

F i s c h b a c h
Transportation Group, LLC

Traffic Engineering and Planning

Ms. Gillian L. Fischbach, P.E., PTOE, President

May 7, 2018

Mr. Joe Haddix, PE
Civil Site Design Group, PLLC
2305 Kline Avenue, Suite 300
Nashville, TN 37211

Dear Joe:

As requested, I have conducted additional analyses related to the high school that is proposed to be constructed on the north side of Lebanon Road, east of the realigned N. Greenhill Road, in Mt. Juliet, Tennessee. Specifically, these analyses are based on the May 2016 Traffic Impact Study that was prepared by Fischbach Transportation Group, LLC (FTG, LLC) for the planned high school. For reference, the total projected traffic volumes at the completion of the planned high school are shown in the following figure, and the capacity analyses for total projected conditions are shown in Table 1. The analyses, as shown in the May 2016 Traffic Impact Study, are based on the existing two-lane approach on northbound Benton Douglas Parkway, including a separate left turn lane and shared through/right turn lane.

In addition, I have provided capacity analyses for the intersection of Lebanon Road and Benton Douglas Parkway / Realigned N. Greenhill Road, based on a scenario that includes widening northbound Benton Douglas Parkway to include separate left, through, and right turn lanes. These results are also shown in Table 1. As shown, the provision of a third northbound lane on Benton Douglas Parkway at the intersection with Lebanon Road will have a negligible impact on the overall operations at this intersection and the specific operations of the northbound turning movements.

Please contact me if you have any questions about these materials or need any additional information.

Sincerely,

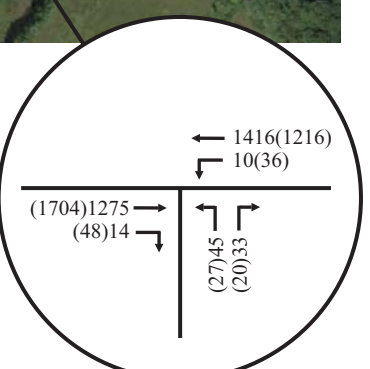
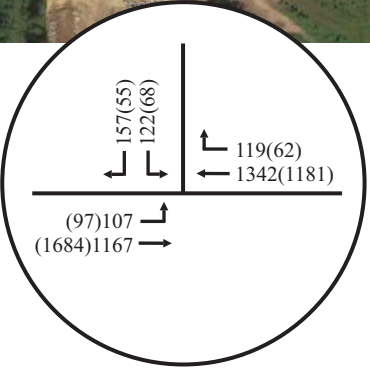
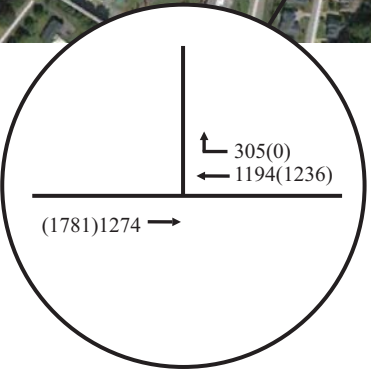
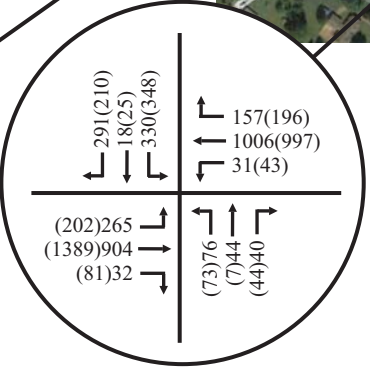
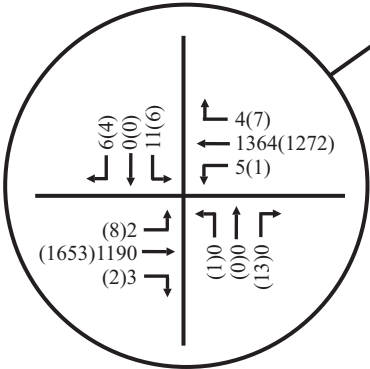
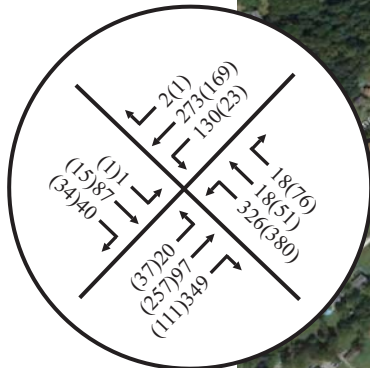


Ms. Gillian L. Fischbach, P.E., PTOE
President

TOTAL PROJECTED PEAK HOUR LEVELS OF SERVICE

INTERSECTION	TURNING MOVEMENT	AM PEAK HOUR		PM PEAK HOUR	
		LEVEL OF SERVICE	95 TH %-ILE QUEUE	LEVEL OF SERVICE	95 TH %-ILE QUEUE
Lebanon Road and Benton Douglas Parkway / Realigned N. Greenhill Road (signalized...and with two northbound turn lanes, as shown in the May 2016 Traffic Impact Study)	Eastbound Left Turns	LOS B	5 veh	LOS B	3 veh
	Eastbound Thrus	LOS B	11 veh	LOS C	17 veh
	Eastbound Right Turns	LOS B	11 veh	LOS C	17 veh
	Westbound Left Turns	LOS B	1 veh	LOS B	1 veh
	Westbound Thrus	LOS C	13 veh	LOS B	11 veh
	Westbound Right Turns	LOS A	2 veh	LOS A	2 veh
	Northbound Left Turns	LOS D	3 veh	LOS C	2 veh
	Northbound Thrus / Right Turns	LOS D	3 veh	LOS C	2 veh
	Southbound Left Turns	LOS C	10 veh	LOS D	12 veh
	Southbound Thrus / Right Turns	LOS D	11 veh	LOS C	8 veh
	OVERALL INTERSECTION	LOS C		LOS C	
Lebanon Road and Benton Douglas Parkway / Realigned N. Greenhill Road (signalized...and with three northbound turn lanes)	Eastbound Left Turns	LOS B	5 veh	LOS B	3 veh
	Eastbound Thrus	LOS B	11 veh	LOS C	17 veh
	Eastbound Right Turns	LOS B	11 veh	LOS C	17 veh
	Westbound Left Turns	LOS B	1 veh	LOS B	1 veh
	Westbound Thrus	LOS C	13 veh	LOS B	11 veh
	Westbound Right Turns	LOS A	3 veh	LOS A	2 veh
	Northbound Left Turns	LOS C	3 veh	LOS C	2 veh
	Northbound Thrus	LOS C	2 veh	LOS C	1 veh
	Northbound Right Turns	LOS C	1 veh	LOS C	2 veh
	Southbound Left Turns	LOS C	11 veh	LOS C	11 veh
	Southbound Thrus / Right Turns	LOS D	11 veh	LOS C	8 veh
OVERALL INTERSECTION	LOS C		LOS C		

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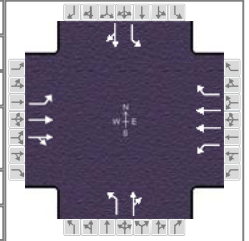
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XX - AM Peak Hour Volumes
 (XX) - PM Peak Hour Volumes

Figure 8.
Total Projected Background Traffic Volumes

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency	FTG			Duration, h	0.25	
Analyst	FTG		Analysis Date	5/11/2016	Area Type	Other
Jurisdiction	Mt. Juliet, TN		Time Period	AM Peak Hour (Total)	PHF	0.95
Urban Street	Lebanon Road		Analysis Year	2016	Analysis Period	1 > 7:00
Intersection	N. Greenhill Road		File Name	2_fuam_sig.xus		
Project Description	10745					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	265	904	32	31	1006	157	76	44	40	330	18	291

Signal Information				Signal Phases									
Cycle, s	90.0	Reference Phase	2										
Offset, s	0	Reference Point	End										
Uncoordinated	No	Simult. Gap E/W	On										
Force Mode	Fixed	Simult. Gap N/S	On										
		Green		3.3	2.3	38.9	5.2	8.2	8.1				
		Yellow		4.0	4.0	4.0	4.0	4.0	4.0				
		Red		0.0	0.0	0.0	0.0	0.0	0.0				

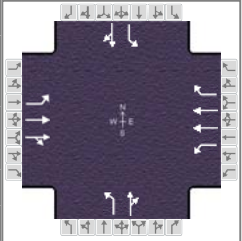
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	13.7	49.2	7.3	42.9	9.2	12.1	21.4	24.3
Change Period, (Y+R _c), s	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Max Allow Headway (MAH), s	3.0	0.0	3.0	0.0	3.0	3.2	3.0	3.2
Queue Clearance Time (g _s), s	9.2		2.9		5.5	6.4	16.9	19.5
Green Extension Time (g _e), s	0.5	0.0	0.0	0.0	0.1	0.8	0.5	0.8
Phase Call Probability	1.00		0.56		0.86	1.00	1.00	1.00
Max Out Probability	0.00		0.00		0.00	0.00	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	279	496	490	33	1059	165	80	88		347	325	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1900	1877	1810	1809	1610	1810	1750		1810	1625	
Queue Service Time (g _s), s	7.2	15.8	15.8	0.9	21.2	3.9	3.5	4.4		14.9	17.5	
Cycle Queue Clearance Time (g _c), s	7.2	15.8	15.8	0.9	21.2	3.9	3.5	4.4		14.9	17.5	
Green Ratio (g/C)	0.56	0.50	0.50	0.47	0.43	0.62	0.15	0.09		0.31	0.23	
Capacity (c), veh/h	381	954	942	324	1562	1006	194	157		485	366	
Volume-to-Capacity Ratio (X)	0.733	0.520	0.520	0.101	0.678	0.164	0.412	0.562		0.716	0.888	
Available Capacity (c _a), veh/h	1041	954	942	991	1562	1006	532	712		759	881	
Back of Queue (Q), veh/ln (95 th percentile)	4.6	10.7	10.6	0.6	13.2	2.1	2.7	3.3		10.1	11.0	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d ₁), s/veh	16.1	15.1	15.1	13.7	20.5	7.1	34.5	39.3		27.2	33.8	
Incremental Delay (d ₂), s/veh	1.0	2.0	2.0	0.1	2.4	0.4	0.5	1.2		0.7	3.0	
Initial Queue Delay (d ₃), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	17.2	17.1	17.2	13.8	22.9	7.4	35.0	40.4		27.9	36.7	
Level of Service (LOS)	B	B	B	B	C	A	D	D		C	D	
Approach Delay, s/veh / LOS	17.1	B		20.7	C		37.9	D		32.2	C	
Intersection Delay, s/veh / LOS	22.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.0	C	2.8	C
Bicycle LOS Score / LOS	1.5	A	1.5	A	0.8	A	1.6	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FTG			Duration, h	0.25
Analyst	FTG	Analysis Date	5/11/2016	Area Type	Other
Jurisdiction	Mt. Juliet, TN	Time Period	PM Peak Hour (Total)	PHF	0.95
Urban Street	Lebanon Road	Analysis Year	2016	Analysis Period	1 > 7:00
Intersection	N. Greenhill Road	File Name	2_fupm_sig.xus		
Project Description	10745				



Demand Information	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Demand (v), veh/h	202	1389	81	43	997	196	73	7	44	348	25	210

Signal Information				Signal Timing (s)													
Cycle, s	80.0	Reference Phase	2	Green	3.8	3.0	38.0	4.9	3.1	7.2	Yellow	4.0	0.0	4.0	4.0	4.0	4.0
Offset, s	0	Reference Point	End	Red	0.0	0.0	0.0	0.0	0.0	0.0	Force Mode	Fixed	Simult. Gap N/S	On	Diagrammatic Signal Phases		

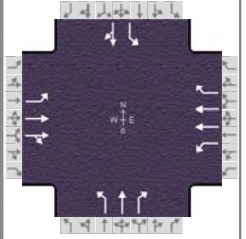
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.8	45.0	7.8	42.0	8.9	11.2	16.0	18.2
Change Period, (Y+R _c), s	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Max Allow Headway (MAH), s	3.0	0.0	3.0	0.0	3.0	3.2	3.0	3.2
Queue Clearance Time (g _s), s	6.5		3.0		5.0	4.5	14.0	13.7
Green Extension Time (g _e), s	0.3	0.0	0.1	0.0	0.1	0.6	0.0	0.5
Phase Call Probability	0.99		0.63		0.82	1.00	1.00	1.00
Max Out Probability	0.00		0.00		0.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	213	779	769	45	1049	206	77	54		366	247	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1900	1863	1810	1809	1610	1810	1645		1810	1637	
Queue Service Time (g _s), s	4.5	27.1	27.4	1.0	17.2	4.4	3.0	2.5		12.0	11.7	
Cycle Queue Clearance Time (g _c), s	4.5	27.1	27.4	1.0	17.2	4.4	3.0	2.5		12.0	11.7	
Green Ratio (g/C)	0.57	0.51	0.51	0.52	0.48	0.63	0.15	0.09		0.26	0.18	
Capacity (c), veh/h	387	975	956	226	1719	1007	209	147		442	291	
Volume-to-Capacity Ratio (X)	0.550	0.799	0.804	0.201	0.610	0.205	0.368	0.365		0.829	0.849	
Available Capacity (c _a), veh/h	907	975	956	860	1719	1007	482	452		442	595	
Back of Queue (Q), veh/ln (95 th percentile)	2.6	16.9	17.0	0.6	10.5	2.3	2.2	1.7		11.7	8.0	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d ₁), s/veh	11.6	16.1	16.2	14.4	15.5	6.4	30.4	34.3		28.3	31.8	
Incremental Delay (d ₂), s/veh	0.5	6.8	7.2	0.2	1.6	0.5	0.4	0.6		11.7	2.7	
Initial Queue Delay (d ₃), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	12.1	22.9	23.3	14.5	17.1	6.9	30.8	34.8		40.0	34.5	
Level of Service (LOS)	B	C	C	B	B	A	C	C		D	C	
Approach Delay, s/veh / LOS	21.8		C	15.4		B	32.5		C	37.8		D
Intersection Delay, s/veh / LOS	22.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.3	B	3.0	C	2.8	C
Bicycle LOS Score / LOS	1.9	A	1.6	A	0.7	A	1.5	A

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information			
Agency	FTG			Duration, h	0.25		
Analyst	FTG		Analysis Date	5/11/2016		Area Type	Other
Jurisdiction	Mt. Juliet, TN		Time Period	AM Peak Hour (Total)		PHF	0.95
Urban Street	Lebanon Road		Analysis Year	2016		Analysis Period	1 > 7:00
Intersection	N. Greenhill Road		File Name	2_fuam_sig (NB thru).xus			
Project Description	10745						



Demand Information	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Demand (v), veh/h	265	904	32	31	1006	157	76	44	40	330	18	291

Signal Information				Signal Timing (s)									
Cycle, s	90.0	Reference Phase	2										
Offset, s	0	Reference Point	End										
Uncoordinated	No	Simult. Gap E/W	On	Green	3.3	2.3	38.9	5.2	3.8	12.4			
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	4.0	4.0	4.0	4.0			
				Red	0.0	0.0	0.0	0.0	0.0	0.0			

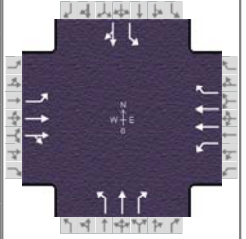
Timer Results	EBL		EBT		WBL		WBT		NBL		NBT		SBL		SBT	
	5	2	1	6	3	8	7	4								
Assigned Phase	5	2	1	6	3	8	7	4								
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	1.1	4.0								
Phase Duration, s	13.6	49.2	7.3	42.9	9.2	16.4	17.0	24.2								
Change Period, ($Y+R_c$), s	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0								
Max Allow Headway (MAH), s	3.0	0.0	3.0	0.0	3.0	3.2	3.0	3.2								
Queue Clearance Time (g_s), s	9.2		2.9		5.3	4.1	15.0	19.5								
Green Extension Time (g_e), s	0.5	0.0	0.0	0.0	0.1	0.8	0.0	0.8								
Phase Call Probability	1.00		0.56		0.86	1.00	1.00	1.00								
Max Out Probability	0.00		0.00		0.00	0.00	1.00	0.00								

Movement Group Results	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Approach Movement												
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	279	496	490	33	1059	165	80	46	42	347	325	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1900	1877	1810	1809	1610	1810	1900	1610	1810	1625	
Queue Service Time (g_s), s	7.2	15.8	15.8	0.9	21.1	4.4	3.3	1.9	2.1	13.0	17.5	
Cycle Queue Clearance Time (g_c), s	7.2	15.8	15.8	0.9	21.1	4.4	3.3	1.9	2.1	13.0	17.5	
Green Ratio (g/C)	0.56	0.50	0.50	0.47	0.43	0.58	0.20	0.14	0.14	0.30	0.22	
Capacity (c), veh/h	381	955	943	324	1565	929	193	262	222	502	365	
Volume-to-Capacity Ratio (X)	0.733	0.519	0.519	0.101	0.677	0.178	0.414	0.177	0.190	0.692	0.891	
Back of Queue (Q), ft/ln (95 th percentile)	114	266	264	14.6	330.6	62.7	63.5	38.8	35.4	263.3	278.8	
Back of Queue (Q), veh/ln (95 th percentile)	4.6	10.6	10.6	0.6	13.2	2.5	2.5	1.6	1.4	10.5	11.2	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	16.1	15.1	15.1	13.7	20.5	9.0	31.3	34.3	34.3	27.5	33.8	
Incremental Delay (d_2), s/veh	1.0	2.0	2.0	0.0	2.4	0.4	0.5	0.1	0.2	3.4	4.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	17.1	17.1	17.1	13.7	22.8	9.4	31.8	34.4	34.5	30.9	38.0	
Level of Service (LOS)	B	B	B	B	C	A	C	C	C	C	D	
Approach Delay, s/veh / LOS	17.1		B	20.8		C	33.2		C	34.3		C
Intersection Delay, s/veh / LOS	22.8						C					

Multimodal Results	EB		WB		NB		SB	
	Pedestrian LOS Score / LOS	2.09	B	1.90	B	2.45	B	2.29
Bicycle LOS Score / LOS	1.53	B	1.52	B	0.77	A	1.60	B

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information			
Agency	FTG			Duration, h	0.25		
Analyst	FTG			Analysis Date	5/11/2016		
Jurisdiction	Mt. Juliet, TN			Area Type	Other		
Urban Street	Lebanon Road			Time Period	PM Peak Hour (Total)		
Intersection	N. Greenhill Road			PHF	0.95		
Project Description	10745			Analysis Year	2016		
				Analysis Period	1 > 7:00		
				File Name	2_fupm_sig (NB thru).xus		



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	202	1389	81	43	997	196	73	7	44	348	25	210

Signal Information				Signal Timing (s)													
Cycle, s	80.0	Reference Phase	2	Green	3.8	3.0	38.0	4.9	3.1	7.2	Yellow	4.0	0.0	4.0	4.0	4.0	4.0
Offset, s	0	Reference Point	End	Red	0.0	0.0	0.0	0.0	0.0	0.0	Force Mode	Fixed	Simult. Gap N/S	On	Signal Diagrams (1-8)		
Uncoordinated	No	Simult. Gap E/W	On														

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	1.1	4.0
Phase Duration, s	10.8	45.0	7.8	42.0	8.9	11.2	16.0	18.2
Change Period, (Y+R _c), s	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Max Allow Headway (MAH), s	3.0	0.0	3.0	0.0	3.0	3.2	3.0	3.2
Queue Clearance Time (g _s), s	6.5		3.0		5.0	4.2	14.0	13.7
Green Extension Time (g _e), s	0.3	0.0	0.1	0.0	0.1	0.6	0.0	0.5
Phase Call Probability	0.99		0.63		0.82	1.00	1.00	1.00
Max Out Probability	0.00		0.00		0.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	213	779	769	45	1049	206	77	7	46	366	247	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1900	1863	1810	1809	1610	1810	1900	1610	1810	1637	
Queue Service Time (g _s), s	4.5	27.1	27.4	1.0	17.2	4.4	3.0	0.3	2.2	12.0	11.7	
Cycle Queue Clearance Time (g _c), s	4.5	27.1	27.4	1.0	17.2	4.4	3.0	0.3	2.2	12.0	11.7	
Green Ratio (g/C)	0.57	0.51	0.51	0.52	0.48	0.63	0.15	0.09	0.09	0.26	0.18	
Capacity (c), veh/h	387	975	956	226	1719	1007	209	170	144	484	291	
Volume-to-Capacity Ratio (X)	0.550	0.799	0.804	0.201	0.610	0.205	0.368	0.043	0.322	0.756	0.849	
Back of Queue (Q), ft/ln (95 th percentile)	66	423.7	424.2	15.1	262.5	56.3	56.2	5.6	36.6	272.4	199.6	
Back of Queue (Q), veh/ln (95 th percentile)	2.6	16.9	17.0	0.6	10.5	2.3	2.2	0.2	1.5	10.9	8.0	
Queue Storage Ratio (RQ) (95 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d ₁), s/veh	11.6	16.1	16.2	14.4	15.5	6.4	30.4	33.3	34.1	27.7	31.8	
Incremental Delay (d ₂), s/veh	0.5	6.8	7.2	0.2	1.6	0.5	0.4	0.0	0.5	6.0	2.7	
Initial Queue Delay (d ₃), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	12.1	22.9	23.3	14.5	17.1	6.9	30.8	33.3	34.6	33.7	34.5	
Level of Service (LOS)	B	C	C	B	B	A	C	C	C	C	C	
Approach Delay, s/veh / LOS	21.8	C		15.4	B		32.3	C		34.0	C	
Intersection Delay, s/veh / LOS	21.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.08	B	1.89	B	2.45	B	2.29	B
Bicycle LOS Score / LOS	1.94	B	1.56	B	0.70	A	1.50	B