



August 19, 2013

MEMORANDUM 081913

To: Barbara Ricozzi, CT DOT
cc: Robert Mezzo, Mayor, Borough of Naugatuck
Jim Stewart, Public Works Director, Borough of Naugatuck
Chris Edson, Chief of Police and Local Traffic Authority, Borough of Naugatuck
Edgar Wynkoop, CT DOT
From: Joe Perrelli, Senior Planner
Subject: Route 63 and Rubber Avenue Intersection Operation Study,
Borough of Naugatuck

Introduction

COGCNV staff studied the intersection of Route 63 and Rubber Avenue in Naugatuck to identify and address existing traffic operations and safety problems. Staff conducted turning movement counts in September 2011 and analyzed three years of accident data to propose improvements that would increase safety and facilitate traffic flow.

Study Area

The Route 63 corridor is a vital connection from the Route 8 expressway to the commercial and residential areas on the west side of town, where 43% of the population resides in high and medium-density residential neighborhoods. Route 63 functions as a Principal Arterial, providing inter-city trips between New Haven and Litchfield counties and direct connections to I-84 in Middlebury and Route 8 in Naugatuck. Rubber Avenue, which is classified as an Urban Collector, hosts commercial destinations as well as the public works garage, the transfer station, and the high school.

The recent reconstruction and widening of the Route 63 bridge over the Naugatuck River has increased motor vehicle traffic through this intersection. Future development in the downtown and the Rubber Avenue Design District will draw additional traffic through this intersection. A map of the intersection is included in Figure 1.

Land uses in the adjacent area are primarily commercial and high-density residential. The intersection lies just south of the central business district and to the east of a major commercial corridor along Rubber Avenue. Commercial uses at the intersection include a social club, a gas

station/convenience store, a pharmacy, and a Dunkin' Donuts, adding a number of access points to the functional area around the intersection. The functional area of an intersection includes the physical intersection as well as areas upstream and downstream of the intersection. According to the AASHTO *Policy on Geometric Design* ("The Green Book"), the functional area is influenced by three variable elements, "(1) perception-reaction decision distance, (2) maneuver distance, and (3) queue-storage distance." Driveways within the area create conflict points for traffic flow and increase the likelihood of collisions.

Figure 1. Route 63 and Rubber Avenue Intersection

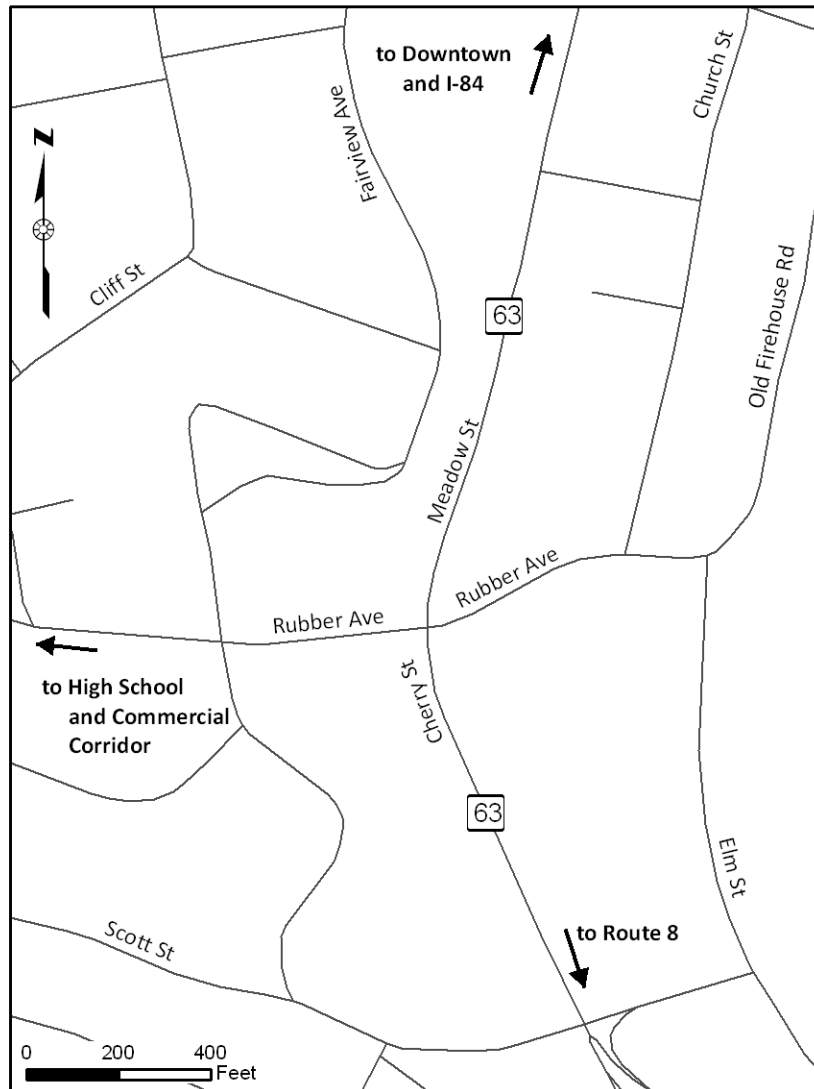


Figure 2. Views at the Intersection of Route 63 & Rubber Avenue: 2012



View on Route 63 from North of the Intersection



View on Route 63 from South of the Intersection



View on Rubber Avenue from West of the Intersection



View on Rubber Avenue from East of the Intersection

Source: Google Streetview on Route 63 and COGCNV Staff Photos on Rubber Ave.

Traffic Volumes

Manual turning movement counts were conducted on a typical weekday morning (7:00 a.m. - 9:00 a.m.) and afternoon (4:00 p.m. - 6:00 p.m.) during peak periods in October 2011. The peak hours are 7:00 a.m. to 8:00 a.m and 5:00 p.m. - 6:00 p.m. The morning and afternoon peak hour traffic volumes are presented in Appendix A. In addition to turning movement counts, average daily traffic (ADT) counts were obtained from CT DOT. In 2012, the ADTs on Route 63 were 8,500 vehicles per day (vpd) to the north of the intersection and 11,900 vpd to the south. Rubber Avenue saw 17,800 vpd to the west of the intersection and 9,600 vpd to the east. 1,956 vehicles pass through the intersection during the peak hour (5:00 p.m. - 6:00 p.m.).

Accident Records

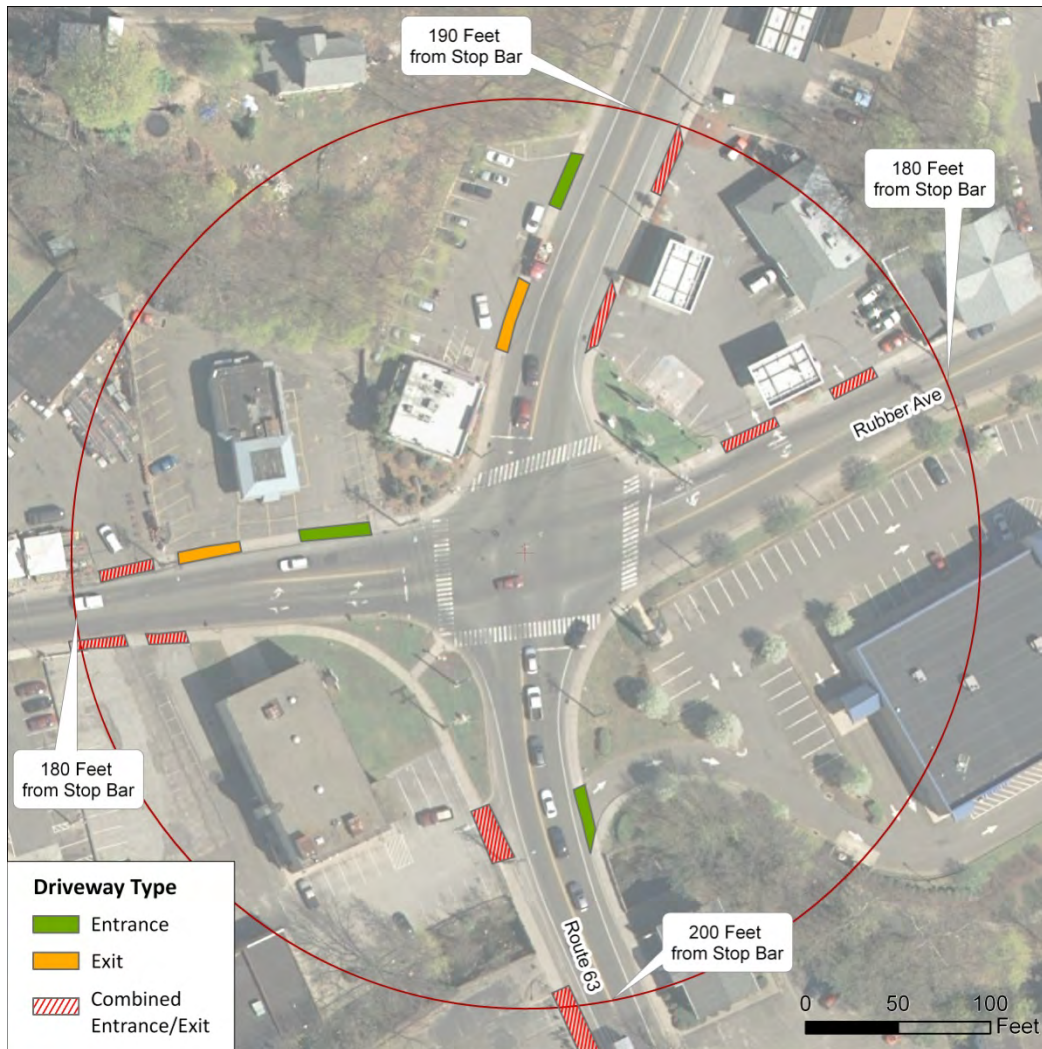
The intersection of Route 63 and Rubber Avenue appears on CT DOT's most current Suggested List of Surveillance Study Sites (SLOSSS), which covers the years from 2006 to 2008. SLOSSS identifies intersections and road segments that have more than 15 accidents during the three-year period and an actual accident rate above a statistically-derived improbable accident rate. The actual accident rate is computed with the actual rate per million vehicles. The improbable accident rate is generated from accident rate data for similar locations in Connecticut.¹

21% of the collision occurred at commercial drives. While the impact of the driveway in each instance is unclear, at least seven accidents involved vehicles exiting commercial drives, five of which were labeled as *Turning-Intersecting Paths*. Figure 3 shows the layout of driveways within 250 feet of the intersection with markers indicating distance from the stop bar at each approach. For perspective, each of these markers falls at or just beyond the functional area of the intersection. The gas station on the northeast corner of the intersection has four separate bi-directional access points that fall within the functional area of the intersection. During the afternoon peak hour, a gas station/convenience store generates an average of 105 trips, while Dunkin Donuts can generate 65 trips. These additional trips result in traffic, operation, safety, and capacity problems.²

¹ TASR and SLOSSS data are privileged information and not admissible in court, pursuant to Title 23 USC Section 409.

² "Trip Generation: 8th Edition," Institute of Transportation Engineers. 2008. (p. 1898-1899)

Figure 3. Rubber Avenue and Route 63: Driveway Access within 250 feet



To get a more complete understanding of the types, severity, and patterns of accidents at this location, accident records from 2009-2011 were obtained from the Crash Data Repository. During this period, there were a total of 47 accidents within the vicinity of the intersection divided among several accident types. Figure 4 shows a collision diagram for the intersection. The predominant accident types were rear-end collisions (27%) followed by those involving turning vehicles on intersecting paths (18%) and turning vehicles headed in opposite directions. Accidents involving turning vehicles made up 40% of the accidents at the intersection. While in the field conducting counts, staff observed a recurring problem of left-turning northbound vehicles getting blocking the intersection while awaiting a break in oncoming traffic. At the end of Phase 2, during the 2.0 second All-Red interval, one or two of these vehicles will finish their left turn maneuver. As a result, these vehicles are usually still turning at the same time that the next phase starts up.

The majority of the accidents occurred in clear (84%) and dry (82%) weather conditions in daylight (78%). Tables 1 to 3 below summarize accident characteristics based on type, contributing factor, and injury severity.

Figure 4. Rubber Avenue and Route 63 Collision Diagram 2009-2011



Source: Accident History: 2009-2011, CT Crash Data Repository, www.ctcrash.uconn.edu

Note: The position of crash symbols does not reflect the actual positioning of vehicles during a collision.

Table 1. Accidents by Collision Type: 2009-2011

Type of Collision	Count	Percent
Rear-End	14	30
Turning-Intersecting Paths	7	15
Turning-Opposite Direction	7	15
Angle	4	9
Sideswipe-Same Direction	4	9
Turning-Same Direction	4	9
All Other	7	15
Total	47	100

Table 2. Accidents by Contributing Factor: 2009-2011

Contributing Factor	Count	Percent
Following Too Closely	12	24
Failed to Grant Right of Way	10	20
Improper Passing Maneuver	5	10
Violated Traffic Control	5	10
All Other	15	27
Total	47	100

Table 3. Accidents by Injury Severity: 2009-2011

Injury Severity	Count	Percent
A-Injury <i>(Incapacitating Evident Injury)</i>	1	2
B-Injury <i>(Non-incapacitating Evident Injury)</i>	1	2
C-Injury <i>(Possible Injury)</i>	8	17
Property Damage Only	37	79
Total	47	100

Analysis of Existing Operations

Level of Service (LOS) analyses were performed at the intersection to measure delay and volume-to-capacity ratios for the morning and afternoon peak hours. Level of Service for signalized intersections is defined in terms of vehicle delay, which is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. The delay experienced by a motorist is made up of a number of factors that relate to signal control, geometry, traffic flow, and incidents. It is dependent on the quality of progression, the cycle length, the green ratio, and the volume-to-capacity ratio for the lane group in question.

There are six defined Levels of Service, with “A” being the most favorable and “F” being the worst. Based on our analysis of existing operations, the intersection operates at LOS E during the morning peak period and LOS F during the afternoon peak. According to the Highway Capacity Manual, LOS E indicates operations with delays between 55 to 80 seconds per vehicle, while LOS F indicates ≥ 80 seconds of delay. At LOS F, traffic flow is unstable and volumes reach or exceed capacity. Tables 4 and 5 provide a summary of LOS and delay by approach. Refer to Appendix B for reports on the analysis of existing operations.

Table 4. Morning Peak Hour LOS Analysis

Approach	Lane Group	v/c Ratio	Delay by Lane Group (sec/veh)	LOS by Lane Group
Route 63 NB	LTR	0.37	21.4	C
Route 63 SB	LTR	0.90	68.9	E
Rubber Ave WB	TR	0.93	78.4	E
Rubber Ave WB	L	0.36	47.9	D
Rubber Ave EB	TR	0.81	42.5	D
Rubber Ave EB	L	0.82	58.4	E
Intersection		0.93	54.2	D

Table 5. Afternoon Peak Hour LOS Analysis

Approach	Lane Group	v/c Ratio	Delay by Lane Group (sec/veh)	LOS by Lane Group
Route 63 NB	LTR	0.79	32.2	C
Route 63 SB	LTR	0.81	52.4	D
Rubber Ave WB	TR	1.06	108.7	F
Rubber Ave WB	L	1.42	300.6	F
Rubber Ave EB	TR	1.09	102.1	F
Rubber Ave EB	L	1.04	114.9	F
Intersection		1.42	85.8	F

LTR - Shared lane for Left, Thru, and Right turns

TR - Shared lane for Thru and Right turns

Proposed Improvements

From observations in the field, the intersection seems to function at capacity. One issue is the presence of multiple commercial drives within the functional area of the intersection which creates conflicts between vehicles approaching the intersection and those that are entering/exiting the commercial properties. The highest concentrations of commercial drives are to the north of the intersection on Route 63 and to the west on Rubber Avenue. There is also an issue with NB left-turning vehicles on Route 63 getting stuck at the light as they await a break in oncoming traffic during Phase 2. It is strongly recommended that at least 1.0 additional second be added to the All-Red phase after Phase 2 to ensure safety of these persistent maneuvers.

While the same situation was not apparent in the field for WB vehicles, the calculated control delay and accident history seem to show a need for increased all-red time to allow additional time for left-turning vehicles to clear the intersection at the end of the phase.

Improvement Option A: Minimizing Operational Deficiencies

Signal timing/optimization was considered as a near-term improvement option for the intersection, which currently operates at LOS F in the PM peak hour. The signal was optimized with the exclusive Ped phase included under two separate scenarios. One scenario kept the approaches "as they are," switched to a dual-ring structure, and increased the cycle length from 117.5 seconds to 152 in an attempt to accommodate traffic volumes. The second scenario included an exclusive left turn lane for the NB approach, switched to a dual-ring structure, and reduced the cycle length to 109 seconds. The exclusive left turn lane reduces overall intersection delay better than the other alternative. It seems that the additional capacity on the NB approach frees up opportunities to dedicate more time to the other approaches during the cycle. Tables 6 through 7 provide a summary of LOS and delay for the alternative timings during the afternoon peak hour. The complete timing plans and analyses are included in Appendix B.

Table 6. Alternative Timing: Afternoon Peak Hour LOS Analysis.

Approach	Lane Group	v/c Ratio	Delay by Lane Group (sec/veh)	LOS by Lane Group
Route 63 NB	LTR	0.91	50.8	D
Route 63 SB	LTR	0.80	62.1	E
Rubber Ave WB	TR	0.84	69.3	E
Rubber Ave WB	L	0.99	149.5	F
Rubber Ave EB	TR	0.96	72.8	E
Rubber Ave EB	L	0.74	49.4	D
Intersection		0.99	65.9	E

Table 7. Alternative Timing with NB Left Lane: Afternoon Peak Hour LOS Analysis

Approach	Lane Group	v/c Ratio	Delay by Lane Group (sec/veh)	LOS by Lane Group
Route 63 NB	TR	0.21	20.7	C
Route 63 NB	L	0.93	69.1	E
Route 63 SB	LTR	0.76	46.5	D
Rubber Ave WB	TR	0.67	37.2	D
Rubber Ave WB	L	0.82	78.7	E
Rubber Ave EB	TR	0.98	66.3	E
Rubber Ave EB	L	0.80	53.6	D
Intersection		0.98	53.2	D

LTR - Shared lane for Left, Thru, and Right turns

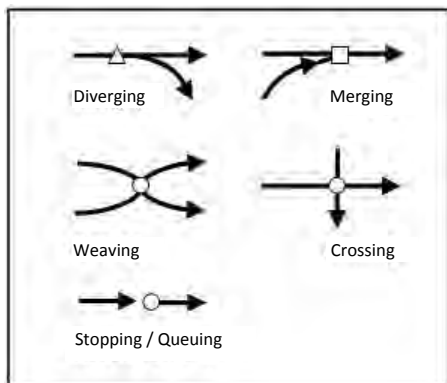
TR - Shared lane for Thru and Right turns

The exclusive pedestrian phase was left intact as a means of maintaining the same service level for pedestrian movements at the intersection. As a result, the overall intersection delay appears higher than in the field, where there may be around 8-10 pedestrian calls during the peak hour. All red phases were either maintained or increased in some cases to improve the level of safety for vehicles attempting to clear the intersection at the end of a phase. Staff witnessed a number of vehicles blocking the intersection while waiting to complete a left turn maneuver.

Improvement Option B: Access Management

The numerous access points around the intersection create significant opportunities for conflicting maneuvers. Given the number of access points within the vicinity of the intersection, it will be challenging to maintain access to businesses while providing safer traffic flow. Simple

Figure 5. Types of Traffic Conflicts



Safe Access is Good for Business (FHWA-HOP-06107). August 2006. (p. 2)

access management techniques could be implemented, like adding signage and pavement markings at the one-way accesses and egresses to alert motorists of the configuration of each driveway. Figure 3 above shows the location of driveways that are one-way. Still, additional measures can be taken to restrict traffic flow to and from each property in order to reduce the number of conflict points. Figure 5 shows different types of conflicts that can be experienced at each driveway.

Working with property owners in the area, it may be possible to coordinate traffic flow at each property so that the existing bi-directional driveways could be converted to one-way accesses and egresses. As an alternative, left-turn prohibitions could be considered at each egress to further eliminate possible conflict points. Figure 6 shows the arrangement of conflict points that currently exist to the

north of the intersection on Meadow Street [Rte. 63] and how they would be reduced if a partial median were installed to limit left-turn maneuvers at the driveways closest to the intersection. A slightly-raised median would act as a physical barrier to those making left-turns out of the driveways on Route 63. It would also function as a traffic calming element, causing motorists to approach the intersection with more caution and be more mindful of vehicles turning in and out of the surrounding properties.

Figure 7 shows a sketch of the area with medians to the north and east of the intersection. These locations were selected because of their traffic volumes, alignment, and accident histories. The medians serve to reinforce left-turn prohibitions from adjacent driveways, while keeping the curb cuts open. Note that both medians in the sketch end before the driveways that are further from the intersection, leaving open the possibility to make left-turns in and out of those driveways. The medians can be extended to restrict left-turns to and from the driveways that are further out, but this would result in a greater disruption in business access. Extending the medians would be the most restrictive method of access management in the area short of closing existing curb cuts, which would require a great deal of cooperation from the property owner.

Figure 6. Traffic Conflicts on Meadow Street

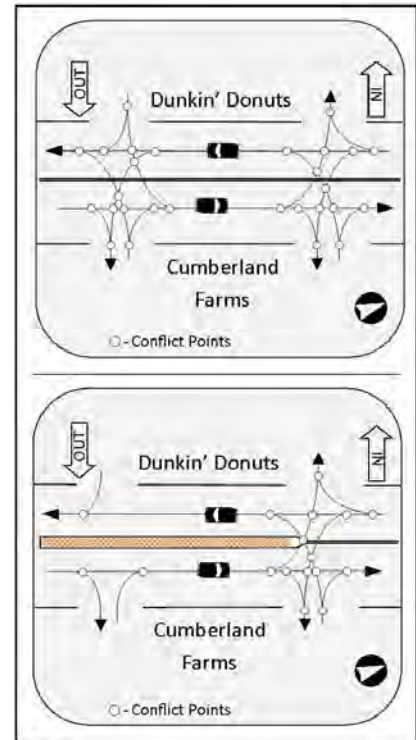


Figure 7. Sketch of Area with Medians at Two Approaches



Appendix A:

Peak Period

Traffic Counts: AM/PM

Route 63 at Rubber Avenue, Naugatuck

Thursday, October 6, 2011

7:00 - 9:00 A.M.

Time	Rte 63/Meadow St SB					Rubber Ave WB					Rte 63/Cherry St NB					Rubber Ave EB				Int. Total
	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Approach Total	
7:00	22	54	5	0	81	4	78	10	0	92	7	15	42	0	64	58	48	48	154	391
7:15	12	52	5	2	69	4	39	12	0	55	6	18	24	0	48	61	63	39	163	335
7:30	24	61	9	0	94	1	33	10	0	44	8	24	30	1	62	49	36	26	111	311
7:45	26	49	3	0	78	7	41	10	0	58	9	19	28	1	56	48	42	53	143	335
8:00	25	65	10	1	100	2	30	10	1	42	6	16	30	1	52	53	38	27	118	312
8:15	28	50	8	0	86	8	33	7	0	48	6	19	29	1	54	42	42	34	118	306
8:30	35	41	15	1	91	5	43	16	1	64	23	16	36	2	75	43	54	36	133	363
8:45	30	45	11	1	86	5	45	9	0	59	12	17	32	1	61	39	59	45	143	349
Peak Hour	84	216	22		322	16	191	42			30	76	124		230	216	189	166	571	1372
Totals																				

Route 63 at Rubber Avenue, Naugatuck

Thursday, October 13, 2011

4:00 - 6:00 P.M.

Time	Rte 63/Meadow St SB					Rubber Ave WB					Rte 63/Cherry St NB					Rubber Ave EB				Int. Total
	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Approach Total	
4:00	27	49	12	2	88	1	73	13	0	87	5	20	52	0	77	47	78	28	153	405
4:15	41	59	4	1	104	6	81	17	1	104	10	22	75	0	107	49	67	30	146	461
4:30	37	42	7	0	86	8	90	3	0	101	14	31	84	0	129	46	67	26	139	455
4:45	35	52	7	0	94	6	76	13	0	95	11	33	66	2	110	48	66	33	147	446
5:00	42	55	3	0	100	6	92	17	1	115	14	26	68	1	108	37	71	36	144	467
5:15	47	56	0	1	103	3	91	15	0	109	13	37	81	1	131	64	78	26	168	511
5:30	31	60	8	0	99	1	86	18	1	105	6	29	76	0	111	74	74	40	188	503
5:45	42	47	12	0	101	5	88	21	0	114	10	35	68	1	113	38	70	39	147	475
Peak Hour	162	218	23		403	15	357	71		443	43	127	293		463	213	293	141	647	1956
Totals																				

 Peak Hour

Appendix B:

Synchro Analysis
of Existing Operations: AM/PM

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/13/2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	166	189	216	42	191	16	124	76	30	22	216	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	8	10	10	8	8	16	8	8	16	8
Storage Length (ft)	250		0	250		0	0		0	0		0
Storage Lanes	1		0	1		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	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		0.920			0.989			0.983			0.965	
Flt Protected	0.950			0.950				0.974			0.997	
Satd. Flow (prot)	1652	1599	0	1652	1719	0	0	2021	0	0	2031	0
Flt Permitted	0.187			0.383				0.330			0.958	
Satd. Flow (perm)	325	1599	0	666	1719	0	0	685	0	0	1952	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		52			3			7			15	
Link Speed (mph)		25			25			25			25	
Link Distance (ft)		460			501			559			466	
Travel Time (s)		12.5			13.7			15.2			12.7	
Peak Hour Factor	0.78	0.82	0.82	0.88	0.63	0.63	0.90	0.90	0.90	0.86	0.86	0.86
Adj. Flow (vph)	213	230	263	48	303	25	138	84	33	26	251	98
Shared Lane Traffic (%)												
Lane Group Flow (vph)	213	493	0	48	328	0	0	255	0	0	375	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.20	1.09	1.09	1.20	1.20	0.85	1.20	1.20	0.85	1.20
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3		3	3		1	1		1	1	
Detector Template							Left			Left		
Leading Detector (ft)	28	28		28	28		20	206		20	206	
Trailing Detector (ft)	0	0		0	0		0	200		0	200	
Detector 1 Position(ft)	0	0		0	0		0	200		0	200	
Detector 1 Size(ft)	6	6		6	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	12	12		12	12							
Detector 2 Size(ft)	6	6		6	6							
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0	0.0							
Detector 3 Position(ft)	22	22		22	22							
Detector 3 Size(ft)	6	6		6	6							
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Detector 3 Position(ft)	
Detector 3 Size(ft)	
Detector 3 Type	

Lanes, Volumes, Timings

3: Cherry/Meadow & Rubber

8/13/2013



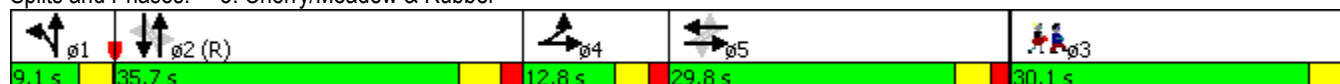
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0	0.0							
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	4	4 5			5		1	1 2				2
Permitted Phases	4 5			5	5		1 2			2		2
Detector Phase	4	5		5	5		1	2		2		2
Switch Phase												
Minimum Initial (s)	3.0			7.0	7.0		6.0			18.0		18.0
Minimum Split (s)	7.8			20.8	20.8		9.1			23.7		23.7
Total Split (s)	12.8			29.8	29.8		9.1			35.7		35.7
Total Split (%)	10.9%			25.4%	25.4%		7.7%			30.4%		30.4%
Maximum Green (s)	8.0			25.0	25.0		6.0			30.0		30.0
Yellow Time (s)	3.0			3.0	3.0		3.0			3.7		3.7
All-Red Time (s)	1.8			1.8	1.8		0.1			2.0		2.0
Lost Time Adjust (s)	0.0			0.0	0.0							0.0
Total Lost Time (s)	4.8			4.8	4.8							5.7
Lead/Lag	Lead			Lag	Lag		Lead			Lag		Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes		Yes
Vehicle Extension (s)	1.0			2.0	2.0		0.2			3.5		3.5
Recall Mode	None			None	None		Max			C-Min		C-Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	37.7	42.5		24.0	24.0				57.9			24.3
Actuated g/C Ratio	0.32	0.36		0.20	0.20				0.49			0.21
v/c Ratio	0.82	0.81		0.36	0.93				0.37			0.90
Control Delay	58.4	42.5		47.9	78.4				21.4			68.9
Queue Delay	0.0	0.0		0.0	0.0				0.0			0.0
Total Delay	58.4	42.5		47.9	78.4				21.4			68.9
LOS	E	D		D	E				C			E
Approach Delay		47.3			74.5				21.4			68.9
Approach LOS		D			E				C			E

Intersection Summary

Area Type: Other
 Cycle Length: 117.5
 Actuated Cycle Length: 117.5
 Offset: 9.1 (8%), Referenced to phase 2:NBSB, Start of Green
 Natural Cycle: 105
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.93
 Intersection Signal Delay: 54.2
 Intersection Capacity Utilization 75.5%
 Analysis Period (min) 15

Intersection LOS: D
 ICU Level of Service D

Splits and Phases: 3: Cherry/Meadow & Rubber



Lane Group	ø3
Detector 3 Channel	
Detector 3 Extend (s)	
Turn Type	
Protected Phases	3
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	30.1
Total Split (s)	30.1
Total Split (%)	26%
Maximum Green (s)	26.0
Yellow Time (s)	4.0
All-Red Time (s)	0.1
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	19.0
Pedestrian Calls (#/hr)	8
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Intersection Summary	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/7/2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	141	293	213	71	357	15	293	127	43	23	218	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	8	10	10	8	8	16	8	8	16	8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frts		0.937			0.994			0.987				0.946
Flt Protected	0.950			0.950				0.969				0.997
Satd. Flow (prot)	1652	1629	0	1652	1728	0	0	2019	0	0	1991	0
Flt Permitted	0.175			0.182				0.263				0.948
Satd. Flow (perm)	304	1629	0	316	1728	0	0	548	0	0	1893	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		28			1			4				22
Link Speed (mph)		25			25			25				25
Link Distance (ft)		460			501			559				466
Travel Time (s)		12.5			13.7			15.2				12.7
Peak Hour Factor	0.79	0.85	0.85	0.85	0.95	0.95	0.88	0.88	0.88	0.98	0.98	0.98
Adj. Flow (vph)	178	345	251	84	376	16	333	144	49	23	222	165
Shared Lane Traffic (%)												
Lane Group Flow (vph)	178	596	0	84	392	0	0	526	0	0	410	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.20	1.09	1.09	1.20	1.20	0.85	1.20	1.20	0.85	1.20
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3		3	3		1	1		1	1	
Detector Template										Left		
Leading Detector (ft)	28	28		28	28		206	206		20	0	
Trailing Detector (ft)	0	0		0	0		200	200		0	0	
Detector 1 Position(ft)	0	0		0	0		200	200		0	200	
Detector 1 Size(ft)	6	6		6	6		6	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Call	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	12	12		12	12							
Detector 2 Size(ft)	6	6		6	6							
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0	0.0							
Detector 3 Position(ft)	22	22		22	22							
Detector 3 Size(ft)	6	6		6	6							
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0	0.0							
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/7/2013

Lane Group	ø12
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Detector 3 Position(ft)	
Detector 3 Size(ft)	
Detector 3 Type	
Detector 3 Channel	
Detector 3 Extend (s)	
Turn Type	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/7/2013

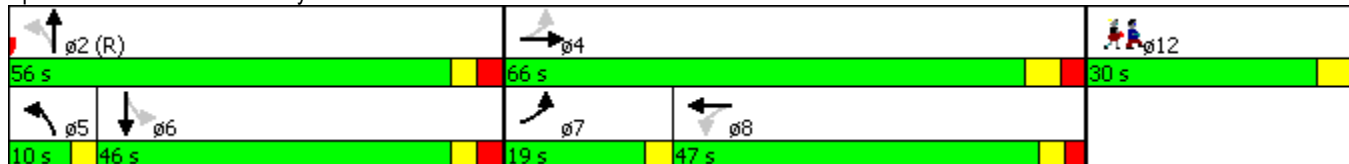


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases	7	4			8		5	2				6
Permitted Phases	4	4		8			2			6		
Detector Phase	7	4		8	8		5	2		6		6
Switch Phase												
Minimum Initial (s)	1.0	3.0		7.0	7.0		4.0	6.0		5.0		5.0
Minimum Split (s)	4.0	12.0		21.0	21.0		8.5	12.0		11.7		11.7
Total Split (s)	19.0	66.0		47.0	47.0		10.0	56.0		46.0		46.0
Total Split (%)	12.5%	43.4%		30.9%	30.9%		6.6%	36.8%		30.3%		30.3%
Maximum Green (s)	16.0	59.0		41.5	41.5		7.0	50.0		40.0		40.0
Yellow Time (s)	3.0	4.0		3.0	3.0		3.0	3.0		3.0		3.0
All-Red Time (s)	0.0	3.0		2.5	2.5		0.0	3.0		3.0		3.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0				0.0
Total Lost Time (s)	3.0	7.0		5.5	5.5			6.0				6.0
Lead/Lag	Lead			Lag	Lag		Lead			Lag		Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes		Yes
Vehicle Extension (s)	1.0	1.0		2.0	2.0		3.0	0.2		3.5		3.5
Recall Mode	None	None		None	None		Max	C-Max		Min		Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	60.0	56.0		40.9	40.9			77.0				40.0
Actuated g/C Ratio	0.39	0.37		0.27	0.27			0.51				0.26
v/c Ratio	0.74	0.96		0.99	0.84			0.91				0.80
Control Delay	49.4	72.8		149.5	69.3			50.8				62.1
Queue Delay	0.0	0.0		0.0	0.0			0.0				0.0
Total Delay	49.4	72.8		149.5	69.3			50.8				62.1
LOS	D	E		F	E			D				E
Approach Delay		67.4			83.4			50.8				62.1
Approach LOS		E			F			D				E

Intersection Summary

Area Type: Other
 Cycle Length: 152
 Actuated Cycle Length: 152
 Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
 Natural Cycle: 150
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.99
 Intersection Signal Delay: 65.9
 Intersection LOS: E
 Intersection Capacity Utilization 102.8%
 ICU Level of Service G
 Analysis Period (min) 15

Splits and Phases: 3: Cherry/Meadow & Rubber



Lanes, Volumes, Timings
 3: Cherry/Meadow & Rubber

8/7/2013

Lane Group	ø12
Protected Phases	12
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	30.0
Total Split (s)	30.0
Total Split (%)	20%
Maximum Green (s)	26.0
Yellow Time (s)	4.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	19.0
Pedestrian Calls (#/hr)	8
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Intersection Summary	

Appendix C:

Results of Signal
Optimization: AM/PM

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/7/2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	166	189	216	42	191	16	124	76	30	22	216	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	8	10	10	8	8	16	8	8	16	8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr _t		0.920			0.988			0.982				0.965
Fl _t Protected	0.950			0.950				0.974				0.997
Satd. Flow (prot)	1652	1599	0	1652	1718	0	0	2019	0	0	2031	0
Fl _t Permitted	0.341			0.287				0.380				0.963
Satd. Flow (perm)	593	1599	0	499	1718	0	0	788	0	0	1962	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		44			3			5				11
Link Speed (mph)		25			25			25				25
Link Distance (ft)		460			501			559				466
Travel Time (s)		12.5			13.7			15.2				12.7
Peak Hour Factor	0.79	0.85	0.85	0.85	0.95	0.95	0.88	0.88	0.88	0.98	0.98	0.98
Adj. Flow (vph)	210	222	254	49	201	17	141	86	34	22	220	86
Shared Lane Traffic (%)												
Lane Group Flow (vph)	210	476	0	49	218	0	0	261	0	0	328	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.20	1.09	1.09	1.20	1.20	0.85	1.20	1.20	0.85	1.20
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3		3	3		1	1		1	1	
Detector Template										Left		
Leading Detector (ft)	28	28		28	28		206	206		20		0
Trailing Detector (ft)	0	0		0	0		200	200		0		0
Detector 1 Position(ft)	0	0		0	0		200	200		0		200
Detector 1 Size(ft)	6	6		6	6		6	6		20		6
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex		Call
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0		0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0		0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0		0.0
Detector 2 Position(ft)	12	12		12	12							
Detector 2 Size(ft)	6	6		6	6							
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0	0.0							
Detector 3 Position(ft)	22	22		22	22							
Detector 3 Size(ft)	6	6		6	6							
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0	0.0							
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm		NA

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/7/2013

Lane Group	ø12
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Detector 3 Position(ft)	
Detector 3 Size(ft)	
Detector 3 Type	
Detector 3 Channel	
Detector 3 Extend (s)	
Turn Type	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/7/2013

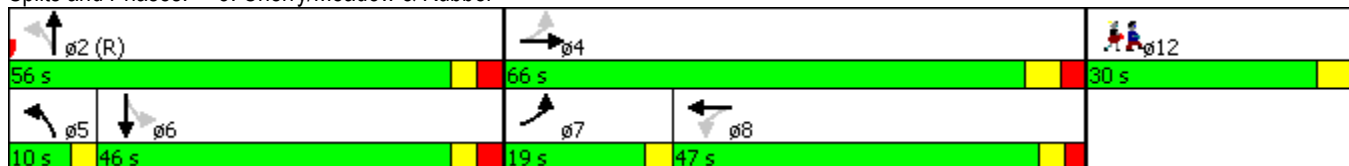


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases	7	4			8		5	2				6
Permitted Phases	4	4		8			2			6		
Detector Phase	7	4		8	8		5	2		6		6
Switch Phase												
Minimum Initial (s)	1.0	3.0		7.0	7.0		4.0	6.0		5.0		5.0
Minimum Split (s)	4.0	12.0		21.0	21.0		8.5	12.0		11.7		11.7
Total Split (s)	19.0	66.0		47.0	47.0		10.0	56.0		46.0		46.0
Total Split (%)	12.5%	43.4%		30.9%	30.9%		6.6%	36.8%		30.3%		30.3%
Maximum Green (s)	16.0	59.0		41.5	41.5		7.0	50.0		40.0		40.0
Yellow Time (s)	3.0	4.0		3.0	3.0		3.0	3.0		3.0		3.0
All-Red Time (s)	0.0	3.0		2.5	2.5		0.0	3.0		3.0		3.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0				0.0
Total Lost Time (s)	3.0	7.0		5.5	5.5			6.0				6.0
Lead/Lag	Lead			Lag	Lag		Lead			Lag		Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes		Yes
Vehicle Extension (s)	1.0	1.0		2.0	2.0		3.0	0.2		3.5		3.5
Recall Mode	None	None		None	None		Max	C-Max		Min		Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	50.9	46.9		30.1	30.1		86.1			40.0		
Actuated g/C Ratio	0.33	0.31		0.20	0.20		0.57			0.26		
v/c Ratio	0.69	0.91		0.49	0.64		0.34			0.63		
Control Delay	49.5	67.3		69.0	62.5		24.2			53.8		
Queue Delay	0.0	0.0		0.0	0.0		0.0			0.0		
Total Delay	49.5	67.3		69.0	62.5		24.2			53.8		
LOS	D	E		E	E		C			D		
Approach Delay		61.8			63.7		24.2			53.8		
Approach LOS		E			E		C			D		

Intersection Summary

Area Type: Other
 Cycle Length: 152
 Actuated Cycle Length: 152
 Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.91
 Intersection Signal Delay: 54.1
 Intersection LOS: D
 Intersection Capacity Utilization 79.8%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 3: Cherry/Meadow & Rubber



Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/7/2013

Lane Group	ø12
Protected Phases	12
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	30.0
Total Split (s)	30.0
Total Split (%)	20%
Maximum Green (s)	26.0
Yellow Time (s)	4.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	19.0
Pedestrian Calls (#/hr)	8
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Intersection Summary	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	141	293	213	71	357	15	293	127	43	23	218	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	8	10	10	8	8	16	8	8	16	8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr't		0.937			0.994			0.987				0.946
Flt Protected	0.950			0.950				0.969				0.997
Satd. Flow (prot)	1652	1629	0	1652	1728	0	0	2019	0	0	1991	0
Flt Permitted	0.170			0.185				0.262				0.946
Satd. Flow (perm)	296	1629	0	322	1728	0	0	546	0	0	1889	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		28			1			4				22
Link Speed (mph)		25			25			25				25
Link Distance (ft)		460			501			559				466
Travel Time (s)		12.5			13.7			15.2				12.7
Peak Hour Factor	0.79	0.85	0.85	0.85	0.95	0.95	0.88	0.88	0.88	0.98	0.98	0.98
Adj. Flow (vph)	178	345	251	84	376	16	333	144	49	23	222	165
Shared Lane Traffic (%)												
Lane Group Flow (vph)	178	596	0	84	392	0	0	526	0	0	410	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.20	1.09	1.09	1.20	1.20	0.85	1.20	1.20	0.85	1.20
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3		3	3		1	1		1	1	
Detector Template										Left		
Leading Detector (ft)	28	28		28	28		206	206		20		0
Trailing Detector (ft)	0	0		0	0		200	200		0		0
Detector 1 Position(ft)	0	0		0	0		200	200		0		200
Detector 1 Size(ft)	6	6		6	6		6	6		20		6
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex		Call
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0		0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0		0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0		0.0
Detector 2 Position(ft)	12	12		12	12							
Detector 2 Size(ft)	6	6		6	6							
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0	0.0							
Detector 3 Position(ft)	22	22		22	22							
Detector 3 Size(ft)	6	6		6	6							
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0	0.0							
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm		NA

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013

Lane Group	ø12
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Detector 3 Position(ft)	
Detector 3 Size(ft)	
Detector 3 Type	
Detector 3 Channel	
Detector 3 Extend (s)	
Turn Type	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013

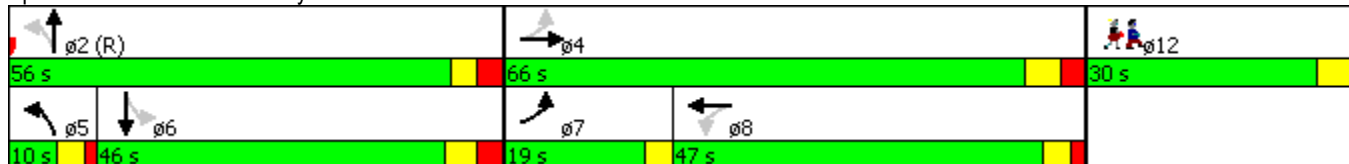


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases	7	4			8		5	2				6
Permitted Phases	4	4		8			2			6		
Detector Phase	7	4		8	8		5	2		6		6
Switch Phase												
Minimum Initial (s)	1.0	3.0		7.0	7.0		4.0	6.0		5.0		5.0
Minimum Split (s)	4.0	12.0		21.0	21.0		8.5	12.0		11.7		11.7
Total Split (s)	19.0	66.0		47.0	47.0		10.0	56.0		46.0		46.0
Total Split (%)	12.5%	43.4%		30.9%	30.9%		6.6%	36.8%		30.3%		30.3%
Maximum Green (s)	16.0	59.0		42.0	42.0		5.5	50.0		39.3		39.3
Yellow Time (s)	3.0	4.0		3.0	3.0		3.0	3.0		3.7		3.7
All-Red Time (s)	0.0	3.0		2.0	2.0		1.5	3.0		3.0		3.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0				0.0
Total Lost Time (s)	3.0	7.0		5.0	5.0			6.0				6.7
Lead/Lag	Lead			Lag	Lag		Lead			Lag		Lag
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes		Yes
Vehicle Extension (s)	1.0	1.0		2.0	2.0		3.0	0.2		3.5		3.5
Recall Mode	None	None		None	None		Max	C-Max		Min		Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	60.0	56.0		41.4	41.4			77.0				39.3
Actuated g/C Ratio	0.39	0.37		0.27	0.27			0.51				0.26
v/c Ratio	0.75	0.96		0.97	0.83			0.91				0.81
Control Delay	50.1	72.8		141.2	67.8			51.0				63.9
Queue Delay	0.0	0.0		0.0	0.0			0.0				0.0
Total Delay	50.1	72.8		141.2	67.8			51.0				63.9
LOS	D	E		F	E			D				E
Approach Delay		67.6			80.7			51.0				63.9
Approach LOS		E			F			D				E

Intersection Summary

Area Type: Other
 Cycle Length: 152
 Actuated Cycle Length: 152
 Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
 Natural Cycle: 150
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.97
 Intersection Signal Delay: 65.7
 Intersection LOS: E
 Intersection Capacity Utilization 103.0%
 ICU Level of Service G
 Analysis Period (min) 15

Splits and Phases: 3: Cherry/Meadow & Rubber



Lane Group	ø12
Protected Phases	12
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	30.0
Total Split (s)	30.0
Total Split (%)	20%
Maximum Green (s)	26.0
Yellow Time (s)	4.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	19.0
Pedestrian Calls (#/hr)	8
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Intersection Summary	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	166	189	216	42	191	16	124	76	30	22	216	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	8	10	10	8	8	16	8	8	16	8
Lane Util. Factor	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		0.920			0.988			0.957				0.965
Flt Protected	0.950			0.950			0.950					0.997
Satd. Flow (prot)	1652	1599	0	1652	1718	0	1534	2020	0	0	2031	0
Flt Permitted	0.565			0.168			0.324					0.978
Satd. Flow (perm)	982	1599	0	292	1718	0	523	2020	0	0	1992	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		59			4			17				12
Link Speed (mph)		25			25			25				25
Link Distance (ft)		460			501			559				466
Travel Time (s)		12.5			13.7			15.2				12.7
Peak Hour Factor	0.79	0.85	0.85	0.85	0.95	0.95	0.88	0.88	0.88	0.98	0.98	0.98
Adj. Flow (vph)	210	222	254	49	201	17	141	86	34	22	220	86
Shared Lane Traffic (%)												
Lane Group Flow (vph)	210	476	0	49	218	0	141	120	0	0	328	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			8				8
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.20	1.09	1.09	1.20	1.20	0.85	1.20	1.20	0.85	1.20
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3		3	3		1	1		1	1	
Detector Template										Left		
Leading Detector (ft)	28	28		28	28		206	206		20	0	
Trailing Detector (ft)	0	0		0	0		200	200		0	0	
Detector 1 Position(ft)	0	0		0	0		200	200		0	200	
Detector 1 Size(ft)	6	6		6	6		6	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Call	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	12	12		12	12							
Detector 2 Size(ft)	6	6		6	6							
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0	0.0							
Detector 3 Position(ft)	22	22		22	22							
Detector 3 Size(ft)	6	6		6	6							
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0	0.0							
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		Perm	NA	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013

Lane Group	ø12
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Detector 3 Position(ft)	
Detector 3 Size(ft)	
Detector 3 Type	
Detector 3 Channel	
Detector 3 Extend (s)	
Turn Type	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013

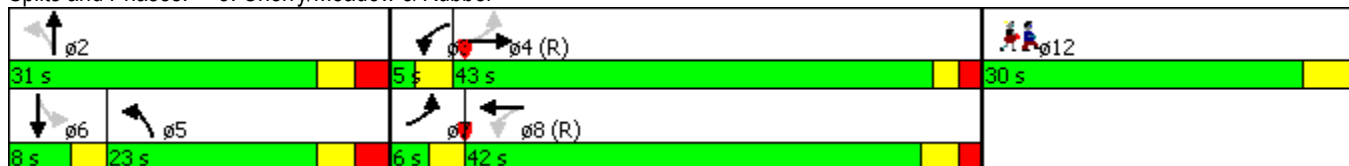


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases	7	4		3	8		5	2				6
Permitted Phases	4	4		8			2			6		
Detector Phase	7	4		3	8		5	2		6		6
Switch Phase												
Minimum Initial (s)	1.0	3.0		1.0	7.0		3.0	6.0		5.0		5.0
Minimum Split (s)	4.0	12.0		4.0	21.0		10.0	12.0		8.0		8.0
Total Split (s)	6.0	43.0		5.0	42.0		23.0	31.0		8.0		8.0
Total Split (%)	5.5%	39.4%		4.6%	38.5%		21.1%	28.4%		7.3%		7.3%
Maximum Green (s)	3.0	39.0		2.0	37.0		17.0	25.0		5.0		5.0
Yellow Time (s)	3.0	2.0		3.0	3.0		3.0	3.0		3.0		3.0
All-Red Time (s)	0.0	2.0		0.0	2.0		3.0	3.0		0.0		0.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0				0.0
Total Lost Time (s)	3.0	4.0		3.0	5.0		6.0	6.0				3.0
Lead/Lag	Lead	Lag		Lead	Lag		Lag			Lead		Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes		Yes
Vehicle Extension (s)	1.0	1.0		3.0	2.0		1.0	0.2		3.5		3.5
Recall Mode	Min	C-Min		Max	C-Max		None	None		None		None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	49.1	39.0		51.4	39.7		40.2	40.2				28.0
Actuated g/C Ratio	0.45	0.36		0.47	0.36		0.37	0.37				0.26
v/c Ratio	0.42	0.78		0.18	0.35		0.51	0.16				0.63
Control Delay	20.7	37.6		17.5	27.6		38.3	22.8				43.1
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0				0.0
Total Delay	20.7	37.6		17.5	27.6		38.3	22.8				43.1
LOS	C	D		B	C		D	C				D
Approach Delay		32.4			25.8			31.2				43.1
Approach LOS		C			C			C				D

Intersection Summary

Area Type: Other
 Cycle Length: 109
 Actuated Cycle Length: 109
 Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.78
 Intersection Signal Delay: 33.3
 Intersection LOS: C
 Intersection Capacity Utilization 66.1%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 3: Cherry/Meadow & Rubber



Lane Group	ø12
Protected Phases	12
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	30.0
Total Split (s)	30.0
Total Split (%)	28%
Maximum Green (s)	26.0
Yellow Time (s)	4.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	19.0
Pedestrian Calls (#/hr)	8
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Intersection Summary	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	141	293	213	71	357	15	293	127	43	23	218	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	8	10	10	8	8	16	8	8	16	8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr _t		0.937			0.994			0.962				0.946
Fl _t Protected	0.950			0.950			0.950					0.997
Satd. Flow (prot)	1652	1629	0	1652	1728	0	1534	2031	0	0	1991	0
Fl _t Permitted	0.279			0.118			0.256					0.978
Satd. Flow (perm)	485	1629	0	205	1728	0	413	2031	0	0	1953	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		37			2			15				23
Link Speed (mph)		25			25			25				25
Link Distance (ft)		460			501			559				466
Travel Time (s)		12.5			13.7			15.2				12.7
Peak Hour Factor	0.79	0.85	0.85	0.85	0.95	0.95	0.88	0.88	0.88	0.98	0.98	0.98
Adj. Flow (vph)	178	345	251	84	376	16	333	144	49	23	222	165
Shared Lane Traffic (%)												
Lane Group Flow (vph)	178	596	0	84	392	0	333	193	0	0	410	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			8				8
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.20	1.09	1.09	1.20	1.20	0.85	1.20	1.20	0.85	1.20
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3		3	3		1	1		1	1	
Detector Template										Left		
Leading Detector (ft)	28	28		28	28		206	206		20	0	
Trailing Detector (ft)	0	0		0	0		200	200		0	0	
Detector 1 Position(ft)	0	0		0	0		200	200		0	200	
Detector 1 Size(ft)	6	6		6	6		6	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Call	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	12	12		12	12							
Detector 2 Size(ft)	6	6		6	6							
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0	0.0							
Detector 3 Position(ft)	22	22		22	22							
Detector 3 Size(ft)	6	6		6	6							
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0	0.0							
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		Perm	NA	

Lanes, Volumes, Timings
 3: Cherry/Meadow & Rubber

8/6/2013

Lane Group	ø12
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Fr't	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Detector 3 Position(ft)	
Detector 3 Size(ft)	
Detector 3 Type	
Detector 3 Channel	
Detector 3 Extend (s)	
Turn Type	

Lanes, Volumes, Timings
3: Cherry/Meadow & Rubber

8/6/2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Protected Phases	7	4		3	8		5	2				6
Permitted Phases	4	4		8			2			6		
Detector Phase	7	4		3	8		5	2		6		6
Switch Phase												
Minimum Initial (s)	1.0	3.0		1.0	7.0		3.0	6.0		5.0		5.0
Minimum Split (s)	4.0	12.0		4.0	21.0		10.0	12.0		8.0		8.0
Total Split (s)	6.0	43.0		5.0	42.0		23.0	31.0		8.0		8.0
Total Split (%)	5.5%	39.4%		4.6%	38.5%		21.1%	28.4%		7.3%		7.3%
Maximum Green (s)	3.0	39.0		2.0	37.0		17.0	25.0		5.0		5.0
Yellow Time (s)	3.0	2.0		3.0	3.0		3.0	3.0		3.0		3.0
All-Red Time (s)	0.0	2.0		0.0	2.0		3.0	3.0		0.0		0.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0				0.0
Total Lost Time (s)	3.0	4.0		3.0	5.0		6.0	6.0				3.0
Lead/Lag	Lead	Lag		Lead	Lag		Lag			Lead		Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes		Yes
Vehicle Extension (s)	1.0	1.0		3.0	2.0		1.0	0.2		3.5		3.5
Recall Mode	Min	C-Min		Max	C-Max		None	None		None		None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	43.0	39.0		41.0	37.0		49.0	49.0				29.0
Actuated g/C Ratio	0.39	0.36		0.38	0.34		0.45	0.45				0.27
v/c Ratio	0.80	0.98		0.82	0.67		0.93	0.21				0.76
Control Delay	53.6	66.3		78.7	37.2		69.1	20.7				46.5
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0				0.0
Total Delay	53.6	66.3		78.7	37.2		69.1	20.7				46.5
LOS	D	E		E	D		E	C				D
Approach Delay		63.4			44.6			51.3				46.5
Approach LOS		E			D			D				D

Intersection Summary

Area Type: Other
 Cycle Length: 109
 Actuated Cycle Length: 109
 Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green
 Natural Cycle: 140
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.98
 Intersection Signal Delay: 53.2
 Intersection LOS: D
 Intersection Capacity Utilization 86.2%
 ICU Level of Service E
 Analysis Period (min) 15

Splits and Phases: 3: Cherry/Meadow & Rubber



Lane Group	ø12
Protected Phases	12
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	30.0
Total Split (s)	30.0
Total Split (%)	28%
Maximum Green (s)	26.0
Yellow Time (s)	4.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	19.0
Pedestrian Calls (#/hr)	8
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Intersection Summary	