Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				325		633
Volume				11		5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

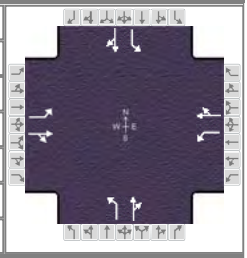
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	13					11		5
C(m) (vph)	1144					325		633
v/c	0.01					0.03		0.01
95% queue length	0.03					0.10		0.02
Control Delay	8.2					16.5		10.7
LOS	A					C		B
Approach Delay							14.7	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.2	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst	M. McDonald	Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	AM	PHF	0.95
Urban Street	IL Rte 176	Analysis Year	2013	Analysis Period	1> 7:00
Intersection	IL RTE 176 and Haligus…	File Name	Exist Haligus AM.xus		
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	13	403	18	38	268	2	22	70	79	1	18	8

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.0	54.9	2.2	0.8	10.1	0.0	1	2	3	4	5	6	7	8
Yellow	3.5	4.0	3.5	0.0	4.0	0.0								
Red	0.0	2.0	0.0	0.0	2.0	0.0								

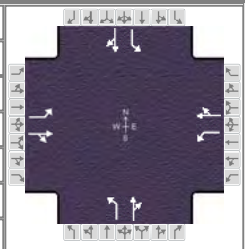
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	6.5	60.9	6.5	60.9	6.5	16.9	5.7	16.1
Change Period, ($Y+R_c$), s	3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0
Max Allow Headway (*MAH*), s	3.9	0.0	3.9	0.0	4.0	5.1	4.0	5.1
Queue Clearance Time (g_s), s	2.2		2.7		3.0	10.0	2.0	3.2
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0	0.0	1.0	0.0	1.0
Phase Call Probability	1.00		1.00		0.99	0.99	0.72	0.99
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	14	443		40	284		23	157		1	27	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1813		1810	1773		1810	1717		1810	1800	
Queue Service Time (g_s), s	0.2	11.3		0.7	6.7		1.0	8.0		0.0	1.2	
Cycle Queue Clearance Time (g_c), s	0.2	11.3		0.7	6.7		1.0	8.0		0.0	1.2	
Green Ratio (*g/C*)	0.64	0.61		0.64	0.61		0.15	0.12		0.14	0.11	
Capacity (*c*), veh/h	730	1106		590	1082		278	208		137	202	
Volume-to-Capacity Ratio (*X*)	0.019	0.401		0.068	0.263		0.083	0.754		0.008	0.136	
Available Capacity (c_a), veh/h	1432	1106		1372	1082		711	865		787	890	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	6.6		0.4	3.8		0.8	6.6		0.0	1.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.03	0.00		0.08	0.00		0.17	0.00		0.01	0.00	
Uniform Delay (d_1), s/veh	6.1	9.0		6.8	8.1		33.3	38.3		34.1	36.0	
Incremental Delay (d_2), s/veh	0.0	1.1		0.0	0.6		0.1	7.7		0.0	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	6.1	10.1		6.9	8.7		33.4	45.9		34.1	36.5	
Level of Service (LOS)	A	B		A	A		C	D		C	D	
Approach Delay, s/veh / LOS	10.0	B		8.5	A		44.3	D		36.4	D	
Intersection Delay, s/veh / LOS	16.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.2	A	1.0	A	0.8	A	0.5	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst	M. McDonald	Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	PM	PHF	0.95
Urban Street	IL Rte 176	Analysis Year	2013	Analysis Period	1> 7:00
Intersection	IL RTE 176 and Haligus…	File Name	Exist Haligus PM.xus		
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	15	316	42	79	407	4	20	27	48	4	57	21

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	3.0	0.6	56.7	2.8	7.9	0.0	5	6	7	8
Yellow	3.5	0.0	4.0	3.5	4.0	0.0				
Red	0.0	0.0	2.0	0.0	2.0	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	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	6.5	62.7	7.1	63.3	6.3	13.9	6.3	13.9
Change Period, ($Y+R_c$), s	3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0
Max Allow Headway (*MAH*), s	3.9	0.0	3.9	0.0	4.0	5.1	4.0	5.1
Queue Clearance Time (g_s), s	2.3		3.4		2.9	6.0	2.2	5.9
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0	0.0	0.6	0.0	0.6
Phase Call Probability	1.00		1.00		0.93	0.99	0.93	0.98
Max Out Probability	0.00		0.00		1.00	0.00	0.49	0.00

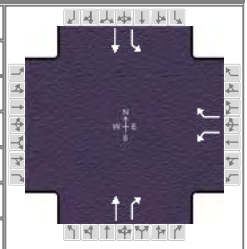
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	16	377		83	433		21	79		4	82	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1789		1810	1773		1810	1687		1810	1812	
Queue Service Time (g_s), s	0.3	8.9		1.4	10.6		0.9	4.0		0.2	3.9	
Cycle Queue Clearance Time (g_c), s	0.3	8.9		1.4	10.6		0.9	4.0		0.2	3.9	
Green Ratio (*g/C*)	0.66	0.63		0.67	0.64		0.12	0.09		0.12	0.09	
Capacity (*c*), veh/h	623	1127		695	1128		166	148		194	160	
Volume-to-Capacity Ratio (*X*)	0.025	0.334		0.120	0.383		0.127	0.532		0.022	0.514	
Available Capacity (c_a), veh/h	910	1127		991	1128		241	388		269	417	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	5.0		0.7	5.8		0.7	3.2		0.1	3.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.03	0.00		0.15	0.00		0.16	0.00		0.03	0.00	
Uniform Delay (d_1), s/veh	6.0	7.8		5.6	7.9		35.5	39.3		35.1	39.2	
Incremental Delay (d_2), s/veh	0.0	0.8		0.1	1.0		0.3	4.2		0.0	3.6	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	6.0	8.6		5.7	8.9		35.9	43.4		35.1	42.8	
Level of Service (LOS)	A	A		A	A		D	D		D	D	
Approach Delay, s/veh / LOS	8.5	A		8.3	A		41.8	D		42.4	D	
Intersection Delay, s/veh / LOS	14.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	1.3	A	0.7	A	0.6	A

Appendix E – HCS 2010 Reports – Proposed Traffic/Conditions

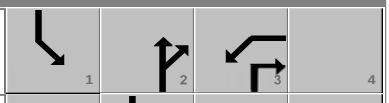
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst	M. McDonald	Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	AM	PHF	0.95
Urban Street	IL Rte 176	Analysis Year	2030	Analysis Period	1> 7:00
Intersection	IL TRE 176 and IL Rte 176	File Name	Prop IL 47 AM.xus		
Project Description	Proposed AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				119		281		570	166	379	615	

Signal Information			
Cycle, s	100.0	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	9.5	54.0	21.0	0.0	0.0	0.0
Yellow	3.5	4.0	4.0	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

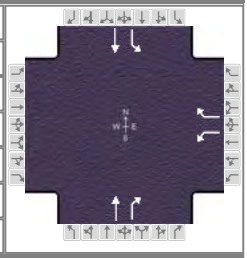
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				27.0		60.0	13.0	73.0
Change Period, ($Y+R_c$), s				6.0		6.0	3.5	6.0
Max Allow Headway (*MAH*), s				8.0		0.0	7.9	0.0
Queue Clearance Time (g_s), s				21.1			11.5	
Green Extension Time (g_e), s				0.0		0.0	0.0	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				125		296		600	175	399	647	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1707		1519		1835	1477	1675	1852	
Queue Service Time (g_s), s				6.3		19.1		22.4	3.4	9.5	17.7	
Cycle Queue Clearance Time (g_c), s				6.3		19.1		22.4	3.4	9.5	17.7	
Green Ratio (*g/C*)				0.21		0.21		0.54	0.75	0.66	0.67	
Capacity (*c*), veh/h				358		319		991	1108	475	1241	
Volume-to-Capacity Ratio (*X*)				0.349		0.927		0.606	0.158	0.840	0.522	
Available Capacity (c_a), veh/h				358		319		991	1108	475	1241	
Back of Queue (*Q*), veh/ln (95 th percentile)				4.8		14.8		13.4	1.2	9.2	9.5	
Queue Storage Ratio (*RQ*) (95 th percentile)				0.26		0.81		0.00	0.14	0.94	0.00	
Uniform Delay (d_1), s/veh				33.7		38.8		15.7	3.5	16.1	8.4	
Incremental Delay (d_2), s/veh				2.7		34.8		2.7	0.3	16.2	1.6	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				36.3		73.6		18.5	3.8	32.3	9.9	
Level of Service (LOS)				D		E		B	A	C	A	
Approach Delay, s/veh / LOS	0.0			62.5		E	15.2		B	18.5		B
Intersection Delay, s/veh / LOS	25.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	2.2	B

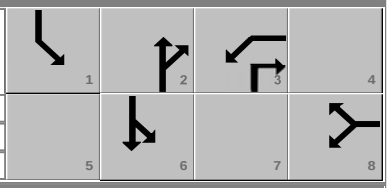
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst	M. McDonald	Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	AM	PHF	0.95
Urban Street	IL Rte 176	Analysis Year	2030	Analysis Period	1> 7:00
Intersection	IL Rte 176 and IL Rte 176	File Name	Prop IL 47 PM.xus		
Project Description	Proposed PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				177		435		760	164	348	685	

Signal Information			
Cycle, s	120.0	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	7.5	67.0	30.0	0.0	0.0	0.0
Yellow	3.5	4.0	4.0	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

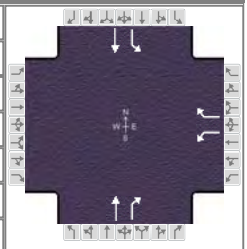
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				36.0		73.0	11.0	84.0
Change Period, ($Y+R_c$), s				6.0		6.0	3.5	6.0
Max Allow Headway (*MAH*), s				8.1		0.0	7.9	0.0
Queue Clearance Time (g_s), s				32.0			9.5	
Green Extension Time (g_e), s				0.0		0.0	0.0	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				186		458		800	173	366	721	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1707		1519		1835	1477	1675	1852	
Queue Service Time (g_s), s				11.0		30.0		41.0	3.0	7.5	26.8	
Cycle Queue Clearance Time (g_c), s				11.0		30.0		41.0	3.0	7.5	26.8	
Green Ratio (*g/C*)				0.25		0.25		0.56	0.81	0.64	0.65	
Capacity (*c*), veh/h				427		380		1024	1194	303	1204	
Volume-to-Capacity Ratio (*X*)				0.437		1.206		0.781	0.145	1.207	0.599	
Available Capacity (c_a), veh/h				427		380		1024	1194	303	1204	
Back of Queue (*Q*), veh/ln (95 th percentile)				8.3		33.9		23.6	1.0	23.4	14.9	
Queue Storage Ratio (*RQ*) (95 th percentile)				0.46		1.85		0.00	0.12	2.40	0.00	
Uniform Delay (d_1), s/veh				37.9		45.0		20.8	2.5	28.9	12.0	
Incremental Delay (d_2), s/veh				3.2		115.0		5.9	0.3	120.2	2.2	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				41.1		160.0		26.7	2.8	149.1	14.2	
Level of Service (LOS)				D		F		C	A	F	B	
Approach Delay, s/veh / LOS	0.0			125.6		F	22.4		C	59.7		E
Intersection Delay, s/veh / LOS	62.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	0.7	A
Bicycle LOS Score / LOS				F	2.1	B	2.3	B

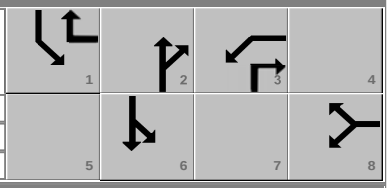
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst	M. McDonald	Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	AM	PHF	0.95
Urban Street	IL Rte 47	Analysis Year	2030	Analysis Period	1> 7:00
Intersection	IL Rte 47 and IL Rte 176	File Name	Prop IL 47 AM_WB RT Overlap.xus		
Project Description	Proposed AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				119		281		570	166	379	615	

Signal Information			
Cycle, s	100.0	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	17.1	52.4	15.0	0.0	0.0	0.0
Yellow	3.5	4.0	4.0	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

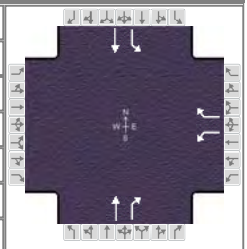
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				21.0		58.4	20.6	79.0
Change Period, ($Y+R_c$), s				6.0		6.0	3.5	6.0
Max Allow Headway (*MAH*), s				8.0		0.0	7.9	0.0
Queue Clearance Time (g_s), s				17.0			10.9	
Green Extension Time (g_e), s				0.0		0.0	6.1	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.03	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				125		296		600	175	399	647	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1707		1519		1835	1477	1675	1852	
Queue Service Time (g_s), s				6.7		15.0		23.1	4.4	8.9	14.5	
Cycle Queue Clearance Time (g_c), s				6.7		15.0		23.1	4.4	8.9	14.5	
Green Ratio (*g/C*)				0.15		0.32		0.52	0.67	0.71	0.73	
Capacity (*c*), veh/h				256		487		962	996	584	1352	
Volume-to-Capacity Ratio (*X*)				0.489		0.608		0.623	0.175	0.684	0.479	
Available Capacity (c_a), veh/h				256		487		962	996	1010	1352	
Back of Queue (*Q*), veh/ln (95 th percentile)				5.6		10.3		14.0	2.0	6.3	7.0	
Queue Storage Ratio (*RQ*) (95 th percentile)				0.31		0.56		0.00	0.24	0.65	0.00	
Uniform Delay (d_1), s/veh				39.0		28.7		16.8	6.0	11.9	5.6	
Incremental Delay (d_2), s/veh				6.5		5.5		3.0	0.4	6.4	1.2	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				45.5		34.2		19.8	6.4	18.3	6.8	
Level of Service (LOS)				D		C		B	A	B	A	
Approach Delay, s/veh / LOS	0.0			37.6		D	16.8		B	11.2		B
Intersection Delay, s/veh / LOS	18.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	2.2	B

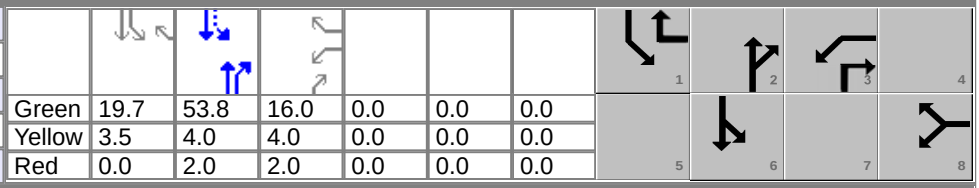
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst	M. McDonald	Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	AM	PHF	0.95
Urban Street	IL Rte 176	Analysis Year	2030	Analysis Period	1> 7:00
Intersection	IL Rte 176 and IL Rte 176	File Name	Prop IL 47 PM_WB RT Overlap.xus		
Project Description	Proposed PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				177		435		760	164	348	685	

Signal Information			
Cycle, s	105.0	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	19.7	53.8	16.0	0.0	0.0	0.0
Yellow	3.5	4.0	4.0	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				22.0		59.8	23.2	83.0
Change Period, ($Y+R_c$), s				6.0		6.0	3.5	6.0
Max Allow Headway (*MAH*), s				8.1		0.0	7.9	0.0
Queue Clearance Time (g_s), s				18.0			13.6	
Green Extension Time (g_e), s				0.0		0.0	5.9	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.01	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				186		458		800	173	366	721	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1707		1519		1835	1477	1675	1852	
Queue Service Time (g_s), s				10.9		16.0		39.6	4.7	11.6	17.9	
Cycle Queue Clearance Time (g_c), s				10.9		16.0		39.6	4.7	11.6	17.9	
Green Ratio (*g/C*)				0.15		0.34		0.51	0.67	0.72	0.73	
Capacity (*c*), veh/h				260		517		939	981	468	1358	
Volume-to-Capacity Ratio (*X*)				0.716		0.885		0.852	0.176	0.783	0.531	
Available Capacity (c_a), veh/h				260		517		939	981	1022	1358	
Back of Queue (*Q*), veh/ln (95 th percentile)				9.3		18.6		23.8	2.2	9.8	8.7	
Queue Storage Ratio (*RQ*) (95 th percentile)				0.51		1.02		0.00	0.26	1.00	0.00	
Uniform Delay (d_1), s/veh				42.3		32.7		22.2	6.7	23.0	6.1	
Incremental Delay (d_2), s/veh				15.6		19.5		9.6	0.4	12.3	1.5	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				57.9		52.2		31.8	7.1	35.4	7.6	
Level of Service (LOS)				E		D		C	A	D	A	
Approach Delay, s/veh / LOS	0.0			53.8		D	27.4		C	17.0		B
Intersection Delay, s/veh / LOS	29.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	0.7	A
Bicycle LOS Score / LOS				F	2.1	B	2.3	B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: M. McDonald
Agency/Co.: TranSystems
Date Performed: 2/3/2016
Analysis Time Period: Proposed AM
Intersection: IL Rte 176 and Helen St
Jurisdiction: Crystal Lake
Units: U. S. Customary
Analysis Year: 2030
Project ID:
East/West Street: IL Rte 176
North/South Street: Helen Street
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	20	480			320	46
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Hourly Flow Rate, HFR	21	505			336	48
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	Undivided /					
RT Channelized?						Yes
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				134		45
Peak Hour Factor, PHF				0.95		0.95
Hourly Flow Rate, HFR				141		47
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	21					141		47
C(m) (vph)	1223					314		711
v/c	0.02					0.45		0.07
95% queue length	0.05					2.22		0.21
Control Delay	8.0					25.5		10.4
LOS	A					D		B
Approach Delay							21.7	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: M. McDonald
Agency/Co.: TranSystems
Date Performed: 2/3/2016
Analysis Time Period: Proposed AM
Intersection: IL Rte 176 and Helen St
Jurisdiction: Crystal Lake
Units: U. S. Customary
Analysis Year: 2030
Project ID:
East/West Street: IL Rte 176
North/South Street: Helen Street
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	480			320	46
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Peak-15 Minute Volume	5	126			84	12
Hourly Flow Rate, HFR	21	505			336	48
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						Yes
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				134		45
Peak Hour Factor, PHF				0.95		0.95
Peak-15 Minute Volume				35		12
Hourly Flow Rate, HFR				141		47
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0	
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0	
Percent Blockage	0	0	0	0	

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1700	3	0	120	55	1670
	Through	0	1700	3	0	120	55	1670
S5	Left-Turn	0	1700	3	0	90	55	3530
	Through	0	1700	3	0	90	55	3530

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	2					0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4		6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2					0		0
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	0	0	0	0

Total Saturation Flow Rate, s (vph)	1700	1700	1700	1700
Arrival Type	3	3	3	3
Effective Green, g (sec)	0	0	0	0
Cycle Length, C (sec)	120	120	90	90
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.000	0.000	0.000	0.000
g(q1)	0.0	0.0	0.0	0.0
g(q2)	0.0	0.0	0.0	0.0
g(q)	0.0	0.0	0.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha		0.550		0.550
beta		0.645		0.645
Travel time, t(a) (sec)		20.656		43.661
Smoothing Factor, F		0.120		0.061
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	0	0	0	0
Min platooned flow, V(c,min)	1000	1000	1000	1000
Duration of blocked period, t(p)	0.0	0.0	0.0	0.0
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	1.000		
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	336					883		336
s	1500					1500		1500
Px	1.000					1.000		1.000
V c,u,x	336					883		336
C r,x	1223					319		711
C plat,x	1223					319		711

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					1500	1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.					9		12	
Conflicting Flows							336	
Potential Capacity							711	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							711	
Probability of Queue free St.					1.00		0.93	
Step 2: LT from Major St.					4		1	
Conflicting Flows							336	
Potential Capacity							1223	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							1223	
Probability of Queue free St.					1.00		0.98	
Maj L-Shared Prob Q free St.								
Step 3: TH from Minor St.					8		11	
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor					1.00		1.00	
Cap. Adj. factor due to Impeding mvmnt					0.98		0.98	
Movement Capacity								
Probability of Queue free St.					1.00		1.00	
Step 4: LT from Minor St.					7		10	
Conflicting Flows							883	
Potential Capacity							319	
Pedestrian Impedance Factor					1.00		1.00	
Maj. L, Min T Impedance factor					0.98			
Maj. L, Min T Adj. Imp Factor.					0.99			
Cap. Adj. factor due to Impeding mvmnt					0.92		0.98	
Movement Capacity							314	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.					8		11	
Part 1 - First Stage								
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor								
Cap. Adj. factor due to Impeding mvmnt								
Movement Capacity								
Probability of Queue free St.								

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		883
Potential Capacity		319
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.92	0.98
Movement Capacity		314
Results for Two-stage process:		
a		
y		
C t		314

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				141		47
Movement Capacity (vph)				314		711
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				314		711
Volume				141		47
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	21					141		47
C(m) (vph)	1223					314		711
v/c	0.02					0.45		0.07
95% queue length	0.05					2.22		0.21
Control Delay	8.0					25.5		10.4
LOS	A					D		B
Approach Delay							21.7	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.0	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst:	M. McDonald
Agency/Co.:	TranSystems
Date Performed:	2/3/2016
Analysis Time Period:	Proposed PM
Intersection:	IL Rte 176 and Helen St
Jurisdiction:	Crystal Lake
Units: U. S. Customary	
Analysis Year:	2030
Project ID:	
East/West Street:	IL Rte 176
North/South Street:	Helen Street
Intersection Orientation: EW	Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	69	428			439	147
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Hourly Flow Rate, HFR	72	450			462	154
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						Yes
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				67		22
Peak Hour Factor, PHF				0.95		0.95
Hourly Flow Rate, HFR				70		23
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	72					70		23
C(m) (vph)	1099					235		604
v/c	0.07					0.30		0.04
95% queue length	0.21					1.20		0.12
Control Delay	8.5					26.7		11.2
LOS	A					D		B
Approach Delay							22.9	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: M. McDonald
Agency/Co.: TranSystems
Date Performed: 2/3/2016
Analysis Time Period: Proposed PM
Intersection: IL Rte 176 and Helen St
Jurisdiction: Crystal Lake
Units: U. S. Customary
Analysis Year: 2030
Project ID:
East/West Street: IL Rte 176
North/South Street: Helen Street
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	69	428		439	147	
Peak-Hour Factor, PHF	0.95	0.95		0.95	0.95	
Peak-15 Minute Volume	18	113		116	39	
Hourly Flow Rate, HFR	72	450		462	154	
Percent Heavy Vehicles	2	--	--	--	--	
Median Type/Storage	Undivided		/			
RT Channelized?					Yes	
Lanes	1	1		1	1	
Configuration	L	T		T	R	
Upstream Signal?		Yes		Yes		

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				67		22
Peak Hour Factor, PHF				0.95		0.95
Peak-15 Minute Volume				18		6
Hourly Flow Rate, HFR				70		23
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0	
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0	
Percent Blockage	0	0	0	0	

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1700	3	0	120	55	1670
	Through	0	1700	3	0	120	55	1670
S5	Left-Turn	0	1700	3	0	90	55	3530
	Through	0	1700	3	0	90	55	3530

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	2					0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4		6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2					0		0
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	0	0	0	0

Total Saturation Flow Rate, s (vph)	1700	1700	1700	1700
Arrival Type	3	3	3	3
Effective Green, g (sec)	0	0	0	0
Cycle Length, C (sec)	120	120	90	90
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.000	0.000	0.000	0.000
g(q1)	0.0	0.0	0.0	0.0
g(q2)	0.0	0.0	0.0	0.0
g(q)	0.0	0.0	0.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha		0.550		0.550
beta		0.645		0.645
Travel time, t(a) (sec)		20.656		43.661
Smoothing Factor, F		0.120		0.061
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	0	0	0	0
Min platooned flow, V(c,min)	1000	1000	1000	1000
Duration of blocked period, t(p)	0.0	0.0	0.0	0.0
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	1.000		
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	462					1056		462
s	1500					1500		1500
Px	1.000					1.000		1.000
V c,u,x	462					1056		462
C r,x	1099					252		604
C plat,x	1099					252		604

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					1500	1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.					9		12	
Conflicting Flows							462	
Potential Capacity							604	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							604	
Probability of Queue free St.					1.00		0.96	
Step 2: LT from Major St.					4		1	
Conflicting Flows							462	
Potential Capacity							1099	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							1099	
Probability of Queue free St.					1.00		0.93	
Maj L-Shared Prob Q free St.								
Step 3: TH from Minor St.					8		11	
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor					1.00		1.00	
Cap. Adj. factor due to Impeding mvmnt					0.93		0.93	
Movement Capacity								
Probability of Queue free St.					1.00		1.00	
Step 4: LT from Minor St.					7		10	
Conflicting Flows							1056	
Potential Capacity							252	
Pedestrian Impedance Factor					1.00		1.00	
Maj. L, Min T Impedance factor					0.93			
Maj. L, Min T Adj. Imp Factor.					0.95			
Cap. Adj. factor due to Impeding mvmnt					0.91		0.93	
Movement Capacity							235	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.					8		11	
Part 1 - First Stage								
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor								
Cap. Adj. factor due to Impeding mvmnt								
Movement Capacity								
Probability of Queue free St.								

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1056
Potential Capacity		252
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	
Maj. L, Min T Adj. Imp Factor.	0.95	
Cap. Adj. factor due to Impeding mvmnt	0.91	0.93
Movement Capacity		235
Results for Two-stage process:		
a		
y		
C t		235

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				70		23
Movement Capacity (vph)				235		604
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				235		604
Volume				70		23
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	72					70		23
C(m) (vph)	1099					235		604
v/c	0.07					0.30		0.04
95% queue length	0.21					1.20		0.12
Control Delay	8.5					26.7		11.2
LOS	A					D		B
Approach Delay							22.9	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.93	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.5	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: M. McDonald
Agency/Co.: TranSystems
Date Performed: 2/3/2016
Analysis Time Period: Proposed AM
Intersection: IL Rte 176 and Bryn Mawr Ln
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2030
Project ID: Bryn Mawr Phase II Subdivision
East/West Street: IL Rte 176
North/South Street: Bryn Mawr Lane
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	609			360	11
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Hourly Flow Rate, HFR	6	641			378	11
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided /					
RT Channelized?						Yes
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				27		7
Peak Hour Factor, PHF				0.95		0.95
Hourly Flow Rate, HFR				28		7
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	6					28		7
C(m) (vph)	1192					260		673
v/c	0.01					0.11		0.01
95% queue length	0.02					0.36		0.03
Control Delay	8.0					20.5		10.4
LOS	A					C		B
Approach Delay							18.5	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: M. McDonald
Agency/Co.: TranSystems
Date Performed: 2/3/2016
Analysis Time Period: Proposed AM
Intersection: IL Rte 176 and Bryn Mawr Ln
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2030
Project ID: Bryn Mawr Phase II Subdivision
East/West Street: IL Rte 176
North/South Street: Bryn Mawr Lane
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	6	609			360	11
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Peak-15 Minute Volume	2	160			95	3
Hourly Flow Rate, HFR	6	641			378	11
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						Yes
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				27		7
Peak Hour Factor, PHF				0.95		0.95
Peak-15 Minute Volume				7		2
Hourly Flow Rate, HFR				28		7
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0	
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0	
Percent Blockage	0	0	0	0	

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1700	3	0	120	55	4000
	Through	0	1700	3	0	120	55	4000
S5	Left-Turn	0	1700	3	0	90	55	1415
	Through	0	1700	3	0	90	55	1415

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4		6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0		0
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	0	0	0	0

Total Saturation Flow Rate, s (vph)	1700	1700	1700	1700
Arrival Type	3	3	3	3
Effective Green, g (sec)	0	0	0	0
Cycle Length, C (sec)	120	120	90	90
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.000	0.000	0.000	0.000
g(q1)	0.0	0.0	0.0	0.0
g(q2)	0.0	0.0	0.0	0.0
g(q)	0.0	0.0	0.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha		0.550		0.550
beta		0.645		0.645
Travel time, t(a) (sec)		49.474		17.502
Smoothing Factor, F		0.054		0.139
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	0	0	0	0
Min platooned flow, V(c,min)	1000	1000	1000	1000
Duration of blocked period, t(p)	0.0	0.0	0.0	0.0
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	1.000		
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	378					1031		378
s	1500					1500		1500
Px	1.000					1.000		1.000
V c,u,x	378					1031		378
C r,x	1192					261		673
C plat,x	1192					261		673

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					1500	1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.					9		12	
Conflicting Flows							378	
Potential Capacity							673	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							673	
Probability of Queue free St.					1.00		0.99	
Step 2: LT from Major St.					4		1	
Conflicting Flows							378	
Potential Capacity							1192	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							1192	
Probability of Queue free St.					1.00		0.99	
Maj L-Shared Prob Q free St.								
Step 3: TH from Minor St.					8		11	
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor					1.00		1.00	
Cap. Adj. factor due to Impeding mvmnt					0.99		0.99	
Movement Capacity								
Probability of Queue free St.					1.00		1.00	
Step 4: LT from Minor St.					7		10	
Conflicting Flows							1031	
Potential Capacity							261	
Pedestrian Impedance Factor					1.00		1.00	
Maj. L, Min T Impedance factor					0.99			
Maj. L, Min T Adj. Imp Factor.					1.00			
Cap. Adj. factor due to Impeding mvmnt					0.99		0.99	
Movement Capacity							260	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.					8		11	
Part 1 - First Stage								
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor								
Cap. Adj. factor due to Impeding mvmnt								
Movement Capacity								
Probability of Queue free St.								

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1031
Potential Capacity		261
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		260
Results for Two-stage process:		
a		
y		
C t		260

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				28		7
Movement Capacity (vph)				260		673
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				260		673
Volume				28		7
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	6					28		7
C(m) (vph)	1192					260		673
v/c	0.01					0.11		0.01
95% queue length	0.02					0.36		0.03
Control Delay	8.0					20.5		10.4
LOS	A					C		B
Approach Delay							18.5	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.0	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: M. McDonald
Agency/Co.: TranSystems
Date Performed: 2/3/2016
Analysis Time Period: Proposed PM
Intersection: IL Rte 176 and Bryn Mawr Ln
Jurisdiction: IDOT/Crystal Lake
Units: U. S. Customary
Analysis Year: 2030
Project ID: Bryn Mawr Phase II Subdivision
East/West Street: IL Rte 176
North/South Street: Bryn Mawr Lane
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	14	482			581	30
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Hourly Flow Rate, HFR	14	507			611	31
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided /					
RT Channelized?						Yes
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				12		6
Peak Hour Factor, PHF				0.95		0.95
Hourly Flow Rate, HFR				12		6
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	14					12		6
C(m) (vph)	978					219		497
v/c	0.01					0.05		0.01
95% queue length	0.04					0.17		0.04
Control Delay	8.7					22.4		12.3
LOS	A					C		B
Approach Delay							19.0	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: M. McDonald
Agency/Co.: TranSystems
Date Performed: 2/3/2016
Analysis Time Period: Proposed PM
Intersection: IL Rte 176 and Bryn Mawr Ln
Jurisdiction: IDOT/Crystal Lake
Units: U. S. Customary
Analysis Year: 2030
Project ID: Bryn Mawr Phase II Subdivision
East/West Street: IL Rte 176
North/South Street: Bryn Mawr Lane
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	14	482			581	30
Peak-Hour Factor, PHF	0.95	0.95			0.95	0.95
Peak-15 Minute Volume	4	127			153	8
Hourly Flow Rate, HFR	14	507			611	31
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						Yes
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				12		6
Peak Hour Factor, PHF				0.95		0.95
Peak-15 Minute Volume				3		2
Hourly Flow Rate, HFR				12		6
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0	
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0	
Percent Blockage	0	0	0	0	

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1700	3	0	120	55	4000
	Through	0	1700	3	0	120	55	4000
S5	Left-Turn	0	1700	3	0	90	55	1415
	Through	0	1700	3	0	90	55	1415

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4		6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0		0
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	0	0	0	0

Total Saturation Flow Rate, s (vph)	1700	1700	1700	1700
Arrival Type	3	3	3	3
Effective Green, g (sec)	0	0	0	0
Cycle Length, C (sec)	120	120	90	90
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.000	0.000	0.000	0.000
g(q1)	0.0	0.0	0.0	0.0
g(q2)	0.0	0.0	0.0	0.0
g(q)	0.0	0.0	0.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha		0.550		0.550
beta		0.645		0.645
Travel time, t(a) (sec)		49.474		17.502
Smoothing Factor, F		0.054		0.139
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	0	0	0	0
Min platooned flow, V(c,min)	1000	1000	1000	1000
Duration of blocked period, t(p)	0.0	0.0	0.0	0.0
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	1.000		
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	611					1146		611
s	1500					1500		1500
Px	1.000					1.000		1.000
V c,u,x	611					1146		611
C r,x	978					222		497
C plat,x	978					222		497

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					1500	1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.					9		12	
Conflicting Flows							611	
Potential Capacity							497	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							497	
Probability of Queue free St.					1.00		0.99	
Step 2: LT from Major St.					4		1	
Conflicting Flows							611	
Potential Capacity							978	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							978	
Probability of Queue free St.					1.00		0.99	
Maj L-Shared Prob Q free St.								
Step 3: TH from Minor St.					8		11	
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor					1.00		1.00	
Cap. Adj. factor due to Impeding mvmnt					0.99		0.99	
Movement Capacity								
Probability of Queue free St.					1.00		1.00	
Step 4: LT from Minor St.					7		10	
Conflicting Flows							1146	
Potential Capacity							222	
Pedestrian Impedance Factor					1.00		1.00	
Maj. L, Min T Impedance factor					0.99			
Maj. L, Min T Adj. Imp Factor.					0.99			
Cap. Adj. factor due to Impeding mvmnt					0.98		0.99	
Movement Capacity							219	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.					8		11	
Part 1 - First Stage								
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor								
Cap. Adj. factor due to Impeding mvmnt								
Movement Capacity								
Probability of Queue free St.								

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1146
Potential Capacity		222
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.98	0.99
Movement Capacity		219
Results for Two-stage process:		
a		
y		
C t		219

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				12		6
Movement Capacity (vph)				219		497
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				219		497
Volume				12		6
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

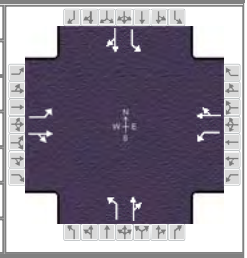
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	14					12		6
C(m) (vph)	978					219		497
v/c	0.01					0.05		0.01
95% queue length	0.04					0.17		0.04
Control Delay	8.7					22.4		12.3
LOS	A					C		B
Approach Delay							19.0	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.7	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

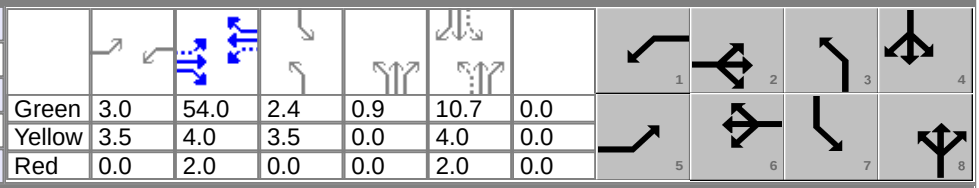
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst	M. McDonald	Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	AM	PHF	0.95
Urban Street	IL Rte 176	Analysis Year	2030	Analysis Period	1> 7:00
Intersection	IL RTE 176 and Haligus…	File Name	Prop Haligus AM.xus		
Project Description	Proposed AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	546	34	41	330	2	27	75	85	1	20	11

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.0	54.0	2.4	0.9	10.7	0.0
Yellow	3.5	4.0	3.5	0.0	4.0	0.0
Red	0.0	2.0	0.0	0.0	2.0	0.0

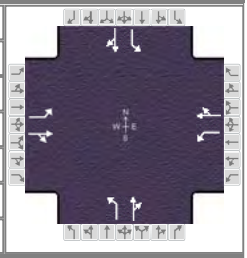
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	6.5	60.0	6.5	60.0	6.7	17.6	5.9	16.7
Change Period, ($Y+R_c$), s	3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0
Max Allow Headway (*MAH*), s	3.9	0.0	3.9	0.0	4.0	5.1	4.0	5.1
Queue Clearance Time (g_s), s	2.4		2.8		3.2	10.5	2.0	3.5
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0	0.0	1.1	0.0	1.1
Phase Call Probability	1.00		1.00		0.99	1.00	0.79	0.99
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	21	611		43	349		28	168		1	33	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1808		1810	1774		1810	1717		1810	1786	
Queue Service Time (g_s), s	0.4	18.3		0.8	8.8		1.2	8.5		0.0	1.5	
Cycle Queue Clearance Time (g_c), s	0.4	18.3		0.8	8.8		1.2	8.5		0.0	1.5	
Green Ratio (*g/C*)	0.63	0.60		0.63	0.60		0.16	0.13		0.15	0.12	
Capacity (*c*), veh/h	643	1085		467	1065		289	221		142	213	
Volume-to-Capacity Ratio (*X*)	0.033	0.562		0.092	0.328		0.098	0.761		0.007	0.153	
Available Capacity (c_a), veh/h	1328	1085		1232	1065		716	861		427	878	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2	10.2		0.4	5.1		0.9	7.0		0.0	1.2	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.04	0.00		0.09	0.00		0.21	0.00		0.01	0.00	
Uniform Delay (d_1), s/veh	6.8	10.8		8.2	8.9		32.6	37.9		33.4	35.6	
Incremental Delay (d_2), s/veh	0.0	2.1		0.1	0.8		0.1	7.5		0.0	0.5	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	6.8	13.0		8.2	9.8		32.8	45.3		33.4	36.0	
Level of Service (LOS)	A	B		A	A		C	D		C	D	
Approach Delay, s/veh / LOS	12.8	B		9.6	A		43.5	D		35.9	D	
Intersection Delay, s/veh / LOS	17.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.5	A	1.1	A	0.8	A	0.5	A

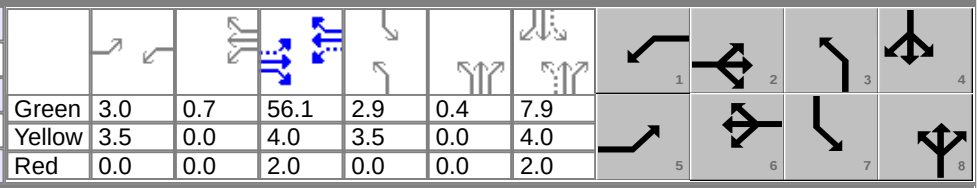
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	TranSystems			Duration, h	0.25
Analyst		Analysis Date	Feb 3, 2016	Area Type	Other
Jurisdiction	Crystal Lake	Time Period	AM	PHF	0.95
Urban Street	IL Rte 176	Analysis Year	2030	Analysis Period	1> 7:00
Intersection	IL RTE 176 and Haligus…	File Name	Prop Haligus PM.xus		
Project Description	Proposed AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	19	395	52	85	567	5	30	29	52	5	61	30

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.0	0.7	56.1	2.9	0.4	7.9						
Yellow	3.5	0.0	4.0	3.5	0.0	4.0						
Red	0.0	0.0	2.0	0.0	0.0	2.0						

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	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	6.5	62.1	7.2	62.8	6.7	14.3	6.4	13.9
Change Period, ($Y+R_c$), s	3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0
Max Allow Headway (*MAH*), s	3.9	0.0	3.9	0.0	4.0	5.1	4.0	5.1
Queue Clearance Time (g_s), s	2.3		3.6		3.4	6.4	2.2	6.6
Green Extension Time (g_e), s	0.0	0.0	0.2	0.0	0.0	0.7	0.0	0.7
Phase Call Probability	1.00		1.00		0.95	1.00	0.96	0.99
Max Out Probability	0.00		0.00		1.00	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	20	471		89	602		32	85		5	96	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1789		1810	1773		1810	1686		1810	1794	
Queue Service Time (g_s), s	0.3	12.1		1.6	17.1		1.4	4.4		0.2	4.6	
Cycle Queue Clearance Time (g_c), s	0.3	12.1		1.6	17.1		1.4	4.4		0.2	4.6	
Green Ratio (*g/C*)	0.66	0.62		0.66	0.63		0.12	0.09		0.12	0.09	
Capacity (*c*), veh/h	488	1115		613	1119		194	155		167	158	
Volume-to-Capacity Ratio (*X*)	0.041	0.422		0.146	0.538		0.163	0.550		0.032	0.606	
Available Capacity (c_a), veh/h	1209	1115		917	1119		239	405		219	424	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2	6.9		0.8	9.1		1.1	3.5		0.2	4.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.04	0.00		0.17	0.00		0.24	0.00		0.04	0.00	
Uniform Delay (d_1), s/veh	7.3	8.7		6.2	9.3		35.3	39.1		35.1	39.5	
Incremental Delay (d_2), s/veh	0.0	1.2		0.1	1.9		0.4	4.3		0.1	5.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	7.3	9.8		6.3	11.1		35.6	43.3		35.2	44.8	
Level of Service (LOS)	A	A		A	B		D	D		D	D	
Approach Delay, s/veh / LOS	9.7	A		10.5	B		41.3	D		44.3	D	
Intersection Delay, s/veh / LOS	15.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	1.6	A	0.7	A	0.7	A

Appendix F – HCS 2010 Traffic Signal Warrant Reports