

Study Area Intersections

City of Niagara Falls Intersections

- 1 Grassy Brook Road at Morris Road
- 2 Biggar Road at Morris Road
- 3 Biggar Road at Crowland Avenue
- 4 Lyons Creek Road at Willodell Road
- 18 Carl Road at Crowland Avenue

Region of Niagara Intersections

- 5 McLeod Road at Montrose Road
- 6 McLeod Road at Oakwood Drive
- 7 Niagara Square Drive at Montrose Road
- 8 Chippawa Creek Road at Montrose Road
- 9 Oakwood Drive at Montrose Road
- 10 Grassy Brook Road at Montrose Road
- 11 Biggar Road / Lyons Creek Road at Montrose Road
- 12 Lyons Creek Road at Stanley Avenue
- 13 Carl Road at Montrose Road

Ministry of Transportation Ontario Intersections

- 14 McLeod Road at QEW Southbound Off-Ramp
- 15 McLeod Road at QEW Northbound Off-Ramp
- 16 Lyons Creek Road at QEW Southbound Off-Ramp
- 17 Lyons Creek Road at QEW Southbound Off-Ramp

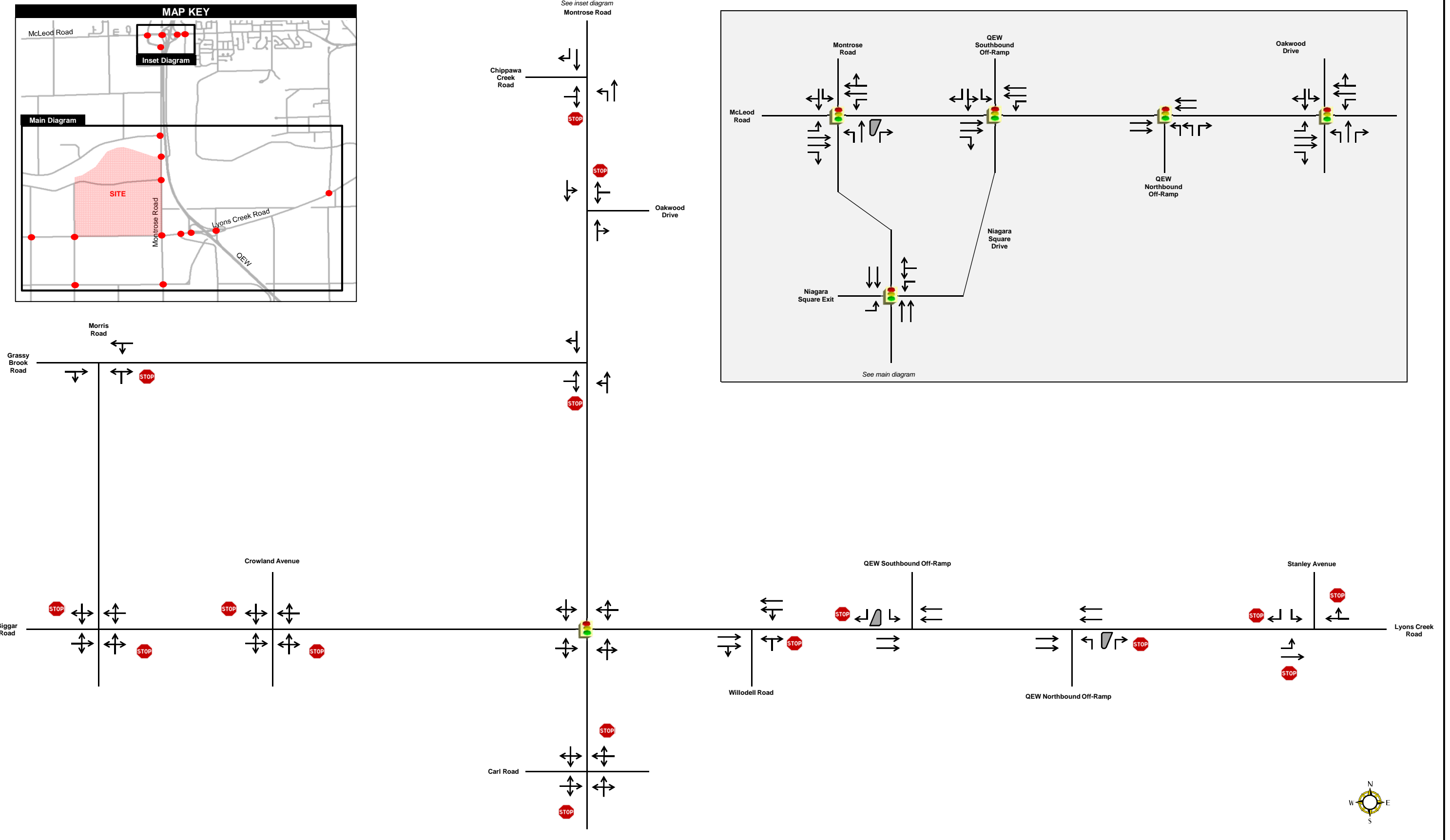
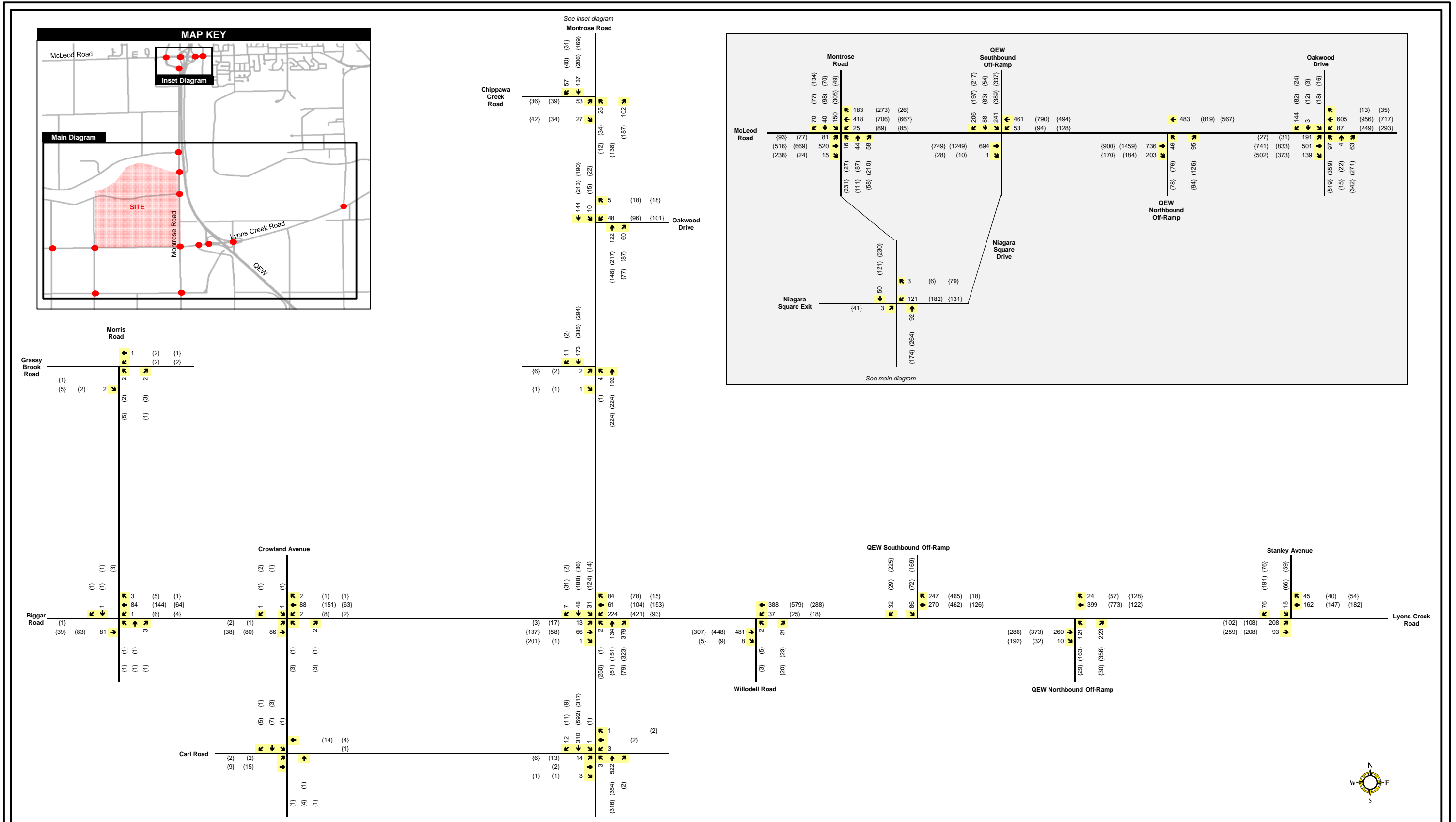


FIGURE 2
 Existing Lane Configuration



APPENDIX B
 GRAND NIAGARA SECONDARY PLAN
 BACKGROUND ANALYSIS REPORT
 APRIL 2016

HCM Signalized Intersection Capacity Analysis

7: Regional Rd 98 & Montrose Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘			↘	↔			↕			↕	
Volume (vph)	3	0	0	121	0	3	0	92	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5			5.5	5.5			5.2			5.2	
Lane Util. Factor	1.00			0.95	0.95			0.95			0.95	
Frt	1.00			1.00	0.99			1.00			1.00	
Flt Protected	0.95			0.95	0.95			1.00			1.00	
Satd. Flow (prot)	1770			1681	1678			3574			3539	
Flt Permitted	0.71			0.95	0.95			1.00			1.00	
Satd. Flow (perm)	1323			1681	1678			3574			3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	0	0	132	0	3	0	100	0	0	54	0
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	0	0	0	0
Lane Group Flow (vph)	3	0	0	67	45	0	0	100	0	0	54	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	1%	2%	2%	2%	2%
Turn Type	Perm			Perm	NA			NA			NA	
Protected Phases					6			8			4	
Permitted Phases	2			6								
Actuated Green, G (s)	15.5			15.5	15.5			3.1			3.1	
Effective Green, g (s)	15.5			15.5	15.5			3.1			3.1	
Actuated g/C Ratio	0.53			0.53	0.53			0.11			0.11	
Clearance Time (s)	5.5			5.5	5.5			5.2			5.2	
Vehicle Extension (s)	3.0			3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	699			889	887			378			374	
v/s Ratio Prot								c0.03			0.02	
v/s Ratio Perm	0.00			c0.04	0.03							
v/c Ratio	0.00			0.08	0.05			0.26			0.14	
Uniform Delay, d1	3.3			3.4	3.3			12.1			11.9	
Progression Factor	1.00			1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.0			0.0	0.0			0.4			0.2	
Delay (s)	3.3			3.4	3.4			12.4			12.1	
Level of Service	A			A	A			B			B	
Approach Delay (s)		3.3			3.4			12.4			12.1	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	8.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	29.3	Sum of lost time (s)	10.7
Intersection Capacity Utilization	22.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

11: Montrose Rd & Biggar Rd/Lyons Creek Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	13	66	1	224	61	84	2	134	379	31	48	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.3			6.3			6.3			6.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.97			0.90			0.99	
Flt Protected		0.99			0.97			1.00			0.98	
Satd. Flow (prot)		1771			1639			1645			1554	
Flt Permitted		0.92			0.76			1.00			0.78	
Satd. Flow (perm)		1641			1290			1645			1240	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	72	1	243	66	91	2	146	412	34	52	8
RTOR Reduction (vph)	0	1	0	0	15	0	0	109	0	0	3	0
Lane Group Flow (vph)	0	86	0	0	385	0	0	451	0	0	91	0
Heavy Vehicles (%)	8%	6%	2%	9%	5%	12%	2%	4%	4%	16%	23%	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)		27.9			27.9			30.4			30.4	
Effective Green, g (s)		27.9			27.9			30.4			30.4	
Actuated g/C Ratio		0.39			0.39			0.43			0.43	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		645			507			705			531	
v/s Ratio Prot												
v/s Ratio Perm		0.05			c0.30			0.27			0.07	
v/c Ratio		0.13			0.76			0.64			0.17	
Uniform Delay, d1		13.8			18.6			15.9			12.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.3			8.4			4.4			0.7	
Delay (s)		14.0			27.0			20.3			13.2	
Level of Service		B			C			C			B	
Approach Delay (s)		14.0			27.0			20.3			13.2	
Approach LOS		B			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	21.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	70.9	Sum of lost time (s)	12.6
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX B
 GRAND NIAGARA SECONDARY PLAN
 BACKGROUND ANALYSIS REPORT
 APRIL 2016

HCM Signalized Intersection Capacity Analysis
 14: McLeod Rd & QEW Southbound Off Ramp

11/27/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↓	↑↑					↓	↑	↑
Volume (vph)	0	694	1	53	461	0	0	0	0	241	88	206
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.8		3.0	6.8					7.0	7.0	7.0
Lane Util. Factor		0.91		1.00	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	0.99
Flpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Frt		1.00		1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00		0.95	1.00					0.95	0.98	1.00
Satd. Flow (prot)		4987		1769	3505					1676	1726	1563
Flt Permitted		1.00		0.28	1.00					0.95	0.98	1.00
Satd. Flow (perm)		4987		524	3505					1676	1726	1563
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	754	1	58	501	0	0	0	0	262	96	224
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	137
Lane Group Flow (vph)	0	755	0	58	501	0	0	0	0	176	182	87
Confl. Peds. (#/hr)			2	2			1			3	3	1
Heavy Vehicles (%)	2%	4%	2%	2%	3%	2%	4%	9%	4%	2%	2%	2%
Turn Type		NA		pm+pt	NA					Perm	NA	Perm
Protected Phases		4		3	8						6	6
Permitted Phases				8						6		6
Actuated Green, G (s)		20.2		27.3	27.3					26.2	26.2	26.2
Effective Green, g (s)		20.2		27.3	27.3					26.2	26.2	26.2
Actuated g/C Ratio		0.30		0.41	0.41					0.39	0.39	0.39
Clearance Time (s)		6.8		3.0	6.8					7.0	7.0	7.0
Vehicle Extension (s)		3.0		3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)		1496		288	1421					652	671	608
v/s Ratio Prot		c0.15		0.01	c0.14							
v/s Ratio Perm				0.07						0.11	0.11	0.06
v/c Ratio		0.50		0.20	0.35					0.27	0.27	0.14
Uniform Delay, d1		19.4		12.5	13.9					14.0	14.0	13.3
Progression Factor		1.00		1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		0.3		0.3	0.2					1.0	1.0	0.5
Delay (s)		19.7		12.8	14.0					15.0	15.0	13.8
Level of Service		B		B	B					B	B	B
Approach Delay (s)		19.7			13.9			0.0			14.6	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM 2000 Control Delay	16.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	67.3	Sum of lost time (s)	16.8
Intersection Capacity Utilization	52.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
 15: QEW Northbound Off Ramp

11/27/2015



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↓	↑
Volume (vph)	736	0	0	483	46	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.0			8.0	8.0	8.0
Lane Util. Factor	0.95			0.95	0.97	1.00
Frpb, ped/bikes	1.00			1.00	1.00	0.98
Flpb, ped/bikes	1.00			1.00	1.00	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	1.00			1.00	0.95	1.00
Satd. Flow (prot)	3539			3438	3433	1517
Flt Permitted	1.00			1.00	0.95	1.00
Satd. Flow (perm)	3539			3438	3433	1517
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	800	0	0	525	50	103
RTOR Reduction (vph)	0	0	0	0	0	67
Lane Group Flow (vph)	800	0	0	525	50	36
Confl. Peds. (#/hr)					4	13
Heavy Vehicles (%)	2%	7%	2%	5%	2%	4%
Turn Type	NA			NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases						2
Actuated Green, G (s)	20.7			20.7	20.0	20.0
Effective Green, g (s)	20.7			20.7	20.0	20.0
Actuated g/C Ratio	0.37			0.37	0.35	0.35
Clearance Time (s)	8.0			8.0	8.0	8.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	1292			1255	1210	535
v/s Ratio Prot	c0.23			0.15	0.01	
v/s Ratio Perm						c0.02
v/c Ratio	0.62			0.42	0.04	0.07
Uniform Delay, d1	14.8			13.5	12.1	12.2
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.9			0.2	0.1	0.2
Delay (s)	15.7			13.7	12.1	12.4
Level of Service	B			B	B	B
Approach Delay (s)	15.7			13.7	12.3	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	14.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	56.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	42.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX B
 GRAND NIAGARA SECONDARY PLAN
 BACKGROUND ANALYSIS REPORT
 APRIL 2016

HCM Unsignalized Intersection Capacity Analysis

1: Morris Rd & Grassy Brook Rd

11/27/2015

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Volume (veh/h)	0	2	0	1	2	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	2	0	1	2	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			2		2	1
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2		2	1
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1620		1020	1083
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	2	1	4			
Volume Left	0	0	2			
Volume Right	2	0	2			
cSH	1700	1620	1051			
Volume to Capacity	0.00	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.4			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.4			
Approach LOS			A			
Intersection Summary						
Average Delay			4.8			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

2: Biggar Rd & Morris Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↔	↔	↔	↔	↔		↔	↔	↔	↔	↔	
Volume (veh/h)	0	81	0	1	84	3	0	0	3	0	1	0	
Sign Control		Free			Free			Stop			Stop		
Grade		0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	0	88	0	1	91	3	0	0	3	0	1	0	
Pedestrians													
Lane Width (m)													
Walking Speed (m/s)													
Percent Blockage													
Right turn flare (veh)													
Median type		None			None								
Median storage (veh)													
Upstream signal (m)													
pX, platoon unblocked													
vC, conflicting volume	95			88			184	185	88	186	183	93	
vC1, stage 1 conf vol													
vC2, stage 2 conf vol													
vCu, unblocked vol	95			88			184	185	88	186	183	93	
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	7.5	6.2	
tC, 2 stage (s)													
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.9	3.3	
p0 queue free %	100			100			100	100	100	100	100	100	
cM capacity (veh/h)	1499			1508			776	709	970	771	566	964	
Direction, Lane #	EB 1	WB 1	NB 1	SB 1									
Volume Total	88	96	3	1									
Volume Left	0	1	0	0									
Volume Right	0	3	3	0									
cSH	1499	1508	970	566									
Volume to Capacity	0.00	0.00	0.00	0.00									
Queue Length 95th (m)	0.0	0.0	0.1	0.0									
Control Delay (s)	0.0	0.1	8.7	11.4									
Lane LOS		A	A	B									
Approach Delay (s)	0.0	0.1	8.7	11.4									
Approach LOS			A	B									
Intersection Summary													
Average Delay				0.3									
Intersection Capacity Utilization				15.4%	ICU Level of Service	A							
Analysis Period (min)				15									

APPENDIX B
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HCM Unsignalized Intersection Capacity Analysis
 3: Crowland Avenue & Biggar Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	0	86	0	2	88	2	0	0	2	1	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	93	0	2	96	2	0	0	2	1	0	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	98			93			196	196	93	197	195	97
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	98			93			196	196	93	197	195	97
tC, single (s)	4.1			4.6			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.7			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1495			1247			762	699	964	760	700	960
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	93	100	2	2								
Volume Left	0	2	0	1								
Volume Right	0	2	2	1								
cSH	1495	1247	964	848								
Volume to Capacity	0.00	0.00	0.00	0.00								
Queue Length 95th (m)	0.0	0.0	0.1	0.1								
Control Delay (s)	0.0	0.2	8.7	9.3								
Lane LOS		A	A	A								
Approach Delay (s)	0.0	0.2	8.7	9.3								
Approach LOS			A	A								
Intersection Summary												
Average Delay				0.3								
Intersection Capacity Utilization				16.4%	ICU Level of Service	A						
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
 4: Willodell Rd & Lyons Creek Rd

11/27/2015

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Volume (veh/h)	481	8	37	388	2	21
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	523	9	40	422	2	23
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)	372					
pX, platoon unblocked						
vC, conflicting volume			532		818	266
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			532		818	266
tC, single (s)			4.1		6.8	7.3
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.5
p0 queue free %			96		99	97
cM capacity (veh/h)			1032		302	684
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	349	183	181	281	25	
Volume Left	0	0	40	0	2	
Volume Right	0	9	0	0	23	
cSH	1700	1700	1032	1700	616	
Volume to Capacity	0.21	0.11	0.04	0.17	0.04	
Queue Length 95th (m)	0.0	0.0	1.0	0.0	1.0	
Control Delay (s)	0.0	0.0	2.2	0.0	11.1	
Lane LOS			A		B	
Approach Delay (s)	0.0		0.9		11.1	
Approach LOS					B	
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			38.7%		ICU Level of Service	A
Analysis Period (min)			15			

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HCM Unsignalized Intersection Capacity Analysis

8: Montrose Rd & Chippawa Creek Rd

11/27/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	53	27	25	0	137	57
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	58	29	27	0	149	62
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None	None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	203	149	211			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	203	149	211			
tC, single (s)	6.5	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.3			
p0 queue free %	92	97	98			
cM capacity (veh/h)	750	898	1325			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	87	27	0	149	62	
Volume Left	58	27	0	0	0	
Volume Right	29	0	0	0	62	
cSH	794	1325	1700	1700	1700	
Volume to Capacity	0.11	0.02	0.00	0.09	0.04	
Queue Length 95th (m)	2.9	0.5	0.0	0.0	0.0	
Control Delay (s)	10.1	7.8	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	10.1	7.8		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay			3.4			
Intersection Capacity Utilization			25.1%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

9: Montrose Rd & Oakwood Dr

11/27/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	48	5	122	60	10	144
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	52	5	133	65	11	157
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	343	165			198	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	343	165			198	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	92	99			99	
cM capacity (veh/h)	648	879			1375	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	58	198	167			
Volume Left	52	0	11			
Volume Right	5	65	0			
cSH	664	1700	1375			
Volume to Capacity	0.09	0.12	0.01			
Queue Length 95th (m)	2.3	0.0	0.2			
Control Delay (s)	10.9	0.0	0.6			
Lane LOS	B		A			
Approach Delay (s)	10.9	0.0	0.6			
Approach LOS	B					
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			25.8%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

10: Montrose Rd & Grassy Brook Rd

11/27/2015

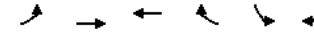


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕	↕	↔
Volume (veh/h)	2	1	4	192	173	11
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	1	4	209	188	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	411	194	200			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	411	194	200			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	595	847	1372			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	3	213	200			
Volume Left	2	4	0			
Volume Right	1	0	12			
cSH	660	1372	1700			
Volume to Capacity	0.00	0.00	0.12			
Queue Length 95th (m)	0.1	0.1	0.0			
Control Delay (s)	10.5	0.2	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.5	0.2	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization		23.3%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

12: Lyons Creek Rd & Stanley Ave

11/27/2015



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↕	↔	↔	↔
Sign Control		Stop	Stop		Stop	
Volume (vph)	208	93	162	45	18	76
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	226	101	176	49	20	83
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total (vph)	226	101	225	20	83	
Volume Left (vph)	226	0	0	20	0	
Volume Right (vph)	0	0	49	0	83	
Hadj (s)	0.57	0.02	-0.11	0.53	-0.58	
Departure Headway (s)	5.6	5.0	4.9	6.4	5.3	
Degree Utilization, x	0.35	0.14	0.30	0.03	0.12	
Capacity (veh/h)	627	699	717	524	628	
Control Delay (s)	10.3	7.6	10.0	8.4	7.8	
Approach Delay (s)	9.5		10.0	7.9		
Approach LOS	A		A	A		
Intersection Summary						
Delay			9.4			
Level of Service			A			
Intersection Capacity Utilization			36.1%		ICU Level of Service	A
Analysis Period (min)			15			

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HCM Unsignalized Intersection Capacity Analysis

13: Carl Rd & Montrose Rd

11/27/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	14	0	3	3	0	1	3	522	0	1	310	12
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	0	3	3	0	1	3	567	0	1	337	13
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1			3			221	40	2	323	41	1
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1			3			221	40	2	323	41	1
tC, single (s)	4.1			4.1			7.4	6.5	6.2	7.1	6.6	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.8	4.0	3.3	3.5	4.1	3.4
p0 queue free %	99			100			99	32	100	100	59	99
cM capacity (veh/h)	1622			1619			451	839	1083	284	830	1067

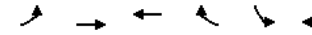
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	18	4	571	351
Volume Left	15	3	3	1
Volume Right	3	1	0	13
cSH	1622	1619	835	832
Volume to Capacity	0.01	0.00	0.68	0.42
Queue Length 95th (m)	0.2	0.0	44.4	16.9
Control Delay (s)	6.0	5.4	18.1	12.4
Lane LOS	A	A	C	B
Approach Delay (s)	6.0	5.4	18.1	12.4
Approach LOS			C	B

Intersection Summary			
Average Delay		15.7	
Intersection Capacity Utilization	39.7%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

16: QEW Southbound Off Ramp

11/27/2015



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↓	↓
Volume (veh/h)	0	165	270	0	86	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	179	293	0	93	35
Pedestrians		1				
Lane Width (m)		3.6				
Walking Speed (m/s)		1.2				
Percent Blockage		0				
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	293				383	148
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293				383	148
tC, single (s)	4.1				7.1	7.1
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	100				83	96
cM capacity (veh/h)	1265				564	847

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	90	90	147	147	93	35
Volume Left	0	0	0	0	93	0
Volume Right	0	0	0	0	0	35
cSH	1700	1700	1700	1700	564	847
Volume to Capacity	0.05	0.05	0.09	0.09	0.17	0.04
Queue Length 95th (m)	0.0	0.0	0.0	0.0	4.7	1.0
Control Delay (s)	0.0	0.0	0.0	0.0	12.6	9.4
Lane LOS					B	A
Approach Delay (s)	0.0		0.0		11.8	
Approach LOS					B	

Intersection Summary			
Average Delay		2.5	
Intersection Capacity Utilization	19.2%		ICU Level of Service A
Analysis Period (min)	15		

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HCM Unsignalized Intersection Capacity Analysis
 17: QEW Northbound Off Ramp & Lyons Creek Rd

11/27/2015

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↔	↔
Volume (veh/h)	260	0	0	399	121	223
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	283	0	0	434	132	242
Pedestrians	1					
Lane Width (m)	3.6					
Walking Speed (m/s)	1.2					
Percent Blockage	0					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			283		500	141
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol					500	141
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		74	72
cM capacity (veh/h)			1277		502	881
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	141	141	217	217	132	242
Volume Left	0	0	0	0	132	0
Volume Right	0	0	0	0	0	242
cSH	1700	1700	1700	1700	502	881
Volume to Capacity	0.08	0.08	0.13	0.13	0.26	0.28
Queue Length 95th (m)	0.0	0.0	0.0	0.0	8.3	9.0
Control Delay (s)	0.0	0.0	0.0	0.0	14.7	10.6
Lane LOS					B	B
Approach Delay (s)	0.0		0.0		12.1	
Approach LOS					B	
Intersection Summary						
Average Delay			4.1			
Intersection Capacity Utilization			27.7%		ICU Level of Service A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
 18: Crowland Avenue & Carl Road

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	2	13	0	3	9	0	1	1	3	2	0	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	14	0	3	10	0	1	1	3	2	0	2
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	16	13	5	4								
Volume Left (vph)	2	3	1	2								
Volume Right (vph)	0	0	3	2								
Hadj (s)	0.15	0.08	-0.29	0.24								
Departure Headway (s)	4.1	4.0	3.7	4.2								
Degree Utilization, x	0.02	0.01	0.01	0.01								
Capacity (veh/h)	873	888	966	844								
Control Delay (s)	7.2	7.1	6.7	7.2								
Approach Delay (s)	7.2	7.1	6.7	7.2								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay				7.1								
Level of Service	A											
Intersection Capacity Utilization				13.3%			ICU Level of Service			A		
Analysis Period (min)	15											

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HCM Signalized Intersection Capacity Analysis

7: 11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔			↔	↔			↔			↔	
Volume (vph)	41	0	0	182	0	6	0	264	0	0	121	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5			5.5	5.5			5.2			5.2	
Lane Util. Factor	1.00			0.95	0.95			0.95			0.95	
Frt	1.00			1.00	0.99			1.00			1.00	
Flt Protected	0.95			0.95	0.96			1.00			1.00	
Satd. Flow (prot)	1770			1698	1689			3610			3539	
Flt Permitted	0.69			0.95	0.96			1.00			1.00	
Satd. Flow (perm)	1281			1698	1689			3610			3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	45	0	0	198	0	7	0	287	0	0	132	0
RTOR Reduction (vph)	0	0	0	0	32	0	0	0	0	0	0	0
Lane Group Flow (vph)	45	0	0	103	70	0	0	287	0	0	132	0
Heavy Vehicles (%)	2%	2%	2%	1%	2%	2%	2%	0%	2%	2%	2%	2%
Turn Type	Perm			Perm	NA			NA			NA	
Protected Phases					6			8			4	
Permitted Phases	2			6								
Actuated Green, G (s)	9.7			9.7	9.7			8.3			8.3	
Effective Green, g (s)	9.7			9.7	9.7			8.3			8.3	
Actuated g/C Ratio	0.34			0.34	0.34			0.29			0.29	
Clearance Time (s)	5.5			5.5	5.5			5.2			5.2	
Vehicle Extension (s)	3.0			3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	432			573	570			1044			1023	
v/s Ratio Prot								c0.08			0.04	
v/s Ratio Perm	0.04			c0.06	0.04							
v/c Ratio	0.10			0.18	0.12			0.27			0.13	
Uniform Delay, d1	6.5			6.7	6.6			7.9			7.5	
Progression Factor	1.00			1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.1			0.2	0.1			0.1			0.1	
Delay (s)	6.6			6.8	6.7			8.0			7.6	
Level of Service	A			A	A			A			A	
Approach Delay (s)		6.6			6.8			8.0			7.6	
Approach LOS		A			A			A			A	
Intersection Summary												
HCM 2000 Control Delay			7.5									
HCM 2000 Volume to Capacity ratio			0.22									
Actuated Cycle Length (s)			28.7					10.7				
Intersection Capacity Utilization		23.9%										
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

11: Montrose Rd & Biggar Rd/Lyons Creek Rd 11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (vph)	17	58	1	421	104	78	1	151	323	124	188	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.3			6.3			6.3			6.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.98			0.91			0.99	
Flt Protected		0.99			0.97			1.00			0.98	
Satd. Flow (prot)		1733			1717			1617			1738	
Flt Permitted		0.85			0.74			1.00			0.51	
Satd. Flow (perm)		1494			1317			1617			904	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	63	1	458	113	85	1	164	351	135	204	34
RTOR Reduction (vph)	0	1	0	0	7	0	0	93	0	0	4	0
Lane Group Flow (vph)	0	81	0	0	649	0	0	423	0	0	369	0
Heavy Vehicles (%)		6%		2%	4%	7%	8%	2%	6%	7%	13%	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)		40.0			40.0			30.0			30.0	
Effective Green, g (s)		40.0			40.0			30.0			30.0	
Actuated g/C Ratio		0.48			0.48			0.36			0.36	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		723			637			587			328	
v/s Ratio Prot												
v/s Ratio Perm		0.05			c0.49			0.26			c0.41	
v/c Ratio		0.11			1.02			0.72			1.12	
Uniform Delay, d1		11.6			21.3			22.7			26.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.2			40.6			7.5			87.4	
Delay (s)		11.8			61.9			30.2			113.7	
Level of Service		B			E			C			F	
Approach Delay (s)		11.8			61.9			30.2			113.7	
Approach LOS		B			E			C			F	
Intersection Summary												
HCM 2000 Control Delay			61.2									
HCM 2000 Volume to Capacity ratio			1.06									
Actuated Cycle Length (s)			82.6					12.6				
Intersection Capacity Utilization		102.4%										
Analysis Period (min)			15									
c Critical Lane Group												

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HCM Signalized Intersection Capacity Analysis
 14: McLeod Rd & QEW Southbound Off Ramp

11/27/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↓	↑↑					↓	↓	↓
Volume (vph)	0	1249	10	94	790	0	0	0	0	389	83	197
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.8		3.0	6.8					7.0	7.0	7.0
Lane Util. Factor		0.91		1.00	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Frt		1.00		1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00		0.95	1.00					0.95	0.97	1.00
Satd. Flow (prot)		5078		1770	3539					1629	1619	1568
Flt Permitted		1.00		0.13	1.00					0.95	0.97	1.00
Satd. Flow (perm)		5078		240	3539					1629	1619	1568
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1358	11	102	859	0	0	0	0	423	90	214
RTOR Reduction (vph)	0	1	0	0	0	0	0	0	0	0	0	92
Lane Group Flow (vph)	0	1368	0	102	859	0	0	0	0	254	259	122
Confl. Peds. (#/hr)			6	6						2	2	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	5%	13%	3%
Turn Type		NA		pm+pt	NA					Perm	NA	Perm
Protected Phases		4		3	8						6	
Permitted Phases				8						6		6
Actuated Green, G (s)		28.0		37.2	37.2					26.5	26.5	26.5
Effective Green, g (s)		28.0		37.2	37.2					26.5	26.5	26.5
Actuated g/C Ratio		0.36		0.48	0.48					0.34	0.34	0.34
Clearance Time (s)		6.8		3.0	6.8					7.0	7.0	7.0
Vehicle Extension (s)		3.0		3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)		1834		237	1698					557	553	536
v/s Ratio Prot		c0.27		0.03	c0.24							
v/s Ratio Perm				0.17						0.16	0.16	0.08
v/c Ratio		0.75		0.43	0.51					0.46	0.47	0.23
Uniform Delay, d1		21.6		13.0	13.8					19.9	20.0	18.2
Progression Factor		1.00		1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		1.7		1.3	0.2					2.7	2.8	1.0
Delay (s)		23.3		14.3	14.1					22.6	22.8	19.2
Level of Service		C		B	B					C	C	B
Approach Delay (s)		23.3			14.1			0.0			21.7	
Approach LOS		C			B			A			C	

Intersection Summary			
HCM 2000 Control Delay	20.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	77.5	Sum of lost time (s)	16.8
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
 15: QEW Northbound Off Ramp

11/27/2015



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↓	↑
Volume (vph)	1459	0	0	819	76	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.0			8.0	8.0	8.0
Lane Util. Factor	0.95			0.95	0.97	1.00
Frpb, ped/bikes	1.00			1.00	1.00	0.98
Flpb, ped/bikes	1.00			1.00	1.00	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	1.00			1.00	0.95	1.00
Satd. Flow (prot)	3505			3539	3367	1529
Flt Permitted	1.00			1.00	0.95	1.00
Satd. Flow (perm)	3505			3539	3367	1529
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1586	0	0	890	83	137
RTOR Reduction (vph)	0	0	0	0	0	15
Lane Group Flow (vph)	1586	0	0	890	83	122
Confl. Peds. (#/hr)			3	3		3
Heavy Vehicles (%)	3%	3%	2%	2%	4%	4%
Turn Type	NA			NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases						2
Actuated Green, G (s)	39.1			39.1	20.1	20.1
Effective Green, g (s)	39.1			39.1	20.1	20.1
Actuated g/C Ratio	0.52			0.52	0.27	0.27
Clearance Time (s)	8.0			8.0	8.0	8.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	1822			1840	899	408
v/s Ratio Prot	c0.45			0.25	0.02	
v/s Ratio Perm						c0.08
v/c Ratio	0.87			0.48	0.09	0.30
Uniform Delay, d1	15.8			11.6	20.7	21.9
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	4.9			0.2	0.2	1.9
Delay (s)	20.7			11.8	20.9	23.8
Level of Service	C			B	C	C
Approach Delay (s)	20.7			11.8	22.7	
Approach LOS	C			B	C	

Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	75.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX B
 GRAND NIAGARA SECONDARY PLAN
 BACKGROUND ANALYSIS REPORT
 APRIL 2016

HCM Unsignalized Intersection Capacity Analysis

1: Morris Rd & Grassy Brook Rd

11/27/2015

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Volume (veh/h)	0	2	2	2	2	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	2	2	2	2	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			2		8	1
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2		8	1
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1620		1012	1083
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	2	4	5			
Volume Left	0	2	2			
Volume Right	2	0	3			
cSH	1700	1620	1054			
Volume to Capacity	0.00	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	3.6	8.4			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.6	8.4			
Approach LOS			A			
Intersection Summary						
Average Delay			5.1			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

2: Biggar Rd & Morris Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	0	83	0	6	144	5	1	1	0	0	1	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	90	0	7	157	5	1	1	0	0	1	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	162			90			264	265	90	263	262	159
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	162			90			264	265	90	263	262	159
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	7.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	4.2
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1417			1505			684	638	968	687	640	683
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	90	168	2	2								
Volume Left	0	7	1	0								
Volume Right	0	5	0	1								
cSH	1417	1505	660	661								
Volume to Capacity	0.00	0.00	0.00	0.00								
Queue Length 95th (m)	0.0	0.1	0.1	0.1								
Control Delay (s)	0.0	0.3	10.5	10.5								
Lane LOS		A	B	B								
Approach Delay (s)	0.0	0.3	10.5	10.5								
Approach LOS			B	B								
Intersection Summary												
Average Delay				0.4								
Intersection Capacity Utilization				22.8%			ICU Level of Service	A				
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis

3: Crowland Avenue & Biggar Rd

11/27/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	1	80	0	8	151	1	1	0	1	1	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	87	0	9	164	1	1	0	1	1	0	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	165			87			272	272	87	272	271	165
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	165			87			272	272	87	272	271	165
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			100	100	100	100	100	100
cM capacity (veh/h)	1413			1509			676	631	972	676	631	880

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	88	174	2	2
Volume Left	1	9	1	1
Volume Right	0	1	1	1
cSH	1413	1509	797	765
Volume to Capacity	0.00	0.01	0.00	0.00
Queue Length 95th (m)	0.0	0.1	0.1	0.1
Control Delay (s)	0.1	0.4	9.5	9.7
Lane LOS	A	A	A	A
Approach Delay (s)	0.1	0.4	9.5	9.7
Approach LOS			A	A

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization	22.8%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

4: Willodell Rd & Lyons Creek Rd

11/27/2015



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Volume (veh/h)	448	9	25	579	5	23
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	487	10	27	629	5	25
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)	372					
pX, platoon unblocked						
vC, conflicting volume			497		861	248
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			497		861	248
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		98	97
cM capacity (veh/h)			1063		287	752

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	325	172	237	420	30
Volume Left	0	0	27	0	5
Volume Right	0	10	0	0	25
cSH	1700	1700	1063	1700	583
Volume to Capacity	0.19	0.10	0.03	0.25	0.05
Queue Length 95th (m)	0.0	0.0	0.6	0.0	1.3
Control Delay (s)	0.0	0.0	1.2	0.0	11.5
Lane LOS			A		B
Approach Delay (s)	0.0		0.4		11.5
Approach LOS					B

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization	42.7%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

8: Montrose Rd & Chippawa Creek Rd

11/27/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	39	34	34	0	206	40
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	42	37	37	0	224	43
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None	None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	298	224	267			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	298	224	267			
tC, single (s)	6.4	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	94	95	97			
cM capacity (veh/h)	674	798	1296			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	79	37	0	224	43	
Volume Left	42	37	0	0	0	
Volume Right	37	0	0	0	43	
cSH	727	1296	1700	1700	1700	
Volume to Capacity	0.11	0.03	0.00	0.13	0.03	
Queue Length 95th (m)	2.9	0.7	0.0	0.0	0.0	
Control Delay (s)	10.6	7.9	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	10.6	7.9		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay	2.9					
Intersection Capacity Utilization	28.4%					ICU Level of Service A
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

9: Montrose Rd & Oakwood Dr

11/27/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	96	18	217	87	15	213
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	20	236	95	16	232
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	547	283			330	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	547	283			330	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	79	97			99	
cM capacity (veh/h)	491	756			1229	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	124	330	248			
Volume Left	104	0	16			
Volume Right	20	95	0			
cSH	520	1700	1229			
Volume to Capacity	0.24	0.19	0.01			
Queue Length 95th (m)	7.4	0.0	0.3			
Control Delay (s)	14.1	0.0	0.6			
Lane LOS	B		A			
Approach Delay (s)	14.1	0.0	0.6			
Approach LOS	B					
Intersection Summary						
Average Delay	2.7					
Intersection Capacity Utilization	36.6%					ICU Level of Service A
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

10: Montrose Rd & Grassy Brook Rd

11/27/2015

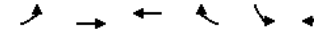


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕	↕	↔
Volume (veh/h)	2	1	1	224	385	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	1	1	243	418	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	665	420	421			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	665	420	421			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	100	100			
cM capacity (veh/h)	425	634	1138			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	3	245	421			
Volume Left	2	1	0			
Volume Right	1	0	2			
cSH	477	1138	1700			
Volume to Capacity	0.01	0.00	0.25			
Queue Length 95th (m)	0.2	0.0	0.0			
Control Delay (s)	12.6	0.0	0.0			
Lane LOS	B	A				
Approach Delay (s)	12.6	0.0	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		30.4%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

12: Lyons Creek Rd & Stanley Ave

11/27/2015

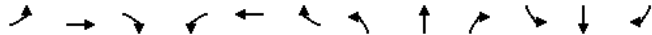


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↕	↔	↕	↕
Sign Control		Stop	Stop		Stop	
Volume (vph)	108	208	147	40	66	191
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	117	226	160	43	72	208
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total (vph)	117	226	203	72	208	
Volume Left (vph)	117	0	0	72	0	
Volume Right (vph)	0	0	43	0	208	
Hadj (s)	0.57	0.00	-0.09	0.53	-0.65	
Departure Headway (s)	6.1	5.5	5.4	6.4	5.3	
Degree Utilization, x	0.20	0.35	0.31	0.13	0.30	
Capacity (veh/h)	563	626	632	527	642	
Control Delay (s)	9.4	10.2	10.8	9.2	9.3	
Approach Delay (s)	9.9		10.8	9.3		
Approach LOS	A		B	A		
Intersection Summary						
Delay			9.9			
Level of Service			A			
Intersection Capacity Utilization			29.8%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

13: Carl Rd & Montrose Rd

11/27/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	13	2	1	0	2	0	0	354	2	1	592	11
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	2	1	0	2	0	0	385	2	1	643	12
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	2			3			367	33	3	228	34	2
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2			3			367	33	3	228	34	2
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			100	55	100	100	25	99
cM capacity (veh/h)	1620			1619			221	852	1081	466	853	1082

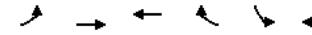
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	17	2	387	657
Volume Left	14	0	0	1
Volume Right	1	0	2	12
cSH	1620	1619	853	855
Volume to Capacity	0.01	0.00	0.45	0.77
Queue Length 95th (m)	0.2	0.0	19.1	60.7
Control Delay (s)	5.9	0.0	12.7	21.6
Lane LOS	A		B	C
Approach Delay (s)	5.9	0.0	12.7	21.6
Approach LOS			B	C

Intersection Summary			
Average Delay		18.1	
Intersection Capacity Utilization	46.8%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

16: QEW Southbound Off Ramp

11/27/2015



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	↕
Volume (veh/h)	0	317	462	0	72	29
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	345	502	0	78	32
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	502				674	251
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	502				674	251
tC, single (s)	4.1				6.9	7.0
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.4
p0 queue free %	100				80	96
cM capacity (veh/h)	1058				383	734

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	172	172	251	251	78	32
Volume Left	0	0	0	0	78	0
Volume Right	0	0	0	0	0	32
cSH	1700	1700	1700	1700	383	734
Volume to Capacity	0.10	0.10	0.15	0.15	0.20	0.04
Queue Length 95th (m)	0.0	0.0	0.0	0.0	6.0	1.1
Control Delay (s)	0.0	0.0	0.0	0.0	16.8	10.1
Lane LOS					C	B
Approach Delay (s)	0.0		0.0		14.9	
Approach LOS					B	

Intersection Summary			
Average Delay		1.7	
Intersection Capacity Utilization	31.0%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
 17: QEW Northbound Off Ramp & Lyons Creek Rd

11/27/2015

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↔	↔
Volume (veh/h)	373	0	0	773	163	356
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	405	0	0	840	177	387
Pedestrians	1					
Lane Width (m)	3.6					
Walking Speed (m/s)	1.2					
Percent Blockage	0					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			405		827	203
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			405		827	203
tC, single (s)			4.1		6.9	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		41	52
cM capacity (veh/h)			1150		302	807
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	203	203	420	420	177	387
Volume Left	0	0	0	0	177	0
Volume Right	0	0	0	0	0	387
cSH	1700	1700	1700	1700	302	807
Volume to Capacity	0.12	0.12	0.25	0.25	0.59	0.48
Queue Length 95th (m)	0.0	0.0	0.0	0.0	27.9	21.0
Control Delay (s)	0.0	0.0	0.0	0.0	32.5	13.5
Lane LOS					D	B
Approach Delay (s)	0.0		0.0		19.5	
Approach LOS					C	
Intersection Summary						
Average Delay			6.1			
Intersection Capacity Utilization			39.0%		ICU Level of Service A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
 18: Crowland Avenue & Carl Road

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	2	15	0	0	14	0	0	1	0	1	7	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	16	0	0	15	0	0	1	0	1	8	5
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	18	15	1	14								
Volume Left (vph)	2	0	0	1								
Volume Right (vph)	0	0	0	5								
Hadj (s)	0.06	0.03	0.03	-0.18								
Departure Headway (s)	4.0	4.0	4.0	3.8								
Degree Utilization, x	0.02	0.02	0.00	0.01								
Capacity (veh/h)	889	895	875	936								
Control Delay (s)	7.1	7.1	7.0	6.8								
Approach Delay (s)	7.1	7.1	7.0	6.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay				7.0								
Level of Service	A											
Intersection Capacity Utilization				13.3%		ICU Level of Service			A			
Analysis Period (min)	15											

APPENDIX B
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HCM Signalized Intersection Capacity Analysis
 7: Montrose Rd & Niagara Square Dr

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	0	0	0	131	0	79	0	174	0	0	230	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0			4.0			4.0	
Lane Util. Factor				0.95	0.95			0.95			0.95	
Frt				1.00	0.88			1.00			1.00	
Flt Protected				0.95	0.99			1.00			1.00	
Satd. Flow (prot)				1681	1544			3539			3539	
Flt Permitted				0.95	0.99			1.00			1.00	
Satd. Flow (perm)				1681	1544			3539			3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	142	0	86	0	189	0	0	250	0
RTOR Reduction (vph)	0	0	0	0	77	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	119	32	0	0	189	0	0	250	0
Turn Type	Perm			custom	NA			NA			NA	
Protected Phases					6l			2			6l	
Permitted Phases	4			8								
Actuated Green, G (s)				8.3	9.5			30.2			9.5	
Effective Green, g (s)				8.3	9.5			30.2			9.5	
Actuated g/C Ratio				0.14	0.16			0.50			0.16	
Clearance Time (s)				4.0	4.0			4.0			4.0	
Vehicle Extension (s)				3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)				232	244			1781			560	
v/s Ratio Prot								c0.05			c0.07	
v/s Ratio Perm				c0.07	0.02							
w/c Ratio				0.51	0.13			0.11			0.45	
Uniform Delay, d1				24.0	21.7			7.8			22.9	
Progression Factor				1.00	1.00			1.00			1.00	
Incremental Delay, d2				1.9	0.2			0.0			0.6	
Delay (s)				25.9	22.0			7.8			23.4	
Level of Service				C	C			A			C	
Approach Delay (s)		0.0			24.0			7.8			23.4	
Approach LOS		A			C			A			C	

Intersection Summary			
HCM 2000 Control Delay	19.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	19.1%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.
 c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
 11: Montrose Rd & Biggar Rd/Lyons Creek Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	3	137	201	93	153	15	250	51	79	14	36	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.92		0.99	0.99		0.97	0.97		0.97	1.00	
Flt Protected		1.00		0.98	0.98		0.97	0.97		0.99	0.99	
Satd. Flow (prot)		1714		1816	1816		1756	1829		1829	1829	
Flt Permitted		1.00		0.81	0.81		0.77	0.89		0.89	0.89	
Satd. Flow (perm)		1711		1488	1488		1392	1644		1644	1644	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	149	218	101	166	16	272	55	86	15	39	2
RTOR Reduction (vph)	0	129	0	0	5	0	0	23	0	0	1	0
Lane Group Flow (vph)	0	241	0	0	278	0	0	390	0	0	55	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	1%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			2	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)		16.0			16.0			16.0			16.0	
Effective Green, g (s)		16.0			16.0			16.0			16.0	
Actuated g/C Ratio		0.40			0.40			0.40			0.40	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Lane Grp Cap (vph)		684			595			556			657	
v/s Ratio Prot												
v/s Ratio Perm		0.14			c0.19			c0.28			0.03	
w/c Ratio		0.35			0.47			0.70			0.08	
Uniform Delay, d1		8.4			8.9			10.0			7.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.4			2.6			7.2			0.2	
Delay (s)		9.8			11.5			17.2			7.7	
Level of Service		A			B			B			A	
Approach Delay (s)		9.8			11.5			17.2			7.7	
Approach LOS		A			B			B			A	


Intersection Summary			
HCM 2000 Control Delay	12.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

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HCM Signalized Intersection Capacity Analysis
 14: McLeod Rd & QEW Southbound Off Ramp


11/27/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↑↑↑		↓	↑↑					↓	↓	↓	
Volume (vph)	0	749	28	128	494	0	0	0	0	337	54	217	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)		4.0		4.0	4.0					4.0	4.0	4.0	
Lane Util. Factor		0.91		1.00	0.95					0.95	0.95	1.00	
Frpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00	
Frt		0.99		1.00	1.00					1.00	1.00	0.85	
Flt Protected		1.00		0.95	1.00					0.95	0.97	1.00	
Satd. Flow (prot)		5055		1786	3471					1698	1688	1615	
Flt Permitted		1.00		0.30	1.00					0.95	0.97	1.00	
Satd. Flow (perm)		5055		569	3471					1698	1688	1615	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Adj. Flow (vph)	0	814	30	139	537	0	0	0	0	366	59	236	
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	0	0	0	106	
Lane Group Flow (vph)	0	834	0	139	537	0	0	0	0	212	213	130	
Confl. Peds. (#/hr)	9		4	4		9							
Heavy Vehicles (%)	2%	2%	2%	1%	4%	2%	2%	2%	2%	1%	9%	0%	
Turn Type	NA		Perm	NA						Perm	NA	Perm	
Protected Phases		4			8						6	6	
Permitted Phases				8						6		6	
Actuated Green, G (s)		16.0		16.0	16.0					16.0	16.0	16.0	
Effective Green, g (s)		16.0		16.0	16.0					16.0	16.0	16.0	
Actuated g/C Ratio		0.40		0.40	0.40					0.40	0.40	0.40	
Clearance Time (s)		4.0		4.0	4.0					4.0	4.0	4.0	
Lane Grp Cap (vph)		2022		227	1388					679	675	646	
v/s Ratio Prot		0.17			0.15					0.12	0.13	0.08	
v/s Ratio Perm				c0.24						0.31	0.32	0.20	
v/c Ratio		0.41		0.61	0.39					8.2	8.2	7.8	
Uniform Delay, d1		8.6		9.5	8.5					1.00	1.00	1.00	
Progression Factor		1.65		1.00	1.00					1.2	1.2	0.7	
Incremental Delay, d2		0.6		11.7	0.8					9.4	9.5	8.5	
Delay (s)		14.8		21.3	9.3					A	A	A	
Level of Service		B		C	A					A	A	A	
Approach Delay (s)		14.8			11.8			0.0				9.1	
Approach LOS		B			B			A				A	
Intersection Summary													
HCM 2000 Control Delay			12.1		HCM 2000 Level of Service					B			
HCM 2000 Volume to Capacity ratio			0.46										
Actuated Cycle Length (s)			40.0		Sum of lost time (s)					8.0			
Intersection Capacity Utilization			43.0%		ICU Level of Service					A			
Analysis Period (min)			15										

HCM Signalized Intersection Capacity Analysis
 15: QEW Northbound Off Ramp

11/27/2015



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↓	↑
Volume (vph)	900	0	0	567	78	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	4.0
Lane Util. Factor	0.95			0.95	0.97	1.00
Frpb, ped/bikes	1.00			1.00	1.00	1.00
Flpb, ped/bikes	1.00			1.00	1.00	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	1.00			1.00	0.95	1.00
Satd. Flow (prot)	3574			3574	3400	1583
Flt Permitted	1.00			1.00	0.95	1.00
Satd. Flow (perm)	3574			3574	3400	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	978	0	0	616	85	102
RTOR Reduction (vph)	0	0	0	0	0	22
Lane Group Flow (vph)	978	0	0	616	85	80
Confl. Peds. (#/hr)		12	12			
Heavy Vehicles (%)	1%	2%	2%	1%	3%	2%
Turn Type	NA			NA	Prot	Perm
Protected Phases		4		8	2	
Permitted Phases						2
Actuated Green, G (s)		16.0		16.0	16.0	16.0
Effective Green, g (s)		16.0		16.0	16.0	16.0
Actuated g/C Ratio		0.40		0.40	0.40	0.40
Clearance Time (s)		4.0		4.0	4.0	4.0
Lane Grp Cap (vph)		1429		1429	1360	633
v/s Ratio Prot		c0.27		0.17	0.03	
v/s Ratio Perm						c0.05
v/c Ratio		0.68		0.43	0.06	0.13
Uniform Delay, d1		9.9		8.7	7.4	7.6
Progression Factor		1.00		1.00	1.00	1.00
Incremental Delay, d2		2.7		1.0	0.1	0.4
Delay (s)		12.6		9.7	7.5	8.0
Level of Service		B		A	A	A
Approach Delay (s)		12.6		9.7	7.8	
Approach LOS		B		A	A	
Intersection Summary						
HCM 2000 Control Delay			11.1		HCM 2000 Level of Service	
HCM 2000 Volume to Capacity ratio			0.41			
Actuated Cycle Length (s)			40.0		Sum of lost time (s)	
Intersection Capacity Utilization			37.4%		ICU Level of Service	
Analysis Period (min)			15			

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HCM Unsignalized Intersection Capacity Analysis
 1: Morris Rd & Grassy Brook Rd

11/27/2015

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Volume (veh/h)	1	5	2	1	5	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	5	2	1	5	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			7		9	4
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			7		9	4
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1614		1010	1080
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	7	3	7			
Volume Left	0	2	5			
Volume Right	5	0	1			
cSH	1700	1614	1021			
Volume to Capacity	0.00	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.2			
Control Delay (s)	0.0	4.8	8.5			
Lane LOS		A	A			
Approach Delay (s)	0.0	4.8	8.5			
Approach LOS			A			
Intersection Summary						
Average Delay			4.4			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 2: Biggar Rd & Morris Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	1	39	0	4	64	1	1	1	1	3	1	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	42	0	4	70	1	1	1	1	3	1	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume		72		42			125	125	42	126	124	72
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol		72		42			125	125	42	126	124	72
tC, single (s)		4.1		4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)		2.2		2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %		100		100			100	100	100	100	100	100
cM capacity (veh/h)		1527		1567			845	762	1028	842	763	988
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	43	75	3	4								
Volume Left	1	4	1	3								
Volume Right	0	1	1	0								
cSH	1527	1567	865	821								
Volume to Capacity	0.00	0.00	0.00	0.01								
Queue Length 95th (m)	0.0	0.1	0.1	0.1								
Control Delay (s)	0.2	0.4	9.2	9.4								
Lane LOS	A	A	A	A								
Approach Delay (s)	0.2	0.4	9.2	9.4								
Approach LOS			A	A								
Intersection Summary												
Average Delay				0.9								
Intersection Capacity Utilization				15.9%			ICU Level of Service			A		
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
 3: Crowland Avenue & Biggar Rd

11/27/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (veh/h)	2	38	0	2	63	1	3	0	3	0	1	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	41	0	2	68	1	3	0	3	0	1	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	70			41			122	120	41	122	119	69
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	70			41			122	120	41	122	119	69
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1531			1568			849	769	1030	848	769	994

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	43	72	7	3
Volume Left	2	2	3	0
Volume Right	0	1	3	2
cSH	1531	1568	930	906
Volume to Capacity	0.00	0.00	0.01	0.00
Queue Length 95th (m)	0.0	0.0	0.2	0.1
Control Delay (s)	0.4	0.2	8.9	9.0
Lane LOS	A	A	A	A
Approach Delay (s)	0.4	0.2	8.9	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay		1.0	
Intersection Capacity Utilization	14.0%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
 4: Willodell Rd & Lyons Creek Rd

11/27/2015



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Volume (veh/h)	307	5	18	288	3	20
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	334	5	20	313	3	22
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)	372					
pX, platoon unblocked						
vC, conflicting volume			339		532	170
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			339		532	170
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		99	97
cM capacity (veh/h)			1217		470	845

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	222	117	124	209	25
Volume Left	0	0	20	0	3
Volume Right	0	5	0	0	22
cSH	1700	1700	1217	1700	765
Volume to Capacity	0.13	0.07	0.02	0.12	0.03
Queue Length 95th (m)	0.0	0.0	0.4	0.0	0.8
Control Delay (s)	0.0	0.0	1.4	0.0	9.9
Lane LOS			A		A
Approach Delay (s)	0.0		0.5		9.9
Approach LOS					A

Intersection Summary			
Average Delay		0.6	
Intersection Capacity Utilization	30.5%		ICU Level of Service A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

8: Montrose Rd & Chippawa Creek Rd

11/27/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	36	42	12	138	169	31
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	39	46	13	150	184	34
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None	None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	360	184	217			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	360	184	217			
tC, single (s)	6.5	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.2			
p0 queue free %	94	95	99			
cM capacity (veh/h)	615	859	1352			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	85	13	150	184	34	
Volume Left	39	13	0	0	0	
Volume Right	46	0	0	0	34	
cSH	726	1352	1700	1700	1700	
Volume to Capacity	0.12	0.01	0.09	0.11	0.02	
Queue Length 95th (m)	3.2	0.2	0.0	0.0	0.0	
Control Delay (s)	10.6	7.7	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	10.6	0.6		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay	2.1					
Intersection Capacity Utilization	21.2%					
ICU Level of Service	A					
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

9: Montrose Rd & Oakwood Dr

11/27/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	101	18	148	77	22	190
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	110	20	161	84	24	207
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	457	203			245	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	457	203			245	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	80	98			98	
cM capacity (veh/h)	551	838			1304	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	129	245	230			
Volume Left	110	0	24			
Volume Right	20	84	0			
cSH	581	1700	1304			
Volume to Capacity	0.22	0.14	0.02			
Queue Length 95th (m)	6.8	0.0	0.4			
Control Delay (s)	13.0	0.0	1.0			
Lane LOS	B		A			
Approach Delay (s)	13.0	0.0	1.0			
Approach LOS	B					
Intersection Summary						
Average Delay	3.1					
Intersection Capacity Utilization	40.4%					
ICU Level of Service	A					
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

10: Montrose Rd & Grassy Brook Rd

11/27/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	6	1	0	224	294	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	1	0	243	320	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	563	320	320			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	563	320	320			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	100	100			
cM capacity (veh/h)	487	721	1240			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	8	243	320			
Volume Left	7	0	0			
Volume Right	1	0	0			
cSH	511	1240	1700			
Volume to Capacity	0.01	0.00	0.19			
Queue Length 95th (m)	0.4	0.0	0.0			
Control Delay (s)	12.1	0.0	0.0			
Lane LOS	B					
Approach Delay (s)	12.1	0.0	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		0.2				
Intersection Capacity Utilization		25.5%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

12: Lyons Creek Rd & Stanley Ave

11/27/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control	Stop	Stop			Stop	
Volume (vph)	102	259	182	54	59	76
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	111	282	198	59	64	83
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total (vph)	111	282	257	64	83	
Volume Left (vph)	111	0	0	64	0	
Volume Right (vph)	0	0	59	0	83	
Hadj (s)	0.58	0.02	-0.10	0.58	-0.63	
Departure Headway (s)	5.8	5.2	5.1	6.7	5.4	
Degree Utilization, x	0.18	0.41	0.36	0.12	0.12	
Capacity (veh/h)	597	672	682	501	607	
Control Delay (s)	8.8	10.5	11.0	9.3	8.0	
Approach Delay (s)	10.1		11.0	8.6		
Approach LOS	B		B	A		
Intersection Summary						
Delay			10.1			
Level of Service			B			
Intersection Capacity Utilization			31.8%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

13: Carl Rd & Montrose Rd

11/27/2015

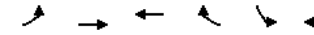


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	6	0	1	0	0	2	0	316	0	0	317	9
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	0	1	0	0	2	0	343	0	0	345	10
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	2			1			197	16	1	186	15	1
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2			1			197	16	1	186	15	1
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	61	100	100	61	99
cM capacity (veh/h)	1620			1622			522	875	1084	536	874	1083
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	8	2	343	354								
Volume Left	7	0	0	0								
Volume Right	1	2	0	10								
cSH	1620	1622	875	878								
Volume to Capacity	0.00	0.00	0.39	0.40								
Queue Length 95th (m)	0.1	0.0	15.1	15.8								
Control Delay (s)	6.2	0.0	11.7	11.8								
Lane LOS	A		B	B								
Approach Delay (s)	6.2	0.0	11.7	11.8								
Approach LOS			B	B								
Intersection Summary												
Average Delay			11.7									
Intersection Capacity Utilization		29.2%		ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

16: QEW Southbound Off Ramp

11/27/2015



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	↕
Volume (veh/h)	0	301	126	0	169	225
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	327	137	0	184	245
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	137				301	68
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	137				301	68
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				72	75
cM capacity (veh/h)	1445				667	981
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	164	164	68	68	184	245
Volume Left	0	0	0	0	184	0
Volume Right	0	0	0	0	0	245
cSH	1700	1700	1700	1700	667	981
Volume to Capacity	0.10	0.10	0.04	0.04	0.28	0.25
Queue Length 95th (m)	0.0	0.0	0.0	0.0	9.0	7.9
Control Delay (s)	0.0	0.0	0.0	0.0	12.4	9.9
Lane LOS					B	A
Approach Delay (s)	0.0		0.0		11.0	
Approach LOS					B	
Intersection Summary						
Average Delay			5.3			
Intersection Capacity Utilization		24.3%		ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 17: QEW Northbound Off Ramp & Lyons Creek Rd

11/27/2015

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↔	↔
Volume (veh/h)	286	0	0	122	29	30
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	311	0	0	133	32	33
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			311		377	155
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			311		377	155
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		95	96
cM capacity (veh/h)			1246		597	863
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	155	155	66	66	32	33
Volume Left	0	0	0	0	32	0
Volume Right	0	0	0	0	0	33
cSH	1700	1700	1700	1700	597	863
Volume to Capacity	0.09	0.09	0.04	0.04	0.05	0.04
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.3	0.9
Control Delay (s)	0.0	0.0	0.0	0.0	11.4	9.3
Lane LOS					B	A
Approach Delay (s)	0.0		0.0		10.3	
Approach LOS					B	
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			17.9%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 18: Crowland Avenue & Carl Road

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	2	9	0	1	4	0	1	4	1	0	3	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	10	0	1	4	0	1	4	1	0	3	1
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	12	5	7	4								
Volume Left (vph)	2	1	1	0								
Volume Right (vph)	0	0	1	1								
Hadj (s)	0.07	0.07	-0.03	-0.12								
Departure Headway (s)	4.0	4.0	3.9	3.8								
Degree Utilization, x	0.01	0.01	0.01	0.00								
Capacity (veh/h)	891	890	913	931								
Control Delay (s)	7.1	7.0	6.9	6.8								
Approach Delay (s)	7.1	7.0	6.9	6.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.0									
Level of Service			A									
Intersection Capacity Utilization			13.3%		ICU Level of Service							A
Analysis Period (min)			15									

APPENDIX B
GRAND NIAGARA SECONDARY PLAN
BACKGROUND ANALYSIS REPORT
APRIL 2016

HCM Signalized Intersection Capacity Analysis
6: Oakwood Dr & McLeod Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔		↔	↔	↔	↔	↔	↔
Volume (vph)	191	501	139	87	605	0	97	4	63	0	3	144
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	-1.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.85	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3539		1770	1863	1583		1589	
Flt Permitted	0.40	1.00	1.00	0.37	1.00		0.64	1.00	1.00		1.00	
Satd. Flow (perm)	748	3539	1583	692	3539		1196	1863	1583		1589	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	208	545	151	95	658	0	105	4	68	0	3	157
RTOR Reduction (vph)	0	0	94	0	0	0	0	0	38	0	87	0
Lane Group Flow (vph)	208	545	57	95	658	0	105	4	30	0	73	0
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	NA
Protected Phases		4		3	8			2			6	
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	29.9	29.9	29.9	37.7	37.7		36.3	36.3	36.3		36.3	
Effective Green, g (s)	33.9	33.9	33.9	41.7	41.7		40.3	40.3	40.3		40.3	
Actuated g/C Ratio	0.38	0.38	0.38	0.46	0.46		0.45	0.45	0.45		0.45	
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0		8.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5		2.5	
Lane Grp Cap (vph)	281	1333	596	426	1639		535	834	708		711	
v/s Ratio Prot		0.15		0.02	c0.19			0.00			0.05	
v/s Ratio Perm	c0.28		0.04	0.08			c0.09		0.02			
v/c Ratio	0.74	0.41	0.10	0.22	0.40		0.20	0.00	0.04		0.10	
Uniform Delay, d1	24.2	20.7	18.1	13.9	15.9		15.0	13.8	14.0		14.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2	9.5	0.1	0.1	0.2	0.1		0.8	0.0	0.1		0.3	
Delay (s)	33.8	20.8	18.2	14.1	16.0		15.9	13.8	14.1		14.7	
Level of Service	C	C	B	B	B		B	B	B		B	
Approach Delay (s)		23.4			15.8			15.1			14.7	
Approach LOS		C			B			B			B	
Intersection Summary												
HCM 2000 Control Delay		19.1			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.43										
Actuated Cycle Length (s)		90.0			Sum of lost time (s)				8.0			
Intersection Capacity Utilization		56.4%			ICU Level of Service				B			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Montrose Rd & Biggar Rd/Lyons Creek Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (vph)	13	66	1	224	61	84	2	134	379	31	48	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.3			2.3			2.3			2.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.97			0.90			0.99	
Flt Protected		0.99			0.97			1.00			0.98	
Satd. Flow (prot)		1771			1639			1645			1554	
Flt Permitted		0.93			0.79			1.00			0.79	
Satd. Flow (perm)		1659			1331			1645			1251	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	72	1	243	66	91	2	146	412	34	52	8
RTOR Reduction (vph)	0	1	0	0	15	0	0	105	0	0	4	0
Lane Group Flow (vph)	0	86	0	0	385	0	0	455	0	0	90	0
Heavy Vehicles (%)	8%	6%	2%	9%	5%	12%	2%	4%	4%	16%	23%	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)		27.4			27.4			30.4			30.4	
Effective Green, g (s)		31.4			31.4			34.4			34.4	
Actuated g/C Ratio		0.45			0.45			0.49			0.49	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		739			593			803			611	
v/s Ratio Prot												
v/s Ratio Perm		0.05			c0.29			0.28			0.07	
v/c Ratio		0.12			0.65			0.57			0.15	
Uniform Delay, d1		11.4			15.2			12.7			9.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.2			4.0			2.9			0.5	
Delay (s)		11.6			19.2			15.6			10.4	
Level of Service		B			B			B			B	
Approach Delay (s)		11.6			19.2			15.6			10.4	
Approach LOS		B			B			B			B	
Intersection Summary												
HCM 2000 Control Delay		16.1			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.60										
Actuated Cycle Length (s)		70.4			Sum of lost time (s)				4.6			
Intersection Capacity Utilization		64.6%			ICU Level of Service				C			
Analysis Period (min)		15										
c Critical Lane Group												

APPENDIX B
 GRAND NIAGARA SECONDARY PLAN
 BACKGROUND ANALYSIS REPORT
 APRIL 2016

HCM Signalized Intersection Capacity Analysis

6: Oakwood Dr & McLeod Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	31	833	373	249	956	13	359	22	271	18	12	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	-1.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.99	1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.99	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1767	3574	1559	1769	3601		1793	1863	1563	1768	1591	
Flt Permitted	0.24	1.00	1.00	0.14	1.00		0.69	1.00	1.00	0.74	1.00	
Satd. Flow (perm)	442	3574	1559	260	3601		1304	1863	1563	1380	1591	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	905	405	271	1039	14	390	24	295	20	13	89
RTOR Reduction (vph)	0	0	268	0	1	0	0	0	168	0	38	0
Lane Group Flow (vph)	34	905	137	271	1052	0	390	24	127	20	64	0
Confl. Peds. (#/hr)	5	14	14	14	7	5	7	1	1	1	1	7
Heavy Vehicles (%)	2%	1%	1%	2%	0%	2%	0%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	NA	Perm	Perm	NA	NA	NA
Protected Phases	3 8 8											
Permitted Phases	4 4 8 2 2 6 6											
Actuated Green, G (s)	26.5	26.5	26.5	39.4	39.4		34.6	34.6	34.6	34.6	34.6	
Effective Green, g (s)	30.5	30.5	30.5	43.4	43.4		38.6	38.6	38.6	38.6	38.6	
Actuated g/C Ratio	0.34	0.34	0.34	0.48	0.48		0.43	0.43	0.43	0.43	0.43	
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0	8.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	149	1211	528	358	1736		559	799	670	591	682	
v/s Ratio Prot	c0.25 c0.12 0.29 0.01 0.04											
v/s Ratio Perm	0.08 0.09 0.25 c0.30 0.08 0.01											
v/c Ratio	0.23 0.75 0.26 0.76 0.61 0.70 0.03 0.19 0.03 0.09											
Uniform Delay, d1	21.3 26.3 21.6 17.7 17.0 20.9 14.9 16.0 14.9 15.3											
Progression Factor	1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00											
Incremental Delay, d2	0.6 2.4 0.2 8.4 0.5 7.1 0.1 0.6 0.1 0.3											
Delay (s)	21.9 28.8 21.8 26.2 17.6 28.0 14.9 16.6 15.0 15.6											
Level of Service	C C C C B C B B B B											
Approach Delay (s)	26.5 19.3 22.8 15.5											
Approach LOS	C B C B											
Intersection Summary												
HCM 2000 Control Delay	22.6		HCM 2000 Level of Service				C					
HCM 2000 Volume to Capacity ratio	0.70											
Actuated Cycle Length (s)	90.0				Sum of lost time (s)				8.0			
Intersection Capacity Utilization	73.5%				ICU Level of Service				D			
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

11: Montrose Rd & Biggar Rd/Lyons Creek Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	58	1	421	104	78	1	151	323	124	188	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.3 2.3 2.3											
Lane Util. Factor	1.00 1.00 1.00											
Frt	1.00 0.98 0.91 0.99											
Flt Protected	0.99 0.97 1.00 0.98											
Satd. Flow (prot)	1733 1717 1617 1738											
Flt Permitted	0.86 0.76 1.00 0.60											
Satd. Flow (perm)	1515 1345 1617 1060											
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	63	1	458	113	85	1	164	351	135	204	34
RTOR Reduction (vph)	0 0 0 6 0 0 92 0 0 4 0											
Lane Group Flow (vph)	0 82 0 0 650 0 0 424 0 0 369 0											
Heavy Vehicles (%)	6% 9% 2% 4% 7% 8% 2% 6% 7% 13% 2% 3%											
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	4 4 8 8 2 2 6 6											
Permitted Phases	4 8 2 6											
Actuated Green, G (s)	37.7 37.7 32.3 32.3											
Effective Green, g (s)	41.7 41.7 36.3 36.3											
Actuated g/C Ratio	0.50 0.50 0.44 0.44											
Clearance Time (s)	6.3 6.3 6.3 6.3											
Vehicle Extension (s)	6.0 6.0 6.0 6.0											
Lane Grp Cap (vph)	764 679 710 465											
v/s Ratio Prot	0.05 c0.48 0.26 c0.35											
v/c Ratio	0.11 0.96 0.60 0.79											
Uniform Delay, d1	10.7 19.6 17.6 19.9											
Progression Factor	1.00 1.00 1.00 1.00											
Incremental Delay, d2	0.2 24.9 3.7 13.0											
Delay (s)	10.9 44.5 21.3 32.9											
Level of Service	B D C C											
Approach Delay (s)	10.9 44.5 21.3 32.9											
Approach LOS	B D C C											
Intersection Summary												
HCM 2000 Control Delay	32.8				HCM 2000 Level of Service				C			
HCM 2000 Volume to Capacity ratio	0.88											
Actuated Cycle Length (s)	82.6				Sum of lost time (s)				4.6			
Intersection Capacity Utilization	96.7%				ICU Level of Service				F			
Analysis Period (min)	15											
c Critical Lane Group												

APPENDIX B
 GRAND NIAGARA SECONDARY PLAN
 BACKGROUND ANALYSIS REPORT
 APRIL 2016

HCM Signalized Intersection Capacity Analysis

6: Oakwood Dr & McLeod Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	27	741	502	293	717	35	519	15	342	16	3	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	-1.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.99	1.00
Fipb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99	1.00	1.00	0.85	1.00	0.87	1.00	0.87
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1770	3574	1574	1769	3515	1764	1863	1575	1764	1563	1563	1563
Flt Permitted	0.32	1.00	1.00	0.20	1.00	0.74	1.00	1.00	0.75	1.00	1.00	1.00
Satd. Flow (perm)	592	3574	1574	379	3515	1371	1863	1575	1387	1563	1563	1563
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	805	546	318	779	38	564	16	372	17	3	26
RTOR Reduction (vph)	0	0	352	0	4	0	0	0	127	0	14	0
Lane Group Flow (vph)	29	805	194	318	813	0	564	16	245	17	15	0
Confl. Peds. (#/hr)			4	4			3		3	3		3
Heavy Vehicles (%)	2%	1%	1%	2%	2%	2%	2%	2%	1%	2%	2%	4%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	NA	Perm	Perm	NA	NA	NA
Protected Phases		4		3	8			2		6		6
Permitted Phases	4		4	8			2		2	6		6
Actuated Green, G (s)	28.0	28.0	28.0	37.0	37.0		37.0	37.0	37.0	37.0		37.0
Effective Green, g (s)	32.0	32.0	32.0	41.0	41.0		41.0	41.0	41.0	41.0		41.0
Actuated g/C Ratio	0.36	0.36	0.36	0.46	0.46		0.46	0.46	0.46	0.46		0.46
Clearance Time (s)	8.0	8.0	8.0	3.0	8.0		8.0	8.0	8.0	8.0		8.0
Lane Grp Cap (vph)	210	1270	559	327	1601		624	848	717	631		712
v/s Ratio Prot		c0.23		c0.11	0.23			0.01				0.01
v/s Ratio Perm	0.05		0.12	0.33			c0.41		0.16	0.01		
v/c Ratio	0.14	0.63	0.35	0.97	0.51		0.90	0.02	0.34	0.03		0.02
Uniform Delay, d1	19.7	24.1	21.3	19.1	17.4		22.7	13.5	15.8	13.5		13.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	1.4	2.4	1.7	43.3	1.2		18.9	0.0	1.3	0.1		0.1
Delay (s)	21.0	26.5	23.0	62.3	18.5		41.6	13.5	17.1	13.6		13.5
Level of Service	C	C	C	E	B		D	B	B	B		B
Approach Delay (s)		25.0			30.8			31.5				13.5
Approach LOS		C			C			C				B
Intersection Summary												
HCM 2000 Control Delay	28.5		HCM 2000 Level of Service				C					
HCM 2000 Volume to Capacity ratio	0.78											
Actuated Cycle Length (s)	90.0											
Intersection Capacity Utilization	85.0%		ICU Level of Service				E					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

11: Montrose Rd & Biggar Rd/Lyons Creek Rd

11/27/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Volume (vph)	3	137	201	93	153	15	250	51	79	14	36	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		0.0			0.0			0.0			0.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.92			0.99			0.97			0.97	
Flt Protected		1.00			0.98			0.97			0.99	
Satd. Flow (prot)		1714			1816			1756			1829	
Flt Permitted		1.00			0.84			0.80			0.91	
Satd. Flow (perm)		1711			1545			1452			1686	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	149	218	101	166	16	272	55	86	15	39	2
RTOR Reduction (vph)	0	109	0	0	6	0	0	24	0	0	1	0
Lane Group Flow (vph)	0	261	0	0	278	0	0	390	0	0	55	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	1%	2%	2%	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)		16.0			16.0			16.0			16.0	
Effective Green, g (s)		20.0			20.0			20.0			20.0	
Actuated g/C Ratio		0.50			0.50			0.50			0.50	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Lane Grp Cap (vph)		855			772			726			843	
v/s Ratio Prot												
v/s Ratio Perm		0.15			c0.18			c0.27			0.03	
v/c Ratio		0.31			0.36			0.54			0.07	
Uniform Delay, d1		5.9			6.1			6.8			5.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.9			1.3			2.8			0.1	
Delay (s)		6.8			7.4			9.7			5.3	
Level of Service		A			A			A			A	
Approach Delay (s)		6.8			7.4			9.7			5.3	
Approach LOS		A			A			A			A	
Intersection Summary												
HCM 2000 Control Delay	7.9		HCM 2000 Level of Service				A					
HCM 2000 Volume to Capacity ratio	0.39											
Actuated Cycle Length (s)	40.0											
Intersection Capacity Utilization	71.8%		ICU Level of Service				C					
Analysis Period (min)	15											
c Critical Lane Group												