6

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 404 vph
- SB Volume = 411 vph

Table L-9. Ellington Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) – PM

Min Headway	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Distance (ft)	PM	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference
-40	4:30-4:45	1	2.0	-1.0	11	12.2	-1.2	2	2.0	0.0	22	12.3	9.7
	4:45-5:00	2	1.5	0.0	14	9.9	3.6	3	2.0	1.0	27	12.3	14.7
	5:00-5:15	2	2.5	-1.0	6	12.8	-6.8	3	1.4	1.6	12	10.4	1.6
	5:15-5:30	2	1.3	0.2	9	10.5	-1.5	3	1.6	1.4	18	11.4	6.6
-35	4:30-4:45	1	2.0	-1.0	11	12.2	-1.2	2	2.0	0.0	22	12.3	9.7
	4:45-5:00	2	1.5	0.0	14	9.9	3.6	3	2.0	1.0	27	12.3	14.7
	5:00-5:15	2	2.5	-1.0	6	12.8	-6.8	3	1.4	1.6	12	10.4	1.6
	5:15-5:30	2	1.3	0.2	9	10.5	-1.5	3	1.6	1.4	18	11.4	6.6
-30	4:30-4:45	1	2.0	-1.0	11	12.2	-1.2	2	2.0	0.0	22	12.3	9.7
	4:45-5:00	2	1.5	0.0	14	9.9	3.6	3	2.0	1.0	27	12.3	14.7
	5:00-5:15	2	2.5	-1.0	6	12.8	-6.8	3	1.4	1.6	12	10.4	1.6
	5:15-5:30	2	1.3	0.2	9	10.5	-1.5	3	1.6	1.4	18	11.4	6.6
-20	4:30-4:45	1	2.2	-1.2	11	12.6	-1.6	2	2.1	-0.1	22	13.5	8.5
	4:45-5:00	2	1.5	0.0	14	10.6	2.9	3	2.2	0.8	27	12.4	14.6
	5:00-5:15	2	2.7	-1.2	6	12.2	-6.2	3	1.8	1.2	12	11.4	0.6
	5:15-5:30	2	1.4	0.1	9	10.5	-1.5	3	2.1	0.9	18	13.4	4.6
-10	4:30-4:45	1	2.1	-1.1	11	12.1	-1.1	2	9.5	-7.5	22	24.2	-2.2
	4:45-5:00	2	1.5	0.0	14	10.5	3.0	3	7.1	-4.1	27	22.4	4.6
	5:00-5:15	2	2.6	-1.1	6	12.4	-6.4	3	6.2	-3.2	12	18.8	-6.8
	5:15-5:30	2	1.1	0.4	9	9.6	-0.6	3	8.0	-5.0	18	23.4	-5.4

Min Headway	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Distance (ft)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
Existing	4:30-4:45	1	2.1	-1.1	11	12.0	-1.0	2	11.5	-9.5	22	26.5	-4.5
	4:45-5:00	2	1.8	-0.3	14	11.8	1.7	3	7.6	-4.6	27	22.2	4.8
	5:00-5:15	2	2.1	-0.6	6	11.6	-5.6	3	8.0	-5.0	12	21.7	-9.7
	5:15-5:30	2	1.3	0.2	9	9.8	-0.8	3	10.7	-7.7	18	28.8	-10.8
10	4:30-4:45	1	2.7	-1.7	11	12.9	-1.9	2	19.2	-17.2	22	34.9	-12.9
	4:45-5:00	2	2.0	-0.5	14	11.6	1.9	3	19.1	-16.1	27	35.8	-8.8
	5:00-5:15	2	2.9	-1.4	6	12.6	-6.6	3	17.0	-14.0	12	30.4	-18.4
	5:15-5:30	2	1.8	-0.3	9	10.7	-1.7	3	24.6	-21.6	18	39.2	-21.2
20	4:30-4:45	1	5.7	-4.7	11	22.9	-11.9	2	33.9	-31.9	22	48.8	-26.8
	4:45-5:00	2	5.2	-3.7	14	20.5	-7.0	3	43.7	-40.7	27	56.5	-29.5
	5:00-5:15	2	6.5	-5.0	6	21.0	-15.0	3	48.8	-45.8	12	58.0	-46.0
	5:15-5:30	2	3.1	-1.6	9	14.4	-5.4	3	57.5	-54.5	18	63.1	-45.1

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 404 vph
- SB Volume = 411 vph

Table L-10. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) – PM

Reduced Speed of	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Approach (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	7.5 to 12.5	4:30-4:45	1	4.1	-3.1	11	16.2	-5.2	2	16.9	-14.9	22	29.8	-7.8
		4:45-5:00	2	3.8	-2.3	14	14.2	-0.7	3	18.7	-15.7	27	33.5	-6.5
		5:00-5:15	2	5.6	-4.1	6	16.9	-10.9	3	15.9	-12.9	12	29.7	-17.7
		5:15-5:30	2	3.4	-1.9	9	14.6	-5.6	3	22.6	-19.6	18	37.1	-19.1
15	7.5 to 12.5	4:30-4:45	1	4.1	-3.1	11	16.2	-5.2	2	16.9	-14.9	22	29.8	-7.8
		4:45-5:00	2	3.8	-2.3	14	14.2	-0.7	3	18.7	-15.7	27	33.5	-6.5
		5:00-5:15	2	5.6	-4.1	6	16.9	-10.9	3	15.9	-12.9	12	29.7	-17.7
		5:15-5:30	2	3.4	-1.9	9	14.6	-5.6	3	22.6	-19.6	18	37.1	-19.1
20	12.5 to 17.5	4:30-4:45	1	2.4	-1.4	11	12.5	-1.5	2	8.0	-6.0	22	22.8	-0.8
		4:45-5:00	2	1.8	-0.3	14	10.6	2.9	3	6.9	-3.9	27	22.3	4.7
		5:00-5:15	2	2.9	-1.4	6	13.0	-7.0	3	4.9	-1.9	12	16.0	-4.0
		5:15-5:30	2	1.5	0.0	9	11.5	-2.5	3	7.0	-4.0	18	22.0	-4.0
25	17.5 to 22.5	4:30-4:45	1	2.0	-1.0	11	11.5	-0.5	2	9.1	-7.1	22	22.2	-0.2
		4:45-5:00	2	1.7	-0.2	14	10.8	2.7	3	6.7	-3.7	27	20.5	6.5
		5:00-5:15	2	1.8	-0.3	6	10.5	-4.5	3	7.2	-4.2	12	19.1	-7.1
		5:15-5:30	2	1.3	0.2	9	10.1	-1.1	3	8.6	-5.6	18	25.7	-7.7
30 (Existing condition)	22.5 to 27.5	4:30-4:45	1	2.1	-1.1	11	11.8	-0.8	2	11.9	-9.9	22	26.6	-4.6
		4:45-5:00	2	1.9	-0.4	14	12.1	1.4	3	8.5	-5.5	27	24.3	2.7
		5:00-5:15	2	2.5	-1.0	6	12.4	-6.4	3	6.8	-3.8	12	19.0	-7.0
		5:15-5:30	2	1.5	0.0	9	10.4	-1.4	3	6.7	-3.7	18	21.8	-3.8

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	Difference	Field	Simulation	**Difference**
35	22.5 TO 27.5	4:30-4:45	1	2.1	-1.1	11	11.8	-0.8	2	11.9	-9.9	22	26.6	-4.6
		4:45-5:00	2	1.9	-0.4	14	12.1	1.4	3	8.5	-5.5	27	24.3	2.7
		5:00-5:15	2	2.5	-1.0	6	12.4	-6.4	3	6.8	-3.8	12	19.0	-7.0
		5:15-5:30	2	1.5	0.0	9	10.4	-1.4	3	6.7	-3.7	18	21.8	-3.8
40	27.5 TO 32.5	4:30-4:45	1	2.3	-1.3	11	12.2	-1.2	2	13.4	-11.4	22	29.2	-7.2
		4:45-5:00	2	1.8	-0.3	14	11.2	2.3	3	12.1	-9.1	27	28.0	-1.0
		5:00-5:15	2	3.9	-2.4	6	13.7	-7.7	3	7.5	-4.5	12	22.0	-10.0
		5:15-5:30	2	1.5	0.0	9	10.3	-1.3	3	15.6	-12.6	18	33.6	-15.6
45	32.5 TO 37.5	4:30-4:45	1	2.3	-1.3	11	12.1	-1.1	2	21.8	-19.8	22	36.8	-14.8
		4:45-5:00	2	2.0	-0.5	14	11.5	2.0	3	22.6	-19.6	27	36.4	-9.4
		5:00-5:15	2	4.6	-3.1	6	14.7	-8.7	3	16.5	-13.5	12	29.9	-17.9
		5:15-5:30	2	1.8	-0.3	9	11.5	-2.5	3	23.9	-20.9	18	40.9	-22.9
50	37.5 TO 42.5	4:30-4:45	1	2.4	-1.4	11	12.8	-1.8	2	21.4	-19.4	22	35.2	-13.2
		4:45-5:00	2	1.9	-0.4	14	11.0	2.5	3	23.8	-20.8	27	39.3	-12.3
		5:00-5:15	2	3.5	-2.0	6	13.9	-7.9	3	23.7	-20.7	12	38.9	-26.9
		5:15-5:30	2	1.2	0.3	9	10.5	-1.5	3	34.9	-31.9	18	48.8	-30.8
55	42.5 TO 47.5	4:30-4:45	1	2.3	-1.3	11	11.2	-0.2	2	23.2	-21.2	22	36.4	-14.4
		4:45-5:00	2	1.7	-0.2	14	10.8	2.7	3	27.1	-24.1	27	43.3	-16.3
		5:00-5:15	2	3.4	-1.9	6	14.0	-8.0	3	24.9	-21.9	12	40.1	-28.1
		5:15-5:30	2	1.3	0.2	9	10.4	-1.4	3	32.9	-29.9	18	46.8	-28.8

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9,W-3.4,S-4,E-4,N.E-3.9
- NB Volume = 404 vph
- SB Volume = 411 vph

APPENDIX M

ELLINGTON ROUNDABOUT:

CALIBRATION VARIABLES VS. TRAVEL TIME

APPENDIX M – ELLINGTON ROUNDABOUT: CALIBRATION VARIABLES VS. TRAVEL TIME

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Table M-1.a. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM – NB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
15	10 to 30	7:00 - 7:15	5	6	11	14	8.9	8.3	11.9	11.1	-3.9	-2.3	-0.9	2.9
		7:15 - 7:30	4	6	12	16	8.0	7.3	11.5	9.3	-4.0	-1.3	0.5	6.7
		7:30 - 7:45	6	7	14	15	7.5	8.5	10.7	10.8	-1.5	-1.5	3.3	4.2
		7:45 - 8:00	5	7	13	13	7.1	8.3	11.0	10.4	-2.1	-1.3	2.0	2.6
20	10 to 35	7:00 - 7:15	5	6	11	14	8.6	8.4	11.0	10.2	-3.6	-2.4	0.0	3.8
		7:15 - 7:30	4	6	12	16	7.0	8.1	10.9	8.4	-3.0	-2.1	1.1	7.6
		7:30 - 7:45	6	7	14	15	7.0	7.9	9.9	10.3	-1.0	-0.9	4.1	4.7
		7:45 - 8:00	5	7	13	13	6.8	7.3	10.3	9.4	-1.8	-0.3	2.7	3.6
25	15 to 40	7:00 - 7:15	5	6	11	14	6.7	7.5	10.7	8.7	-1.7	-1.5	0.3	5.3
		7:15 - 7:30	4	6	12	16	7.4	7.2	9.5	8.3	-3.4	-1.2	2.5	7.7
		7:30 - 7:45	6	7	14	15	6.8	6.5	8.8	9.0	-0.8	0.5	5.2	6.0
		7:45 - 8:00	5	7	13	13	7.8	6.4	9.4	8.6	-2.8	0.6	3.6	4.4
30	15 to 45	7:00 - 7:15	5	6	11	14	6.5	6.9	9.5	7.4	-1.5	-0.9	1.5	6.6
		7:15 - 7:30	4	6	12	16	6.6	6.5	8.7	6.8	-2.6	-0.5	3.3	9.2
		7:30 - 7:45	6	7	14	15	6.0	7.3	8.4	8.3	0.0	-0.3	5.6	6.7
		7:45 - 8:00	5	7	13	13	6.7	6.5	8.5	8.9	-1.7	0.5	4.5	4.1
35	20 to 50	7:00 - 7:15	5	6	11	14	6.4	6.7	8.2	6.8	-1.4	-0.7	2.8	7.2
		7:15 - 7:30	4	6	12	16	7.0	5.6	8.0	6.2	-3.0	0.4	4.0	9.8
		7:30 - 7:45	6	7	14	15	5.3	6.7	8.1	7.1	0.7	0.3	5.9	7.9
		7:45 - 8:00	5	7	13	13	6.1	6.4	7.6	7.1	-1.1	0.6	5.4	5.9

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
40 (Existing condition)	25 to 55	7:00 - 7:15	5	6	11	14	6.3	7.0	7.9	6.3	-1.3	-1.0	3.1	7.7
		7:15 - 7:30	4	6	12	16	5.5	5.5	8.0	6.0	-1.5	0.5	4.0	10.0
		7:30 - 7:45	6	7	14	15	5.6	6.1	7.7	6.8	0.4	0.9	6.3	8.2
		7:45 - 8:00	5	7	13	13	6.0	6.6	7.9	7.3	-1.0	0.4	5.1	5.7
45	30 to 60	7:00 - 7:15	5	6	11	0	6.2	6.3	7.8	6.1	-1.2	-0.3	3.2	-6.1
		7:15 - 7:30	4	6	12	0	6.4	5.8	7.7	6.3	-2.4	0.2	4.3	-6.3
		7:30 - 7:45	6	7	14	14	5.6	6.0	7.8	7.1	0.4	1.0	6.2	6.9
		7:45 - 8:00	5	7	13	0	5.9	6.2	7.4	6.4	-0.9	0.8	5.6	-6.4
50	35 to 65	7:00 - 7:15	5	6	11	0	5.9	6.3	7.6	6.4	-0.9	-0.3	3.4	-6.4
		7:15 - 7:30	4	6	12	0	6.4	6.0	7.3	5.8	-2.4	0.0	4.7	-5.8
		7:30 - 7:45	6	7	14	14	5.7	6.5	7.6	6.6	0.3	0.5	6.4	7.4
		7:45 - 8:00	5	7	13	0	5.4	6.0	7.4	6.4	-0.4	1.0	5.6	-6.4
55	40 to 70	7:00 - 7:15	5	6	11	0	6.0	7.1	8.2	6.3	-1.0	-1.1	2.8	-6.3
		7:15 - 7:30	4	6	12	0	6.4	5.8	7.7	5.8	-2.4	0.2	4.3	-5.8
		7:30 - 7:45	6	7	14	14	6.2	5.8	7.6	6.7	-0.2	1.2	6.4	7.3
		7:45 - 8:00	5	7	13	0	5.8	6.5	7.1	6.6	-0.8	0.5	5.9	-6.6

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NB Volume = 190 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-1.b. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM – WB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
15	10 to 30	7:00 - 7:15	2	6	13	14	2.4	7.5	11.0	13.1	-0.4	-1.5	2.0	0.9
		7:15 - 7:30	3	7	12	15	2.5	7.5	11.6	13.3	0.5	-0.5	0.4	1.7
		7:30 - 7:45	4	7	12	15	2.6	7.5	11.7	13.5	1.4	-0.5	0.3	1.5
		7:45 - 8:00	4	10	13	16	3.4	7.2	11.2	14.6	0.6	2.8	1.8	1.4
20	10 to 35	7:00 - 7:15	2	6	13	14	2.4	7.1	11.4	13.0	-0.4	-1.1	1.6	1.0
		7:15 - 7:30	3	7	12	15	2.5	7.2	11.5	12.4	0.5	-0.2	0.5	2.6
		7:30 - 7:45	4	7	12	15	2.2	7.4	11.2	13.1	1.8	-0.4	0.8	1.9
		7:45 - 8:00	4	10	13	16	3.2	7.1	11.6	13.9	0.8	2.9	1.4	2.1
25	15 to 40	7:00 - 7:15	2	6	13	14	2.1	6.4	9.9	11.2	-0.1	-0.4	3.1	2.8
		7:15 - 7:30	3	7	12	15	2.5	6.4	9.9	10.9	0.5	0.6	2.1	4.1
		7:30 - 7:45	4	7	12	15	2.2	6.3	9.9	10.9	1.8	0.7	2.1	4.1
		7:45 - 8:00	4	10	13	16	3.3	6.3	9.5	11.2	0.7	3.7	3.5	4.8
30	15 to 45	7:00 - 7:15	2	6	13	14	2.0	5.6	9.2	10.3	0.0	0.4	3.8	3.7
		7:15 - 7:30	3	7	12	15	2.1	5.8	9.3	10.4	0.9	1.2	2.7	4.6
		7:30 - 7:45	4	7	12	15	2.0	5.9	9.3	9.8	2.0	1.1	2.7	5.2
		7:45 - 8:00	4	10	13	16	2.9	5.9	9.3	10.3	1.1	4.1	3.7	5.7
35	20 to 50	7:00 - 7:15	2	6	13	14	1.9	5.2	8.9	9.2	0.1	0.8	4.1	4.8
		7:15 - 7:30	3	7	12	15	2.0	5.6	8.9	9.4	1.0	1.4	3.1	5.6
		7:30 - 7:45	4	7	12	15	1.9	5.4	8.9	8.2	2.1	1.6	3.1	6.8
		7:45 - 8:00	4	10	13	16	2.8	5.3	8.3	9.2	1.2	4.7	4.7	6.8

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
40 (Existing condition)	25 to 55	7:00 - 7:15	2	6	13	14	2.0	5.2	8.8	8.5	0.0	0.8	4.2	5.5
		7:15 - 7:30	3	7	12	15	1.9	5.5	8.2	9.2	1.1	1.5	3.8	5.8
		7:30 - 7:45	4	7	12	15	1.9	5.1	8.5	8.0	2.1	1.9	3.5	7.0
		7:45 - 8:00	4	10	13	16	2.6	5.4	7.8	8.9	1.4	4.6	5.2	7.1
45	30 to 60	7:00 - 7:15	2	6	13	14	2.2	5.2	8.5	8.5	-0.2	0.8	4.5	5.5
		7:15 - 7:30	3	7	12	23	2.0	5.2	8.3	8.0	1.0	1.8	3.7	15.0
		7:30 - 7:45	4	7	12	15	2.0	5.1	8.2	7.7	2.0	1.9	3.8	7.3
		7:45 - 8:00	4	10	13	16	2.7	5.2	8.2	8.9	1.3	4.8	4.8	7.1
50	35 to 65	7:00 - 7:15	2	6	13	14	2.0	5.2	8.4	8.5	0.0	0.8	4.6	5.5
		7:15 - 7:30	3	7	12	23	2.0	5.3	8.5	8.4	1.0	1.7	3.5	14.6
		7:30 - 7:45	4	7	12	15	1.9	5.0	7.6	7.4	2.1	2.0	4.4	7.6
		7:45 - 8:00	4	10	13	16	2.5	5.0	8.1	9.1	1.5	5.0	4.9	6.9
55	40 to 70	7:00 - 7:15	2	6	13	14	2.0	5.1	8.2	8.4	0.0	0.9	4.8	5.6
		7:15 - 7:30	3	7	12	23	2.0	5.3	8.2	8.6	1.0	1.7	3.8	14.4
		7:30 - 7:45	4	7	12	15	1.9	5.4	8.1	7.5	2.1	1.6	3.9	7.5
		7:45 - 8:00	4	10	13	16	2.7	5.2	8.0	8.8	1.3	4.8	5.0	7.2

Note:

- Circulating Speed = 13.7 – 18.8 mph
- WB Volume = 281 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-1.c. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM – SB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
15	10 to 30	7:00 - 7:15	4	8	13	15	5.4	9.9	15.3	17.5	-1.4	-1.9	-2.3	-2.5
		7:15 - 7:30	4	9	11	17	5.3	10.2	15.3	18.4	-1.3	-1.2	-4.3	-1.4
		7:30 - 7:45	4	8	11	16	5.7	9.9	14.6	17.4	-1.7	-1.9	-3.6	-1.4
		7:45 - 8:00	4	9	11	15	5.7	9.2	15.3	17.4	-1.7	-0.2	-4.3	-2.4
20	10 to 35	7:00 - 7:15	4	8	13	15	5.8	9.8	15.8	16.9	-1.8	-1.8	-2.8	-1.9
		7:15 - 7:30	4	9	11	17	5.2	10.0	15.8	17.1	-1.2	-1.0	-4.8	-0.1
		7:30 - 7:45	4	8	11	16	5.4	9.6	15.1	16.8	-1.4	-1.6	-4.1	-0.8
		7:45 - 8:00	4	9	11	15	5.4	9.3	15.2	16.4	-1.4	-0.3	-4.2	-1.4
25	15 to 40	7:00 - 7:15	4	8	13	15	4.4	8.2	12.7	14.1	-0.4	-0.2	0.3	0.9
		7:15 - 7:30	4	9	11	17	4.8	8.4	12.7	14.1	-0.8	0.6	-1.7	2.9
		7:30 - 7:45	4	8	11	16	5.4	8.0	13.1	14.2	-1.4	0.0	-2.1	1.8
		7:45 - 8:00	4	9	11	15	5.2	7.5	12.4	13.9	-1.2	1.5	-1.4	1.1
30	15 to 45	7:00 - 7:15	4	8	13	15	4.8	7.5	11.6	13.0	-0.8	0.5	1.4	2.0
		7:15 - 7:30	4	9	11	17	4.9	7.8	11.6	12.8	-0.9	1.2	-0.6	4.2
		7:30 - 7:45	4	8	11	16	4.7	7.7	12.3	12.6	-0.7	0.3	-1.3	3.4
		7:45 - 8:00	4	9	11	15	5.0	7.1	11.9	12.4	-1.0	1.9	-0.9	2.6
35	20 to 50	7:00 - 7:15	4	8	13	15	5.2	7.3	11.7	11.6	-1.2	0.7	1.3	3.4
		7:15 - 7:30	4	9	11	17	5.0	7.4	11.7	11.6	-1.0	1.6	-0.7	5.4
		7:30 - 7:45	4	8	11	16	5.1	7.0	12.4	11.4	-1.1	1.0	-1.4	4.6
		7:45 - 8:00	4	9	11	15	4.4	6.5	11.9	11.4	-0.4	2.5	-0.9	3.6

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
40 (Existing condition)	25 TO 55	7:00 - 7:15	4	8	13	15	4.5	7.0	11.6	10.8	-0.5	1.0	1.4	4.2
		7:15 - 7:30	4	9	11	17	4.9	7.2	11.6	11.3	-0.9	1.8	-0.6	5.7
		7:30 - 7:45	4	8	11	16	5.3	7.0	12.1	10.9	-1.3	1.0	-1.1	5.1
		7:45 - 8:00	4	9	11	15	4.8	6.6	11.5	11.2	-0.8	2.4	-0.5	3.8
45	30 TO 60	7:00 - 7:15	4	8	13	15	5.4	6.9	11.7	11.1	-1.4	1.1	1.3	3.9
		7:15 - 7:30	4	9	11	17	5.1	7.2	11.7	10.8	-1.1	1.8	-0.7	6.2
		7:30 - 7:45	4	8	11	16	5.4	6.9	11.8	11.0	-1.4	1.1	-0.8	5.0
		7:45 - 8:00	4	9	11	15	4.6	6.7	11.8	10.9	-0.6	2.3	-0.8	4.1
50	35 TO 65	7:00 - 7:15	4	8	13	15	5.1	7.1	11.4	10.7	-1.1	0.9	1.6	4.3
		7:15 - 7:30	4	9	11	17	4.7	7.2	11.4	10.5	-0.7	1.8	-0.4	6.5
		7:30 - 7:45	4	8	11	16	4.7	7.1	11.4	10.6	-0.7	0.9	-0.4	5.4
		7:45 - 8:00	4	9	11	15	4.8	6.8	11.4	10.6	-0.8	2.2	-0.4	4.4
55	40 TO 70	7:00 - 7:15	4	8	13	15	5.1	7.0	11.4	10.8	-1.1	1.0	1.6	4.2
		7:15 - 7:30	4	9	11	17	5.5	7.0	11.4	10.4	-1.5	2.0	-0.4	6.6
		7:30 - 7:45	4	8	11	16	5.2	7.1	11.8	10.5	-1.2	0.9	-0.8	5.5
		7:45 - 8:00	4	9	11	15	4.5	6.4	11.5	10.6	-0.5	2.6	-0.5	4.4

Note:

- Circulating Speed = 13.7 – 18.8 mph
- SB Volume = 591 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-1.d. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM – EB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
15	10 to 30	7:00 - 7:15	3	6	11	12	9.6	16.8	16.9	22.9	-6.6	-10.8	-5.9	-10.9
		7:15 - 7:30	4	6	11	13	13.3	13.0	16.9	23.8	-9.3	-7.0	-5.9	-10.8
		7:30 - 7:45	7	7	10	14	10.3	18.3	18.2	24.3	-3.3	-11.3	-8.2	-10.3
		7:45 - 8:00	3	7	11	12	9.7	14.7	17.4	24.7	-6.7	-7.7	-6.4	-12.7
20	10 to 35	7:00 - 7:15	3	6	11	12	11.1	17.6	16.2	22.4	-8.1	-11.6	-5.2	-10.4
		7:15 - 7:30	4	6	11	13	8.5	12.7	17.2	21.3	-4.5	-6.7	-6.2	-8.3
		7:30 - 7:45	7	7	10	14	15.2	16.8	18.2	23.8	-8.2	-9.8	-8.2	-9.8
		7:45 - 8:00	3	7	11	12	12.9	15.5	17.4	22.3	-9.9	-8.5	-6.4	-10.3
25	15 to 40	7:00 - 7:15	3	6	11	12	6.0	12.3	12.9	18.5	-3.0	-6.3	-1.9	-6.5
		7:15 - 7:30	4	6	11	13	9.1	10.9	13.6	18.7	-5.1	-4.9	-2.6	-5.7
		7:30 - 7:45	7	7	10	14	7.0	12.9	13.3	17.1	0.0	-5.9	-3.3	-3.1
		7:45 - 8:00	3	7	11	12	9.6	13.5	13.4	18.7	-6.6	-6.5	-2.4	-6.7
30	15 to 45	7:00 - 7:15	3	6	11	12	7.4	11.0	11.8	16.4	-4.4	-5.0	-0.8	-4.4
		7:15 - 7:30	4	6	11	13	6.5	9.4	12.1	15.8	-2.5	-3.4	-1.1	-2.8
		7:30 - 7:45	7	7	10	14	11.1	10.8	11.6	15.5	-4.1	-3.8	-1.6	-1.5
		7:45 - 8:00	3	7	11	12	6.1	11.8	12.0	15.1	-3.1	-4.8	-1.0	-3.1
35	20 to 50	7:00 - 7:15	3	6	11	12	4.6	9.3	10.3	13.8	-1.6	-3.3	0.7	-1.8
		7:15 - 7:30	4	6	11	13	8.2	8.7	10.9	13.5	-4.2	-2.7	0.1	-0.5
		7:30 - 7:45	7	7	10	14	6.6	10.9	9.9	13.6	0.4	-3.9	0.1	0.4
		7:45 - 8:00	3	7	11	12	5.5	9.6	10.8	13.9	-2.5	-2.6	0.2	-1.9

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
40 (Existing condition)	25 to 55	7:00 - 7:15	3	6	11	12	6.3	9.8	9.7	13.4	-3.3	-3.8	1.3	-1.4
		7:15 - 7:30	4	6	11	13	7.6	8.1	10.1	14.1	-3.6	-2.1	0.9	-1.1
		7:30 - 7:45	7	7	10	14	5.3	10.2	10.1	13.2	1.7	-3.2	-0.1	0.8
		7:45 - 8:00	3	7	11	12	6.4	9.8	10.3	12.6	-3.4	-2.8	0.7	-0.6
45	30 to 60	7:00 - 7:15	3	6	11	12	6.1	8.6	9.5	13.3	-3.1	-2.6	1.5	-1.3
		7:15 - 7:30	4	6	11	13	7.9	8.3	10.0	13.1	-3.9	-2.3	1.0	-0.1
		7:30 - 7:45	7	7	10	14	4.5	10.2	10.0	12.6	2.5	-3.2	0.0	1.4
		7:45 - 8:00	3	7	11	12	6.3	9.2	10.3	12.9	-3.3	-2.2	0.7	-0.9
50	35 to 65	7:00 - 7:15	3	6	11	12	5.6	9.3	9.6	12.3	-2.6	-3.3	1.4	-0.3
		7:15 - 7:30	4	6	11	13	7.0	8.4	9.5	13.4	-3.0	-2.4	1.5	-0.4
		7:30 - 7:45	7	7	10	14	6.5	9.1	10.3	13.8	0.5	-2.1	-0.3	0.2
		7:45 - 8:00	3	7	11	12	5.4	9.3	10.0	12.7	-2.4	-2.3	1.0	-0.7
55	40 to 70	7:00 - 7:15	3	6	11	12	5.3	8.8	10.2	13.1	-2.3	-2.8	0.8	-1.1
		7:15 - 7:30	4	6	11	13	6.1	8.9	10.1	13.2	-2.1	-2.9	0.9	-0.2
		7:30 - 7:45	7	7	10	14	5.8	9.6	10.1	12.3	1.2	-2.6	-0.1	1.7
		7:45 - 8:00	3	7	11	12	7.1	9.7	9.9	12.3	-4.1	-2.7	1.1	-0.3

Note:

- Circulating Speed = 13.7 – 18.8 mph
- EB Volume = 218 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-1.e. Ellington Roundabout – Approach Speed (mph) vs. Travel Time (seconds) – AM – NEB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
15	10 to 30	7:00 - 7:15	2	5	9	14	3.1	10.6	13.6	7.6	-1.1	-5.6	-4.6	6.4
		7:15 - 7:30	2	5	11	15	2.9	9.8	13.4	6.1	-0.9	-4.8	-2.4	8.9
		7:30 - 7:45	2	6	8	16	2.8	10.2	13.3	1.0	-0.8	-4.2	-5.3	15.0
		7:45 - 8:00	2	6	8	15	3.2	10.2	12.6	7.2	-1.2	-4.2	-4.6	7.8
20	10 to 35	7:00 - 7:15	2	5	9	14	3.1	10.6	12.5	6.9	-1.1	-5.6	-3.5	7.1
		7:15 - 7:30	2	5	11	15	3.0	10.8	12.3	6.1	-1.0	-5.8	-1.3	8.9
		7:30 - 7:45	2	6	8	16	2.7	11.0	12.5	1.1	-0.7	-5.0	-4.5	14.9
		7:45 - 8:00	2	6	8	15	2.9	10.2	11.7	6.8	-0.9	-4.2	-3.7	8.2
25	15 to 40	7:00 - 7:15	2	5	9	14	2.8	9.0	10.6	3.1	-0.8	-4.0	-1.6	10.9
		7:15 - 7:30	2	5	11	15	2.6	7.8	11.1	6.2	-0.6	-2.8	-0.1	8.8
		7:30 - 7:45	2	6	8	16	2.5	8.0	10.1	0.9	-0.5	-2.0	-2.1	15.1
		7:45 - 8:00	2	6	8	15	2.8	8.6	9.5	5.2	-0.8	-2.6	-1.5	9.8
30	15 to 45	7:00 - 7:15	2	5	9	14	2.8	8.5	9.3	3.6	-0.8	-3.5	-0.3	10.4
		7:15 - 7:30	2	5	11	15	2.5	7.0	9.4	4.0	-0.5	-2.0	1.6	11.0
		7:30 - 7:45	2	6	8	16	2.3	7.2	8.7	0.7	-0.3	-1.2	-0.7	15.3
		7:45 - 8:00	2	6	8	15	2.6	7.7	9.0	6.0	-0.6	-1.7	-1.0	9.0
35	20 to 50	7:00 - 7:15	2	5	9	14	2.6	7.6	8.5	2.8	-0.6	-2.6	0.5	11.2
		7:15 - 7:30	2	5	11	15	2.4	6.4	8.3	4.4	-0.4	-1.4	2.7	10.6
		7:30 - 7:45	2	6	8	16	2.3	7.0	8.2	1.2	-0.3	-1.0	-0.2	14.8
		7:45 - 8:00	2	6	8	15	2.5	6.5	7.6	4.5	-0.5	-0.5	0.4	10.5

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
40 (Existing condition)	25 to 55	7:00 - 7:15	2	5	9	14	2.6	6.9	7.8	4.1	-0.6	-1.9	1.2	9.9
		7:15 - 7:30	2	5	11	15	2.5	6.5	7.9	4.5	-0.5	-1.5	3.1	10.5
		7:30 - 7:45	2	6	8	16	2.3	6.6	7.8	1.1	-0.3	-0.6	0.2	14.9
		7:45 - 8:00	2	6	8	15	2.6	6.1	7.5	3.7	-0.6	-0.1	0.5	11.3
45	30 to 60	7:00 - 7:15	2	5	9	14	2.6	6.8	7.6	4.1	-0.6	-1.8	1.4	9.9
		7:15 - 7:30	2	5	11	15	2.3	6.3	7.8	3.7	-0.3	-1.3	3.2	11.3
		7:30 - 7:45	2	6	8	16	2.3	6.1	7.4	0.6	-0.3	-0.1	0.6	15.4
		7:45 - 8:00	2	6	8	15	2.7	5.8	7.5	5.5	-0.7	0.2	0.5	9.5
50	35 to 65	7:00 - 7:15	2	5	9	14	2.6	6.8	7.8	3.7	-0.6	-1.8	1.2	10.3
		7:15 - 7:30	2	5	11	15	2.4	6.0	7.7	4.1	-0.4	-1.0	3.3	10.9
		7:30 - 7:45	2	6	8	16	2.3	6.8	7.4	1.0	-0.3	-0.8	0.6	15.0
		7:45 - 8:00	2	6	8	15	2.5	5.9	7.4	4.2	-0.5	0.1	0.6	10.8
55	40 to 70	7:00 - 7:15	2	5	9	14	2.6	6.9	7.5	2.9	-0.6	-1.9	1.5	11.1
		7:15 - 7:30	2	5	11	15	2.4	5.9	7.7	3.8	-0.4	-0.9	3.3	11.2
		7:30 - 7:45	2	6	8	16	2.3	6.6	7.6	1.0	-0.3	-0.6	0.4	15.0
		7:45 - 8:00	2	6	8	15	2.7	6.4	7.1	4.5	-0.7	-0.4	0.9	10.5

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NEB Volume = 193 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-2.a. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM – NB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
10	10 to 15	7:00 - 7:15	5	6	11	0	6.1	6.3	9.2	7.4	-1.1	-0.3	1.8	-7.4
		7:15 - 7:30	4	6	12	0	6.7	7	8.5	6.7	-2.7	-1.0	3.5	-6.7
		7:30 - 7:45	6	7	14	14	6.2	6.2	8.5	7.9	-0.2	0.8	5.5	6.1
		7:45 - 8:00	5	7	13	0	7.3	6.4	8.5	7.4	-2.3	0.6	4.5	-7.4
15	15 to 20 **(16 to 20 Existing condition)**	7:00 - 7:15	5	6	11	0	6.5	6.1	8.1	6.2	-1.5	-0.1	2.9	-6.2
		7:15 - 7:30	4	6	12	0	6.8	6.9	7.8	6.6	-2.8	-0.9	4.2	-6.6
		7:30 - 7:45	6	7	14	14	6.5	6.7	8.2	6.7	-0.5	0.3	5.8	7.3
		7:45 - 8:00	5	7	13	0	6.5	6.1	7.7	6.7	-1.5	0.9	5.3	-6.7
20	20 to 25	7:00 - 7:15	5	6	11	0	5.1	4.9	7.1	6.1	-0.1	1.1	3.9	-6.1
		7:15 - 7:30	4	6	12	0	5.5	5.8	8.0	6.7	-1.5	0.2	4.0	-6.7
		7:30 - 7:45	6	7	14	14	6.2	5.9	7.8	7.9	-0.2	1.1	6.2	6.1
		7:45 - 8:00	5	7	13	0	6.2	5.5	7.7	7.4	-1.2	1.5	5.3	-7.4
25	25 to 30	7:00 - 7:15	5	6	11	0	3.4	4.1	5.3	3.9	1.6	1.9	5.7	-3.9
		7:15 - 7:30	4	6	12	0	3.3	3.5	5.2	4.2	0.7	2.5	6.8	-4.2
		7:30 - 7:45	6	7	14	14	3.8	3.6	5.3	3.8	2.2	3.4	8.7	10.2
		7:45 - 8:00	5	7	13	0	3.1	3.9	6.1	4.0	1.9	3.1	6.9	-4.0
30	30 to 35	7:00 - 7:15	5	6	11	0	2.8	2.3	2.8	2.3	2.2	3.7	8.2	-2.3
		7:15 - 7:30	4	6	12	0	2.6	2.2	2.9	2.8	1.4	3.8	9.1	-2.8
		7:30 - 7:45	6	7	14	14	2.9	3.4	2.5	3.2	3.1	3.6	11.5	10.8
		7:45 - 8:00	5	7	13	0	2.1	3.5	3.3	3.2	2.9	3.5	9.7	-3.2

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- NB Volume = 190 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-2.b. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM – WB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
10	10 to 15	7:00 - 7:15	2	6	13	14	2.1	5.6	9.1	10.2	-0.1	0.4	3.9	3.8
		7:15 - 7:30	3	7	12	23	2.1	6.2	9.3	9.7	0.9	0.8	2.7	13.3
		7:30 - 7:45	4	7	12	15	2.1	5.8	9.5	9.7	1.9	1.2	2.5	5.3
		7:45 - 8:00	4	10	13	16	3.0	6.0	9.0	10.5	1.0	4.0	4.0	5.5
15	15 to 20 **(16 to 20 Existing condition)**	7:00 - 7:15	2	6	13	14	2.1	5.6	9.1	10.2	-0.1	0.4	3.9	3.8
		7:15 - 7:30	3	7	12	23	2.1	6.2	9.3	9.7	0.9	0.8	2.7	13.3
		7:30 - 7:45	4	7	12	15	2.1	5.8	9.5	9.7	1.9	1.2	2.5	5.3
		7:45 - 8:00	4	10	13	16	3.0	6.0	9.0	10.5	1.0	4.0	4.0	5.5
20	20 to 25	7:00 - 7:15	2	6	13	14	2.1	5.6	9.1	10.2	-0.1	0.4	3.9	3.8
		7:15 - 7:30	3	7	12	23	2.1	6.2	9.3	9.7	0.9	0.8	2.7	13.3
		7:30 - 7:45	4	7	12	15	2.1	5.8	9.5	9.7	1.9	1.2	2.5	5.3
		7:45 - 8:00	4	10	13	16	3.0	6.0	9.0	10.5	1.0	4.0	4.0	5.5
25	25 to 30	7:00 - 7:15	2	6	13	14	2.1	5.6	9.1	10.2	-0.1	0.4	3.9	3.8
		7:15 - 7:30	3	7	12	23	2.1	6.2	9.3	9.7	0.9	0.8	2.7	13.3
		7:30 - 7:45	4	7	12	15	2.1	5.8	9.5	9.7	1.9	1.2	2.5	5.3
		7:45 - 8:00	4	10	13	16	3.0	6.0	9.0	10.5	1.0	4.0	4.0	5.5
30	30 to 35	7:00 - 7:15	2	6	13	14	2.1	5.6	9.1	10.2	-0.1	0.4	3.9	3.8
		7:15 - 7:30	3	7	12	23	2.1	6.2	9.3	9.7	0.9	0.8	2.7	13.3
		7:30 - 7:45	4	7	12	15	2.1	5.8	9.5	9.7	1.9	1.2	2.5	5.3
		7:45 - 8:00	4	10	13	16	3.0	6.0	9.0	10.5	1.0	4.0	4.0	5.5

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- WB Volume = 281 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-2.c. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM – SB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
10	10 to 15	7:00 - 7:15	4	8	13	15	4.5	7.3	11.7	13.5	-0.5	0.7	1.3	1.5
		7:15 - 7:30	4	9	11	17	4.9	7.8	11.7	12.9	-0.9	1.2	-0.7	4.1
		7:30 - 7:45	4	8	11	16	4.8	7.7	12.3	12.7	-0.8	0.3	-1.3	3.3
		7:45 - 8:00	4	9	11	15	4.6	7.1	12.1	12.7	-0.6	1.9	-1.1	2.3
15	15 to 20 **(16 to 20 Existing condition)**	7:00 - 7:15	4	8	13	15	4.5	7.3	11.7	13.5	-0.5	0.7	1.3	1.5
		7:15 - 7:30	4	9	11	17	4.9	7.8	11.7	12.9	-0.9	1.2	-0.7	4.1
		7:30 - 7:45	4	8	11	16	4.8	7.7	12.3	12.7	-0.8	0.3	-1.3	3.3
		7:45 - 8:00	4	9	11	15	4.6	7.1	12.1	12.7	-0.6	1.9	-1.1	2.3
20	20 to 25	7:00 - 7:15	4	8	13	15	4.5	7.3	11.7	13.5	-0.5	0.7	1.3	1.5
		7:15 - 7:30	4	9	11	17	4.9	7.8	11.7	12.9	-0.9	1.2	-0.7	4.1
		7:30 - 7:45	4	8	11	16	4.8	7.7	12.3	12.7	-0.8	0.3	-1.3	3.3
		7:45 - 8:00	4	9	11	15	4.6	7.1	12.1	12.7	-0.6	1.9	-1.1	2.3
25	25 to 30	7:00 - 7:15	4	8	13	15	4.5	7.3	11.7	13.5	-0.5	0.7	1.3	1.5
		7:15 - 7:30	4	9	11	17	4.9	7.8	11.7	12.9	-0.9	1.2	-0.7	4.1
		7:30 - 7:45	4	8	11	16	4.8	7.7	12.3	12.7	-0.8	0.3	-1.3	3.3
		7:45 - 8:00	4	9	11	15	4.6	7.1	12.1	12.7	-0.6	1.9	-1.1	2.3
30	30 to 35	7:00 - 7:15	4	8	13	15	4.5	7.3	11.7	13.5	-0.5	0.7	1.3	1.5
		7:15 - 7:30	4	9	11	17	4.9	7.8	11.7	12.9	-0.9	1.2	-0.7	4.1
		7:30 - 7:45	4	8	11	16	4.8	7.7	12.3	12.7	-0.8	0.3	-1.3	3.3
		7:45 - 8:00	4	9	11	15	4.6	7.1	12.1	12.7	-0.6	1.9	-1.1	2.3

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- SB Volume = 591 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-2.d. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM – EB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
10	10 to 15	7:00 - 7:15	3	6	11	12	6.7	11.3	11.3	16.2	-3.7	-5.3	-0.3	-4.2
		7:15 - 7:30	4	6	11	13	7.8	9.5	11.7	16.3	-3.8	-3.5	-0.7	-3.3
		7:30 - 7:45	7	7	10	14	6.3	11.5	11.7	15.2	0.7	-4.5	-1.7	-1.2
		7:45 - 8:00	3	7	11	12	8.6	11.0	11.7	15.6	-5.6	-4.0	-0.7	-3.6
15	15 to 20 **(16 to 20 Existing condition)**	7:00 - 7:15	3	6	11	12	6.7	11.3	11.3	16.2	-3.7	-5.3	-0.3	-4.2
		7:15 - 7:30	4	6	11	13	7.8	9.5	11.7	16.3	-3.8	-3.5	-0.7	-3.3
		7:30 - 7:45	7	7	10	14	6.3	11.5	11.7	15.2	0.7	-4.5	-1.7	-1.2
		7:45 - 8:00	3	7	11	12	8.6	11.0	11.7	15.6	-5.6	-4.0	-0.7	-3.6
20	20 to 25	7:00 - 7:15	3	6	11	12	6.7	11.3	11.3	16.2	-3.7	-5.3	-0.3	-4.2
		7:15 - 7:30	4	6	11	13	7.8	9.5	11.7	16.3	-3.8	-3.5	-0.7	-3.3
		7:30 - 7:45	7	7	10	14	6.3	11.5	11.7	15.2	0.7	-4.5	-1.7	-1.2
		7:45 - 8:00	3	7	11	12	8.6	11.0	11.7	15.6	-5.6	-4.0	-0.7	-3.6
25	25 to 30	7:00 - 7:15	3	6	11	12	6.7	11.3	11.3	16.2	-3.7	-5.3	-0.3	-4.2
		7:15 - 7:30	4	6	11	13	7.8	9.5	11.7	16.3	-3.8	-3.5	-0.7	-3.3
		7:30 - 7:45	7	7	10	14	6.3	11.5	11.7	15.2	0.7	-4.5	-1.7	-1.2
		7:45 - 8:00	3	7	11	12	8.6	11.0	11.7	15.6	-5.6	-4.0	-0.7	-3.6
30	30 to 35	7:00 - 7:15	3	6	11	12	6.7	11.3	11.3	16.2	-3.7	-5.3	-0.3	-4.2
		7:15 - 7:30	4	6	11	13	7.8	9.5	11.7	16.3	-3.8	-3.5	-0.7	-3.3
		7:30 - 7:45	7	7	10	14	6.3	11.5	11.7	15.2	0.7	-4.5	-1.7	-1.2
		7:45 - 8:00	3	7	11	12	8.6	11.0	11.7	15.6	-5.6	-4.0	-0.7	-3.6

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- EB Volume = 218 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-2.e. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM – NEB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
10	10 to 15	7:00 - 7:15	2	5	9	14	2.6	7.9	8.8	3.7	-0.6	-2.9	0.2	10.3
		7:15 - 7:30	2	5	11	15	2.3	7.2	8.8	3.7	-0.3	-2.2	2.2	11.3
		7:30 - 7:45	2	6	8	16	2.4	7.7	8.7	0.7	-0.4	-1.7	-0.7	15.3
		7:45 - 8:00	2	6	8	15	2.7	6.6	8.1	4.6	-0.7	-0.6	-0.1	10.4
15	15 to 20 **(16 to 20 Existing condition)**	7:00 - 7:15	2	5	9	14	2.6	7.9	8.8	3.7	-0.6	-2.9	0.2	10.3
		7:15 - 7:30	2	5	11	15	2.3	7.2	8.8	3.7	-0.3	-2.2	2.2	11.3
		7:30 - 7:45	2	6	8	16	2.4	7.7	8.7	0.7	-0.4	-1.7	-0.7	15.3
		7:45 - 8:00	2	6	8	15	2.7	6.6	8.1	4.6	-0.7	-0.6	-0.1	10.4
20	20 to 25	7:00 - 7:15	2	5	9	14	2.6	7.9	8.8	3.7	-0.6	-2.9	0.2	10.3
		7:15 - 7:30	2	5	11	15	2.3	7.2	8.8	3.7	-0.3	-2.2	2.2	11.3
		7:30 - 7:45	2	6	8	16	2.4	7.7	8.7	0.7	-0.4	-1.7	-0.7	15.3
		7:45 - 8:00	2	6	8	15	2.7	6.6	8.1	4.6	-0.7	-0.6	-0.1	10.4
25	25 to 30	7:00 - 7:15	2	5	9	14	2.6	7.9	8.8	3.7	-0.6	-2.9	0.2	10.3
		7:15 - 7:30	2	5	11	15	2.3	7.2	8.8	3.7	-0.3	-2.2	2.2	11.3
		7:30 - 7:45	2	6	8	16	2.4	7.7	8.7	0.7	-0.4	-1.7	-0.7	15.3
		7:45 - 8:00	2	6	8	15	2.7	6.6	8.1	4.6	-0.7	-0.6	-0.1	10.4
30	30 to 35	7:00 - 7:15	2	5	9	14	2.6	7.9	8.8	3.7	-0.6	-2.9	0.2	10.3
		7:15 - 7:30	2	5	11	15	2.3	7.2	8.8	3.7	-0.3	-2.2	2.2	11.3
		7:30 - 7:45	2	6	8	16	2.4	7.7	8.7	0.7	-0.4	-1.7	-0.7	15.3
		7:45 - 8:00	2	6	8	15	2.7	6.6	8.1	4.6	-0.7	-0.6	-0.1	10.4

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- NEB Volume = 193 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-3.a. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM – NB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
-1	7:00 - 7:15	5	6	11	13	5.8	6.2	8.2	7.5	-0.8	-0.2	2.8	5.5
	7:15 - 7:30	4	6	12	15	5.2	5.3	8.1	6.7	-1.2	0.7	3.9	8.3
	7:30 - 7:45	6	7	14	0	5.4	6.0	8.1	7.6	0.6	1.0	5.9	-7.6
	7:45 - 8:00	5	7	13	0	5.4	5.9	8.0	8.1	-0.4	1.1	5.0	-8.1
-0.5	7:00 - 7:15	5	6	11	13	5.8	5.9	8.3	8.0	-0.8	0.1	2.7	5.0
	7:15 - 7:30	4	6	12	15	5.9	5.5	8.1	6.5	-1.9	0.5	3.9	8.5
	7:30 - 7:45	6	7	14	0	5.8	6.1	7.9	7.8	0.2	0.9	6.1	-7.8
	7:45 - 8:00	5	7	13	0	6.1	6.4	7.9	7.8	-1.1	0.6	5.1	-7.8
0.5	7:00 - 7:15	5	6	11	13	6.6	8.3	9.7	7.6	-1.6	-2.3	1.3	5.4
	7:15 - 7:30	4	6	12	15	7.1	7.2	9.5	6.6	-3.1	-1.2	2.5	8.4
	7:30 - 7:45	6	7	14	0	7.7	7.2	9.1	7.9	-1.7	-0.2	4.9	-7.9
	7:45 - 8:00	5	7	13	0	7.6	7.9	9.4	7.9	-2.6	-0.9	3.6	-7.9
1	7:00 - 7:15	5	6	11	13	8.1	7.4	9.8	7.9	-3.1	-1.4	1.2	5.1
	7:15 - 7:30	4	6	12	15	8.5	8.2	9.3	7.0	-4.5	-2.2	2.7	8.0
	7:30 - 7:45	6	7	14	0	6.9	7.7	8.9	8.0	-0.9	-0.7	5.1	-8.0
	7:45 - 8:00	5	7	13	0	9.1	8.6	8.8	8.3	-4.1	-1.6	4.2	-8.3
2	7:00 - 7:15	5	6	11	13	8.6	8.3	9.9	7.5	-3.6	-2.3	1.1	5.5
	7:15 - 7:30	4	6	12	15	8.7	10.4	9.3	6.8	-4.7	-4.4	2.7	8.2
	7:30 - 7:45	6	7	14	0	8.0	9.4	9.7	7.8	-2.0	-2.4	4.3	-7.8
	7:45 - 8:00	5	7	13	0	9.8	8.9	8.7	7.6	-4.8	-1.9	4.3	-7.6

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
3	7:00 - 7:15	5	6	11	13	10.2	8.7	10.9	7.5	-5.2	-2.7	0.1	5.5
	7:15 - 7:30	4	6	12	15	10.5	9.7	10.1	6.9	-6.5	-3.7	1.9	8.1
	7:30 - 7:45	6	7	14	0	9.2	10.2	9.3	7.7	-3.2	-3.2	4.7	-7.7
	7:45 - 8:00	5	7	13	0	10.1	9.6	10.3	7.8	-5.1	-2.6	2.7	-7.8

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- NB Volume = 190 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-3.b. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM – WB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
-1	7:00 - 7:15	2	6	13	14	1.5	5.0	8.5	9.4	0.5	1.0	4.5	4.6
	7:15 - 7:30	3	7	12	15	1.5	5.5	8.9	10.0	1.5	1.5	3.1	5.0
	7:30 - 7:45	4	7	12	15	1.5	5.6	8.8	9.4	2.5	1.4	3.2	5.6
	7:45 - 8:00	4	10	13	16	2.2	5.7	8.6	9.5	1.8	4.3	4.4	6.5
-0.5	7:00 - 7:15	2	6	13	14	1.3	5.3	8.8	9.9	0.7	0.7	4.2	4.1
	7:15 - 7:30	3	7	12	15	1.3	5.9	9.2	10.1	1.7	1.1	2.8	4.9
	7:30 - 7:45	4	7	12	15	1.3	5.6	9.3	9.6	2.7	1.4	2.7	5.4
	7:45 - 8:00	4	10	13	16	2.2	5.6	8.6	10.1	1.8	4.4	4.4	5.9
0.5	7:00 - 7:15	2	6	13	14	1.5	5.8	9.7	10.6	0.5	0.2	3.3	3.4
	7:15 - 7:30	3	7	12	15	1.4	6.0	10.2	10.3	1.6	1.0	1.8	4.7
	7:30 - 7:45	4	7	12	15	1.4	6.2	9.9	10.2	2.6	0.8	2.1	4.8
	7:45 - 8:00	4	10	13	16	2.5	5.8	10.0	10.9	1.5	4.2	3.0	5.1
1	7:00 - 7:15	2	6	13	14	4.5	8.4	12.0	12.9	-2.5	-2.4	1.0	1.1
	7:15 - 7:30	3	7	12	15	4.2	8.9	14.6	12.2	-1.2	-1.9	-2.6	3.0
	7:30 - 7:45	4	7	12	15	4.5	8.2	13.2	11.8	-0.5	-1.2	-1.2	3.2
	7:45 - 8:00	4	10	13	16	5.2	7.9	14.3	13.0	-1.2	2.1	-1.3	3.0
2	7:00 - 7:15	2	6	13	14	6.4	9.8	15.0	14.0	-4.4	-3.8	-2.0	0.0
	7:15 - 7:30	3	7	12	15	6.2	10.0	16.5	13.1	-3.2	-3.0	-4.5	2.0
	7:30 - 7:45	4	7	12	15	6.0	9.4	15.5	12.7	-2.0	-2.4	-3.5	2.3
	7:45 - 8:00	4	10	13	16	6.2	8.6	15.5	13.7	-2.2	1.4	-2.5	2.3

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
3	7:00 - 7:15	2	6	13	14	7.8	11.1	19.8	14.5	-5.8	-5.1	-6.8	-0.5
	7:15 - 7:30	3	7	12	15	8.2	10.9	20.8	16.0	-5.2	-3.9	-8.8	-1.0
	7:30 - 7:45	4	7	12	15	7.3	11.0	20.3	15.6	-3.3	-4.0	-8.3	-0.6
	7:45 - 8:00	4	10	13	16	7.3	9.9	18.2	14.7	-3.3	0.1	-5.2	1.3

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- WB Volume = 281 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-3.c. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM – SB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
-1	7:00 - 7:15	4	8	13	15	3.4	6.4	8.9	11.4	0.6	1.6	4.1	3.6
	7:15 - 7:30	4	9	11	17	3.5	6.6	8.9	11.5	0.5	2.4	2.1	5.5
	7:30 - 7:45	4	8	11	16	3.9	6.6	9.2	11.4	0.1	1.4	1.8	4.6
	7:45 - 8:00	4	9	11	15	3.6	6.0	9.0	11.5	0.4	3.0	2.0	3.5
-0.5	7:00 - 7:15	4	8	13	15	4.3	7.0	10.5	11.8	-0.3	1.0	2.5	3.2
	7:15 - 7:30	4	9	11	17	4.4	7.3	10.5	11.8	-0.4	1.7	0.5	5.2
	7:30 - 7:45	4	8	11	16	4.1	7.1	10.6	12.0	-0.1	0.9	0.4	4.0
	7:45 - 8:00	4	9	11	15	4.5	6.7	10.4	11.7	-0.5	2.3	0.6	3.3
0.5	7:00 - 7:15	4	8	13	15	6.6	8.4	14.9	14.2	-2.6	-0.4	-1.9	0.8
	7:15 - 7:30	4	9	11	17	5.9	8.8	14.9	14.1	-1.9	0.2	-3.9	2.9
	7:30 - 7:45	4	8	11	16	5.2	8.7	15.2	13.7	-1.2	-0.7	-4.2	2.3
	7:45 - 8:00	4	9	11	15	6.0	7.7	14.5	13.5	-2.0	1.3	-3.5	1.5
1	7:00 - 7:15	4	8	13	15	6.8	11.1	19.2	16.1	-2.8	-3.1	-6.2	-1.1
	7:15 - 7:30	4	9	11	17	9.4	10.1	19.2	15.6	-5.4	-1.1	-8.2	1.4
	7:30 - 7:45	4	8	11	16	6.9	9.4	20.4	16.6	-2.9	-1.4	-9.4	-0.6
	7:45 - 8:00	4	9	11	15	8.2	9.3	19.9	15.0	-4.2	-0.3	-8.9	0.0
2	7:00 - 7:15	4	8	13	15	11.1	13.3	30.6	18.3	-7.1	-5.3	-17.6	-3.3
	7:15 - 7:30	4	9	11	17	10.8	13.4	30.6	18.2	-6.8	-4.4	-19.6	-1.2
	7:30 - 7:45	4	8	11	16	12.1	13.8	31.3	17.7	-8.1	-5.8	-20.3	-1.7
	7:45 - 8:00	4	9	11	15	13.0	12.8	27.1	17.2	-9.0	-3.8	-16.1	-2.2

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
3	7:00 - 7:15	4	8	13	15	18.1	20.3	43.1	23.0	-14.1	-12.3	-30.1	-8.0
	7:15 - 7:30	4	9	11	17	14.0	17.7	43.1	25.3	-10.0	-8.7	-32.1	-8.3
	7:30 - 7:45	4	8	11	16	18.6	18.3	45.5	26.5	-14.6	-10.3	-34.5	-10.5
	7:45 - 8:00	4	9	11	15	10.8	15.6	35.5	22.8	-6.8	-6.6	-24.5	-7.8

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- SB Volume = 591 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-3.d. Ellington Roundabout - Critical Gap (seconds) vs. Travel Time (seconds) – AM – EB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
-1	7:00 - 7:15	3	6	11	12	8.4	11.8	11.8	16.8	-5.4	-5.8	-0.8	-4.8
	7:15 - 7:30	4	6	11	13	7.2	9.5	12.0	15.7	-3.2	-3.5	-1.0	-2.7
	7:30 - 7:45	7	7	10	14	7.6	12.5	12.8	16.2	-0.6	-5.5	-2.8	-2.2
	7:45 - 8:00	3	7	11	12	7.9	11.4	12.6	16.1	-4.9	-4.4	-1.6	-4.1
-0.5	7:00 - 7:15	3	6	11	12	6.5	11.6	12.0	16.1	-3.5	-5.6	-1.0	-4.1
	7:15 - 7:30	4	6	11	13	7.5	9.1	11.5	15.1	-3.5	-3.1	-0.5	-2.1
	7:30 - 7:45	7	7	10	14	7.0	10.9	12.1	15.5	0.0	-3.9	-2.1	-1.5
	7:45 - 8:00	3	7	11	12	6.8	11.2	11.8	16.2	-3.8	-4.2	-0.8	-4.2
0.5	7:00 - 7:15	3	6	11	12	5.1	10.4	11.8	15.1	-2.1	-4.4	-0.8	-3.1
	7:15 - 7:30	4	6	11	13	6.2	8.7	11.9	15.4	-2.2	-2.7	-0.9	-2.4
	7:30 - 7:45	7	7	10	14	8.1	10.1	12.0	14.9	-1.1	-3.1	-2.0	-0.9
	7:45 - 8:00	3	7	11	12	7.6	9.9	11.6	15.5	-4.6	-2.9	-0.6	-3.5
1	7:00 - 7:15	3	6	11	12	4.5	10.1	11.0	13.9	-1.5	-4.1	0.0	-1.9
	7:15 - 7:30	4	6	11	13	6.8	10.0	10.4	14.9	-2.8	-4.0	0.6	-1.9
	7:30 - 7:45	7	7	10	14	9.0	10.4	11.0	15.2	-2.0	-3.4	-1.0	-1.2
	7:45 - 8:00	3	7	11	12	7.4	10.0	12.2	15.4	-4.4	-3.0	-1.2	-3.4
2	7:00 - 7:15	3	6	11	12	4.4	8.0	9.3	12.0	-1.4	-2.0	1.7	0.0
	7:15 - 7:30	4	6	11	13	5.9	7.7	9.5	12.2	-1.9	-1.7	1.5	0.8
	7:30 - 7:45	7	7	10	14	6.8	8.7	9.6	12.5	0.2	-1.7	0.4	1.5
	7:45 - 8:00	3	7	11	12	4.7	8.2	9.8	12.9	-1.7	-1.2	1.2	-0.9

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
3	7:00 - 7:15	3	6	11	12	4.9	6.6	8.5	11.3	-1.9	-0.6	2.5	0.7
	7:15 - 7:30	4	6	11	13	4.6	6.3	8.8	10.8	-0.6	-0.3	2.2	2.2
	7:30 - 7:45	7	7	10	14	5.1	7.1	8.6	12.1	1.9	-0.1	1.4	1.9
	7:45 - 8:00	3	7	11	12	4.8	7.6	9.2	11.5	-1.8	-0.6	1.8	0.5

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- EB Volume = 218 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-3.e. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM – NEB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
-1	7:00 - 7:15	2	5	9	14	2.6	6.1	7.0	2.7	-0.6	-1.1	2.0	11.3
	7:15 - 7:30	2	5	11	15	2.4	5.7	7.3	4.3	-0.4	-0.7	3.7	10.7
	7:30 - 7:45	2	6	8	16	2.0	6.0	7.0	0.7	0.0	0.0	1.0	15.3
	7:45 - 8:00	2	6	8	15	2.4	5.4	7.0	4.8	-0.4	0.6	1.0	10.2
-0.5	7:00 - 7:15	2	5	9	14	2.5	6.8	8.0	2.6	-0.5	-1.8	1.0	11.4
	7:15 - 7:30	2	5	11	15	2.3	6.2	7.8	3.9	-0.3	-1.2	3.2	11.1
	7:30 - 7:45	2	6	8	16	2.2	6.4	7.6	0.7	-0.2	-0.4	0.4	15.3
	7:45 - 8:00	2	6	8	15	2.5	6.0	7.6	4.7	-0.5	0.0	0.4	10.3
0.5	7:00 - 7:15	2	5	9	14	2.7	9.1	9.5	3.5	-0.7	-4.1	-0.5	10.5
	7:15 - 7:30	2	5	11	15	2.5	7.9	9.6	4.7	-0.5	-2.9	1.4	10.3
	7:30 - 7:45	2	6	8	16	2.4	8.6	9.4	1.7	-0.4	-2.6	-1.4	14.3
	7:45 - 8:00	2	6	8	15	2.6	8.2	9.1	5.3	-0.6	-2.2	-1.1	9.7
1	7:00 - 7:15	2	5	9	14	2.9	8.2	9.8	2.9	-0.9	-3.2	-0.8	11.1
	7:15 - 7:30	2	5	11	15	2.6	8.2	10.6	5.8	-0.6	-3.2	0.4	9.2
	7:30 - 7:45	2	6	8	16	2.4	8.1	9.7	0.6	-0.4	-2.1	-1.7	15.4
	7:45 - 8:00	2	6	8	15	2.5	8.3	10.3	4.6	-0.5	-2.3	-2.3	10.4
2	7:00 - 7:15	2	5	9	14	2.7	9.3	10.1	2.0	-0.7	-4.3	-1.1	12.0
	7:15 - 7:30	2	5	11	15	2.6	8.6	10.6	5.1	-0.6	-3.6	0.4	9.9
	7:30 - 7:45	2	6	8	16	2.4	9.2	10.4	1.2	-0.4	-3.2	-2.4	14.8
	7:45 - 8:00	2	6	8	15	2.6	7.9	10.1	9.0	-0.6	-1.9	-2.1	6.0

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
3	7:00 - 7:15	2	5	9	14	2.9	9.0	10.8	3.2	-0.9	-4.0	-1.8	10.8
	7:15 - 7:30	2	5	11	15	2.5	8.3	11.0	4.5	-0.5	-3.3	0.0	10.5
	7:30 - 7:45	2	6	8	16	2.3	8.3	10.3	2.3	-0.3	-2.3	-2.3	13.7
	7:45 - 8:00	2	6	8	15	2.6	8.6	10.5	7.9	-0.6	-2.6	-2.5	7.1

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- NEB Volume = 193 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-4.a. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – AM – NB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
-30	7:00 - 7:15	5	6	11	14	6.5	6.4	8.9	7.5	-1.5	-0.4	2.1	6.5
	7:15 - 7:30	4	6	12	16	6.4	6.5	8.6	6.9	-2.4	-0.5	3.4	9.1
	7:30 - 7:45	6	7	14	15	6.2	7.1	8.5	7.8	-0.2	-0.1	5.5	7.2
	7:45 - 8:00	5	7	13	13	6.7	6.2	8.5	7.9	-1.7	0.8	4.5	5.1
-20	7:00 - 7:15	5	6	11	0	6.5	7.0	8.9	7.4	-1.5	-1.0	2.1	-7.4
	7:15 - 7:30	4	6	12	0	6.3	6.6	8.5	6.7	-2.3	-0.6	3.5	-6.7
	7:30 - 7:45	6	7	14	14	6.0	6.9	8.4	7.9	0.0	0.1	5.6	6.1
	7:45 - 8:00	5	7	13	0	6.5	7.1	8.8	7.2	-1.5	-0.1	4.2	-7.2
-10	7:00 - 7:15	5	6	11	0	6.9	6.2	8.6	8.0	-1.9	-0.2	2.4	-8.0
	7:15 - 7:30	4	6	12	0	6.7	6.7	8.6	6.6	-2.7	-0.7	3.4	-6.6
	7:30 - 7:45	6	7	14	14	6.1	6.9	8.5	7.9	-0.1	0.1	5.5	6.1
	7:45 - 8:00	5	7	13	0	7.4	6.7	8.8	7.8	-2.4	0.3	4.2	-7.8
10	7:00 - 7:15	5	6	11	0	7.0	7.0	8.7	7.4	-2.0	-1.0	2.3	-7.4
	7:15 - 7:30	4	6	12	0	7.0	7.6	8.9	6.6	-3.0	-1.6	3.1	-6.6
	7:30 - 7:45	6	7	14	14	6.7	6.7	8.4	8.0	-0.7	0.3	5.6	6.0
	7:45 - 8:00	5	7	13	0	7.4	7.0	8.4	7.5	-2.4	0.0	4.6	-7.5
20	7:00 - 7:15	5	6	11	0	9.6	7.5	9.4	7.3	-4.6	-1.5	1.6	-7.3
	7:15 - 7:30	4	6	12	0	9.6	6.9	9.3	6.6	-5.6	-0.9	2.7	-6.6
	7:30 - 7:45	6	7	14	14	8.3	10.4	9.0	7.6	-2.3	-3.4	5.0	6.4
	7:45 - 8:00	5	7	13	0	10.8	8.1	8.1	7.7	-5.8	-1.1	4.9	-7.7

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
25	7:00 - 7:15	5	6	11	13	9.6	7.5	9.4	7.3	-4.6	-1.5	1.6	5.7
	7:15 - 7:30	4	6	12	15	9.6	6.9	9.3	6.6	-5.6	-0.9	2.7	8.4
	7:30 - 7:45	6	7	14	0	8.3	10.4	9.0	7.6	-2.3	-3.4	5.0	-7.6
	7:45 - 8:00	5	7	13	0	10.8	8.1	8.1	7.7	-5.8	-1.1	4.9	-7.7
30	7:00 - 7:15	5	6	11	13	9.2	9.0	9.4	7.3	-4.2	-3.0	1.6	5.7
	7:15 - 7:30	4	6	12	15	11.2	8.1	8.8	6.8	-7.2	-2.1	3.2	8.2
	7:30 - 7:45	6	7	14	0	8.9	11.3	9.5	7.6	-2.9	-4.3	4.5	-7.6
	7:45 - 8:00	5	7	13	0	11.0	8.9	8.8	7.3	-6.0	-1.9	4.2	-7.3
35	7:00 - 7:15	5	6	11	13	8.4	8.8	9.6	7.1	-3.4	-2.8	1.4	5.9
	7:15 - 7:30	4	6	12	15	10.8	7.4	8.2	6.7	-6.8	-1.4	3.8	8.3
	7:30 - 7:45	6	7	14	0	9.9	12.1	9.2	8.1	-3.9	-5.1	4.8	-8.1
	7:45 - 8:00	5	7	13	0	9.5	8.5	9.5	7.4	-4.5	-1.5	3.5	-7.4
36	7:00 - 7:15	5	6	11	13	7.7	7.8	8.5	7.0	-2.7	-1.8	2.5	6.0
	7:15 - 7:30	4	6	12	15	9.3	7.6	8.4	6.3	-5.3	-1.6	3.6	8.7
	7:30 - 7:45	6	7	14	0	7.2	8.9	8.5	7.7	-1.2	-1.9	5.5	-7.7
	7:45 - 8:00	5	7	13	0	8.4	8.7	8.1	7.3	-3.4	-1.7	4.9	-7.3
37	7:00 - 7:15	5	6	11	13	8.2	7.8	8.4	7.1	-3.2	-1.8	2.6	5.9
	7:15 - 7:30	4	6	12	15	10.1	7.2	7.9	6.2	-6.1	-1.2	4.1	8.8
	7:30 - 7:45	6	7	14	0	8.1	8.7	8.8	7.9	-2.1	-1.7	5.2	-7.9
	7:45 - 8:00	5	7	13	0	8.9	7.8	8.3	7.4	-3.9	-0.8	4.7	-7.4

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
40	7:00 - 7:15	5	6	11	13	7.8	8.6	8.7	7.1	-2.8	-2.6	2.3	5.9
	7:15 - 7:30	4	6	12	15	9.7	7.5	7.9	6.5	-5.7	-1.5	4.1	8.5
	7:30 - 7:45	6	7	14	0	8.4	8.1	7.8	7.7	-2.4	-1.1	6.2	-7.7
	7:45 - 8:00	5	7	13	0	8.6	7.6	8.5	7.3	-3.6	-0.6	4.5	-7.3

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- NB Volume = 190 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-4.b. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – AM – WB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
-30	7:00 - 7:15	2	6	13	14	2.1	5.7	9.2	10.0	-0.1	0.3	3.8	4.0
	7:15 - 7:30	3	7	12	15	2.2	6.1	9.9	10.3	0.8	0.9	2.1	4.7
	7:30 - 7:45	4	7	12	15	2.0	5.8	8.9	9.5	2.0	1.2	3.1	5.5
	7:45 - 8:00	4	10	13	16	2.9	5.9	9.1	10.4	1.1	4.1	3.9	5.6
-20	7:00 - 7:15	2	6	13	14	2.1	5.7	9.3	10.2	-0.1	0.3	3.7	3.8
	7:15 - 7:30	3	7	12	23	2.2	6.0	9.3	10.1	0.8	1.0	2.7	12.9
	7:30 - 7:45	4	7	12	15	1.9	5.8	9.1	10.2	2.1	1.2	2.9	4.8
	7:45 - 8:00	4	10	13	16	2.9	6.0	8.9	10.0	1.1	4.0	4.1	6.0
-10	7:00 - 7:15	2	6	13	14	2.0	5.6	9.2	10.0	0.0	0.4	3.8	4.0
	7:15 - 7:30	3	7	12	23	2.1	5.9	9.3	10.1	0.9	1.1	2.7	12.9
	7:30 - 7:45	4	7	12	15	2.0	5.9	9.0	9.6	2.0	1.1	3.0	5.4
	7:45 - 8:00	4	10	13	16	2.9	5.9	9.0	10.4	1.1	4.1	4.0	5.6
10	7:00 - 7:15	2	6	13	14	2.0	5.6	9.1	9.9	0.0	0.4	3.9	4.1
	7:15 - 7:30	3	7	12	23	2.1	5.7	9.5	10.3	0.9	1.3	2.5	12.7
	7:30 - 7:45	4	7	12	15	1.9	5.7	9.4	9.9	2.1	1.3	2.6	5.1
	7:45 - 8:00	4	10	13	16	2.9	5.7	9.0	10.1	1.1	4.3	4.0	5.9
20	7:00 - 7:15	2	6	13	14	2.4	6.2	9.6	10.2	-0.4	-0.2	3.4	3.8
	7:15 - 7:30	3	7	12	23	2.3	6.4	9.7	10.4	0.7	0.6	2.3	12.6
	7:30 - 7:45	4	7	12	15	2.4	5.9	8.9	9.5	1.6	1.1	3.1	5.5
	7:45 - 8:00	4	10	13	16	3.5	6.0	9.1	10.9	0.5	4.0	3.9	5.1

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
25	7:00 - 7:15	2	6	13	14	2.4	6.2	9.6	10.2	-0.4	-0.2	3.4	3.8
	7:15 - 7:30	3	7	12	15	2.3	6.4	9.7	10.4	0.7	0.6	2.3	4.6
	7:30 - 7:45	4	7	12	15	2.4	5.9	8.9	9.5	1.6	1.1	3.1	5.5
	7:45 - 8:00	4	10	13	16	3.5	6.0	9.1	10.9	0.5	4.0	3.9	5.1
30	7:00 - 7:15	2	6	13	14	1.4	5.9	9.3	10.4	0.6	0.1	3.7	3.6
	7:15 - 7:30	3	7	12	15	1.4	6.5	9.8	9.7	1.6	0.5	2.2	5.3
	7:30 - 7:45	4	7	12	15	1.4	5.9	8.7	9.7	2.6	1.1	3.3	5.3
	7:45 - 8:00	4	10	13	16	2.5	6.0	9.8	10.8	1.5	4.0	3.2	5.2
35	7:00 - 7:15	2	6	13	14	1.4	5.9	10.3	10.5	0.6	0.1	2.7	3.5
	7:15 - 7:30	3	7	12	15	1.4	6.7	10.0	10.2	1.6	0.3	2.0	4.8
	7:30 - 7:45	4	7	12	15	1.4	6.2	9.7	9.6	2.6	0.8	2.3	5.4
	7:45 - 8:00	4	10	13	16	2.7	6.3	10.5	10.6	1.3	3.7	2.5	5.4
36	7:00 - 7:15	2	6	13	14	1.5	7.9	17.2	15.7	0.5	-1.9	-4.2	-1.7
	7:15 - 7:30	3	7	12	15	1.5	8.9	15.6	11.9	1.5	-1.9	-3.6	3.1
	7:30 - 7:45	4	7	12	15	1.5	8.9	13.9	16.2	2.5	-1.9	-1.9	-1.2
	7:45 - 8:00	4	10	13	16	2.6	8.4	15.2	13.4	1.4	1.6	-2.2	2.6
37	7:00 - 7:15	2	6	13	14	1.5	8.3	17.4	14.2	0.5	-2.3	-4.4	-0.2
	7:15 - 7:30	3	7	12	15	1.5	9.7	17.0	12.3	1.5	-2.7	-5.0	2.7
	7:30 - 7:45	4	7	12	15	1.5	8.5	14.2	15.5	2.5	-1.5	-2.2	-0.5
	7:45 - 8:00	4	10	13	16	2.9	8.7	17.4	14.0	1.1	1.3	-4.4	2.0

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
40	7:00 - 7:15	2	6	13	14	1.5	7.8	16.8	16.4	0.5	-1.8	-3.8	-2.4
	7:15 - 7:30	3	7	12	15	1.5	9.5	17.4	11.0	1.5	-2.5	-5.4	4.0
	7:30 - 7:45	4	7	12	15	1.5	8.8	14.4	15.6	2.5	-1.8	-2.4	-0.6
	7:45 - 8:00	4	10	13	16	3.2	8.7	17.0	11.9	0.8	1.3	-4.0	4.1

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- WB Volume = 281 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-4.c. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – AM – SB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
-30	7:00 - 7:15	4	8	13	15	4.3	6.9	10.8	12.3	-0.3	1.1	2.2	2.7
	7:15 - 7:30	4	9	11	17	4.4	7.4	10.8	12.3	-0.4	1.6	0.2	4.7
	7:30 - 7:45	4	8	11	16	4.7	7.3	11.3	12.3	-0.7	0.7	-0.3	3.7
	7:45 - 8:00	4	9	11	15	4.4	6.9	11.1	12.3	-0.4	2.1	-0.1	2.7
-20	7:00 - 7:15	4	8	13	15	4.5	7.4	11.4	12.6	-0.5	0.6	1.6	2.4
	7:15 - 7:30	4	9	11	17	4.7	7.5	11.4	12.6	-0.7	1.5	-0.4	4.4
	7:30 - 7:45	4	8	11	16	4.6	7.5	11.4	12.3	-0.6	0.5	-0.4	3.7
	7:45 - 8:00	4	9	11	15	4.8	6.9	11.7	12.3	-0.8	2.1	-0.7	2.7
-10	7:00 - 7:15	4	8	13	15	5.0	7.3	11.9	13.0	-1.0	0.7	1.1	2.0
	7:15 - 7:30	4	9	11	17	5.1	8.1	11.9	12.9	-1.1	0.9	-0.9	4.1
	7:30 - 7:45	4	8	11	16	4.8	7.6	12.2	12.8	-0.8	0.4	-1.2	3.2
	7:45 - 8:00	4	9	11	15	4.3	7.1	12.8	12.3	-0.3	1.9	-1.8	2.7
10	7:00 - 7:15	4	8	13	15	4.8	7.7	11.7	12.8	-0.8	0.3	1.3	2.2
	7:15 - 7:30	4	9	11	17	5.4	7.8	11.7	12.8	-1.4	1.2	-0.7	4.2
	7:30 - 7:45	4	8	11	16	4.8	7.7	12.3	12.6	-0.8	0.3	-1.3	3.4
	7:45 - 8:00	4	9	11	15	4.4	7.0	12.3	12.4	-0.4	2.0	-1.3	2.6
20	7:00 - 7:15	4	8	13	15	5.3	7.7	11.8	13.2	-1.3	0.3	1.2	1.8
	7:15 - 7:30	4	9	11	17	5.0	7.9	11.8	12.9	-1.0	1.1	-0.8	4.1
	7:30 - 7:45	4	8	11	16	5.0	7.6	13.0	12.6	-1.0	0.4	-2.0	3.4
	7:45 - 8:00	4	9	11	15	4.5	7.5	12.8	12.8	-0.5	1.5	-1.8	2.2

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
25	7:00 - 7:15	4	8	13	15	5.3	7.7	11.8	13.2	-1.3	0.3	1.2	1.8
	7:15 - 7:30	4	9	11	17	5.0	7.9	11.8	12.9	-1.0	1.1	-0.8	4.1
	7:30 - 7:45	4	8	11	16	5.0	7.6	13.0	12.6	-1.0	0.4	-2.0	3.4
	7:45 - 8:00	4	9	11	15	4.5	7.5	12.8	12.8	-0.5	1.5	-1.8	2.2
30	7:00 - 7:15	4	8	13	15	4.6	7.9	12.5	12.7	-0.6	0.1	0.5	2.3
	7:15 - 7:30	4	9	11	17	4.7	8.0	12.5	13.1	-0.7	1.0	-1.5	3.9
	7:30 - 7:45	4	8	11	16	4.7	7.8	13.3	12.9	-0.7	0.2	-2.3	3.1
	7:45 - 8:00	4	9	11	15	4.8	7.2	12.4	12.6	-0.8	1.8	-1.4	2.4
35	7:00 - 7:15	4	8	13	15	5.1	7.9	12.8	13.1	-1.1	0.1	0.2	1.9
	7:15 - 7:30	4	9	11	17	5.5	8.3	12.8	13.3	-1.5	0.7	-1.8	3.7
	7:30 - 7:45	4	8	11	16	4.6	8.0	13.7	13.0	-0.6	0.0	-2.7	3.0
	7:45 - 8:00	4	9	11	15	5.3	7.4	13.3	12.9	-1.3	1.6	-2.3	2.1
36	7:00 - 7:15	4	8	13	15	7.5	8.9	18.8	14.1	-3.5	-0.9	-5.8	0.9
	7:15 - 7:30	4	9	11	17	6.7	9.7	18.8	14.9	-2.7	-0.7	-7.8	2.1
	7:30 - 7:45	4	8	11	16	6.1	9.9	19.8	13.8	-2.1	-1.9	-8.8	2.2
	7:45 - 8:00	4	9	11	15	6.3	9.7	18.6	14.1	-2.3	-0.7	-7.6	0.9
37	7:00 - 7:15	4	8	13	15	5.8	8.7	18.7	15.8	-1.8	-0.7	-5.7	-0.8
	7:15 - 7:30	4	9	11	17	8.3	9.7	18.7	14.7	-4.3	-0.7	-7.7	2.3
	7:30 - 7:45	4	8	11	16	7.0	10.2	18.0	14.1	-3.0	-2.2	-7.0	1.9
	7:45 - 8:00	4	9	11	15	6.9	8.9	18.2	13.8	-2.9	0.1	-7.2	1.2

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
40	7:00 - 7:15	4	8	13	15	6.5	10.4	17.8	15.4	-2.5	-2.4	-4.8	-0.4
	7:15 - 7:30	4	9	11	17	6.2	9.8	17.8	16.0	-2.2	-0.8	-6.8	1.0
	7:30 - 7:45	4	8	11	16	7.4	9.3	18.3	15.7	-3.4	-1.3	-7.3	0.3
	7:45 - 8:00	4	9	11	15	6.3	9.6	19.0	14.5	-2.3	-0.6	-8.0	0.5

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- SB Volume = 591 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-4.d. Ellington Roundabout – Min Headway Distance (ft) vs. Travel Time (seconds) – AM – EB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
-30	7:00 - 7:15	3	6	11	12	9.1	10.3	11.4	16.4	-6.1	-4.3	-0.4	-4.4
	7:15 - 7:30	4	6	11	13	7.9	9.9	12.3	14.9	-3.9	-3.9	-1.3	-1.9
	7:30 - 7:45	7	7	10	14	8.1	11.6	12.4	14.9	-1.1	-4.6	-2.4	-0.9
	7:45 - 8:00	3	7	11	12	6.0	11.2	11.5	16.0	-3.0	-4.2	-0.5	-4.0
-20	7:00 - 7:15	3	6	11	12	6.2	10.6	11.3	16.8	-3.2	-4.6	-0.3	-4.8
	7:15 - 7:30	4	6	11	13	7.2	9.4	12.2	17.0	-3.2	-3.4	-1.2	-4.0
	7:30 - 7:45	7	7	10	14	7.8	11.2	11.9	14.6	-0.8	-4.2	-1.9	-0.6
	7:45 - 8:00	3	7	11	12	9.2	11.4	11.6	15.2	-6.2	-4.4	-0.6	-3.2
-10	7:00 - 7:15	3	6	11	12	7.3	10.5	11.6	14.5	-4.3	-4.5	-0.6	-2.5
	7:15 - 7:30	4	6	11	13	7.2	9.5	11.7	14.7	-3.2	-3.5	-0.7	-1.7
	7:30 - 7:45	7	7	10	14	6.2	10.9	11.8	16.8	0.8	-3.9	-1.8	-2.8
	7:45 - 8:00	3	7	11	12	7.5	11.2	11.3	16.4	-4.5	-4.2	-0.3	-4.4
10	7:00 - 7:15	3	6	11	12	7.1	11.0	11.2	15.0	-4.1	-5.0	-0.2	-3.0
	7:15 - 7:30	4	6	11	13	7.0	8.9	11.5	15.7	-3.0	-2.9	-0.5	-2.7
	7:30 - 7:45	7	7	10	14	6.5	11.1	11.5	14.7	0.5	-4.1	-1.5	-0.7
	7:45 - 8:00	3	7	11	12	5.8	11.0	12.1	16.4	-2.8	-4.0	-1.1	-4.4
20	7:00 - 7:15	3	6	11	12	6.6	11.2	12.6	17.4	-3.6	-5.2	-1.6	-5.4
	7:15 - 7:30	4	6	11	13	6.9	10.5	12.3	15.5	-2.9	-4.5	-1.3	-2.5
	7:30 - 7:45	7	7	10	14	7.8	13.1	12.1	15.5	-0.8	-6.1	-2.1	-1.5
	7:45 - 8:00	3	7	11	12	7.7	11.1	11.9	15.6	-4.7	-4.1	-0.9	-3.6

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
25	7:00 - 7:15	3	6	11	12	6.6	11.2	12.6	17.4	-3.6	-5.2	-1.6	-5.4
	7:15 - 7:30	4	6	11	13	6.9	10.5	12.3	15.5	-2.9	-4.5	-1.3	-2.5
	7:30 - 7:45	7	7	10	14	7.8	13.1	12.1	15.5	-0.8	-6.1	-2.1	-1.5
	7:45 - 8:00	3	7	11	12	7.7	11.1	11.9	15.6	-4.7	-4.1	-0.9	-3.6
30	7:00 - 7:15	3	6	11	12	7.5	11.4	11.8	16.0	-4.5	-5.4	-0.8	-4.0
	7:15 - 7:30	4	6	11	13	6.8	10.0	11.8	16.3	-2.8	-4.0	-0.8	-3.3
	7:30 - 7:45	7	7	10	14	6.8	11.1	12.9	16.3	0.2	-4.1	-2.9	-2.3
	7:45 - 8:00	3	7	11	12	7.8	11.8	12.2	16.6	-4.8	-4.8	-1.2	-4.6
35	7:00 - 7:15	3	6	11	12	6.9	12.4	12.2	15.3	-3.9	-6.4	-1.2	-3.3
	7:15 - 7:30	4	6	11	13	7.2	10.1	11.8	15.5	-3.2	-4.1	-0.8	-2.5
	7:30 - 7:45	7	7	10	14	15.6	12.6	13.1	17.9	-8.6	-5.6	-3.1	-3.9
	7:45 - 8:00	3	7	11	12	7.1	11.6	12.9	17.0	-4.1	-4.6	-1.9	-5.0
36	7:00 - 7:15	3	6	11	12	7.2	11.1	12.3	15.7	-4.2	-5.1	-1.3	-3.7
	7:15 - 7:30	4	6	11	13	11.2	12.5	11.8	15.5	-7.2	-6.5	-0.8	-2.5
	7:30 - 7:45	7	7	10	14	9.7	12.1	11.8	14.6	-2.7	-5.1	-1.8	-0.6
	7:45 - 8:00	3	7	11	12	6.6	11.4	11.7	17.4	-3.6	-4.4	-0.7	-5.4
37	7:00 - 7:15	3	6	11	12	7.2	10.5	12.1	15.1	-4.2	-4.5	-1.1	-3.1
	7:15 - 7:30	4	6	11	13	10.0	11.9	12.2	15.4	-6.0	-5.9	-1.2	-2.4
	7:30 - 7:45	7	7	10	14	11.5	13.6	12.1	16.1	-4.5	-6.6	-2.1	-2.1
	7:45 - 8:00	3	7	11	12	9.2	11.6	13.6	16.5	-6.2	-4.6	-2.6	-4.5

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
40	7:00 - 7:15	3	6	11	12	7.1	10.3	12.2	15.9	-4.1	-4.3	-1.2	-3.9
	7:15 - 7:30	4	6	11	13	8.5	10.0	12.9	14.1	-4.5	-4.0	-1.9	-1.1
	7:30 - 7:45	7	7	10	14	9.4	11.7	12.2	16.7	-2.4	-4.7	-2.2	-2.7
	7:45 - 8:00	3	7	11	12	5.4	11.6	12.3	18.6	-2.4	-4.6	-1.3	-6.6

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- EB Volume = 218 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-4.e. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – AM – NEB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
-30	7:00 - 7:15	2	5	9	14	2.6	7.6	8.5	3.7	-0.6	-2.6	0.5	10.3
	7:15 - 7:30	2	5	11	15	2.6	7.1	8.9	5.5	-0.6	-2.1	2.1	9.5
	7:30 - 7:45	2	6	8	16	2.2	7.2	8.3	0.7	-0.2	-1.2	-0.3	15.3
	7:45 - 8:00	2	6	8	15	2.5	6.9	8.5	4.6	-0.5	-0.9	-0.5	10.4
-20	7:00 - 7:15	2	5	9	14	2.6	8.0	8.5	2.5	-0.6	-3.0	0.5	11.5
	7:15 - 7:30	2	5	11	15	2.4	6.9	9.1	4.0	-0.4	-1.9	1.9	11.0
	7:30 - 7:45	2	6	8	16	2.5	6.9	8.5	0.7	-0.5	-0.9	-0.5	15.3
	7:45 - 8:00	2	6	8	15	2.4	6.8	8.0	4.6	-0.4	-0.8	0.0	10.4
-10	7:00 - 7:15	2	5	9	14	2.6	8.5	8.4	2.6	-0.6	-3.5	0.6	11.4
	7:15 - 7:30	2	5	11	15	2.4	7.8	8.6	3.6	-0.4	-2.8	2.4	11.4
	7:30 - 7:45	2	6	8	16	2.4	7.0	8.5	0.7	-0.4	-1.0	-0.5	15.3
	7:45 - 8:00	2	6	8	15	2.4	6.8	8.1	5.1	-0.4	-0.8	-0.1	9.9
10	7:00 - 7:15	2	5	9	14	2.7	8.4	9.4	3.5	-0.7	-3.4	-0.4	10.5
	7:15 - 7:30	2	5	11	15	2.6	7.6	9.3	4.5	-0.6	-2.6	1.7	10.5
	7:30 - 7:45	2	6	8	16	2.4	7.8	9.2	0.7	-0.4	-1.8	-1.2	15.3
	7:45 - 8:00	2	6	8	15	2.7	7.6	8.4	4.8	-0.7	-1.6	-0.4	10.2
20	7:00 - 7:15	2	5	9	14	2.6	11.1	10.5	3.0	-0.6	-6.1	-1.5	11.0
	7:15 - 7:30	2	5	11	15	2.2	10.3	11.0	3.9	-0.2	-5.3	0.0	11.1
	7:30 - 7:45	2	6	8	16	2.7	10.8	11.8	0.7	-0.7	-4.8	-3.8	15.3
	7:45 - 8:00	2	6	8	15	2.8	8.1	10.6	5.9	-0.8	-2.1	-2.6	9.1

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
25	7:00 - 7:15	2	5	9	14	2.6	11.1	10.5	3.0	-0.6	-6.1	-1.5	11.0
	7:15 - 7:30	2	5	11	15	2.2	10.3	11.0	3.9	-0.2	-5.3	0.0	11.1
	7:30 - 7:45	2	6	8	16	2.7	10.8	11.8	0.7	-0.7	-4.8	-3.8	15.3
	7:45 - 8:00	2	6	8	15	2.8	8.1	10.6	5.9	-0.8	-2.1	-2.6	9.1
30	7:00 - 7:15	2	5	9	14	2.6	9.8	11.7	3.5	-0.6	-4.8	-2.7	10.5
	7:15 - 7:30	2	5	11	15	2.5	10.1	11.8	3.9	-0.5	-5.1	-0.8	11.1
	7:30 - 7:45	2	6	8	16	2.4	10.7	11.7	0.7	-0.4	-4.7	-3.7	15.3
	7:45 - 8:00	2	6	8	15	2.6	10.7	11.9	4.4	-0.6	-4.7	-3.9	10.6
35	7:00 - 7:15	2	5	9	14	2.5	11.9	11.3	2.6	-0.5	-6.9	-2.3	11.4
	7:15 - 7:30	2	5	11	15	2.3	11.5	11.2	4.3	-0.3	-6.5	-0.2	10.7
	7:30 - 7:45	2	6	8	16	2.4	10.0	12.6	0.7	-0.4	-4.0	-4.6	15.3
	7:45 - 8:00	2	6	8	15	2.8	11.3	11.3	4.2	-0.8	-5.3	-3.3	10.8
36	7:00 - 7:15	2	5	9	14	2.6	8.8	10.4	2.5	-0.6	-3.8	-1.4	11.5
	7:15 - 7:30	2	5	11	15	2.4	8.5	11.2	4.2	-0.4	-3.5	-0.2	10.8
	7:30 - 7:45	2	6	8	16	2.1	10.1	10.9	0.7	-0.1	-4.1	-2.9	15.3
	7:45 - 8:00	2	6	8	15	2.7	9.7	11.0	4.3	-0.7	-3.7	-3.0	10.7
37	7:00 - 7:15	2	5	9	14	2.6	9.7	10.4	7.1	-0.6	-4.7	-1.4	6.9
	7:15 - 7:30	2	5	11	15	2.4	9.7	11.1	4.0	-0.4	-4.7	-0.1	11.0
	7:30 - 7:45	2	6	8	16	2.1	10.5	11.1	1.7	-0.1	-4.5	-3.1	14.3
	7:45 - 8:00	2	6	8	15	2.6	10.6	10.2	5.7	-0.6	-4.6	-2.2	9.3

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
40	7:00 - 7:15	2	5	9	14	2.5	9.7	10.0	2.5	-0.5	-4.7	-1.0	11.5
	7:15 - 7:30	2	5	11	15	2.5	7.9	11.3	5.4	-0.5	-2.9	-0.3	9.6
	7:30 - 7:45	2	6	8	16	2.2	8.0	11.7	0.7	-0.2	-2.0	-3.7	15.3
	7:45 - 8:00	2	6	8	15	2.5	8.9	10.8	5.4	-0.5	-2.9	-2.8	9.6

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- NEB Volume = 193 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-5.a. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM – NB

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
10	7.5 to 12.5	7:00 - 7:15	5	6	11	13	8.4	8.4	10.6	8.5	-3.4	-2.4	0.4	4.5
		7:15 - 7:30	4	6	12	15	8.2	8.3	10.2	8.0	-4.2	-2.3	1.8	7.0
		7:30 - 7:45	6	7	14	0	7.8	8.7	10.2	9.1	-1.8	-1.7	3.8	-9.1
		7:45 - 8:00	5	7	13	0	7.8	8.6	10.6	9.0	-2.8	-1.6	2.4	-9.0
15	7.5 to 12.5	7:00 - 7:15	5	6	11	13	8.4	8.4	10.6	8.5	-3.4	-2.4	0.4	4.5
		7:15 - 7:30	4	6	12	15	8.2	8.3	10.2	8.0	-4.2	-2.3	1.8	7.0
		7:30 - 7:45	6	7	14	0	7.8	8.7	10.2	9.1	-1.8	-1.7	3.8	-9.1
		7:45 - 8:00	5	7	13	0	7.8	8.6	10.6	9.0	-2.8	-1.6	2.4	-9.0
20	12.5 to 17.5	7:00 - 7:15	5	6	11	13	7.4	7.6	9.9	8.2	-2.4	-1.6	1.1	-8.2
		7:15 - 7:30	4	6	12	15	6.9	6.5	9.3	7.8	-2.9	-0.5	2.7	-7.8
		7:30 - 7:45	6	7	14	0	7.4	7.3	9.4	8.6	-1.4	-0.3	4.6	-8.6
		7:45 - 8:00	5	7	13	0	7.2	7.3	9.2	8.7	-2.2	-0.3	3.8	-8.7
25	17.5 to 22.5	7:00 - 7:15	5	6	11	13	7.7	6.5	9.0	7.5	-2.7	-0.5	2.0	-7.5
		7:15 - 7:30	4	6	12	15	6.8	5.9	9.0	7.3	-2.8	0.1	3.0	-7.3
		7:30 - 7:45	6	7	14	0	5.9	6.6	8.8	8.1	0.1	0.4	5.2	-8.1
		7:45 - 8:00	5	7	13	0	6.6	7.3	8.8	8.8	-1.6	-0.3	4.2	-8.8
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	5	6	11	13	7.1	7.2	9.0	7.3	-2.1	-1.2	2.0	-7.3
		7:15 - 7:30	4	6	12	15	6.4	6.5	8.7	6.4	-2.4	-0.5	3.3	-6.4
		7:30 - 7:45	6	7	14	0	5.9	6.4	8.4	8.0	0.1	0.6	5.6	-8.0
		7:45 - 8:00	5	7	13	0	6.9	6.9	9.1	7.5	-1.9	0.1	3.9	-7.5

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
35	22.5 to 27.5	7:00 - 7:15	5	6	11	13	7.1	7.2	9.0	7.3	-2.1	-1.2	2.0	-7.3
		7:15 - 7:30	4	6	12	15	6.4	6.5	8.7	6.4	-2.4	-0.5	3.3	-6.4
		7:30 - 7:45	6	7	14	0	5.9	6.4	8.4	8.0	0.1	0.6	5.6	-8.0
		7:45 - 8:00	5	7	13	0	6.9	6.9	9.1	7.5	-1.9	0.1	3.9	-7.5
40	27.5 to 32.5	7:00 - 7:15	5	6	11	13	6.4	6.9	9.3	7.4	-1.4	-0.9	1.7	-7.4
		7:15 - 7:30	4	6	12	15	6.8	6.7	8.3	6.8	-2.8	-0.7	3.7	-6.8
		7:30 - 7:45	6	7	14	0	5.9	6.4	8.4	7.5	0.1	0.6	5.6	-7.5
		7:45 - 8:00	5	7	13	0	6.8	6.7	8.7	7.6	-1.8	0.3	4.3	-7.6
45	32.5 to 37.5	7:00 - 7:15	5	6	11	13	7.2	6.5	9.0	7.0	-2.2	-0.5	2.0	-7.0
		7:15 - 7:30	4	6	12	15	6.4	6.4	8.4	6.5	-2.4	-0.4	3.6	-6.5
		7:30 - 7:45	6	7	14	0	6.0	6.1	8.3	7.5	0.0	0.9	5.7	-7.5
		7:45 - 8:00	5	7	13	0	6.8	6.0	8.8	7.5	-1.8	1.0	4.2	-7.5
50	37.5 to 42.5	7:00 - 7:15	5	6	11	13	6.5	6.0	9.2	7.4	-1.5	0.0	1.8	-7.4
		7:15 - 7:30	4	6	12	15	7.0	6.7	7.9	6.5	-3.0	-0.7	4.1	-6.5
		7:30 - 7:45	6	7	14	0	5.9	6.0	7.9	7.3	0.1	1.0	6.1	-7.3
		7:45 - 8:00	5	7	13	0	6.2	6.5	8.4	6.9	-1.2	0.5	4.6	-6.9
55	42.5 to 47.5	7:00 - 7:15	5	6	11	13	6.8	5.9	8.6	6.8	-1.8	0.1	2.4	-6.8
		7:15 - 7:30	4	6	12	15	5.7	6.5	8.2	6.6	-1.7	-0.5	3.8	-6.6
		7:30 - 7:45	6	7	14	0	5.6	5.3	7.8	7.4	0.4	1.7	6.2	-7.4
		7:45 - 8:00	5	7	13	0	6.2	6.9	8.1	7.3	-1.2	0.1	4.9	-7.3

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NB Volume = 190 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-5.b. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM – WB

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
10	7.5 to 12.5	7:00 - 7:15	2	6	13	14	3.5	8.9	14.3	13.4	-1.5	-2.9	-1.3	0.6
		7:15 - 7:30	3	7	12	23	3.7	8.9	15.0	13.6	-0.7	-1.9	-3.0	9.4
		7:30 - 7:45	4	7	12	15	3.8	8.7	14.9	12.6	0.2	-1.7	-2.9	2.4
		7:45 - 8:00	4	10	13	16	4.4	8.7	14.5	13.8	-0.4	1.3	-1.5	2.2
15	7.5 to 12.5	7:00 - 7:15	2	6	13	14	3.5	8.9	14.3	13.4	-1.5	-2.9	-1.3	0.6
		7:15 - 7:30	3	7	12	23	3.7	8.9	15.0	13.6	-0.7	-1.9	-3.0	9.4
		7:30 - 7:45	4	7	12	15	3.8	8.7	14.9	12.6	0.2	-1.7	-2.9	2.4
		7:45 - 8:00	4	10	13	16	4.4	8.7	14.5	13.8	-0.4	1.3	-1.5	2.2
20	12.5 to 17.5	7:00 - 7:15	2	6	13	14	2.8	7.0	11.4	11.3	-0.8	-1.0	1.6	2.7
		7:15 - 7:30	3	7	12	23	2.9	7.1	11.4	11.1	0.1	-0.1	0.6	11.9
		7:30 - 7:45	4	7	12	15	2.9	7.2	11.2	10.8	1.1	-0.2	0.8	4.2
		7:45 - 8:00	4	10	13	16	3.4	7.0	11.1	12.3	0.6	3.0	1.9	3.7
25	17.5 to 22.5	7:00 - 7:15	2	6	13	14	2.5	6.0	9.7	10.9	-0.5	0.0	3.3	3.1
		7:15 - 7:30	3	7	12	23	2.5	6.4	10.1	10.8	0.5	0.6	1.9	12.2
		7:30 - 7:45	4	7	12	15	2.4	6.3	9.9	10.6	1.6	0.7	2.1	4.4
		7:45 - 8:00	4	10	13	16	3.2	6.1	9.6	10.6	0.8	3.9	3.4	5.4
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	2	6	13	14	2.0	5.4	9.2	10.3	0.0	0.6	3.8	3.7
		7:15 - 7:30	3	7	12	23	2.2	6.0	9.5	9.9	0.8	1.0	2.5	13.1
		7:30 - 7:45	4	7	12	15	2.1	5.9	9.1	9.5	1.9	1.1	2.9	5.5
		7:45 - 8:00	4	10	13	16	2.9	5.8	8.7	10.2	1.1	4.2	4.3	5.8

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	R	T	BL	L	R	T	BL	L	R	T	BL	L
35	22.5 to 27.5	7:00 - 7:15	2	6	13	14	2.0	5.4	9.2	10.3	0.0	0.6	3.8	3.7
		7:15 - 7:30	3	7	12	23	2.2	6.0	9.5	9.9	0.8	1.0	2.5	13.1
		7:30 - 7:45	4	7	12	15	2.1	5.9	9.1	9.5	1.9	1.1	2.9	5.5
		7:45 - 8:00	4	10	13	16	2.9	5.8	8.7	10.2	1.1	4.2	4.3	5.8
40	27.5 to 32.5	7:00 - 7:15	2	6	13	14	1.8	5.1	8.7	8.9	0.2	0.9	4.3	5.1
		7:15 - 7:30	3	7	12	23	1.7	5.7	8.9	9.9	1.3	1.3	3.1	13.1
		7:30 - 7:45	4	7	12	15	1.8	5.4	8.3	9.5	2.2	1.6	3.7	5.5
		7:45 - 8:00	4	10	13	16	2.6	5.3	8.3	9.3	1.4	4.7	4.7	6.7
45	32.5 to 37.5	7:00 - 7:15	2	6	13	14	1.6	5.2	8.0	8.7	0.4	0.8	5.0	5.3
		7:15 - 7:30	3	7	12	23	1.7	5.2	8.6	9.0	1.3	1.8	3.4	14.0
		7:30 - 7:45	4	7	12	15	1.7	5.2	8.1	8.7	2.3	1.8	3.9	6.3
		7:45 - 8:00	4	10	13	16	2.6	5.1	7.8	9.0	1.4	4.9	5.2	7.0
50	37.5 to 42.5	7:00 - 7:15	2	6	13	14	1.6	4.7	7.6	8.9	0.4	1.3	5.4	5.1
		7:15 - 7:30	3	7	12	23	1.7	5.0	8.5	9.7	1.3	2.0	3.5	13.3
		7:30 - 7:45	4	7	12	15	1.6	4.8	7.6	9.6	2.4	2.2	4.4	5.4
		7:45 - 8:00	4	10	13	16	2.3	4.8	7.6	9.0	1.7	5.2	5.4	7.0
55	42.5 to 47.5	7:00 - 7:15	2	6	13	14	7.6	-1.8	0.3	4.3	-5.6	7.8	12.7	9.7
		7:15 - 7:30	3	7	12	23	7.0	-2.2	-0.5	2.0	-4.0	9.2	12.5	21.0
		7:30 - 7:45	4	7	12	15	6.5	-2.4	-0.4	3.6	-2.5	9.4	12.4	11.4
		7:45 - 8:00	4	10	13	16	7.5	0.0	0.9	5.7	-3.5	10.0	12.1	10.3

Note:

- Circulating Speed = 13.7 – 18.8 mph
- WB Volume = 281 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-5.c. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM – SB

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
10	7.5 to 12.5	7:00 - 7:15	4	8	13	15	6.9	9.4	17.6	15.2	-2.9	-1.4	-4.6	-0.2
		7:15 - 7:30	4	9	11	17	6.7	10.1	17.6	15.4	-2.7	-1.1	-6.6	1.6
		7:30 - 7:45	4	8	11	16	7.0	9.7	17.3	15.3	-3.0	-1.7	-6.3	0.7
		7:45 - 8:00	4	9	11	15	6.8	9.3	17.6	15.2	-2.8	-0.3	-6.6	-0.2
15	7.5 to 12.5	7:00 - 7:15	4	8	13	15	6.9	9.4	17.6	15.2	-2.9	-1.4	-4.6	-0.2
		7:15 - 7:30	4	9	11	17	6.7	10.1	17.6	15.4	-2.7	-1.1	-6.6	1.6
		7:30 - 7:45	4	8	11	16	7.0	9.7	17.3	15.3	-3.0	-1.7	-6.3	0.7
		7:45 - 8:00	4	9	11	15	6.8	9.3	17.6	15.2	-2.8	-0.3	-6.6	-0.2
20	12.5 to 17.5	7:00 - 7:15	4	8	13	15	5.8	8.1	13.6	13.5	-1.8	-0.1	-0.6	1.5
		7:15 - 7:30	4	9	11	17	5.3	8.5	13.6	13.7	-1.3	0.5	-2.6	3.3
		7:30 - 7:45	4	8	11	16	5.3	8.3	13.7	13.4	-1.3	-0.3	-2.7	2.6
		7:45 - 8:00	4	9	11	15	5.8	7.7	13.2	13.3	-1.8	1.3	-2.2	1.7
25	17.5 to 22.5	7:00 - 7:15	4	8	13	15	5.2	8.1	12.3	13.0	-1.2	-0.1	0.7	2.0
		7:15 - 7:30	4	9	11	17	5.3	7.9	12.3	13.2	-1.3	1.1	-1.3	3.8
		7:30 - 7:45	4	8	11	16	5.5	7.8	12.6	12.7	-1.5	0.2	-1.6	3.3
		7:45 - 8:00	4	9	11	15	5.1	7.4	12.4	13.0	-1.1	1.6	-1.4	2.0
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	4	8	13	15	4.9	7.6	12.0	12.8	-0.9	0.4	1.0	2.2
		7:15 - 7:30	4	9	11	17	4.5	7.7	12.0	12.6	-0.5	1.3	-1.0	4.4
		7:30 - 7:45	4	8	11	16	4.8	7.5	12.3	12.9	-0.8	0.5	-1.3	3.1
		7:45 - 8:00	4	9	11	15	4.7	7.3	12.1	12.8	-0.7	1.7	-1.1	2.2

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	R	BR	T	L	R	BR	T	L	R	BR	T	L
35	22.5 to 27.5	7:00 - 7:15	4	8	13	15	4.9	7.6	12.0	12.8	-0.9	0.4	1.0	2.2
		7:15 - 7:30	4	9	11	17	4.5	7.7	12.0	12.6	-0.5	1.3	-1.0	4.4
		7:30 - 7:45	4	8	11	16	4.8	7.5	12.3	12.9	-0.8	0.5	-1.3	3.1
		7:45 - 8:00	4	9	11	15	4.7	7.3	12.1	12.8	-0.7	1.7	-1.1	2.2
40	27.5 to 32.5	7:00 - 7:15	4	8	13	15	4.8	7.4	11.5	12.6	-0.8	0.6	1.5	2.4
		7:15 - 7:30	4	9	11	17	5.0	7.6	11.5	12.4	-1.0	1.4	-0.5	4.6
		7:30 - 7:45	4	8	11	16	4.7	7.5	12.3	12.4	-0.7	0.5	-1.3	3.6
		7:45 - 8:00	4	9	11	15	4.2	7.1	11.6	12.1	-0.2	1.9	-0.6	2.9
45	32.5 to 37.5	7:00 - 7:15	4	8	13	15	4.4	7.4	11.6	11.9	-0.4	0.6	1.4	3.1
		7:15 - 7:30	4	9	11	17	4.7	7.7	11.6	12.7	-0.7	1.3	-0.6	4.3
		7:30 - 7:45	4	8	11	16	4.6	7.3	11.7	12.3	-0.6	0.7	-0.7	3.7
		7:45 - 8:00	4	9	11	15	4.4	6.7	11.3	12.1	-0.4	2.3	-0.3	2.9
50	37.5 to 42.5	7:00 - 7:15	4	8	13	15	4.7	7.4	11.5	12.0	-0.7	0.6	1.5	3.0
		7:15 - 7:30	4	9	11	17	4.3	7.5	11.5	12.6	-0.3	1.5	-0.5	4.4
		7:30 - 7:45	4	8	11	16	4.6	7.1	11.4	11.9	-0.6	0.9	-0.4	4.1
		7:45 - 8:00	4	9	11	15	4.4	6.7	11.6	11.9	-0.4	2.3	-0.6	3.1
55	42.5 to 47.5	7:00 - 7:15	4	8	13	15	4.8	7.5	11.9	12.3	-0.8	0.5	1.1	2.7
		7:15 - 7:30	4	9	11	17	4.6	7.4	11.9	12.3	-0.6	1.6	-0.9	4.7
		7:30 - 7:45	4	8	11	16	4.5	7.2	11.8	11.9	-0.5	0.8	-0.8	4.1
		7:45 - 8:00	4	9	11	15	4.9	6.7	11.1	12.1	-0.9	2.3	-0.1	2.9

Note:

- Circulating Speed = 13.7 – 18.8 mph
- SB Volume = 591 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-5.d. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM – EB

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
10	7.5 to 12.5	7:00 - 7:15	3	6	11	12	9.9	15.3	15.9	21.2	-6.9	-9.3	-4.9	-9.2
		7:15 - 7:30	4	6	11	13	10.8	13.0	14.9	21.2	-6.8	-7.0	-3.9	-8.2
		7:30 - 7:45	7	7	10	14	14.2	16.2	15.9	23.0	-7.2	-9.2	-5.9	-9.0
		7:45 - 8:00	3	7	11	12	10.1	16.2	15.8	22.3	-7.1	-9.2	-4.8	-10.3
15	7.5 to 12.5	7:00 - 7:15	3	6	11	12	9.9	15.3	15.9	21.2	-6.9	-9.3	-4.9	-9.2
		7:15 - 7:30	4	6	11	13	10.8	13.0	14.9	21.2	-6.8	-7.0	-3.9	-8.2
		7:30 - 7:45	7	7	10	14	14.2	16.2	15.9	23.0	-7.2	-9.2	-5.9	-9.0
		7:45 - 8:00	3	7	11	12	10.1	16.2	15.8	22.3	-7.1	-9.2	-4.8	-10.3
20	12.5 to 17.5	7:00 - 7:15	3	6	11	12	6.9	13.1	12.8	17.3	-3.9	-7.1	-1.8	-5.3
		7:15 - 7:30	4	6	11	13	10.8	11.3	13.3	18.7	-6.8	-5.3	-2.3	-5.7
		7:30 - 7:45	7	7	10	14	7.1	13.3	14.1	18.2	-0.1	-6.3	-4.1	-4.2
		7:45 - 8:00	3	7	11	12	9.1	13.7	13.8	17.4	-6.1	-6.7	-2.8	-5.4
25	17.5 to 22.5	7:00 - 7:15	3	6	11	12	9.1	12.0	12.1	16.2	-6.1	-6.0	-1.1	-4.2
		7:15 - 7:30	4	6	11	13	8.4	10.0	12.1	15.6	-4.4	-4.0	-1.1	-2.6
		7:30 - 7:45	7	7	10	14	6.2	11.0	11.7	16.3	0.8	-4.0	-1.7	-2.3
		7:45 - 8:00	3	7	11	12	8.2	11.4	11.6	14.7	-5.2	-4.4	-0.6	-2.7
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	3	6	11	12	7.4	10.7	11.1	15.5	-4.4	-4.7	-0.1	-3.5
		7:15 - 7:30	4	6	11	13	6.0	8.8	11.6	15.2	-2.0	-2.8	-0.6	-2.2
		7:30 - 7:45	7	7	10	14	6.4	10.5	11.5	14.7	0.6	-3.5	-1.5	-0.7
		7:45 - 8:00	3	7	11	12	5.3	9.1	11.0	13.6	-2.3	-2.1	0.0	-1.6

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	HR	R	T	L	HR	R	T	L	HR	R	T	L
35	22.5 to 27.5	7:00 - 7:15	3	6	11	12	7.4	10.7	11.1	15.5	-4.4	-4.7	-0.1	-3.5
		7:15 - 7:30	4	6	11	13	6.0	8.8	11.6	15.2	-2.0	-2.8	-0.6	-2.2
		7:30 - 7:45	7	7	10	14	6.4	10.5	11.5	14.7	0.6	-3.5	-1.5	-0.7
		7:45 - 8:00	3	7	11	12	5.3	9.1	11.0	13.6	-2.3	-2.1	0.0	-1.6
40	27.5 to 32.5	7:00 - 7:15	3	6	11	12	7.8	10.4	10.6	13.8	-4.8	-4.4	0.4	-1.8
		7:15 - 7:30	4	6	11	13	6.8	8.2	10.5	13.6	-2.8	-2.2	0.5	-0.6
		7:30 - 7:45	7	7	10	14	5.6	9.6	10.4	14.2	1.4	-2.6	-0.4	-0.2
		7:45 - 8:00	3	7	11	12	6.5	9.5	10.6	12.5	-3.5	-2.5	0.4	-0.5
45	32.5 to 37.5	7:00 - 7:15	3	6	11	12	6.7	8.6	9.3	13.0	-3.7	-2.6	1.7	-1.0
		7:15 - 7:30	4	6	11	13	6.4	6.9	9.5	13.8	-2.4	-0.9	1.5	-0.8
		7:30 - 7:45	7	7	10	14	5.2	9.1	11.2	12.5	1.8	-2.1	-1.2	1.5
		7:45 - 8:00	3	7	11	12	4.6	9.1	10.7	13.1	-1.6	-2.1	0.3	-1.1
50	37.5 to 42.5	7:00 - 7:15	3	6	11	12	5.8	8.3	9.1	12.5	-2.8	-2.3	1.9	-0.5
		7:15 - 7:30	4	6	11	13	6.5	7.1	9.7	13.0	-2.5	-1.1	1.3	0.0
		7:30 - 7:45	7	7	10	14	5.4	9.3	10.5	13.4	1.6	-2.3	-0.5	0.6
		7:45 - 8:00	3	7	11	12	5.0	8.3	10.1	12.2	-2.0	-1.3	0.9	-0.2
55	42.5 to 47.5	7:00 - 7:15	3	6	11	12	4.3	7.7	9.3	11.5	-1.3	-1.7	1.7	0.5
		7:15 - 7:30	4	6	11	13	6.2	6.9	9.5	13.0	-2.2	-0.9	1.5	0.0
		7:30 - 7:45	7	7	10	14	5.2	9.5	10.4	12.3	1.8	-2.5	-0.4	1.7
		7:45 - 8:00	3	7	11	12	4.4	8.7	9.5	12.4	-1.4	-1.7	1.5	-0.4

Note:

- Circulating Speed = 13.7 – 18.8 mph
- EB Volume = 218 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-5.e. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM – NEB

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
10	7.5 to 12.5	7:00 - 7:15	2	5	9	14	3.2	9.2	10.2	3.7	-1.2	-4.2	-1.2	10.3
		7:15 - 7:30	2	5	11	15	3.0	9.1	10.2	4.7	-1.0	-4.1	0.8	10.3
		7:30 - 7:45	2	6	8	16	2.8	8.4	10.6	0.9	-0.8	-2.4	-2.6	15.1
		7:45 - 8:00	2	6	8	15	3.1	8.8	9.8	6.2	-1.1	-2.8	-1.8	8.8
15	7.5 to 12.5	7:00 - 7:15	2	5	9	14	3.2	9.2	10.2	3.7	-1.2	-4.2	-1.2	10.3
		7:15 - 7:30	2	5	11	15	3.0	9.1	10.2	4.7	-1.0	-4.1	0.8	10.3
		7:30 - 7:45	2	6	8	16	2.8	8.4	10.6	0.9	-0.8	-2.4	-2.6	15.1
		7:45 - 8:00	2	6	8	15	3.1	8.8	9.8	6.2	-1.1	-2.8	-1.8	8.8
20	12.5 to 17.5	7:00 - 7:15	2	5	9	14	2.9	8.7	9.8	3.1	-0.9	-3.7	-0.8	10.9
		7:15 - 7:30	2	5	11	15	2.7	7.8	9.9	7.4	-0.7	-2.8	1.1	7.6
		7:30 - 7:45	2	6	8	16	2.7	8.3	9.5	0.8	-0.7	-2.3	-1.5	15.2
		7:45 - 8:00	2	6	8	15	2.9	8.2	9.3	6.0	-0.9	-2.2	-1.3	9.0
25	17.5 to 22.5	7:00 - 7:15	2	5	9	14	2.7	8.2	9.4	2.9	-0.7	-3.2	-0.4	11.1
		7:15 - 7:30	2	5	11	15	2.6	7.3	9.5	4.9	-0.6	-2.3	1.5	10.1
		7:30 - 7:45	2	6	8	16	2.5	7.8	9.1	1.0	-0.5	-1.8	-1.1	15.0
		7:45 - 8:00	2	6	8	15	2.8	7.3	8.5	6.3	-0.8	-1.3	-0.5	8.7
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	2	5	9	14	2.6	7.7	9.0	2.8	-0.6	-2.7	0.0	11.2
		7:15 - 7:30	2	5	11	15	2.4	6.9	8.9	5.7	-0.4	-1.9	2.1	9.3
		7:30 - 7:45	2	6	8	16	2.3	7.1	8.4	0.9	-0.3	-1.1	-0.4	15.1
		7:45 - 8:00	2	6	8	15	2.5	7.3	8.4	5.3	-0.5	-1.3	-0.4	9.7

Reduced Speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	AM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
35	22.5 to 27.5	7:00 - 7:15	2	5	9	14	2.6	7.7	9.0	2.8	-0.6	-2.7	0.0	11.2
		7:15 - 7:30	2	5	11	15	2.4	6.9	8.9	5.7	-0.4	-1.9	2.1	9.3
		7:30 - 7:45	2	6	8	16	2.3	7.1	8.4	0.9	-0.3	-1.1	-0.4	15.1
		7:45 - 8:00	2	6	8	15	2.5	7.3	8.4	5.3	-0.5	-1.3	-0.4	9.7
40	27.5 to 32.5	7:00 - 7:15	2	5	9	14	2.5	7.9	8.8	2.6	-0.5	-2.9	0.2	11.4
		7:15 - 7:30	2	5	11	15	2.3	7.4	8.9	3.5	-0.3	-2.4	2.1	11.5
		7:30 - 7:45	2	6	8	16	2.4	6.8	8.4	0.9	-0.4	-0.8	-0.4	15.1
		7:45 - 8:00	2	6	8	15	2.5	6.5	8.2	5.5	-0.5	-0.5	-0.2	9.5
45	32.5 to 37.5	7:00 - 7:15	2	5	9	14	2.5	8.0	9.1	2.0	-0.5	-3.0	-0.1	12.0
		7:15 - 7:30	2	5	11	15	2.2	6.1	8.5	4.0	-0.2	-1.1	2.5	11.0
		7:30 - 7:45	2	6	8	16	2.2	6.9	8.2	0.8	-0.2	-0.9	-0.2	15.2
		7:45 - 8:00	2	6	8	15	2.2	6.5	7.8	6.7	-0.2	-0.5	0.2	8.3
50	37.5 to 42.5	7:00 - 7:15	2	5	9	14	2.4	6.6	8.5	2.3	-0.4	-1.6	0.5	11.7
		7:15 - 7:30	2	5	11	15	2.2	6.3	8.0	4.1	-0.2	-1.3	3.0	10.9
		7:30 - 7:45	2	6	8	16	2.0	6.9	7.7	0.6	0.0	-0.9	0.3	15.4
		7:45 - 8:00	2	6	8	15	2.6	6.3	8.1	9.2	-0.6	-0.3	-0.1	5.8
55	42.5 to 47.5	7:00 - 7:15	2	5	9	14	2.4	6.7	8.3	2.3	-0.4	-1.7	0.7	11.7
		7:15 - 7:30	2	5	11	15	2.4	6.7	8.1	3.2	-0.4	-1.7	2.9	11.8
		7:30 - 7:45	2	6	8	16	2.0	6.2	7.8	0.5	0.0	-0.2	0.2	15.5
		7:45 - 8:00	2	6	8	15	2.2	6.6	7.5	6.4	-0.2	-0.6	0.5	8.6

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NEB Volume = 193 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-6.a. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM – NB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
15	10 to 30	4:30-4:45	5	6	11	14	7.8	8.6	10.7	9.8	-3	-3	0	4
		4:45-5:00	4	6	12	16	7.9	8.3	10.6	11.2	-4	-2	1	5
		5:00-5:15	6	7	14	15	8.3	7.9	10.8	10.1	-2	-1	3	5
		5:15-5:30	5	7	13	13	6.8	8.4	10.5	10.4	-2	-1	2	3
20	10 to 35	4:30-4:45	5	6	11	14	7.7	8.3	10.3	9.3	-3	-2	1	5
		4:45-5:00	4	6	12	16	7.5	8.0	10.4	10.4	-3	-2	2	6
		5:00-5:15	6	7	14	15	7.2	8.2	10.6	10.0	-1	-1	3	5
		5:15-5:30	5	7	13	13	7.7	8.4	10.1	9.9	-3	-1	3	3
25	15 to 40	4:30-4:45	5	6	11	14	6.0	7.0	8.4	7.9	-1.0	-1.0	2.6	6.1
		4:45-5:00	4	6	12	16	6.8	7.1	8.8	9.0	-2.8	-1.1	3.2	7.0
		5:00-5:15	6	7	14	15	7.0	6.8	8.8	8.1	-1.0	0.2	5.2	6.9
		5:15-5:30	5	7	13	13	6.8	6.7	8.6	8.3	-1.8	0.3	4.4	4.7
30	15 to 45	4:30-4:45	5	6	11	14	5.8	6.7	8.0	7.3	-0.8	-0.7	3.0	6.7
		4:45-5:00	4	6	12	16	6.1	6.4	8.1	7.9	-2.1	-0.4	3.9	8.1
		5:00-5:15	6	7	14	15	6.1	6.3	8.4	7.6	-0.1	0.7	5.6	7.4
		5:15-5:30	5	7	13	13	5.7	6.4	7.9	7.7	-0.7	0.6	5.1	5.3
35	20 to 50	4:30-4:45	5	6	11	14	6.1	6.0	7.6	6.8	-1.1	0.0	3.4	7.2
		4:45-5:00	4	6	12	16	5.5	6.0	7.5	7.4	-1.5	0.0	4.5	8.6
		5:00-5:15	6	7	14	15	6.0	6.1	7.6	6.7	0.0	0.9	6.4	8.3
		5:15-5:30	5	7	13	13	6.1	6.1	7.2	7.2	-1.1	0.9	5.8	5.8

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
40 (Existing condition)	25 to 55	4:30-4:45	5	6	11	14	6.0	6.0	7.3	6.6	-1.0	0.0	3.7	7.4
		4:45-5:00	4	6	12	16	5.5	6.3	7.3	7.0	-1.5	-0.3	4.7	9.0
		5:00-5:15	6	7	14	15	6.3	5.9	7.4	6.5	-0.3	1.1	6.6	8.5
		5:15-5:30	5	7	13	13	5.7	5.5	7.0	6.6	-0.7	1.5	6.0	6.4
45	30 to 60	4:30-4:45	5	6	11	14	5.9	5.9	7.1	6.5	-0.9	0.1	3.9	7.5
		4:45-5:00	4	6	12	16	5.7	5.7	7.3	6.9	-1.7	0.3	4.7	9.1
		5:00-5:15	6	7	14	15	6.5	5.8	7.0	6.2	-0.5	1.2	7.0	8.8
		5:15-5:30	5	7	13	13	5.6	5.6	6.9	6.6	-0.6	1.4	6.1	6.4
50	35 to 65	4:30-4:45	5	6	11	14	5.6	6.1	7.1	6.4	-0.6	-0.1	3.9	7.6
		4:45-5:00	4	6	12	16	5.7	5.6	7.1	7.0	-1.7	0.4	4.9	9.0
		5:00-5:15	6	7	14	15	5.8	5.9	7.0	6.4	0.2	1.1	7.0	8.6
		5:15-5:30	5	7	13	13	5.9	5.8	6.9	6.6	-0.9	1.2	6.1	6.4
55	40 to 70	4:30-4:45	5	6	11	14	5.8	6.4	7.4	6.5	-0.8	-0.4	3.6	7.5
		4:45-5:00	4	6	12	16	5.7	6.1	7.0	6.8	-1.7	-0.1	5.0	9.2
		5:00-5:15	6	7	14	15	6.0	5.7	6.9	6.3	0.0	1.3	7.1	8.7
		5:15-5:30	5	7	13	13	5.7	5.8	6.9	6.7	-0.7	1.2	6.1	6.3

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NB Volume = 404 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-6.b. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM – WB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	R	TH	BL	L	R	TH	BL	L	R	TH	BL	L
15	10 to 30	4:30-4:45	2	6	13	14	5.6	9.4	12.2	16.6	-3.6	-3.4	0.8	-2.6
		4:45-5:00	3	7	12	23	5.1	10.5	11.7	16.7	-2.1	-3.5	0.3	6.3
		5:00-5:15	4	7	12	15	5.0	10.6	13.2	16.3	-1.0	-3.6	-1.2	-1.3
		5:15-5:30	4	10	13	16	5.9	10.0	11.7	16.4	-1.9	0.0	1.3	-0.4
20	10 to 35	4:30-4:45	2	6	13	14	5.3	9.2	11.8	16.0	-3.3	-3.2	1.2	-2.0
		4:45-5:00	3	7	12	23	5.0	10.5	12.1	15.7	-2.0	-3.5	-0.1	7.3
		5:00-5:15	4	7	12	15	5.2	9.6	12.6	15.9	-1.2	-2.6	-0.6	-0.9
		5:15-5:30	4	10	13	16	6.0	9.9	11.1	15.2	-2.0	0.1	1.9	0.8
25	15 to 40	4:30-4:45	2	6	13	14	4.4	8.7	10.0	13.5	-2.4	-2.7	3.0	0.5
		4:45-5:00	3	7	12	23	4.2	8.4	10.2	14.2	-1.2	-1.4	1.8	8.8
		5:00-5:15	4	7	12	15	4.3	8.5	9.4	13.7	-0.3	-1.5	2.6	1.3
		5:15-5:30	4	10	13	16	4.8	8.2	9.6	13.2	-0.8	1.8	3.4	2.8
30	15 to 45	4:30-4:45	2	6	13	14	3.9	7.7	9.1	12.1	-1.9	-1.7	3.9	1.9
		4:45-5:00	3	7	12	23	3.7	7.3	8.7	11.8	-0.7	-0.3	3.3	11.2
		5:00-5:15	4	7	12	15	3.6	7.1	8.9	11.8	0.4	-0.1	3.1	3.2
		5:15-5:30	4	10	13	16	4.3	7.6	9.0	12.0	-0.3	2.4	4.0	4.0
35	20 to 50	4:30-4:45	2	6	13	14	3.6	6.8	8.4	11.0	-1.6	-0.8	4.6	3.0
		4:45-5:00	3	7	12	23	3.5	7.0	8.1	11.0	-0.5	0.0	3.9	12.0
		5:00-5:15	4	7	12	15	3.5	6.8	7.6	10.9	0.5	0.2	4.4	4.1
		5:15-5:30	4	10	13	16	4.2	6.9	7.8	10.8	-0.2	3.1	5.2	5.2

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	R	TH	BL	L	R	TH	BL	L	R	TH	BL	L
40 (Existing condition)	25 to 55	4:30-4:45	2	6	13	14	3.2	6.2	7.7	10.0	-1.2	-0.2	5.3	4.0
		4:45-5:00	3	7	12	23	3.3	6.4	7.6	9.8	-0.3	0.6	4.4	13.2
		5:00-5:15	4	7	12	15	3.4	6.9	7.5	10.4	0.6	0.1	4.5	4.6
		5:15-5:30	4	10	13	16	3.9	6.4	7.8	9.9	0.1	3.6	5.2	6.1
45	30 to 60	4:30-4:45	2	6	13	14	3.3	6.0	7.5	9.9	-1.3	0.0	5.5	4.1
		4:45-5:00	3	7	12	23	3.2	6.6	7.5	9.5	-0.2	0.4	4.5	13.5
		5:00-5:15	4	7	12	15	3.4	6.8	7.6	9.7	0.6	0.2	4.4	5.3
		5:15-5:30	4	10	13	16	3.7	6.2	7.4	9.3	0.3	3.8	5.6	6.7
50	35 to 65	4:30-4:45	2	6	13	14	3.0	6.3	7.8	9.9	-1.0	-0.3	5.2	4.1
		4:45-5:00	3	7	12	23	3.3	6.3	7.7	9.4	-0.3	0.7	4.3	13.6
		5:00-5:15	4	7	12	15	3.4	6.7	7.7	9.5	0.6	0.3	4.3	5.5
		5:15-5:30	4	10	13	16	3.6	6.5	7.6	9.3	0.4	3.5	5.4	6.7
55	40 to 70	4:30-4:45	2	6	13	14	3.1	5.6	7.7	9.5	-1.1	0.4	5.3	4.5
		4:45-5:00	3	7	12	23	3.3	6.7	7.6	9.8	-0.3	0.3	4.4	13.2
		5:00-5:15	4	7	12	15	3.5	6.7	7.3	9.1	0.5	0.3	4.7	5.9
		5:15-5:30	4	10	13	16	4.0	6.2	7.3	8.5	0.0	3.8	5.7	7.5

Note:

- Circulating Speed = 13.7 – 18.8 mph
- WB Volume = 434 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-6.c. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM – SB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
15	10 to 30	4:30-4:45	4	8	13	15	9.0	12.3	14.8	20.2	-5.0	-4.3	-1.8	-5.2
		4:45-5:00	4	9	11	17	13.1	11.6	14.8	19.3	-9.1	-2.6	-3.8	-2.3
		5:00-5:15	4	8	11	16	12.1	11.3	15.7	19.1	-8.1	-3.3	-4.7	-3.1
		5:15-5:30	4	9	11	15	10.8	13.1	14.0	19.7	-6.8	-4.1	-3.0	-4.7
20	10 to 35	4:30-4:45	4	8	13	15	9.3	11.7	14.5	19.4	-5.3	-3.7	-1.5	-4.4
		4:45-5:00	4	9	11	17	11.3	12.6	14.5	17.7	-7.3	-3.6	-3.5	-0.7
		5:00-5:15	4	8	11	16	10.0	13.0	14.5	17.6	-6.0	-5.0	-3.5	-1.6
		5:15-5:30	4	9	11	15	9.0	11.4	14.9	18.3	-5.0	-2.4	-3.9	-3.3
25	15 to 40	4:30-4:45	4	8	13	15	8.3	11.6	12.6	16.2	-4.3	-3.6	0.4	-1.2
		4:45-5:00	4	9	11	17	10.6	9.4	12.6	15.8	-6.6	-0.4	-1.6	1.2
		5:00-5:15	4	8	11	16	9.8	10.8	11.9	15.4	-5.8	-2.8	-0.9	0.6
		5:15-5:30	4	9	11	15	7.8	9.9	12.8	14.5	-3.8	-0.9	-1.8	0.5
30	15 to 45	4:30-4:45	4	8	13	15	8.9	9.6	11.5	14.3	-4.9	-1.6	1.5	0.7
		4:45-5:00	4	9	11	17	9.2	9.4	11.5	13.3	-5.2	-0.4	-0.5	3.7
		5:00-5:15	4	8	11	16	10.1	9.6	10.6	13.3	-6.1	-1.6	0.4	2.7
		5:15-5:30	4	9	11	15	8.6	9.9	11.0	14.0	-4.6	-0.9	0.0	1.0
35	20 to 50	4:30-4:45	4	8	13	15	8.6	8.8	10.9	12.9	-4.6	-0.8	2.1	2.1
		4:45-5:00	4	9	11	17	9.8	9.8	10.9	11.9	-5.8	-0.8	0.1	5.1
		5:00-5:15	4	8	11	16	9.0	9.6	9.6	13.4	-5.0	-1.6	1.4	2.6
		5:15-5:30	4	9	11	15	7.5	9.3	10.3	12.9	-3.5	-0.3	0.7	2.1

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
40 (Existing condition)	25 to 55	4:30-4:45	4	8	13	15	7.2	9.2	10.2	12.9	-3.2	-1.2	2.8	2.1
		4:45-5:00	4	9	11	17	7.1	8.8	10.2	11.8	-3.1	0.2	0.8	5.2
		5:00-5:15	4	8	11	16	8.8	9.2	9.9	12.5	-4.8	-1.2	1.1	3.5
		5:15-5:30	4	9	11	15	8.0	8.9	10.1	12.2	-4.0	0.1	0.9	2.8
45	30 to 60	4:30-4:45	4	8	13	15	7.6	9.3	9.7	13.2	-3.6	-1.3	3.3	1.8
		4:45-5:00	4	9	11	17	8.8	9.0	9.7	11.3	-4.8	0.0	1.3	5.7
		5:00-5:15	4	8	11	16	9.4	9.8	9.8	12.5	-5.4	-1.8	1.2	3.5
		5:15-5:30	4	9	11	15	8.1	8.7	10.0	12.0	-4.1	0.3	1.0	3.0
50	35 to 65	4:30-4:45	4	8	13	15	7.0	8.9	10.3	12.2	-3.0	-0.9	2.7	2.8
		4:45-5:00	4	9	11	17	8.5	8.3	10.3	11.7	-4.5	0.7	0.7	5.3
		5:00-5:15	4	8	11	16	6.9	10.4	9.4	12.0	-2.9	-2.4	1.6	4.0
		5:15-5:30	4	9	11	15	8.0	9.0	9.6	12.5	-4.0	0.0	1.4	2.5
55	40 to 70	4:30-4:45	4	8	13	15	8.3	8.7	10.4	12.2	-4.3	-0.7	2.6	2.8
		4:45-5:00	4	9	11	17	9.3	9.3	10.4	11.3	-5.3	-0.3	0.6	5.7
		5:00-5:15	4	8	11	16	10.0	9.5	9.2	12.2	-6.0	-1.5	1.8	3.8
		5:15-5:30	4	9	11	15	8.8	9.0	10.0	11.3	-4.8	0.0	1.0	3.7

Note:

- Circulating Speed = 13.7 – 18.8 mph
- SB Volume = 411 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-6.d. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM – EB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
15	10 to 30	4:30-4:45	3	6	11	12	3.3	7.6	10.7	13.7	-0.3	-1.6	0.3	-1.7
		4:45-5:00	4	6	11	13	4.2	6.8	11.0	14.1	-0.2	-0.8	0.0	-1.1
		5:00-5:15	7	7	10	14	3.6	7.1	10.4	13.8	3.4	-0.1	-0.4	0.2
		5:15-5:30	3	7	11	12	3.6	7.7	10.2	13.5	-0.6	-0.7	0.8	-1.5
20	10 to 35	4:30-4:45	3	6	11	12	3.4	7.6	10.5	14.0	-0.4	-1.6	0.5	-2.0
		4:45-5:00	4	6	11	13	3.9	6.9	10.9	13.9	0.1	-0.9	0.1	-0.9
		5:00-5:15	7	7	10	14	3.4	7.2	10.2	13.4	3.6	-0.2	-0.2	0.6
		5:15-5:30	3	7	11	12	3.7	7.6	9.8	13.2	-0.7	-0.6	1.2	-1.2
25	15 to 40	4:30-4:45	3	6	11	12	3.2	6.1	8.3	10.8	-0.2	-0.1	2.7	1.2
		4:45-5:00	4	6	11	13	3.4	5.8	8.5	11.2	0.6	0.2	2.5	1.8
		5:00-5:15	7	7	10	14	3.0	6.2	8.2	10.9	4.0	0.8	1.8	3.1
		5:15-5:30	3	7	11	12	3.4	6.2	8.0	10.9	-0.4	0.8	3.0	1.1
30	15 to 45	4:30-4:45	3	6	11	12	2.8	5.5	7.5	9.9	0.2	0.5	3.5	2.1
		4:45-5:00	4	6	11	13	3.1	5.4	7.7	10.2	0.9	0.6	3.3	2.8
		5:00-5:15	7	7	10	14	2.8	5.5	7.3	9.8	4.2	1.5	2.7	4.2
		5:15-5:30	3	7	11	12	3.2	5.8	7.2	9.8	-0.2	1.2	3.8	2.2
35	20 to 50	4:30-4:45	3	6	11	12	2.8	5.2	6.7	9.1	0.2	0.8	4.3	2.9
		4:45-5:00	4	6	11	13	3.0	5.0	6.9	9.3	1.0	1.0	4.1	3.7
		5:00-5:15	7	7	10	14	2.8	5.3	6.6	9.1	4.2	1.7	3.4	4.9
		5:15-5:30	3	7	11	12	3.2	5.5	6.6	9.0	-0.2	1.5	4.4	3.0

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
40 (Existing condition)	25 to 55	4:30-4:45	3	6	11	12	2.7	5.2	6.4	8.6	0.3	0.8	4.6	3.4
		4:45-5:00	4	6	11	13	3.1	4.9	6.5	8.8	0.9	1.1	4.5	4.2
		5:00-5:15	7	7	10	14	2.7	5.1	6.4	8.8	4.3	1.9	3.6	5.2
		5:15-5:30	3	7	11	12	3.2	5.4	6.4	8.6	-0.2	1.6	4.6	3.4
45	30 to 60	4:30-4:45	3	6	11	12	2.7	5.1	6.3	8.6	0.3	0.9	4.7	3.4
		4:45-5:00	4	6	11	13	3.0	4.9	6.4	8.7	1.0	1.1	4.6	4.3
		5:00-5:15	7	7	10	14	2.7	5.1	6.2	8.7	4.3	1.9	3.8	5.3
		5:15-5:30	3	7	11	12	3.0	5.4	6.3	8.5	0.0	1.6	4.7	3.5
50	35 to 65	4:30-4:45	3	6	11	12	2.7	5.1	6.4	8.7	0.3	0.9	4.6	3.3
		4:45-5:00	4	6	11	13	3.0	4.9	6.4	8.7	1.0	1.1	4.6	4.3
		5:00-5:15	7	7	10	14	2.7	5.1	6.2	8.7	4.3	1.9	3.8	5.3
		5:15-5:30	3	7	11	12	3.0	5.4	6.3	8.5	0.0	1.6	4.7	3.5
55	40 to 70	4:30-4:45	3	6	11	12	2.8	5.1	6.3	8.7	0.2	0.9	4.7	3.3
		4:45-5:00	4	6	11	13	3.0	5.0	6.4	8.6	1.0	1.0	4.6	4.4
		5:00-5:15	7	7	10	14	2.7	5.1	6.3	8.6	4.3	1.9	3.7	5.4
		5:15-5:30	3	7	11	12	3.0	5.4	6.3	8.5	0.0	1.6	4.7	3.5

Note:

- Circulating Speed = 13.7 – 18.8 mph
- EB Volume = 236 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-6.e. Ellington Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM – NEB

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
15	10 to 30	4:30-4:45	2	5	9	14	2.9	11.3	12.2	7.2	-0.9	-6.3	-3.2	6.8
		4:45-5:00	2	5	11	15	3.0	8.2	12.4	6.6	-1.0	-3.2	-1.4	8.4
		5:00-5:15	2	6	8	16	2.8	9.2	12.7	6.7	-0.8	-3.2	-4.7	9.3
		5:15-5:30	2	6	8	15	3.0	8.7	12.1	9.8	-1.0	-2.7	-4.1	5.2
20	10 to 35	4:30-4:45	2	5	9	14	3.0	9.6	12.5	6.8	-1.0	-4.6	-3.5	7.2
		4:45-5:00	2	5	11	15	3.0	9.0	12.1	4.9	-1.0	-4.0	-1.1	10.1
		5:00-5:15	2	6	8	16	2.9	8.6	12.6	6.5	-0.9	-2.6	-4.6	9.5
		5:15-5:30	2	6	8	15	2.8	8.5	11.8	8.9	-0.8	-2.5	-3.8	6.1
25	15 to 40	4:30-4:45	2	5	9	14	2.7	7.0	9.8	7.2	-0.7	-2.0	-0.8	6.8
		4:45-5:00	2	5	11	15	2.7	6.9	10.1	4.3	-0.7	-1.9	0.9	10.7
		5:00-5:15	2	6	8	16	2.6	7.2	10.3	5.4	-0.6	-1.2	-2.3	10.6
		5:15-5:30	2	6	8	15	2.7	7.3	9.8	6.6	-0.7	-1.3	-1.8	8.4
30	15 to 45	4:30-4:45	2	5	9	14	2.6	6.6	8.7	5.3	-0.6	-1.6	0.3	8.7
		4:45-5:00	2	5	11	15	2.4	7.4	9.0	3.8	-0.4	-2.4	2.0	11.2
		5:00-5:15	2	6	8	16	2.5	6.6	8.8	6.3	-0.5	-0.6	-0.8	9.7
		5:15-5:30	2	6	8	15	2.6	7.7	8.6	5.4	-0.6	-1.7	-0.6	9.6
35	20 to 50	4:30-4:45	2	5	9	14	2.5	6.0	7.7	5.6	-0.5	-1.0	1.3	8.4
		4:45-5:00	2	5	11	15	2.5	5.9	8.0	5.0	-0.5	-0.9	3.0	10.0
		5:00-5:15	2	6	8	16	2.5	6.2	7.9	5.1	-0.5	-0.2	0.1	10.9
		5:15-5:30	2	6	8	15	2.5	6.4	7.6	4.3	-0.5	-0.4	0.4	10.7

Approach	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
40 (Existing condition)	25 to 55	4:30-4:45	2	5	9	14	2.5	6.3	7.6	5.2	-0.5	-1.3	1.4	8.8
		4:45-5:00	2	5	11	15	2.5	6.7	7.5	2.6	-0.5	-1.7	3.5	12.4
		5:00-5:15	2	6	8	16	2.5	6.7	7.4	6.2	-0.5	-0.7	0.6	9.8
		5:15-5:30	2	6	8	15	2.4	6.6	7.5	6.7	-0.4	-0.6	0.5	8.3
45	30 to 60	4:30-4:45	2	5	9	14	2.6	5.6	7.6	5.2	-0.6	-0.6	1.4	8.8
		4:45-5:00	2	5	11	15	2.5	6.2	7.5	3.4	-0.5	-1.2	3.5	11.6
		5:00-5:15	2	6	8	16	2.4	5.9	7.5	5.4	-0.4	0.1	0.5	10.6
		5:15-5:30	2	6	8	15	2.5	6.2	7.3	4.9	-0.5	-0.2	0.7	10.1
50	35 to 65	4:30-4:45	2	5	9	14	2.6	5.9	7.6	4.8	-0.6	-0.9	1.4	9.2
		4:45-5:00	2	5	11	15	2.6	6.4	7.4	4.2	-0.6	-1.4	3.6	10.8
		5:00-5:15	2	6	8	16	2.5	6.5	7.4	5.7	-0.5	-0.5	0.6	10.3
		5:15-5:30	2	6	8	15	2.5	6.2	7.1	4.9	-0.5	-0.2	0.9	10.1
55	40 to 70	4:30-4:45	2	5	9	14	2.5	5.8	7.6	4.5	-0.5	-0.8	1.4	9.5
		4:45-5:00	2	5	11	15	2.6	6.3	7.3	3.6	-0.6	-1.3	3.7	11.4
		5:00-5:15	2	6	8	16	2.4	6.2	7.5	5.4	-0.4	-0.2	0.5	10.6
		5:15-5:30	2	6	8	15	2.5	5.9	7.4	5.4	-0.5	0.1	0.6	9.6

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NEB Volume = 343 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-7.a. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM – NB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Speed (mph)	(mph)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
10	10 to 15	4:30-4:45	5	6	11	14	6.1	6.5	8.1	7.5	-1.1	-0.5	2.9	6.5
		4:45-5:00	4	6	12	16	6.6	6.5	7.8	7.9	-2.6	-0.5	4.2	8.1
		5:00-5:15	6	7	14	15	6.5	6.2	8.2	7.6	-0.5	0.8	5.8	7.4
		5:15-5:30	5	7	13	13	5.7	6.5	7.8	7.7	-0.7	0.5	5.2	5.3
15	15 to 20 **(16 to 20 Existing condition)**	4:30-4:45	5	6	11	14	6.1	6.5	8.1	7.5	-1.1	-0.5	2.9	6.5
		4:45-5:00	4	6	12	16	6.6	6.5	7.8	7.9	-2.6	-0.5	4.2	8.1
		5:00-5:15	6	7	14	15	6.5	6.2	8.2	7.6	-0.5	0.8	5.8	7.4
		5:15-5:30	5	7	13	13	5.7	6.5	7.8	7.7	-0.7	0.5	5.2	5.3
20	20 to 25	4:30-4:45	5	6	11	14	6.1	6.5	8.1	7.5	-1.1	-0.5	2.9	6.5
		4:45-5:00	4	6	12	16	6.6	6.5	7.8	7.9	-2.6	-0.5	4.2	8.1
		5:00-5:15	6	7	14	15	6.5	6.2	8.2	7.6	-0.5	0.8	5.8	7.4
		5:15-5:30	5	7	13	13	5.7	6.5	7.8	7.7	-0.7	0.5	5.2	5.3
25	25 to 30	4:30-4:45	5	6	11	14	6.1	6.5	8.1	7.5	-1.1	-0.5	2.9	6.5
		4:45-5:00	4	6	12	16	6.6	6.5	7.8	7.9	-2.6	-0.5	4.2	8.1
		5:00-5:15	6	7	14	15	6.5	6.2	8.2	7.6	-0.5	0.8	5.8	7.4
		5:15-5:30	5	7	13	13	5.7	6.5	7.8	7.7	-0.7	0.5	5.2	5.3
30	30 to 35	4:30-4:45	5	6	11	14	6.1	6.5	8.1	7.5	-1.1	-0.5	2.9	6.5
		4:45-5:00	4	6	12	16	6.6	6.5	7.8	7.9	-2.6	-0.5	4.2	8.1
		5:00-5:15	6	7	14	15	6.5	6.2	8.2	7.6	-0.5	0.8	5.8	7.4
		5:15-5:30	5	7	13	13	5.7	6.5	7.8	7.7	-0.7	0.5	5.2	5.3

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- NB Volume = 404 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-7.b. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM – WB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	R	TH	BL	L	R	TH	BL	L	R	TH	BL	L
10	10 to 15	4:30-4:45	2	6	13	14	3.6	7.2	8.8	11.4	-1.6	-1.2	4.2	2.6
		4:45-5:00	3	7	12	23	3.9	7.4	8.7	11.9	-0.9	-0.4	3.3	11.1
		5:00-5:15	4	7	12	15	4.1	7.5	9.3	11.5	-0.1	-0.5	2.7	3.5
		5:15-5:30	4	10	13	16	4.3	6.9	8.6	11.1	-0.3	3.1	4.4	4.9
15	15 to 20 **(16 to 20 Existing condition)**	4:30-4:45	2	6	13	14	3.6	7.2	8.8	11.4	-1.6	-1.2	4.2	2.6
		4:45-5:00	3	7	12	23	3.9	7.4	8.7	11.9	-0.9	-0.4	3.3	11.1
		5:00-5:15	4	7	12	15	4.1	7.5	9.3	11.5	-0.1	-0.5	2.7	3.5
		5:15-5:30	4	10	13	16	4.3	6.9	8.6	11.1	-0.3	3.1	4.4	4.9
20	20 to 25	4:30-4:45	2	6	13	14	3.6	7.2	8.8	11.4	-1.6	-1.2	4.2	2.6
		4:45-5:00	3	7	12	23	3.9	7.4	8.7	11.9	-0.9	-0.4	3.3	11.1
		5:00-5:15	4	7	12	15	4.1	7.5	9.3	11.5	-0.1	-0.5	2.7	3.5
		5:15-5:30	4	10	13	16	4.3	6.9	8.6	11.1	-0.3	3.1	4.4	4.9
25	25 to 30	4:30-4:45	2	6	13	14	3.6	7.2	8.8	11.4	-1.6	-1.2	4.2	2.6
		4:45-5:00	3	7	12	23	3.9	7.4	8.7	11.9	-0.9	-0.4	3.3	11.1
		5:00-5:15	4	7	12	15	4.1	7.5	9.3	11.5	-0.1	-0.5	2.7	3.5
		5:15-5:30	4	10	13	16	4.3	6.9	8.6	11.1	-0.3	3.1	4.4	4.9
30	30 to 35	4:30-4:45	2	6	13	14	3.6	7.2	8.8	11.4	-1.6	-1.2	4.2	2.6
		4:45-5:00	3	7	12	23	3.9	7.4	8.7	11.9	-0.9	-0.4	3.3	11.1
		5:00-5:15	4	7	12	15	4.1	7.5	9.3	11.5	-0.1	-0.5	2.7	3.5
		5:15-5:30	4	10	13	16	4.3	6.9	8.6	11.1	-0.3	3.1	4.4	4.9

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- WB Volume = 434 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-7.c. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM – SB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
10	10 to 15	4:30-4:45	4	8	13	15	7.2	9.6	11.1	14.1	-3.2	-1.6	1.9	0.9
		4:45-5:00	4	9	11	17	7.7	9.8	11.1	13.4	-3.7	-0.8	-0.1	3.6
		5:00-5:15	4	8	11	16	7.9	9.7	10.6	13.6	-3.9	-1.7	0.4	2.4
		5:15-5:30	4	9	11	15	8.3	9.2	10.9	14.1	-4.3	-0.2	0.1	0.9
15	15 to 20 **(16 to 20 Existing condition)**	4:30-4:45	4	8	13	15	7.2	9.6	11.1	14.1	-3.2	-1.6	1.9	0.9
		4:45-5:00	4	9	11	17	7.7	9.8	11.1	13.4	-3.7	-0.8	-0.1	3.6
		5:00-5:15	4	8	11	16	7.9	9.7	10.6	13.6	-3.9	-1.7	0.4	2.4
		5:15-5:30	4	9	11	15	8.3	9.2	10.9	14.1	-4.3	-0.2	0.1	0.9
20	20 to 25	4:30-4:45	4	8	13	15	7.2	9.6	11.1	14.1	-3.2	-1.6	1.9	0.9
		4:45-5:00	4	9	11	17	7.7	9.8	11.1	13.4	-3.7	-0.8	-0.1	3.6
		5:00-5:15	4	8	11	16	7.9	9.7	10.6	13.6	-3.9	-1.7	0.4	2.4
		5:15-5:30	4	9	11	15	8.3	9.2	10.9	14.1	-4.3	-0.2	0.1	0.9
25	25 to 30	4:30-4:45	4	8	13	15	7.2	9.6	11.1	14.1	-3.2	-1.6	1.9	0.9
		4:45-5:00	4	9	11	17	7.7	9.8	11.1	13.4	-3.7	-0.8	-0.1	3.6
		5:00-5:15	4	8	11	16	7.9	9.7	10.6	13.6	-3.9	-1.7	0.4	2.4
		5:15-5:30	4	9	11	15	8.3	9.2	10.9	14.1	-4.3	-0.2	0.1	0.9
30	30 to 35	4:30-4:45	4	8	13	15	7.2	9.6	11.1	14.1	-3.2	-1.6	1.9	0.9
		4:45-5:00	4	9	11	17	7.7	9.8	11.1	13.4	-3.7	-0.8	-0.1	3.6
		5:00-5:15	4	8	11	16	7.9	9.7	10.6	13.6	-3.9	-1.7	0.4	2.4
		5:15-5:30	4	9	11	15	8.3	9.2	10.9	14.1	-4.3	-0.2	0.1	0.9

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- SB Volume = 411 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-7.d. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM – EB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
10	10 to 15	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
		4:45-5:00	4	6	11	13	3.1	5.4	7.8	10.2	0.9	0.6	3.2	2.8
		5:00-5:15	7	7	10	14	2.8	5.6	7.5	10.1	4.2	1.4	2.5	3.9
		5:15-5:30	3	7	11	12	3.3	5.9	7.3	10.0	-0.3	1.1	3.7	2.0
15	15 to 20 **(16 to 20 Existing condition)**	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
		4:45-5:00	4	6	11	13	3.1	5.4	7.8	10.2	0.9	0.6	3.2	2.8
		5:00-5:15	7	7	10	14	2.8	5.6	7.5	10.1	4.2	1.4	2.5	3.9
		5:15-5:30	3	7	11	12	3.3	5.9	7.3	10.0	-0.3	1.1	3.7	2.0
20	20 to 25	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
		4:45-5:00	4	6	11	13	3.1	5.4	7.8	10.2	0.9	0.6	3.2	2.8
		5:00-5:15	7	7	10	14	2.8	5.6	7.5	10.1	4.2	1.4	2.5	3.9
		5:15-5:30	3	7	11	12	3.3	5.9	7.3	10.0	-0.3	1.1	3.7	2.0
25	25 to 30	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
		4:45-5:00	4	6	11	13	3.1	5.4	7.8	10.2	0.9	0.6	3.2	2.8
		5:00-5:15	7	7	10	14	2.8	5.6	7.5	10.1	4.2	1.4	2.5	3.9
		5:15-5:30	3	7	11	12	3.3	5.9	7.3	10.0	-0.3	1.1	3.7	2.0
30	30 to 35	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
		4:45-5:00	4	6	11	13	3.1	5.4	7.8	10.2	0.9	0.6	3.2	2.8
		5:00-5:15	7	7	10	14	2.8	5.6	7.5	10.1	4.2	1.4	2.5	3.9
		5:15-5:30	3	7	11	12	3.3	5.9	7.3	10.0	-0.3	1.1	3.7	2.0

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- EB Volume = 236 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-7.e. Ellington Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM – NEB

Circulating	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	(mph)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
10	10 to 15	4:30-4:45	2	5	9	14	2.5	6.6	8.2	4.2	-0.5	-1.6	0.8	9.8
		4:45-5:00	2	5	11	15	2.5	6.7	8.4	4.5	-0.5	-1.7	2.6	10.5
		5:00-5:15	2	6	8	16	2.5	6.5	8.7	5.4	-0.5	-0.5	-0.7	10.6
		5:15-5:30	2	6	8	15	2.6	6.3	8.5	4.5	-0.6	-0.3	-0.5	10.5
15	15 to 20 **(16 to 20 Existing condition)**	4:30-4:45	2	5	9	14	2.5	6.6	8.2	4.2	-0.5	-1.6	0.8	9.8
		4:45-5:00	2	5	11	15	2.5	6.7	8.4	4.5	-0.5	-1.7	2.6	10.5
		5:00-5:15	2	6	8	16	2.5	6.5	8.7	5.4	-0.5	-0.5	-0.7	10.6
		5:15-5:30	2	6	8	15	2.6	6.3	8.5	4.5	-0.6	-0.3	-0.5	10.5
20	20 to 25	4:30-4:45	2	5	9	14	2.5	6.6	8.2	4.2	-0.5	-1.6	0.8	9.8
		4:45-5:00	2	5	11	15	2.5	6.7	8.4	4.5	-0.5	-1.7	2.6	10.5
		5:00-5:15	2	6	8	16	2.5	6.5	8.7	5.4	-0.5	-0.5	-0.7	10.6
		5:15-5:30	2	6	8	15	2.6	6.3	8.5	4.5	-0.6	-0.3	-0.5	10.5
25	25 to 30	4:30-4:45	2	5	9	14	2.5	6.6	8.2	4.2	-0.5	-1.6	0.8	9.8
		4:45-5:00	2	5	11	15	2.5	6.7	8.4	4.5	-0.5	-1.7	2.6	10.5
		5:00-5:15	2	6	8	16	2.5	6.5	8.7	5.4	-0.5	-0.5	-0.7	10.6
		5:15-5:30	2	6	8	15	2.6	6.3	8.5	4.5	-0.6	-0.3	-0.5	10.5
30	30 to 35	4:30-4:45	2	5	9	14	2.5	6.6	8.2	4.2	-0.5	-1.6	0.8	9.8
		4:45-5:00	2	5	11	15	2.5	6.7	8.4	4.5	-0.5	-1.7	2.6	10.5
		5:00-5:15	2	6	8	16	2.5	6.5	8.7	5.4	-0.5	-0.5	-0.7	10.6
		5:15-5:30	2	6	8	15	2.6	6.3	8.5	4.5	-0.6	-0.3	-0.5	10.5

Note:

- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- NEB Volume = 343 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-8.a. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM – NB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
-1	4:30-4:45	5	6	11	14	7.8	7.3	8.3	7.3	-2.8	-1.3	2.7	6.7
	4:45-5:00	4	6	12	16	7.8	7.1	8.2	7.8	-3.8	-1.1	3.8	8.2
	5:00-5:15	6	7	14	15	7.6	7.1	8.4	7.4	-1.6	-0.1	5.6	7.6
	5:15-5:30	5	7	13	13	6.8	7.1	8.0	7.6	-1.8	-0.1	5.0	5.4
-0.5	4:30-4:45	5	6	11	14	5.0	5.9	7.6	7.3	0.0	0.1	3.4	6.7
	4:45-5:00	4	6	12	16	5.3	5.9	7.6	7.7	-1.3	0.1	4.4	8.3
	5:00-5:15	6	7	14	15	5.4	5.9	7.7	7.5	0.6	1.1	6.3	7.5
	5:15-5:30	5	7	13	13	5.5	5.8	7.5	7.4	-0.5	1.2	5.5	5.6
0.5	4:30-4:45	5	6	11	14	7.3	7.1	8.3	7.0	-2.3	-1.1	2.7	7.0
	4:45-5:00	4	6	12	16	7.4	6.5	8.3	8.0	-3.4	-0.5	3.7	8.0
	5:00-5:15	6	7	14	15	7.4	7.4	8.3	7.5	-1.4	-0.4	5.7	7.5
	5:15-5:30	5	7	13	13	6.9	7.1	8.5	7.6	-1.9	-0.1	4.5	5.4
1	4:30-4:45	5	6	11	14	7.8	8.6	10.7	9.8	-2.8	-2.6	0.3	4.2
	4:45-5:00	4	6	12	16	7.9	8.3	10.6	11.2	-3.9	-2.3	1.4	4.8
	5:00-5:15	6	7	14	15	8.3	7.9	10.8	10.1	-2.3	-0.9	3.2	4.9
	5:15-5:30	5	7	13	13	6.8	8.4	10.5	10.4	-1.8	-1.4	2.5	2.6
2	4:30-4:45	5	6	11	14	9.9	8.8	9.3	8.3	-4.9	-2.8	1.7	5.7
	4:45-5:00	4	6	12	16	10.0	9.8	9.1	8.0	-6.0	-3.8	2.9	8.0
	5:00-5:15	6	7	14	15	9.7	9.4	9.2	8.1	-3.7	-2.4	4.8	6.9
	5:15-5:30	5	7	13	13	8.6	8.2	8.3	7.6	-3.6	-1.2	4.7	5.4

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
3	4:30-4:45	5	6	11	14	10.7	10.5	9.9	8.4	-5.7	-4.5	1.1	5.6
	4:45-5:00	4	6	12	16	11.1	11.1	9.5	8.6	-7.1	-5.1	2.5	7.4
	5:00-5:15	6	7	14	15	12.9	9.7	9.9	8.0	-6.9	-2.7	4.1	7.0
	5:15-5:30	5	7	13	13	12.5	10.5	9.5	7.6	-7.5	-3.5	3.5	5.4

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- NB Volume = 404 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-8.b. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM – WB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	R	T	BL	L	R	T	BL	L	R	T	BL	L
-1	4:30-4:45	2	6	13	14	8.7	12.3	13.9	16.2	-6.7	-6.3	-0.9	-2.2
	4:45-5:00	3	7	12	15	8.7	13.3	13.8	17.6	-5.7	-6.3	-1.8	2.6
	5:00-5:15	4	7	12	15	8.3	12.9	14.2	17.0	-4.3	-5.9	-2.2	-2.0
	5:15-5:30	4	10	13	16	8.1	11.8	14.1	17.2	-4.1	-1.8	-1.1	-1.2
-0.5	4:30-4:45	2	6	13	14	2.9	6.2	7.9	10.5	-0.9	-0.2	5.1	3.5
	4:45-5:00	3	7	12	15	2.9	6.6	7.9	11.3	0.1	0.4	4.1	3.7
	5:00-5:15	4	7	12	15	3.1	6.4	7.7	10.9	0.9	0.6	4.3	4.1
	5:15-5:30	4	10	13	16	3.5	6.2	8.0	10.7	0.5	3.8	5.0	5.3
0.5	4:30-4:45	2	6	13	14	5.2	8.1	9.8	12.4	-3.2	-2.1	3.2	1.6
	4:45-5:00	3	7	12	15	4.5	8.9	9.7	13.0	-1.5	-1.9	2.3	2.0
	5:00-5:15	4	7	12	15	4.4	8.7	9.3	12.7	-0.4	-1.7	2.7	2.3
	5:15-5:30	4	10	13	16	4.8	8.8	9.8	12.6	-0.8	1.2	3.2	3.4
1	4:30-4:45	2	6	13	14	5.6	9.4	12.2	16.6	-3.6	-3.4	0.8	-2.6
	4:45-5:00	3	7	12	15	5.1	10.5	11.7	16.7	-2.1	-3.5	0.3	-1.7
	5:00-5:15	4	7	12	15	5.0	10.6	13.2	16.3	-1.0	-3.6	-1.2	-1.3
	5:15-5:30	4	10	13	16	5.9	10.0	11.7	16.4	-1.9	0.0	1.3	-0.4
2	4:30-4:45	2	6	13	14	10.2	12.2	14.9	17.9	-8.2	-6.2	-1.9	-3.9
	4:45-5:00	3	7	12	15	10.3	16.0	15.6	19.1	-7.3	-9.0	-3.6	-4.9
	5:00-5:15	4	7	12	15	9.9	14.7	15.4	19.3	-5.9	-7.7	-3.4	-4.3
	5:15-5:30	4	10	13	16	9.6	14.4	16.0	17.9	-5.6	-4.4	-3.0	-1.9

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	R	T	BL	L	R	T	BL	L	R	T	BL	L
3	4:30-4:45	2	6	13	14	11.8	14.7	17.6	18.0	-9.8	-8.7	-4.6	-4.0
	4:45-5:00	3	7	12	15	11.0	16.6	17.7	19.8	-8.0	-9.6	-5.7	-4.8
	5:00-5:15	4	7	12	15	12.2	17.0	17.3	22.6	-8.2	-10.0	-5.3	-7.6
	5:15-5:30	4	10	13	16	10.3	14.9	19.5	19.8	-6.3	-4.9	-6.5	-3.8

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- WB Volume = 434 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-8.c. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM – SB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
-1	4:30-4:45	4	8	13	15	18.2	18.4	17.8	24.2	-14.2	-10.4	-4.8	-9.2
	4:45-5:00	4	9	11	17	16.2	19.7	17.8	24.3	-12.2	-10.7	-6.8	-7.3
	5:00-5:15	4	8	11	16	23.0	19.1	19.9	21.3	-19.0	-11.1	-8.9	-5.3
	5:15-5:30	4	9	11	15	22.4	18.5	20.0	21.6	-18.4	-9.5	-9.0	-6.6
-0.5	4:30-4:45	4	8	13	15	6.4	7.2	9.4	11.8	-2.4	0.8	3.6	3.2
	4:45-5:00	4	9	11	17	6.1	7.8	9.4	11.5	-2.1	1.2	1.6	5.5
	5:00-5:15	4	8	11	16	6.1	7.5	8.7	11.9	-2.1	0.5	2.3	4.1
	5:15-5:30	4	9	11	15	6.1	6.9	9.3	12.1	-2.1	2.1	1.7	2.9
0.5	4:30-4:45	4	8	13	15	8.2	12.9	14.1	16.4	-4.2	-4.9	-1.1	-1.4
	4:45-5:00	4	9	11	17	11.2	12.5	14.1	17.4	-7.2	-3.5	-3.1	-0.4
	5:00-5:15	4	8	11	16	10.8	10.7	14.1	16.5	-6.8	-2.7	-3.1	-0.5
	5:15-5:30	4	9	11	15	10.7	12.4	14.3	15.8	-6.7	-3.4	-3.3	-0.8
1	4:30-4:45	4	8	13	15	9.0	12.3	14.8	20.2	-5.0	-4.3	-1.8	-5.2
	4:45-5:00	4	9	11	17	13.1	11.6	14.8	19.3	-9.1	-2.6	-3.8	-2.3
	5:00-5:15	4	8	11	16	12.1	11.3	15.7	19.1	-8.1	-3.3	-4.7	-3.1
	5:15-5:30	4	9	11	15	10.8	13.1	14.0	19.7	-6.8	-4.1	-3.0	-4.7
2	4:30-4:45	4	8	13	15	15.5	21.5	18.9	26.4	-11.5	-13.5	-5.9	-11.4
	4:45-5:00	4	9	11	17	26.9	19.9	18.9	24.6	-22.9	-10.9	-7.9	-7.6
	5:00-5:15	4	8	11	16	23.8	19.3	19.9	26.5	-19.8	-11.3	-8.9	-10.5
	5:15-5:30	4	9	11	15	18.9	21.7	22.1	24.5	-14.9	-12.7	-11.1	-9.5

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
3	4:30-4:45	4	8	13	15	16.7	22.8	24.4	22.1	-12.7	-14.8	-11.4	-7.1
	4:45-5:00	4	9	11	17	22.2	26.8	24.4	26.6	-18.2	-17.8	-13.4	-9.6
	5:00-5:15	4	8	11	16	31.9	26.5	22.5	26.7	-27.9	-18.5	-11.5	-10.7
	5:15-5:30	4	9	11	15	26.7	20.8	23.3	27.6	-22.7	-11.8	-12.3	-12.6

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- SB Volume = 411 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-8.d. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM – EB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
-1	4:30-4:45	3	6	11	12	2.9	5.5	7.5	9.8	0.1	0.5	3.5	2.2
	4:45-5:00	4	6	11	13	3.1	5.2	7.6	10.1	0.9	0.8	3.4	2.9
	5:00-5:15	7	7	10	14	2.8	5.5	7.3	9.9	4.2	1.5	2.7	4.1
	5:15-5:30	3	7	11	12	3.1	5.9	7.2	9.9	-0.1	1.1	3.8	2.1
-0.5	4:30-4:45	3	6	11	12	2.9	5.5	7.5	10.0	0.1	0.5	3.5	2.0
	4:45-5:00	4	6	11	13	3.1	5.3	7.7	10.3	0.9	0.7	3.3	2.7
	5:00-5:15	7	7	10	14	2.8	5.6	7.4	10.0	4.2	1.4	2.6	4.0
	5:15-5:30	3	7	11	12	3.1	5.9	7.3	10.1	-0.1	1.1	3.7	1.9
0.5	4:30-4:45	3	6	11	12	2.9	5.5	7.5	9.9	0.1	0.5	3.5	2.1
	4:45-5:00	4	6	11	13	3.2	5.4	7.7	10.2	0.8	0.6	3.3	2.8
	5:00-5:15	7	7	10	14	2.8	5.6	7.3	9.9	4.2	1.4	2.7	4.1
	5:15-5:30	3	7	11	12	3.3	6.0	7.3	9.9	-0.3	1.0	3.7	2.1
1	4:30-4:45	3	6	11	12	3.3	7.6	10.7	13.7	-0.3	-1.6	0.3	-1.7
	4:45-5:00	4	6	11	13	4.2	6.8	11.0	14.1	-0.2	-0.8	0.0	-1.1
	5:00-5:15	7	7	10	14	3.6	7.1	10.4	13.8	3.4	-0.1	-0.4	0.2
	5:15-5:30	3	7	11	12	3.6	7.7	10.2	13.5	-0.6	-0.7	0.8	-1.5
2	4:30-4:45	3	6	11	12	2.9	5.5	7.4	9.7	0.1	0.5	3.6	2.3
	4:45-5:00	4	6	11	13	3.3	5.2	7.5	10.0	0.7	0.8	3.5	3.0
	5:00-5:15	7	7	10	14	2.8	5.4	7.2	9.8	4.2	1.6	2.8	4.2
	5:15-5:30	3	7	11	12	3.1	5.8	7.2	9.7	-0.1	1.2	3.8	2.3

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
3	4:30-4:45	3	6	11	12	2.8	5.4	7.3	9.7	0.2	0.6	3.7	2.3
	4:45-5:00	4	6	11	13	3.1	5.2	7.5	10.0	0.9	0.8	3.5	3.0
	5:00-5:15	7	7	10	14	2.8	5.4	7.1	9.7	4.2	1.6	2.9	4.3
	5:15-5:30	3	7	11	12	3.1	5.7	7.1	9.7	-0.1	1.3	3.9	2.3

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- EB Volume = 236 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-8.e. Ellington Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM – NEB

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
-1	4:30-4:45	2	5	9	14	2.6	6.2	8.0	5.0	-0.6	-1.2	1.0	9.0
	4:45-5:00	2	5	11	15	2.6	6.2	8.1	3.9	-0.6	-1.2	2.9	11.1
	5:00-5:15	2	6	8	16	2.4	6.9	8.4	4.7	-0.4	-0.9	-0.4	11.3
	5:15-5:30	2	6	8	15	2.5	7.0	8.1	5.0	-0.5	-1.0	-0.1	10.0
-0.5	4:30-4:45	2	5	9	14	2.7	6.3	7.7	5.0	-0.7	-1.3	1.3	9.0
	4:45-5:00	2	5	11	15	2.7	6.2	7.8	4.7	-0.7	-1.2	3.2	10.3
	5:00-5:15	2	6	8	16	2.7	6.1	7.9	5.3	-0.7	-0.1	0.1	10.7
	5:15-5:30	2	6	8	15	3.0	6.4	7.7	4.8	-1.0	-0.4	0.3	10.2
0.5	4:30-4:45	2	5	9	14	2.9	6.4	8.5	4.6	-0.9	-1.4	0.5	9.4
	4:45-5:00	2	5	11	15	2.7	6.6	8.8	4.3	-0.7	-1.6	2.2	10.7
	5:00-5:15	2	6	8	16	3.0	7.7	8.9	6.8	-1.0	-1.7	-0.9	9.2
	5:15-5:30	2	6	8	15	3.1	6.7	8.3	4.7	-1.1	-0.7	-0.3	10.3
1	4:30-4:45	2	5	9	14	2.9	11.3	12.2	7.2	-0.9	-6.3	-3.2	6.8
	4:45-5:00	2	5	11	15	3.0	8.2	12.4	6.6	-1.0	-3.2	-1.4	8.4
	5:00-5:15	2	6	8	16	2.8	9.2	12.7	6.7	-0.8	-3.2	-4.7	9.3
	5:15-5:30	2	6	8	15	3.0	8.7	12.1	9.8	-1.0	-2.7	-4.1	5.2
2	4:30-4:45	2	5	9	14	2.6	7.8	9.4	6.8	-0.6	-2.8	-0.4	7.2
	4:45-5:00	2	5	11	15	2.9	7.7	9.2	3.4	-0.9	-2.7	1.8	11.6
	5:00-5:15	2	6	8	16	2.7	8.1	9.3	5.8	-0.7	-2.1	-1.3	10.2
	5:15-5:30	2	6	8	15	2.7	7.5	9.1	4.5	-0.7	-1.5	-1.1	10.5

Gap	Peak Period	Field Measurement				Simulation Results				Difference			
(seconds)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
3	4:30-4:45	2	5	9	14	2.8	9.8	10.8	6.9	-0.8	-4.8	-1.8	7.1
	4:45-5:00	2	5	11	15	2.6	9.5	10.3	3.9	-0.6	-4.5	0.7	11.1
	5:00-5:15	2	6	8	16	2.6	8.4	10.6	5.8	-0.6	-2.4	-2.6	10.2
	5:15-5:30	2	6	8	15	2.8	8.4	9.9	5.3	-0.8	-2.4	-1.9	9.7

Note:

- **Critical Gap: EB = 4.0s, WB=3.4s, SB=4.0s, NB=3.9, NEB=3.9 (Existing condition)**
- NEB Volume = 343 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-9.a. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – PM – NB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
-40	4:30-4:45	5	6	11	14	5.8	6.7	8.0	7.4	-0.8	-0.7	3.0	6.6
	4:45-5:00	4	6	12	16	5.9	6.7	8.1	7.8	-1.9	-0.7	3.9	8.2
	5:00-5:15	6	7	14	15	6.8	6.2	8.2	7.5	-0.8	0.8	5.8	7.5
	5:15-5:30	5	7	13	13	6.1	6.4	8.0	7.8	-1.1	0.6	5.0	5.2
-35	4:30-4:45	5	6	11	14	5.8	6.7	8.0	7.4	-0.8	-0.7	3.0	6.6
	4:45-5:00	4	6	12	16	5.9	6.7	8.1	7.8	-1.9	-0.7	3.9	8.2
	5:00-5:15	6	7	14	15	6.8	6.2	8.2	7.5	-0.8	0.8	5.8	7.5
	5:15-5:30	5	7	13	13	6.1	6.4	8.0	7.8	-1.1	0.6	5.0	5.2
-30	4:30-4:45	5	6	11	14	5.8	6.7	8.0	7.4	-0.8	-0.7	3.0	6.6
	4:45-5:00	4	6	12	16	5.9	6.7	8.1	7.8	-1.9	-0.7	3.9	8.2
	5:00-5:15	6	7	14	15	6.8	6.2	8.2	7.5	-0.8	0.8	5.8	7.5
	5:15-5:30	5	7	13	13	6.1	6.4	8.0	7.8	-1.1	0.6	5.0	5.2
-20	4:30-4:45	5	6	11	14	5.9	7.1	7.9	7.3	-0.9	-1.1	3.1	6.7
	4:45-5:00	4	6	12	16	5.9	6.5	8.0	7.9	-1.9	-0.5	4.0	8.1
	5:00-5:15	6	7	14	15	5.9	6.6	8.0	7.3	0.1	0.4	6.0	7.7
	5:15-5:30	5	7	13	13	5.6	6.8	7.8	7.6	-0.6	0.2	5.2	5.4
-10	4:30-4:45	5	6	11	14	6.1	6.7	7.9	7.3	-1.1	-0.7	3.1	6.7
	4:45-5:00	4	6	12	16	5.8	6.4	8.0	8.0	-1.8	-0.4	4.0	8.0
	5:00-5:15	6	7	14	15	6.7	6.4	8.1	7.3	-0.7	0.6	5.9	7.7
	5:15-5:30	5	7	13	13	6.1	6.4	7.7	7.9	-1.1	0.6	5.3	5.1

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
10	4:30-4:45	5	6	11	14	6.9	6.9	8.5	7.0	-1.9	-0.9	2.5	7.0
	4:45-5:00	4	6	12	16	6.6	6.9	8.4	8.0	-2.6	-0.9	3.6	8.0
	5:00-5:15	6	7	14	15	6.9	6.8	8.3	7.6	-0.9	0.2	5.7	7.4
	5:15-5:30	5	7	13	13	6.5	6.9	8.5	7.8	-1.5	0.1	4.5	5.2
20	4:30-4:45	5	6	11	14	8.3	6.7	9.3	6.9	-3.3	-0.7	1.7	7.1
	4:45-5:00	4	6	12	16	7.1	7.8	8.0	7.8	-3.1	-1.8	4.0	8.2
	5:00-5:15	6	7	14	15	7.8	8.1	8.4	7.4	-1.8	-1.1	5.6	7.6
	5:15-5:30	5	7	13	13	7.3	7.2	8.4	7.4	-2.3	-0.2	4.6	5.6

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- NB Volume = 404 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-9.b. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – PM – WB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	R	T	BL	L	R	T	BL	L	R	T	BL	L
-40	4:30-4:45	2	6	13	14	3.8	7.5	9.3	11.9	-1.8	-1.5	3.7	2.1
	4:45-5:00	3	7	12	23	3.8	7.5	9.2	11.7	-0.8	-0.5	2.8	11.3
	5:00-5:15	4	7	12	15	3.9	7.3	8.8	11.9	0.1	-0.3	3.2	3.1
	5:15-5:30	4	10	13	16	4.2	7.7	9.2	11.8	-0.2	2.3	3.8	4.2
-35	4:30-4:45	2	6	13	14	3.8	7.5	9.3	11.9	-1.8	-1.5	3.7	2.1
	4:45-5:00	3	7	12	15	3.8	7.5	9.2	11.7	-0.8	-0.5	2.8	3.3
	5:00-5:15	4	7	12	15	3.9	7.3	8.8	11.9	0.1	-0.3	3.2	3.1
	5:15-5:30	4	10	13	16	4.2	7.7	9.2	11.8	-0.2	2.3	3.8	4.2
-30	4:30-4:45	2	6	13	14	3.8	7.5	9.3	11.9	-1.8	-1.5	3.7	2.1
	4:45-5:00	3	7	12	23	3.8	7.5	9.2	11.7	-0.8	-0.5	2.8	11.3
	5:00-5:15	4	7	12	15	3.9	7.3	8.8	11.9	0.1	-0.3	3.2	3.1
	5:15-5:30	4	10	13	16	4.2	7.7	9.2	11.8	-0.2	2.3	3.8	4.2
-20	4:30-4:45	2	6	13	14	3.8	7.1	9.2	11.8	-1.8	-1.1	3.8	2.2
	4:45-5:00	3	7	12	23	3.8	7.6	8.7	12.0	-0.8	-0.6	3.3	11.0
	5:00-5:15	4	7	12	15	3.8	7.6	8.6	11.4	0.2	-0.6	3.4	3.6
	5:15-5:30	4	10	13	16	4.6	7.4	8.6	11.1	-0.6	2.6	4.4	4.9
-10	4:30-4:45	2	6	13	14	3.8	8.0	8.7	11.5	-1.8	-2.0	4.3	2.5
	4:45-5:00	3	7	12	23	3.9	6.8	8.6	11.9	-0.9	0.2	3.4	11.1
	5:00-5:15	4	7	12	15	3.8	7.7	8.3	12.0	0.2	-0.7	3.7	3.0
	5:15-5:30	4	10	13	16	4.0	7.3	8.4	11.1	0.0	2.7	4.6	4.9

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	R	T	BL	L	R	T	BL	L	R	T	BL	L
10	4:30-4:45	2	6	13	14	3.7	7.3	8.4	11.8	-1.7	-1.3	4.6	2.2
	4:45-5:00	3	7	12	23	3.7	7.1	8.8	11.5	-0.7	-0.1	3.2	11.5
	5:00-5:15	4	7	12	15	4.1	8.0	8.7	11.8	-0.1	-1.0	3.3	3.2
	5:15-5:30	4	10	13	16	4.5	6.9	8.7	11.2	-0.5	3.1	4.3	4.8
20	4:30-4:45	2	6	13	14	4.4	7.8	9.2	11.9	-2.4	-1.8	3.8	2.1
	4:45-5:00	3	7	12	23	4.3	8.0	9.3	12.9	-1.3	-1.0	2.7	10.1
	5:00-5:15	4	7	12	15	4.7	7.9	9.1	12.5	-0.7	-0.9	2.9	2.5
	5:15-5:30	4	10	13	16	4.8	7.8	9.5	11.4	-0.8	2.2	3.5	4.6

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- WB Volume = 434 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-9.c. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – PM – SB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
-40	4:30-4:45	4	8	13	15	6.3	7.0	8.9	11.2	-2.3	1.0	4.1	3.8
	4:45-5:00	4	9	11	17	5.9	7.2	8.9	11.5	-1.9	1.8	2.1	5.5
	5:00-5:15	4	8	11	16	5.2	6.9	9.0	11.4	-1.2	1.1	2.0	4.6
	5:15-5:30	4	9	11	15	6.1	6.8	8.7	11.0	-2.1	2.2	2.3	4.0
-35	4:30-4:45	4	8	13	15	6.3	7.0	8.9	11.2	-2.3	1.0	4.1	3.8
	4:45-5:00	4	9	11	17	5.9	7.2	8.9	11.5	-1.9	1.8	2.1	5.5
	5:00-5:15	4	8	11	16	5.2	6.9	9.0	11.4	-1.2	1.1	2.0	4.6
	5:15-5:30	4	9	11	15	6.1	6.8	8.7	11.0	-2.1	2.2	2.3	4.0
-30	4:30-4:45	4	8	13	15	6.3	7.0	8.9	11.2	-2.3	1.0	4.1	3.8
	4:45-5:00	4	9	11	17	5.9	7.2	8.9	11.5	-1.9	1.8	2.1	5.5
	5:00-5:15	4	8	11	16	5.2	6.9	9.0	11.4	-1.2	1.1	2.0	4.6
	5:15-5:30	4	9	11	15	6.1	6.8	8.7	11.0	-2.1	2.2	2.3	4.0
-20	4:30-4:45	4	8	13	15	6.3	7.5	9.1	11.3	-2.3	0.5	3.9	3.7
	4:45-5:00	4	9	11	17	6.9	7.6	9.1	11.6	-2.9	1.4	1.9	5.4
	5:00-5:15	4	8	11	16	5.4	7.1	9.1	12.0	-1.4	0.9	1.9	4.0
	5:15-5:30	4	9	11	15	6.0	7.0	8.7	11.1	-2.0	2.0	2.3	3.9
-10	4:30-4:45	4	8	13	15	8.6	10.1	11.3	13.4	-4.6	-2.1	1.7	1.6
	4:45-5:00	4	9	11	17	7.6	10.0	11.3	13.8	-3.6	-1.0	-0.3	3.2
	5:00-5:15	4	8	11	16	7.1	9.6	10.3	14.3	-3.1	-1.6	0.7	1.7
	5:15-5:30	4	9	11	15	7.7	8.3	11.3	13.5	-3.7	0.7	-0.3	1.5

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
10	4:30-4:45	4	8	13	15	10.0	9.8	12.0	15.0	-6.0	-1.8	1.0	0.0
	4:45-5:00	4	9	11	17	8.8	10.1	12.0	15.2	-4.8	-1.1	-1.0	1.8
	5:00-5:15	4	8	11	16	10.6	10.6	11.3	16.1	-6.6	-2.6	-0.3	-0.1
	5:15-5:30	4	9	11	15	7.7	10.2	11.1	15.3	-3.7	-1.2	-0.1	-0.3
20	4:30-4:45	4	8	13	15	9.7	12.1	14.6	15.7	-5.7	-4.1	-1.6	-0.7
	4:45-5:00	4	9	11	17	17.7	14.2	14.6	15.9	-13.7	-5.2	-3.6	1.1
	5:00-5:15	4	8	11	16	6.5	14.3	13.3	15.6	-2.5	-6.3	-2.3	0.4
	5:15-5:30	4	9	11	15	7.3	10.9	14.5	16.7	-3.3	-1.9	-3.5	-1.7

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- SB Volume = 411 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-9.d. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – PM – EB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
-40	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
	4:45-5:00	4	6	11	13	3.2	5.3	7.7	10.2	0.8	0.7	3.3	2.8
	5:00-5:15	7	7	10	14	2.8	5.6	7.4	10.0	4.2	1.4	2.6	4.0
	5:15-5:30	3	7	11	12	3.2	5.9	7.3	10.1	-0.2	1.1	3.7	1.9
-35	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
	4:45-5:00	4	6	11	13	3.2	5.3	7.7	10.2	0.8	0.7	3.3	2.8
	5:00-5:15	7	7	10	14	2.8	5.6	7.4	10.0	4.2	1.4	2.6	4.0
	5:15-5:30	3	7	11	12	3.2	5.9	7.3	10.1	-0.2	1.1	3.7	1.9
-30	4:30-4:45	3	6	11	12	2.8	5.6	7.6	9.9	0.2	0.4	3.4	2.1
	4:45-5:00	4	6	11	13	3.2	5.3	7.7	10.2	0.8	0.7	3.3	2.8
	5:00-5:15	7	7	10	14	2.8	5.6	7.4	10.0	4.2	1.4	2.6	4.0
	5:15-5:30	3	7	11	12	3.2	5.9	7.3	10.1	-0.2	1.1	3.7	1.9
-20	4:30-4:45	3	6	11	12	2.8	5.5	7.6	9.8	0.2	0.5	3.4	2.2
	4:45-5:00	4	6	11	13	3.1	5.5	7.8	10.3	0.9	0.5	3.2	2.7
	5:00-5:15	7	7	10	14	2.9	5.7	7.4	10.1	4.1	1.3	2.6	3.9
	5:15-5:30	3	7	11	12	3.1	5.9	7.4	10.1	-0.1	1.1	3.6	1.9
-10	4:30-4:45	3	6	11	12	2.9	5.5	7.5	9.9	0.1	0.5	3.5	2.1
	4:45-5:00	4	6	11	13	3.2	5.4	7.8	10.4	0.8	0.6	3.2	2.6
	5:00-5:15	7	7	10	14	2.8	5.6	7.5	10.0	4.2	1.4	2.5	4.0
	5:15-5:30	3	7	11	12	3.1	6.0	7.3	10.0	-0.1	1.0	3.7	2.0

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
10	4:30-4:45	3	6	11	12	2.8	5.6	7.7	10.1	0.2	0.4	3.3	1.9
	4:45-5:00	4	6	11	13	3.1	5.3	7.8	10.2	0.9	0.7	3.2	2.8
	5:00-5:15	7	7	10	14	2.9	5.7	7.5	10.0	4.1	1.3	2.5	4.0
	5:15-5:30	3	7	11	12	3.3	5.9	7.3	10.0	-0.3	1.1	3.7	2.0
20	4:30-4:45	3	6	11	12	3.0	5.5	7.6	10.0	0.0	0.5	3.4	2.0
	4:45-5:00	4	6	11	13	3.3	5.3	7.7	10.2	0.7	0.7	3.3	2.8
	5:00-5:15	7	7	10	14	2.9	5.6	7.4	9.9	4.1	1.4	2.6	4.1
	5:15-5:30	3	7	11	12	3.1	5.9	7.3	9.9	-0.1	1.1	3.7	2.1

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- EB Volume = 236 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-9.e. Ellington Roundabout - Min Headway Distance (ft) vs. Travel Time (seconds) – PM – NEB

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
-40	4:30-4:45	2	5	9	14	2.8	6.1	8.4	6.0	-0.8	-1.1	0.6	8.0
	4:45-5:00	2	5	11	15	2.8	6.6	8.3	3.3	-0.8	-1.6	2.7	11.7
	5:00-5:15	2	6	8	16	2.5	6.4	8.4	6.2	-0.5	-0.4	-0.4	9.8
	5:15-5:30	2	6	8	15	2.6	6.8	8.1	4.7	-0.6	-0.8	-0.1	10.3
-35	4:30-4:45	2	5	9	14	2.8	6.1	8.4	6.0	-0.8	-1.1	0.6	8.0
	4:45-5:00	2	5	11	15	2.8	6.6	8.3	3.3	-0.8	-1.6	2.7	11.7
	5:00-5:15	2	6	8	16	2.5	6.4	8.4	6.2	-0.5	-0.4	-0.4	9.8
	5:15-5:30	2	6	8	15	2.6	6.8	8.1	4.7	-0.6	-0.8	-0.1	10.3
-30	4:30-4:45	2	5	9	14	2.5	6.1	8.4	6.0	-0.5	-1.1	0.6	8.0
	4:45-5:00	2	5	11	15	2.5	6.6	8.3	3.3	-0.5	-1.6	2.7	11.7
	5:00-5:15	2	6	8	16	2.4	6.4	8.4	6.2	-0.4	-0.4	-0.4	9.8
	5:15-5:30	2	6	8	15	2.4	6.8	8.1	4.7	-0.4	-0.8	-0.1	10.3
-20	4:30-4:45	2	5	9	14	2.7	6.2	8.1	5.8	-0.7	-1.2	0.9	8.2
	4:45-5:00	2	5	11	15	2.6	6.4	8.2	4.9	-0.6	-1.4	2.8	10.1
	5:00-5:15	2	6	8	16	2.5	6.5	8.5	8.9	-0.5	-0.5	-0.5	7.1
	5:15-5:30	2	6	8	15	2.4	7.1	8.3	6.7	-0.4	-1.1	-0.3	8.3
-10	4:30-4:45	2	5	9	14	2.5	6.9	8.2	4.6	-0.5	-1.9	0.8	9.4
	4:45-5:00	2	5	11	15	2.4	6.6	8.5	4.9	-0.4	-1.6	2.5	10.1
	5:00-5:15	2	6	8	16	2.7	6.4	8.5	4.8	-0.7	-0.4	-0.5	11.2
	5:15-5:30	2	6	8	15	2.5	6.5	8.5	4.6	-0.5	-0.5	-0.5	10.4

Min Headway	Peak Period	Field Measurement				Simulation Results				Difference			
Distance (ft)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
10	4:30-4:45	2	5	9	14	2.5	6.8	8.4	4.2	-0.5	-1.8	0.6	9.8
	4:45-5:00	2	5	11	15	2.5	6.1	8.5	4.5	-0.5	-1.1	2.5	10.5
	5:00-5:15	2	6	8	16	2.5	6.5	8.6	5.2	-0.5	-0.5	-0.6	10.8
	5:15-5:30	2	6	8	15	2.6	5.8	8.1	4.7	-0.6	0.2	-0.1	10.3
20	4:30-4:45	2	5	9	14	2.5	6.7	8.2	4.6	-0.5	-1.7	0.8	9.4
	4:45-5:00	2	5	11	15	2.5	6.5	8.5	4.3	-0.5	-1.5	2.5	10.7
	5:00-5:15	2	6	8	16	2.5	6.1	8.5	6.1	-0.5	-0.1	-0.5	9.9
	5:15-5:30	2	6	8	15	2.5	6.7	8.0	4.5	-0.5	-0.7	0.0	10.5

Note:

- **Min Headway Distance: EB=56 ft, WB=56 ft, SB=70 ft, NB=55 ft, NEB=52 ft (Existing condition)**
- NEB Volume = 343 vph
- Approach Speed = SB,WB,NB-30 mph,EB-25 mph,NEB-35
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-10.a. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM – NB

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
10	7.5 to 12.5	4:30-4:45	5	6	11	14	7.0	7.2	9.1	8.0	-2.0	-1.2	1.9	6.0
		4:45-5:00	4	6	12	16	6.5	7.4	9.1	9.0	-2.5	-1.4	2.9	7.0
		5:00-5:15	6	7	14	15	7.3	7.4	9.0	8.1	-1.3	-0.4	5.0	6.9
		5:15-5:30	5	7	13	13	7.1	7.1	8.9	8.6	-2.1	-0.1	4.1	4.4
15	7.5 to 12.5	4:30-4:45	5	6	11	14	7.0	7.2	9.1	8.0	-2.0	-1.2	1.9	6.0
		4:45-5:00	4	6	12	16	6.5	7.4	9.1	9.0	-2.5	-1.4	2.9	7.0
		5:00-5:15	6	7	14	15	7.3	7.4	9.0	8.1	-1.3	-0.4	5.0	6.9
		5:15-5:30	5	7	13	13	7.1	7.1	8.9	8.6	-2.1	-0.1	4.1	4.4
20	12.5 to 17.5	4:30-4:45	5	6	11	14	6.3	7.1	8.4	7.6	-1.3	-1.1	2.6	6.4
		4:45-5:00	4	6	12	16	6.6	6.7	8.3	8.3	-2.6	-0.7	3.7	7.7
		5:00-5:15	6	7	14	15	6.6	6.5	8.5	7.8	-0.6	0.5	5.5	7.2
		5:15-5:30	5	7	13	13	6.2	6.4	8.4	7.9	-1.2	0.6	4.6	5.1
25	17.5 to 22.5	4:30-4:45	5	6	11	14	6.3	6.7	8.1	7.5	-1.3	-0.7	2.9	6.5
		4:45-5:00	4	6	12	16	6.6	6.8	8.1	8.1	-2.6	-0.8	3.9	7.9
		5:00-5:15	6	7	14	15	6.2	6.5	8.2	7.6	-0.2	0.5	5.8	7.4
		5:15-5:30	5	7	13	13	6.4	6.5	8.3	7.6	-1.4	0.5	4.7	5.4
30 (Existing condition)	22.5 to 27.5	4:30-4:45	5	6	11	14	6.4	6.3	8.0	7.4	-1.4	-0.3	3.0	6.6
		4:45-5:00	4	6	12	16	6.3	6.7	8.2	7.8	-2.3	-0.7	3.8	8.2
		5:00-5:15	6	7	14	15	5.9	6.6	8.1	7.5	0.1	0.4	5.9	7.5
		5:15-5:30	5	7	13	13	6.0	6.6	7.9	7.5	-1.0	0.4	5.1	5.5

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	R	TH	L	HL	R	TH	L	HL	R	TH	L	HL
35	22.5 to 27.5	4:30-4:45	5	6	11	14	6.4	6.3	8.0	7.4	-1.4	-0.3	3.0	6.6
		4:45-5:00	4	6	12	16	6.3	6.7	8.2	7.8	-2.3	-0.7	3.8	8.2
		5:00-5:15	6	7	14	15	5.9	6.6	8.1	7.5	0.1	0.4	5.9	7.5
		5:15-5:30	5	7	13	13	6.0	6.6	7.9	7.5	-1.0	0.4	5.1	5.5
40	27.5 to 32.5	4:30-4:45	5	6	11	14	6.9	6.9	8.4	7.1	-1.9	-0.9	2.6	6.9
		4:45-5:00	4	6	12	16	6.2	6.8	8.2	7.8	-2.2	-0.8	3.8	8.2
		5:00-5:15	6	7	14	15	6.3	6.6	8.0	7.2	-0.3	0.4	6.0	7.8
		5:15-5:30	5	7	13	13	6.0	6.5	7.9	7.5	-1.0	0.5	5.1	5.5
45	32.5 to 37.5	4:30-4:45	5	6	11	14	6.3	6.9	8.0	7.1	-1.3	-0.9	3.0	6.9
		4:45-5:00	4	6	12	16	6.5	6.4	8.0	7.9	-2.5	-0.4	4.0	8.1
		5:00-5:15	6	7	14	15	6.4	6.5	8.1	7.7	-0.4	0.5	5.9	7.3
		5:15-5:30	5	7	13	13	6.0	6.4	7.9	7.1	-1.0	0.6	5.1	5.9
50	37.5 to 42.5	4:30-4:45	5	6	11	14	5.9	6.8	7.8	7.0	-0.9	-0.8	3.2	7.0
		4:45-5:00	4	6	12	16	6.6	6.7	7.9	7.6	-2.6	-0.7	4.1	8.4
		5:00-5:15	6	7	14	15	6.6	6.7	7.9	7.3	-0.6	0.3	6.1	7.7
		5:15-5:30	5	7	13	13	5.4	6.2	7.5	7.0	-0.4	0.8	5.5	6.0
55	42.5 to 47.5	4:30-4:45	5	6	11	14	6.5	6.1	7.8	6.8	-1.5	-0.1	3.2	7.2
		4:45-5:00	4	6	12	16	5.9	6.2	7.8	7.6	-1.9	-0.2	4.2	8.4
		5:00-5:15	6	7	14	15	5.8	6.4	7.8	7.1	0.2	0.6	6.2	7.9
		5:15-5:30	5	7	13	13	5.7	5.8	7.5	7.1	-0.7	1.2	5.5	5.9

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NB Volume = 404 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-10.b. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM – WB

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	R	T	BL	L	R	T	BL	L	R	T	BL	L
10	7.5 to 12.5	4:30-4:45	2	6	13	14	4.7	8.4	10.3	13.2	-2.7	-2.4	2.7	0.8
		4:45-5:00	3	7	12	23	4.6	8.7	10.0	13.3	-1.6	-1.7	2.0	9.7
		5:00-5:15	4	7	12	15	4.7	8.6	10.5	12.9	-0.7	-1.6	1.5	2.1
		5:15-5:30	4	10	13	16	5.2	8.5	10.2	12.7	-1.2	1.5	2.8	3.3
15	7.5 to 12.5	4:30-4:45	2	6	13	14	4.7	8.4	10.3	13.2	-2.7	-2.4	2.7	0.8
		4:45-5:00	3	7	12	23	4.6	8.7	10.0	13.3	-1.6	-1.7	2.0	9.7
		5:00-5:15	4	7	12	15	4.7	8.6	10.5	12.9	-0.7	-1.6	1.5	2.1
		5:15-5:30	4	10	13	16	5.2	8.5	10.2	12.7	-1.2	1.5	2.8	3.3
20	12.5 to 17.5	4:30-4:45	2	6	13	14	4.2	7.4	9.6	12.0	-2.2	-1.4	3.4	2.0
		4:45-5:00	3	7	12	23	4.4	8.2	10.0	12.3	-1.4	-1.2	2.0	10.7
		5:00-5:15	4	7	12	15	4.5	7.9	9.3	13.2	-0.5	-0.9	2.7	1.8
		5:15-5:30	4	10	13	16	4.7	7.7	9.4	12.3	-0.7	2.3	3.6	3.7
25	17.5 to 22.5	4:30-4:45	2	6	13	14	4.1	7.3	9.1	12.1	-2.1	-1.3	3.9	1.9
		4:45-5:00	3	7	12	23	3.9	7.5	8.9	12.5	-0.9	-0.5	3.1	10.5
		5:00-5:15	4	7	12	15	4.3	7.6	9.1	11.4	-0.3	-0.6	2.9	3.6
		5:15-5:30	4	10	13	16	4.7	7.2	9.1	11.7	-0.7	2.8	3.9	4.3
30 (Existing condition)	22.5 to 27.5	4:30-4:45	2	6	13	14	3.9	7.1	9.0	11.4	-1.9	-1.1	4.0	2.6
		4:45-5:00	3	7	12	23	3.8	7.2	8.8	12.0	-0.8	-0.2	3.2	11.0
		5:00-5:15	4	7	12	15	3.9	7.7	8.5	11.4	0.1	-0.7	3.5	3.6
		5:15-5:30	4	10	13	16	4.4	7.3	8.2	11.1	-0.4	2.7	4.8	4.9

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
approach (mph)	(mph)	PM	R	T	BL	L	R	T	BL	L	R	T	BL	L
35	22.5 to 27.5	4:30-4:45	2	6	13	14	3.9	7.1	9.0	11.4	-1.9	-1.1	4.0	2.6
		4:45-5:00	3	7	12	23	3.8	7.2	8.8	12.0	-0.8	-0.2	3.2	11.0
		5:00-5:15	4	7	12	15	3.9	7.7	8.5	11.4	0.1	-0.7	3.5	3.6
		5:15-5:30	4	10	13	16	4.4	7.3	8.2	11.1	-0.4	2.7	4.8	4.9
40	27.5 to 32.5	4:30-4:45	2	6	13	14	3.9	7.0	8.2	11.4	-1.9	-1.0	4.8	2.6
		4:45-5:00	3	7	12	23	3.6	7.0	8.0	11.1	-0.6	0.0	4.0	11.9
		5:00-5:15	4	7	12	15	3.9	7.3	8.7	11.5	0.1	-0.3	3.3	3.5
		5:15-5:30	4	10	13	16	4.6	7.4	8.6	11.6	-0.6	2.6	4.4	4.4
45	32.5 to 37.5	4:30-4:45	2	6	13	14	3.7	6.9	8.3	11.1	-1.7	-0.9	4.7	2.9
		4:45-5:00	3	7	12	23	3.5	7.2	8.1	11.6	-0.5	-0.2	3.9	11.4
		5:00-5:15	4	7	12	15	3.5	7.3	8.0	11.4	0.5	-0.3	4.0	3.6
		5:15-5:30	4	10	13	16	4.0	7.8	7.8	11.4	0.0	2.2	5.2	4.6
50	37.5 to 42.5	4:30-4:45	2	6	13	14	3.7	6.7	8.5	11.6	-1.7	-0.7	4.5	2.4
		4:45-5:00	3	7	12	23	4.0	7.4	8.1	11.8	-1.0	-0.4	3.9	11.2
		5:00-5:15	4	7	12	15	3.9	7.2	8.9	10.7	0.1	-0.2	3.1	4.3
		5:15-5:30	4	10	13	16	4.1	7.3	8.0	11.8	-0.1	2.7	5.0	4.2
55	42.5 to 47.5	4:30-4:45	2	6	13	14	3.7	6.7	8.5	11.0	-1.7	-0.7	4.5	3.0
		4:45-5:00	3	7	12	23	3.8	7.3	8.3	11.9	-0.8	-0.3	3.7	11.1
		5:00-5:15	4	7	12	15	3.7	7.5	8.2	11.5	0.3	-0.5	3.8	3.5
		5:15-5:30	4	10	13	16	4.3	7.3	8.9	11.2	-0.3	2.7	4.1	4.8

Note:

- Circulating Speed = 13.7 – 18.8 mph
- WB Volume = 434 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-10.c. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM – SB

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
10	7.5 to 12.5	4:30-4:45	4	8	13	15	9.6	10.0	11.1	15.1	-5.6	-2.0	1.9	-0.1
		4:45-5:00	4	9	11	17	9.0	10.2	11.1	14.3	-5.0	-1.2	-0.1	2.7
		5:00-5:15	4	8	11	16	9.5	10.4	11.3	14.6	-5.5	-2.4	-0.3	1.4
		5:15-5:30	4	9	11	15	9.9	10.3	10.8	14.9	-5.9	-1.3	0.2	0.1
15	7.5 to 12.5	4:30-4:45	4	8	13	15	9.6	10.0	11.1	15.1	-5.6	-2.0	1.9	-0.1
		4:45-5:00	4	9	11	17	9.0	10.2	11.1	14.3	-5.0	-1.2	-0.1	2.7
		5:00-5:15	4	8	11	16	9.5	10.4	11.3	14.6	-5.5	-2.4	-0.3	1.4
		5:15-5:30	4	9	11	15	9.9	10.3	10.8	14.9	-5.9	-1.3	0.2	0.1
20	12.5 to 17.5	4:30-4:45	4	8	13	15	7.3	8.5	10.7	13.5	-3.3	-0.5	2.3	1.5
		4:45-5:00	4	9	11	17	8.2	9.1	10.7	13.4	-4.2	-0.1	0.3	3.6
		5:00-5:15	4	8	11	16	8.7	9.2	10.4	13.5	-4.7	-1.2	0.6	2.5
		5:15-5:30	4	9	11	15	7.9	8.5	10.7	13.3	-3.9	0.5	0.3	1.7
25	17.5 to 22.5	4:30-4:45	4	8	13	15	7.5	9.1	11.3	13.0	-3.5	-1.1	1.7	2.0
		4:45-5:00	4	9	11	17	8.5	9.6	11.3	13.0	-4.5	-0.6	-0.3	4.0
		5:00-5:15	4	8	11	16	9.4	8.9	11.0	13.6	-5.4	-0.9	0.0	2.4
		5:15-5:30	4	9	11	15	6.6	9.4	10.7	13.6	-2.6	-0.4	0.3	1.4
30 (Existing condition)	22.5 to 27.5	4:30-4:45	4	8	13	15	8.4	8.9	11.5	13.9	-4.4	-0.9	1.5	1.1
		4:45-5:00	4	9	11	17	8.1	9.2	11.5	13.2	-4.1	-0.2	-0.5	3.8
		5:00-5:15	4	8	11	16	8.9	9.2	10.4	13.6	-4.9	-1.2	0.6	2.4
		5:15-5:30	4	9	11	15	7.8	9.0	10.4	13.1	-3.8	0.0	0.6	1.9

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	R	BR	T	L	R	BR	T	L	R	BR	T	L
35	22.5 to 27.5	4:30-4:45	4	8	13	15	8.4	8.9	11.5	13.9	-4.4	-0.9	1.5	1.1
		4:45-5:00	4	9	11	17	8.1	9.2	11.5	13.2	-4.1	-0.2	-0.5	3.8
		5:00-5:15	4	8	11	16	8.9	9.2	10.4	13.6	-4.9	-1.2	0.6	2.4
		5:15-5:30	4	9	11	15	7.8	9.0	10.4	13.1	-3.8	0.0	0.6	1.9
40	27.5 to 32.5	4:30-4:45	4	8	13	15	8.4	10.6	10.8	13.6	-4.4	-2.6	2.2	1.4
		4:45-5:00	4	9	11	17	8.1	9.5	10.8	13.2	-4.1	-0.5	0.2	3.8
		5:00-5:15	4	8	11	16	9.3	10.1	10.7	14.5	-5.3	-2.1	0.3	1.5
		5:15-5:30	4	9	11	15	8.7	9.5	12.1	13.9	-4.7	-0.5	-1.1	1.1
45	32.5 to 37.5	4:30-4:45	4	8	13	15	7.7	10.3	11.9	15.4	-3.7	-2.3	1.1	-0.4
		4:45-5:00	4	9	11	17	9.4	9.6	11.9	15.0	-5.4	-0.6	-0.9	2.0
		5:00-5:15	4	8	11	16	8.5	10.2	10.8	14.7	-4.5	-2.2	0.2	1.3
		5:15-5:30	4	9	11	15	10.2	9.2	11.1	14.8	-6.2	-0.2	-0.1	0.2
50	37.5 to 42.5	4:30-4:45	4	8	13	15	8.6	11.3	12.2	15.0	-4.6	-3.3	0.8	0.0
		4:45-5:00	4	9	11	17	10.1	11.0	12.2	14.0	-6.1	-2.0	-1.2	3.0
		5:00-5:15	4	8	11	16	9.3	10.3	11.7	16.1	-5.3	-2.3	-0.7	-0.1
		5:15-5:30	4	9	11	15	10.3	10.8	12.5	14.7	-6.3	-1.8	-1.5	0.3
55	42.5 to 47.5	4:30-4:45	4	8	13	15	10.3	11.3	12.5	14.2	-6.3	-3.3	0.5	0.8
		4:45-5:00	4	9	11	17	10.9	10.9	12.5	13.8	-6.9	-1.9	-1.5	3.2
		5:00-5:15	4	8	11	16	11.4	10.3	11.7	14.8	-7.4	-2.3	-0.7	1.2
		5:15-5:30	4	9	11	15	11.7	9.7	11.8	14.0	-7.7	-0.7	-0.8	1.0

Note:

- Circulating Speed = 13.7 – 18.8 mph
- SB Volume = 411 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-10.d. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM – EB

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
10	7.5 to 12.5	4:30-4:45	3	6	11	12	4.6	8.3	9.6	13.6	-1.6	-2.3	1.4	-1.6
		4:45-5:00	4	6	11	13	5.0	8.1	9.9	13.9	-1.0	-2.1	1.1	-0.9
		5:00-5:15	7	7	10	14	4.7	8.3	9.6	13.7	2.3	-1.3	0.4	0.3
		5:15-5:30	3	7	11	12	4.9	8.8	9.4	13.7	-1.9	-1.8	1.6	-1.7
15	7.5 to 12.5	4:30-4:45	3	6	11	12	4.6	8.3	9.6	13.6	-1.6	-2.3	1.4	-1.6
		4:45-5:00	4	6	11	13	5.0	8.1	9.9	13.9	-1.0	-2.1	1.1	-0.9
		5:00-5:15	7	7	10	14	4.7	8.3	9.6	13.7	2.3	-1.3	0.4	0.3
		5:15-5:30	3	7	11	12	4.9	8.8	9.4	13.7	-1.9	-1.8	1.6	-1.7
20	12.5 to 17.5	4:30-4:45	3	6	11	12	3.4	6.5	8.3	11.0	-0.4	-0.5	2.7	1.0
		4:45-5:00	4	6	11	13	3.7	6.2	8.5	11.5	0.3	-0.2	2.5	1.5
		5:00-5:15	7	7	10	14	3.5	6.5	8.1	11.2	3.5	0.5	1.9	2.8
		5:15-5:30	3	7	11	12	3.8	7.0	8.1	11.2	-0.8	0.0	2.9	0.8
25	17.5 to 22.5	4:30-4:45	3	6	11	12	3.2	5.6	7.6	9.9	-0.2	0.4	3.4	2.1
		4:45-5:00	4	6	11	13	3.2	5.3	7.8	10.4	0.8	0.7	3.2	2.6
		5:00-5:15	7	7	10	14	2.8	5.5	7.4	10.0	4.2	1.5	2.6	4.0
		5:15-5:30	3	7	11	12	3.1	6.0	7.4	10.0	-0.1	1.0	3.6	2.0
30 (Existing condition)	22.5 to 27.5	4:30-4:45	3	6	11	12	2.7	4.9	7.1	9.2	0.3	1.1	3.9	2.8
		4:45-5:00	4	6	11	13	2.8	4.7	7.2	9.5	1.2	1.3	3.8	3.5
		5:00-5:15	7	7	10	14	2.5	5.0	6.9	9.2	4.5	2.0	3.1	4.8
		5:15-5:30	3	7	11	12	2.7	5.3	6.8	9.1	0.3	1.7	4.2	2.9

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	HR	R	T	L	HR	R	T	L	HR	R	T	L
35	22.5 to 27.5	4:30-4:45	3	6	11	12	2.7	4.9	7.1	9.2	0.3	1.1	3.9	2.8
		4:45-5:00	4	6	11	13	2.8	4.7	7.2	9.5	1.2	1.3	3.8	3.5
		5:00-5:15	7	7	10	14	2.5	5.0	6.9	9.2	4.5	2.0	3.1	4.8
		5:15-5:30	3	7	11	12	2.7	5.3	6.8	9.1	0.3	1.7	4.2	2.9
40	27.5 to 32.5	4:30-4:45	3	6	11	12	2.1	4.2	6.5	8.4	0.9	1.8	4.5	3.6
		4:45-5:00	4	6	11	13	2.3	4.1	6.6	8.7	1.7	1.9	4.4	4.3
		5:00-5:15	7	7	10	14	2.2	4.4	6.3	8.3	4.8	2.6	3.7	5.7
		5:15-5:30	3	7	11	12	2.3	4.7	6.3	8.4	0.7	2.3	4.7	3.6
45	32.5 to 37.5	4:30-4:45	3	6	11	12	1.9	3.9	5.9	7.8	1.1	2.1	5.1	4.2
		4:45-5:00	4	6	11	13	2.3	3.7	6.1	8.0	1.7	2.3	4.9	5.0
		5:00-5:15	7	7	10	14	1.8	3.9	5.8	7.8	5.2	3.1	4.2	6.2
		5:15-5:30	3	7	11	12	2.2	4.2	5.9	7.9	0.8	2.8	5.1	4.1
50	37.5 to 42.5	4:30-4:45	3	6	11	12	1.8	3.7	5.7	7.5	1.2	2.3	5.3	4.5
		4:45-5:00	4	6	11	13	1.9	3.3	5.7	7.6	2.1	2.7	5.3	5.4
		5:00-5:15	7	7	10	14	1.7	3.6	5.5	7.6	5.3	3.4	4.5	6.4
		5:15-5:30	3	7	11	12	1.9	3.9	5.4	7.4	1.1	3.1	5.6	4.6
55	42.5 to 47.5	4:30-4:45	3	6	11	12	1.6	3.4	5.5	7.4	1.4	2.6	5.5	4.6
		4:45-5:00	4	6	11	13	1.8	3.3	5.6	7.4	2.2	2.7	5.4	5.6
		5:00-5:15	7	7	10	14	1.6	3.6	5.3	7.3	5.4	3.4	4.7	6.7
		5:15-5:30	3	7	11	12	1.8	3.8	5.4	7.2	1.2	3.2	5.6	4.8

Note:

- Circulating Speed = 13.7 – 18.8 mph
- EB Volume = 236 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

Table M-10.e. Ellington Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM – NEB

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
10	7.5 to 12.5	4:30-4:45	2	5	9	14	3.6	8.2	10.5	7.6	-1.6	-3.2	-1.5	6.4
		4:45-5:00	2	5	11	15	3.6	8.4	10.6	4.5	-1.6	-3.4	0.4	10.5
		5:00-5:15	2	6	8	16	3.4	8.7	10.6	6.0	-1.4	-2.7	-2.6	10.0
		5:15-5:30	2	6	8	15	3.5	8.7	10.0	7.3	-1.5	-2.7	-2.0	7.7
15	7.5 to 12.5	4:30-4:45	2	5	9	14	3.6	8.2	10.5	7.6	-1.6	-3.2	-1.5	6.4
		4:45-5:00	2	5	11	15	3.6	8.4	10.6	4.5	-1.6	-3.4	0.4	10.5
		5:00-5:15	2	6	8	16	3.4	8.7	10.6	6.0	-1.4	-2.7	-2.6	10.0
		5:15-5:30	2	6	8	15	3.5	8.7	10.0	7.3	-1.5	-2.7	-2.0	7.7
20	12.5 to 17.5	4:30-4:45	2	5	9	14	3.0	7.6	9.7	6.4	-1.0	-2.6	-0.7	7.6
		4:45-5:00	2	5	11	15	3.0	7.9	9.3	4.0	-1.0	-2.9	1.7	11.0
		5:00-5:15	2	6	8	16	2.9	7.2	9.7	5.6	-0.9	-1.2	-1.7	10.4
		5:15-5:30	2	6	8	15	3.0	7.1	9.2	7.4	-1.0	-1.1	-1.2	7.6
25	17.5 to 22.5	4:30-4:45	2	5	9	14	2.6	7.1	8.8	5.5	-0.6	-2.1	0.2	8.5
		4:45-5:00	2	5	11	15	2.6	7.2	8.8	3.8	-0.6	-2.2	2.2	11.2
		5:00-5:15	2	6	8	16	2.8	6.7	9.1	5.9	-0.8	-0.7	-1.1	10.1
		5:15-5:30	2	6	8	15	2.6	6.7	8.8	7.5	-0.6	-0.7	-0.8	7.5
30 (Existing condition)	22.5 to 27.5	4:30-4:45	2	5	9	14	2.6	6.6	8.5	4.9	-0.6	-1.6	0.5	9.1
		4:45-5:00	2	5	11	15	2.4	6.3	8.8	3.7	-0.4	-1.3	2.2	11.3
		5:00-5:15	2	6	8	16	2.5	6.6	8.5	5.2	-0.5	-0.6	-0.5	10.8
		5:15-5:30	2	6	8	15	2.6	6.7	8.2	5.7	-0.6	-0.7	-0.2	9.3

Reduced speed of	Range	Peak Period	Field Measurement				Simulation Results				Difference			
Approach (mph)	(mph)	PM	HR	BR	BL	HL	HR	BR	BL	HL	HR	BR	BL	HL
35	22.5 to 27.5	4:30-4:45	2	5	9	14	2.6	6.6	8.5	4.9	-0.6	-1.6	0.5	9.1
		4:45-5:00	2	5	11	15	2.4	6.3	8.8	3.7	-0.4	-1.3	2.2	11.3
		5:00-5:15	2	6	8	16	2.5	6.6	8.5	5.2	-0.5	-0.6	-0.5	10.8
		5:15-5:30	2	6	8	15	2.6	6.7	8.2	5.7	-0.6	-0.7	-0.2	9.3
40	27.5 to 32.5	4:30-4:45	2	5	9	14	2.3	6.0	8.2	5.0	-0.3	-1.0	0.8	9.0
		4:45-5:00	2	5	11	15	2.4	6.7	8.3	4.8	-0.4	-1.7	2.7	10.2
		5:00-5:15	2	6	8	16	2.2	6.4	8.3	4.7	-0.2	-0.4	-0.3	11.3
		5:15-5:30	2	6	8	15	2.6	6.2	7.6	4.3	-0.6	-0.2	0.4	10.7
45	32.5 to 37.5	4:30-4:45	2	5	9	14	2.2	5.3	7.4	5.1	-0.2	-0.3	1.6	8.9
		4:45-5:00	2	5	11	15	2.4	6.4	7.8	5.0	-0.4	-1.4	3.2	10.0
		5:00-5:15	2	6	8	16	2.4	6.2	7.8	4.3	-0.4	-0.2	0.2	11.7
		5:15-5:30	2	6	8	15	2.1	5.9	7.2	4.8	-0.1	0.1	0.8	10.2
50	37.5 to 42.5	4:30-4:45	2	5	9	14	2.1	5.6	7.4	4.3	-0.1	-0.6	1.6	9.7
		4:45-5:00	2	5	11	15	2.1	5.2	7.5	3.2	-0.1	-0.2	3.5	11.8
		5:00-5:15	2	6	8	16	2.0	6.5	7.4	4.8	0.0	-0.5	0.6	11.2
		5:15-5:30	2	6	8	15	2.0	4.9	6.8	3.9	0.0	1.1	1.2	11.1
55	42.5 to 47.5	4:30-4:45	2	5	9	14	2.1	6.0	7.0	5.2	-0.1	-1.0	2.0	8.8
		4:45-5:00	2	5	11	15	2.2	5.4	7.4	4.1	-0.2	-0.4	3.6	10.9
		5:00-5:15	2	6	8	16	2.0	5.3	7.5	4.4	0.0	0.7	0.5	11.6
		5:15-5:30	2	6	8	15	2.0	5.3	6.8	4.2	0.0	0.7	1.2	10.8

Note:

- Circulating Speed = 13.7 – 18.8 mph
- NEB Volume = 343 vph
- Gap Considered = N-3.9, W-3.4, S-4, E-4, N.E-3.9

APPENDIX N

WEST HAVEN ROUNDABOUT:

CALIBRATION VARIABLES VS. QUEUES

APPENDIX N – WEST HAVEN ROUNDABOUT: CALIBRATION VARIABLES VS. QUEUES

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Table N-1. West Haven Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) - AM

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
20	10 to 35	7:00 - 7:15	2	0.1	1.9	3	2.4	0.6	1	0.1	0.9	7	2.4	4.6
		7:15 - 7:30	1	0.0	1.0	5	1.7	3.3	1	0.1	0.9	6	2.4	3.6
		7:30 - 7:45	1	0.1	0.9	5	1.9	3.1	1	0.1	0.9	7	2.9	4.1
		7:45 - 8:00	1	0.0	1.0	4	2.0	2.0	1	0.1	0.9	4	2.5	1.5
25	15 to 40	7:00 - 7:15	2	0.0	2.0	3	1.6	1.4	1	0.0	1.0	7	2.1	4.9
		7:15 - 7:30	1	0.0	1.0	5	1.2	3.8	1	0.0	1.0	6	1.8	4.2
		7:30 - 7:45	1	0.0	1.0	5	1.3	3.7	1	0.0	1.0	7	2.2	4.8
		7:45 - 8:00	1	0.0	1.0	4	1.6	2.4	1	0.0	1.0	4	1.8	2.2
30 (Existing condition)	15 to 45	7:00 - 7:15	2	0.0	2.0	3	1.6	1.4	1	0.0	1.0	7	1.9	5.1
		7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.0	1.0	6	2.1	3.9
		7:30 - 7:45	1	0.0	1.0	5	1.8	3.2	1	0.0	1.0	7	2.2	4.8
		7:45 - 8:00	1	0.0	1.0	4	1.3	2.7	1	0.0	1.0	4	2.0	2.0
35	20 to 50	7:00 - 7:15	2	0.0	2.0	3	1.4	1.6	1	0.0	1.0	7	1.6	5.4
		7:15 - 7:30	1	0.0	1.0	5	1.2	3.8	1	0.0	1.0	6	1.6	4.4
		7:30 - 7:45	1	0.0	1.0	5	1.3	3.7	1	0.0	1.0	7	2.2	4.8
		7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	1.5	2.5

Note:

- Circulating Speed = 13 – 18 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 298 vph
- EB Volume = 177 vph

Table N-2. West Haven Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) - AM

Circulating	Range	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	2	0.0	2.0	3	1.5	1.5	1	0.0	1.0	7	1.9	5.1
		7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.0	1.0	6	1.9	4.1
		7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.1	4.9
		7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.0	2.0
15	15 to 20	7:00 - 7:15	2	0.0	2.0	3	1.5	1.5	1	0.0	1.0	7	1.9	5.1
		7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.0	1.0	6	1.9	4.1
		7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.1	4.9
		7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.0	2.0
20	20 to 25	7:00 - 7:15	2	0.0	2.0	3	1.5	1.5	1	0.0	1.0	7	1.9	5.1
		7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.0	1.0	6	1.9	4.1
		7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.1	4.9
		7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.0	2.0
25	25 to 30	7:00 - 7:15	2	0.0	2.0	3	1.5	1.5	1	0.0	1.0	7	1.9	5.1
		7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.0	1.0	6	1.9	4.1
		7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.1	4.9
		7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.0	2.0
30	30 to 35	7:00 - 7:15	2	0.0	2.0	3	1.5	1.5	1	0.0	1.0	7	1.9	5.1
		7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.0	1.0	6	1.9	4.1
		7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.1	4.9
		7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.0	2.0

Note:

- Approach Speed = 30 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 298 vph
- EB Volume = 177 vph

Table N-3. West Haven Roundabout – Critical Gap (seconds) vs. Queue Length (# of Vehicles) - AM

Gap	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
(seconds)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-1	7:00 - 7:15	2	0.0	2.0	3	0.9	2.1	1	0.0	1.0	7	1.2	5.8
	7:15 - 7:30	1	0.0	1.0	5	1.0	4.0	1	0.0	1.0	6	1.0	5.0
	7:30 - 7:45	1	0.0	1.0	5	1.2	3.8	1	0.0	1.0	7	1.3	5.7
	7:45 - 8:00	1	0.0	1.0	4	0.9	3.1	1	0.0	1.0	4	1.5	2.5
1	7:00 - 7:15	2	0.1	1.9	3	2.2	0.8	1	0.1	0.9	7	2.6	4.4
	7:15 - 7:30	1	0.0	1.0	5	2.3	2.7	1	0.1	0.9	6	3.6	2.4
	7:30 - 7:45	1	0.1	0.9	5	2.0	3.0	1	0.1	0.9	7	2.8	4.2
	7:45 - 8:00	1	0.1	0.9	4	1.8	2.2	1	0.1	0.9	4	2.8	1.2
2	7:00 - 7:15	2	0.2	1.8	3	2.6	0.4	1	0.3	0.7	7	3.6	3.4
	7:15 - 7:30	1	0.1	0.9	5	2.9	2.1	1	0.3	0.7	6	5.4	0.6
	7:30 - 7:45	1	0.1	0.9	5	2.4	2.6	1	0.2	0.8	7	3.5	3.5
	7:45 - 8:00	1	0.1	0.9	4	2.6	1.4	1	0.2	0.8	4	4.3	-0.3
3	7:00 - 7:15	2	0.3	1.7	3	2.9	0.1	1	0.7	0.3	7	5.3	1.7
	7:15 - 7:30	1	0.3	0.7	5	3.6	1.4	1	0.7	0.3	6	7.4	-1.4
	7:30 - 7:45	1	0.2	0.8	5	2.8	2.2	1	0.4	0.6	7	4.8	2.2
	7:45 - 8:00	1	0.2	0.8	4	3.5	0.5	1	0.6	0.4	4	5.4	-1.4

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- Approach Speed = 30 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 298 vph
- EB Volume = 177 vph

Table N-4. West Haven Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) - AM

Min Headway	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Distance (ft)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-10	7:00 - 7:15	2	0.0	2.0	3	1.1	1.9	1	0.0	1.0	7	1.6	5.4
	7:15 - 7:30	1	0.0	1.0	5	1.0	4.0	1	0.0	1.0	6	1.6	4.4
	7:30 - 7:45	1	0.0	1.0	5	1.3	3.7	1	0.0	1.0	7	1.9	5.1
	7:45 - 8:00	1	0.0	1.0	4	1.1	2.9	1	0.0	1.0	4	1.9	2.1
10	7:00 - 7:15	2	0.0	2.0	3	1.4	1.6	1	0.0	1.0	7	2.0	5.0
	7:15 - 7:30	1	0.0	1.0	5	1.3	3.7	1	0.0	1.0	6	1.9	4.1
	7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.1	4.9
	7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.1	1.9
20	7:00 - 7:15	2	0.0	2.0	3	1.4	1.6	1	0.0	1.0	7	1.8	5.2
	7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.1	0.9	6	2.2	3.8
	7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.2	4.8
	7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.1	1.9
30	7:00 - 7:15	2	0.0	2.0	3	1.6	1.4	1	0.1	0.9	7	2.0	5.0
	7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.1	0.9	6	2.3	3.7
	7:30 - 7:45	1	0.0	1.0	5	1.8	3.2	1	0.1	0.9	7	2.3	4.7
	7:45 - 8:00	1	0.0	1.0	4	1.5	2.5	1	0.0	1.0	4	2.1	1.9

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- Approach Speed = 30 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 298 vph
- EB Volume = 177 vph

Table N-5. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) - AM

Reduced Speed of	Range	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
15	7.5 to 12.5	7:00 - 7:15	2	0.1	1.9	3	2.7	0.3	1	0.2	0.8	7	4.5	2.5
		7:15 - 7:30	1	0.1	0.9	5	2.4	2.6	1	0.2	0.8	6	4.5	1.5
		7:30 - 7:45	1	0.1	0.9	5	2.4	2.6	1	0.1	0.9	7	3.2	3.8
		7:45 - 8:00	1	0.1	0.9	4	2.2	1.8	1	0.2	0.8	4	3.8	0.2
20	12.5 to 17.5	7:00 - 7:15	2	0.0	2.0	3	1.6	1.4	1	0.1	0.9	7	2.1	4.9
		7:15 - 7:30	1	0.0	1.0	5	2.3	2.7	1	0.1	0.9	6	2.6	3.4
		7:30 - 7:45	1	0.1	0.9	5	1.7	3.3	1	0.1	0.9	7	2.4	4.6
		7:45 - 8:00	1	0.0	1.0	4	1.7	2.3	1	0.1	0.9	4	2.3	1.7
25 (Existing condition)	17.5 to 22.5	7:00 - 7:15	2	0.0	2.0	3	1.5	1.5	1	0.0	1.0	7	1.7	5.3
		7:15 - 7:30	1	0.0	1.0	5	1.2	3.8	1	0.0	1.0	6	2.1	3.9
		7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.1	0.9	7	2.0	5.0
		7:45 - 8:00	1	0.0	1.0	4	1.7	2.3	1	0.0	1.0	4	1.9	2.1
30	22.5 to 27.5	7:00 - 7:15	2	0.0	2.0	3	1.5	1.5	1	0.0	1.0	7	1.9	5.1
		7:15 - 7:30	1	0.0	1.0	5	1.4	3.6	1	0.0	1.0	6	1.9	4.1
		7:30 - 7:45	1	0.0	1.0	5	1.9	3.1	1	0.0	1.0	7	2.1	4.9
		7:45 - 8:00	1	0.0	1.0	4	1.4	2.6	1	0.0	1.0	4	2.1	1.9
35	22.5 to 27.5	7:00 - 7:15	2	0.0	2.0	3	1.4	1.6	1	0.0	1.0	7	2.2	4.8
		7:15 - 7:30	1	0.0	1.0	5	1.8	3.2	1	0.0	1.0	6	2.0	4.0
		7:30 - 7:45	1	0.0	1.0	5	1.5	3.5	1	0.0	1.0	7	2.1	4.9
		7:45 - 8:00	1	0.0	1.0	4	1.3	2.7	1	0.0	1.0	4	2.3	1.7

Note:

- Approach Speed = 30 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 298 vph
- EB Volume = 177 vph

Table N-6. West Haven Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) – PM

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
20	10 to 35	4:30 - 4:45	1	25.5	-24.5	6	26.5	-20.5	1	30.5	-29.5	6	32.6	-26.6
		4:45 - 5:00	2	25.6	-23.6	8	26.6	-18.6	1	31.4	-30.4	15	32.7	-17.7
		5:00 - 5:15	2	25.6	-23.6	26	26.6	-0.6	2	31.4	-29.4	7	32.8	-25.8
		5:15 - 5:30	1	25.6	-24.6	9	26.7	-17.7	1	31.4	-30.4	5	32.7	-27.7
25	15 to 40	4:30 - 4:45	1	25.3	-24.3	6	26.7	-20.7	1	29.5	-28.5	6	32.5	-26.5
		4:45 - 5:00	2	25.3	-23.3	8	26.7	-18.7	1	31.4	-30.4	15	32.8	-17.8
		5:00 - 5:15	2	25.5	-23.5	26	26.6	-0.6	2	31.3	-29.3	7	32.5	-25.5
		5:15 - 5:30	1	25.5	-24.5	9	26.6	-17.6	1	31.4	-30.4	5	32.8	-27.8
30 (Existing condition)	15 to 45	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.5	-27.5	6	33.0	-27.0
		4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.4	-23.4	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
35	20 to 50	4:30 - 4:45	1	24.2	-23.2	6	27.0	-21.0	1	28.1	-27.1	6	32.0	-26.0
		4:45 - 5:00	2	25.1	-23.1	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.4	-23.4	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
40	25 to 55	4:30 - 4:45	1	24.7	-23.7	6	27.0	-21.0	1	27.7	-26.7	6	32.0	-26.0
		4:45 - 5:00	2	25.1	-23.1	8	27.0	-19.0	1	31.2	-30.2	15	33.0	-18.0
		5:00 - 5:15	2	25.3	-23.3	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.2	-24.2	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0

Approach	Range	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
45	30 to 60	4:30 - 4:45	1	24.7	-23.7	6	27.0	-21.0	1	27.6	-26.6	6	32.0	-26.0
		4:45 - 5:00	2	25.0	-23.0	8	27.0	-19.0	1	31.2	-30.2	15	33.0	-18.0
		5:00 - 5:15	2	25.3	-23.3	26	27.0	-1.0	2	31.2	-29.2	7	33.0	-26.0
		5:15 - 5:30	1	25.2	-24.2	9	26.0	-17.0	1	31.2	-30.2	5	33.0	-28.0

Note:

- Circulating Speed = 13 - 18 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 359 vph
- EB Volume = 593 vph

Table N-7. West Haven Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) – PM

Circulating	Range	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	32.0	-26.0
		4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
15	15 to 35	4:30 - 4:45	1	24.7	-23.7	6	27.0	-21.0	1	27.8	-26.8	6	32.0	-26.0
		4:45 - 5:00	2	25.0	-23.0	8	27.0	-19.0	1	31.2	-30.2	15	33.0	-18.0
		5:00 - 5:15	2	25.3	-23.3	26	27.0	-1.0	2	31.2	-29.2	7	33.0	-26.0
		5:15 - 5:30	1	25.2	-24.2	9	26.0	-17.0	1	31.3	-30.3	5	33.0	-28.0
20	20 to 25	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	32.0	-26.0
		4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
25	25 to 30	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.5	-27.5	6	33.0	-27.0
		4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.4	-23.4	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
30	30 to 35	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	32.0	-26.0
		4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0

Note:

- Approach Speed = 30 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 359 vph
- EB Volume = 593 vph

Table N-8. West Haven Roundabout – Critical Gap (seconds) vs. Queue Length (# of Vehicles) – PM

Gap	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
(seconds)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-2	4:30 - 4:45	1	14.3	-13.3	6	23.0	-17.0	1	13.7	-12.7	6	21.0	-15.0
	4:45 - 5:00	2	20.8	-18.8	8	25.0	-17.0	1	22.5	-21.5	15	28.0	-13.0
	5:00 - 5:15	2	24.7	-22.7	26	27.0	-1.0	2	28.2	-26.2	7	31.0	-24.0
	5:15 - 5:30	1	24.7	-23.7	9	27.0	-18.0	1	30.4	-29.4	5	33.0	-28.0
-1	4:30 - 4:45	1	23.9	-22.9	6	27.0	-21.0	1	25.1	-24.1	6	31.0	-25.0
	4:45 - 5:00	2	25.0	-23.0	8	27.0	-19.0	1	29.8	-28.8	15	33.0	-18.0
	5:00 - 5:15	2	25.2	-23.2	26	27.0	-1.0	2	31.2	-29.2	7	33.0	-26.0
	5:15 - 5:30	1	25.2	-24.2	9	27.0	-18.0	1	31.2	-30.2	5	33.0	-28.0
1	4:30 - 4:45	1	25.0	-24.0	6	27.0	-21.0	1	29.3	-28.3	6	33.0	-27.0
	4:45 - 5:00	2	25.3	-23.3	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
	5:00 - 5:15	2	25.4	-23.4	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
	5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- Approach Speed = 30 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 359 vph
- EB Volume = 593 vph

Table N-9. West Haven Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) - PM

Min Headway	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Distance (ft)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-20	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	33.0	-27.0
	4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
	5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
	5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
-10	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	33.0	-27.0
	4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
	5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
	5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
10	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	33.0	-27.0
	4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
	5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
	5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
20	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	33.0	-27.0
	4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
	5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
	5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
30	4:30 - 4:45	1	24.9	-23.9	6	27.0	-21.0	1	28.4	-27.4	6	33.0	-27.0
	4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
	5:00 - 5:15	2	25.5	-23.5	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
	5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- Approach Speed = 30 mph
- Gap Considered = Maximum Likelihood Method
- WB Volume = 359 vph
- EB Volume = 593 vph

Table N-10. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) - PM

Reduced Speed of	Range	Peak Period	EB Queue Average			EB Queue Max			WB Queue Average			WB Queue Max		
Approach (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
35	7.5 to 12.5	4:30 - 4:45	1	24.8	-23.8	6	27.0	-21.0	1	28.5	-27.5	6	33.0	-27.0
		4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.4	-23.4	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
40	12.5 to 17.5	4:30 - 4:45	1	24.6	-23.6	6	27.0	-21.0	1	28.1	-27.1	6	32.0	-26.0
		4:45 - 5:00	2	25.0	-23.0	8	27.0	-19.0	1	31.2	-30.2	15	33.0	-18.0
		5:00 - 5:15	2	25.3	-23.3	26	27.0	-1.0	2	31.2	-29.2	7	33.0	-26.0
		5:15 - 5:30	1	25.2	-24.2	9	27.0	-18.0	1	31.2	-30.2	5	33.0	-28.0
45	17.5 to 22.5	4:30 - 4:45	1	24.8	-23.8	6	27.0	-21.0	1	28.6	-27.6	6	33.0	-27.0
		4:45 - 5:00	2	25.1	-23.1	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.4	-23.4	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0
50	22.5 to 27.5	4:30 - 4:45	1	24.6	-23.6	6	27.0	-21.0	1	27.8	-26.8	6	32.0	-26.0
		4:45 - 5:00	2	25.0	-23.0	8	27.0	-19.0	1	31.2	-30.2	15	33.0	-18.0
		5:00 - 5:15	2	25.3	-23.3	26	27.0	-1.0	2	31.2	-29.2	7	33.0	-26.0
		5:15 - 5:30	1	25.2	-24.2	9	26.0	-17.0	1	31.2	-30.2	5	33.0	-28.0
55	22.5 to 27.5	4:30 - 4:45	1	24.6	-23.6	6	27.0	-21.0	1	28.3	-27.3	6	32.0	-26.0
		4:45 - 5:00	2	25.2	-23.2	8	27.0	-19.0	1	31.3	-30.3	15	33.0	-18.0
		5:00 - 5:15	2	25.4	-23.4	26	27.0	-1.0	2	31.3	-29.3	7	33.0	-26.0
		5:15 - 5:30	1	25.3	-24.3	9	27.0	-18.0	1	31.3	-30.3	5	33.0	-28.0

Note:

- Approach Speed = 30 mph
- **Reduced speed of Approach: 25 mph**
- Gap Considered = Maximum Likelihood Method
- WB Volume = 359 vph
- EB Volume = 593 vph

APPENDIX O

WEST HAVEN ROUNDABOUT:

CALIBRATION VARIABLES VS. TRAVEL TIME

APPENDIX O – WEST HAVEN ROUNDABOUT: CALIBRATION VARIABLES VS. TRAVEL TIME

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Table O-1.a. West Haven Roundabout – Approach Speed (mph) vs. Travel Time (seconds) – AM – EB

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	AM	R	L	R	L	R	L
20	10 to 35	7:00 - 7:15	3	8	3.3	6.0	-0.3	2.0
		7:15 - 7:30	3	7	3.2	6.1	-0.2	0.9
		7:30 - 7:45	3	7	3.1	5.8	-0.1	1.2
		7:45 - 8:00	3	8	3.2	4.5	-0.2	3.5
25	15 to 40	7:00 - 7:15	3	8	2.9	5.2	0.1	2.8
		7:15 - 7:30	3	7	2.8	5.2	0.2	1.8
		7:30 - 7:45	3	7	2.8	5.0	0.2	2.0
		7:45 - 8:00	3	8	2.9	3.8	0.1	4.2
30 (Existing condition)	15 to 45	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.6	4.6	0.4	2.4
		7:30 - 7:45	3	7	2.6	4.6	0.4	2.4
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
35	20 to 50	7:00 - 7:15	3	8	2.4	4.3	0.6	3.7
		7:15 - 7:30	3	7	2.4	4.2	0.6	2.8
		7:30 - 7:45	3	7	2.5	4.2	0.5	2.8
		7:45 - 8:00	3	8	2.4	3.1	0.6	4.9

Note:

- Circulating Speed = 13 - 18 mph
- EB Volume = 631 vph

Table O-1.b. West Haven Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - WB

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	AM	R	L	R	L	R	L
20	10 to 35	7:00 - 7:15	3	7	2.3	5.8	0.7	1.2
		7:15 - 7:30	3	8	2.3	5.6	0.7	2.4
		7:30 - 7:45	3	8	2.3	5.8	0.7	2.2
		7:45 - 8:00	2	8	2.3	6.0	-0.3	2.0
25	15 to 40	7:00 - 7:15	3	7	2.1	5.0	0.9	2.0
		7:15 - 7:30	3	8	2.1	4.9	0.9	3.1
		7:30 - 7:45	3	8	2.1	5.0	0.9	3.0
		7:45 - 8:00	2	8	2.1	5.1	-0.1	2.9
30 (Existing condition)	15 to 45	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.5	1.0	3.5
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
35	20 to 50	7:00 - 7:15	3	7	1.9	4.2	1.1	2.8
		7:15 - 7:30	3	8	1.9	4.2	1.1	3.8
		7:30 - 7:45	3	8	1.9	4.2	1.1	3.8
		7:45 - 8:00	2	8	1.9	4.2	0.1	3.8

Note:

- Circulating Speed = 13 - 18 mph
- WB Volume = 631 vph

Table O-1.c. West Haven Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - SB

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	AM	R	L	R	L	R	L
20	10 to 35	7:00 - 7:15	4	10	3.3	7.5	0.7	2.5
		7:15 - 7:30	3	8	3.5	7.5	-0.5	0.5
		7:30 - 7:45	3	8	3.4	7.5	-0.4	0.5
		7:45 - 8:00	3	8	3.3	7.2	-0.3	0.8
25 (Existing condition)	15 to 40	7:00 - 7:15	4	10	2.9	6.0	1.1	4.0
		7:15 - 7:30	3	8	3.0	6.6	0.0	1.4
		7:30 - 7:45	3	8	3.1	6.4	-0.1	1.6
		7:45 - 8:00	3	8	3.1	6.3	-0.1	1.7
30	15 to 45	7:00 - 7:15	4	10	2.8	5.5	1.2	4.5
		7:15 - 7:30	3	8	2.8	6.0	0.2	2.0
		7:30 - 7:45	3	8	2.9	5.6	0.1	2.4
		7:45 - 8:00	3	8	2.8	5.6	0.2	2.4
35	20 to 50	7:00 - 7:15	4	10	2.7	5.1	1.3	4.9
		7:15 - 7:30	3	8	2.8	5.7	0.2	2.3
		7:30 - 7:45	3	8	2.7	5.3	0.3	2.7
		7:45 - 8:00	3	8	2.7	5.2	0.3	2.8

Note:

- Circulating Speed = 13 - 18 mph
- SB Volume = 631 vph

Table O-2.a. West Haven Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - EB

Circulating	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	AM	R	L	R	L	R	L
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.5	4.6	0.5	2.4
		7:30 - 7:45	3	7	2.5	4.6	0.5	2.4
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
15	15 to 20	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.5	4.6	0.5	2.4
		7:30 - 7:45	3	7	2.5	4.6	0.5	2.4
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
20	20 to 25	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.5	4.6	0.5	2.4
		7:30 - 7:45	3	7	2.5	4.6	0.5	2.4
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
25	25 to 30	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.5	4.6	0.5	2.4
		7:30 - 7:45	3	7	2.5	4.6	0.5	2.4
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
30	30 to 35	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.5	4.6	0.5	2.4
		7:30 - 7:45	3	7	2.6	4.6	0.4	2.4
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6

Note:

- Approach Speed = 30 mph
- EB Volume = 631 vph

Table O-2.b. West Haven Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - WB

Circulating	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	AM	R	L	R	L	R	L
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.5	1.0	3.5
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
15	15 to 20	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.5	1.0	3.5
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
20	20 to 25	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.5	1.0	3.5
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
25	25 to 30	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.5	1.0	3.5
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
30	30 to 35	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.5	1.0	3.5
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4

Note:

- Approach Speed = 30 mph
- WB Volume = 631 vph

Table O-2.c. West Haven Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - SB

Circulating	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	AM	R	L	R	L	R	L
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	4	10	2.9	5.5	1.1	4.5
		7:15 - 7:30	3	8	2.8	5.9	0.2	2.1
		7:30 - 7:45	3	8	2.8	5.6	0.2	2.4
		7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
15	15 to 20	7:00 - 7:15	4	10	2.9	5.5	1.1	4.5
		7:15 - 7:30	3	8	2.8	5.9	0.2	2.1
		7:30 - 7:45	3	8	2.8	5.6	0.2	2.4
		7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
20	20 to 25	7:00 - 7:15	4	10	2.9	5.5	1.1	4.5
		7:15 - 7:30	3	8	2.8	5.9	0.2	2.1
		7:30 - 7:45	3	8	2.8	5.6	0.2	2.4
		7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
25	25 to 30	7:00 - 7:15	4	10	2.9	5.5	1.1	4.5
		7:15 - 7:30	3	8	2.8	5.9	0.2	2.1
		7:30 - 7:45	3	8	2.8	5.6	0.2	2.4
		7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
30	30 to 35	7:00 - 7:15	4	10	2.9	5.5	1.1	4.5
		7:15 - 7:30	3	8	2.8	5.9	0.2	2.1
		7:30 - 7:45	3	8	2.8	5.6	0.2	2.4
		7:45 - 8:00	3	8	2.8	5.5	0.2	2.5

Note:

- Approach Speed = 30 mph
- SB Volume = 631 vph

Table O-3.a. West Haven Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - EB

Gap	Peak Period	Field Measurement		Simulation Results		Difference	
(seconds)	AM	R	L	R	L	R	L
-1	7:00 - 7:15	3	8	2.5	4.6	0.5	3.4
	7:15 - 7:30	3	7	2.5	4.6	0.5	2.4
	7:30 - 7:45	3	7	2.5	4.4	0.5	2.6
	7:45 - 8:00	3	8	2.5	3.3	0.5	4.7
1	7:00 - 7:15	3	8	2.8	4.8	0.2	3.2
	7:15 - 7:30	3	7	2.7	4.7	0.3	2.3
	7:30 - 7:45	3	7	2.7	4.7	0.3	2.3
	7:45 - 8:00	3	8	2.8	3.8	0.2	4.2
2	7:00 - 7:15	3	8	2.9	4.9	0.1	3.1
	7:15 - 7:30	3	7	2.8	4.9	0.2	2.1
	7:30 - 7:45	3	7	2.8	4.8	0.2	2.2
	7:45 - 8:00	3	8	2.9	3.9	0.1	4.1
3	7:00 - 7:15	3	8	3.0	5.2	0.0	2.8
	7:15 - 7:30	3	7	2.9	5.0	0.1	2.0
	7:30 - 7:45	3	7	2.9	4.9	0.1	2.1
	7:45 - 8:00	3	8	3.0	4.2	0.0	3.8

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- EB Volume = 631 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-3.b. West Haven Roundabout - Critical Gap (seconds) vs. Travel Time (seconds) – AM - WB

Gap	Peak Period	Field Measurement		Simulation Results		Difference	
(seconds)	AM	R	L	R	L	R	L
-1	7:00 - 7:15	3	7	1.9	4.4	1.1	2.6
	7:15 - 7:30	3	8	1.9	4.4	1.1	3.6
	7:30 - 7:45	3	8	1.9	4.5	1.1	3.5
	7:45 - 8:00	2	8	1.9	4.5	0.1	3.5
1	7:00 - 7:15	3	7	2.1	4.7	0.9	2.3
	7:15 - 7:30	3	8	2.1	4.7	0.9	3.3
	7:30 - 7:45	3	8	2.1	4.7	0.9	3.3
	7:45 - 8:00	2	8	2.1	4.8	-0.1	3.2
2	7:00 - 7:15	3	7	2.3	4.9	0.7	2.1
	7:15 - 7:30	3	8	2.2	4.8	0.8	3.2
	7:30 - 7:45	3	8	2.2	4.8	0.8	3.2
	7:45 - 8:00	2	8	2.2	5.0	-0.2	3.0
3	7:00 - 7:15	3	7	2.5	5.0	0.5	2.0
	7:15 - 7:30	3	8	2.3	5.0	0.7	3.0
	7:30 - 7:45	3	8	2.3	5.0	0.7	3.0
	7:45 - 8:00	2	8	2.4	5.2	-0.4	2.8

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- WB Volume = 631 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-3.c. West Haven Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - SB

Gap	Peak Period	Field Measurement		Simulation Results		Difference	
(seconds)	AM	R	L	R	L	R	L
-1	7:00 - 7:15	4	10	2.6	5.2	1.4	4.8
	7:15 - 7:30	3	8	2.5	5.6	0.5	2.4
	7:30 - 7:45	3	8	2.7	5.3	0.3	2.7
	7:45 - 8:00	3	8	2.5	5.2	0.5	2.8
1	7:00 - 7:15	4	10	3.0	6.7	1.0	3.3
	7:15 - 7:30	3	8	3.3	7.2	-0.3	0.8
	7:30 - 7:45	3	8	3.1	6.6	-0.1	1.4
	7:45 - 8:00	3	8	3.0	6.6	0.0	1.4
2	7:00 - 7:15	4	10	3.3	7.4	0.7	2.6
	7:15 - 7:30	3	8	3.4	8.3	-0.4	-0.3
	7:30 - 7:45	3	8	3.6	7.6	-0.6	0.4
	7:45 - 8:00	3	8	3.4	6.9	-0.4	1.1
3	7:00 - 7:15	4	10	3.7	8.8	0.3	1.2
	7:15 - 7:30	3	8	3.8	8.8	-0.8	-0.8
	7:30 - 7:45	3	8	3.8	8.5	-0.8	-0.5
	7:45 - 8:00	3	8	3.7	7.6	-0.7	0.4

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- SB Volume = 631 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-4.a. West Haven Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - EB

Min Headway	Peak Period	Field Measurement		Simulation Results		Difference	
Distance (ft)	AM	R	L	R	L	R	L
-10	7:00 - 7:15	3	8	2.5	4.7	0.5	3.3
	7:15 - 7:30	3	7	2.5	4.6	0.5	2.4
	7:30 - 7:45	3	7	2.5	4.5	0.5	2.5
	7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
10	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
	7:15 - 7:30	3	7	2.6	4.7	0.4	2.3
	7:30 - 7:45	3	7	2.6	4.6	0.4	2.4
	7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
20	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
	7:15 - 7:30	3	7	2.6	4.7	0.4	2.3
	7:30 - 7:45	3	7	2.6	4.6	0.4	2.4
	7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
30	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
	7:15 - 7:30	3	7	2.6	4.7	0.4	2.3
	7:30 - 7:45	3	7	2.6	4.6	0.4	2.4
	7:45 - 8:00	3	8	2.6	3.4	0.4	4.6

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- EB Volume = 631 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-4.b. West Haven Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - WB

Min Headway	Peak Period	Field Measurement		Simulation Results		Difference	
Distance (ft)	AM	R	L	R	L	R	L
-10	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
	7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
	7:30 - 7:45	3	8	1.9	4.5	1.1	3.5
	7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
10	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
	7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
	7:30 - 7:45	3	8	2.0	4.6	1.0	3.4
	7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
20	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
	7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
	7:30 - 7:45	3	8	2.0	4.6	1.0	3.4
	7:45 - 8:00	2	8	2.0	4.7	0.0	3.3
30	7:00 - 7:15	3	7	2.0	4.6	1.0	2.4
	7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
	7:30 - 7:45	3	8	2.0	4.6	1.0	3.4
	7:45 - 8:00	2	8	2.0	4.7	0.0	3.3

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- WB Volume = 631 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-4.c. West Haven Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - SB

Min Headway	Peak Period	Field Measurement		Simulation Results		Difference	
Distance (ft)	AM	R	L	R	L	R	L
-10	7:00 - 7:15	4	10	2.8	5.4	1.2	4.6
	7:15 - 7:30	3	8	2.9	6.0	0.1	2.0
	7:30 - 7:45	3	8	2.9	5.5	0.1	2.5
	7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
10	7:00 - 7:15	4	10	2.8	5.6	1.2	4.4
	7:15 - 7:30	3	8	2.8	5.9	0.2	2.1
	7:30 - 7:45	3	8	2.9	5.6	0.1	2.4
	7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
20	7:00 - 7:15	4	10	2.8	5.6	1.2	4.4
	7:15 - 7:30	3	8	2.9	6.0	0.1	2.0
	7:30 - 7:45	3	8	2.9	5.7	0.1	2.3
	7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
30	7:00 - 7:15	4	10	2.8	5.6	1.2	4.4
	7:15 - 7:30	3	8	2.8	6.0	0.2	2.0
	7:30 - 7:45	3	8	2.9	5.7	0.1	2.3
	7:45 - 8:00	3	8	2.8	5.5	0.2	2.5

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- SB Volume = 631 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-5.a. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - EB

Reduced Speed of	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Approach (mph)	(mph)	AM	R	L	R	L	R	L
15	7.5 to 12.5	7:00 - 7:15	3	8	3.3	5.5	-0.3	2.5
		7:15 - 7:30	3	7	3.3	5.5	-0.3	1.5
		7:30 - 7:45	3	7	3.3	5.4	-0.3	1.6
		7:45 - 8:00	3	8	3.3	4.2	-0.3	3.8
20	12.5 to 17.5	7:00 - 7:15	3	8	3.0	5.1	0.0	2.9
		7:15 - 7:30	3	7	3.0	5.0	0.0	2.0
		7:30 - 7:45	3	7	3.0	5.0	0.0	2.0
		7:45 - 8:00	3	8	3.1	3.8	-0.1	4.2
25 (Existing condition)	17.5 to 22.5	7:00 - 7:15	3	8	2.8	4.9	0.2	3.1
		7:15 - 7:30	3	7	2.8	4.8	0.2	2.2
		7:30 - 7:45	3	7	2.8	4.7	0.2	2.3
		7:45 - 8:00	3	8	2.8	3.6	0.2	4.4
30	22.5 to 27.5	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.6	4.6	0.4	2.4
		7:30 - 7:45	3	7	2.6	4.6	0.4	2.4
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6
35	22.5 to 27.5	7:00 - 7:15	3	8	2.6	4.7	0.4	3.3
		7:15 - 7:30	3	7	2.6	4.7	0.4	2.3
		7:30 - 7:45	3	7	2.5	4.5	0.5	2.5
		7:45 - 8:00	3	8	2.6	3.4	0.4	4.6

Note:

- Approach Speed = 30 mph
- EB Volume = 631 vph
- Circulating Speed = 13 - 18 mph

Table O-5.b. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - WB

Reduced Speed of	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Approach (mph)	(mph)	AM	R	L	R	L	R	L
15	7.5 to 12.5	7:00 - 7:15	3	7	2.8	5.5	0.2	1.5
		7:15 - 7:30	3	8	2.8	5.5	0.2	2.5
		7:30 - 7:45	3	8	2.8	5.6	0.2	2.4
		7:45 - 8:00	2	8	2.8	5.6	-0.8	2.4
20	12.5 to 17.5	7:00 - 7:15	3	7	2.5	5.1	0.5	1.9
		7:15 - 7:30	3	8	2.4	5.0	0.6	3.0
		7:30 - 7:45	3	8	2.5	5.2	0.5	2.8
		7:45 - 8:00	2	8	2.5	5.2	-0.5	2.8
25 (Existing condition)	17.5 to 22.5	7:00 - 7:15	3	7	2.2	4.8	0.8	2.2
		7:15 - 7:30	3	8	2.1	4.7	0.9	3.3
		7:30 - 7:45	3	8	2.2	4.8	0.8	3.2
		7:45 - 8:00	2	8	2.2	4.9	-0.2	3.1
30	22.5 to 27.5	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.5	1.0	3.5
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4
35	22.5 to 27.5	7:00 - 7:15	3	7	2.0	4.5	1.0	2.5
		7:15 - 7:30	3	8	1.9	4.5	1.1	3.5
		7:30 - 7:45	3	8	2.0	4.6	1.0	3.4
		7:45 - 8:00	2	8	2.0	4.6	0.0	3.4

Note:

- Approach Speed = 30 mph
- WB Volume = 631 vph
- Circulating Speed = 13 - 18 mph

Table O-5.c. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - SB

Reduced Speed of	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Approach (mph)	(mph)	AM	R	L	R	L	R	L
15	7.5 to 12.5	7:00 - 7:15	4	10	3.4	6.8	0.6	3.2
		7:15 - 7:30	3	8	3.5	6.9	-0.5	1.1
		7:30 - 7:45	3	8	3.4	6.8	-0.4	1.2
		7:45 - 8:00	3	8	3.5	6.7	-0.5	1.3
20 (Existing condition)	12.5 to 17.5	7:00 - 7:15	4	10	3.1	6.2	0.9	3.8
		7:15 - 7:30	3	8	3.0	6.4	0.0	1.6
		7:30 - 7:45	3	8	3.2	6.1	-0.2	1.9
		7:45 - 8:00	3	8	3.2	6.1	-0.2	1.9
25	17.5 to 22.5	7:00 - 7:15	4	10	2.9	5.8	1.1	4.2
		7:15 - 7:30	3	8	3.0	5.9	0.0	2.1
		7:30 - 7:45	3	8	2.9	5.7	0.1	2.3
		7:45 - 8:00	3	8	3.0	5.6	0.0	2.4
30	22.5 to 27.5	7:00 - 7:15	4	10	2.8	5.5	1.2	4.5
		7:15 - 7:30	3	8	2.8	5.9	0.2	2.1
		7:30 - 7:45	3	8	2.9	5.6	0.1	2.4
		7:45 - 8:00	3	8	2.8	5.5	0.2	2.5
35	22.5 to 27.5	7:00 - 7:15	4	10	2.6	5.5	1.4	4.5
		7:15 - 7:30	3	8	2.8	5.5	0.2	2.5
		7:30 - 7:45	3	8	2.7	5.3	0.3	2.7
		7:45 - 8:00	3	8	2.7	5.4	0.3	2.6

Note:

- Approach Speed = 30 mph
- SB Volume = 631 vph
- Circulating Speed = 13 - 18 mph

Table O-6.a. West Haven Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - EB

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
20	10 to 35	4:30 - 4:45	4	8	4.1	6.9	-0.1	1.1
		4:45 - 5:00	4	9	4.2	6.8	-0.2	2.2
		5:00 - 5:15	4	8	4.2	7.0	-0.2	1.0
		5:15 - 5:30	4	9	4.2	5.8	-0.2	3.2
25	15 to 40	4:30 - 4:45	4	8	3.7	6.1	0.3	1.9
		4:45 - 5:00	4	9	3.8	6.1	0.2	2.9
		5:00 - 5:15	4	8	3.8	6.2	0.2	1.8
		5:15 - 5:30	4	9	3.8	5.2	0.2	3.8
30 (Existing condition)	15 to 45	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
		5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
35	20 to 50	4:30 - 4:45	4	8	3.4	5.4	0.6	2.6
		4:45 - 5:00	4	9	3.5	5.5	0.5	3.5
		5:00 - 5:15	4	8	3.6	5.6	0.4	2.4
		5:15 - 5:30	4	9	3.6	4.7	0.4	4.3
40	25 to 55	4:30 - 4:45	4	8	3.4	5.3	0.6	2.7
		4:45 - 5:00	4	9	3.5	5.4	0.5	3.6
		5:00 - 5:15	4	8	3.6	5.5	0.4	2.5
		5:15 - 5:30	4	9	3.6	4.7	0.4	4.3

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
45	30 to 60	4:30 - 4:45	4	8	3.4	5.2	0.6	2.8
		4:45 - 5:00	4	9	3.5	5.4	0.5	3.6
		5:00 - 5:15	4	8	3.5	5.4	0.5	2.6
		5:15 - 5:30	4	9	3.6	4.6	0.4	4.4

Note:

- Circulating Speed = 13 - 18 mph
- EB Volume = 1241 vph

Table O-6.b. West Haven Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - WB

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
20	10 to 35	4:30 - 4:45	3	7	3.3	6.9	-0.3	0.1
		4:45 - 5:00	3	7	3.3	6.6	-0.3	0.4
		5:00 - 5:15	3	8	3.3	6.9	-0.3	1.1
		5:15 - 5:30	3	8	3.4	7.0	-0.4	1.0
25	15 to 40	4:30 - 4:45	3	7	3.2	6.2	-0.2	0.8
		4:45 - 5:00	3	7	3.2	6.1	-0.2	0.9
		5:00 - 5:15	3	8	3.2	6.2	-0.2	1.8
		5:15 - 5:30	3	8	3.2	6.2	-0.2	1.8
30 (Existing condition)	15 to 45	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
35	20 to 50	4:30 - 4:45	3	7	3.1	5.7	-0.1	1.3
		4:45 - 5:00	3	7	3.1	5.6	-0.1	1.4
		5:00 - 5:15	3	8	3.1	5.7	-0.1	2.3
		5:15 - 5:30	3	8	3.1	5.7	-0.1	2.3
40	25 to 55	4:30 - 4:45	3	7	3.1	5.6	-0.1	1.4
		4:45 - 5:00	3	7	3.1	5.6	-0.1	1.4
		5:00 - 5:15	3	8	3.1	5.6	-0.1	2.4
		5:15 - 5:30	3	8	3.1	5.6	-0.1	2.4

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
45	30 to 60	4:30 - 4:45	3	7	3.1	5.5	-0.1	1.5
		4:45 - 5:00	3	7	3.1	5.6	-0.1	1.4
		5:00 - 5:15	3	8	3.1	5.6	-0.1	2.4
		5:15 - 5:30	3	8	3.1	5.6	-0.1	2.4

Note:

- Circulating Speed = 13 - 18 mph
- WB Volume = 1241 vph

Table O-6.c. West Haven Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - SB

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
20	10 to 35	4:30 - 4:45	5	8	4.9	12.7	0.1	-4.7
		4:45 - 5:00	5	10	5.1	12.5	-0.1	-2.5
		5:00 - 5:15	4	10	4.9	12.4	-0.9	-2.4
		5:15 - 5:30	3	10	5.0	12.4	-2.0	-2.4
25 (Existing condition)	15 to 40	4:30 - 4:45	5	8	4.7	11.3	0.3	-3.3
		4:45 - 5:00	5	10	4.5	11.3	0.5	-1.3
		5:00 - 5:15	4	10	4.7	11.2	-0.7	-1.2
		5:15 - 5:30	3	10	4.5	10.8	-1.5	-0.8
30	15 to 45	4:30 - 4:45	5	8	4.6	10.9	0.4	-2.9
		4:45 - 5:00	5	10	4.5	10.5	0.5	-0.5
		5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
		5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4
35	20 to 50	4:30 - 4:45	5	8	4.6	10.4	0.4	-2.4
		4:45 - 5:00	5	10	4.4	10.1	0.6	-0.1
		5:00 - 5:15	4	10	4.5	10.3	-0.5	-0.3
		5:15 - 5:30	3	10	4.4	10.0	-1.4	0.0
40	25 to 55	4:30 - 4:45	5	8	4.6	10.3	0.4	-2.3
		4:45 - 5:00	5	10	4.4	10.1	0.6	-0.1
		5:00 - 5:15	4	10	4.4	10.2	-0.4	-0.2
		5:15 - 5:30	3	10	4.5	9.9	-1.5	0.1

Approach	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
45	30 to 60	4:30 - 4:45	5	8	4.6	10.3	0.4	-2.3
		4:45 - 5:00	5	10	4.4	10.1	0.6	-0.1
		5:00 - 5:15	4	10	4.5	10.2	-0.5	-0.2
		5:15 - 5:30	3	10	4.4	9.8	-1.4	0.2

Note:

- Circulating Speed = 13 - 18 mph
- SB Volume = 1241 vph

Table O-7.a. West Haven Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - EB

Circulating	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
		5:15 - 5:30	4	9	3.6	5.0	0.4	4.0
15	15 to 20	4:30 - 4:45	4	8	3.4	5.3	0.6	2.7
		4:45 - 5:00	4	9	3.5	5.4	0.5	3.6
		5:00 - 5:15	4	8	3.6	5.4	0.4	2.6
		5:15 - 5:30	4	9	3.6	4.7	0.4	4.3
20	20 to 25	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
		5:15 - 5:30	4	9	3.6	5.0	0.4	4.0
25	25 to 30	4:30 - 4:45	4	8	3.5	5.7	0.5	2.3
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.9	0.4	2.1
		5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
30	30 to 35	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
		5:15 - 5:30	4	9	3.6	5.0	0.4	4.0

Note:

- Approach Speed = 30 mph
- EB Volume = 1241 vph

Table O-7.b. West Haven Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - WB

Circulating	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
15	15 to 20	4:30 - 4:45	3	7	3.1	5.5	-0.1	1.5
		4:45 - 5:00	3	7	3.1	5.5	-0.1	1.5
		5:00 - 5:15	3	8	3.1	5.6	-0.1	2.4
		5:15 - 5:30	3	8	3.1	5.6	-0.1	2.4
20	20 to 25	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
25	25 to 30	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
30	30 to 35	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1

Note:

- Approach Speed = 30 mph
- NB Volume = 1241 vph

Table O-7.c. West Haven Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - SB

Circulating	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Speed (mph)	(mph)	PM	R	L	R	L	R	L
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	5	8	4.7	10.9	0.3	-2.9
		4:45 - 5:00	5	10	4.5	10.5	0.5	-0.5
		5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
		5:15 - 5:30	3	10	4.4	10.5	-1.4	-0.5
15	15 to 20	4:30 - 4:45	5	8	4.6	10.3	0.4	-2.3
		4:45 - 5:00	5	10	4.4	10.3	0.6	-0.3
		5:00 - 5:15	4	10	4.5	10.2	-0.5	-0.2
		5:15 - 5:30	3	10	4.4	9.9	-1.4	0.1
20	20 to 25	4:30 - 4:45	5	8	4.7	10.9	0.3	-2.9
		4:45 - 5:00	5	10	4.5	10.5	0.5	-0.5
		5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
		5:15 - 5:30	3	10	4.4	10.5	-1.4	-0.5
25	25 to 30	4:30 - 4:45	5	8	4.6	10.9	0.4	-2.9
		4:45 - 5:00	5	10	4.5	10.5	0.5	-0.5
		5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
		5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4
30	30 to 35	4:30 - 4:45	5	8	4.7	10.9	0.3	-2.9
		4:45 - 5:00	5	10	4.5	10.5	0.5	-0.5
		5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
		5:15 - 5:30	3	10	4.4	10.5	-1.4	-0.5

Note:

- Approach Speed = 30 mph
- SB Volume = 1241 vph

Table O-8.a. West Haven Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - EB

Gap	Peak Period	Field Measurement		Simulation Results		Difference	
(seconds)	PM	R	L	R	L	R	L
-2	4:30 - 4:45	4	8	3.1	5.3	0.9	2.7
	4:45 - 5:00	4	9	3.4	5.6	0.6	3.4
	5:00 - 5:15	4	8	3.5	5.8	0.5	2.2
	5:15 - 5:30	4	9	3.6	4.7	0.4	4.3
-1	4:30 - 4:45	4	8	3.4	5.3	0.6	2.7
	4:45 - 5:00	4	9	3.5	5.3	0.5	3.7
	5:00 - 5:15	4	8	3.5	5.4	0.5	2.6
	5:15 - 5:30	4	9	3.6	4.6	0.4	4.4
1	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
	4:45 - 5:00	4	9	3.7	5.8	0.3	3.2
	5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
	5:15 - 5:30	4	9	3.6	4.9	0.4	4.1

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- EB Volume = 1241 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-8.b. West Haven Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - WB

Gap	Peak Period	Field Measurement		Simulation Results		Difference	
(seconds)	PM	R	L	R	L	R	L
-2	4:30 - 4:45	3	7	2.8	5.5	0.2	1.5
	4:45 - 5:00	3	7	2.9	5.7	0.1	1.3
	5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
	5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
-1	4:30 - 4:45	3	7	3.1	5.5	-0.1	1.5
	4:45 - 5:00	3	7	3.1	5.5	-0.1	1.5
	5:00 - 5:15	3	8	3.1	5.6	-0.1	2.4
	5:15 - 5:30	3	8	3.1	5.6	-0.1	2.4
1	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
	4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
	5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
	5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- WB Volume = 1241 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-8.c. West Haven Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - SB

Gap	Peak Period	Field Measurement		Simulation Results		Difference	
(seconds)	PM	R	L	R	L	R	L
-2	4:30 - 4:45	5	8	4.1	8.8	0.9	-0.8
	4:45 - 5:00	5	10	4.2	9.4	0.8	0.6
	5:00 - 5:15	4	10	4.6	10.4	-0.6	-0.4
	5:15 - 5:30	3	10	4.4	10.3	-1.4	-0.3
-1	4:30 - 4:45	5	8	4.6	10.2	0.4	-2.2
	4:45 - 5:00	5	10	4.4	10.2	0.6	-0.2
	5:00 - 5:15	4	10	4.6	10.2	-0.6	-0.2
	5:15 - 5:30	3	10	4.4	9.8	-1.4	0.2
1	4:30 - 4:45	5	8	4.7	10.8	0.3	-2.8
	4:45 - 5:00	5	10	4.4	10.4	0.6	-0.4
	5:00 - 5:15	4	10	4.6	10.8	-0.6	-0.8
	5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4

Note:

- **Critical Gap: EB = 3.8s, WB=4.4s, SB=4.4s (Existing condition)**
- SB Volume = 1241 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-9.a. West Haven Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - EB

Min Headway	Peak Period	Field Measurement		Simulation Results		Difference	
Distance (ft)	PM	R	L	R	L	R	L
-20	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
	4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
	5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
	5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
-10	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
	4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
	5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
	5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
10	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
	4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
	5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
	5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
20	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
	4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
	5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
	5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
30	4:30 - 4:45	4	8	3.6	5.7	0.4	2.3
	4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
	5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
	5:15 - 5:30	4	9	3.7	4.9	0.3	4.1

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- EB Volume = 1241 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-9.b. West Haven Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - WB

Min Headway	Peak Period	Field Measurement		Simulation Results		Difference	
Distance (ft)	PM	R	L	R	L	R	L
-20	4:30 - 4:45	3	7	3.1	5.8	-0.1	1.2
	4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
	5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
	5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
-10	4:30 - 4:45	3	7	3.1	5.8	-0.1	1.2
	4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
	5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
	5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
10	4:30 - 4:45	3	7	3.1	5.8	-0.1	1.2
	4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
	5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
	5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
20	4:30 - 4:45	3	7	3.1	5.8	-0.1	1.2
	4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
	5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
	5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
30	4:30 - 4:45	3	7	3.1	5.8	-0.1	1.2
	4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
	5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
	5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- WB Volume = 1241 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-9.c. West Haven Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - SB

Min Headway	Peak Period	Field Measurement		Simulation Results		Difference	
Distance (ft)	PM	R	L	R	L	R	L
-20	4:30 - 4:45	5	8	4.7	10.8	0.3	-2.8
	4:45 - 5:00	5	10	4.5	10.4	0.5	-0.4
	5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
	5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4
-10	4:30 - 4:45	5	8	4.7	10.8	0.3	-2.8
	4:45 - 5:00	5	10	4.5	10.4	0.5	-0.4
	5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
	5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4
10	4:30 - 4:45	5	8	4.7	10.8	0.3	-2.8
	4:45 - 5:00	5	10	4.5	10.4	0.5	-0.4
	5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
	5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4
20	4:30 - 4:45	5	8	4.7	10.8	0.3	-2.8
	4:45 - 5:00	5	10	4.5	10.4	0.5	-0.4
	5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
	5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4
30	4:30 - 4:45	5	8	4.7	10.8	0.3	-2.8
	4:45 - 5:00	5	10	4.5	10.4	0.5	-0.4
	5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
	5:15 - 5:30	3	10	4.4	10.4	-1.4	-0.4

Note:

- **Min Headway Distance: EB=94 ft, WB=140 ft, SB=140 ft, (Existing condition)**
- SB Volume = 1241 vph
- Approach Speed = 30 mph
- Circulating Speed = 13 - 18 mph

Table O-10.a. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - EB

Reduced Speed of	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Approach (mph)	(mph)	PM	R	L	R	L	R	L
35	22.5 to 27.5	4:30 - 4:45	4	8	3.5	5.7	0.5	2.3
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
		5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
40	27.5 to 32.5	4:30 - 4:45	4	8	3.4	5.2	0.6	2.8
		4:45 - 5:00	4	9	3.5	5.4	0.5	3.6
		5:00 - 5:15	4	8	3.5	5.4	0.5	2.6
		5:15 - 5:30	4	9	3.6	4.6	0.4	4.4
45	27.5 to 32.5	4:30 - 4:45	4	8	3.5	5.6	0.5	2.4
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.8	0.4	2.2
		5:15 - 5:30	4	9	3.7	4.9	0.3	4.1
50	37.5 to 42.5	4:30 - 4:45	4	8	3.4	5.2	0.6	2.8
		4:45 - 5:00	4	9	3.5	5.4	0.5	3.6
		5:00 - 5:15	4	8	3.5	5.4	0.5	2.6
		5:15 - 5:30	4	9	3.6	4.6	0.4	4.4
55	42.5 to 47.5	4:30 - 4:45	4	8	3.5	5.7	0.5	2.3
		4:45 - 5:00	4	9	3.6	5.8	0.4	3.2
		5:00 - 5:15	4	8	3.6	5.9	0.4	2.1
		5:15 - 5:30	4	9	3.6	4.9	0.4	4.1

Note:

- Approach Speed = 30 mph
- **Reduced speed of Approach: 25 mph**
- Circulating Speed = 13 - 18 mph
- EB Volume = 1241 vph

Table O-10.b. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - WB

Reduced Speed of	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Approach (mph)	(mph)	PM	R	L	R	L	R	L
35	22.5 to 27.5	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
40	27.5 to 32.5	4:30 - 4:45	3	7	3.1	5.5	-0.1	1.5
		4:45 - 5:00	3	7	3.1	5.5	-0.1	1.5
		5:00 - 5:15	3	8	3.1	5.6	-0.1	2.4
		5:15 - 5:30	3	8	3.1	5.6	-0.1	2.4
45	27.5 to 32.5	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1
50	37.5 to 42.5	4:30 - 4:45	3	7	3.1	5.5	-0.1	1.5
		4:45 - 5:00	3	7	3.1	5.5	-0.1	1.5
		5:00 - 5:15	3	8	3.1	5.6	-0.1	2.4
		5:15 - 5:30	3	8	3.1	5.6	-0.1	2.4
55	42.5 to 47.5	4:30 - 4:45	3	7	3.1	5.9	-0.1	1.1
		4:45 - 5:00	3	7	3.1	5.8	-0.1	1.2
		5:00 - 5:15	3	8	3.1	5.9	-0.1	2.1
		5:15 - 5:30	3	8	3.1	5.9	-0.1	2.1

Note:

- Approach Speed = 30 mph
- **Reduced speed of Approach: 25 mph**
- Circulating Speed = 13 - 18 mph
- WB Volume = 1241 vph

Table O-10.c. West Haven Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - SB

Reduced Speed of	Range	Peak Period	Field Measurement		Simulation Results		Difference	
Approach (mph)	(mph)	PM	R	L	R	L	R	L
35	22.5 to 27.5	4:30 - 4:45	5	8	5.0	11.0	0.0	-3.0
		4:45 - 5:00	5	10	4.0	10.0	1.0	0.0
		5:00 - 5:15	4	10	5.0	11.0	-1.0	-1.0
		5:15 - 5:30	3	10	4.0	10.0	-1.0	0.0
40	27.5 to 32.5	4:30 - 4:45	5	8	5.0	10.0	0.0	-2.0
		4:45 - 5:00	5	10	4.0	10.0	1.0	0.0
		5:00 - 5:15	4	10	5.0	10.0	-1.0	0.0
		5:15 - 5:30	3	10	4.0	10.0	-1.0	0.0
45	27.5 to 32.5	4:30 - 4:45	5	8	4.6	10.7	0.4	-2.7
		4:45 - 5:00	5	10	4.4	10.5	0.6	-0.5
		5:00 - 5:15	4	10	4.6	10.7	-0.6	-0.7
		5:15 - 5:30	3	10	4.5	10.4	-1.5	-0.4
50	37.5 to 42.5	4:30 - 4:45	5	8	4.7	10.3	0.3	-2.3
		4:45 - 5:00	5	10	4.4	10.0	0.6	0.0
		5:00 - 5:15	4	10	4.4	10.3	-0.4	-0.3
		5:15 - 5:30	3	10	4.5	9.8	-1.5	0.2
55	42.5 to 47.5	4:30 - 4:45	5	8	5.0	11.0	0.0	-3.0
		4:45 - 5:00	5	10	4.0	11.0	1.0	-1.0
		5:00 - 5:15	4	10	5.0	11.0	-1.0	-1.0
		5:15 - 5:30	3	10	4.0	10.0	-1.0	0.0

Note:

- Approach Speed = 30 mph
- **Reduced speed of Approach: 20 mph**
- Circulating Speed = 13 - 18 mph
- SB Volume = 1241 vph

APPENDIX P

KILLINGWORTH ROUNDABOUT:

CALIBRATION VARIABLES VS. QUEUES

APPENDIX P – KILLINGWORTH ROUNDABOUT: CALIBRATION VARIABLES VS. QUEUES

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Table P-1. Killingworth Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) - AM

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	15 to 40	7:00 - 7:15	1	0.6	0.4	9	8.8	0.2	2	0.9	1.1	6	12.2	-6.2
		7:15 - 7:30	2	0.5	1.5	12	8.8	3.2	1	0.6	0.4	6	9.6	-3.6
		7:30 - 7:45	1	0.6	0.4	10	9.5	0.5	1	0.7	0.3	6	11.2	-5.2
		7:45 - 8:00	2	0.5	1.5	9	8.9	0.1	1	0.8	0.2	7	10.6	-3.6
30	15 to 45	7:00 - 7:15	1	0.4	0.6	9	7.6	1.4	2	0.6	1.4	6	10.6	-4.6
		7:15 - 7:30	2	0.3	1.7	12	6.5	5.5	1	0.5	0.5	6	8.1	-2.1
		7:30 - 7:45	1	0.4	0.6	10	7.9	2.1	1	0.4	0.6	6	8.0	-2.0
		7:45 - 8:00	2	0.3	1.7	9	6.5	2.5	1	0.5	0.5	7	7.8	-0.8
35	20 to 50	7:00 - 7:15	1	0.2	0.8	9	6.4	2.6	2	0.6	1.4	6	10.1	-4.1
		7:15 - 7:30	2	0.2	1.8	12	6.9	5.1	1	0.4	0.6	6	7.2	-1.2
		7:30 - 7:45	1	0.2	0.8	10	6.0	4.0	1	0.3	0.7	6	6.4	-0.4
		7:45 - 8:00	2	0.2	1.8	9	5.9	3.1	1	0.4	0.6	7	7.6	-0.6
40	25 to 55	7:00 - 7:15	1	0.2	0.8	9	5.9	3.1	2	0.4	1.6	6	8.4	-2.4
		7:15 - 7:30	2	0.2	1.8	12	5.9	6.1	1	0.3	0.7	6	6.8	-0.8
		7:30 - 7:45	1	0.2	0.8	10	6.3	3.7	1	0.3	0.7	6	6.5	-0.5
		7:45 - 8:00	2	0.2	1.8	9	5.9	3.1	1	0.3	0.7	7	6.6	0.4
45	30 to 60	7:00 - 7:15	1	0.2	0.8	9	6.6	2.4	2	0.4	1.6	6	7.8	-1.8
		7:15 - 7:30	2	0.2	1.8	12	5.8	6.2	1	0.3	0.7	6	7.0	-1.0
		7:30 - 7:45	1	0.2	0.8	10	6.3	3.7	1	0.2	0.8	6	6.1	-0.1
		7:45 - 8:00	2	0.2	1.8	9	6.3	2.7	1	0.3	0.7	7	6.3	0.7

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	35 to 65	7:00 - 7:15	1	0.2	0.8	9	6.3	2.7	2	0.4	1.6	6	8.2	-2.2
		7:15 - 7:30	2	0.2	1.8	12	5.3	6.7	1	0.3	0.7	6	6.7	-0.7
		7:30 - 7:45	1	0.2	0.8	10	6.5	3.5	1	0.2	0.8	6	5.9	0.1
		7:45 - 8:00	2	0.2	1.8	9	6.2	2.8	1	0.3	0.7	7	6.2	0.8

Note:

- Circulating Speed = 13 – 18 mph
- Gap Considered = Maximum Likelihood Method
- **Approach speed: EB=40 mph, WB=40 mph, SB=35 mph, NB=40 mph (Existing condition)**
- NB Volume = 381 vph
- SB Volume = 409 vph

Table P-2. Killingworth Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) - AM

Circulating	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.4	1.6	6	8.0	-2.0
		7:15 - 7:30	2	0.2	1.8	12	5.8	6.2	1	0.3	0.7	6	6.2	-0.2
		7:30 - 7:45	1	0.2	0.8	10	5.9	4.1	1	0.3	0.7	6	6.6	-0.6
		7:45 - 8:00	2	0.2	1.8	9	6.6	2.4	1	0.3	0.7	7	6.7	0.3
15	15 to 20	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.4	1.6	6	8.0	-2.0
		7:15 - 7:30	2	0.2	1.8	12	5.8	6.2	1	0.3	0.7	6	6.2	-0.2
		7:30 - 7:45	1	0.2	0.8	10	5.9	4.1	1	0.3	0.7	6	6.6	-0.6
		7:45 - 8:00	2	0.2	1.8	9	6.6	2.4	1	0.3	0.7	7	6.7	0.3
20	20 to 25	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.4	1.6	6	8.0	-2.0
		7:15 - 7:30	2	0.2	1.8	12	5.8	6.2	1	0.3	0.7	6	6.2	-0.2
		7:30 - 7:45	1	0.2	0.8	10	5.9	4.1	1	0.3	0.7	6	6.6	-0.6
		7:45 - 8:00	2	0.2	1.8	9	6.6	2.4	1	0.3	0.7	7	6.7	0.3
25	25 to 30	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.4	1.6	6	8.0	-2.0
		7:15 - 7:30	2	0.2	1.8	12	5.8	6.2	1	0.3	0.7	6	6.2	-0.2
		7:30 - 7:45	1	0.2	0.8	10	5.9	4.1	1	0.3	0.7	6	6.6	-0.6
		7:45 - 8:00	2	0.2	1.8	9	6.6	2.4	1	0.3	0.7	7	6.7	0.3
30	30 to 35	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.4	1.6	6	8.0	-2.0
		7:15 - 7:30	2	0.2	1.8	12	5.8	6.2	1	0.3	0.7	6	6.2	-0.2
		7:30 - 7:45	1	0.2	0.8	10	5.9	4.1	1	0.3	0.7	6	6.6	-0.6
		7:45 - 8:00	2	0.2	1.8	9	6.6	2.4	1	0.3	0.7	7	6.7	0.3

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 381 vph
- SB Volume = 409 vph

Table P-3. Killingworth Roundabout – Critical Gap (seconds) vs. Queue Length (# of Vehicles) - AM

Gap	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
(seconds)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-1	7:00 - 7:15	1	0.1	0.9	9	5.4	3.6	2	0.3	1.7	6	7.7	-1.7
	7:15 - 7:30	2	0.2	1.8	12	6.4	5.6	1	0.2	0.8	6	5.9	0.1
	7:30 - 7:45	1	0.2	0.8	10	5.7	4.3	1	0.2	0.8	6	6.5	-0.5
	7:45 - 8:00	2	0.2	1.8	9	6.4	2.6	1	0.2	0.8	7	6.1	0.9
1	7:00 - 7:15	1	0.3	0.7	9	7.3	1.7	2	0.6	1.4	6	9.4	-3.4
	7:15 - 7:30	2	0.4	1.6	12	8.1	3.9	1	0.5	0.5	6	7.6	-1.6
	7:30 - 7:45	1	0.3	0.7	10	7.4	2.6	1	0.4	0.6	6	7.3	-1.3
	7:45 - 8:00	2	0.4	1.6	9	7.6	1.4	1	0.4	0.6	7	6.7	0.3
2	7:00 - 7:15	1	0.6	0.4	9	8.4	0.6	2	0.9	1.1	6	10.3	-4.3
	7:15 - 7:30	2	0.8	1.2	12	9.3	2.7	1	0.8	0.2	6	8.8	-2.8
	7:30 - 7:45	1	0.7	0.3	10	8.8	1.2	1	0.5	0.5	6	7.7	-1.7
	7:45 - 8:00	2	0.5	1.5	9	7.6	1.4	1	0.6	0.4	7	7.4	-0.4
3	7:00 - 7:15	1	1.0	0.0	9	9.8	-0.8	2	1.3	0.7	6	11.1	-5.1
	7:15 - 7:30	2	0.8	1.2	12	8.7	3.3	1	1.1	-0.1	6	9.2	-3.2
	7:30 - 7:45	1	1.2	-0.2	10	10.8	-0.8	1	0.9	0.1	6	8.6	-2.6
	7:45 - 8:00	2	1.6	0.4	9	10.9	-1.9	1	0.8	0.2	7	8.1	-1.1

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- NB Volume = 381 vph
- SB Volume = 409 vph

Table P-4. Killingworth Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) - AM

Min Headway	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Distance (ft)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-20	7:00 - 7:15	1	0.2	0.8	9	6.3	2.7	2	0.4	1.6	6	7.9	-1.9
	7:15 - 7:30	2	0.2	1.8	12	5.9	6.1	1	0.3	0.7	6	6.1	-0.1
	7:30 - 7:45	1	0.2	0.8	10	6.0	4.0	1	0.3	0.7	6	7.1	-1.1
	7:45 - 8:00	2	0.2	1.8	9	6.5	2.5	1	0.3	0.7	7	6.1	0.9
-10	7:00 - 7:15	1	0.2	0.8	9	6.2	2.8	2	0.4	1.6	6	7.5	-1.5
	7:15 - 7:30	2	0.2	1.8	12	5.9	6.1	1	0.3	0.7	6	6.2	-0.2
	7:30 - 7:45	1	0.2	0.8	10	6.2	3.8	1	0.3	0.7	6	6.6	-0.6
	7:45 - 8:00	2	0.2	1.8	9	6.3	2.7	1	0.3	0.7	7	6.3	0.7
10	7:00 - 7:15	1	0.2	0.8	9	6.7	2.3	2	0.4	1.6	6	8.3	-2.3
	7:15 - 7:30	2	0.2	1.8	12	5.8	6.2	1	0.3	0.7	6	6.5	-0.5
	7:30 - 7:45	1	0.2	0.8	10	6.0	4.0	1	0.3	0.7	6	6.8	-0.8
	7:45 - 8:00	2	0.2	1.8	9	6.5	2.5	1	0.4	0.6	7	7.0	0.0
20	7:00 - 7:15	1	0.3	0.7	9	6.6	2.4	2	0.3	1.7	6	8.0	-2.0
	7:15 - 7:30	2	0.2	1.8	12	5.9	6.1	1	0.3	0.7	6	6.5	-0.5
	7:30 - 7:45	1	0.2	0.8	10	6.5	3.5	1	0.3	0.7	6	6.7	-0.7
	7:45 - 8:00	2	0.2	1.8	9	7.0	2.0	1	0.3	0.7	7	6.9	0.1
30	7:00 - 7:15	1	0.2	0.8	9	6.3	2.7	2	0.4	1.6	6	7.9	-1.9
	7:15 - 7:30	2	0.2	1.8	12	6.1	5.9	1	0.3	0.7	6	7.1	-1.1
	7:30 - 7:45	1	0.3	0.7	10	6.5	3.5	1	0.3	0.7	6	6.4	-0.4
	7:45 - 8:00	2	0.2	1.8	9	7.3	1.7	1	0.3	0.7	7	6.5	0.5

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- NB Volume = 381 vph
- SB Volume = 409 vph

Table P-5. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) - AM

Reduced Speed of	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	17.5 to 22.5	7:00 - 7:15	1	0.4	0.6	9	8.6	0.4	2	0.7	1.3	6	10.1	-4.1
		7:15 - 7:30	2	0.4	1.6	12	8.1	3.9	1	0.6	0.4	6	8.1	-2.1
		7:30 - 7:45	1	0.4	0.6	10	8.1	1.9	1	0.4	0.6	6	7.9	-1.9
		7:45 - 8:00	2	0.4	1.6	9	8.6	0.4	1	0.6	0.4	7	8.5	-1.5
30	22.5 to 27.5	7:00 - 7:15	1	0.2	0.8	9	6.6	2.4	2	0.5	1.5	6	9.0	-3.0
		7:15 - 7:30	2	0.3	1.7	12	7.2	4.8	1	0.4	0.6	6	7.3	-1.3
		7:30 - 7:45	1	0.3	0.7	10	7.4	2.6	1	0.3	0.7	6	7.4	-1.4
		7:45 - 8:00	2	0.3	1.7	9	7.2	1.8	1	0.4	0.6	7	7.3	-0.3
35	22.5 to 27.5	7:00 - 7:15	1	0.2	0.8	9	7.0	2.0	2	0.4	1.6	6	8.6	-2.6
		7:15 - 7:30	2	0.3	1.7	12	7.5	4.5	1	0.3	0.7	6	5.8	0.2
		7:30 - 7:45	1	0.3	0.7	10	7.0	3.0	1	0.2	0.8	6	6.2	-0.2
		7:45 - 8:00	2	0.3	1.7	9	7.2	1.8	1	0.3	0.7	7	6.0	1.0
40	27.5 to 32.5	7:00 - 7:15	1	0.2	0.8	9	5.9	3.1	2	0.4	1.6	6	7.3	-1.3
		7:15 - 7:30	2	0.2	1.8	12	6.0	6.0	1	0.3	0.7	6	7.5	-1.5
		7:30 - 7:45	1	0.2	0.8	10	6.4	3.6	1	0.3	0.7	6	7.3	-1.3
		7:45 - 8:00	2	0.2	1.8	9	6.6	2.4	1	0.3	0.7	7	6.6	0.4
45	32.5 to 37.5	7:00 - 7:15	1	0.2	0.8	9	5.6	3.4	2	0.4	1.6	6	8.4	-2.4
		7:15 - 7:30	2	0.2	1.8	12	5.9	6.1	1	0.3	0.7	6	6.1	-0.1
		7:30 - 7:45	1	0.2	0.8	10	6.1	3.9	1	0.2	0.8	6	5.6	0.4
		7:45 - 8:00	2	0.3	1.7	9	6.9	2.1	1	0.4	0.6	7	6.4	0.6

Reduced Speed of	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Approach (mph)	(mph)	AM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	37.5 to 42.5	7:00 - 7:15	1	0.2	0.8	9	5.6	3.4	2	0.5	1.5	6	9.4	-3.4
		7:15 - 7:30	2	0.2	1.8	12	5.1	6.9	1	0.4	0.6	6	7.0	-1.0
		7:30 - 7:45	1	0.2	0.8	10	5.5	4.5	1	0.2	0.8	6	6.0	0.0
		7:45 - 8:00	2	0.2	1.8	9	5.3	3.7	1	0.3	0.7	7	6.0	1.0

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- **Reduced Speed of Approach: EB=30 mph, WB=30 mph, SB=25 mph, NB=30 mhp (Existing condition)**
- NB Volume = 381 vph
- SB Volume = 409 vph

Table P-6. Killingworth Roundabout - Approach Speed (mph) vs. Queue Length (# of vehicles) – PM

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference
25	15 to 40	4:30 - 4:45	3	3.4	-0.4	7	19.0	-12.0	1	8.9	-7.9	6	25.4	-19.4
		4:45 - 5:00	2	3.2	-1.2	9	19.9	-10.9	1	6.7	-5.7	4	21.9	-17.9
		5:00 - 5:15	1	3.3	-2.3	5	17.5	-12.5	1	5.1	-4.1	8	17.3	-9.3
		5:15 - 5:30	2	2.4	-0.4	20	16.1	3.9	1	6.5	-5.5	10	20.8	-10.8
30	15 to 45	4:30 - 4:45	3	2.0	1.0	7	16.6	-9.6	1	4.8	-3.8	6	21.5	-15.5
		4:45 - 5:00	2	2.9	-0.9	9	17.7	-8.7	1	3.7	-2.7	4	18.2	-14.2
		5:00 - 5:15	1	1.9	-0.9	5	13.5	-8.5	1	4.3	-3.3	8	19.4	-11.4
		5:15 - 5:30	2	1.7	0.3	20	14.5	5.5	1	3.3	-2.3	10	16.9	-6.9
35	20 to 50	4:30 - 4:45	3	1.7	1.3	7	14.5	-7.5	1	4.6	-3.6	6	18.5	-12.5
		4:45 - 5:00	2	2.4	-0.4	9	17.6	-8.6	1	3.3	-2.3	4	17.5	-13.5
		5:00 - 5:15	1	1.5	-0.5	5	13.6	-8.6	1	3.0	-2.0	8	15.9	-7.9
		5:15 - 5:30	2	1.4	0.6	20	12.5	7.5	1	4.1	-3.1	10	17.7	-7.7
40	25 to 55	4:30 - 4:45	3	1.1	1.9	7	11.5	-4.5	1	3.9	-2.9	6	18.1	-12.1
		4:45 - 5:00	2	2.0	0.0	9	16.8	-7.8	1	3.1	-2.1	4	16.9	-12.9
		5:00 - 5:15	1	1.5	-0.5	5	14.0	-9.0	1	2.9	-1.9	8	16.0	-8.0
		5:15 - 5:30	2	1.3	0.7	20	10.4	9.6	1	2.6	-1.6	10	14.7	-4.7
45	30 to 60	4:30 - 4:45	3	1.3	1.7	7	11.8	-4.8	1	3.5	-2.5	6	16.5	-10.5
		4:45 - 5:00	2	2.2	-0.2	9	16.2	-7.2	1	3.0	-2.0	4	16.6	-12.6
		5:00 - 5:15	1	1.8	-0.8	5	14.1	-9.1	1	2.4	-1.4	8	13.9	-5.9
		5:15 - 5:30	2	1.1	0.9	20	10.2	9.8	1	2.1	-1.1	10	14.0	-4.0

Approach	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference	Field	Simulation	Difference
50	35 to 65	4:30 - 4:45	3	1.3	1.7	7	12.2	-5.2	1	3.9	-2.9	6	17.9	-11.9
		4:45 - 5:00	2	1.7	0.3	9	16.3	-7.3	1	2.8	-1.8	4	16.6	-12.6
		5:00 - 5:15	1	1.3	-0.3	5	12.7	-7.7	1	2.8	-1.8	8	16.0	-8.0
		5:15 - 5:30	2	1.2	0.8	20	10.9	9.1	1	3.3	-2.3	10	15.1	-5.1

Note:

- Circulating Speed = 16 – 22 mph
- Gap Considered = Maximum Likelihood Method
- **Approach speed: EB=40 mph, WB=40 mph, SB=35 mph, NB=40 mph (Existing condition)**
- NB Volume = 493 vph
- SB Volume = 513 vph

Table P-7. Killingworth Roundabout - Circulating Speed (mph) vs. Queue Length (# of vehicles) - PM

Circulating	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Speed (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	3	1.1	1.9	7	12.6	-5.6	1	10.9	-9.9	6	24.0	-18.0
		4:45 - 5:00	2	1.6	0.4	9	13.6	-4.6	1	7.3	-6.3	4	22.1	-18.1
		5:00 - 5:15	1	1.2	-0.2	5	12.5	-7.5	1	8.0	-7.0	8	23.3	-15.3
		5:15 - 5:30	2	0.8	1.2	20	10.9	9.1	1	5.7	-4.7	10	20.5	-10.5
15	15 to 20	4:30 - 4:45	3	1.4	1.6	7	13.7	-6.7	1	2.8	-1.8	6	16.7	-10.7
		4:45 - 5:00	2	1.7	0.3	9	15.2	-6.2	1	2.0	-1.0	4	12.7	-8.7
		5:00 - 5:15	1	1.7	-0.7	5	13.6	-8.6	1	1.7	-0.7	8	13.1	-5.1
		5:15 - 5:30	2	1.1	0.9	20	9.9	10.1	1	1.7	-0.7	10	13.3	-3.3
20	20 to 25	4:30 - 4:45	3	1.2	1.8	7	13.2	-6.2	1	2.0	-1.0	6	13.0	-7.0
		4:45 - 5:00	2	1.4	0.6	9	12.0	-3.0	1	1.6	-0.6	4	12.2	-8.2
		5:00 - 5:15	1	1.6	-0.6	5	12.2	-7.2	1	1.2	-0.2	8	12.1	-4.1
		5:15 - 5:30	2	0.7	1.3	20	8.7	11.3	1	1.5	-0.5	10	12.1	-2.1
25	25 to 30	4:30 - 4:45	3	0.9	2.1	7	11.0	-4.0	1	1.8	-0.8	6	13.8	-7.8
		4:45 - 5:00	2	0.9	1.1	9	11.1	-2.1	1	1.4	-0.4	4	11.7	-7.7
		5:00 - 5:15	1	1.1	-0.1	5	12.1	-7.1	1	1.1	-0.1	8	12.2	-4.2
		5:15 - 5:30	2	0.8	1.2	20	9.7	10.3	1	1.4	-0.4	10	13.6	-3.6
30	30 to 35	4:30 - 4:45	3	1.0	2.0	7	11.5	-4.5	1	1.8	-0.8	6	14.2	-8.2
		4:45 - 5:00	2	1.2	0.8	9	10.9	-1.9	1	1.1	-0.1	4	10.3	-6.3
		5:00 - 5:15	1	1.0	0.0	5	11.6	-6.6	1	1.1	-0.1	8	12.0	-4.0
		5:15 - 5:30	2	0.8	1.2	20	9.1	10.9	1	1.2	-0.2	10	12.0	-2.0

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- NB Volume = 493 vph
- SB Volume = 513 vph

Table P-8. Killingworth Roundabout – Critical Gap (seconds) vs. Queue Length (# of Vehicles) – PM

Gap	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
(seconds)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-2	4:30 - 4:45	3	2.2	0.8	7	17.2	-10.2	1	4.8	-3.8	6	20.4	-14.4
	4:45 - 5:00	2	2.5	-0.5	9	15.2	-6.2	1	3.7	-2.7	4	20.3	-16.3
	5:00 - 5:15	1	1.5	-0.5	5	13.0	-8.0	1	2.6	-1.6	8	14.9	-6.9
	5:15 - 5:30	2	1.2	0.8	20	10.1	9.9	1	2.6	-1.6	10	15.7	-5.7
-1	4:30 - 4:45	3	2.1	0.9	7	14.9	-7.9	1	4.1	-3.1	6	18.8	-12.8
	4:45 - 5:00	2	2.0	0.0	9	14.8	-5.8	1	3.3	-2.3	4	18.8	-14.8
	5:00 - 5:15	1	2.4	-1.4	5	14.8	-9.8	1	3.3	-2.3	8	17.6	-9.6
	5:15 - 5:30	2	1.4	0.6	20	12.3	7.7	1	1.9	-0.9	10	14.3	-4.3
1	4:30 - 4:45	3	2.0	1.0	7	15.1	-8.1	1	4.3	-3.3	6	20.7	-14.7
	4:45 - 5:00	2	1.8	0.2	9	14.6	-5.6	1	2.4	-1.4	4	15.9	-11.9
	5:00 - 5:15	1	1.2	-0.2	5	10.9	-5.9	1	2.6	-1.6	8	16.4	-8.4
	5:15 - 5:30	2	1.5	0.5	20	11.4	8.6	1	2.6	-1.6	10	15.7	-5.7
2	4:30 - 4:45	3	1.1	1.9	7	12.2	-5.2	1	10.3	-9.3	6	24.3	-18.3
	4:45 - 5:00	2	1.1	0.9	9	12.2	-3.2	1	8.1	-7.1	4	23.0	-19.0
	5:00 - 5:15	1	0.9	0.1	5	9.9	-4.9	1	7.1	-6.1	8	19.5	-11.5
	5:15 - 5:30	2	1.0	1.0	20	10.8	9.2	1	6.3	-5.3	10	20.0	-10.0

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
-
- NB Volume = 493 vph
- SB Volume = 513 vph

Table P-9. Killingworth Roundabout - Min Headway Distance (ft) vs. Queue Length (# of vehicles) - PM

Min Headway	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Distance (ft)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
-20	4:30 - 4:45	3	2.1	0.9	7	15.5	-8.5	1	2.1	-1.1	6	13.3	-7.3
	4:45 - 5:00	2	2.5	-0.5	9	16.3	-7.3	1	1.2	-0.2	4	11.6	-7.6
	5:00 - 5:15	1	2.6	-1.6	5	16.9	-11.9	1	1.2	-0.2	8	11.9	-3.9
	5:15 - 5:30	2	1.2	0.8	20	11.4	8.6	1	1.2	-0.2	10	11.2	-1.2
-10	4:30 - 4:45	3	1.6	1.4	7	14.0	-7.0	1	2.8	-1.8	6	17.6	-11.6
	4:45 - 5:00	2	2.9	-0.9	9	18.6	-9.6	1	1.7	-0.7	4	13.5	-9.5
	5:00 - 5:15	1	2.8	-1.8	5	16.9	-11.9	1	2.0	-1.0	8	13.8	-5.8
	5:15 - 5:30	2	0.9	1.1	20	9.1	10.9	1	2.4	-1.4	10	14.6	-4.6
10	4:30 - 4:45	3	1.5	1.5	7	14.7	-7.7	1	5.2	-4.2	6	20.9	-14.9
	4:45 - 5:00	2	2.1	-0.1	9	16.2	-7.2	1	4.5	-3.5	4	19.1	-15.1
	5:00 - 5:15	1	1.0	0.0	5	11.2	-6.2	1	4.6	-3.6	8	20.6	-12.6
	5:15 - 5:30	2	1.5	0.5	20	12.1	7.9	1	3.1	-2.1	10	17.3	-7.3
20	4:30 - 4:45	3	0.6	2.4	7	8.7	-1.7	1	7.3	-6.3	6	22.1	-16.1
	4:45 - 5:00	2	0.9	1.1	9	11.3	-2.3	1	5.1	-4.1	4	19.8	-15.8
	5:00 - 5:15	1	0.9	0.1	5	11.8	-6.8	1	5.7	-4.7	8	21.0	-13.0
	5:15 - 5:30	2	0.8	1.2	20	9.9	10.1	1	3.9	-2.9	10	17.4	-7.4
30	4:30 - 4:45	3	0.7	2.3	7	9.7	-2.7	1	9.7	-8.7	6	23.7	-17.7
	4:45 - 5:00	2	1.0	1.0	9	11.9	-2.9	1	6.7	-5.7	4	22.5	-18.5
	5:00 - 5:15	1	0.8	0.2	5	10.0	-5.0	1	7.3	-6.3	8	22.1	-14.1
	5:15 - 5:30	2	1.1	0.9	20	12.0	8.0	1	5.4	-4.4	10	19.1	-9.1

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- NB Volume = 493 vph
- SB Volume = 513 vph

Table P-10. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Queue Length (# of vehicles) - PM

Reduced Speed of	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Approach (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
25	17.5 to 22.5	4:30 - 4:45	3	1.2	1.8	7	12.9	-5.9	1	6.0	-5.0	6	21.0	-15.0
		4:45 - 5:00	2	1.9	0.1	9	15.3	-6.3	1	3.7	-2.7	4	17.7	-13.7
		5:00 - 5:15	1	1.4	-0.4	5	11.4	-6.4	1	4.7	-3.7	8	19.6	-11.6
		5:15 - 5:30	2	1.1	0.9	20	11.4	8.6	1	3.3	-2.3	10	16.6	-6.6
30	22.5 to 27.5	4:30 - 4:45	3	1.1	1.9	7	12.1	-5.1	1	4.4	-3.4	6	18.9	-12.9
		4:45 - 5:00	2	2.1	-0.1	9	14.3	-5.3	1	2.6	-1.6	4	14.4	-10.4
		5:00 - 5:15	1	1.5	-0.5	5	12.5	-7.5	1	4.0	-3.0	8	16.9	-8.9
		5:15 - 5:30	2	1.3	0.7	20	12.0	8.0	1	2.7	-1.7	10	15.2	-5.2
35	22.5 to 27.5	4:30 - 4:45	3	1.3	1.7	7	13.0	-6.0	1	4.2	-3.2	6	17.7	-11.7
		4:45 - 5:00	2	2.7	-0.7	9	18.1	-9.1	1	2.9	-1.9	4	17.8	-13.8
		5:00 - 5:15	1	2.2	-1.2	5	15.7	-10.7	1	4.1	-3.1	8	20.6	-12.6
		5:15 - 5:30	2	1.1	0.9	20	10.8	9.2	1	3.3	-2.3	10	17.2	-7.2
40	27.5 to 32.5	4:30 - 4:45	3	1.9	1.1	7	14.6	-7.6	1	3.9	-2.9	6	18.6	-12.6
		4:45 - 5:00	2	2.0	0.0	9	17.1	-8.1	1	2.7	-1.7	4	15.7	-11.7
		5:00 - 5:15	1	2.7	-1.7	5	14.9	-9.9	1	2.5	-1.5	8	14.6	-6.6
		5:15 - 5:30	2	1.2	0.8	20	12.1	7.9	1	4.0	-3.0	10	17.6	-7.6
45	32.5 to 37.5	4:30 - 4:45	3	1.2	1.8	7	12.3	-5.3	1	4.5	-3.5	6	18.7	-12.7
		4:45 - 5:00	2	2.0	0.0	9	14.5	-5.5	1	2.5	-1.5	4	15.1	-11.1
		5:00 - 5:15	1	1.5	-0.5	5	11.7	-6.7	1	2.3	-1.3	8	15.4	-7.4
		5:15 - 5:30	2	1.1	0.9	20	10.3	9.7	1	2.7	-1.7	10	15.6	-5.6

Reduced Speed of	Range	Peak Period	NB Queue Average			NB Queue Max			SB Queue Average			SB Queue Max		
Approach (mph)	(mph)	PM	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**	Field	Simulation	**Difference**
50	37.5 to 42.5	4:30 - 4:45	3	1.4	1.6	7	14.8	-7.8	1	3.6	-2.6	6	17.8	-11.8
		4:45 - 5:00	2	1.8	0.2	9	15.5	-6.5	1	2.8	-1.8	4	16.2	-12.2
		5:00 - 5:15	1	1.8	-0.8	5	14.6	-9.6	1	2.9	-1.9	8	16.6	-8.6
		5:15 - 5:30	2	1.2	0.8	20	10.7	9.3	1	2.0	-1.0	10	13.6	-3.6

Note:

- Approach Speed = 40 mph
- Gap Considered = Maximum Likelihood Method
- **Reduced Speed of Approach: EB=30 mph, WB=30 mph, SB=25 mph, NB=30 mhp (Existing condition)**
- NB Volume = 493 vph
- SB Volume = 513 vph

APPENDIX Q

KILLINGWORTH ROUNDABOUT:

CALIBRATION VARIABLES VS. TRAVEL TIME

APPENDIX Q – KILLINGWORTH ROUNDABOUT: CALIBRATION VARIABLES VS. TRAVEL TIME

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Table Q-1.a. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - EB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	7:00 - 7:15	4	7	14	4.5	6.5	13.8	-0.5	0.5	0.2
		7:15 - 7:30	4	10	12	4.4	6.6	13.5	-0.4	3.4	-1.5
		7:30 - 7:45	4	10	0	4.4	6.5	13.3	-0.4	3.5	-13.3
		7:45 - 8:00	4	8	12	4.5	6.5	13.6	-0.5	1.5	-1.6
30	15 to 45	7:00 - 7:15	4	7	14	4.0	5.4	9.7	0.0	1.6	4.3
		7:15 - 7:30	4	10	12	4.0	5.6	9.5	0.0	4.4	2.5
		7:30 - 7:45	4	10	0	4.0	5.5	9.3	0.0	4.5	-9.3
		7:45 - 8:00	4	8	12	4.2	5.5	9.6	-0.2	2.5	2.4
35	20 to 50	7:00 - 7:15	4	7	14	3.8	5.1	8.9	0.2	1.9	5.1
		7:15 - 7:30	4	10	12	3.9	5.1	8.7	0.1	4.9	3.3
		7:30 - 7:45	4	10	0	3.9	5.0	8.6	0.1	5.0	-8.6
		7:45 - 8:00	4	8	12	3.9	5.2	8.5	0.1	2.8	3.5
40 (Existing condition)	25 to 55	7:00 - 7:15	4	7	14	3.8	4.8	8.3	0.2	2.2	5.7
		7:15 - 7:30	4	10	12	3.6	4.9	7.9	0.4	5.1	4.1
		7:30 - 7:45	4	10	0	3.8	4.9	8.0	0.2	5.1	-8.0
		7:45 - 8:00	4	8	12	3.8	4.9	8.0	0.2	3.1	4.0
45	30 to 60	7:00 - 7:15	4	7	14	3.9	4.9	8.1	0.1	2.1	5.9
		7:15 - 7:30	4	10	12	3.7	4.7	7.7	0.3	5.3	4.3
		7:30 - 7:45	4	10	0	3.8	4.9	7.9	0.2	5.1	-7.9
		7:45 - 8:00	4	8	12	3.8	4.9	7.7	0.2	3.1	4.3

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	7:00 - 7:15	4	7	14	3.8	4.8	8.2	0.2	2.2	5.8
		7:15 - 7:30	4	10	12	3.8	4.7	7.6	0.2	5.3	4.4
		7:30 - 7:45	4	10	0	3.7	4.8	7.8	0.3	5.2	-7.8
		7:45 - 8:00	4	8	12	3.8	4.8	7.7	0.2	3.2	4.3

Note:

- Circulating Speed = 13 - 18 mph
- EB Volume = 1194 vph

Table Q-1.b. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - NB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	7:00 - 7:15	3	6	10	1.8	7.4	9.9	1.2	-1.4	0.1
		7:15 - 7:30	2	5	10	1.8	7.3	9.7	0.2	-2.3	0.3
		7:30 - 7:45	2	7	9	1.8	7.2	9.8	0.2	-0.2	-0.8
		7:45 - 8:00	3	5	10	1.7	7.4	9.9	1.3	-2.4	0.1
30	15 to 45	7:00 - 7:15	3	6	10	1.5	5.5	7.9	1.5	0.5	2.1
		7:15 - 7:30	2	5	10	1.5	5.3	7.4	0.5	-0.3	2.6
		7:30 - 7:45	2	7	9	1.4	5.4	7.3	0.6	1.6	1.7
		7:45 - 8:00	3	5	10	1.5	5.5	7.6	1.5	-0.5	2.4
35	20 to 50	7:00 - 7:15	3	6	10	1.4	5.0	7.1	1.6	1.0	2.9
		7:15 - 7:30	2	5	10	1.5	4.9	6.7	0.5	0.1	3.3
		7:30 - 7:45	2	7	9	1.4	4.9	6.7	0.6	2.1	2.3
		7:45 - 8:00	3	5	10	1.4	5.0	6.8	1.6	0.0	3.2
40 (Existing condition)	25 to 55	7:00 - 7:15	3	6	10	1.4	4.6	6.5	1.6	1.4	3.5
		7:15 - 7:30	2	5	10	1.4	4.8	6.3	0.6	0.2	3.7
		7:30 - 7:45	2	7	9	1.4	4.6	6.3	0.6	2.4	2.7
		7:45 - 8:00	3	5	10	1.4	4.6	6.4	1.6	0.4	3.6
45	30 to 60	7:00 - 7:15	3	6	10	1.4	4.6	6.2	1.6	1.4	3.8
		7:15 - 7:30	2	5	10	1.4	4.6	6.2	0.6	0.4	3.8
		7:30 - 7:45	2	7	9	1.4	4.6	6.1	0.6	2.4	2.9
		7:45 - 8:00	3	5	10	1.4	4.6	6.0	1.6	0.4	4.0

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	7:00 - 7:15	3	6	10	1.4	4.5	6.2	1.6	1.5	3.8
		7:15 - 7:30	2	5	10	1.4	4.5	6.0	0.6	0.5	4.0
		7:30 - 7:45	2	7	9	1.5	4.6	6.1	0.5	2.4	2.9
		7:45 - 8:00	3	5	10	1.3	4.5	6.0	1.7	0.5	4.0

Note:

- Circulating Speed = 13 - 18 mph
- NB Volume = 1194 vph

Table Q-1.c. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - SB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	7:00 - 7:15	3	6	10	1.9	7.4	10.0	1.1	-1.4	0.0
		7:15 - 7:30	3	6	10	1.9	7.1	9.3	1.1	-1.1	0.7
		7:30 - 7:45	3	8	10	1.9	7.1	9.7	1.1	0.9	0.3
		7:45 - 8:00	3	7	13	1.9	7.1	9.7	1.1	-0.1	3.3
30	15 to 45	7:00 - 7:15	3	6	10	1.7	6.2	8.0	1.3	-0.2	2.0
		7:15 - 7:30	3	6	10	1.7	6.0	7.8	1.3	0.0	2.2
		7:30 - 7:45	3	8	10	1.7	5.9	7.9	1.3	2.1	2.1
		7:45 - 8:00	3	7	13	1.8	5.9	7.8	1.2	1.1	5.2
35 (Existing condition)	20 to 50	7:00 - 7:15	3	6	10	1.7	5.5	7.2	1.3	0.5	2.8
		7:15 - 7:30	3	6	10	1.7	5.6	7.0	1.3	0.4	3.0
		7:30 - 7:45	3	8	10	1.6	5.4	7.1	1.4	2.6	2.9
		7:45 - 8:00	3	7	13	1.6	5.4	7.1	1.4	1.6	5.9
40	25 to 55	7:00 - 7:15	3	6	10	1.6	5.1	6.5	1.4	0.9	3.5
		7:15 - 7:30	3	6	10	1.6	5.1	6.3	1.4	0.9	3.7
		7:30 - 7:45	3	8	10	1.6	5.0	6.4	1.4	3.0	3.6
		7:45 - 8:00	3	7	13	1.6	5.2	6.5	1.4	1.8	6.5
45	30 to 60	7:00 - 7:15	3	6	10	1.6	4.9	6.2	1.4	1.1	3.8
		7:15 - 7:30	3	6	10	1.6	5.0	5.9	1.4	1.0	4.1
		7:30 - 7:45	3	8	10	1.6	4.7	6.1	1.4	3.3	3.9
		7:45 - 8:00	3	7	13	1.6	4.9	6.1	1.4	2.1	6.9

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	7:00 - 7:15	3	6	10	1.5	4.9	6.1	1.5	1.1	3.9
		7:15 - 7:30	3	6	10	1.6	4.9	5.9	1.4	1.1	4.1
		7:30 - 7:45	3	8	10	1.5	4.7	6.0	1.5	3.3	4.0
		7:45 - 8:00	3	7	13	1.6	4.8	6.0	1.4	2.2	7.0

Note:

- Circulating Speed = 13 - 18 mph
- SB Volume = 1194 vph

Table Q-1.d. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – AM - WB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	7:00 - 7:15	2	7	10	4.5	7.3	11.5	-2.5	-0.3	-1.5
		7:15 - 7:30	2	6	10	4.3	6.7	11.3	-2.3	-0.7	-1.3
		7:30 - 7:45	2	5	10	4.3	6.8	11.0	-2.3	-1.8	-1.0
		7:45 - 8:00	2	6	10	4.5	6.9	11.5	-2.5	-0.9	-1.5
30	15 to 45	7:00 - 7:15	2	7	10	4.0	6.2	9.9	-2.0	0.8	0.1
		7:15 - 7:30	2	6	10	4.0	6.0	10.1	-2.0	0.0	-0.1
		7:30 - 7:45	2	5	10	3.9	5.9	9.7	-1.9	-0.9	0.3
		7:45 - 8:00	2	6	10	4.1	6.1	9.8	-2.1	-0.1	0.2
35	20 to 50	7:00 - 7:15	2	7	10	3.7	5.6	8.9	-1.7	1.4	1.1
		7:15 - 7:30	2	6	10	3.7	5.5	9.1	-1.7	0.5	0.9
		7:30 - 7:45	2	5	10	3.7	5.6	8.8	-1.7	-0.6	1.2
		7:45 - 8:00	2	6	10	3.8	5.6	8.7	-1.8	0.4	1.3
40 (Existing condition)	25 to 55	7:00 - 7:15	2	7	10	3.7	5.1	8.5	-1.7	1.9	1.5
		7:15 - 7:30	2	6	10	3.7	5.3	8.6	-1.7	0.7	1.4
		7:30 - 7:45	2	5	10	3.8	5.3	8.2	-1.8	-0.3	1.8
		7:45 - 8:00	2	6	10	3.7	5.3	8.3	-1.7	0.7	1.7
45	30 to 60	7:00 - 7:15	2	7	10	3.6	4.9	8.1	-1.6	2.1	1.9
		7:15 - 7:30	2	6	10	3.5	5.1	8.3	-1.5	0.9	1.7
		7:30 - 7:45	2	5	10	3.8	5.3	8.2	-1.8	-0.3	1.8
		7:45 - 8:00	2	6	10	3.6	5.3	8.1	-1.6	0.7	1.9

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	7:00 - 7:15	2	7	10	3.6	4.9	7.7	-1.6	2.1	2.3
		7:15 - 7:30	2	6	10	3.6	5.1	8.1	-1.6	0.9	1.9
		7:30 - 7:45	2	5	10	3.6	5.3	8.0	-1.6	-0.3	2.0
		7:45 - 8:00	2	6	10	3.6	5.3	8.1	-1.6	0.7	1.9

Note:

- Circulating Speed = 13 - 18 mph
- WB Volume = 1194 vph

Table Q-2.a. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - EB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	4	7	14	4	5	8	0	2	6
		7:15 - 7:30	4	10	12	4	5	8	0	5	4
		7:30 - 7:45	4	10	0	4	5	8	0	5	-8
		7:45 - 8:00	4	8	12	4	5	8	0	3	4
15	15 to 20	7:00 - 7:15	4	7	14	4	5	8	0	2	6
		7:15 - 7:30	4	10	12	4	5	8	0	5	4
		7:30 - 7:45	4	10	0	4	5	8	0	5	-8
		7:45 - 8:00	4	8	12	4	5	8	0	3	4
20	20 to 25	7:00 - 7:15	4	7	14	4	5	8	0	2	6
		7:15 - 7:30	4	10	12	4	5	8	0	5	4
		7:30 - 7:45	4	10	0	4	5	8	0	5	-8
		7:45 - 8:00	4	8	12	4	5	8	0	3	4
25	25 to 30	7:00 - 7:15	4	7	14	4	5	8	0	2	6
		7:15 - 7:30	4	10	12	4	5	8	0	5	4
		7:30 - 7:45	4	10	0	4	5	8	0	5	-8
		7:45 - 8:00	4	8	12	4	5	8	0	3	4
30	30 to 35	7:00 - 7:15	4	7	14	4	5	8	0	2	6
		7:15 - 7:30	4	10	12	4	5	8	0	5	4
		7:30 - 7:45	4	10	0	4	5	8	0	5	-8
		7:45 - 8:00	4	8	12	4	5	8	0	3	4

Note:

- Approach Speed = 40 mph
- EB Volume = 1194 vph

Table Q-2.b. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - NB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	3	6	10	1	5	6	2	1	4
		7:15 - 7:30	2	5	10	1	5	6	1	0	4
		7:30 - 7:45	2	7	9	1	5	6	1	2	3
		7:45 - 8:00	3	5	10	1	5	6	2	0	4
15	15 to 20	7:00 - 7:15	3	6	10	1	5	6	2	1	4
		7:15 - 7:30	2	5	10	1	5	6	1	0	4
		7:30 - 7:45	2	7	9	1	5	6	1	2	3
		7:45 - 8:00	3	5	10	1	5	6	2	0	4
20	20 to 25	7:00 - 7:15	3	6	10	1	5	6	2	1	4
		7:15 - 7:30	2	5	10	1	5	6	1	0	4
		7:30 - 7:45	2	7	9	1	5	6	1	2	3
		7:45 - 8:00	3	5	10	1	5	6	2	0	4
25	25 to 30	7:00 - 7:15	3	6	10	1	5	6	2	1	4
		7:15 - 7:30	2	5	10	1	5	6	1	0	4
		7:30 - 7:45	2	7	9	1	5	6	1	2	3
		7:45 - 8:00	3	5	10	1	5	6	2	0	4
30	30 to 35	7:00 - 7:15	3	6	10	1	5	6	2	1	4
		7:15 - 7:30	2	5	10	1	5	6	1	0	4
		7:30 - 7:45	2	7	9	1	5	6	1	2	3
		7:45 - 8:00	3	5	10	1	5	6	2	0	4

Note:

- Approach Speed = 40 mph
- NB Volume = 1194 vph

Table Q-2.c. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - SB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	3	6	10	2	5	6	1	1	4
		7:15 - 7:30	3	6	10	2	5	6	1	1	4
		7:30 - 7:45	3	8	10	2	5	6	1	3	4
		7:45 - 8:00	3	7	13	2	5	6	1	2	7
15	15 to 20	7:00 - 7:15	3	6	10	2	5	6	1	1	4
		7:15 - 7:30	3	6	10	2	5	6	1	1	4
		7:30 - 7:45	3	8	10	2	5	6	1	3	4
		7:45 - 8:00	3	7	13	2	5	6	1	2	7
20	20 to 25	7:00 - 7:15	3	6	10	2	5	6	1	1	4
		7:15 - 7:30	3	6	10	2	5	6	1	1	4
		7:30 - 7:45	3	8	10	2	5	6	1	3	4
		7:45 - 8:00	3	7	13	2	5	6	1	2	7
25	25 to 30	7:00 - 7:15	3	6	10	2	5	6	1	1	4
		7:15 - 7:30	3	6	10	2	5	6	1	1	4
		7:30 - 7:45	3	8	10	2	5	6	1	3	4
		7:45 - 8:00	3	7	13	2	5	6	1	2	7
30	30 to 35	7:00 - 7:15	3	6	10	2	5	6	1	1	4
		7:15 - 7:30	3	6	10	2	5	6	1	1	4
		7:30 - 7:45	3	8	10	2	5	6	1	3	4
		7:45 - 8:00	3	7	13	2	5	6	1	2	7

Note:

- Approach Speed = 40 mph
- SB Volume = 1194 vph

Table Q-2.d. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – AM - WB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	7:00 - 7:15	2	7	10	4	5	9	-2	2	1
		7:15 - 7:30	2	6	10	4	5	9	-2	1	1
		7:30 - 7:45	2	5	10	4	5	8	-2	0	2
		7:45 - 8:00	2	6	10	4	5	8	-2	1	2
15	15 to 20	7:00 - 7:15	2	7	10	4	5	9	-2	2	1
		7:15 - 7:30	2	6	10	4	5	9	-2	1	1
		7:30 - 7:45	2	5	10	4	5	8	-2	0	2
		7:45 - 8:00	2	6	10	4	5	8	-2	1	2
20	20 to 25	7:00 - 7:15	2	7	10	4	5	9	-2	2	1
		7:15 - 7:30	2	6	10	4	5	9	-2	1	1
		7:30 - 7:45	2	5	10	4	5	8	-2	0	2
		7:45 - 8:00	2	6	10	4	5	8	-2	1	2
25	25 to 30	7:00 - 7:15	2	7	10	4	5	9	-2	2	1
		7:15 - 7:30	2	6	10	4	5	9	-2	1	1
		7:30 - 7:45	2	5	10	4	5	8	-2	0	2
		7:45 - 8:00	2	6	10	4	5	8	-2	1	2
30	30 to 35	7:00 - 7:15	2	7	10	4	5	9	-2	2	1
		7:15 - 7:30	2	6	10	4	5	9	-2	1	1
		7:30 - 7:45	2	5	10	4	5	8	-2	0	2
		7:45 - 8:00	2	6	10	4	5	8	-2	1	2

Note:

- Approach Speed = 40 mph
- WB Volume = 1194 vph

Table Q-3.a. Killingworth Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - EB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	4	7	14	3.6	4.7	8.0	0.4	2.3	6.0
	7:15 - 7:30	4	10	12	3.5	4.7	7.8	0.5	5.3	4.2
	7:30 - 7:45	4	10	0	3.5	4.6	7.8	0.5	5.4	-7.8
	7:45 - 8:00	4	8	12	3.5	4.7	7.7	0.5	3.3	4.3
1	7:00 - 7:15	4	7	14	4.0	5.0	8.4	0.0	2.0	5.6
	7:15 - 7:30	4	10	12	3.9	5.0	8.0	0.1	5.0	4.0
	7:30 - 7:45	4	10	0	3.9	5.1	8.3	0.1	4.9	-8.3
	7:45 - 8:00	4	8	12	4.0	5.1	8.2	0.0	2.9	3.8
2	7:00 - 7:15	4	7	14	4.0	5.2	8.7	0.0	1.8	5.3
	7:15 - 7:30	4	10	12	4.0	5.1	8.3	0.0	4.9	3.7
	7:30 - 7:45	4	10	0	4.1	5.2	8.3	-0.1	4.8	-8.3
	7:45 - 8:00	4	8	12	4.3	5.2	8.4	-0.3	2.8	3.6
3	7:00 - 7:15	4	7	14	4.1	5.2	8.5	-0.1	1.8	5.5
	7:15 - 7:30	4	10	12	4.0	5.2	8.4	0.0	4.8	3.6
	7:30 - 7:45	4	10	0	4.1	5.3	8.5	-0.1	4.7	-8.5
	7:45 - 8:00	4	8	12	4.3	5.3	8.5	-0.3	2.7	3.5

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- EB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-3.b. Killingworth Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - NB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	3	6	10	1.3	4.6	6.5	1.7	1.4	3.5
	7:15 - 7:30	2	5	10	1.4	4.6	6.3	0.6	0.4	3.7
	7:30 - 7:45	2	7	9	1.4	4.7	6.3	0.6	2.3	2.7
	7:45 - 8:00	3	5	10	1.4	4.7	6.3	1.6	0.3	3.7
1	7:00 - 7:15	3	6	10	1.5	4.8	6.5	1.5	1.2	3.5
	7:15 - 7:30	2	5	10	1.5	4.9	6.5	0.5	0.1	3.5
	7:30 - 7:45	2	7	9	1.5	4.9	6.4	0.5	2.1	2.6
	7:45 - 8:00	3	5	10	1.5	4.8	6.5	1.5	0.2	3.5
2	7:00 - 7:15	3	6	10	1.7	5.0	6.6	1.3	1.0	3.4
	7:15 - 7:30	2	5	10	1.6	5.2	6.9	0.4	-0.2	3.1
	7:30 - 7:45	2	7	9	1.7	5.0	6.7	0.3	2.0	2.3
	7:45 - 8:00	3	5	10	1.6	5.0	6.7	1.4	0.0	3.3
3	7:00 - 7:15	3	6	10	1.8	5.2	6.8	1.2	0.8	3.2
	7:15 - 7:30	2	5	10	1.8	5.2	6.9	0.2	-0.2	3.1
	7:30 - 7:45	2	7	9	1.8	5.3	6.9	0.2	1.7	2.1
	7:45 - 8:00	3	5	10	1.8	5.3	6.9	1.2	-0.3	3.1

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- NB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-3.c. Killingworth Roundabout - Critical Gap (seconds) vs. Travel Time (seconds) – AM - SB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	3	6	10	1.5	5.2	6.4	1.5	0.8	3.6
	7:15 - 7:30	3	6	10	1.5	5.1	6.3	1.5	0.9	3.7
	7:30 - 7:45	3	8	10	1.5	5.0	6.4	1.5	3.0	3.6
	7:45 - 8:00	3	7	13	1.5	5.1	6.5	1.5	1.9	6.5
1	7:00 - 7:15	3	6	10	1.7	5.1	6.6	1.3	0.9	3.4
	7:15 - 7:30	3	6	10	1.6	5.1	6.3	1.4	0.9	3.7
	7:30 - 7:45	3	8	10	1.6	5.1	6.4	1.4	2.9	3.6
	7:45 - 8:00	3	7	13	1.6	5.0	6.5	1.4	2.0	6.5
2	7:00 - 7:15	3	6	10	1.8	5.3	6.6	1.2	0.7	3.4
	7:15 - 7:30	3	6	10	1.8	5.1	6.4	1.2	0.9	3.6
	7:30 - 7:45	3	8	10	1.7	5.0	6.5	1.3	3.0	3.5
	7:45 - 8:00	3	7	13	1.8	5.2	6.6	1.2	1.8	6.4
3	7:00 - 7:15	3	6	10	1.9	5.3	6.7	1.1	0.7	3.3
	7:15 - 7:30	3	6	10	1.9	5.2	6.5	1.1	0.8	3.5
	7:30 - 7:45	3	8	10	1.9	5.1	6.6	1.1	2.9	3.4
	7:45 - 8:00	3	7	13	1.8	5.2	6.5	1.2	1.8	6.5

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- SB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-3.d. Killingworth Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – AM - WB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	AM	R	TH	L	R	TH	L	R	TH	L
-1	7:00 - 7:15	2	7	10	3.5	5.2	8.1	-1.5	1.8	1.9
	7:15 - 7:30	2	6	10	3.5	5.0	8.6	-1.5	1.0	1.4
	7:30 - 7:45	2	5	10	3.4	5.1	8.2	-1.4	-0.1	1.8
	7:45 - 8:00	2	6	10	3.6	5.2	8.0	-1.6	0.8	2.0
1	7:00 - 7:15	2	7	10	3.9	5.1	8.5	-1.9	1.9	1.5
	7:15 - 7:30	2	6	10	4.0	5.6	8.5	-2.0	0.4	1.5
	7:30 - 7:45	2	5	10	3.9	5.6	8.4	-1.9	-0.6	1.6
	7:45 - 8:00	2	6	10	4.0	5.5	8.5	-2.0	0.5	1.5
2	7:00 - 7:15	2	7	10	4.2	5.4	8.5	-2.2	1.6	1.5
	7:15 - 7:30	2	6	10	4.1	5.8	8.6	-2.1	0.2	1.4
	7:30 - 7:45	2	5	10	4.1	5.8	8.7	-2.1	-0.8	1.3
	7:45 - 8:00	2	6	10	4.2	5.8	8.7	-2.2	0.2	1.3
3	7:00 - 7:15	2	7	10	4.3	5.4	8.6	-2.3	1.6	1.4
	7:15 - 7:30	2	6	10	4.3	5.9	8.7	-2.3	0.1	1.3
	7:30 - 7:45	2	5	10	4.2	5.9	8.7	-2.2	-0.9	1.3
	7:45 - 8:00	2	6	10	4.2	5.8	8.7	-2.2	0.2	1.3

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- WB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-4.a. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - EB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-20	7:00 - 7:15	4	7	14	3.8	4.8	8.3	0.2	2.2	5.7
	7:15 - 7:30	4	10	12	3.7	4.9	8.0	0.3	5.1	4.0
	7:30 - 7:45	4	10	0	3.8	4.9	8.0	0.2	5.1	-8.0
	7:45 - 8:00	4	8	12	3.7	4.9	8.2	0.3	3.1	3.8
-10	7:00 - 7:15	4	7	14	3.8	4.9	8.2	0.2	2.1	5.8
	7:15 - 7:30	4	10	12	3.6	4.9	8.0	0.4	5.1	4.0
	7:30 - 7:45	4	10	0	3.8	4.9	8.0	0.2	5.1	-8.0
	7:45 - 8:00	4	8	12	3.8	4.9	8.1	0.2	3.1	3.9
10	7:00 - 7:15	4	7	14	3.8	4.8	8.2	0.2	2.2	5.8
	7:15 - 7:30	4	10	12	3.7	4.8	8.0	0.3	5.2	4.0
	7:30 - 7:45	4	10	0	3.8	4.9	8.1	0.2	5.1	-8.1
	7:45 - 8:00	4	8	12	3.8	4.9	8.0	0.2	3.1	4.0
20	7:00 - 7:15	4	7	14	3.8	4.8	8.2	0.2	2.2	5.8
	7:15 - 7:30	4	10	12	3.6	4.8	7.9	0.4	5.2	4.1
	7:30 - 7:45	4	10	0	3.8	4.9	8.1	0.2	5.1	-8.1
	7:45 - 8:00	4	8	12	3.8	4.9	8.0	0.2	3.1	4.0
30	7:00 - 7:15	4	7	14	3.8	4.8	8.2	0.2	2.2	5.8
	7:15 - 7:30	4	10	12	3.7	4.9	7.9	0.3	5.1	4.1
	7:30 - 7:45	4	10	0	3.7	4.9	8.1	0.3	5.1	-8.1
	7:45 - 8:00	4	8	12	3.8	4.9	8.0	0.2	3.1	4.0

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
- EB Volume = 1194 vph

Table Q-4.b. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - NB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	3	6	10	1.4	4.7	6.5	1.6	1.3	3.5
	7:15 - 7:30	2	5	10	1.4	4.6	6.3	0.6	0.4	3.7
	7:30 - 7:45	2	7	9	1.4	4.7	6.2	0.6	2.3	2.8
	7:45 - 8:00	3	5	10	1.4	4.7	6.3	1.6	0.3	3.7
-20	7:00 - 7:15	3	6	10	1.4	4.6	6.5	1.6	1.4	3.5
	7:15 - 7:30	2	5	10	1.4	4.6	6.3	0.6	0.4	3.7
	7:30 - 7:45	2	7	9	1.4	4.7	6.3	0.6	2.3	2.7
	7:45 - 8:00	3	5	10	1.4	4.7	6.4	1.6	0.3	3.6
-10	7:00 - 7:15	3	6	10	1.5	4.6	6.5	1.5	1.4	3.5
	7:15 - 7:30	2	5	10	1.4	4.6	6.2	0.6	0.4	3.8
	7:30 - 7:45	2	7	9	1.4	4.6	6.3	0.6	2.4	2.7
	7:45 - 8:00	3	5	10	1.4	4.7	6.3	1.6	0.3	3.7
10	7:00 - 7:15	3	6	10	1.4	4.7	6.5	1.6	1.3	3.5
	7:15 - 7:30	2	5	10	1.4	4.7	6.3	0.6	0.3	3.7
	7:30 - 7:45	2	7	9	1.4	4.7	6.3	0.6	2.3	2.7
	7:45 - 8:00	3	5	10	1.4	4.7	6.3	1.6	0.3	3.7
20	7:00 - 7:15	3	6	10	1.5	4.6	6.5	1.5	1.4	3.5
	7:15 - 7:30	2	5	10	1.4	4.6	6.2	0.6	0.4	3.8
	7:30 - 7:45	2	7	9	1.4	4.7	6.3	0.6	2.3	2.7
	7:45 - 8:00	3	5	10	1.4	4.7	6.4	1.6	0.3	3.6

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
- NB Volume = 1194 vph

Table Q-4.c. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - SB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	3	6	10	1.6	5.1	6.5	1.4	0.9	3.5
	7:15 - 7:30	3	6	10	1.6	5.1	6.3	1.4	0.9	3.7
	7:30 - 7:45	3	8	10	1.6	5.0	6.4	1.4	3.0	3.6
	7:45 - 8:00	3	7	13	1.6	5.1	6.4	1.4	1.9	6.6
-20	7:00 - 7:15	3	6	10	1.6	5.0	6.5	1.4	1.0	3.5
	7:15 - 7:30	3	6	10	1.6	5.3	6.3	1.4	0.7	3.7
	7:30 - 7:45	3	8	10	1.6	5.0	6.4	1.4	3.0	3.6
	7:45 - 8:00	3	7	13	1.6	5.2	6.4	1.4	1.8	6.6
-10	7:00 - 7:15	3	6	10	1.6	5.0	6.5	1.4	1.0	3.5
	7:15 - 7:30	3	6	10	1.6	5.2	6.3	1.4	0.8	3.7
	7:30 - 7:45	3	8	10	1.6	5.0	6.4	1.4	3.0	3.6
	7:45 - 8:00	3	7	13	1.6	5.2	6.4	1.4	1.8	6.6
10	7:00 - 7:15	3	6	10	1.6	5.0	6.5	1.4	1.0	3.5
	7:15 - 7:30	3	6	10	1.6	5.2	6.2	1.4	0.8	3.8
	7:30 - 7:45	3	8	10	1.6	4.9	6.4	1.4	3.1	3.6
	7:45 - 8:00	3	7	13	1.6	5.1	6.4	1.4	1.9	6.6
20	7:00 - 7:15	3	6	10	1.6	5.1	6.5	1.4	0.9	3.5
	7:15 - 7:30	3	6	10	1.6	5.1	6.3	1.4	0.9	3.7
	7:30 - 7:45	3	8	10	1.5	5.0	6.4	1.5	3.0	3.6
	7:45 - 8:00	3	7	13	1.6	5.1	6.3	1.4	1.9	6.7

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
  NB Volume = 1194 vph

Table Q-4.d. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – AM - WB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	AM	R	TH	L	R	TH	L	R	TH	L
-30	7:00 - 7:15	2	7	10	3.6	5.1	8.4	-1.6	1.9	1.6
	7:15 - 7:30	2	6	10	3.7	5.2	8.6	-1.7	0.8	1.4
	7:30 - 7:45	2	5	10	3.8	5.2	8.2	-1.8	-0.2	1.8
	7:45 - 8:00	2	6	10	3.7	5.5	8.3	-1.7	0.5	1.7
-20	7:00 - 7:15	2	7	10	3.7	5.0	8.5	-1.7	2.0	1.5
	7:15 - 7:30	2	6	10	3.7	5.3	8.7	-1.7	0.7	1.3
	7:30 - 7:45	2	5	10	3.8	5.2	8.3	-1.8	-0.2	1.7
	7:45 - 8:00	2	6	10	3.8	5.4	8.5	-1.8	0.6	1.5
-10	7:00 - 7:15	2	7	10	3.6	5.0	8.4	-1.6	2.0	1.6
	7:15 - 7:30	2	6	10	3.7	5.3	8.7	-1.7	0.7	1.3
	7:30 - 7:45	2	5	10	3.8	5.2	8.3	-1.8	-0.2	1.7
	7:45 - 8:00	2	6	10	3.7	5.4	8.3	-1.7	0.6	1.7
10	7:00 - 7:15	2	7	10	3.7	5.0	8.4	-1.7	2.0	1.6
	7:15 - 7:30	2	6	10	3.7	5.2	8.6	-1.7	0.8	1.4
	7:30 - 7:45	2	5	10	3.7	5.3	8.3	-1.7	-0.3	1.7
	7:45 - 8:00	2	6	10	3.7	5.4	8.3	-1.7	0.6	1.7
20	7:00 - 7:15	2	7	10	3.6	5.0	8.5	-1.6	2.0	1.5
	7:15 - 7:30	2	6	10	3.7	5.2	8.4	-1.7	0.8	1.6
	7:30 - 7:45	2	5	10	3.8	5.3	8.1	-1.8	-0.3	1.9
	7:45 - 8:00	2	6	10	3.7	5.4	8.3	-1.7	0.6	1.7

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
- NB Volume = 1194 vph

Table Q-5.a. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - EB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	17.5 to 22.5	7:00 - 7:15	4	7	14	4.0	5.1	8.4	0.0	1.9	5.6
		7:15 - 7:30	4	10	12	3.9	5.2	8.2	0.1	4.8	3.8
		7:30 - 7:45	4	10	0	4.0	5.1	8.4	0.0	4.9	-8.4
		7:45 - 8:00	4	8	12	4.0	5.2	8.3	0.0	2.8	3.7
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	4	7	14	4.0	5.0	8.4	0.0	2.0	5.6
		7:15 - 7:30	4	10	12	3.7	5.0	8.1	0.3	5.0	3.9
		7:30 - 7:45	4	10	0	3.8	5.0	8.2	0.2	5.0	-8.2
		7:45 - 8:00	4	8	12	3.8	5.0	8.2	0.2	3.0	3.8
35	22.5 to 27.5	7:00 - 7:15	4	7	14	3.9	5.0	8.4	0.1	2.0	5.6
		7:15 - 7:30	4	10	12	3.8	5.0	8.1	0.2	5.0	3.9
		7:30 - 7:45	4	10	0	3.8	5.0	8.1	0.2	5.0	-8.1
		7:45 - 8:00	4	8	12	3.9	5.0	8.2	0.1	3.0	3.8
40	27.5 to 32.5	7:00 - 7:15	4	7	14	3.7	4.9	8.2	0.3	2.1	5.8
		7:15 - 7:30	4	10	12	3.7	4.9	8.0	0.3	5.1	4.0
		7:30 - 7:45	4	10	0	3.8	4.9	8.1	0.2	5.1	-8.1
		7:45 - 8:00	4	8	12	3.8	4.9	8.0	0.2	3.1	4.0
45	32.5 to 37.5	7:00 - 7:15	4	7	14	3.7	4.8	8.1	0.3	2.2	5.9
		7:15 - 7:30	4	10	12	3.7	4.8	8.0	0.3	5.2	4.0
		7:30 - 7:45	4	10	0	3.7	4.8	7.9	0.3	5.2	-7.9
		7:45 - 8:00	4	8	12	3.7	4.8	7.8	0.3	3.2	4.2

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	7:00 - 7:15	4	7	14	3.7	4.7	8.1	0.3	2.3	5.9
		7:15 - 7:30	4	10	12	3.6	4.7	7.8	0.4	5.3	4.2
		7:30 - 7:45	4	10	0	3.6	4.7	7.8	0.4	5.3	-7.8
		7:45 - 8:00	4	8	12	3.6	4.7	7.8	0.4	3.3	4.2

Note:

- Approach Speed = 40 mph
- EB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-5.b. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - NB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	17.5 to 22.5	7:00 - 7:15	3	6	10	1.7	5.3	7.1	1.3	0.7	2.9
		7:15 - 7:30	2	5	10	1.7	5.2	7.0	0.3	-0.2	3.0
		7:30 - 7:45	2	7	9	1.7	5.3	6.9	0.3	1.7	2.1
		7:45 - 8:00	3	5	10	1.7	5.3	6.9	1.3	-0.3	3.1
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	3	6	10	1.6	4.9	6.8	1.4	1.1	3.2
		7:15 - 7:30	2	5	10	1.6	5.0	6.7	0.4	0.0	3.3
		7:30 - 7:45	2	7	9	1.6	5.0	6.6	0.4	2.0	2.4
		7:45 - 8:00	3	5	10	1.5	5.0	6.6	1.5	0.0	3.4
35	22.5 to 27.5	7:00 - 7:15	3	6	10	1.6	5.0	6.6	1.4	1.0	3.4
		7:15 - 7:30	2	5	10	1.5	4.9	6.5	0.5	0.1	3.5
		7:30 - 7:45	2	7	9	1.5	5.0	6.5	0.5	2.0	2.5
		7:45 - 8:00	3	5	10	1.5	4.9	6.6	1.5	0.1	3.4
40	27.5 to 32.5	7:00 - 7:15	3	6	10	1.4	4.6	6.5	1.6	1.4	3.5
		7:15 - 7:30	2	5	10	1.4	4.7	6.3	0.6	0.3	3.7
		7:30 - 7:45	2	7	9	1.4	4.7	6.2	0.6	2.3	2.8
		7:45 - 8:00	3	5	10	1.4	4.6	6.2	1.6	0.4	3.8
45	32.5 to 37.5	7:00 - 7:15	3	6	10	1.3	4.5	6.3	1.7	1.5	3.7
		7:15 - 7:30	2	5	10	1.3	4.4	6.1	0.7	0.6	3.9
		7:30 - 7:45	2	7	9	1.3	4.5	6.0	0.7	2.5	3.0
		7:45 - 8:00	3	5	10	1.3	4.6	6.1	1.7	0.4	3.9

Reduced Speed of	**Range**	**Peak Period**	**Field Measurement**			**Simulation Results**			**Difference**		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	7:00 - 7:15	3	6	10	1.2	4.3	6.2	1.8	1.7	3.8
		7:15 - 7:30	2	5	10	1.3	4.3	5.9	0.7	0.7	4.1
		7:30 - 7:45	2	7	9	1.3	4.3	5.9	0.7	2.7	3.1
		7:45 - 8:00	3	5	10	1.2	4.3	5.9	1.8	0.7	4.1

Note:

- Approach Speed = 40 mph
- NB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-5.c. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - SB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25 (Existing condition)	17.5 to 22.5	7:00 - 7:15	3	6	10	2.0	5.6	7.0	1.0	0.4	3.0
		7:15 - 7:30	3	6	10	2.0	5.7	6.9	1.0	0.3	3.1
		7:30 - 7:45	3	8	10	2.0	5.6	7.0	1.0	2.4	3.0
		7:45 - 8:00	3	7	13	2.0	5.7	7.0	1.0	1.3	6.0
30	22.5 to 27.5	7:00 - 7:15	3	6	10	1.8	5.3	6.8	1.2	0.7	3.2
		7:15 - 7:30	3	6	10	1.8	5.4	6.6	1.2	0.6	3.4
		7:30 - 7:45	3	8	10	1.8	5.3	6.7	1.2	2.7	3.3
		7:45 - 8:00	3	7	13	1.8	5.3	6.7	1.2	1.7	6.3
35	22.5 to 27.5	7:00 - 7:15	3	6	10	1.6	5.2	6.6	1.4	0.8	3.4
		7:15 - 7:30	3	6	10	1.6	5.0	6.4	1.4	1.0	3.6
		7:30 - 7:45	3	8	10	1.5	5.0	6.4	1.5	3.0	3.6
		7:45 - 8:00	3	7	13	1.6	5.1	6.6	1.4	1.9	6.4
40	27.5 to 32.5	7:00 - 7:15	3	6	10	1.6	5.0	6.5	1.4	1.0	3.5
		7:15 - 7:30	3	6	10	1.6	5.1	6.3	1.4	0.9	3.7
		7:30 - 7:45	3	8	10	1.6	5.0	6.4	1.4	3.0	3.6
		7:45 - 8:00	3	7	13	1.6	5.1	6.4	1.4	1.9	6.6
45	32.5 to 37.5	7:00 - 7:15	3	6	10	1.5	4.9	6.3	1.5	1.1	3.7
		7:15 - 7:30	3	6	10	1.4	4.8	6.1	1.6	1.2	3.9
		7:30 - 7:45	3	8	10	1.4	4.7	6.2	1.6	3.3	3.8
		7:45 - 8:00	3	7	13	1.5	4.9	6.3	1.5	2.1	6.7

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	7:00 - 7:15	3	6	10	1.4	4.9	6.2	1.6	1.1	3.8
		7:15 - 7:30	3	6	10	1.4	4.9	6.0	1.6	1.1	4.0
		7:30 - 7:45	3	8	10	1.3	4.7	6.1	1.7	3.3	3.9
		7:45 - 8:00	3	7	13	1.4	4.9	6.2	1.6	2.1	6.8

Note:

- Approach Speed = 40 mph
- SB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-5.d. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – AM - WB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
25	17.5 to 22.5	7:00 - 7:15	2	7	10	3.8	5.6	8.5	-1.8	1.4	1.5
		7:15 - 7:30	2	6	10	3.9	5.6	8.8	-1.9	0.4	1.2
		7:30 - 7:45	2	5	10	3.8	5.7	8.5	-1.8	-0.7	1.5
		7:45 - 8:00	2	6	10	3.9	5.7	8.7	-1.9	0.3	1.3
30 (Existing condition)	22.5 to 27.5	7:00 - 7:15	2	7	10	3.7	5.3	8.5	-1.7	1.7	1.5
		7:15 - 7:30	2	6	10	3.8	5.4	8.4	-1.8	0.6	1.6
		7:30 - 7:45	2	5	10	3.8	5.5	8.5	-1.8	-0.5	1.5
		7:45 - 8:00	2	6	10	3.9	5.6	8.5	-1.9	0.4	1.5
35	22.5 to 27.5	7:00 - 7:15	2	7	10	3.7	5.2	8.5	-1.7	1.8	1.5
		7:15 - 7:30	2	6	10	3.7	5.3	8.5	-1.7	0.7	1.5
		7:30 - 7:45	2	5	10	3.8	5.6	8.5	-1.8	-0.6	1.5
		7:45 - 8:00	2	6	10	3.8	5.5	8.6	-1.8	0.5	1.4
40	27.5 to 32.5	7:00 - 7:15	2	7	10	3.6	5.1	8.4	-1.6	1.9	1.6
		7:15 - 7:30	2	6	10	3.7	5.3	8.6	-1.7	0.7	1.4
		7:30 - 7:45	2	5	10	3.8	5.3	8.4	-1.8	-0.3	1.6
		7:45 - 8:00	2	6	10	3.8	5.3	8.4	-1.8	0.7	1.6
45	32.5 to 37.5	7:00 - 7:15	2	7	10	3.6	5.0	8.1	-1.6	2.0	1.9
		7:15 - 7:30	2	6	10	3.7	5.1	8.4	-1.7	0.9	1.6
		7:30 - 7:45	2	5	10	3.6	5.2	8.2	-1.6	-0.2	1.8
		7:45 - 8:00	2	6	10	3.6	5.3	8.3	-1.6	0.7	1.7

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	AM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	7:00 - 7:15	2	7	10	3.3	4.9	8.2	-1.3	2.1	1.8
		7:15 - 7:30	2	6	10	3.5	5.0	8.2	-1.5	1.0	1.8
		7:30 - 7:45	2	5	10	3.4	5.2	8.0	-1.4	-0.2	2.0
		7:45 - 8:00	2	6	10	3.6	5.2	8.1	-1.6	0.8	1.9

Note:

- Approach Speed = 40 mph
- WB Volume = 1194 vph
- Circulating Speed = 13 - 18 mph

Table Q-6.a. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - EB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	4:30 - 4:45	4	7	14	4.4	6.5	14.6	-0.4	0.5	-0.6
		4:45 - 5:00	4	10	12	4.5	6.6	14.7	-0.5	3.4	-2.7
		5:00 - 5:15	4	10	0	4.5	6.6	14.5	-0.5	3.4	-14.5
		5:15 - 5:30	4	8	12	4.5	6.4	14.4	-0.5	1.6	-2.4
30	15 to 40	4:30 - 4:45	4	7	14	4.3	6.1	14.6	-0.3	0.9	-0.6
		4:45 - 5:00	4	10	12	4.3	6.2	14.5	-0.3	3.8	-2.5
		5:00 - 5:15	4	10	0	4.3	6.0	14.4	-0.3	4.0	-14.4
		5:15 - 5:30	4	8	12	4.2	5.9	14.5	-0.2	2.1	-2.5
35	20 to 50	4:30 - 4:45	4	7	14	4.1	5.7	14.5	-0.1	1.3	-0.5
		4:45 - 5:00	4	10	12	4.1	5.8	14.5	-0.1	4.2	-2.5
		5:00 - 5:15	4	10	0	4.1	5.7	14.5	-0.1	4.3	-14.5
		5:15 - 5:30	4	8	12	4.1	5.6	14.4	-0.1	2.4	-2.4
40 (Existing condition)	25 to 55	4:30 - 4:45	4	7	14	4.0	5.6	14.5	0.0	1.4	-0.5
		4:45 - 5:00	4	10	12	4.1	5.7	14.4	-0.1	4.3	-2.4
		5:00 - 5:15	4	10	0	4.1	5.5	14.3	-0.1	4.5	-14.3
		5:15 - 5:30	4	8	12	4.1	5.5	14.3	-0.1	2.5	-2.3
45	30 to 60	4:30 - 4:45	4	7	14	4.0	5.7	14.4	0.0	1.3	-0.4
		4:45 - 5:00	4	10	12	4.2	5.6	14.5	-0.2	4.4	-2.5
		5:00 - 5:15	4	10	0	4.1	5.5	14.4	-0.1	4.5	-14.4
		5:15 - 5:30	4	8	12	4.1	5.4	14.6	-0.1	2.6	-2.6

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	4:30 - 4:45	4	7	14	4.0	5.4	14.6	0.0	1.6	-0.6
		4:45 - 5:00	4	10	12	4.0	5.7	14.4	0.0	4.3	-2.4
		5:00 - 5:15	4	10	0	4.0	5.5	14.4	0.0	4.5	-14.4
		5:15 - 5:30	4	8	12	4.0	5.4	14.4	0.0	2.6	-2.4

Note:

- Circulating Speed = 13 - 18 mph
- EB Volume = 1578 vph

Table Q-6.b. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - NB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	4:30 - 4:45	3	6	10	1.9	9.2	10.1	1.1	-3.2	-0.1
		4:45 - 5:00	2	5	10	1.8	9.3	12.7	0.2	-4.3	-2.7
		5:00 - 5:15	2	7	9	2.0	9.3	12.7	0.0	-2.3	-3.7
		5:15 - 5:30	3	5	10	2.0	9.5	12.6	1.0	-4.5	-2.6
30	15 to 40	4:30 - 4:45	3	6	10	1.8	9.1	8.5	1.2	-3.1	1.5
		4:45 - 5:00	2	5	10	1.8	9.2	12.6	0.2	-4.2	-2.6
		5:00 - 5:15	2	7	9	1.8	9.2	12.4	0.2	-2.2	-3.4
		5:15 - 5:30	3	5	10	1.8	9.2	12.6	1.2	-4.2	-2.6
35	20 to 50	4:30 - 4:45	3	6	10	1.7	9.1	7.9	1.3	-3.1	2.1
		4:45 - 5:00	2	5	10	1.8	9.2	12.6	0.2	-4.2	-2.6
		5:00 - 5:15	2	7	9	1.7	9.2	12.4	0.3	-2.2	-3.4
		5:15 - 5:30	3	5	10	1.7	9.1	12.4	1.3	-4.1	-2.4
40 (Existing condition)	25 to 55	4:30 - 4:45	3	6	10	1.8	9.1	7.4	1.2	-3.1	2.6
		4:45 - 5:00	2	5	10	1.7	9.2	12.4	0.3	-4.2	-2.4
		5:00 - 5:15	2	7	9	1.7	9.1	12.5	0.3	-2.1	-3.5
		5:15 - 5:30	3	5	10	1.7	9.1	12.4	1.3	-4.1	-2.4
45	30 to 60	4:30 - 4:45	3	6	10	1.7	9.1	7.1	1.3	-3.1	2.9
		4:45 - 5:00	2	5	10	1.7	9.1	12.5	0.3	-4.1	-2.5
		5:00 - 5:15	2	7	9	1.7	9.2	12.5	0.3	-2.2	-3.5
		5:15 - 5:30	3	5	10	1.9	9.1	12.4	1.1	-4.1	-2.4

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	4:30 - 4:45	3	6	10	1.7	9.1	7.0	1.3	-3.1	3.0
		4:45 - 5:00	2	5	10	1.7	9.1	12.6	0.3	-4.1	-2.6
		5:00 - 5:15	2	7	9	1.7	9.1	12.4	0.3	-2.1	-3.4
		5:15 - 5:30	3	5	10	1.7	9.1	12.4	1.3	-4.1	-2.4

Note:

- Circulating Speed = 13 - 18 mph
- NB Volume = 1578 vph

Table Q-6.c. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - SB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	4:30 - 4:45	3	6	10	2.0	7.4	9.8	1.0	-1.4	0.2
		4:45 - 5:00	3	6	10	2.0	7.1	9.8	1.0	-1.1	0.2
		5:00 - 5:15	3	8	10	2.0	7.2	9.7	1.0	0.8	0.3
		5:15 - 5:30	3	7	13	2.0	7.3	9.6	1.0	-0.3	3.4
30	15 to 40	4:30 - 4:45	3	6	10	1.9	6.2	8.1	1.1	-0.2	1.9
		4:45 - 5:00	3	6	10	1.9	6.0	8.1	1.1	0.0	1.9
		5:00 - 5:15	3	8	10	1.9	6.1	8.3	1.1	1.9	1.7
		5:15 - 5:30	3	7	13	1.8	6.1	8.1	1.2	0.9	4.9
35 (Existing condition)	20 to 50	4:30 - 4:45	3	6	10	1.8	5.6	7.5	1.2	0.4	2.5
		4:45 - 5:00	3	6	10	1.8	5.5	7.3	1.2	0.5	2.7
		5:00 - 5:15	3	8	10	1.9	5.6	7.5	1.1	2.4	2.5
		5:15 - 5:30	3	7	13	1.8	5.6	7.4	1.2	1.4	5.6
40	25 to 55	4:30 - 4:45	3	6	10	1.8	5.2	6.9	1.2	0.8	3.1
		4:45 - 5:00	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
		5:00 - 5:15	3	8	10	1.8	5.1	6.9	1.2	2.9	3.1
		5:15 - 5:30	3	7	13	1.7	5.1	6.9	1.3	1.9	6.1
45	30 to 60	4:30 - 4:45	3	6	10	1.8	5.0	6.6	1.2	1.0	3.4
		4:45 - 5:00	3	6	10	1.8	5.0	6.7	1.2	1.0	3.3
		5:00 - 5:15	3	8	10	1.8	5.0	6.6	1.2	3.0	3.4
		5:15 - 5:30	3	7	13	1.8	5.0	6.6	1.2	2.0	6.4

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	4:30 - 4:45	3	6	10	1.8	4.9	6.5	1.2	1.1	3.5
		4:45 - 5:00	3	6	10	1.8	4.9	6.7	1.2	1.1	3.3
		5:00 - 5:15	3	8	10	1.8	4.9	6.6	1.2	3.1	3.4
		5:15 - 5:30	3	7	13	1.8	4.9	6.6	1.2	2.1	6.4

Note:

- Circulating Speed = 13 - 18 mph
- SB Volume = 1578 vph

Table Q-6.d. Killingworth Roundabout - Approach Speed (mph) vs. Travel Time (seconds) – PM - WB

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	15 to 40	4:30 - 4:45	2	7	10	5.0	7.4	12.2	-3.0	-0.4	-2.2
		4:45 - 5:00	2	6	10	4.9	7.6	12.0	-2.9	-1.6	-2.0
		5:00 - 5:15	2	5	10	5.2	7.5	11.9	-3.2	-2.5	-1.9
		5:15 - 5:30	2	6	10	4.9	7.7	11.8	-2.9	-1.7	-1.8
30	15 to 40	4:30 - 4:45	2	7	10	4.9	6.3	10.8	-2.9	0.7	-0.8
		4:45 - 5:00	2	6	10	4.7	7.2	10.8	-2.7	-1.2	-0.8
		5:00 - 5:15	2	5	10	4.8	7.2	10.9	-2.8	-2.2	-0.9
		5:15 - 5:30	2	6	10	4.8	7.2	10.7	-2.8	-1.2	-0.7
35	20 to 50	4:30 - 4:45	2	7	10	4.8	5.7	10.2	-2.8	1.3	-0.2
		4:45 - 5:00	2	6	10	4.6	7.0	10.0	-2.6	-1.0	0.0
		5:00 - 5:15	2	5	10	4.8	7.1	10.0	-2.8	-2.1	0.0
		5:15 - 5:30	2	6	10	4.9	7.1	10.0	-2.9	-1.1	0.0
40 (Existing condition)	25 to 55	4:30 - 4:45	2	7	10	4.7	5.4	9.8	-2.7	1.6	0.2
		4:45 - 5:00	2	6	10	4.8	6.8	9.9	-2.8	-0.8	0.1
		5:00 - 5:15	2	5	10	4.8	7.0	9.6	-2.8	-2.0	0.4
		5:15 - 5:30	2	6	10	4.8	6.9	9.4	-2.8	-0.9	0.6
45	30 to 60	4:30 - 4:45	2	7	10	4.8	5.2	9.5	-2.8	1.8	0.5
		4:45 - 5:00	2	6	10	4.8	7.0	9.5	-2.8	-1.0	0.5
		5:00 - 5:15	2	5	10	4.8	6.9	9.3	-2.8	-1.9	0.7
		5:15 - 5:30	2	6	10	4.8	6.6	9.3	-2.8	-0.6	0.7

Approach	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	35 to 65	4:30 - 4:45	2	7	10	4.7	5.1	9.5	-2.7	1.9	0.5
		4:45 - 5:00	2	6	10	4.6	6.9	9.5	-2.6	-0.9	0.5
		5:00 - 5:15	2	5	10	4.9	6.9	9.1	-2.9	-1.9	0.9
		5:15 - 5:30	2	6	10	4.8	7.0	9.3	-2.8	-1.0	0.7

Note:

- Circulating Speed = 13 - 18 mph
- WB Volume = 1578 vph

Table Q-7.a. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - EB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	4	7	14	4.4	6.5	15.7	-0.4	0.5	-1.7
		4:45 - 5:00	4	10	12	4.4	5.4	17.4	-0.4	4.6	-5.4
		5:00 - 5:15	4	10	0	4.4	6.5	17.4	-0.4	3.5	-17.4
		5:15 - 5:30	4	8	12	4.5	6.4	17.4	-0.5	1.6	-5.4
15	15 to 20	4:30 - 4:45	4	7	14	4.0	5.3	12.9	0.0	1.7	1.1
		4:45 - 5:00	4	10	12	3.9	5.4	12.9	0.1	4.6	-0.9
		5:00 - 5:15	4	10	0	4.0	5.3	13.0	0.0	4.7	-13.0
		5:15 - 5:30	4	8	12	4.0	5.3	12.9	0.0	2.7	-0.9
20	20 to 25	4:30 - 4:45	4	7	14	3.8	5.1	10.6	0.2	1.9	3.4
		4:45 - 5:00	4	10	12	3.8	5.2	10.6	0.2	4.8	1.4
		5:00 - 5:15	4	10	0	3.9	5.1	10.8	0.1	4.9	-10.8
		5:15 - 5:30	4	8	12	3.9	5.1	10.8	0.1	2.9	1.2
25	25 to 30	4:30 - 4:45	4	7	14	3.9	5.2	9.5	0.1	1.8	4.5
		4:45 - 5:00	4	10	12	3.9	5.2	9.5	0.1	4.8	2.5
		5:00 - 5:15	4	10	0	4.0	5.0	9.4	0.0	5.0	-9.4
		5:15 - 5:30	4	8	12	3.8	5.0	9.5	0.2	3.0	2.5
30	30 to 35	4:30 - 4:45	4	7	14	3.9	5.0	8.6	0.1	2.0	5.4
		4:45 - 5:00	4	10	12	4.0	5.0	8.5	0.0	5.0	3.5
		5:00 - 5:15	4	10	0	4.0	5.1	8.8	0.0	4.9	-8.8
		5:15 - 5:30	4	8	12	4.0	5.1	8.6	0.0	2.9	3.4

Note:

- Approach Speed = 40 mph
- EB Volume = 1578 vph

Table Q-7.b. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - NB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	3	6	10	1.8	11.0	7.8	1.2	-5.0	2.2
		4:45 - 5:00	2	5	10	1.7	11.1	15.3	0.3	-6.1	-5.3
		5:00 - 5:15	2	7	9	1.7	11.2	15.2	0.3	-4.2	-6.2
		5:15 - 5:30	3	5	10	1.7	11.2	15.3	1.3	-6.2	-5.3
15	15 to 20	4:30 - 4:45	3	6	10	1.7	8.1	7.1	1.3	-2.1	2.9
		4:45 - 5:00	2	5	10	1.8	8.0	11.1	0.2	-3.0	-1.1
		5:00 - 5:15	2	7	9	1.7	8.1	11.0	0.3	-1.1	-2.0
		5:15 - 5:30	3	5	10	1.8	8.1	11.0	1.2	-3.1	-1.0
20	20 to 25	4:30 - 4:45	3	6	10	1.7	6.5	6.9	1.3	-0.5	3.1
		4:45 - 5:00	2	5	10	1.7	6.4	8.9	0.3	-1.4	1.1
		5:00 - 5:15	2	7	9	1.6	6.6	8.7	0.4	0.4	0.3
		5:15 - 5:30	3	5	10	1.6	6.4	8.8	1.4	-1.4	1.2
25	25 to 30	4:30 - 4:45	3	6	10	1.6	5.7	6.6	1.4	0.3	3.4
		4:45 - 5:00	2	5	10	1.6	5.8	7.6	0.4	-0.8	2.4
		5:00 - 5:15	2	7	9	1.6	5.7	7.7	0.4	1.3	1.3
		5:15 - 5:30	3	5	10	1.7	5.7	7.6	1.3	-0.7	2.4
30	30 to 35	4:30 - 4:45	3	6	10	1.7	5.2	6.6	1.3	0.8	3.4
		4:45 - 5:00	2	5	10	1.7	5.3	7.0	0.3	-0.3	3.0
		5:00 - 5:15	2	7	9	1.6	5.3	6.9	0.4	1.7	2.1
		5:15 - 5:30	3	5	10	1.7	5.2	6.9	1.3	-0.2	3.1

Note:

- Approach Speed = 40 mph
- NB Volume = 1578 vph

Table Q-7.c. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - SB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	3	6	10	1.9	5.3	7.1	1.1	0.7	2.9
		4:45 - 5:00	3	6	10	1.9	5.3	7.1	1.1	0.7	2.9
		5:00 - 5:15	3	8	10	1.9	5.4	7.1	1.1	2.6	2.9
		5:15 - 5:30	3	7	13	1.9	5.3	7.1	1.1	1.7	5.9
15	15 to 20	4:30 - 4:45	3	6	10	1.8	5.2	6.8	1.2	0.8	3.2
		4:45 - 5:00	3	6	10	1.7	5.1	6.7	1.3	0.9	3.3
		5:00 - 5:15	3	8	10	1.7	5.0	6.8	1.3	3.0	3.2
		5:15 - 5:30	3	7	13	1.7	5.1	6.7	1.3	1.9	6.3
20	20 to 25	4:30 - 4:45	3	6	10	1.8	5.1	6.5	1.2	0.9	3.5
		4:45 - 5:00	3	6	10	1.7	5.0	6.5	1.3	1.0	3.5
		5:00 - 5:15	3	8	10	1.7	5.1	6.6	1.3	2.9	3.4
		5:15 - 5:30	3	7	13	1.7	5.0	6.6	1.3	2.0	6.4
25	25 to 30	4:30 - 4:45	3	6	10	1.7	5.1	6.5	1.3	0.9	3.5
		4:45 - 5:00	3	6	10	1.7	5.0	6.5	1.3	1.0	3.5
		5:00 - 5:15	3	8	10	1.7	5.1	6.5	1.3	2.9	3.5
		5:15 - 5:30	3	7	13	1.7	5.0	6.4	1.3	2.0	6.6
30	30 to 35	4:30 - 4:45	3	6	10	1.7	5.1	6.6	1.3	0.9	3.4
		4:45 - 5:00	3	6	10	1.7	5.0	6.4	1.3	1.0	3.6
		5:00 - 5:15	3	8	10	1.7	5.0	6.5	1.3	3.0	3.5
		5:15 - 5:30	3	7	13	1.7	5.0	6.4	1.3	2.0	6.6

Note:

- Approach Speed = 40 mph
- SB Volume = 1578 vph

Table Q-7.d. Killingworth Roundabout - Circulating Speed (mph) vs. Travel Time (seconds) – PM - WB

Circulating	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Speed (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
10	10 to 15 **(13 to 18 Existing condition)**	4:30 - 4:45	2	7	10	5.8	5.5	10.9	-3.8	1.5	-0.9
		4:45 - 5:00	2	6	10	5.6	8.2	10.9	-3.6	-2.2	-0.9
		5:00 - 5:15	2	5	10	5.7	8.2	10.7	-3.7	-3.2	-0.7
		5:15 - 5:30	2	6	10	5.9	8.5	10.8	-3.9	-2.5	-0.8
15	15 to 20	4:30 - 4:45	2	7	10	4.3	5.3	9.0	-2.3	1.7	1.0
		4:45 - 5:00	2	6	10	4.4	6.4	9.1	-2.4	-0.4	0.9
		5:00 - 5:15	2	5	10	4.4	6.6	9.1	-2.4	-1.6	0.9
		5:15 - 5:30	2	6	10	4.4	6.4	9.2	-2.4	-0.4	0.8
20	20 to 25	4:30 - 4:45	2	7	10	4.0	5.2	8.8	-2.0	1.8	1.2
		4:45 - 5:00	2	6	10	4.2	5.9	8.8	-2.2	0.1	1.2
		5:00 - 5:15	2	5	10	4.2	5.9	8.5	-2.2	-0.9	1.5
		5:15 - 5:30	2	6	10	4.1	5.8	8.6	-2.1	0.2	1.4
25	25 to 30	4:30 - 4:45	2	7	10	3.9	5.1	8.5	-1.9	1.9	1.5
		4:45 - 5:00	2	6	10	4.2	5.9	8.8	-2.2	0.1	1.2
		5:00 - 5:15	2	5	10	4.1	5.8	8.5	-2.1	-0.8	1.5
		5:15 - 5:30	2	6	10	3.9	5.6	8.5	-1.9	0.4	1.5
30	30 to 35	4:30 - 4:45	2	7	10	3.9	5.2	8.5	-1.9	1.8	1.5
		4:45 - 5:00	2	6	10	4.1	5.8	8.8	-2.1	0.2	1.2
		5:00 - 5:15	2	5	10	4.0	5.7	8.7	-2.0	-0.7	1.3
		5:15 - 5:30	2	6	10	3.8	5.6	8.5	-1.8	0.4	1.5

Note:

- Approach Speed = 40 mph
- WB Volume = 1578 vph

Table Q-8.a. Killingworth Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - EB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-2	4:30 - 4:45	4	7	14	3.8	5.6	14.4	0.2	1.4	-0.4
	4:45 - 5:00	4	10	12	4.0	5.6	14.4	0.0	4.4	-2.4
	5:00 - 5:15	4	10	0	4.0	5.5	14.3	0.0	4.5	-14.3
	5:15 - 5:30	4	8	12	3.9	5.5	14.3	0.1	2.5	-2.3
-1	4:30 - 4:45	4	7	14	4.0	5.6	14.4	0.0	1.4	-0.4
	4:45 - 5:00	4	10	12	4.1	5.7	14.4	-0.1	4.3	-2.4
	5:00 - 5:15	4	10	0	4.0	5.5	14.5	0.0	4.5	-14.5
	5:15 - 5:30	4	8	12	4.0	5.6	14.4	0.0	2.4	-2.4
1	4:30 - 4:45	4	7	14	4.0	5.7	14.5	0.0	1.3	-0.5
	4:45 - 5:00	4	10	12	4.0	5.6	14.5	0.0	4.4	-2.5
	5:00 - 5:15	4	10	0	4.0	5.5	14.3	0.0	4.5	-14.3
	5:15 - 5:30	4	8	12	4.0	5.7	14.5	0.0	2.3	-2.5
2	4:30 - 4:45	4	7	14	3.1	4.9	11.2	0.9	2.1	2.8
	4:45 - 5:00	4	10	12	3.2	5.2	13.7	0.8	4.8	-1.7
	5:00 - 5:15	4	10	0	3.9	5.0	10.1	0.1	5.0	-10.1
	5:15 - 5:30	4	8	12	3.7	4.8	13.2	0.3	3.2	-1.2

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- EB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph

Table Q-8.b. Killingworth Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - NB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-2	4:30 - 4:45	3	6	10	2.1	9.7	7.6	0.9	-3.7	2.4
	4:45 - 5:00	2	5	10	2.1	9.4	13.1	-0.1	-4.4	-3.1
	5:00 - 5:15	2	7	9	1.8	9.6	13.0	0.2	-2.6	-4.0
	5:15 - 5:30	3	5	10	2.2	9.5	12.8	0.8	-4.5	-2.8
-1	4:30 - 4:45	3	6	10	2.0	9.2	7.5	1.0	-3.2	2.5
	4:45 - 5:00	2	5	10	1.8	9.3	12.7	0.2	-4.3	-2.7
	5:00 - 5:15	2	7	9	1.7	9.4	12.6	0.3	-2.4	-3.6
	5:15 - 5:30	3	5	10	1.8	9.3	12.5	1.2	-4.3	-2.5
1	4:30 - 4:45	3	6	10	1.8	9.0	7.3	1.2	-3.0	2.7
	4:45 - 5:00	2	5	10	1.7	9.1	12.5	0.3	-4.1	-2.5
	5:00 - 5:15	2	7	9	1.7	9.1	12.4	0.3	-2.1	-3.4
	5:15 - 5:30	3	5	10	1.7	9.1	12.4	1.3	-4.1	-2.4
2	4:30 - 4:45	3	6	10	1.7	8.9	7.3	1.3	-2.9	2.7
	4:45 - 5:00	2	5	10	1.7	9.0	12.4	0.3	-4.0	-2.4
	5:00 - 5:15	2	7	9	1.6	8.9	12.2	0.4	-1.9	-3.2
	5:15 - 5:30	3	5	10	1.6	9.0	12.3	1.4	-4.0	-2.3

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- NB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph

Table Q-8.c. Killingworth Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - SB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-2	4:30 - 4:45	3	6	10	1.8	5.4	7.1	1.2	0.6	2.9
	4:45 - 5:00	3	6	10	1.8	5.5	7.2	1.2	0.5	2.8
	5:00 - 5:15	3	8	10	1.8	5.5	7.2	1.2	2.5	2.8
	5:15 - 5:30	3	7	13	1.8	5.4	7.1	1.2	1.6	5.9
-1	4:30 - 4:45	3	6	10	1.8	5.2	6.9	1.2	0.8	3.1
	4:45 - 5:00	3	6	10	1.8	5.2	6.9	1.2	0.8	3.1
	5:00 - 5:15	3	8	10	1.8	5.3	7.1	1.2	2.7	2.9
	5:15 - 5:30	3	7	13	1.8	5.2	6.8	1.2	1.8	6.2
1	4:30 - 4:45	3	6	10	1.8	5.2	6.8	1.2	0.8	3.2
	4:45 - 5:00	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
	5:00 - 5:15	3	8	10	1.8	5.1	6.8	1.2	2.9	3.2
	5:15 - 5:30	3	7	13	1.8	5.1	6.8	1.2	1.9	6.2
2	4:30 - 4:45	3	6	10	1.9	5.4	6.8	1.1	0.6	3.2
	4:45 - 5:00	3	6	10	1.9	5.2	6.7	1.1	0.8	3.3
	5:00 - 5:15	3	8	10	1.9	5.3	6.9	1.1	2.7	3.1
	5:15 - 5:30	3	7	13	1.9	5.3	6.8	1.1	1.7	6.2

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- SB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph

Table Q-8.d. Killingworth Roundabout – Critical Gap (seconds) vs. Travel Time (seconds) – PM - WB

Gap	Peak Period	Field Measurement			Simulation Results			Difference		
(seconds)	PM	R	TH	L	R	TH	L	R	TH	L
-2	4:30 - 4:45	2	7	10	4.5	5.5	9.9	-2.5	1.5	0.1
	4:45 - 5:00	2	6	10	4.9	7.2	9.9	-2.9	-1.2	0.1
	5:00 - 5:15	2	5	10	4.7	7.0	9.8	-2.7	-2.0	0.2
	5:15 - 5:30	2	6	10	4.8	7.2	9.9	-2.8	-1.2	0.1
-1	4:30 - 4:45	2	7	10	4.7	5.4	10.0	-2.7	1.6	0.0
	4:45 - 5:00	2	6	10	4.9	7.1	9.7	-2.9	-1.1	0.3
	5:00 - 5:15	2	5	10	4.7	7.1	9.7	-2.7	-2.1	0.3
	5:15 - 5:30	2	6	10	4.7	6.9	9.6	-2.7	-0.9	0.4
1	4:30 - 4:45	2	7	10	5.0	5.3	9.4	-3.0	1.7	0.6
	4:45 - 5:00	2	6	10	4.8	7.1	9.5	-2.8	-1.1	0.5
	5:00 - 5:15	2	5	10	4.7	7.0	9.3	-2.7	-2.0	0.7
	5:15 - 5:30	2	6	10	4.7	6.7	9.2	-2.7	-0.7	0.8
2	4:30 - 4:45	2	7	10	4.8	5.5	9.5	-2.8	1.5	0.5
	4:45 - 5:00	2	6	10	4.7	7.0	9.5	-2.7	-1.0	0.5
	5:00 - 5:15	2	5	10	4.8	6.9	9.4	-2.8	-1.9	0.6
	5:15 - 5:30	2	6	10	4.7	6.7	9.2	-2.7	-0.7	0.8

Note:

- Approach Speed = 40 mph
- **Critical Gap: EB = 4.8s, WB=4.0s, SB=4.0s, NB=3.0s (Existing condition)**
- WB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph

Table Q-9.a. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - EB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-20	4:30 - 4:45	4	7	14	4.0	5.6	14.3	0.0	1.4	-0.3
	4:45 - 5:00	4	10	12	4.0	5.4	14.3	0.0	4.6	-2.3
	5:00 - 5:15	4	10	0	4.0	5.5	14.5	0.0	4.5	-14.5
	5:15 - 5:30	4	8	12	4.0	5.6	14.4	0.0	2.4	-2.4
-10	4:30 - 4:45	4	7	14	4.0	5.6	14.4	0.0	1.4	-0.4
	4:45 - 5:00	4	10	12	4.0	5.6	14.4	0.0	4.4	-2.4
	5:00 - 5:15	4	10	0	4.0	5.5	14.3	0.0	4.5	-14.3
	5:15 - 5:30	4	8	12	4.1	5.6	14.4	-0.1	2.4	-2.4
10	4:30 - 4:45	4	7	14	4.1	5.6	14.5	-0.1	1.4	-0.5
	4:45 - 5:00	4	10	12	4.0	5.8	14.6	0.0	4.2	-2.6
	5:00 - 5:15	4	10	0	4.2	5.7	14.3	-0.2	4.3	-14.3
	5:15 - 5:30	4	8	12	4.0	5.5	14.4	0.0	2.5	-2.4
20	4:30 - 4:45	4	7	14	4.2	5.7	14.9	-0.2	1.3	-0.9
	4:45 - 5:00	4	10	12	4.0	5.5	14.4	0.0	4.5	-2.4
	5:00 - 5:15	4	10	0	4.1	5.1	14.8	-0.1	4.9	-14.8
	5:15 - 5:30	4	8	12	4.2	5.6	14.3	-0.2	2.4	-2.3
30	4:30 - 4:45	4	7	14	3.8	4.9	13.2	0.2	2.1	0.8
	4:45 - 5:00	4	10	12	4.0	5.5	14.3	0.0	4.5	-2.3
	5:00 - 5:15	4	10	0	4.2	5.6	11.5	-0.2	4.4	-11.5
	5:15 - 5:30	4	8	12	4.1	5.5	14.4	-0.1	2.5	-2.4

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
- EB Volume = 1578 vph

Table Q-9.b. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - NB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-20	4:30 - 4:45	3	6	10	1.9	9.1	7.5	1.1	-3.1	2.5
	4:45 - 5:00	2	5	10	1.8	9.3	12.6	0.2	-4.3	-2.6
	5:00 - 5:15	2	7	9	1.8	9.2	12.6	0.2	-2.2	-3.6
	5:15 - 5:30	3	5	10	1.8	9.2	12.5	1.2	-4.2	-2.5
-10	4:30 - 4:45	3	6	10	2.0	9.1	7.4	1.0	-3.1	2.6
	4:45 - 5:00	2	5	10	1.8	9.3	12.6	0.2	-4.3	-2.6
	5:00 - 5:15	2	7	9	1.8	9.3	12.5	0.2	-2.3	-3.5
	5:15 - 5:30	3	5	10	1.7	9.0	12.4	1.3	-4.0	-2.4
10	4:30 - 4:45	3	6	10	1.7	9.0	7.3	1.3	-3.0	2.7
	4:45 - 5:00	2	5	10	1.7	9.1	12.3	0.3	-4.1	-2.3
	5:00 - 5:15	2	7	9	1.6	9.0	12.4	0.4	-2.0	-3.4
	5:15 - 5:30	3	5	10	1.7	9.1	12.5	1.3	-4.1	-2.5
20	4:30 - 4:45	3	6	10	1.6	8.8	7.3	1.4	-2.8	2.7
	4:45 - 5:00	2	5	10	1.6	9.0	12.4	0.4	-4.0	-2.4
	5:00 - 5:15	2	7	9	1.6	8.9	12.3	0.4	-1.9	-3.3
	5:15 - 5:30	3	5	10	1.7	9.0	12.3	1.3	-4.0	-2.3
30	4:30 - 4:45	3	6	10	1.6	8.9	7.2	1.4	-2.9	2.8
	4:45 - 5:00	2	5	10	1.6	8.9	12.3	0.4	-3.9	-2.3
	5:00 - 5:15	2	7	9	1.5	9.0	12.2	0.5	-2.0	-3.2
	5:15 - 5:30	3	5	10	1.7	9.0	12.4	1.3	-4.0	-2.4

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
- NB Volume = 1578 vph

Table Q-9.c. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - SB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-20	4:30 - 4:45	3	6	10	1.8	5.2	6.9	1.2	0.8	3.1
	4:45 - 5:00	3	6	10	1.7	5.0	6.8	1.3	1.0	3.2
	5:00 - 5:15	3	8	10	1.7	5.2	6.9	1.3	2.8	3.1
	5:15 - 5:30	3	7	13	1.7	5.1	6.8	1.3	1.9	6.2
-10	4:30 - 4:45	3	6	10	1.8	5.2	6.9	1.2	0.8	3.1
	4:45 - 5:00	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
	5:00 - 5:15	3	8	10	1.8	5.1	6.9	1.2	2.9	3.1
	5:15 - 5:30	3	7	13	1.8	5.2	6.8	1.2	1.8	6.2
10	4:30 - 4:45	3	6	10	1.8	5.2	6.8	1.2	0.8	3.2
	4:45 - 5:00	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
	5:00 - 5:15	3	8	10	1.8	5.2	6.9	1.2	2.8	3.1
	5:15 - 5:30	3	7	13	1.8	5.1	6.7	1.2	1.9	6.3
20	4:30 - 4:45	3	6	10	1.8	5.2	6.8	1.2	0.8	3.2
	4:45 - 5:00	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
	5:00 - 5:15	3	8	10	1.9	5.2	6.9	1.1	2.8	3.1
	5:15 - 5:30	3	7	13	1.8	5.1	6.7	1.2	1.9	6.3
30	4:30 - 4:45	3	6	10	1.8	5.2	6.7	1.2	0.8	3.3
	4:45 - 5:00	3	6	10	1.8	5.1	6.7	1.2	0.9	3.3
	5:00 - 5:15	3	8	10	1.8	5.2	6.9	1.2	2.8	3.1
	5:15 - 5:30	3	7	13	1.7	5.1	6.7	1.3	1.9	6.3

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
- SB Volume = 1578 vph

Table Q-9.d. Killingworth Roundabout - Min. Headway Distance (ft) vs. Travel Time (seconds) – PM - WB

Min Headway	Peak Period	Field Measurement			Simulation Results			Difference		
Distance (ft)	PM	R	TH	L	R	TH	L	R	TH	L
-20	4:30 - 4:45	2	7	10	4.6	5.3	9.7	-2.6	1.7	0.3
	4:45 - 5:00	2	6	10	4.8	7.1	9.9	-2.8	-1.1	0.1
	5:00 - 5:15	2	5	10	5.1	7.1	9.7	-3.1	-2.1	0.3
	5:15 - 5:30	2	6	10	4.9	6.9	9.5	-2.9	-0.9	0.5
-10	4:30 - 4:45	2	7	10	4.6	5.3	9.6	-2.6	1.7	0.4
	4:45 - 5:00	2	6	10	4.9	7.0	9.9	-2.9	-1.0	0.1
	5:00 - 5:15	2	5	10	4.8	7.2	9.7	-2.8	-2.2	0.3
	5:15 - 5:30	2	6	10	4.7	6.8	9.5	-2.7	-0.8	0.5
10	4:30 - 4:45	2	7	10	4.8	5.3	9.6	-2.8	1.7	0.4
	4:45 - 5:00	2	6	10	4.7	7.0	9.6	-2.7	-1.0	0.4
	5:00 - 5:15	2	5	10	4.7	7.1	9.6	-2.7	-2.1	0.4
	5:15 - 5:30	2	6	10	4.8	6.9	9.4	-2.8	-0.9	0.6
20	4:30 - 4:45	2	7	10	4.6	5.4	9.8	-2.6	1.6	0.2
	4:45 - 5:00	2	6	10	4.8	7.0	9.4	-2.8	-1.0	0.6
	5:00 - 5:15	2	5	10	4.8	6.9	9.4	-2.8	-1.9	0.6
	5:15 - 5:30	2	6	10	4.7	7.0	9.6	-2.7	-1.0	0.4
30	4:30 - 4:45	2	7	10	4.6	5.4	9.8	-2.6	1.6	0.2
	4:45 - 5:00	2	6	10	4.7	6.7	9.4	-2.7	-0.7	0.6
	5:00 - 5:15	2	5	10	4.6	6.9	9.4	-2.6	-1.9	0.6
	5:15 - 5:30	2	6	10	4.7	7.1	9.3	-2.7	-1.1	0.7

Note:

- Approach Speed = 40 mph
- **Min Headway Distance: EB=53 ft, WB=53 ft, SB=53 ft, NB=53 ft (Existing condition)**
- Circulating Speed = 13 - 18 mph
- WB Volume = 1578 vph

Table Q-10.a. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - EB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	17.5 to 22.5	4:30 - 4:45	4	7	14	4.2	5.7	14.7	-0.2	1.3	-0.7
		4:45 - 5:00	4	10	12	4.0	5.7	14.7	0.0	4.3	-2.7
		5:00 - 5:15	4	10	0	4.1	5.6	14.4	-0.1	4.4	-14.4
		5:15 - 5:30	4	8	12	4.1	5.7	14.6	-0.1	2.3	-2.6
30 (Existing condition)	22.5 to 27.5	4:30 - 4:45	4	7	14	4.0	5.6	14.3	0.0	1.4	-0.3
		4:45 - 5:00	4	10	12	4.0	5.6	14.5	0.0	4.4	-2.5
		5:00 - 5:15	4	10	0	4.1	5.7	14.5	-0.1	4.3	-14.5
		5:15 - 5:30	4	8	12	4.1	5.5	14.6	-0.1	2.5	-2.6
35	22.5 to 27.5	4:30 - 4:45	4	7	14	4.0	5.7	14.7	0.0	1.3	-0.7
		4:45 - 5:00	4	10	12	4.1	5.7	14.4	-0.1	4.3	-2.4
		5:00 - 5:15	4	10	0	4.1	5.6	14.5	-0.1	4.4	-14.5
		5:15 - 5:30	4	8	12	4.1	5.7	14.4	-0.1	2.3	-2.4
40	27.5 to 32.5	4:30 - 4:45	4	7	14	3.9	5.5	14.5	0.1	1.5	-0.5
		4:45 - 5:00	4	10	12	4.1	5.7	14.4	-0.1	4.3	-2.4
		5:00 - 5:15	4	10	0	4.1	5.5	14.5	-0.1	4.5	-14.5
		5:15 - 5:30	4	8	12	4.1	5.5	14.3	-0.1	2.5	-2.3
45	32.5 to 37.5	4:30 - 4:45	4	7	14	4.1	5.6	14.5	-0.1	1.4	-0.5
		4:45 - 5:00	4	10	12	4.1	5.9	14.4	-0.1	4.1	-2.4
		5:00 - 5:15	4	10	0	4.1	5.5	14.4	-0.1	4.5	-14.4
		5:15 - 5:30	4	8	12	4.1	5.5	14.4	-0.1	2.5	-2.4

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	4:30 - 4:45	4	7	14	4.0	5.6	14.6	0.0	1.4	-0.6
		4:45 - 5:00	4	10	12	4.1	5.6	14.5	-0.1	4.4	-2.5
		5:00 - 5:15	4	10	0	4.1	5.6	14.4	-0.1	4.4	-14.4
		5:15 - 5:30	4	8	12	4.1	5.5	14.5	-0.1	2.5	-2.5

Note:

- Approach Speed = 40 mph
- EB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph

Table Q-10.b. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - NB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	17.5 to 22.5	4:30 - 4:45	3	6	10	1.9	9.2	7.7	1.1	-3.2	2.3
		4:45 - 5:00	2	5	10	1.9	9.2	12.7	0.1	-4.2	-2.7
		5:00 - 5:15	2	7	9	1.9	9.4	12.6	0.1	-2.4	-3.6
		5:15 - 5:30	3	5	10	1.9	9.3	12.5	1.1	-4.3	-2.5
30 (Existing condition)	22.5 to 27.5	4:30 - 4:45	3	6	10	2.0	9.2	7.5	1.0	-3.2	2.5
		4:45 - 5:00	2	5	10	1.9	9.3	12.6	0.1	-4.3	-2.6
		5:00 - 5:15	2	7	9	1.7	9.2	12.6	0.3	-2.2	-3.6
		5:15 - 5:30	3	5	10	1.9	9.3	12.4	1.1	-4.3	-2.4
35	22.5 to 27.5	4:30 - 4:45	3	6	10	1.8	9.3	7.3	1.2	-3.3	2.7
		4:45 - 5:00	2	5	10	1.8	9.3	12.6	0.2	-4.3	-2.6
		5:00 - 5:15	2	7	9	1.8	9.3	12.6	0.2	-2.3	-3.6
		5:15 - 5:30	3	5	10	1.9	9.3	12.5	1.1	-4.3	-2.5
40	27.5 to 32.5	4:30 - 4:45	3	6	10	1.7	9.2	7.3	1.3	-3.2	2.7
		4:45 - 5:00	2	5	10	1.7	9.1	12.6	0.3	-4.1	-2.6
		5:00 - 5:15	2	7	9	1.8	9.1	12.4	0.2	-2.1	-3.4
		5:15 - 5:30	3	5	10	1.7	9.1	12.5	1.3	-4.1	-2.5
45	32.5 to 37.5	4:30 - 4:45	3	6	10	1.7	9.0	7.3	1.3	-3.0	2.7
		4:45 - 5:00	2	5	10	1.6	9.0	12.4	0.4	-4.0	-2.4
		5:00 - 5:15	2	7	9	1.7	9.1	12.4	0.3	-2.1	-3.4
		5:15 - 5:30	3	5	10	1.7	9.0	12.3	1.3	-4.0	-2.3

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	4:30 - 4:45	3	6	10	1.6	8.8	7.2	1.4	-2.8	2.8
		4:45 - 5:00	2	5	10	1.6	9.0	12.4	0.4	-4.0	-2.4
		5:00 - 5:15	2	7	9	1.6	9.0	12.3	0.4	-2.0	-3.3
		5:15 - 5:30	3	5	10	1.6	8.9	12.2	1.4	-3.9	-2.2

Note:

- Approach Speed = 40 mph
- NB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph

Table Q-10.c. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - SB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25 (Existing condition)	17.5 to 22.5	4:30 - 4:45	3	6	10	2.0	5.5	7.2	1.0	0.5	2.8
		4:45 - 5:00	3	6	10	2.0	5.5	7.3	1.0	0.5	2.7
		5:00 - 5:15	3	8	10	2.1	5.5	7.3	0.9	2.5	2.7
		5:15 - 5:30	3	7	13	2.0	5.5	7.2	1.0	1.5	5.8
30	22.5 to 27.5	4:30 - 4:45	3	6	10	1.9	5.3	7.0	1.1	0.7	3.0
		4:45 - 5:00	3	6	10	1.9	5.3	7.0	1.1	0.7	3.0
		5:00 - 5:15	3	8	10	2.0	5.3	7.2	1.0	2.7	2.8
		5:15 - 5:30	3	7	13	1.9	5.4	7.0	1.1	1.6	6.0
35	22.5 to 27.5	4:30 - 4:45	3	6	10	1.8	5.2	6.8	1.2	0.8	3.2
		4:45 - 5:00	3	6	10	1.7	5.1	6.9	1.3	0.9	3.1
		5:00 - 5:15	3	8	10	1.8	5.2	7.0	1.2	2.8	3.0
		5:15 - 5:30	3	7	13	1.7	5.2	6.8	1.3	1.8	6.2
40	27.5 to 32.5	4:30 - 4:45	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
		4:45 - 5:00	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
		5:00 - 5:15	3	8	10	1.8	5.1	6.9	1.2	2.9	3.1
		5:15 - 5:30	3	7	13	1.8	5.2	6.8	1.2	1.8	6.2
45	32.5 to 37.5	4:30 - 4:45	3	6	10	1.8	5.1	6.8	1.2	0.9	3.2
		4:45 - 5:00	3	6	10	1.8	5.0	6.7	1.2	1.0	3.3
		5:00 - 5:15	3	8	10	1.7	5.0	6.7	1.3	3.0	3.3
		5:15 - 5:30	3	7	13	1.8	5.0	6.7	1.2	2.0	6.3

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach(mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	4:30 - 4:45	3	6	10	1.8	5.1	6.7	1.2	0.9	3.3
		4:45 - 5:00	3	6	10	1.7	4.9	6.7	1.3	1.1	3.3
		5:00 - 5:15	3	8	10	1.7	5.0	6.7	1.3	3.0	3.3
		5:15 - 5:30	3	7	13	1.6	4.9	6.7	1.4	2.1	6.3

Note:

- Approach Speed = 40 mph
- SB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph

Table Q-10.d. Killingworth Roundabout - Reduced Speed of Approach (mph) vs. Travel Time (seconds) – PM - WB

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
25	17.5 to 22.5	4:30 - 4:45	2	7	10	4.8	5.7	9.7	-2.8	1.3	0.3
		4:45 - 5:00	2	6	10	4.8	7.0	9.8	-2.8	-1.0	0.2
		5:00 - 5:15	2	5	10	4.8	6.9	9.6	-2.8	-1.9	0.4
		5:15 - 5:30	2	6	10	4.9	7.1	9.6	-2.9	-1.1	0.4
30 (Existing condition)	22.5 to 27.5	4:30 - 4:45	2	7	10	4.7	5.5	9.6	-2.7	1.5	0.4
		4:45 - 5:00	2	6	10	5.0	7.1	9.8	-3.0	-1.1	0.2
		5:00 - 5:15	2	5	10	4.7	6.9	9.5	-2.7	-1.9	0.5
		5:15 - 5:30	2	6	10	4.8	6.9	9.5	-2.8	-0.9	0.5
35	22.5 to 27.5	4:30 - 4:45	2	7	10	4.8	5.4	9.6	-2.8	1.6	0.4
		4:45 - 5:00	2	6	10	4.7	7.0	9.8	-2.7	-1.0	0.2
		5:00 - 5:15	2	5	10	4.9	7.1	9.5	-2.9	-2.1	0.5
		5:15 - 5:30	2	6	10	4.8	6.9	9.5	-2.8	-0.9	0.5
40	27.5 to 32.5	4:30 - 4:45	2	7	10	4.6	5.3	9.7	-2.6	1.7	0.3
		4:45 - 5:00	2	6	10	4.7	6.9	9.7	-2.7	-0.9	0.3
		5:00 - 5:15	2	5	10	4.9	7.1	9.5	-2.9	-2.1	0.5
		5:15 - 5:30	2	6	10	4.7	6.9	9.5	-2.7	-0.9	0.5
45	32.5 to 37.5	4:30 - 4:45	2	7	10	4.6	5.3	9.5	-2.6	1.7	0.5
		4:45 - 5:00	2	6	10	4.8	7.1	9.6	-2.8	-1.1	0.4
		5:00 - 5:15	2	5	10	4.9	6.9	9.6	-2.9	-1.9	0.4
		5:15 - 5:30	2	6	10	4.6	6.8	9.3	-2.6	-0.8	0.7

Reduced Speed of	Range	Peak Period	Field Measurement			Simulation Results			Difference		
Approach (mph)	(mph)	PM	R	TH	L	R	TH	L	R	TH	L
50	37.5 to 42.5	4:30 - 4:45	2	7	10	4.8	5.3	9.7	-2.8	1.7	0.3
		4:45 - 5:00	2	6	10	4.8	7.0	9.6	-2.8	-1.0	0.4
		5:00 - 5:15	2	5	10	4.7	6.9	9.3	-2.7	-1.9	0.7
		5:15 - 5:30	2	6	10	4.8	6.9	9.7	-2.8	-0.9	0.3

Note:

- Approach Speed = 40 mph
- WB Volume = 1578 vph
- Circulating Speed = 13 - 18 mph