NEEL-SCHAFFER
Solutions you can build upon

engineers
planners
surveyors
environmental scientists
landscape architects

February 21, 2020

Mr. Mike Harris, P.E.
Director of Engineering
City of Brentwood
1750 General George Patton Drive
Brentwood, TN 37027

RE: Murray Lane & Holly Tree Gap Road Intersection Control Analysis

Dear Mike:

This memorandum documents our recently completed traffic analysis of the referenced intersection. At the request of the City of Brentwood, Neel-Schaffer investigated the operational benefit of modifying the type of intersection control at the intersection of Murray Lane & Holly Tree Gap Road. The study considered multiple traffic control scenarios: the existing multi-way stop condition, roundabout configuration, and traffic signalization with exclusive turn lanes. The following information presents an overview of the assessment and recommendations resulting from the effort.

Purpose

As part of the engineering department's ongoing effort to monitor and promote safe and efficient traffic flow within the city, department officials, in consultation with Neel-Schaffer, investigated the operational benefit of converting the multi-way stop control to roundabout or signalized control. Officials believe modifying the type of intersection control could potentially improve the intersection's operational and safety performance. Employment and residential growth in the area suggest that transportation and traffic needs will continue to grow and evolve into the future. Under current conditions, field observations confirmed that the intersection operates near capacity with undesirable delays during peak travel periods. The conversion to an alternative traffic control strategy could provide a sustainable design that will accommodate anticipated growth of traffic and contribute to improving mobility through the city . The requested assessment compared performance measures between all-way stop, signalized, and roundabout control under existing and horizon year conditions.

Holly Tree Gap Road at Murray Lane

Methodology

The analysis in this assessment considered the Federal Highway Administration's Intersection Control Evaluation (ICE) policy for guidance and alternative evaluation. ICE is a multistep process meant to scan and evaluate alternatives to determine the optimal type of intersection control. This assessment technique serves as a planning-level step to identify relevant improvement scenarios and also eliminate those deemed to be impractical or undesirable. The methodology used in this analysis is an abbreviation of FHWA's ICE policy, focusing on its principles of operational and safety analysis, multimodal considerations, physical constraints, and comparing alternatives. Preliminary tasks began with acquiring intersection turning movement counts and crash history data. A preliminary site visit was conducted in order to recognize above ground obstacles and constraints that could potentially impede a particular design scenario. Intersection capacity and operational review was prepared by using predictive traffic analysis software for all three scenarios under existing and horizon year conditions. The study's analysis utilized this information to evaluate the performance benefits comparing roundabout operations to multi-way stop and a traffic signal conditions. It should be noted that the traffic signalization concept also included consideration of new exclusive turn lanes at the intersection as part of the improvement scenario due to the inherent operational characteristics under signalized conditions. Study assessment referred to the Federal Highway Administration's Intersection Control Evaluation (ICE) policy, National Cooperative Highway Research Program's (NCHRP) Roundabouts: An Informational Guide Reports 572 & 672, Highway Capacity Manuel 6th Edition, the Manual on Uniform Traffic Control Devices, and Tennessee Department of Transportation's Traffic Design Manual for information and criteria.

Analysis results

As previously mentioned, the analysis used an abbreviated approach to FHWA's ICE methodology. The evaluation technique addressed operational and safety analysis, multimodal considerations, physical constraints, and comparing alternatives.

Operational Analysis

Operational analysis compared performances between multi-way stop, traffic signal, and roundabout intersection control scenarios for both existing year and horizon year conditions. The evaluation considered a ten-year horizon period, culminating in 2029. The summary table provides an overview of the intersection level of service and delay for AM & PM peak hours for each scenario and study year.

INTERSECTION LEVEL OF SERVICE ANALYSIS
Conceptual Analysis - Murray Lane & Holly Tree Gap Road

Peak Period		AWSC	Traffic Signal[1]	Roundabout
AM	Existing (2019)	D (31.4sec)	B (13.5sec)	A (9.1sec)
	Horizon Year (2029)	E (41.1sec)	B (15.0sec)	B (11.0sec)
PM	Existing (2019)	F (53.5sec)	B (16.4sec)	A (8.9sec)
	Horizon Year (2029)	F (64.9sec)	C (20.2sec)	B (10.3sec)

[1]Proposed traffic signal would include new southbound left-turn lane, northbound right-turn lane, & westbound right-t

The predictive analysis shows that both alternative traffic control strategies (signalization and roundabout) would be expected to provide superior capacity and operational performance compared

to the existing multi-way stop condition. The analysis results also indicate that the roundabout controlled scenario would be expected to provide optimal intersection performance for both AM & PM peak periods, compared to signalization, although the two alternatives exhibit similar travel delay results. Under current all-way stop control, road users experience some delay in the AM peak and more extensive, unacceptable delay during the PM peak period. Additionally, analysis showed that multi-way stop is not a sustainable method of intersection control into the future with the expected growth of travel demand. This is contributed by the intersection's single lane approaches, high left & right turn movements, and high peak hour volumes that are near the functional capacity of a multi-way stop. Under signalized scenario, the analysis found the intersection's operational performance to be acceptable. This is with the inclusion of additional approach lanes to serve left & right turn movements. However, the roundabout scenario yielded more desirable results, particularly in the PM peak period scenario. This assessment includes consideration of long-term operation and maintenance costs, as well as established safety benefits provided by roundabouts, compared to signalized intersections. The analysis investigated and prepared traffic signal warrants: Warrant 1 Eight-Hour Vehicular Volume and Warrant 2 Four-Hour Vehicular Volume, provided by the MUTCD. The intersection volume did not meet the criteria for satisfying warrant 1, but the criteria for satisfying warrant 2 was met.

Safety Analysis

The analysis included review of crash history data related to this intersection obtained from the Brentwood Police Department. Five total crashes were reported: four rear-end crashes and one angle crash for the period of 2018 and 2019. Federal research evaluating before/after conditions of converting a controlled at grade intersection to a roundabout determined a 35% reduction in overall crash frequency and a 76% reduction in severe injuries, per NCHRP report 572. These reductions in crash frequency and severity is contributed by the geometrical features and design elements that reduce vehicular conflict points and travel speeds in a roundabout. Generally, vehicle speeds are lower and more uniform in a roundabout design, which provides drivers more time to react to potential conflicts. Roundabout characteristics such as inscribed diameter, approach angle, design speed, splitter island radius, etc., provide guidance though the facility, thus, reducing the chance of a severe crash occurring. Experience and engineering judgment suggest that an increase in vehicle crashes could result in conjunction with a conversion from multi-way stop control to signalization.

Multimodal considerations

Currently, multimodal facilities do not exist at this intersection. According to City of Brentwood's Pedestrian Connectivity Study, a bike route is not proposed along this segment of Murray Lane. A sidewalk is present on Murray Lane in the westbound direction starting at Forest Park Drive, approximately 500 feet north of the study intersection. Within recent years, the city has been upgrading and expanding their pedestrian network to accommodate existing and future pedestrian demand. However, pedestrian traffic is minimal at this location and a significant physical barrier in the form of Beech Creek and an associated large culvert crossing exist between Holly Tree Gap Rd and Forest Park Dr. Because of these characteristics, sidewalk extension is not considered for implementation at this time. However, future sidewalk accommodations may be considered as part of the proposed design alternative to allow for future implementation.

Physical Constraints

The preliminary field visit identified potential physical and natural constraints that should be considered in conjunction with preliminary design phases. These include above ground electric utility

facilities, underground utilities (water and natural gas lines), storm water facilities, Beech Creek to the west, right of way limits, and private driveways serving adjacent residences. The finalized roundabout layout will be designed to address these conflicts. A formal digital field survey should be prepared as part of early preliminary engineering to establish the location of these features, potential impacts and to assist informing design decisions. A figure illustrating the identified existing potential constraints is provided in the appendix of the report.

Summary of Recommendations

Based on the results of the prepared analysis, the proposed reconfiguration of multi-way stop control to roundabout control is expected to provide a significant improvement in traffic operation at this intersection. A roundabout will increase capacity and provides a sustainable design that will accommodate forecasted operational demand.

Therefore, we recommend that city officials consider the reconfiguration of intersection control from multi-way stop control to roundabout control at the intersection of Murray Lane & Holly Tree Gap Road. We recommend more in-depth assessment and preliminary engineering, including field survey, to better understand design and construction constraints, costs and impacts on adjacent utilities and property owners. A schematic detailing the roundabout layout is provided in the appendix of this report.

We hope the information included in the analysis is useful as the City pursues the desired improvements at this intersection. If we can be of further assistance or provide additional information, please don't hesitate to contact us.

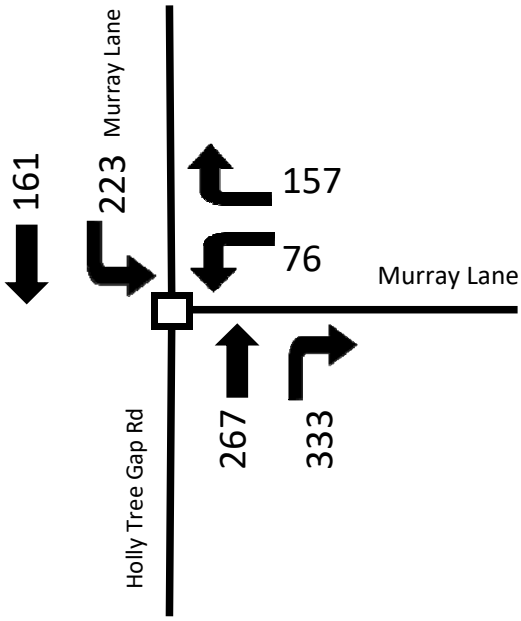
Sincerely,
NEEL-SCHAFFER, INC.

Gregory Judy, P.E., PTOE
Engineer Manager – Vice President

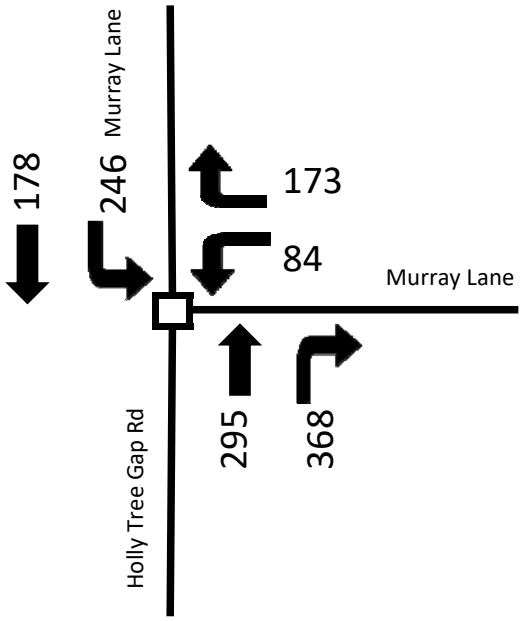
APPENDIX A
Intersection Turn Movement Count Data

Peak Hour Turn Movement Counts

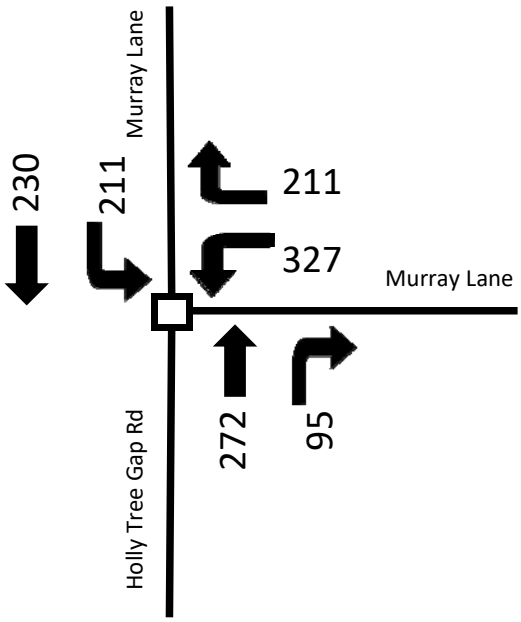
Existing AM (2019)



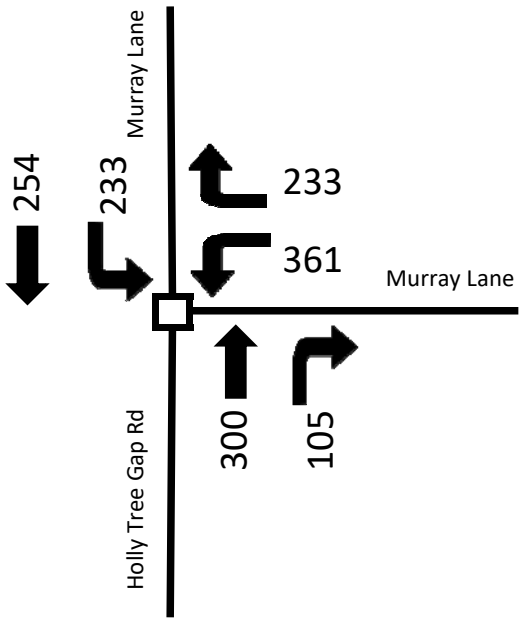
Horizon Year AM (2029)



Existing PM (2019)



Horizon Year PM (2029)



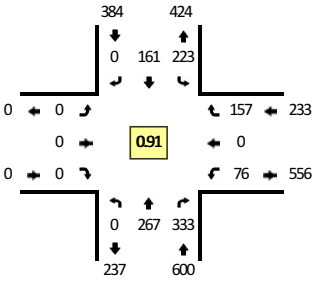
Type of peak hour being reported: Intersection Peak

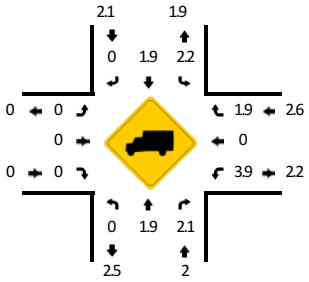
Method for determining peak hour: Total Entering Volume

LOCATION: Holly Tree Gap Rd -- Murray Ln
CITY/STATE: Brentwood, TN

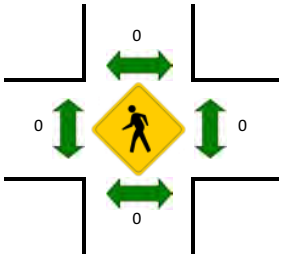
QC JOB #: 15119001
DATE: Wed, Dec 4 2019

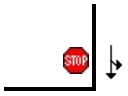
Peak-Hour: 7:15 AM -- 8:15 AM
Peak 15-Min: 7:30 AM -- 7:45 AM

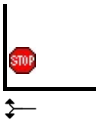


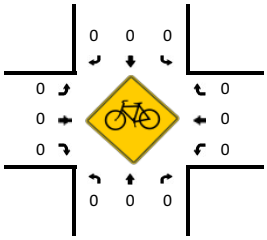


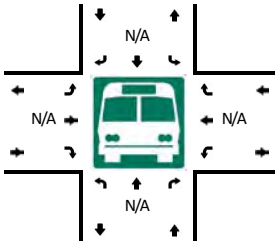
Quality Counts
DATA THAT DRIVES COMMUNITIES

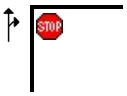


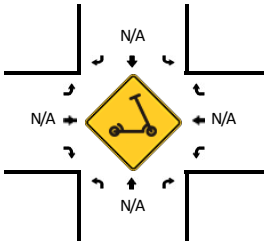












15-Min Count Period Beginning At	Holly Tree Gap Rd (Northbound)				Holly Tree Gap Rd (Southbound)				Murray Ln (Eastbound)				Murray Ln (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	51	78	0	62	21	0	0	0	0	0	0	14	0	21	0	247	
7:15 AM	0	87	92	0	63	28	0	0	0	0	0	0	11	0	41	0	322	
7:30 AM	0	71	85	0	59	48	0	0	0	0	0	0	32	0	40	0	335	
7:45 AM	0	52	83	0	43	47	0	0	0	0	0	0	21	0	49	0	295	1199
8:00 AM	0	57	73	0	58	38	0	0	0	0	0	0	12	0	27	0	265	1217
8:15 AM	0	65	82	0	28	16	0	0	0	0	0	0	12	0	53	0	256	1151
8:30 AM	0	57	67	0	69	45	0	0	0	0	0	0	13	0	61	0	312	1128
8:45 AM	0	31	54	0	69	42	0	0	0	0	0	0	9	0	26	0	231	1064

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	284	340	0	236	192	0	0	0	0	0	0	128	0	160	0	1340
Heavy Trucks	0	8	0		8	4	0		0	0	0		4	0	12		36
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

Report generated on 12/10/2019 6:18 AM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

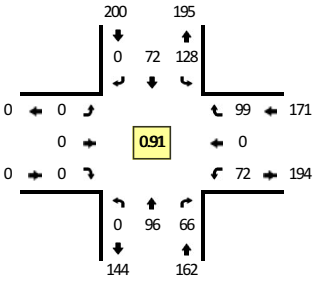
Type of peak hour being reported: Intersection Peak

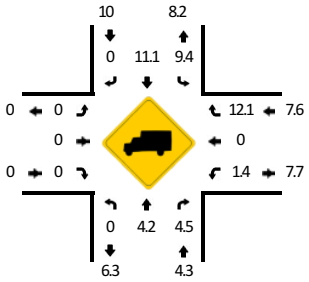
Method for determining peak hour: Total Entering Volume

LOCATION: Holly Tree Gap Rd -- Murray Ln
CITY/STATE: Brentwood, TN

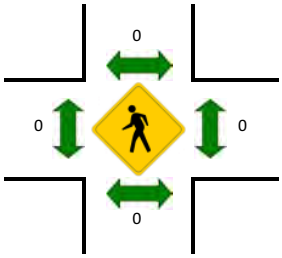
QC JOB #: 15119002
DATE: Wed, Dec 4 2019

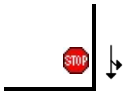
Peak-Hour: 11:15 AM -- 12:15 PM
Peak 15-Min: 11:30 AM -- 11:45 AM

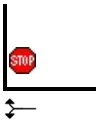


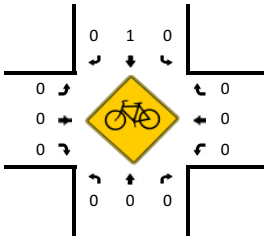


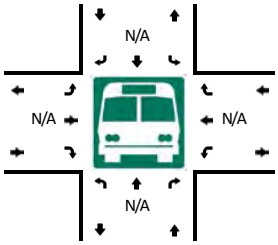
Quality Counts
DATA THAT DRIVES COMMUNITIES

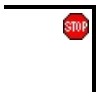


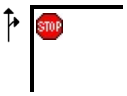


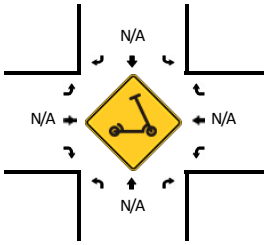












15-Min Count Period Beginning At	Holly Tree Gap Rd (Northbound)				Holly Tree Gap Rd (Southbound)				Murray Ln (Eastbound)				Murray Ln (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
11:00 AM	0	22	16	0	22	19	0	0	0	0	0	0	20	0	25	0	124	
11:15 AM	0	22	17	0	37	14	0	0	0	0	0	0	18	0	25	0	133	
11:30 AM	0	28	25	0	32	22	0	0	0	0	0	0	18	0	21	0	146	
11:45 AM	0	27	11	0	21	16	0	0	0	0	0	0	18	0	27	0	120	523
12:00 PM	0	19	13	0	38	20	0	0	0	0	0	0	18	0	26	0	134	533
12:15 PM	0	23	23	0	23	22	0	0	0	0	0	0	13	0	26	0	130	530
12:30 PM	0	18	23	0	32	20	0	0	0	0	0	0	18	0	30	0	141	525
12:45 PM	0	19	15	0	33	18	0	0	0	0	0	0	9	0	25	0	119	524

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	112	100	0	128	88	0	0	0	0	0	0	72	0	84	0	584
Heavy Trucks	0	8	4		12	12	0		0	0	0		0	0	4		40
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

Report generated on 12/10/2019 6:18 AM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

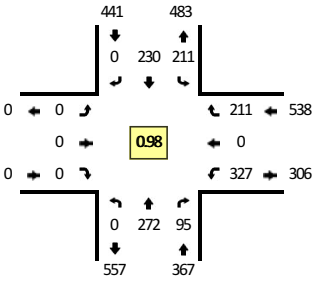
Type of peak hour being reported: Intersection Peak

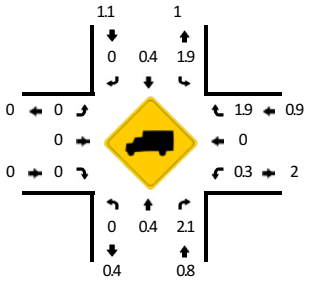
Method for determining peak hour: Total Entering Volume

LOCATION: Holly Tree Gap Rd -- Murray Ln
CITY/STATE: Brentwood, TN

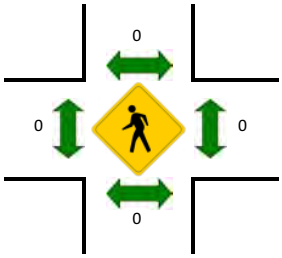
QC JOB #: 15119003
DATE: Wed, Dec 4 2019

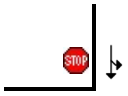
Peak-Hour: 5:00 PM -- 6:00 PM
Peak 15-Min: 5:30 PM -- 5:45 PM

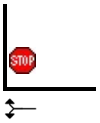


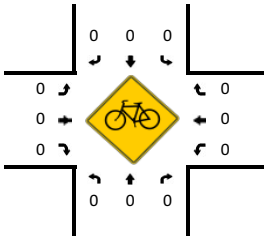


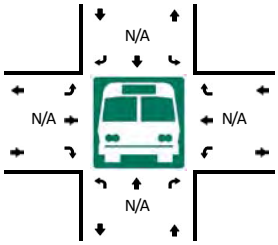
Quality Counts
DATA THAT DRIVES COMMUNITIES

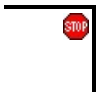


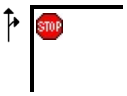


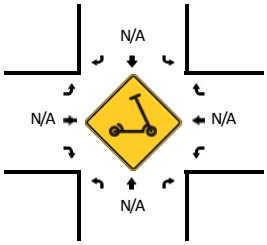












15-Min Count Period Beginning At	Holly Tree Gap Rd (Northbound)				Holly Tree Gap Rd (Southbound)				Murray Ln (Eastbound)				Murray Ln (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
1:00 PM	0	26	7	0	31	15	0	0	0	0	0	0	19	0	26	0	124	
1:15 PM	0	31	14	0	30	13	0	0	0	0	0	0	19	0	36	0	143	
1:30 PM	0	30	13	0	28	15	0	0	0	0	0	0	18	0	28	0	132	
1:45 PM	0	47	21	0	25	14	0	0	0	0	0	0	15	0	34	0	156	555
2:00 PM	0	27	14	0	45	37	0	0	0	0	0	0	14	0	40	0	177	608
2:15 PM	0	40	16	0	22	29	0	0	0	0	0	0	18	0	25	0	150	615
2:30 PM	0	23	9	0	29	18	0	0	0	0	0	0	15	0	32	0	126	609
2:45 PM	0	45	23	0	36	29	0	0	0	0	0	0	41	0	43	0	217	670
3:00 PM	0	37	15	0	28	41	0	0	0	0	0	0	46	0	71	0	238	731
3:15 PM	0	37	16	0	34	40	0	0	0	0	0	0	40	0	55	0	222	803
3:30 PM	0	37	23	0	33	38	0	0	0	0	0	0	30	0	35	0	196	873
3:45 PM	0	41	13	1	50	46	0	0	0	0	0	0	49	0	46	0	246	902
4:00 PM	0	56	34	0	69	60	0	0	0	0	0	0	43	0	57	0	319	983
4:15 PM	0	46	21	0	56	61	0	0	0	0	0	0	54	0	59	0	297	1058
4:30 PM	0	59	27	0	48	45	0	0	0	0	0	0	55	0	56	0	290	1152
4:45 PM	0	71	25	0	51	54	0	0	0	0	0	0	77	0	54	0	332	1238
5:00 PM	0	55	19	0	64	55	0	0	0	0	0	0	88	0	49	0	330	1249
5:15 PM	0	62	17	0	56	65	0	0	0	0	0	0	76	0	60	0	336	1288
5:30 PM	0	82	27	0	49	58	0	0	0	0	0	0	83	0	43	0	342	1340
5:45 PM	0	73	32	0	42	52	0	0	0	0	0	0	80	0	59	0	338	1346
6:00 PM	0	71	22	0	40	39	0	0	0	0	0	0	47	0	33	0	252	1268
6:15 PM	0	61	18	0	22	27	0	0	0	0	0	0	53	0	42	0	223	1155
6:30 PM	0	42	10	0	13	19	0	0	0	0	0	0	23	0	25	0	132	945
6:45 PM	0	30	12	0	24	15	0	0	0	0	0	0	17	0	20	0	118	725

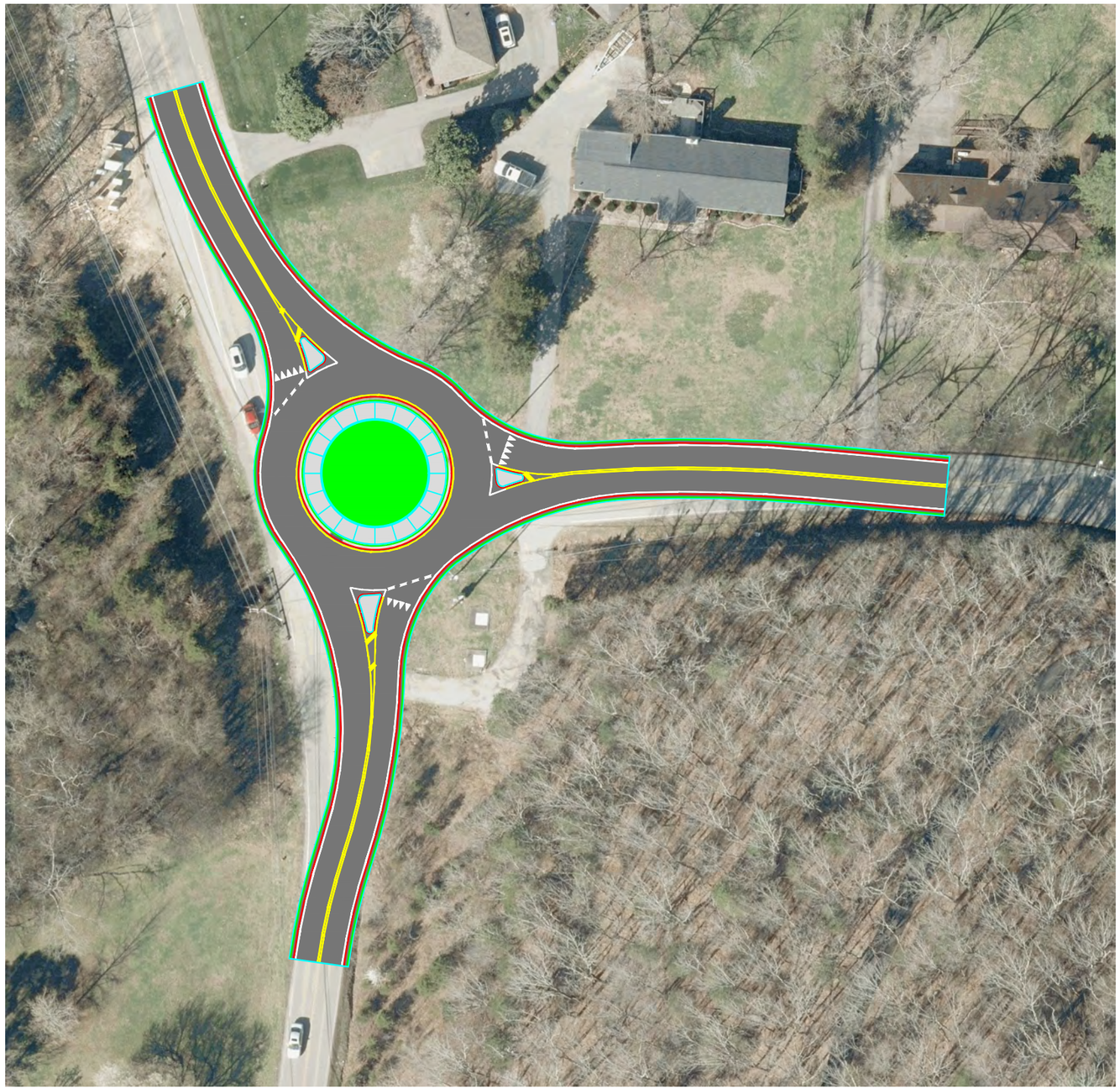
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	328	108	0	196	232	0	0	0	0	0	0	332	0	172	0	1368
Heavy Trucks	0	0	4		0	4	0		0	0	0		4	0	4		16
Buses																	
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Scooters																	

Comments:

Report generated on 12/10/2019 6:18 AM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

APPENDIX B
Conceptual Scenario Layout:
Roundabout Control



N

GRAPHIC SCALE

60 0 30 60 120

(IN FEET)

1 inch = 60 feet

CONCEPT LAYOUT
ROUNDABOUT TRAFFIC CONTROL
MURRAY LANE AT HOLLY TREE GAP ROAD

NEEL-SCHAFFER
Solutions you can build upon

APPENDIX C
Conceptual Scenario Layout:
Signalized Control

TYPE	YEAR	PROJECT NO.	SHEET NO.
CONCEPT	2020	NS.11258.042	1

SUMMARY NOTES

1. TRAFFIC SIGNAL CONTROL
2. 100' SB LEFT-TURN LANE
3. 75' WB RIGHT TURN LANE
4. 75' NB RIGHT TURN LANE

CONCEPT ONLY

SEALED BY

CITY OF BRENTWOOD

CONCEPTUAL SIGNAL LAYOUT

SCALE: 1"=20'

2/25/2020 10:28:40 AM
\\10.1.25.312_trans\11258 - City of Brentwood\Phase 42 - MurrayLn&HollyTreeGap\dgn\0-Sketch\Concept_Signal Layout.dgn

APPENDIX D
Existing Potential Constraints

TYPE	YEAR	PROJECT NO.	SHEET NO.
CONCEPT	2020	NS.11258.042	1

CONCEPT

ONLY

SEALED BY

CITY OF BRENTWOOD

EXISTING POTENTIAL CONSTRAINTS

SCALE: 1"=20'

2/25/2020 11:07:17 AM
\\10.1.25.3\2_trans\11258 - City of Brentwood\Phase 42 - MurrayLn&HollyTreeGap\dgn\0-Sketch\Existing Potential Constraints.sht

APPENDIX E
Intersection Crash History Data

Murray Lane at Holly Tree Gap Road
Crash Summary
4/12/2018 - 9/13/2019

Manner of First Collison	Type of Crash	First Harmful Event	Total Vehicles	Number of Injures	Adverse Conditions
Rear End	Prop Damage	Vehicle In Transport	2	0	Daylight-Clear
Angle	Prop Damage	Vehicle In Transport	2	0	Daylight-Clear
Rear End	Prop Damage	Vehicle In Transport	2	0	Daylight-Cloudy
Rear End	Prop Damage	Vehicle In Transport	2	0	Daylight-Snow & Ice
Rear End	Prop Damage	Vehicle In Transport	2	0	Daylight-Clear

APPENDIX F
Traffic Signal Warrant Summary

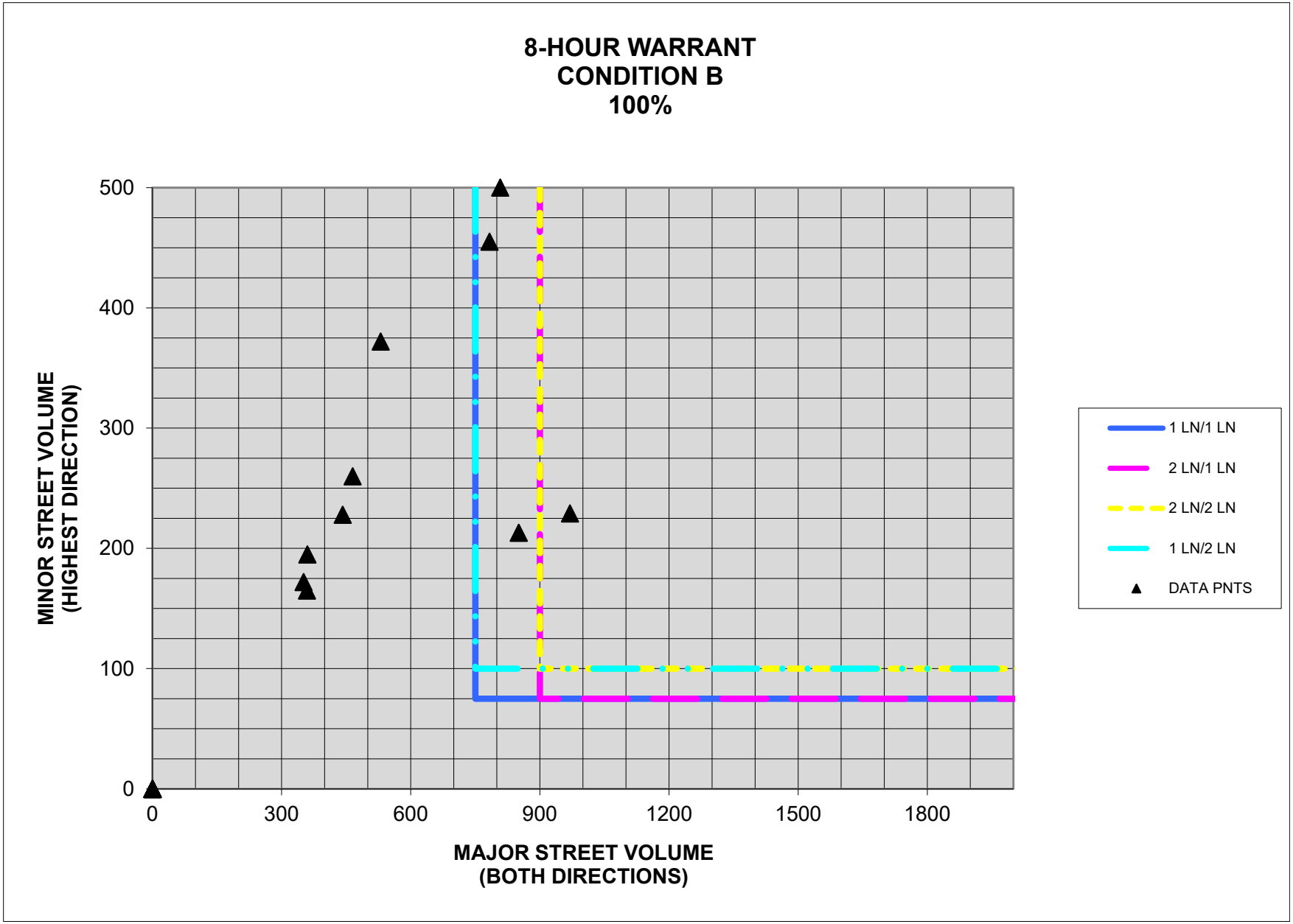
TRAFFIC SIGNAL WARRANT SUMMARY

Time Period	Major Approach: Murray Ln/ Holly Tree Gap Rd	Minor Approach: Murray Ln	WARRANT 1-A (100% Threshold): 8-hr Minimum Vehicular Volume	WARRANT 1 - B (100% Threshold): 8-hr Interruption of Continuous Traffic	WARRANT 2 (100% Threshold): 4-hr Vehicular Volume
7:00 - 8:00	970	229	Yes	Yes	Yes
8:00 - 9:00	851	213	Yes	Yes	Yes
11:00 - 12:00	351	172	No	No	No
12:00 - 13:00	359	165	No	No	No
13:00 14:00	360	195	No	No	No
14:00 15:00	442	228	No	No	No
15:00 16:00	530	372	Yes	No	Yes
16:00 17:00	783	455	Yes	Yes	Yes
17:00 - 18:00	808	538	Yes	Yes	Yes
18:00 - 19:00	465	260	No	No	No
Number of Hours Warrant is MET			5	4	5
Minimum Hours Required to Meet Warrant			8	8	4
			NO	**NO**	**YES**

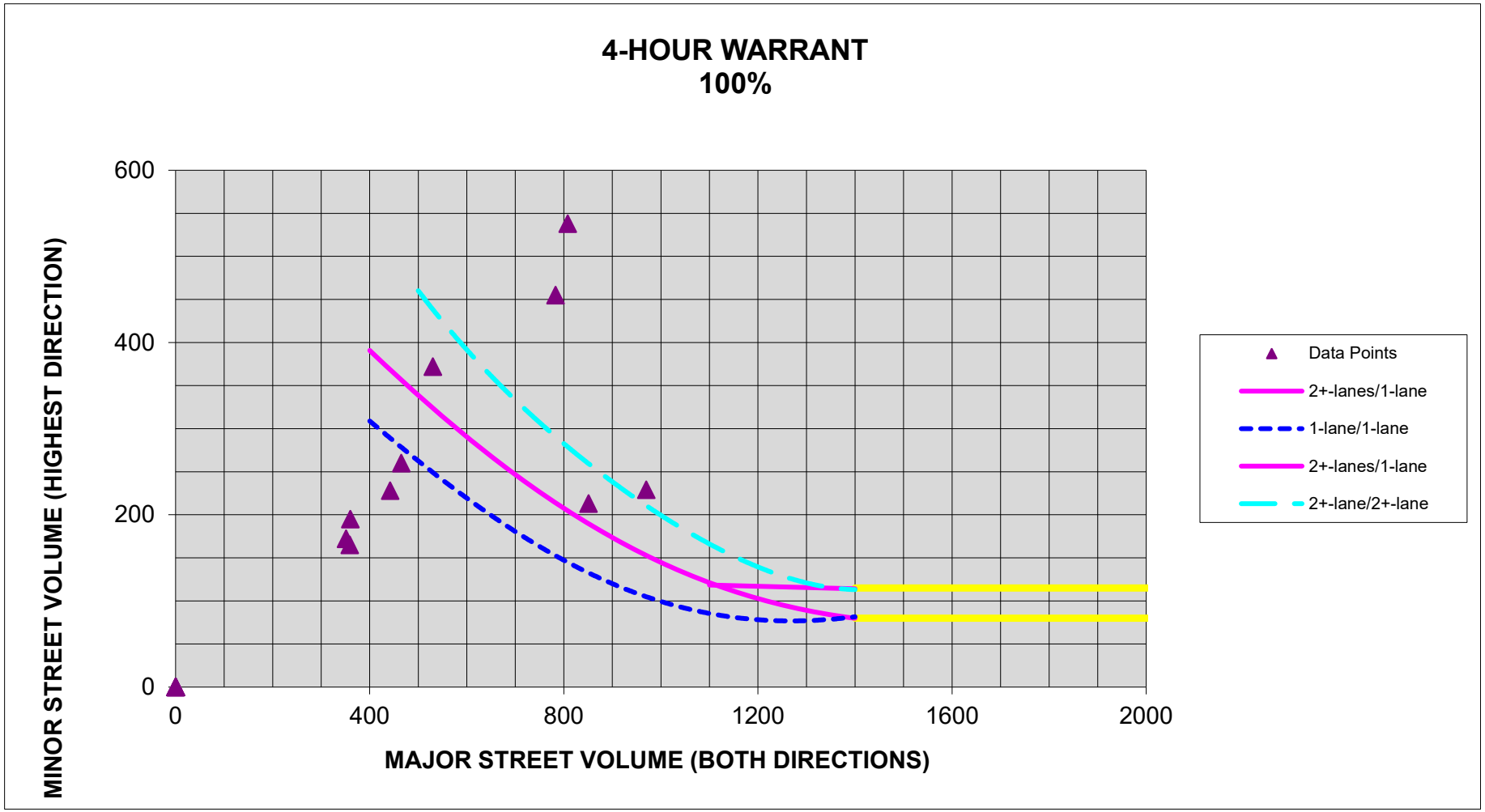
Minimum Volumes (100% Threshold)				
# of Lanes		Warrant 1A	Warrant 1B	Warrant 2
Major St	1	500	750	1300
Minor St	1	150	75	80

Murray Ln at Holly Tree Gap Rd
City of Brentwood

Murray Ln at Holly Tree Gap Rd
City of Brentwood



Murray Ln at Holly Tree Gap Rd
City of Brentwood



APPENDIX G
Highway Capacity Software & Synchro Reports

HCS7 All-Way Stop Control Report

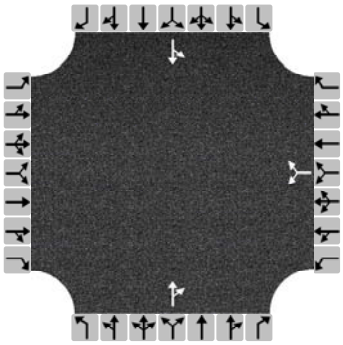
General Information

Analyst	JC
Agency/Co.	NSI
Date Performed	12/27/2019
Analysis Year	2019
Analysis Time Period (hrs)	0.25
Time Analyzed	
Project Description	Existing AM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
Jurisdiction	
East/West Street	Murray Lane
North/South Street	Holly Tree Gap Road
Peak Hour Factor	0.91

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume				76		157		267	333	223	161	
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LR			TR			LT		
Flow Rate, v (veh/h)				256			659			422		
Percent Heavy Vehicles				2			3			2		

Departure Headway and Service Time

Initial Departure Headway, hd (s)				3.20			3.20			3.20		
Initial Degree of Utilization, x				0.228			0.586			0.375		
Final Departure Headway, hd (s)				6.30			5.17			5.88		
Final Degree of Utilization, x				0.448			0.947			0.689		
Move-Up Time, m (s)				2.0			2.0			2.0		
Service Time, ts (s)				4.30			3.17			3.88		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)				256			659			422		
Capacity				572			696			612		
95% Queue Length, Q_{95} (veh)				2.3			13.6			5.4		
Control Delay (s/veh)				14.3			44.8			20.9		
Level of Service, LOS				B			E			C		
Approach Delay (s/veh)				14.3			44.8			20.9		
Approach LOS				B			E			C		
Intersection Delay, s/veh | LOS	31.4						D					

HCS7 All-Way Stop Control Report

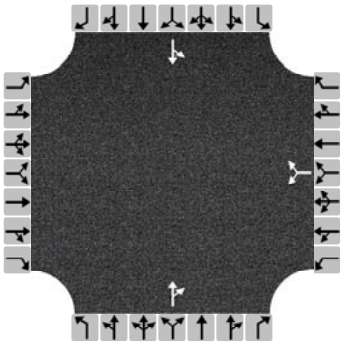
General Information

Analyst	JC
Agency/Co.	NSI
Date Performed	12/27/2019
Analysis Year	2019
Analysis Time Period (hrs)	0.25
Time Analyzed	
Project Description	Existing PM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
Jurisdiction	
East/West Street	Murray Lane
North/South Street	Holly Tree Gap Road
Peak Hour Factor	0.98

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume				327		211		272	95	211	230	
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LR			TR			LT		
Flow Rate, v (veh/h)				549			374			450		
Percent Heavy Vehicles				1			1			1		

Departure Headway and Service Time

Initial Departure Headway, hd (s)				3.20			3.20			3.20		
Initial Degree of Utilization, x				0.488			0.333			0.400		
Final Departure Headway, hd (s)				6.38			6.71			6.78		
Final Degree of Utilization, x				0.973			0.698			0.848		
Move-Up Time, m (s)				2.0			2.0			2.0		
Service Time, ts (s)				4.38			4.71			4.78		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)				549			374			450		
Capacity				564			537			531		
95% Queue Length, Q_{95} (veh)				13.4			5.5			8.9		
Control Delay (s/veh)				56.5			23.7			36.9		
Level of Service, LOS				F			C			E		
Approach Delay (s/veh)				56.5			23.7			36.9		
Approach LOS				F			C			E		
Intersection Delay, s/veh | LOS	41.1						E					

HCS7 All-Way Stop Control Report

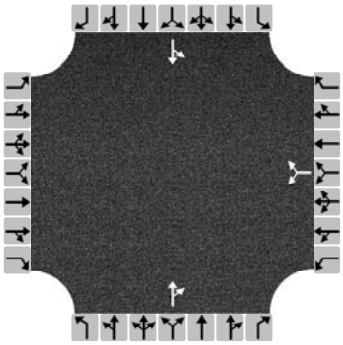
General Information

Analyst	JC
Agency/Co.	NSI
Date Performed	12/27/2019
Analysis Year	2019
Analysis Time Period (hrs)	0.25
Time Analyzed	
Project Description	Horizon Year AM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
Jurisdiction	
East/West Street	Murray Lane
North/South Street	Holly Tree Gap Road
Peak Hour Factor	0.91

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume				84		173		295	368	246	178	
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LR			TR			LT		
Flow Rate, v (veh/h)				282			729			466		
Percent Heavy Vehicles				2			3			2		

Departure Headway and Service Time

Initial Departure Headway, hd (s)				3.20			3.20			3.20		
Initial Degree of Utilization, x				0.251			0.648			0.414		
Final Departure Headway, hd (s)				6.41			5.40			6.00		
Final Degree of Utilization, x				0.503			1.094			0.777		
Move-Up Time, m (s)				2.0			2.0			2.0		
Service Time, ts (s)				4.41			3.40			4.00		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)				282			729			466		
Capacity				561			666			600		
95% Queue Length, Q_{95} (veh)				2.8			20.9			7.3		
Control Delay (s/veh)				15.7			85.2			26.8		
Level of Service, LOS				C			F			D		
Approach Delay (s/veh)				15.7			85.2			26.8		
Approach LOS				C			F			D		
Intersection Delay, s/veh | LOS	53.5						F					

HCS7 All-Way Stop Control Report

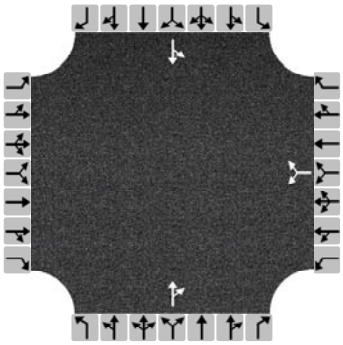
General Information

Analyst	JC
Agency/Co.	NSI
Date Performed	12/27/2019
Analysis Year	2019
Analysis Time Period (hrs)	0.25
Time Analyzed	
Project Description	Horizon Year PM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
Jurisdiction	
East/West Street	Murray Lane
North/South Street	Holly Tree Gap Road
Peak Hour Factor	0.98

Lanes



Vehicle Volume and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume				361		233		300	105	233	254	
% Thrus in Shared Lane												
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration				LR			TR			LT		
Flow Rate, v (veh/h)				606			413			497		
Percent Heavy Vehicles				1			1			1		

Departure Headway and Service Time

Initial Departure Headway, hd (s)				3.20			3.20			3.20		
Initial Degree of Utilization, x				0.539			0.367			0.442		
Final Departure Headway, hd (s)				6.63			6.77			6.83		
Final Degree of Utilization, x				1.117			0.778			0.943		
Move-Up Time, m (s)				2.0			2.0			2.0		
Service Time, ts (s)				4.63			4.77			4.83		

Capacity, Delay and Level of Service

Flow Rate, v (veh/h)				606			413			497		
Capacity				543			531			527		
95% Queue Length, Q_{95} (veh)				19.6			7.1			11.9		
Control Delay (s/veh)				99.4			29.6			52.3		
Level of Service, LOS				F			D			F		
Approach Delay (s/veh)				99.4			29.6			52.3		
Approach LOS				F			D			F		
Intersection Delay, s/veh | LOS	64.9						F					

HCS7 Roundabouts Report

General Information

Analyst	JC
Agency or Co.	NSI
Date Performed	12/27/2019
Analysis Year	2019
Time Analyzed	
Project Description	Existing AM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
E/W Street Name	Murray Lane
N/S Street Name	Holly Tree Gap Road
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.91
Jurisdiction	City of Brentwood

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				TR				LT	
Volume (V), veh/h					0	76		157	0		267	333	0	223	161	
Percent Heavy Vehicles, %					0	4		2	0		2	2	0	2	2	
Flow Rate (v_{PCE}), pc/h					0	87		176	0		299	374	0	250	180	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					263			673			430	
Entry Volume, veh/h					256			660			421	
Circulating Flow (v_c), pc/h	517			299			250			87		
Exiting Flow (v_{ex}), pc/h	624			0			475			267		
Capacity (c_{pce}), pc/h					1017			1069			1263	
Capacity (c), veh/h					992			1048			1237	
v/c Ratio (x)					0.26			0.63			0.34	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					6.2			12.2			6.1	
Lane LOS					A			B			A	
95% Queue, veh					1.0			4.6			1.5	
Approach Delay, s/veh				6.2			12.2			6.1		
Approach LOS				A			B			A		
Intersection Delay, s/veh | LOS	9.1						A					

HCS7 Roundabouts Report

General Information

Analyst	JC
Agency or Co.	NSI
Date Performed	12/27/2019
Analysis Year	2019
Time Analyzed	
Project Description	Existing PM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
E/W Street Name	Murray Lane
N/S Street Name	Holly Tree Gap Road
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.98
Jurisdiction	City of Brentwood

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				TR				LT	
Volume (V), veh/h					0	327		211	0		272	95	0	211	230	
Percent Heavy Vehicles, %					0	0		2	0		0	2	0	2	0	
Flow Rate (v_{PCE}), pc/h					0	335		219	0		279	99	0	219	236	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					554			378			455	
Entry Volume, veh/h					549			375			450	
Circulating Flow (v_c), pc/h	790			279			219			335		
Exiting Flow (v_{ex}), pc/h	318			0			498			571		
Capacity (c_{pce}), pc/h					1038			1104			981	
Capacity (c), veh/h					1029			1095			970	
v/c Ratio (x)					0.53			0.34			0.46	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					10.1			6.7			9.2	
Lane LOS					B			A			A	
95% Queue, veh					3.3			1.5			2.5	
Approach Delay, s/veh				10.1			6.7			9.2		
Approach LOS				B			A			A		
Intersection Delay, s/veh | LOS	8.9						A					

HCS7 Roundabouts Report

General Information

Analyst	JC
Agency or Co.	NSI
Date Performed	12/27/2019
Analysis Year	2029
Time Analyzed	
Project Description	Horizon Year AM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
E/W Street Name	Murray Lane
N/S Street Name	Holly Tree Gap Road
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.91
Jurisdiction	City of Brentwood

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				TR				LT	
Volume (V), veh/h					0	84		173	0		295	368	0	246	178	
Percent Heavy Vehicles, %					0	4		2	0		2	2	0	2	2	
Flow Rate (v_{PCE}), pc/h					0	96		194	0		330	413	0	276	199	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					290			743			475	
Entry Volume, veh/h					283			728			465	
Circulating Flow (v_c), pc/h	571			330			276			96		
Exiting Flow (v_{ex}), pc/h	689			0			524			295		
Capacity (c_{pce}), pc/h					986			1041			1251	
Capacity (c), veh/h					961			1021			1226	
v/c Ratio (x)					0.29			0.71			0.38	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					6.8			15.3			6.6	
Lane LOS					A			C			A	
95% Queue, veh					1.2			6.4			1.8	
Approach Delay, s/veh				6.8			15.3			6.6		
Approach LOS				A			C			A		
Intersection Delay, s/veh | LOS	11.0						B					

HCS7 Roundabouts Report

General Information

Analyst	JC
Agency or Co.	NSI
Date Performed	12/27/2019
Analysis Year	2029
Time Analyzed	
Project Description	Horizon Year PM Peak Hour

Site Information

Intersection	Murray Lane & Holly Tree
E/W Street Name	Murray Lane
N/S Street Name	Holly Tree Gap Road
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.98
Jurisdiction	City of Brentwood

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				TR				LT	
Volume (V), veh/h					0	361		233	0		300	105	0	233	254	
Percent Heavy Vehicles, %					0	0		2	0		0	2	0	2	0	
Flow Rate (v_{PCE}), pc/h					0	369		242	0		307	109	0	242	260	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)					4.9763			4.9763			4.9763	
Follow-Up Headway (s)					2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h					611			416			502	
Entry Volume, veh/h					605			413			496	
Circulating Flow (v_c), pc/h	871			307			242			369		
Exiting Flow (v_{ex}), pc/h	351			0			549			629		
Capacity (c_{pce}), pc/h					1009			1078			947	
Capacity (c), veh/h					1000			1069			937	
v/c Ratio (x)					0.61			0.39			0.53	

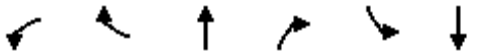
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh					12.0			7.4			10.7	
Lane LOS					B			A			B	
95% Queue, veh					4.2			1.8			3.2	
Approach Delay, s/veh				12.0			7.4			10.7		
Approach LOS				B			A			B		
Intersection Delay, s/veh | LOS	10.3						B					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	76	157	267	333	223	161
Future Volume (veh/h)	76	157	267	333	223	161
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	83	171	290	362	242	175
Adj No. of Lanes	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	279	249	570	484	534	1067
Arrive On Green	0.16	0.16	0.31	0.31	0.13	0.57
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863
Grp Volume(v), veh/h	83	171	290	362	242	175
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863
Q Serve(g_s), s	1.8	4.5	5.7	9.1	3.6	2.0
Cycle Q Clear(g_c), s	1.8	4.5	5.7	9.1	3.6	2.0
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	279	249	570	484	534	1067
V/C Ratio(X)	0.30	0.69	0.51	0.75	0.45	0.16
Avail Cap(c_a), veh/h	1357	1211	796	677	1059	1844
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	16.6	17.7	12.7	13.9	7.9	4.5
Incr Delay (d2), s/veh	0.6	3.3	0.7	2.9	0.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.9	2.2	3.0	4.3	1.8	1.0
LnGrp Delay(d),s/veh	17.1	21.0	13.4	16.8	8.5	4.6
LnGrp LOS	B	C	B	B	A	A
Approach Vol, veh/h	254		652			417
Approach Delay, s/veh	19.8		15.3			6.8
Approach LOS	B		B			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	11.9	19.6				31.5		13.0
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	19.0	19.0				44.0		34.0
Max Q Clear Time (g_c+I1), s	5.6	11.1				4.0		6.5
Green Ext Time (p_c), s	0.5	2.5				4.1		0.8

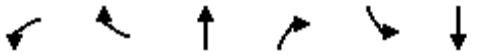
Intersection Summary	
HCM 2010 Ctrl Delay	13.5
HCM 2010 LOS	B



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	327	211	272	95	211	230
Future Volume (veh/h)	327	211	272	95	211	230
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	355	229	296	103	229	250
Adj No. of Lanes	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	438	391	569	483	510	991
Arrive On Green	0.25	0.25	0.31	0.31	0.12	0.53
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863
Grp Volume(v), veh/h	355	229	296	103	229	250
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863
Q Serve(g_s), s	10.2	6.9	7.1	2.6	4.4	3.9
Cycle Q Clear(g_c), s	10.2	6.9	7.1	2.6	4.4	3.9
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	438	391	569	483	510	991
V/C Ratio(X)	0.81	0.59	0.52	0.21	0.45	0.25
Avail Cap(c_a), veh/h	621	554	1407	1196	696	2025
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.2	18.0	15.6	14.0	10.1	6.9
Incr Delay (d2), s/veh	5.4	1.4	1.6	0.5	0.2	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.6	3.1	3.9	1.2	2.1	2.1
LnGrp Delay(d),s/veh	24.7	19.4	17.2	14.5	10.4	7.1
LnGrp LOS	C	B	B	B	B	A
Approach Vol, veh/h	584		399			479
Approach Delay, s/veh	22.6		16.5			8.7
Approach LOS	C		B			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	12.3	22.6				34.9		19.4
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	12.0	41.0				59.0		19.0
Max Q Clear Time (g_c+I1), s	6.4	9.1				5.9		12.2
Green Ext Time (p_c), s	0.2	7.4				8.2		1.2

Intersection Summary	
HCM 2010 Ctrl Delay	16.4
HCM 2010 LOS	B



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	84	173	295	368	246	178
Future Volume (veh/h)	84	173	295	368	246	178
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	91	188	321	400	267	193
Adj No. of Lanes	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	297	265	594	505	525	1085
Arrive On Green	0.17	0.17	0.32	0.32	0.14	0.58
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863
Grp Volume(v), veh/h	91	188	321	400	267	193
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863
Q Serve(g_s), s	2.2	5.4	6.8	11.1	4.3	2.3
Cycle Q Clear(g_c), s	2.2	5.4	6.8	11.1	4.3	2.3
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	297	265	594	505	525	1085
V/C Ratio(X)	0.31	0.71	0.54	0.79	0.51	0.18
Avail Cap(c_a), veh/h	1256	1121	737	626	981	1707
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	17.5	18.9	13.5	14.9	8.4	4.7
Incr Delay (d2), s/veh	0.6	3.5	0.8	5.5	0.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	2.6	3.6	5.6	2.1	1.2
LnGrp Delay(d),s/veh	18.1	22.4	14.2	20.4	9.1	4.7
LnGrp LOS	B	C	B	C	A	A
Approach Vol, veh/h	279		721			460
Approach Delay, s/veh	21.0		17.7			7.3
Approach LOS	C		B			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	12.7	21.3				34.0		14.0
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	19.0	19.0				44.0		34.0
Max Q Clear Time (g_c+I1), s	6.3	13.1				4.3		7.4
Green Ext Time (p_c), s	0.6	2.3				4.7		0.9

Intersection Summary	
HCM 2010 Ctrl Delay	15.0
HCM 2010 LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	361	233	300	105	233	254
Future Volume (veh/h)	361	233	300	105	233	254
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	392	253	326	114	253	276
Adj No. of Lanes	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	448	400	597	507	505	1014
Arrive On Green	0.25	0.25	0.32	0.32	0.12	0.54
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863
Grp Volume(v), veh/h	392	253	326	114	253	276
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863
Q Serve(g_s), s	12.5	8.4	8.5	3.1	5.1	4.7
Cycle Q Clear(g_c), s	12.5	8.4	8.5	3.1	5.1	4.7
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	448	400	597	507	505	1014
V/C Ratio(X)	0.87	0.63	0.55	0.22	0.50	0.27
Avail Cap(c_a), veh/h	481	429	1356	1153	679	1955
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	21.2	19.6	16.5	14.7	10.7	7.2
Incr Delay (d2), s/veh	15.6	2.7	1.7	0.5	0.3	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.0	4.0	4.6	1.4	2.4	2.5
LnGrp Delay(d),s/veh	36.8	22.3	18.2	15.2	11.0	7.5
LnGrp LOS	D	C	B	B	B	A
Approach Vol, veh/h	645		440			529
Approach Delay, s/veh	31.1		17.4			9.2
Approach LOS	C		B			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	13.2	24.9				38.1		20.9
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	13.0	43.0				62.0		16.0
Max Q Clear Time (g_c+I1), s	7.1	10.5				6.7		14.5
Green Ext Time (p_c), s	0.2	8.4				9.3		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	20.2
HCM 2010 LOS	C