

TRAFFIC IMPACT ASSESSMENT

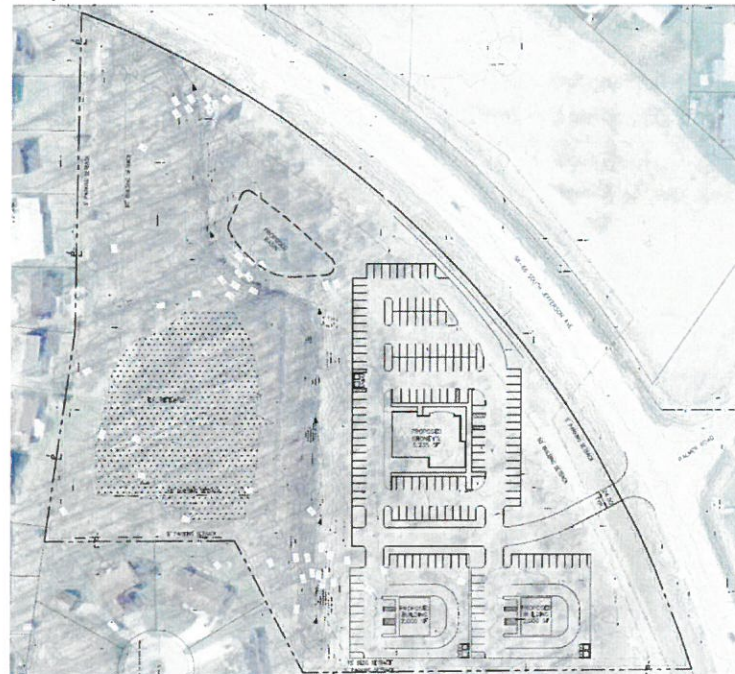
To: Melinda Warner, PE, City of Defiance
From: Steve Diebol, PE, PTOE
CC: Cory Baden, Rob Miller, Greg Schunck
Date: August 7, 2017

Project #: J1840001
Re: Traffic Impact Assessment for Development at Jefferson & Palmer Intersection

Introduction and Background

The purpose of this memo was to assess localized traffic impacts from a mixed-use development on the southwest corner of the intersection of SR66 (Jefferson Avenue) and Palmer Drive. This analysis focuses on proposed traffic generation and future intersection configurations, both temporary and permanent, compared to the background conditions without the development. Previous studies have evaluated the existing and background conditions and recommended improvements, and it is not the intent of this document to repeat those analyses.

The proposed development is anticipated to consist of three restaurants; two fast-food style and one sit-down style. Access will be provided by a new southwest leg to the intersection of SR 66 (Jefferson Avenue) and Palmer Drive. The site plan is shown on the right of this page. The Opening Year of the development is expected to be 2018, and the intersection was also evaluated for the Design Year (2038). The proposed Defiance Combined Middle School/High School building is under construction on Palmer Drive just north of the intersection and is expected to open to students on January 2018. A previous traffic study was performed for the school site and this document was the source of the background conditions traffic counts. The 2017 and 2037 "build" conditions traffic volume scenarios from the previous study were assumed to be representative of the 2018 and 2038 background conditions analyzed here.



The SR 66 (Jefferson Avenue) & Palmer Drive intersection is currently a 3 leg, one-way stop controlled intersection (southwestbound Palmer Drive has a stop sign) with a single lane in each direction at each approach. The previous school traffic study recommended signalization and added left turn lanes on all approaches. The City of Defiance instead prefers a roundabout to be installed at the intersection based on the Feasibility Study conducted in 2016 for a grant application which unfortunately did not receive a funding award. The City of Defiance has indicated they are currently considering the pursuit of construction funds for the roundabout possibly through an Ohio Public Works Commission (OPWC) grant/loan combination package, and if successful the funding could be available in July 2018 for construction. This study will evaluate the background and build traffic volumes under the existing intersection configuration; temporary signal control intended to be maintained until the roundabout can be installed; and the ultimate future roundabout configuration, and to recommend any changes to lane configurations or traffic control in order to adequately serve traffic.

Site Trips

Peak hour site trips were estimated using the 9th Edition of the Institute of Transportation Engineer's (ITE) Trip Generation Manual. Pass-by reductions were also applied for the proposed land uses following the Trip Generation Handbook guidance. The directional distribution used to assign site trips to the adjacent roads were based on the volumes approaching and departing the three other legs of the intersection. The Trip Generation and Trip Distribution summaries are shown in Tables 1.1 and 1.2, respectively. Calculations are provided in the attachments to this memo.

Table 1.1 Trip Generation Summary						
Location / Trip Type	AM Peak Hour			PM Peak Hour		
	IN	OUT	TOTAL	IN	OUT	TOTAL
Fast-Food Restaurant (1,500 sf)	42	39	81	37	34	71
Fast-Food Restaurant (2,500 sf)	69	66	135	62	57	119
Sit-Down Restaurant (6,000 sf)	43	37	80	60	51	111
Subtotal Future Driveway Trips	154	142	296	159	142	301
Less Pass-By Trips	(37)	(35)	(72)	(76)	(68)	(144)
Total Future New Trips	117	107	224	83	74	157

Table 1.2 Trip Distribution									
Direction	Location	Average Percent Distribution							
		AM Peak Hour				PM Peak Hour			
		Entering From		Exiting To		Entering From		Exiting To	
		%	Veh	%	Veh	%	Veh	%	Veh
South	SR 66	33	12	33	12	37	28	37	25
North	SR 66	39	15	39	14	41	31	41	28
East	Palmer Dr.	27	10	27	9	22	17	22	15
Total		100	37	100	35	100	76	100	68

As shown in the table above, the development is expected to generate 224 new AM peak hour trips (117 inbound, 107 outbound) and 157 new PM peak hour trips (83 inbound, 74 outbound). The projected traffic volumes for this analysis are presented in Figure 1 located in the attachments.

Capacity Analysis

The capacity SR 66 (Jefferson Avenue) and Palmer Drive intersection was evaluated for the AM and PM peak hours for Opening Year (2018) and Design Year (2038) conditions. This analysis was conducted using Synchro for unsignalized (one-way and two-way stop control) and signalized control, and using Sidra for roundabout control. It should be noted that the capacity analysis from the previous study did not include Peak Hour Factor (PHF) analysis. Although typical ODOT analysis parameters allow use of default PHFs for design conditions, for this location considering the large amount of school traffic, it is appropriate and necessary to include PHFs in the capacity analysis to assure acceptable operations. The PHFs from the 2014 intersection counts were used for all analyses. Acceptable operations are defined as Level-of-Service (LOS) D or better following the Highway Capacity Manual criteria for LOS according to average vehicular delay. Below is a description of the scenarios that were analyzed for this study:

No Build with Existing Conditions: This scenario presents the intersection capacity results for the No Build traffic volumes (2014 traffic counts plus background growth and Middle School traffic from previous study – defined as background traffic volumes from this point forward) and the existing one-way stop control with existing lane configurations at the study intersection;

Build with Existing Conditions: This scenario presents the intersection capacity results for the Build traffic volumes (background traffic volumes plus site traffic) under two-way stop control with existing lane configurations and a two-lane approach for the site driveway (West leg / eastbound approach) of the study intersection;

No Build with Temporary Signal: This scenario presents the intersection capacity results for the No Build traffic volumes (background traffic volumes) with the installation of a temporary, actuated, two-phase traffic signal and no changes to the existing lane configurations.

Build with Temporary Signal: This scenario presents the intersection capacity results for the Build traffic volumes (background traffic volumes plus site traffic) with the installation of a temporary, actuated, two-phase traffic signal and no changes to the existing lane configurations.

Build Roundabout: This scenario presents the intersection capacity results for the Build traffic volumes (background traffic volumes plus site traffic) with the installation of a roundabout and the required lane configurations for acceptable operations.

Table 1.3 presents a summary of the intersection capacity analysis for the scenarios described above. Capacity analysis output reports are provided in the attachments to this memo.

Table 1.3 Intersection Capacity Analysis Summary										
Approach	No Build w/Ex. Conditions		Build w/Ex. Conditions		No Build w/Temp Signal		Build w/Temp Signal		Build Roundabout	
	2018	2038	2018	2038	2018	2038	2018	2038	2018	2038
AM Peak Hour										
Northbound (Jefferson Ave)	A/0.0 s	A/0.0 s	A/1.2 s	A/1.2 s	A/9.5 s	B/13.3 s	B/12.5 s	B/16.6 s	A/9.2 s	A/9.2 s
Southbound (Jefferson Ave)	B/11.1 s	B/14.4 s	B/10.4 s	B/13.4 s	F/349.9 s	F/440.7 s	F/235.7 s	F/447.5 s	D/33.1 s	E/36.5 s
Eastbound (Site Drive)	NA	NA	F*	F*	NA	NA	C/26.3 s	B/19.5 s	C/16.9 s	C/18.4 s
Westbound (Palmer Drive)	F*	F*	F*	F*	F/110.1 s	F/291.5 s	F/195.9 s	F/188.7 s	C/17.0 s	C/17.5 s
Intersection Overall	F*	F*	F*	F*	F/177.5 s	F/262.6 s	F/144.2 s	F/224.7 s	C/20.8 s	C/22.4 s
PM Peak Hour										
Northbound (Jefferson Ave)	A/0.0 s	A/0.0 s	A/1.5 s	A/1.5 s	A/9.2 s	B/10.1 s	B/10.1 s	B/12.5 s	A/6.4 s	A/6.4 s
Southbound (Jefferson Ave)	A/5.0 s	A/5.5 s	A/4.4 s	A/4.9 s	C/29.8 s	E/78.9 s	B/15.4 s	C/27.6 s	B/11.7 s	B/11.9 s
Eastbound (Site Drive)	NA	NA	F/121.9 s	F/313.0 s	NA	NA	B/16.2 s	B/18.0 s	A/8.5 s	A/8.3 s
Westbound (Palmer Drive)	F/152.8 s	F/405.9 s	F/464.8 s	F*	B/15.6 s	C/31.0 s	C/29.2 s	D/47.4 s	B/12.3 s	B/12.6 s
Intersection Overall	E/42.8 s	F/105.3 s	F/123.9 s	F*	B/18.6 s	D/41.1 s	B/17.0 s	C/26.2 s	A/9.8 s	A/9.9 s

*- Delay cannot be calculated, exceeds 1,000 seconds
NA – Not Applicable

Discussion

As shown in the table above, neither the existing conditions (one or two way stop control) nor the temporary signal will adequately serve even the No Build traffic volumes. The addition of site traffic actually lessens the intersection delays because of pass-by reductions to critical movements which were already operating poorly (southbound left turn, westbound left turn). The primary cause of the failing operations is the high-demand southbound left-turn movement in the AM peak hour with a low PHF (0.56). Therefore, the temporary signal with existing lane configurations is not a viable short term solution until the roundabout can be installed. A temporary signal option with additional lanes (northbound and southbound left-turn lanes, and a westbound left turn lane) would result in adequate operations, however the expense of this installation would likely be greater than the roundabout option and it would be less safe than a roundabout and have more delay.

The Build Roundabout configuration necessary to adequately serve traffic demand consists of a single circulating lane and a single lane entry and exit on all legs except for the northbound approach, which will require a two-lane approach with a right-turn lane in the Opening Year (2018). A secondary design option would be to re-connect the existing Palmer Drive leg south

of the bend to the west to connect with northbound SR 66 (Jefferson Avenue) as a one-way (northbound only) right turn bypass lane. It should be noted that this configuration would require a stop controlled approach to Palmer Drive on the east leg of the roundabout. As shown in the table, this roundabout configuration would operate acceptably in the Opening Year (2018), although the southbound approach would be at LOS D and at some point before the Design Year (2038) this approach would slip to LOS E (increase of only 3.4 seconds of delay). Given the minor increase in delay and the lack of conflicts for the queue (there is approximately 750 feet of storage from the roundabout to Hampton Avenue to the north, and the Design Year (2038) queue length is listed in the Sidra report as being 630 feet), it appears that the roundabout configuration is an acceptable long term improvement option for the intersection.

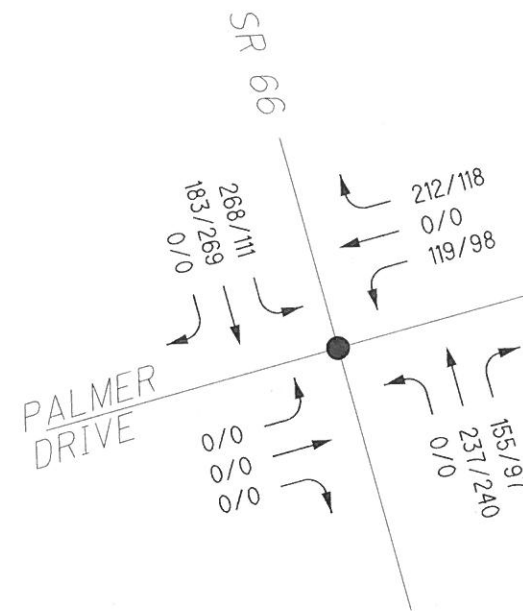
Conclusions

Upon analysis of the background conditions at the SR 66 (Jefferson Avenue) intersection with Palmer Drive considering the Peak Hour Factor, the intersection would operate at LOS F with no changes made to traffic control or lane configurations after the opening of the Defiance Combined Middle School/High School building in January 2018. The addition of site traffic from the proposed three-restaurant development would not significantly change the intersection delays or operations.

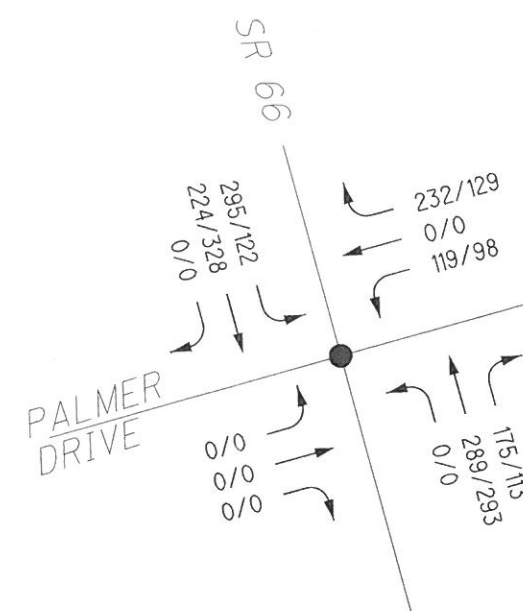
The analysis presented in this memo shows that while a temporary traffic signal without lane additions would provide an improvement to intersection operations compared to the existing conditions, it will still result in an overall LOS F with most approaches operating poorly. A single lane roundabout with single lane entries and exits except for an additional right-turn only lane on the northbound approach would provide acceptable overall operations in both the Opening Year (2018) and the Design Year (2038). It is recommended that the City seeks funding for the design and construction of the roundabout, possibly via the OPWC grant/loan program. If the OPWC funding option is not successful, there are also State Infrastructure Bank (SIB) loan programs for low interest loans/bonds as an alternative option. The poor operations of the intersection are a result of primarily the added traffic from the new school facility complex (per the results of the School Traffic Study and the Feasibility Study) and the proposed restaurants will add to the poor conditions. It is recommended that potential contributions from both the Schools and Developer be discussed with the City of Defiance to determine what is appropriate, as all parties (and the public) would benefit from the installation of a roundabout at this location that would allow traffic to function through the year 2038.

If the intersection were to be left as two-way stop control until the roundabout could be constructed, it is likely that the southbound left-turning traffic bound for the school complex would utilize other routes (Greenler Road to Cleveland Avenue to Palmer Drive) should delays become excessive and delays for the network would come to an equilibrium, though they would likely be LOS F. It is also recommended that the City closely monitor the intersection upon the opening of the Combined School facility to determine if the temporary signal or other means of traffic control (law enforcement officer directing traffic during school arrival and dismissal periods) is necessary for the short term. This may be an acceptable solution should the City desire to avoid the wasteful expenditures of a temporary traffic signal if the roundabout installation can be expedited.

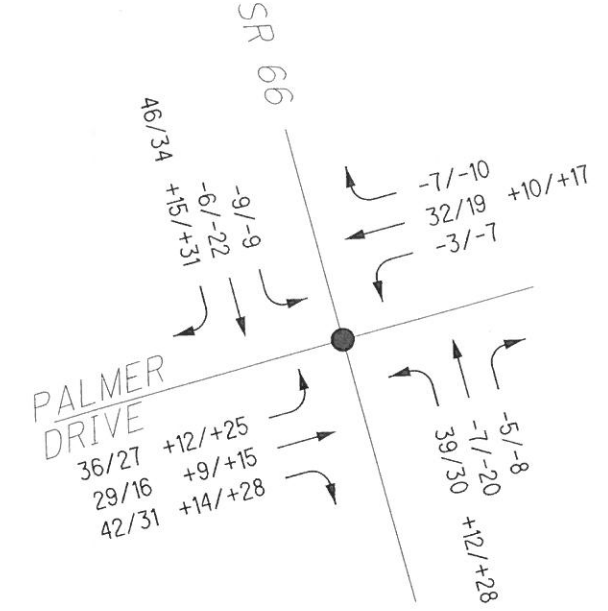
2018 NO BUILD VOLUMES



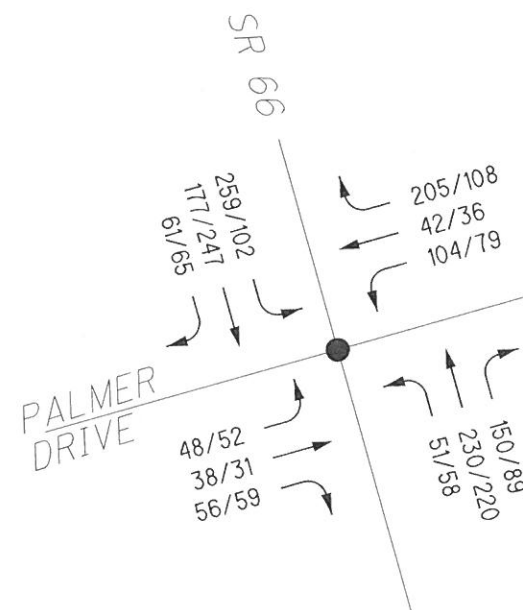
2038 NO BUILD VOLUMES



SITE TRIPS



2018 FUTURE BUILD VOLUMES



2038 FUTURE BUILD VOLUMES

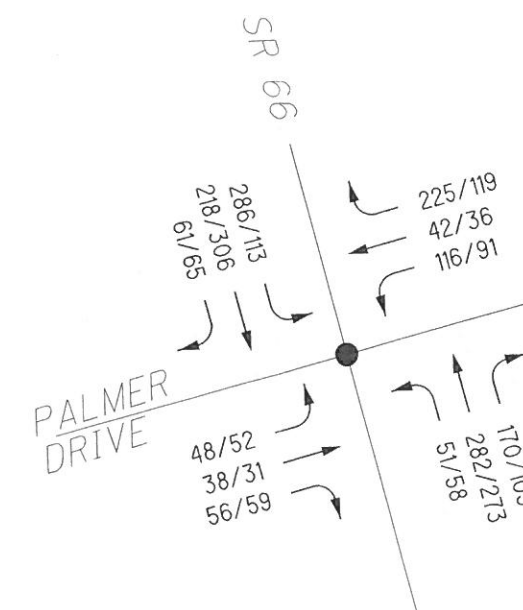


FIGURE 1
DEFIANCE DEVELOPMENT
TRAFFIC VOLUMES

LEGEND


















- 2/1 = AM/PM COUNTS
- +2/+1 = AM/PM SITE TRIPS






















1: SR 66 & Site Driveway/Palmer Dr
HCM Unsignalized Intersection Capacity Analysis

Defiance Traffic Impact Study
Stop Contolled - No Build 2018 AM

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	107	0	212	0	237	155	268	183	0
Future Volume (Veh/h)	0	0	0	107	0	212	0	237	155	268	183	0
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92
Hourly flow rate (vph)	0	0	0	167	0	312	0	289	282	479	265	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None						None					
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1965	1794	265	1653	1653	430	265	571				
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1965	1794	265	1653	1653	430	265	571				
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1	4.3				
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2	2.4				
p0 queue free %	100	100	100	0	100	48	100	49				
cM capacity (veh/h)	13	39	774	45	48	595	1299	931				
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1							
Volume Total	0	0	479	571	744							
Volume Left	0	0	167	0	479							
Volume Right	0	0	312	282	0							
cSH	1700	1700	112	1299	931							
Volume to Capacity	0.00	0.00	4.27	0.00	0.51							
Queue Length 95th (ft)	0	0	Err	0	75							
Control Delay (s)	0.0	0.0	Err	0.0	11.1							
Lane LOS	A	A	F		B							
Approach Delay (s)	0.0		Err	0.0	11.1							
Approach LOS	A		F									
Intersection Summary												
Average Delay			2674.3									
Intersection Capacity Utilization			75.4%	ICU Level of Service				D				
Analysis Period (min)			15									


















1: SR 66 & Site Driveway/Palmer Dr
HCM Unsignalized Intersection Capacity Analysis


















Defiance Traffic Impact Study
Stop Contolled - No Build 2018 PM

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	86	0	118	0	240	97	111	269	0
Future Volume (Veh/h)	0	0	0	86	0	118	0	240	97	111	269	0
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92
Hourly flow rate (vph)	0	0	0	125	0	231	0	369	110	191	302	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1339	1163	302	1108	1108	424	302			479		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1339	1163	302	1108	1108	424	302			479		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2			2.4		
p0 queue free %	100	100	100	19	100	61	100			81		
cM capacity (veh/h)	68	158	738	154	170	599	1259			1010		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1							
Volume Total	0	0	356	479	493							
Volume Left	0	0	125	0	191							
Volume Right	0	0	231	110	0							
cSH	1700	1700	298	1259	1010							
Volume to Capacity	0.00	0.00	1.20	0.00	0.19							
Queue Length 95th (ft)	0	0	394	0	17							
Control Delay (s)	0.0	0.0	152.8	0.0	5.0							
Lane LOS	A	A	F		A							
Approach Delay (s)	0.0		152.8	0.0	5.0							
Approach LOS	A		F									
Intersection Summary												
Average Delay			42.8									
Intersection Capacity Utilization			60.8%		ICU Level of Service			B				
Analysis Period (min)			15									

1: SR 66 & Site Driveway/Palmer Dr
HCM Unsignalized Intersection Capacity Analysis


















Defiance Traffic Impact Study
Stop Contolled - No Build 2038 AM


















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	119	0	232	0	289	175	295	224	0
Future Volume (Veh/h)	0	0	0	119	0	232	0	289	175	295	224	0
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92
Hourly flow rate (vph)	0	0	0	186	0	341	0	352	318	527	325	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None						None					
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2231	2049	325	1890	1890	511	325	670				
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2231	2049	325	1890	1890	511	325	670				
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1	4.3				
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2	2.4				
p0 queue free %	100	100	100	0	100	36	100	38				
cM capacity (veh/h)	6	21	716	26	27	534	1235	853				
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1							
Volume Total	0	0	527	670	852							
Volume Left	0	0	186	0	527							
Volume Right	0	0	341	318	0							
cSH	1700	1700	67	1235	853							
Volume to Capacity	0.00	0.00	7.86	0.00	0.62							
Queue Length 95th (ft)	0	0	Err	0	109							
Control Delay (s)	0.0	0.0	Err	0.0	14.4							
Lane LOS	A	A	F		B							
Approach Delay (s)	0.0		Err	0.0	14.4							
Approach LOS	A		F									
Intersection Summary												
Average Delay	2577.7											
Intersection Capacity Utilization	84.9%			ICU Level of Service			E					
Analysis Period (min)	15											


















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	98	0	129	0	293	113	122	328	0
Future Volume (Veh/h)	0	0	0	98	0	129	0	293	113	122	328	0
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92
Hourly flow rate (vph)	0	0	0	142	0	253	0	451	128	210	369	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None						None					
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1557	1368	369	1304	1304	515	369			579		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1557	1368	369	1304	1304	515	369			579		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2			2.4		
p0 queue free %	100	100	100	0	100	52	100			77		
cM capacity (veh/h)	40	113	677	109	124	531	1190			925		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1							
Volume Total	0	0	395	579	579							
Volume Left	0	0	142	0	210							
Volume Right	0	0	253	128	0							
cSH	1700	1700	222	1190	925							
Volume to Capacity	0.00	0.00	1.78	0.00	0.23							
Queue Length 95th (ft)	0	0	677	0	22							
Control Delay (s)	0.0	0.0	405.9	0.0	5.5							
Lane LOS	A	A	F		A							
Approach Delay (s)	0.0		405.9	0.0	5.5							
Approach LOS	A		F									
Intersection Summary												
Average Delay			105.3									
Intersection Capacity Utilization			69.7%	ICU Level of Service				C				
Analysis Period (min)			15									

1: SR 66 & Site Driveway/Palmer Dr
HCM Unsignalized Intersection Capacity Analysis

Defiance Traffic Impact Study
Stop Contolled - Build 2018 AM

																				
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR								
Lane Configurations																				
Traffic Volume (veh/h)	48	38	56	104	42	205	51	230	150	259	177	61								
Future Volume (Veh/h)	48	38	56	104	42	205	51	230	150	259	177	61								
Sign Control	Stop			Stop			Free			Free										
Grade	0%			0%			0%			0%										
Peak Hour Factor	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92								
Hourly flow rate (vph)	52	41	61	163	46	301	55	280	273	463	257	66								
Pedestrians																				
Lane Width (ft)																				
Walking Speed (ft/s)																				
Percent Blockage																				
Right turn flare (veh)																				
Median type	None						None													
Median storage (veh)																				
Upstream signal (ft)																				
pX, platoon unblocked																				
vC, conflicting volume	2066	1879	290	1824	1776	416	323	553												
vC1, stage 1 conf vol																				
vC2, stage 2 conf vol																				
vCu, unblocked vol	2066	1879	290	1824	1776	416	323	553												
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1	4.3												
tC, 2 stage (s)																				
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2	2.4												
p0 queue free %	0	0	92	0	0	50	96	51												
cM capacity (veh/h)	0	35	749	0	40	605	1237	946												
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1															
Volume Total	52	102	510	608	786															
Volume Left	52	0	163	55	463															
Volume Right	0	61	301	273	66															
cSH	0	81	0	1237	946															
Volume to Capacity	Err	1.26	Err	0.04	0.49															
Queue Length 95th (ft)	Err	191	Err	3	69															
Control Delay (s)	Err	277.4	Err	1.2	10.4															
Lane LOS	F	F	F	A	B															
Approach Delay (s)	Err			Err	1.2	10.4														
Approach LOS	F			F																
Intersection Summary																				
Average Delay				Err																
Intersection Capacity Utilization				88.7%	ICU Level of Service				E											
Analysis Period (min)				15																

																	
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					
Lane Configurations																	
Traffic Volume (veh/h)	52	31	59	79	36	108	58	220	89	102	247	65					
Future Volume (Veh/h)	52	31	59	79	36	108	58	220	89	102	247	65					
Sign Control	Stop			Stop			Free			Free							
Grade	0%			0%			0%			0%							
Peak Hour Factor	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92					
Hourly flow rate (vph)	57	34	64	114	39	212	63	338	101	176	278	71					
Pedestrians																	
Lane Width (ft)																	
Walking Speed (ft/s)																	
Percent Blockage																	
Right turn flare (veh)																	
Median type	None						None										
Median storage (veh)																	
Upstream signal (ft)																	
pX, platoon unblocked																	
vC, conflicting volume	1412	1230	314	1261	1216	388	349	439									
vC1, stage 1 conf vol																	
vC2, stage 2 conf vol																	
vCu, unblocked vol	1412	1230	314	1261	1216	388	349	439									
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1	4.3									
tC, 2 stage (s)																	
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2	2.4									
p0 queue free %	0	76	91	0	73	66	95	83									
cM capacity (veh/h)	51	140	727	88	143	628	1210	1046									
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1												
Volume Total	57	98	365	502	525												
Volume Left	57	0	114	63	176												
Volume Right	0	64	212	101	71												
cSH	51	296	192	1210	1046												
Volume to Capacity	1.12	0.33	1.90	0.05	0.17												
Queue Length 95th (ft)	125	35	668	4	15												
Control Delay (s)	291.7	23.1	464.8	1.5	4.4												
Lane LOS	F	C	F	A	A												
Approach Delay (s)	121.9			464.8	1.5	4.4											
Approach LOS	F	F															
Intersection Summary																	
Average Delay			123.9														
Intersection Capacity Utilization			62.2%	ICU Level of Service				B									
Analysis Period (min)			15														


















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	48	38	56	116	42	225	51	282	170	286	218	61
Future Volume (Veh/h)	48	38	56	116	42	225	51	282	170	286	218	61
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92
Hourly flow rate (vph)	52	41	61	181	46	331	55	344	309	511	316	66
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type							None				None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2334	2134	349	2061	2012	498	382			653		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2334	2134	349	2061	2012	498	382			653		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2			2.4		
p0 queue free %	0	0	91	0	0	39	95			41		
cM capacity (veh/h)	0	19	694	0	23	543	1176			866		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1							
Volume Total	52	102	558	708	893							
Volume Left	52	0	181	55	511							
Volume Right	0	61	331	309	66							
cSH	0	46	0	1176	866							
Volume to Capacity	Err	2.22	Err	0.05	0.59							
Queue Length 95th (ft)	Err	265	Err	4	99							
Control Delay (s)	Err	747.3	Err	1.2	13.4							
Lane LOS	F	F	F	A	B							
Approach Delay (s)	Err		Err	1.2	13.4							
Approach LOS	F		F									
Intersection Summary												
Average Delay			Err									
Intersection Capacity Utilization			98.2%		ICU Level of Service					F		
Analysis Period (min)			15									

1: SR 66 & Site Driveway/Palmer Dr

HCM Unsignalized Intersection Capacity Analysis


















Defiance Traffic Impact Study

Stop Contolled - Build 2038 PM

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	52	31	59	91	36	119	58	273	105	113	306	65
Future Volume (Veh/h)	52	31	59	91	36	119	58	273	105	113	306	65
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92
Hourly flow rate (vph)	57	34	64	132	39	233	63	420	119	195	344	71
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None						None					
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1628	1434	380	1456	1410	480	415	539				
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1628	1434	380	1456	1410	480	415	539				
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.4	4.1	4.3				
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.5	2.2	2.4				
p0 queue free %	0	66	90	0	63	58	94	80				
cM capacity (veh/h)	28	101	667	57	104	557	1144	958				
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1							
Volume Total	57	98	404	602	610							
Volume Left	57	0	132	63	195							
Volume Right	0	64	233	119	71							
cSH	28	226	129	1144	958							
Volume to Capacity	2.06	0.43	3.13	0.06	0.20							
Queue Length 95th (ft)	170	51	Err	4	19							
Control Delay (s)	795.1	32.6	Err	1.5	4.9							
Lane LOS	F	D	F	A	A							
Approach Delay (s)	313.0			Err	1.5	4.9						
Approach LOS	F	F										
Intersection Summary												
Average Delay	2310.5											
Intersection Capacity Utilization	71.4%			ICU Level of Service				C				
Analysis Period (min)	15											


















1: SR 66 & Site Driveway/Palmer Dr
HCM Signalized Intersection Capacity Analysis


















Defiance Traffic Impact Study
Signalized - No Build 2018 AM


















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	107	0	212	0	237	155	268	183	0
Future Volume (vph)	0	0	0	107	0	212	0	237	155	268	183	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			4.5			4.5	
Lane Util. Factor					1.00			1.00			1.00	
Frt					0.91			0.93			1.00	
Flt Protected					0.98			1.00			0.97	
Satd. Flow (prot)					1487			1650			1628	
Flt Permitted					0.88			1.00			0.42	
Satd. Flow (perm)					1337			1650			703	
Peak-hour factor, PHF	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92
Adj. Flow (vph)	0	0	0	167	0	312	0	289	282	479	265	0
RTOR Reduction (vph)	0	0	0	0	96	0	0	50	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	383	0	0	521	0	0	744	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm			Perm	NA			NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)					18.0			43.0			43.0	
Effective Green, g (s)					18.0			43.0			43.0	
Actuated g/C Ratio					0.26			0.61			0.61	
Clearance Time (s)					4.5			4.5			4.5	
Vehicle Extension (s)					3.0			3.0			3.0	
Lane Grp Cap (vph)					343			1013			431	
v/s Ratio Prot								0.32				
v/s Ratio Perm					c0.29						c1.06	
v/c Ratio					1.12			0.51			1.73	
Uniform Delay, d1					26.0			7.6			13.5	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					84.1			1.9			336.4	
Delay (s)					110.1			9.5			349.9	
Level of Service					F			A			F	
Approach Delay (s)		0.0			110.1			9.5			349.9	
Approach LOS		A			F			A			F	
Intersection Summary												
HCM 2000 Control Delay		177.5				HCM 2000 Level of Service		F				
HCM 2000 Volume to Capacity ratio		1.54										
Actuated Cycle Length (s)		70.0				Sum of lost time (s)		9.0				
Intersection Capacity Utilization		76.6%				ICU Level of Service		D				
Analysis Period (min)		15										
c Critical Lane Group												


















1: SR 66 & Site Driveway/Palmer Dr
HCM Signalized Intersection Capacity Analysis


















Defiance Traffic Impact Study
Signalized - No Build 2018 PM


















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	86	0	118	0	240	97	111	269	0
Future Volume (vph)	0	0	0	86	0	118	0	240	97	111	269	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			4.5			4.5	
Lane Util. Factor					1.00			1.00			1.00	
Frt					0.91			0.97			1.00	
Flt Protected					0.98			1.00			0.98	
Satd. Flow (prot)					1487			1708			1690	
Flt Permitted					0.88			1.00			0.61	
Satd. Flow (perm)					1337			1708			1055	
Peak-hour factor, PHF	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92
Adj. Flow (vph)	0	0	0	125	0	231	0	369	110	191	302	0
RTOR Reduction (vph)	0	0	0	0	150	0	0	19	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	206	0	0	460	0	0	493	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm			Perm	NA			NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)					12.6			23.5			23.5	
Effective Green, g (s)					12.6			23.5			23.5	
Actuated g/C Ratio					0.28			0.52			0.52	
Clearance Time (s)					4.5			4.5			4.5	
Vehicle Extension (s)					3.0			3.0			3.0	
Lane Grp Cap (vph)					373			889			549	
v/s Ratio Prot								0.27				
v/s Ratio Perm					c0.15						c0.47	
v/c Ratio					0.55			0.52			0.90	
Uniform Delay, d1					13.8			7.1			9.7	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					1.8			2.1			20.1	
Delay (s)					15.6			9.2			29.8	
Level of Service					B			A			C	
Approach Delay (s)		0.0			15.6			9.2			29.8	
Approach LOS		A			B			A			C	
Intersection Summary												
HCM 2000 Control Delay			18.6			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			45.1			Sum of lost time (s)				9.0		
Intersection Capacity Utilization			62.1%			ICU Level of Service				B		
Analysis Period (min)			15									
c Critical Lane Group												


















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	119	0	232	0	289	175	295	224	0
Future Volume (vph)	0	0	0	119	0	232	0	289	175	295	224	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			4.5			4.5	
Lane Util. Factor					1.00			1.00			1.00	
Frt					0.91			0.94			1.00	
Flt Protected					0.98			1.00			0.97	
Satd. Flow (prot)					1488			1654			1634	
Flt Permitted					0.88			1.00			0.38	
Satd. Flow (perm)					1336			1654			641	
Peak-hour factor, PHF	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92
Adj. Flow (vph)	0	0	0	186	0	341	0	352	318	527	325	0
RTOR Reduction (vph)	0	0	0	0	44	0	0	22	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	483	0	0	648	0	0	852	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm			Perm	NA			NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)					36.5			104.5			104.5	
Effective Green, g (s)					36.5			104.5			104.5	
Actuated g/C Ratio					0.24			0.70			0.70	
Clearance Time (s)					4.5			4.5			4.5	
Vehicle Extension (s)					3.0			3.0			3.0	
Lane Grp Cap (vph)					325			1152			446	
v/s Ratio Prot								0.39				
v/s Ratio Perm					c0.36						c1.33	
v/c Ratio					1.49			0.56			1.91	
Uniform Delay, d1					56.8			11.4			22.8	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					234.7			2.0			417.9	
Delay (s)					291.5			13.3			440.7	
Level of Service					F			B			F	
Approach Delay (s)		0.0			291.5			13.3			440.7	
Approach LOS		A			F			B			F	
Intersection Summary												
HCM 2000 Control Delay		262.6			HCM 2000 Level of Service					F		
HCM 2000 Volume to Capacity ratio		1.80										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)					9.0		
Intersection Capacity Utilization		86.1%			ICU Level of Service					E		
Analysis Period (min)		15										
c Critical Lane Group												

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	98	0	129	0	293	113	122	328	0
Future Volume (vph)	0	0	0	98	0	129	0	293	113	122	328	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			4.5			4.5	
Lane Util. Factor					1.00			1.00			1.00	
Frt					0.91			0.97			1.00	
Flt Protected					0.98			1.00			0.98	
Satd. Flow (prot)					1489			1710			1697	
Flt Permitted					0.88			1.00			0.53	
Satd. Flow (perm)					1335			1710			922	
Peak-hour factor, PHF	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92
Adj. Flow (vph)	0	0	0	142	0	253	0	451	128	210	369	0
RTOR Reduction (vph)	0	0	0	0	112	0	0	16	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	283	0	0	563	0	0	579	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm			Perm	NA			NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)					15.4			33.1			33.1	
Effective Green, g (s)					15.4			33.1			33.1	
Actuated g/C Ratio					0.27			0.58			0.58	
Clearance Time (s)					4.5			4.5			4.5	
Vehicle Extension (s)					3.0			3.0			3.0	
Lane Grp Cap (vph)					357			984			530	
v/s Ratio Prot								0.33				
v/s Ratio Perm					c0.21						c0.63	
v/c Ratio					0.79			0.57			1.09	
Uniform Delay, d1					19.6			7.7			12.2	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					11.4			2.4			66.7	
Delay (s)					31.0			10.1			78.9	
Level of Service					C			B			E	
Approach Delay (s)		0.0			31.0			10.1			78.9	
Approach LOS		A			C			B			E	
Intersection Summary												
HCM 2000 Control Delay			41.1		HCM 2000 Level of Service				D			
HCM 2000 Volume to Capacity ratio			1.00									
Actuated Cycle Length (s)			57.5		Sum of lost time (s)				9.0			
Intersection Capacity Utilization			70.9%		ICU Level of Service				C			
Analysis Period (min)			15									
c Critical Lane Group												

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	38	56	104	42	205	51	230	150	259	177	61
Future Volume (vph)	48	38	56	104	42	205	51	230	150	259	177	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5			4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.91			0.92			0.94			0.99	
Flt Protected	0.95	1.00			0.98			1.00			0.97	
Satd. Flow (prot)	1770	1696			1518			1660			1627	
Flt Permitted	0.35	1.00			0.85			0.89			0.50	
Satd. Flow (perm)	643	1696			1317			1479			837	
Peak-hour factor, PHF	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92
Adj. Flow (vph)	52	41	61	162	46	301	55	280	273	462	257	66
RTOR Reduction (vph)	0	45	0	0	58	0	0	33	0	0	4	0
Lane Group Flow (vph)	52	57	0	0	452	0	0	576	0	0	782	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	23.5	23.5			23.5			57.5			57.5	
Effective Green, g (s)	23.5	23.5			23.5			57.5			57.5	
Actuated g/C Ratio	0.26	0.26			0.26			0.64			0.64	
Clearance Time (s)	4.5	4.5			4.5			4.5			4.5	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	167	442			343			944			534	
v/s Ratio Prot		0.03										
v/s Ratio Perm	0.08				c0.34			0.39			c0.93	
v/c Ratio	0.31	0.13			1.32			0.61			1.47	
Uniform Delay, d1	26.7	25.4			33.2			9.6			16.2	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	1.1	0.1			162.6			2.9			219.4	
Delay (s)	27.8	25.6			195.9			12.5			235.7	
Level of Service	C	C			F			B			F	
Approach Delay (s)		26.3			195.9			12.5			235.7	
Approach LOS		C			F			B			F	
Intersection Summary												
HCM 2000 Control Delay			144.2			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.42									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			9.0			
Intersection Capacity Utilization			89.9%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	31	59	79	36	108	58	220	89	102	247	65
Future Volume (vph)	52	31	59	79	36	108	58	220	89	102	247	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5			4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.90			0.92			0.97			0.98	
Flt Protected	0.95	1.00			0.98			0.99			0.98	
Satd. Flow (prot)	1770	1680			1523			1716			1681	
Flt Permitted	0.45	1.00			0.86			0.90			0.73	
Satd. Flow (perm)	839	1680			1328			1547			1242	
Peak-hour factor, PHF	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92
Adj. Flow (vph)	57	34	64	114	39	212	63	338	101	176	278	71
RTOR Reduction (vph)	0	47	0	0	88	0	0	14	0	0	9	0
Lane Group Flow (vph)	57	51	0	0	277	0	0	488	0	0	516	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	15.4	15.4			15.4			32.6			32.6	
Effective Green, g (s)	15.4	15.4			15.4			32.6			32.6	
Actuated g/C Ratio	0.27	0.27			0.27			0.57			0.57	
Clearance Time (s)	4.5	4.5			4.5			4.5			4.5	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	226	453			358			884			710	
v/s Ratio Prot		0.03										
v/s Ratio Perm	0.07				c0.21			0.32			c0.42	
v/c Ratio	0.25	0.11			0.77			0.55			0.73	
Uniform Delay, d1	16.3	15.7			19.2			7.6			8.9	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	0.6	0.1			10.0			2.5			6.4	
Delay (s)	16.9	15.8			29.2			10.1			15.4	
Level of Service	B	B			C			B			B	
Approach Delay (s)		16.2			29.2			10.1			15.4	
Approach LOS		B			C			B			B	
Intersection Summary												
HCM 2000 Control Delay			17.0			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			57.0			Sum of lost time (s)				9.0		
Intersection Capacity Utilization			63.0%			ICU Level of Service				B		
Analysis Period (min)			15									
c Critical Lane Group												

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	38	56	116	42	225	51	282	170	286	218	61
Future Volume (vph)	48	38	56	116	42	225	51	282	170	286	218	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5			4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.91			0.92			0.94			0.99	
Flt Protected	0.95	1.00			0.98			1.00			0.97	
Satd. Flow (prot)	1770	1696			1515			1663			1633	
Flt Permitted	0.35	1.00			0.85			0.89			0.46	
Satd. Flow (perm)	655	1696			1313			1488			772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.64	0.92	0.68	0.92	0.82	0.55	0.56	0.69	0.92
Adj. Flow (vph)	52	41	61	181	46	331	55	344	309	511	316	66
RTOR Reduction (vph)	0	44	0	0	75	0	0	40	0	0	4	0
Lane Group Flow (vph)	52	58	0	0	483	0	0	668	0	0	889	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	19.5	19.5			19.5			41.5			41.5	
Effective Green, g (s)	19.5	19.5			19.5			41.5			41.5	
Actuated g/C Ratio	0.28	0.28			0.28			0.59			0.59	
Clearance Time (s)	4.5	4.5			4.5			4.5			4.5	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	182	472			365			882			457	
v/s Ratio Prot		0.03										
v/s Ratio Perm	0.08				c0.37			0.45			c1.15	
v/c Ratio	0.29	0.12			1.32			0.76			1.95	
Uniform Delay, d1	19.8	18.9			25.2			10.5			14.2	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	0.9	0.1			163.4			6.0			433.3	
Delay (s)	20.7	19.0			188.7			16.6			447.5	
Level of Service	C	B			F			B			F	
Approach Delay (s)		19.5			188.7			16.6			447.5	
Approach LOS		B			F			B			F	
Intersection Summary												
HCM 2000 Control Delay		224.7			HCM 2000 Level of Service			F				
HCM 2000 Volume to Capacity ratio		1.74										
Actuated Cycle Length (s)		70.0			Sum of lost time (s)			9.0				
Intersection Capacity Utilization		99.4%			ICU Level of Service			F				
Analysis Period (min)		15										
c Critical Lane Group												

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	31	59	91	36	119	58	273	105	113	306	65
Future Volume (vph)	52	31	59	91	36	119	58	273	105	113	306	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5			4.5			4.5	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frt	1.00	0.90			0.92			0.97			0.98	
Flt Protected	0.95	1.00			0.98			0.99			0.98	
Satd. Flow (prot)	1770	1680			1522			1717			1688	
Flt Permitted	0.42	1.00			0.85			0.90			0.68	
Satd. Flow (perm)	787	1680			1320			1550			1159	
Peak-hour factor, PHF	0.92	0.92	0.92	0.69	0.92	0.51	0.92	0.65	0.88	0.58	0.89	0.92
Adj. Flow (vph)	57	34	64	132	39	233	63	420	119	195	344	71
RTOR Reduction (vph)	0	46	0	0	76	0	0	13	0	0	7	0
Lane Group Flow (vph)	57	52	0	0	328	0	0	589	0	0	603	0
Heavy Vehicles (%)	2%	2%	2%	10%	2%	17%	2%	8%	7%	17%	6%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	17.6	17.6			17.6			37.5			37.5	
Effective Green, g (s)	17.6	17.6			17.6			37.5			37.5	
Actuated g/C Ratio	0.27	0.27			0.27			0.59			0.59	
Clearance Time (s)	4.5	4.5			4.5			4.5			4.5	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	216	461			362			906			678	
v/s Ratio Prot		0.03										
v/s Ratio Perm	0.07				c0.25			0.38			c0.52	
v/c Ratio	0.26	0.11			0.91			0.65			0.89	
Uniform Delay, d1	18.2	17.4			22.4			8.9			11.5	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	0.7	0.1			25.2			3.6			16.1	
Delay (s)	18.8	17.5			47.6			12.5			27.6	
Level of Service	B	B			D			B			C	
Approach Delay (s)		18.0			47.6			12.5			27.6	
Approach LOS		B			D			B			C	
Intersection Summary												
HCM 2000 Control Delay			26.2			HCM 2000 Level of Service					C	
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			64.1			Sum of lost time (s)				9.0		
Intersection Capacity Utilization			72.2%			ICU Level of Service				C		
Analysis Period (min)			15									
c Critical Lane Group												

LANE SUMMARY

Site: 101 [2018 AM Build]

SR 66/Palmer Roundabout
Roundabout

Lane Use and Performance													
	Demand Flows			Deg.	Lane	Average	Level of	95% Back of Queue		Lane	Lane	Cap.	Prob.
	Total	HV	Cap.	Satn	Util.	Delay	Service	Veh	Dist	Config	Length	Adj.	Block.
	veh/h	%	veh/h	v/c	%	sec			ft		ft	%	%
South: SR 66													
Lane 1 ^d	336	2.0	792	0.424	100	10.0	LOS A	3.2	80.4	Full	1600	0.0	0.0
Lane 2	273	2.0	827	0.330	100	8.1	LOS A	2.4	59.7	Full	1600	0.0	0.0
Approach	609	2.0		0.424		9.2	LOS A	3.2	80.4				
East: Palmer Dr													
Lane 1 ^d	510	2.0	763	0.668	100	17.0	LOS C	7.1	181.2	Full	1600	0.0	0.0
Approach	510	2.0		0.668		17.0	LOS C	7.1	181.2				
North: SR 66													
Lane 1 ^d	785	2.0	871	0.902	100	33.1	LOS D	20.2	512.3	Full	1600	0.0	0.0
Approach	785	2.0		0.902		33.1	LOS D	20.2	512.3				
West: Site Driveway													
Lane 1 ^d	154	2.0	393	0.392	100	16.9	LOS C	2.8	70.2	Full	1600	0.0	0.0
Approach	154	2.0		0.392		16.9	LOS C	2.8	70.2				
Intersection	2058	2.0		0.902		20.8	LOS C	20.2	512.3				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [2018 PM Build]

SR 66/Palmer Roundabout
Roundabout

Lane Use and Performance													
	Demand Flows			Deg.	Lane	Average	Level of	95% Back of Queue		Lane	Lane	Cap.	Prob.
	Total	HV	Cap.	Satn	Util.	Delay	Service	Veh	Dist	Config	Length	Adj.	Block.
	veh/h	%	veh/h	v/c	%	sec			ft		ft	%	%
South: SR 66													
Lane 1 ^d	402	2.0	1089	0.369	100	7.1	LOS A	2.5	63.2	Full	1600	0.0	0.0
Lane 2	101	2.0	1135	0.089	100	3.9	LOS A	0.5	12.5	Full	1600	0.0	0.0
Approach	503	2.0		0.369		6.4	LOS A	2.5	63.2				
East: Palmer Dr													
Lane 1 ^d	365	2.0	730	0.501	100	12.3	LOS B	3.8	96.8	Full	1600	0.0	0.0
Approach	365	2.0		0.501		12.3	LOS B	3.8	96.8				
North: SR 66													
Lane 1 ^d	524	2.0	923	0.568	100	11.7	LOS B	4.7	118.7	Full	1600	0.0	0.0
Approach	524	2.0		0.568		11.7	LOS B	4.7	118.7				
West: Site Driveway													
Lane 1 ^d	154	2.0	646	0.239	100	8.5	LOS A	1.4	35.8	Full	1600	0.0	0.0
Approach	154	2.0		0.239		8.5	LOS A	1.4	35.8				
Intersection	1546	2.0		0.568		9.8	LOS A	4.7	118.7				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [2038 AM Build]

SR 66/Palmer Roundabout
Roundabout

Lane Use and Performance													
	Demand Flows			Deg.	Lane	Average	Level of	95% Back of Queue		Lane	Lane	Cap.	Prob.
	Total	HV	Cap.	Satn	Util.	Delay	Service	Veh	Dist	Config	Length	Adj.	Block.
	veh/h	%	veh/h	v/c	%	sec			ft		ft	%	%
South: SR 66													
Lane 1 ^d	399	2.0	851	0.469	100	10.3	LOS B	4.0	100.7	Full	1600	0.0	0.0
Lane 2	309	2.0	888	0.348	100	7.9	LOS A	2.7	67.5	Full	1600	0.0	0.0
Approach	708	2.0		0.469		9.2	LOS A	4.0	100.7				
East: Palmer Dr													
Lane 1 ^d	558	2.0	802	0.695	100	17.5	LOS C	8.1	204.7	Full	1600	0.0	0.0
Approach	558	2.0		0.695		17.5	LOS C	8.1	204.7				
North: SR 66													
Lane 1 ^d	893	2.0	954	0.936	100	36.5	LOS E	24.8	630.8	Full	1600	0.0	0.0
Approach	893	2.0		0.936		36.5	LOS E	24.8	630.8				
West: Site Driveway													
Lane 1 ^d	154	2.0	373	0.414	100	18.4	LOS C	3.2	81.2	Full	1600	0.0	0.0
Approach	154	2.0		0.414		18.4	LOS C	3.2	81.2				
Intersection	2314	2.0		0.936		22.4	LOS C	24.8	630.8				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [2038 PM Build]

SR 66/Palmer Roundabout
Roundabout

Lane Use and Performance													
	Demand Flows			Deg.	Lane	Average	Level of	95% Back of Queue		Lane	Lane	Cap.	Prob.
	Total	HV	Cap.	Satn	Util.	Delay	Service	Veh	Dist	Config	Length	Adj.	Block.
	veh/h	%	veh/h	v/c	%	sec			ft		ft	%	%
South: SR 66													
Lane 1 ^d	483	2.0	1195	0.404	100	7.1	LOS A	2.9	73.9	Full	1600	0.0	0.0
Lane 2	119	2.0	1239	0.096	100	3.7	LOS A	0.6	14.0	Full	1600	0.0	0.0
Approach	602	2.0		0.404		6.4	LOS A	2.9	73.9				
East: Palmer Dr													
Lane 1 ^d	404	2.0	762	0.530	100	12.6	LOS B	4.4	112.5	Full	1600	0.0	0.0
Approach	404	2.0		0.530		12.6	LOS B	4.4	112.5				
North: SR 66													
Lane 1 ^d	609	2.0	1009	0.604	100	11.9	LOS B	5.5	139.8	Full	1600	0.0	0.0
Approach	609	2.0		0.604		11.9	LOS B	5.5	139.8				
West: Site Driveway													
Lane 1 ^d	154	2.0	657	0.235	100	8.3	LOS A	1.5	37.6	Full	1600	0.0	0.0
Approach	154	2.0		0.235		8.3	LOS A	1.5	37.6				
Intersection	1770	2.0		0.604		9.9	LOS A	5.5	139.8				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

Trip Generation Calculations

Trips After Pass-By is subtracted			Total trips before pass-by		
In AM	Out AM	AM Total	In AM	Out AM	AM Total
117	107	224	154	142	296
In PM	Out PM	PM Total	In PM	Out PM	PM Total
83	74	157	159	142	301

Building 1									
AM Restaurant (932)				Directional Distribution			Total		
1000 Square Footage Area	Average Rate	Number of Trips		In	Out		In	Out	Total
6k	6	13.33	80	53%	47%		43	37	80
							-9	-8	-17
Total after Pass-by							34	29	63

Pass-By reduction
22%

PM Restaurant (932)									
PM Restaurant (932)				Directional Distribution			Total		
1000 Square Footage Area	Average Rate	Number of Trips		In	Out		In	Out	Total
6k	6	18.49	111	54%	46%		60	51	111
							-26	-22	-48
Total after Pass-by							34	29	63

Pass-By reduction
43%

Building 2									
AM Restaurant (934)				Directional Distribution			Total		
1000 Square Footage Area	Average Rate	Number of Trips		In	Out		In	Out	Total
1.5k	1.5	53.61	81	51%	49%		42	39	81
							-11	-10	-21
Total after Pass-by							31	29	60

Pass-By reduction
25%

PM Restaurant (934)									
PM Restaurant (934)				Directional Distribution			Total		
1000 Square Footage Area	Average Rate	Number of Trips		In	Out		In	Out	Total
1.5k	1.5	47.3	71	52%	48%		37	34	71
							-19	-17	-36
Total after Pass-by							18	17	35

Pass-By reduction
50%

Building 3									
AM Restaurant (934)				Directional Distribution			Total		
1000 Square Footage Area	Average Rate	Number of Trips		In	Out		In	Out	Total
2.5k	2.5	53.61	135	51%	49%		69	66	135
							-17	-17	-34
Total after Pass-by							52	49	101

Pass-By reduction
25%

PM Restaurant (934)									
PM Restaurant (934)				Directional Distribution			Total		
1000 Square Footage Area	Average Rate	Number of Trips		In	Out		In	Out	Total
2.5k	2.5	47.3	119	52%	48%		62	57	119
							-31	-29	-60
Total after Pass-by							31	28	59

Pass-By reduction
50%

Number of Additional Site Trips After Pass by has been subtracted

2018 AM

OUT AFTER PASS BY			
NB	392	36.1	36
SB	451	41.6	42
WB	319	29.4	29
	total	107.1	107

IN AFTER PASS BY			
NB	392	39.5	39
SB	451	45.5	46
WB	319	32.2	32
	total	117.2	117

2018 PM

OUT AFTER PASS BY			
NB	337	27.1	27
SB	380	30.6	31
WB	204	16.4	16
	total	74.1	74

IN AFTER PASS BY			
NB	337	30.4	30
SB	380	34.3	34
WB	204	18.4	19
	total	83.1	83

Pass By Trip Distribution

AM Intersection Volume 1162					PM Intersection volume 921				
AM Pass by trips IN 37					PM Pass by trips IN 76				
	AM Volume		Pass By trips			PM Volume			
NB Thru	237	20%	7.55	7	NB Thru	240	26%	19.80	20
NB Right	155	13%	4.94	5	NB Right	97	11%	8.00	8
SB Thru	183	16%	5.83	6	SB Thru	269	29%	22.20	22
SB Left	268	23%	8.53	9	SB Left	111	12%	9.16	9
WB Right	212	18%	6.75	7	WB Right	118	13%	9.74	10
WB Left	107	9%	3.41	3	WB Left	86	9%	7.10	7
		100%		37.00			100%		76.00

AM Intersection Volume 1162					PM Intersection volume 921				
AM Pass by trips OUT 35					PM Pass by trips OUT 68				
	AM Volume		Pass By trips			PM Volume			
NB Thru	237	20%	7.14	7	NB Thru	240	26%	17.72	18
NB Right	155	13%	4.67	5	NB Right	97	11%	7.16	7
SB Thru	183	16%	5.51	6	SB Thru	269	29%	19.86	20
SB Left	268	23%	8.07	8	SB Left	111	12%	8.20	8
WB Right	212	18%	6.39	6	WB Right	118	13%	8.71	9
WB Left	107	9%	3.22	3	WB Left	86	9%	6.35	6
		100%		35.00			100%		68.00