

# York Street at IL Route 56 (Butterfield Rd) - Traffic Analysis

City of Elmhurst, Illinois

Prepared for: City of Elmhurst



Prepared by:

TranSystems

September 2015

## I. Introduction

TranSystems was hired by the City of Elmhurst to conduct an updated traffic analysis for the intersection of York Street and Illinois Route 56 (Butterfield Road) within the City of Elmhurst, Illinois. A previous study of the intersection was last conducted in 2009 as part of a Traffic Impact Study done for the Elmhurst Memorial Hospital Campus, approximately 0.40 miles southwest of the intersection. At that time existing and future traffic capacity analysis was performed for the intersection using then current traffic counts and considering a 2030 design horizon for future traffic. Based on the results of that study, it was determined that several channelization and other improvements would be required at the intersection to properly accommodate the future traffic, specifically as a result of the new and growing Elmhurst Memorial Hospital campus.

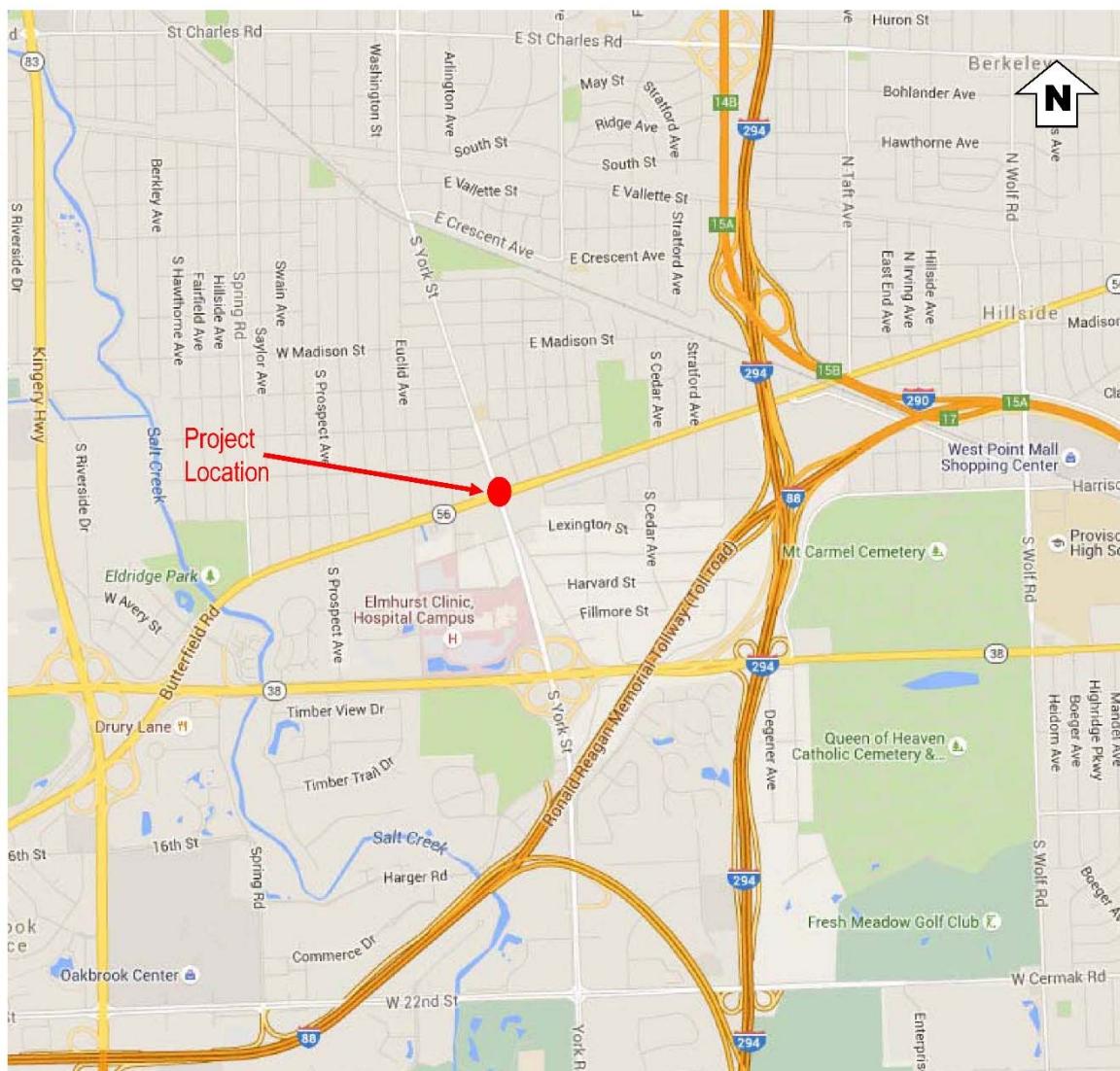
The following study includes taking new traffic counts at the intersection, establishing a peak hour for both weekday AM and PM peak periods, obtaining Average Daily Traffic projections for a 2040 design horizon, applying a suitable growth rate a result of those values, and analyzing both existing and future year traffic and comparing the results to the Traffic Impact Study for the hospital.

## 2. Existing Conditions

The signalized intersection of York Street and Illinois Route 56 (Butterfield Road) is located in the southeast section of the City of Elmhurst, in DuPage County, Illinois. While Illinois Route 56 is a minor arterial route under the jurisdiction of the Illinois Department of Transportation (IDOT), York Street is a minor arterial under the jurisdiction of the City of Elmhurst. The posted speed limit on all four approaches of the York/Butterfield intersection is 35 miles per hour. At the intersection, all four approaches have two through lanes in each direction. However, the cross section narrows to only one lane in each direction on Butterfield Road approximately 700 feet on either side of York Street. On York Street, both the north and south approaches each have one exclusive left-turn lane. Right-turn movements are made from the outside through lanes on both of these approaches. On Butterfield Road, both the east approach and west approach has two through lanes, one exclusive left-turn lane, and one exclusive right-turn lane. See **Figure 1** on the next page for a general map of the study area.

## 3. Data Collection

To properly assess existing conditions at the intersection and capture traffic patterns that include the fully operational Elmhurst Memorial Hospital, fully classified turning movement counts were collected 7:00 a.m. – 9:00 a.m. and 4:00 p.m. – 6:00 p.m. on Tuesday, August 25, 2015. See **Appendix A** for the traffic count data. The weekday AM peak hour was determined to be 7:15 a.m. – 8:15 a.m., and the PM peak hour to be 4:45 p.m. – 5:45 p.m.

**Figure 1 – Project Location**

Peak hour traffic data was used to arrive at the existing Average Daily Traffic (ADT) Values. This was done by taking the PM peak hour traffic for each movement at the intersection, arriving at a total amount of traffic on each leg of the intersection, and then dividing this volume by an appropriate K value. The K value is defined as the percentage of ADT that occurs within the given peak hour. Typically this value ranges between 7% and 12%, with the most common range occurring between 8% and 10%. Traffic on the west leg of the intersection was divided by 17,500 vehicles per day (vpd), which is the ADT value for this approach taken from IDOT's traffic count map. The resulting K value is 9.6%, which falls in the range of commonly used K values. This 9.6% K value was then divided into the total peak hour traffic for the other three intersection approaches, providing ADT values for the other three legs (north, south, and east legs). See **Figure 2** for a table that demonstrates the ADT determination process.

Intersection Leg	Existing Design Hourly Volume by Approach (PM Peak)	K Value	Resulting Existing Average Daily Traffic (ADT)
	X	Y	X / Y
West	1,683	9.6%	17,500*
East	1,633	9.6%	17,000
North	1,831	9.6%	19,100
South	2,227	9.6%	23,200

\* - Taken from IDOT's Existing ADT Map, to determine the appropriate K Value

**Figure 2 – Existing Average Daily Traffic Determination**

The existing ADTs were then submitted to the Chicago Metropolitan Agency for Planning (CMAP), with the request for their agency to use their traffic models to help develop 2040 ADT values for all four intersection approaches. See **Appendix B** for a copy of the CMAP letter sent to the City of Elmhurst with the resulting 2040 ADT information. The 2040 ADT values were then used to establish a uniform growth rate for each of the four intersection approaches, and 2040 DHVs were developed using these rates. **Exhibit I** on the following page provides a comparison of the existing DHVs for each of the turning movements at the intersection for both the AM and PM peak periods against the 2040 DHVs. The exhibit also provides the 2030 DHVs that were determined in the 2009 Traffic Impact Study that was done for the Elmhurst Memorial Hospital campus by Gewalt Hamilton.

## 4. Capacity Analysis

To determine the existing and expected future levels of delay at the intersection, the existing and 2040 peak hour volumes were analyzed using HCS 2010, the preferred capacity analysis program of the Illinois Department of Transportation (IDOT). The signal cycle length was held constant between the existing and 2040 volume analyses, but optimization of the traffic signal splits – the amount of time allotted to each phased movement at the intersection – was performed. Storage calculations utilizing IDOT's Red Time Formula were also performed and compared against the 95<sup>th</sup> percentile queues for each movement. See **Appendix C** for capacity analysis reports and storage length calculations.

**Exhibit 2** provides a comparison of level of service (LOS) and delay in seconds for both peak periods and for both existing and 2040 traffic. From purely a LOS/delay viewpoint, the 2040 traffic's capacity analysis is very similar to the existing traffic capacity analysis. All movements are shown to operate at LOS D or better. Since LOS A through LOS D are often considered the acceptable levels of service, this suggests that even under 2040 traffic, the intersection should operate satisfactorily.

**Exhibit 3** compares the storage requirements for each lane group for both existing and 2040 traffic. The difference in storage requirements between the two scenarios is often 10 feet or less, with all lane group storage requirement increases being a car length or less. The analysis more importantly shows that even under existing conditions, there are two critical lane groups at the intersection that provide less storage than is required: the eastbound right-turn lane and the westbound left-turn lane.

**EXHIBIT I****York Street at Illinois Route 56 (Butterfield Road)****City of Elmhurst****Turning Movement Count Data Comparison**

AM Peak				
Data Year:	Movement	Existing (August 2015)	Future (2040)	2030 Traffic (Gewalt Hamilton TIS)
	EB LT	145	150	200
	EB TH	320	330	355
	EB RT	280	290	220
	WB LT	255	265	420
	WB TH	529	545	350
	WB RT	64	70	50
	NB LT	169	185	170
	NB TH	442	480	615
	NB RT	150	165	160
	SB LT	70	75	105
	SB TH	593	625	745
	SB RT	154	165	140

PM Peak				
Data Year:	Movement	Existing (August 2015)	Future (2040)	2030 Traffic (Gewalt Hamilton TIS)
	EB LT	194	200	195
	EB TH	562	580	425
	EB RT	190	200	185
	WB LT	211	220	365
	WB TH	356	370	305
	WB RT	84	90	55
	NB LT	244	265	190
	NB TH	666	720	900
	NB RT	303	330	290
	SB LT	127	135	155
	SB TH	613	645	625
	SB RT	147	155	120

**EXHIBIT 2****York Street at Illinois Route 56 (Butterfield Road)****City of Elmhurst****Level of Service/Delay Comparison**

Movement	Existing (2015)		2040	
	AM Peak Period	PM Peak Period	AM Peak Period	PM Peak Period
EB LT	C (31.6)	D (35.5)	C (32.4)	D (37.6)
EB TH	C (32.8)	D (42.0)	C (32.6)	D (45.4)
EB RT	D (38.2)	C (29.7)	D (37.5)	C (29.7)
EB Approach	C (34.6)	D (38.2)	C (34.4)	D (40.6)
WB LT	C (22.6)	C (26.0)	C (22.4)	C (26.8)
WB TH	C (26.8)	C (26.1)	C (26.0)	C (26.3)
WB RT	C (20.8)	C (22.6)	C (20.3)	C (22.7)
WB Approach	C (25.1)	C (25.6)	C (24.5)	C (26.0)
NB LT	C (20.6)	C (24.2)	C (24.5)	C (28.3)
NB TH	C (21.3)	C (24.6)	C (22.6)	C (26.4)
NB TH/RT	C (21.5)	C (25.1)	C (22.9)	C (27.1)
NB Approach	C (21.2)	C (24.7)	C (23.1)	C (27.0)
SB LT	B (17.5)	C (26.0)	B (18.5)	C (32.8)
SB TH	C (26.0)	C (25.0)	C (28.4)	C (26.9)
SB TH/RT	C (26.3)	C (25.3)	C (28.7)	C (27.2)
SB Approach	C (25.4)	C (25.3)	C (27.7)	C (27.9)
Overall Intersection	C (26.5)	C (28.5)	C (27.3)	C (30.5)

**EXHIBIT 3****York Street at Illinois Route 56 (Butterfield Road)****City of Elmhurst****Storage Requirement Comparison**

Movement	Approximate Existing Geometric Storage (Feet)	Storage Requirement 2015 Traffic (Feet)	Storage Requirement 2040 Traffic (Feet)
EB LT	270	200	205
EB TH	710 (To Next Unsig Intersection)	290	300
EB RT*	125	270	275
WB LT	95	245	250
WB TH	295 (To Next Unsig Intersection)	240	245
WB RT*	95	75 <sup>+</sup>	70 <sup>+</sup>
NB LT	235	220	245
NB TH	600 (To Next Unsig Intersection)	370	400
NB TH/RT	600 (To Next Unsig Intersection)	330	360
SB LT	105	130	140
SB TH	515 (To Next Unsig Intersection)	310	335
SB TH/RT	515 (To Next Unsig Intersection)	290	310

\* - Note that Right Turns on Red are permitted for this movement but are not considered in the HCS 2010 analysis

<sup>+</sup> - These values are based on red time and 95th % storages and do not consider the 125-ft minimum storage from BDE 36-3I

## 5. Recommendations

Based on the capacity analyses performed for both existing and 2040 traffic, it is recommended that the City of Elmhurst consider lengthening the storage for both the eastbound right-turn lane and westbound left-turn lane at the intersection. **Exhibit 4** on the following page provides a scaled concept drawing of the geometric requirements. The length of the turn lane tapers is 155 feet and is based on the posted speed limit of 35 mph on both of these legs of the intersection. IDOT typically requires the design speed to be the posted speed limit plus 5 mph, but the recommendation is that a variance be requested, in order to minimize impacts. Therefore a 155-foot taper is recommended based on a 35 mph design speed versus a 175-foot taper that would be required for a 40 mph design speed (35 mph posted speed plus 5 mph).

Impacts to adjacent properties need to be fully considered, particularly when designing an extended eastbound right-turn lane. Driveways to the properties along the south side of the west approach of Butterfield Road would need to be modified, and several easements and minor right-of-way takes may be required to properly design the turn lane. Overhead aerial utilities would be impacted and would require some relocation. Catch basins and some additional drainage design would also be required. The eastbound far-back detector loops and handhole would need to be removed and replaced.

In contrast, the westbound left-turn lane extension would require little to no impacts to adjacent properties but may result in increased access restrictions along the east leg of Butterfield Road. No roadway widening would be required to construct an extended left-turn lane, but options of constructing a mountable median versus extending the existing barrier median would need to be considered. Public input would also be needed to be considered, and crash data for the last five years along this stretch of roadway would need to be analyzed, in order to ensure that the type of median makes sense and ensures safe navigation for all drivers along this segment of Butterfield Road.



**EXHIBIT 4**  
YORK STREET AT IL RTE 56 (BUTTERFIELD RD)  
RECOMMENDED IMPROVEMENTS

## Appendix A – Raw Traffic Count Data

## QUALITY COUNTS REPORT

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Intersection: S York St E Butterfield Rd  
 City/State: Elmhurst IL  
 QCJobNo: 13420601  
 ClientID:  
 Date: 8/25/2015  
 Comments:  
 PEAK HOUR START 7:15 AM  
 PEAK HOUR END 8:15 AM  
 PEAK 15-MIN START 7:45 AM  
 PEAK 15-MIN END 8:00 AM  
 PHF 0.96

Lane Configuration:

SIGNAL	SBLane1	SBLane2	SBLane3	SBLane4	SBLane5	SBLane6	SBLane7	SIGNAL
TR	T	L						TR
EBLane7								WBLane1
EBLane6								WBLane2
EBLane5								WBLane3
EBLane4								WBLane4
EBLane3 L								WBLane5
EBLane2 T								WBLane6
EBLane1 TR								WBLane7
SIGNAL	L	T	TR					
	NBLane7	NBLane6	NBLane5	NBLane4	NBLane3	NBLane2	NBLane1	SIGNAL

## PEAK-HOUR VOLUMES

NBLeft	NBThru	NBRight	SBLeft	SBThru	SBRight	EBLeft	EBThru	EBRight	WBLeft	WBThru	WBRight	NBEntering	SBEntering	EBEntering	WBEntering	NBLeaving	SBLeaving	EBLeaving	WBLeaving
169	442	150	70	593	154	145	320	280	255	529	64	761	817	745	848	651	1128	541	851

## PERCENT HEAVY VEHICLES

NBLeft	NBThru	NBRight	SBLeft	SBThru	SBRight	EBLeft	EBThru	EBRight	WBLeft	WBThru	WBRight	NBEntering	SBEntering	EBEntering	WBEntering	NBLeaving	SBLeaving	EBLeaving	WBLeaving
6.5	2	7.3	4.3	1.3	2.6	2.1	4.4	1.8	3.5	4.7	10.9	4.1	1.8	3	4.8	2.9	2	5.2	4.7

## PEAK-HOUR VOLUMES - PEDESTRIANS

North	South	East	West
1	4	2	4

## PEAK-HOUR VOLUMES - BICYCLES

NBLeft	NBThru	NBRight	SBLeft	SBThru	SBRight	EBLeft	EBThru	EBRight	WBLeft	WBThru	WBRight
0	0	1	0	0	1	0	0	0	0	1	0

## PEAK 15-MIN FLOWRATES

VehicleType	NBLeft	NBThru	NBRight	NBUTurn	NBRTOR	SBLeft	SBThru	SBRight	SBUTurn	SBRTOR	EBLeft	EBThru	EBRight	EBUTurn	EBRTOR	WBLeft	WBThru	WBRight	WBUTurn	WBRTOR	Total
All Vehicles	176	484	176	0	0	64	568	188	0	0	168	256	268	0	0	284	572	92	4	0	3300
Heavy Trucks	16	16	12			4	8	8			0	16	4			4	36	8			132
Pedestrians			12				4					12					8				36
Bicycles	0	0	0			0	0	0			0	0	0			0	0	0			0

## ALL-VEHICLE VOLUMES

Time Period	NB Left	NB Thru	NB Right	NB U-Turn	NB RTOR	SB Left	SB Thru	SB Right	SB U-Turn	SB RTOR	EB Left	EB Thru	EB Right	EB U-Turn	EB RTOR	WB Left	WB Thru	WB Right	WB U-Turn	WB RTOR	Total	Hourly Totals
7:00 AM	42	89	45	0	0	24	109	34	0	0	39	86	54	2	0	53	97	19	0	0	693	
7:15 AM	41	118	32	0	0	24	133	41	0	0	37	85	64	0	0	56	144	12	0	0	787	
7:30 AM	38	101	44	1	0	15	153	24	0	0	42	92	68	0	0	64	115	16	0	0	773	
7:45 AM	44	121	44	0	0	16	142	47	0	0	42	64	67	0	0	71	143	23	1	0	825	3078
8:00 AM	45	102	30	0	0	15	165	42	0	0	24	79	81	0	0	63	127	13	0	0	786	3171
8:15 AM	43	99	27	1	0	19	161	33	0	0	30	56	72	0	0	44	90	16	1	0	692	3076
8:30 AM	33	102	37	0	0	21	126	35	0	0	24	71	47	0	0	56	79	12	1	0	644	2947
8:45 AM	30	94	30	0	0	11	123	40	0	0	24	45	51	0	0	58	90	13	0	0	609	2731

## HEAVY-VEHICLE VOLUMES

Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right	Total
7:00 AM	0	2	3	0	1	0	2	2	1	1	3	1	16
7:15 AM	1	4	4	2	2	1	1	3	1	4	5	1	29
7:30 AM	1	0	1	0	4	0	1	3	2	1	4	2	19
7:45 AM	4	4	3	1	2	2	0	4	1	1	9	2	33
8:00 AM	5	1	3	0	0	1	1	4	1	3	7	2	28
8:15 AM	3	5	3	0	2	2	2	2	1	4	2	1	27
8:30 AM	3	4	2	0	3	1	2	7	0	1	5	0	28
8:45 AM	0	3	4	1	4	5	1	9	2	2	5	2	38

## PEDESTRIAN VOLUMES

Time Period	North	South	East	West	Total
7:00 AM	0	0	0	0	0
7:15 AM	0	0	0	0	1
7:30 AM	0	1	0	0	0
7:45 AM	1	3	2	3	3
8:00 AM	0	0	0	0	0
8:15 AM	0	0	0	0	0
8:30 AM	0	0	0	0	0
8:45 AM	1	0	2	1	1

BICYCLE VOLUMES

## QUALITY COUNTS REPORT

=====

Intersection: S York St E Butterfield Rd  
 City/State: Elmhurst IL  
 QCJobNo: 13420602  
 ClientID:  
 Date: 8/25/2015  
 Comments:  
 PEAK HOUR START 4:45 PM  
 PEAK HOUR END 5:45 PM  
 PEAK 15-MIN START 5:15 PM  
 PEAK 15-MIN END 5:30 PM  
 PHF 0.97

		Lane Configuration:								
		SIGNAL	SBLane1	SBLane2	SBLane3	SBLane4	SBLane5	SBLane6	SBLane7	SIGNAL
		TR	T	L						TR
		EBLane7								WBLane1
		EBLane6								WBLane2
		EBLane5								WBLane3
		EBLane4								WBLane4
		EBLane3 L								WBLane5
		EBLane2 T								WBLane6
		EBLane1 TR								WBLane7
		SIGNAL	L	T	TR					
			NBLane7	NBLane6	NBLane5	NBLane4	NBLane3	NBLane2	NBLane1	SIGNAL

## PEAK-HOUR VOLUMES

NBLeft	NBThru	NBRight	SBLeft	SBThru	SBRight	EBLeft	EBThru	EBRight	WBLeft	WBThru	WBRight	NBEntering	SBEntering	EБEntering	WBEntering	NBLeaving	SBLeaving	EБLeaving	WBLeaving
244	666	303	127	613	147	194	562	190	211	356	84	1213	887	946	651	944	1013	994	746

## PERCENT HEAVY VEHICLES

NBLeft	NBThru	NBRight	SBLeft	SBThru	SBRight	EBLeft	EBThru	EBRight	WBLeft	WBThru	WBRight	NBEntering	SBEntering	EБEntering	WBEntering	NBLeaving	SBLeaving	EБLeaving	WBLeaving
0.8	1.4	1.3	0.8	1.8	2.7	3.6	2.5	1.1	2.4	0.8	0	1.2	1.8	2.4	1.2	1.7	1.8	1.9	1.2

## PEAK-HOUR VOLUMES - PEDESTRIANS

North	South	East	West
2	2	4	6

## PEAK-HOUR VOLUMES - BICYCLES

NBLeft	NBThru	NBRight	SBLeft	SBThru	SBRight	EBLeft	EBThru	EBRight	WBLeft	WBThru	WBRight
0	0	0	0	0	0	0	0	0	0	0	0

## PEAK 15-MIN FLOWRATES

VehicleType	NBLeft	NBThru	NBRight	NBUTurn	NBRTOR	SBLeft	SBThru	SBRight	SBUTurn	SBRTOR	EBLeft	EBThru	EBRight	EBUTurn	EBRTOR	WBLeft	WBThru	WBRight	WBUTurn	WBRTOR	Total
All Vehicles	268	656	332	0	0	112	580	156	0	0	200	612	180	0	0	232	376	92	4	0	3800
Heavy Trucks	0	8	4			4	0	0			12	16	0			4	0	0			48
Pedestrians		0					0					8					4				12
Bicycles	0	0	0			0	0	0			0	0	0			0	0	0			0

## ALL-VEHICLE VOLUMES

Time Period	NB Left	NB Thru	NB Right	NB U-Turn	NB RTOR	SB Left	SB Thru	SB Right	SB U-Turn	SB RTOR	EB Left	EB Thru	EB Right	EB U-Turn	EB RTOR	WB Left	WB Thru	WB Right	WB U-Turn	WB RTOR	Total	Hourly Totals
4:30 PM	48	155	70	0	0	21	158	36	0	0	45	114	42	0	0	69	87	23	0	0	868	
4:45 PM	63	151	51	1	0	33	138	40	0	0	43	156	49	0	0	50	99	16	1	0	891	
5:00 PM	70	161	86	0	0	33	164	34	0	0	52	119	56	0	0	57	79	25	0	0	936	
5:15 PM	67	164	83	0	0	28	145	39	0	0	50	153	45	0	0	58	94	23	1	0	950	3645
5:30 PM	43	190	83	0	0	33	166	34	0	0	49	134	40	0	0	44	84	20	0	0	920	3697
5:45 PM	61	142	40	0	0	39	118	33	0	0	35	136	57	0	0	40	111	16	0	0	828	3634
6:00 PM	58	146	64	0	0	47	129	29	0	0	47	92	41	0	0	59	86	23	0	0	821	3519
6:15 PM	45	87	42	0	0	36	123	26	0	0	35	124	44	0	0	42	95	24	0	0	723	3292

## HEAVY-VEHICLE VOLUMES

Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right	Total
4:30 PM	0	0	1	0	4	2	0	2	1	2	0	0	12
4:45 PM	0	3	1	0	4	1	2	4	0	2	2	0	19
5:00 PM	2	2	1	0	3	2	2	5	1	1	1	0	20
5:15 PM	0	2	1	1	0	0	3	4	0	1	0	0	12
5:30 PM	0	2	1	0	4	1	0	1	1	1	0	0	11
5:45 PM	0	0	0	0	2	1	0	3	1	2	0	0	9
6:00 PM	1	1	4	0	2	1	2	1	0	1	1	0	14
6:15 PM	0	0	1	0	1	0	2	1	0	0	0	0	5

## PEDESTRIAN VOLUMES

Time Period	North	South	East	West	Total
4:30 PM	1	2	1	5	
4:45 PM	2	1	0	1	
5:00 PM	0	0	2	0	
5:15 PM	0	0	1	2	
5:30 PM	0	1	1	3	
5:45 PM	0	1	0	0	
6:00 PM	1	0	2	0	
6:15 PM	1	3	1	2	

BICYCLE VOLUMES

## **Appendix B – Chicago Metropolitan Agency for Planning Letter**



# Chicago Metropolitan Agency for Planning

233 South Wacker Drive  
Suite 800  
Chicago, Illinois 60606  
312 454 0400  
[www.cmap.illinois.gov](http://www.cmap.illinois.gov)

September 10, 2015

Hon. Steven M. Morley  
Mayor  
City of Elmhurst  
209 North York Street  
Elmhurst, IL 60126

**Subject: York Street @ Butterfield Road**  
City of Elmhurst

Dear Mayor Morley:

In response to a request made on your behalf and dated September 9, 2015, we have developed year 2040 average daily traffic (ADT) projections for the subject location.

INTERSECTION	West Leg	North Leg	East Leg	South Leg
York St. @ Butterfield Rd.	18,000	20,000	17,500	25,000

Traffic projections are developed using existing ADT data provided in the request letter and the results from the March 2015 CMAP Travel Demand Analysis. The regional travel model uses CMAP 2040 socioeconomic projections and assumes the implementation of the GO TO 2040 Comprehensive Regional Plan for the Northeastern Illinois area.

If you have any questions, please call me at (312) 386-8806.

Sincerely,

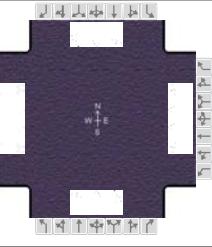
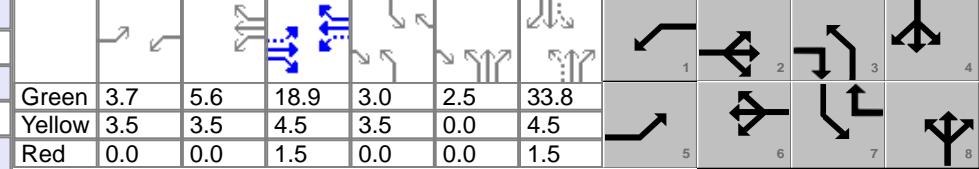
A handwritten signature in black ink, appearing to read "Jose Rodriguez".

Jose Rodriguez, PTP, AICP  
Senior Planner, Research & Analysis

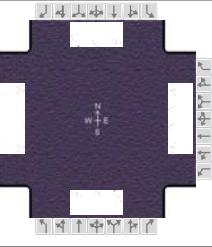
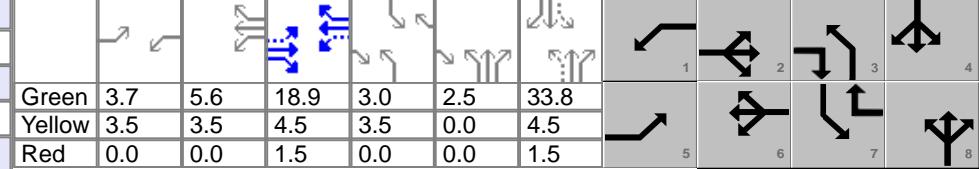
cc: Jacox (TranSystems)  
S\AdminGroups\ResearchAnalysis\Lafayette\SmallAreaTrafficForecasts\CY15\Elmhurst\du-33-15\du-33-15.docx

## **Appendix C – Capacity Analysis Reports and Storage Calculations**

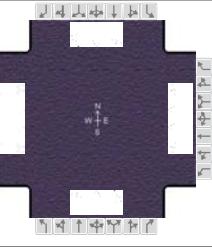
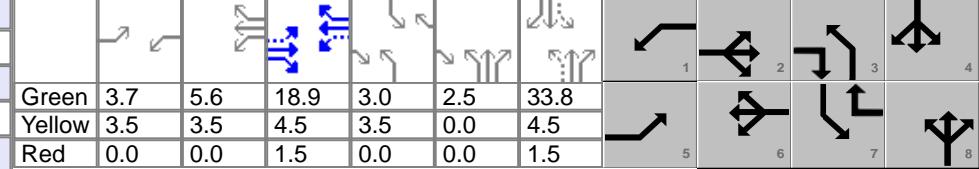
# HCS 2010 Signalized Intersection Input Data

General Information							Intersection Information								
Agency		TranSystems					Duration, h		0.25						
Analyst		R. Jacox		Analysis Date		Sep 9, 2015	Area Type		Other						
Jurisdiction		IDOT/Elmhurst			Time Period		AM Peak Period		PHF	0.95					
Urban Street		IL Route 56 (Butterfield...)			Analysis Year		2015		Analysis Period	1> 7:15					
Intersection		Butterfield/York			File Name		York_Butterfield_EX_AM.xus								
Project Description															
Demand Information				EB		WB		NB		SB					
Approach Movement				L	T	R	L	T	R	L	T	R			
Demand (v), veh/h				145	320	280	255	529	64	169	442	150			
Signal Information															
Cycle, s	90.0	Reference Phase	2	Green	3.7	5.6	18.9	3.0	2.5	33.8					
Offset, s	0	Reference Point	Begin	Yellow	3.5	3.5	4.5	3.5	0.0	4.5					
Uncoordinated	No	Simult. Gap E/W	On	Red	0.0	0.0	1.5	0.0	0.0	1.5					
Force Mode	Fixed	Simult. Gap N/S	On												
Traffic Information				EB		WB		NB		SB					
Approach Movement				L	T	R	L	T	R	L	T	R			
Demand (v), veh/h				145	320	280	255	529	64	169	442	150			
Initial Queue (Q <sub>b</sub> ), veh/h				0	0	0	0	0	0	0	0	0			
Base Saturation Flow Rate (s <sub>0</sub> ), veh/h				1900	2000	1900	1900	2000	1900	1900	1900	1900			
Parking (N <sub>m</sub> ), man/h				None		None		None		None					
Heavy Vehicles (P <sub>HV</sub> ), %				2	4	2	4	5	11	7	3	4			
Ped / Bike / RTOR, /h				0	0	0	0	0	0	0	0	0			
Buses (N <sub>b</sub> ), buses/h				0	0	0	0	0	0	0	0	0			
Arrival Type (AT)				3	3	3	3	3	3	3	3	3			
Upstream Filtering (/)				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Lane Width (W), ft				12.0	12.0	12.0	12.0	12.0	12.0	11.0	12.0				
Turn Bay Length, ft				270	0	120	95	0	95	235	0	105			
Grade (Pg), %					0			0			0				
Speed Limit, mi/h				35	35	35	35	35	35	35	35	35			
Phase Information				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Maximum Green (G <sub>max</sub> ) or Phase Split, s				6.5	17.5	23.0	34.0	9.0	43.0	6.5	40.5				
Yellow Change Interval (Y), s				3.5	4.5	3.5	4.5	3.5	4.5	3.5	4.5				
Red Clearance Interval (R <sub>c</sub> ), s				0.0	1.5	0.0	1.5	0.0	1.5	0.0	1.5				
Minimum Green (G <sub>min</sub> ), s				3	3	3	3	3	8	3	8				
Start-Up Lost Time (I <sub>l</sub> ), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0				
Extension of Effective Green (e), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0				
Passage (PT), s				3.0	2.0	3.0	2.0	3.0	7.0	3.0	7.0				
Recall Mode				Off	Min	Off	Min	Off	Off	Off	Off				
Dual Entry				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Walk (Walk), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Pedestrian Clearance Time (PC), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Multimodal Information				EB		WB		NB		SB					
85th % Speed / Rest in Walk / Corner Radius				0	No	25	0	No	25	0	No	25			
Walkway / Crosswalk Width / Length, ft				9.0	12	0	9.0	12	0	9.0	12	0			
Street Width / Island / Curb				0	0	No	0	0	No	0	0	No			
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0			
Pedestrian Signal / Occupied Parking				No	0.50		No	0.50		No	0.50				

# HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information							
Agency	TranSystems			Duration, h			0.25						
Analyst	R. Jacox		Analysis Date	Sep 9, 2015		Area Type			Other				
Jurisdiction	IDOT/Elmhurst		Time Period	AM Peak Period		PHF			0.95				
Urban Street	IL Route 56 (Butterfield...)		Analysis Year	2015		Analysis Period			1 > 7:15				
Intersection	Butterfield/York		File Name	York_Butterfield_EX_AM.xus									
Project Description													
Demand Information				EB		WB		NB		SB			
Approach Movement			L	T	R	L	T	R	L	T	R		
Demand ( v ), veh/h			145	320	280	255	529	64	169	442	150		
Signal Information													
Cycle, s	90.0	Reference Phase	2										
Offset, s	0	Reference Point	Begin	Green	3.7	5.6	18.9	3.0	2.5	33.8			
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	0.0	4.5			
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5			
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT		
Assigned Phase				5	2	1	6	3	8	7	4		
Case Number				1.1	3.0	1.1	3.0	1.1	4.0	1.1	4.0		
Phase Duration, s				7.2	24.9	16.3	34.0	9.0	42.3	6.5	39.8		
Change Period, ( Y+R <sub>c</sub> ), s				3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0		
Max Allow Headway ( MAH ), s				4.0	0.0	4.0	0.0	4.0	11.9	4.0	11.9		
Queue Clearance Time ( g <sub>s</sub> ), s				5.7		12.3		7.5	13.6	4.4	17.8		
Green Extension Time ( g <sub>e</sub> ), s				0.0	0.0	0.6	0.0	0.0	22.2	0.0	16.0		
Phase Call Probability				1.00		1.00		1.00	1.00	1.00	1.00		
Max Out Probability				1.00		0.10		1.00	0.97	1.00	0.99		
Movement Group Results				EB		WB		NB		SB			
Approach Movement			L	T	R	L	T	R	L	T	R		
Assigned Movement			5	2	12	1	6	16	3	8	18		
Adjusted Flow Rate ( v ), veh/h			153	337	295	268	557	67	178	324	299		
Adjusted Saturation Flow Rate ( s ), veh/h/ln			1774	1831	1579	1740	1813	1451	1691	1845	1685		
Queue Service Time ( g <sub>s</sub> ), s			3.7	7.2	15.1	10.3	11.2	2.9	5.5	11.4	11.6		
Cycle Queue Clearance Time ( g <sub>c</sub> ), s			3.7	7.2	15.1	10.3	11.2	2.9	5.5	11.4	11.6		
Green Ratio ( g/C )			0.25	0.21	0.27	0.37	0.31	0.34	0.45	0.40	0.40		
Capacity ( c ), veh/h			292	768	427	460	1128	500	314	744	680		
Volume-to-Capacity Ratio ( X )			0.523	0.439	0.690	0.584	0.494	0.135	0.566	0.435	0.440		
Available Capacity ( c <sub>a</sub> ), veh/h			292	768	427	602	1128	500	314	758	693		
Back of Queue ( Q ), veh/ln ( 95 th percentile)			2.2	5.9	10.7	7.4	8.5	1.8	4.2	8.7	8.2		
Queue Storage Ratio ( RQ ) ( 95 th percentile)			0.21	0.00	2.27	2.01	0.00	0.52	0.47	0.00	0.00		
Uniform Delay ( d <sub>1</sub> ), s/veh			29.9	31.0	29.4	21.5	25.2	20.3	18.2	19.4	19.5		
Incremental Delay ( d <sub>2</sub> ), s/veh			1.7	1.8	8.8	1.2	1.5	0.6	2.4	1.9	2.1		
Initial Queue Delay ( d <sub>3</sub> ), s/veh			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Control Delay ( d ), s/veh			31.6	32.8	38.2	22.6	26.8	20.8	20.6	21.3	21.5		
Level of Service (LOS)			C	C	D	C	C	C	C	B	C		
Approach Delay, s/veh / LOS			34.6	C	25.1	C			21.2	C	25.4		
Intersection Delay, s/veh / LOS					26.5					C			
Multimodal Results				EB		WB		NB		SB			
Pedestrian LOS Score / LOS			2.8	C		2.8	C		2.9	C	2.9		
Bicycle LOS Score / LOS			1.1	A		1.2	A		1.1	A	1.2		

# HCS 2010 Signalized Intersection Intermediate Values

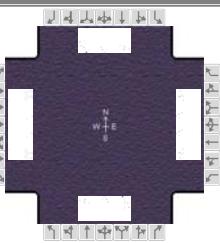
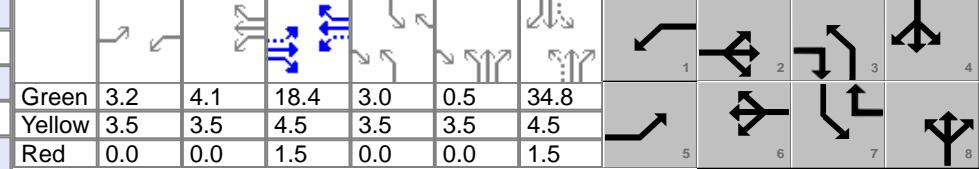
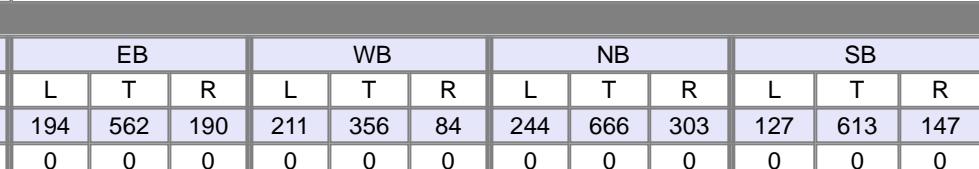
General Information							Intersection Information														
Agency	TranSystems					Duration, h	0.25														
Analyst	R. Jacox		Analysis Date	Sep 9, 2015		Area Type	Other														
Jurisdiction	IDOT/Elmhurst		Time Period	AM Peak Period		PHF	0.95														
Urban Street	IL Route 56 (Butterfield...)		Analysis Year	2015		Analysis Period	1> 7:15														
Intersection	Butterfield/York		File Name	York_Butterfield_EX_AM.xus																	
Project Description																					
Demand Information				EB		WB		NB		SB											
Approach Movement				L	T	R	L	T	R	L	T	R									
Demand ( $v$ ), veh/h				145	320	280	255	529	64	169	442	150									
				70	593	154															
Signal Information																					
Cycle, s	90.0	Reference Phase	2																		
Offset, s	0	Reference Point	Begin	Green	3.7	5.6	18.9	3.0	2.5	33.8											
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	0.0	4.5											
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5											
Saturation Flow / Delay				EB		WB		NB		SB											
				L	T	R	L	T	R	L	T	R									
Lane Width Adjustment Factor ( $f_w$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000									
Heavy Vehicle Adjustment Factor ( $f_{hv}$ )	0.980	0.962	0.980	0.962	0.952	0.901	0.935	0.971	1.000	0.962	0.980	1.000									
Approach Grade Adjustment Factor ( $f_g$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000									
Parking Activity Adjustment Factor ( $f_p$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000									
Bus Blockage Adjustment Factor ( $f_{bb}$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000									
Area Type Adjustment Factor ( $f_a$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000									
Lane Utilization Adjustment Factor ( $f_{lu}$ )	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	1.000									
Work Zone Adjustment Factor ( $f_{wz}$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000									
Left-Turn Adjustment Factor ( $f_{lt}$ )	0.952	0.000		0.952	0.000		0.952	0.000		0.952	0.000										
Right-Turn Adjustment Factor ( $f_{rt}$ )		0.000			0.000			0.913			0.929										
Left-Turn Pedestrian Adjustment Factor ( $f_{lpb}$ )	1.000			1.000			1.000			1.000											
Right-Turn Ped-Bike Adjustment Factor ( $f_{rbp}$ )			1.000			1.000			1.000			1.000									
Movement Saturation Flow Rate ( $s$ ), veh/h	1774	3662		1740	3627		1691	2640		1740	2853										
Proportion of Vehicles Arriving on Green ( $P$ )	0.04	0.21	0.21	0.14	0.31	0.31	0.06	0.40	0.40	0.03	0.38	0.38									
Incremental Delay Factor ( $k$ )	0.13	0.50	0.50	0.11	0.50	0.50	0.16	0.50	0.50	0.11	0.50	0.50									
Signal Timing / Movement Groups				EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R										
Lost Time ( $t_L$ )		3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0										
Green Ratio ( $g/C$ )		0.25	0.21	0.37	0.31	0.45	0.40	0.45	0.41	0.41	0.38										
Permitted Saturation Flow Rate ( $s_p$ ), veh/h/ln	849	0		1019	0	654	0	783	0												
Shared Saturation Flow Rate ( $s_{sh}$ ), veh/h/ln																					
Permitted Effective Green Time ( $g_p$ ), s	18.9	0.0		20.9	0.0	34.8	0.0	33.8	0.0												
Permitted Service Time ( $g_u$ ), s	14.8	0.0		11.7	0.0	18.0	0.0	22.7	0.0												
Permitted Queue Service Time ( $g_{ps}$ ), s	7.1			3.3		7.4		1.2													
Time to First Blockage ( $g_f$ ), s	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Queue Service Time Before Blockage ( $g_{fs}$ ), s																					
Protected Right Saturation Flow ( $s_R$ ), veh/h/ln		1579			1451																
Protected Right Effective Green Time ( $g_R$ ), s		5.5			3.0																
Multimodal				EB		WB		NB		SB											
Pedestrian $F_w / F_v$	2.107	0.00		2.107	0.00	2.224	0.00	2.224	0.00												
Pedestrian $F_s / F_{delay}$	0.000	0.134		0.000	0.123	0.000	0.111	0.000	0.115												
Pedestrian $M_{corner} / M_{cw}$																					
Bicycle $c_b / d_b$	419.33	28.11		622.23	21.36	806.77	16.02	751.22	17.54												
Bicycle $F_w / F_v$	-3.64	0.65		-3.64	0.74	-3.64	0.66	-3.64	0.71												

**--- Messages ---**

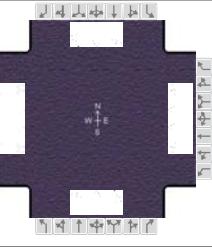
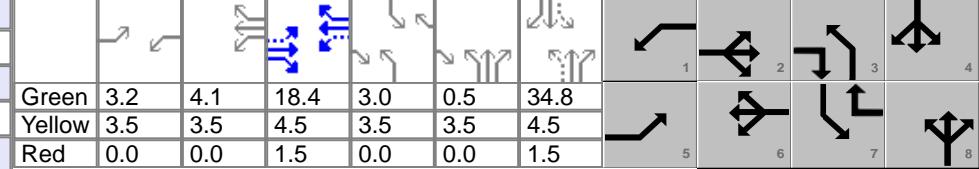
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

**--- Comments ---**

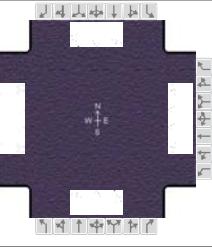
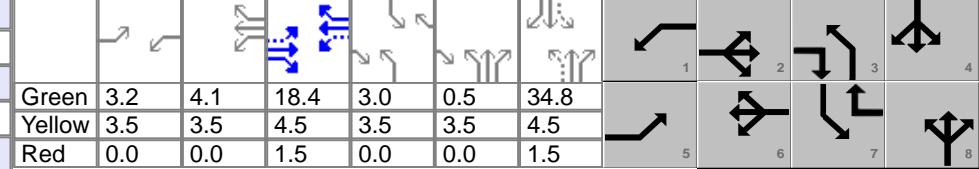
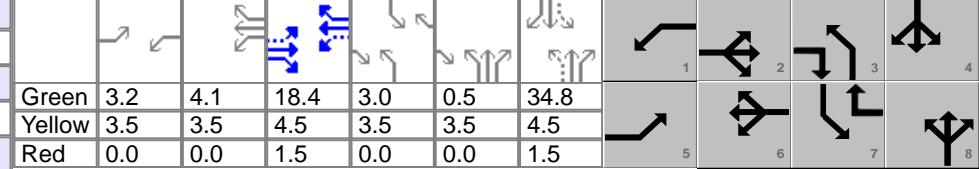
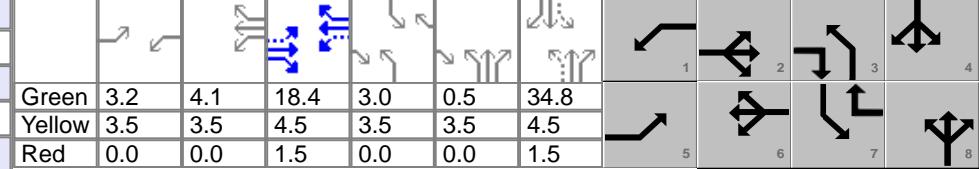
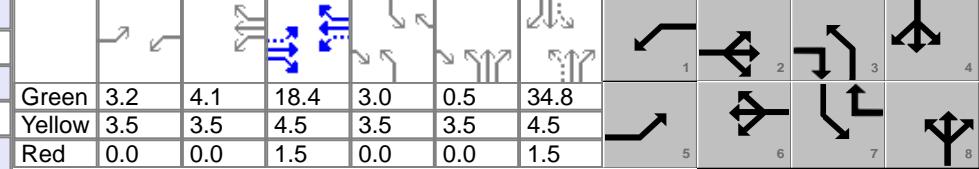
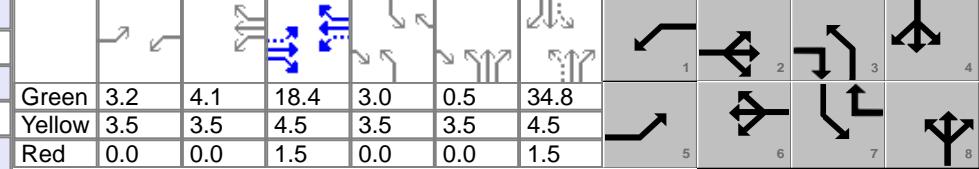
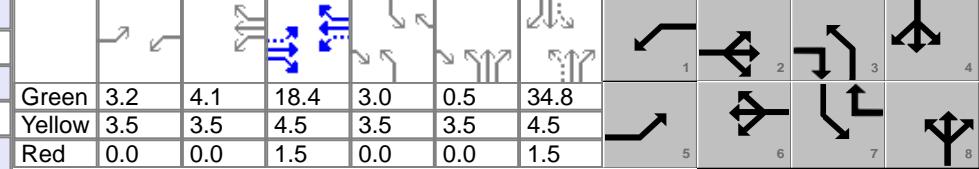
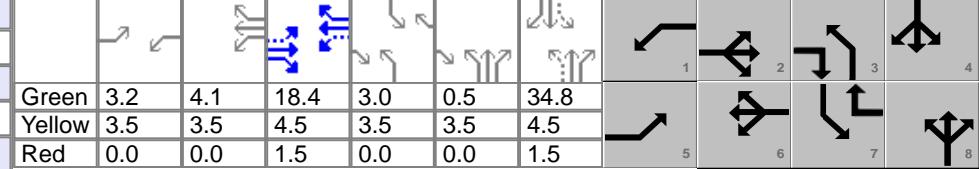
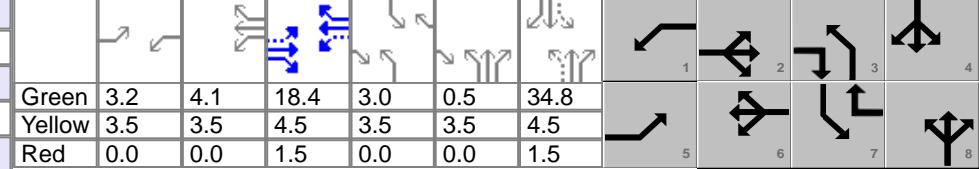
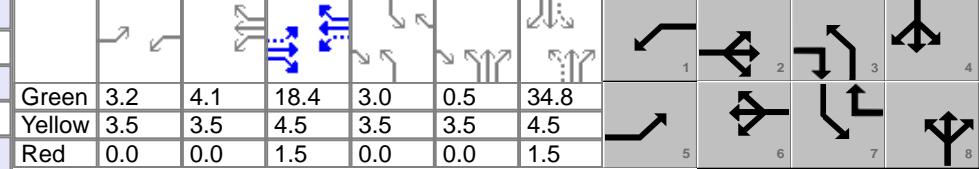
# HCS 2010 Signalized Intersection Input Data

General Information							Intersection Information					
Agency		TranSystems					Duration, h		0.25			
Analyst		R. Jacox		Analysis Date		Sep 9, 2015	Area Type		Other			
Jurisdiction		IDOT/Elmhurst		Time Period		PM Peak Period	PHF		0.95			
Urban Street		IL Route 56 (Butterfield...)		Analysis Year		2015	Analysis Period		1> 7:15			
Intersection		Butterfield/York		File Name		York_Butterfield_EX_PM.xus						
Project Description												
Demand Information				EB		WB		NB		SB		
Approach Movement				L	T	R	L	T	R	L	T	R
Demand ( <i>v</i> ), veh/h				194	562	190	211	356	84	244	666	303
				127	613	147						
Signal Information												
Cycle, s	90.0	Reference Phase	2									
Offset, s	0	Reference Point	Begin	Green	3.2	4.1	18.4	3.0	0.5	34.8		
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	3.5	4.5		
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5		
Traffic Information				EB		WB		NB		SB		
Approach Movement				L	T	R	L	T	R	L	T	R
Demand ( <i>v</i> ), veh/h				194	562	190	211	356	84	244	666	303
Initial Queue ( <i>Q<sub>b</sub></i> ), veh/h				0	0	0	0	0	0	0	0	0
Base Saturation Flow Rate ( <i>s<sub>0</sub></i> ), veh/h				1900	2000	1900	1900	2000	1900	1900	1900	1900
Parking ( <i>N<sub>m</sub></i> ), man/h				None		None		None		None		
Heavy Vehicles ( <i>P<sub>HV</sub></i> ), %				4	3	1	2	1	0	1	1	1
Ped / Bike / RTOR, /h				0	0	0	0	0	0	0	0	0
Buses ( <i>N<sub>b</sub></i> ), buses/h				0	0	0	0	0	0	0	0	0
Arrival Type (AT)				3	3	3	3	3	3	3	3	3
Upstream Filtering (/)				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Width ( <i>W</i> ), ft				12.0	12.0	12.0	12.0	12.0	12.0	11.0	12.0	
Turn Bay Length, ft				270	0	120	95	0	95	235	0	105
Grade ( <i>Pg</i> ), %				0		0		0		0		
Speed Limit, mi/h				35	35	35	35	35	35	35	35	35
Phase Information				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	
Maximum Green ( <i>G<sub>max</sub></i> ) or Phase Split, s				6.5	17.5	21.0	32.0	10.5	45.0	6.5	41.0	
Yellow Change Interval ( <i>Y</i> ), s				3.5	4.5	3.5	4.5	3.5	4.5	3.5	4.5	
Red Clearance Interval ( <i>R<sub>c</sub></i> ), s				0.0	1.5	0.0	1.5	0.0	1.5	0.0	1.5	
Minimum Green ( <i>G<sub>min</sub></i> ), s				3	3	3	3	3	8	3	8	
Start-Up Lost Time ( <i>l<sub>t</sub></i> ), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Extension of Effective Green ( <i>e</i> ), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Passage (PT), s				3.0	2.0	3.0	2.0	3.0	7.0	3.0	7.0	
Recall Mode				Off	Min	Off	Min	Off	Off	Off	Off	
Dual Entry				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Walk (Walk), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Pedestrian Clearance Time (PC), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Multimodal Information				EB		WB		NB		SB		
85th % Speed / Rest in Walk / Corner Radius				0	No	25	0	No	25	0	No	25
Walkway / Crosswalk Width / Length, ft				9.0	12	0	9.0	12	0	9.0	12	0
Street Width / Island / Curb				0	0	No	0	0	No	0	0	No
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking				No	0.50		No	0.50		No	0.50	

# HCS 2010 Signalized Intersection Results Summary

General Information							Intersection Information															
Agency	TranSystems			Duration, h																		
Analyst	R. Jacox		Analysis Date	Sep 9, 2015		Area Type																
Jurisdiction	IDOT/Elmhurst		Time Period	PM Peak Period		PHF		0.95														
Urban Street	IL Route 56 (Butterfield...)		Analysis Year	2015		Analysis Period			1 > 7:15													
Intersection	Butterfield/York		File Name	York_Butterfield_EX_PM.xus																		
Project Description																						
Demand Information				EB		WB		NB		SB												
Approach Movement			L	T	R	L	T	R	L	T	R	L										
Demand ( v ), veh/h			194	562	190	211	356	84	244	666	303	127										
Signal Information																						
Cycle, s	90.0	Reference Phase	2																			
Offset, s	0	Reference Point	Begin	Green	3.2	4.1	18.4	3.0	0.5	34.8												
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	3.5	4.5												
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5												
Timer Results					EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT										
Assigned Phase				5	2	1	6	3	8	7	4											
Case Number				1.1	3.0	1.1	3.0	1.1	4.0	1.1	4.0											
Phase Duration, s				6.7	24.4	14.3	32.0	10.5	44.8	6.5	40.8											
Change Period, ( Y+R <sub>c</sub> ), s				3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0											
Max Allow Headway ( MAH ), s				4.0	0.0	4.0	0.0	4.0	11.9	4.0	11.9											
Queue Clearance Time ( g <sub>s</sub> ), s				5.2		10.4		9.0	22.5	5.0	17.8											
Green Extension Time ( g <sub>e</sub> ), s				0.0	0.0	0.4	0.0	0.0	16.3	0.0	17.0											
Phase Call Probability				1.00		1.00		1.00	1.00	1.00	1.00											
Max Out Probability				1.00		0.11		1.00	1.00	1.00	1.00											
Movement Group Results					EB		WB		NB		SB											
Approach Movement			L	T	R	L	T	R	L	T	R	L										
Assigned Movement			5	2	12	1	6	16	3	8	18	7										
Adjusted Flow Rate ( v ), veh/h			204	592	200	222	375	88	257	539	481	134										
Adjusted Saturation Flow Rate ( s ), veh/h/ln			1740	1849	1594	1774	1885	1610	1792	1881	1681	1792										
Queue Service Time ( g <sub>s</sub> ), s			3.2	13.6	9.3	8.4	7.1	3.5	7.0	20.5	20.5	3.0										
Cycle Queue Clearance Time ( g <sub>c</sub> ), s			3.2	13.6	9.3	8.4	7.1	3.5	7.0	20.5	20.5	3.0										
Green Ratio ( g/C )			0.24	0.20	0.28	0.35	0.29	0.32	0.49	0.43	0.43	0.42										
Capacity ( c ), veh/h			327	754	449	336	1089	519	364	811	725	240										
Volume-to-Capacity Ratio ( X )			0.625	0.785	0.445	0.660	0.344	0.170	0.706	0.664	0.664	0.556										
Available Capacity ( c <sub>a</sub> ), veh/h			327	754	449	471	1089	519	364	815	728	240										
Back of Queue ( Q ), veh/ln ( 95 th percentile)			5.1	11.0	6.8	6.4	5.7	2.5	6.3	14.4	13.2	2.3										
Queue Storage Ratio ( RQ ) ( 95 th percentile)			0.49	0.00	1.43	1.71	0.00	0.66	0.68	0.00	0.00	0.55										
Uniform Delay ( d <sub>1</sub> ), s/veh			31.8	34.0	26.5	23.8	25.3	21.9	18.1	20.4	20.4	23.2										
Incremental Delay ( d <sub>2</sub> ), s/veh			3.7	8.0	3.2	2.2	0.9	0.7	6.1	4.3	4.8	2.8										
Initial Queue Delay ( d <sub>3</sub> ), s/veh			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Control Delay ( d ), s/veh			35.5	42.0	29.7	26.0	26.1	22.6	24.2	24.6	25.1	26.0										
Level of Service (LOS)			D	D	C	C	C	C	C	C	C	C										
Approach Delay, s/veh / LOS			38.2	D	25.6	C		24.7	C		25.3	C										
Intersection Delay, s/veh / LOS					28.5					C												
Multimodal Results					EB		WB		NB		SB											
Pedestrian LOS Score / LOS			2.8	C	2.8	C	2.9	C	2.9	C	2.9	C										
Bicycle LOS Score / LOS			1.3	A	1.1	A	1.5	A	1.3	A	1.3	A										

# HCS 2010 Signalized Intersection Intermediate Values

General Information							Intersection Information									
Agency	TranSystems				Duration, h		0.25									
Analyst	R. Jacox		Analysis Date	Sep 9, 2015		Area Type		Other								
Jurisdiction	IDOT/Elmhurst		Time Period	PM Peak Period		PHF		0.95								
Urban Street	IL Route 56 (Butterfield...)		Analysis Year	2015		Analysis Period		1> 7:15								
Intersection	Butterfield/York		File Name	York_Butterfield_EX_PM.xus												
Project Description																
Demand Information			EB		WB		NB		SB							
Approach Movement			L	T	R	L	T	R	L	T	R					
Demand ( $v$ ), veh/h			194	562	190	211	356	84	244	666	303	127	613	147		
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													
Saturation Flow / Delay			EB		WB		NB		SB							
Lane Width Adjustment Factor ( $f_w$ )			L	T	R	L	T	R	L	T	R					
Heavy Vehicle Adjustment Factor ( $f_{hv}$ )			1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000					
Approach Grade Adjustment Factor ( $f_g$ )			0.962	0.971	0.990	0.980	0.990	1.000	0.990	0.990	0.980					
Parking Activity Adjustment Factor ( $f_p$ )			1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000					
Bus Blockage Adjustment Factor ( $f_{bb}$ )			1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000					
Area Type Adjustment Factor ( $f_a$ )			1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000					
Lane Utilization Adjustment Factor ( $f_{lu}$ )			1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000					
Work Zone Adjustment Factor ( $f_{wz}$ )			1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000					
Left-Turn Adjustment Factor ( $f_{lt}$ )			0.952	0.000		0.952	0.000		0.952	0.000						
Right-Turn Adjustment Factor ( $f_{rt}$ )				0.000			0.000		0.893		0.933					
Left-Turn Pedestrian Adjustment Factor ( $f_{lpb}$ )			1.000			1.000			1.000							
Right-Turn Ped-Bike Adjustment Factor ( $f_{rbp}$ )				1.000			1.000			1.000						
Movement Saturation Flow Rate ( $s$ ), veh/h			1740	3697		1774	3770		1792	2448						
Proportion of Vehicles Arriving on Green ( $P$ )			0.04	0.20	0.20	0.12	0.29	0.29	0.08	0.43	0.43					
Incremental Delay Factor ( $k$ )			0.21	0.50	0.50	0.11	0.50	0.50	0.27	0.50	0.50					
Signal Timing / Movement Groups			EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R						
Lost Time ( $t_L$ )			3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0						
Green Ratio ( $g/C$ )			0.24	0.20	0.35	0.29	0.49	0.43	0.42	0.39						
Permitted Saturation Flow Rate ( $s_p$ ), veh/h/ln			984	0	822	0	684	0	556	0						
Shared Saturation Flow Rate ( $s_{sh}$ ), veh/h/ln																
Permitted Effective Green Time ( $g_p$ ), s			18.4	0.0	20.4	0.0	36.8	0.0	34.8	0.0						
Permitted Service Time ( $g_u$ ), s			16.9	0.0	4.7	0.0	19.0	0.0	16.3	0.0						
Permitted Queue Service Time ( $g_{ps}$ ), s			12.0		4.7		13.3		10.6							
Time to First Blockage ( $g_f$ ), s			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Queue Service Time Before Blockage ( $g_{fs}$ ), s																
Protected Right Saturation Flow ( $s_R$ ), veh/h/ln				1594		1610										
Protected Right Effective Green Time ( $g_R$ ), s				7.0		3.0										
Multimodal			EB		WB		NB		SB							
Pedestrian $F_w / F_v$			2.107	0.00	2.107	0.00	2.224	0.00	2.224	0.00						
Pedestrian $F_s / F_{delay}$			0.000	0.134	0.000	0.125	0.000	0.107	0.000	0.113						
Pedestrian $M_{corner} / M_{cw}$																
Bicycle $c_b / d_b$			407.85	28.52	577.78	22.76	862.73	14.55	773.84	16.91						
Bicycle $F_w / F_v$			-3.64	0.82	-3.64	0.57	-3.64	1.05	-3.64	0.77						

**--- Messages ---**

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

**--- Comments ---**

**York Street at IL Route 56 (Butterfield Rd)**  
**Existing (2015) Traffic**

**AM Peak Period**

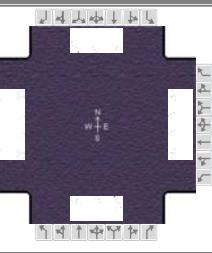
Lane Group	Truck % (decimal) T	Green time (sec) g	Unopposed Green Interval $g_u$	Green time (sec)	Cycle Length (sec) C.L.	Green Ratio g/C.L.	Volume DHV	No. of Lanes N	Cycles/ hr. (3600/C.L.) C	Queue Length (feet)	Storage Length (feet)	95th Percentile BOQ units	95th Percentile Length (feet)	BDE 36-3I Min Storage Length (feet)	Required Storage Length (feet)
EB LT	2%	3.7	14.8	18.5	90	0.21	145	1	40	147	150	2.2	55	125	150
EB TH	4%	18.9		18.9	90	0.21	320	2	40	165	165	5.9	150	125	165
EB RT	2%	27.9		27.9	90	0.31	280	1	40	246	250	10.7	270	125	270
WB LT	4%	12.8	11.7	24.5	90	0.27	255	1	40	240	245	7.4	185	125	245
WB TH	5%	28.0		28	90	0.31	529	2	40	238	240	8.5	215	125	240
WB RT	11%	31.0		31	90	0.34	64	1	40	58	60	1.8	45	125	125
NB LT	7%	9.0	18.0	27	90	0.30	169	1	40	157	160	4.2	105	125	160
NB TH*	2%	36.3		36	90	0.40	308	1	40	234	235	8.7	220	125	235
NB TH/RT*	5%	36.3		36.3	90	0.40	284	1	40	222	225	8.2	205	125	225
SB LT	4%	3.0	22.7	25.7	90	0.29	70	1	40	65	70	1.7	45	125	125
SB TH	1%	33.8		34	90	0.38	387	1	40	306	310	11.6	290	125	310
SB TH/RT	2%	33.8		34	90	0.38	360	1	40	286	290	11.0	275	125	290

**PM Peak Period**

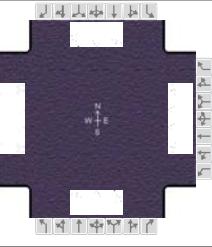
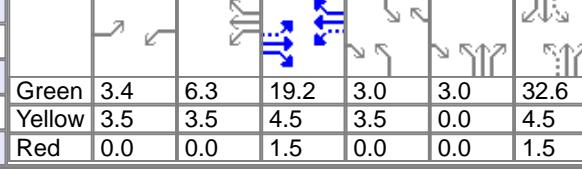
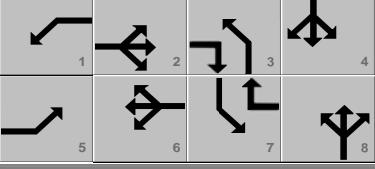
Lane Group	Truck % (decimal) T	Green time (sec) g	Unopposed Green Interval $g_u$	Green time (sec)	Cycle Length (sec) C.L.	Green Ratio g/C.L.	Volume DHV	No. of Lanes N	Cycles/ hr. (3600/C.L.) C	Queue Length (feet)	Storage Length (feet)	95th Percentile BOQ units	95th Percentile Length (feet)	BDE 336-3I Min Storage Length (feet)	Required Storage Length (feet)
EB LT	4%	3.2	16.9	20.1	90	0.22	194	1	40	195	200	5.1	130	125	200
EB TH	3%	18.4		18.4	90	0.20	562	2	40	286	290	11.0	275	125	290
EB RT	1%	25.4		25.4	90	0.28	190	1	40	172	175	6.8	170	125	175
WB LT	2%	11.1	4.7	15.8	90	0.18	211	1	40	223	225	6.4	160	125	225
WB TH	1%	26.0		26	90	0.29	356	2	40	159	160	5.7	145	125	160
WB RT	0%	29.0		29	90	0.32	84	1	40	71	75	2.5	65	125	125
NB LT	1%	7.0	19.0	26	90	0.29	244	1	40	219	220	6.3	160	125	220
NB TH*	1%	38.8		38.8	90	0.43	512	1	40	369	370	14.4	360	125	370
NB TH/RT*	1%	38.8		38.8	90	0.43	457	1	40	329	330	13.2	330	125	330
SB LT	1%	3.0	16.3	19.3	90	0.21	127	1	40	126	130	2.3	60	125	130
SB TH	2%	34.8		34.8	90	0.39	392	1	40	306	310	11.5	290	125	310
SB TH/RT	2%	34.8		34.8	90	0.39	368	1	40	288	290	11.0	275	125	290

\* - Lane Group DHV determined by using the adjusted flow rate for each lane group and multiplying it by the peak hour factor of 0.95

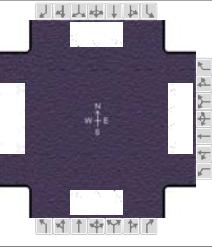
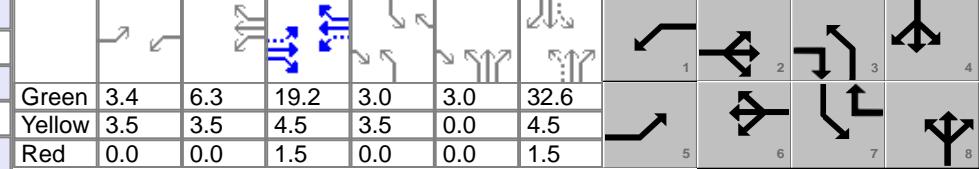
# HCS 2010 Signalized Intersection Input Data

General Information							Intersection Information														
Agency	TranSystems				Duration, h																
Analyst	R. Jacox		Analysis Date		Sep 9, 2015		Area Type		Other												
Jurisdiction	IDOT/Elmhurst			Time Period		AM Peak Period		PHF													
Urban Street	IL Route 56 (Butterfield...)			Analysis Year		2040		Analysis Period													
Intersection	Butterfield/York			File Name		York_Butterfield_2040_AM.xus															
Project Description	2040 Traffic - Existing Geometry																				
Demand Information				EB		WB		NB		SB											
Approach Movement				L	T	R	L	T	R	L	T	R									
Demand ( <i>v</i> ), veh/h				150	330	290	265	545	70	185	480	165									
Signal Information																					
Cycle, s	90.0	Reference Phase	2																		
Offset, s	0	Reference Point	Begin																		
Uncoordinated	No	Simult. Gap E/W	On	Green	3.4	6.3	19.2	3.0	3.0	32.6											
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.5	3.5	4.5	3.5	0.0	4.5											
				Red	0.0	0.0	1.5	0.0	0.0	1.5											
Traffic Information				EB		WB		NB		SB											
Approach Movement				L	T	R	L	T	R	L	T	R									
Demand ( <i>v</i> ), veh/h				150	330	290	265	545	70	185	480	165									
Initial Queue ( <i>Q<sub>b</sub></i> ), veh/h				0	0	0	0	0	0	0	0	0									
Base Saturation Flow Rate ( <i>s<sub>0</sub></i> ), veh/h				1900	2000	1900	1900	2000	1900	1900	1900	1900									
Parking ( <i>N<sub>m</sub></i> ), man/h				None		None		None		None											
Heavy Vehicles ( <i>P<sub>HV</sub></i> ), %				2	4	2	4	5	11	7	3	4									
Ped / Bike / RTOR, /h				0	0	0	0	0	0	0	0	0									
Buses ( <i>N<sub>b</sub></i> ), buses/h				0	0	0	0	0	0	0	0	0									
Arrival Type (AT)				3	3	3	3	3	3	3	3	3									
Upstream Filtering (/)				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00									
Lane Width ( <i>W</i> ), ft				12.0	12.0	12.0	12.0	12.0	12.0	11.0	12.0										
Turn Bay Length, ft				270	0	120	95	0	95	235	0	105									
Grade ( <i>P<sub>g</sub></i> ), %					0			0			0										
Speed Limit, mi/h				35	35	35	35	35	35	35	35	35									
Phase Information				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT										
Maximum Green ( <i>G<sub>max</sub></i> ) or Phase Split, s				6.5	18.5	23.0	35.0	9.5	42.0	6.5	39.0										
Yellow Change Interval ( <i>Y</i> ), s				3.5	4.5	3.5	4.5	3.5	4.5	3.5	4.5										
Red Clearance Interval ( <i>R<sub>c</sub></i> ), s				0.0	1.5	0.0	1.5	0.0	1.5	0.0	1.5										
Minimum Green ( <i>G<sub>min</sub></i> ), s				3	3	3	3	3	8	3	8										
Start-Up Lost Time ( <i>l<sub>t</sub></i> ), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0										
Extension of Effective Green ( <i>e</i> ), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0										
Passage ( <i>PT</i> ), s				3.0	2.0	3.0	2.0	3.0	7.0	3.0	7.0										
Recall Mode				Off	Min	Off	Min	Off	Off	Off	Off										
Dual Entry				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes										
Walk ( <i>Walk</i> ), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Pedestrian Clearance Time ( <i>PC</i> ), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Multimodal Information				EB		WB		NB		SB											
85th % Speed / Rest in Walk / Corner Radius				0	No	25	0	No	25	0	No	25									
Walkway / Crosswalk Width / Length, ft				9.0	12	0	9.0	12	0	9.0	12	0									
Street Width / Island / Curb				0	0	No	0	0	No	0	0	No									
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0									
Pedestrian Signal / Occupied Parking				No	0.50		No	0.50		No	0.50										

# HCS 2010 Signalized Intersection Results Summary

General Information						Intersection Information										
Agency	TranSystems			Duration, h			0.25									
Analyst	R. Jacox		Analysis Date	Sep 9, 2015		Area Type			Other							
Jurisdiction	IDOT/Elmhurst		Time Period	AM Peak Period		PHF			0.95							
Urban Street	IL Route 56 (Butterfield...)		Analysis Year	2040		Analysis Period			1 > 7:15							
Intersection	Butterfield/York		File Name	York_Butterfield_2040_AM.xus												
Project Description	2040 Traffic - Existing Geometry															
Demand Information				EB		WB		NB		SB						
Approach Movement				L	T	R	L	T	R	L	T	R				
Demand ( v ), veh/h				150	330	290	265	545	70	185	480	165				
Signal Information																
Cycle, s	90.0	Reference Phase	2													
Offset, s	0	Reference Point	Begin	Green	3.4	6.3	19.2	3.0	3.0	32.6						
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	0.0	4.5						
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5						
Timer Results				EBL		EBT		WBL		WBT						
Assigned Phase				5		2		1		6		3				
Case Number												8				
Phase Duration, s				6.9		25.2		16.7		35.0		9.5				
Change Period, ( Y+R <sub>c</sub> ), s												41.6				
Max Allow Headway ( MAH ), s				3.5		6.0		3.5		6.0		3.5				
Queue Clearance Time ( g <sub>s</sub> ), s				4.0		0.0		4.0		0.0		11.9				
Green Extension Time ( g <sub>e</sub> ), s				5.4				12.6		8.0		15.0				
Phase Call Probability				0.0		0.0		0.6		0.0		20.2				
Max Out Probability				1.00				1.00		1.00		0.0				
												13.3				
Movement Group Results				EB		WB		NB		SB						
Approach Movement				L	T	R	L	T	R	L	T	R				
Assigned Movement				5	2	12	1	6	16	3	8	18				
Adjusted Flow Rate ( v ), veh/h				158	347	305	279	574	74	195	354	325				
Adjusted Saturation Flow Rate ( s ), veh/h/ln				1774	1831	1579	1740	1813	1451	1691	1845	1683				
Queue Service Time ( g <sub>s</sub> ), s				3.4	7.4	15.5	10.6	11.5	3.1	6.0	12.9	13.0				
Cycle Queue Clearance Time ( g <sub>c</sub> ), s				3.4	7.4	15.5	10.6	11.5	3.1	6.0	12.9	13.0				
Green Ratio ( g/C )				0.25	0.21	0.28	0.38	0.32	0.36	0.45	0.40	0.40				
Capacity ( c ), veh/h				291	781	442	467	1169	516	299	730	666				
Volume-to-Capacity Ratio ( X )				0.543	0.445	0.691	0.598	0.491	0.143	0.650	0.484	0.488				
Available Capacity ( c <sub>a</sub> ), veh/h				291	781	442	596	1169	516	299	738	673				
Back of Queue ( Q ), veh/ln ( 95 th percentile)				2.8	6.1	10.9	7.6	8.6	2.0	5.0	9.6	9.1				
Queue Storage Ratio ( RQ ) ( 95 th percentile)				0.26	0.00	2.31	2.07	0.00	0.56	0.56	0.00	0.00				
Uniform Delay ( d <sub>1</sub> ), s/veh				30.3	30.8	28.9	21.2	24.6	19.7	19.6	20.3	20.4				
Incremental Delay ( d <sub>2</sub> ), s/veh				2.1	1.8	8.6	1.2	1.5	0.6	4.9	2.3	2.5				
Initial Queue Delay ( d <sub>3</sub> ), s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Control Delay ( d ), s/veh				32.4	32.6	37.5	22.4	26.0	20.3	24.5	22.6	22.9				
Level of Service (LOS)				C	C	D	C	C	C	C	C	B				
Approach Delay, s/veh / LOS				34.4		C	24.5		C	23.1		C				
Intersection Delay, s/veh / LOS							27.3					C				
Multimodal Results				EB		WB		NB		SB						
Pedestrian LOS Score / LOS				2.8		C	2.8		C	2.9		C				
Bicycle LOS Score / LOS				1.2		A	1.3		A	1.2		A				

# HCS 2010 Signalized Intersection Intermediate Values

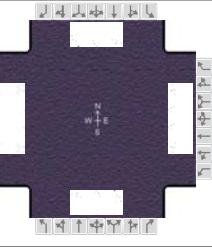
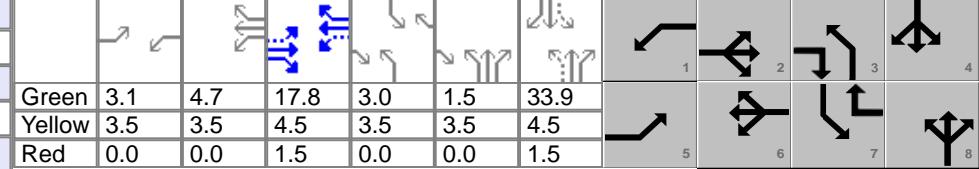
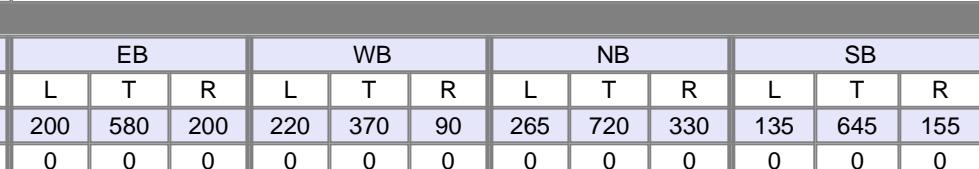
General Information							Intersection Information								
Agency	TranSystems				Duration, h		0.25								
Analyst	R. Jacox		Analysis Date		Sep 9, 2015		Area Type		Other						
Jurisdiction	IDOT/Elmhurst			Time Period		AM Peak Period		PHF		0.95					
Urban Street	IL Route 56 (Butterfield...)			Analysis Year		2040		Analysis Period		1> 7:15					
Intersection	Butterfield/York			File Name		York_Butterfield_2040_AM.xus									
Project Description	2040 Traffic - Existing Geometry														
Demand Information				EB		WB		NB		SB					
Approach Movement				L	T	R	L	T	R	L	T	R			
Demand (v), veh/h				150	330	290	265	545	70	185	480	165			
Signal Information															
Cycle, s	90.0	Reference Phase	2												
Offset, s	0	Reference Point	Begin	Green	3.4	6.3	19.2	3.0	3.0	32.6					
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	0.0	4.5					
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5					
Saturation Flow / Delay					EB		WB		NB		SB				
					L	T	R	L	T	R	L	T	R		
Lane Width Adjustment Factor ( $f_w$ )				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Heavy Vehicle Adjustment Factor ( $f_{hv}$ )				0.980	0.962	0.980	0.962	0.952	0.901	0.935	0.971	1.000	0.962		
Approach Grade Adjustment Factor ( $f_g$ )				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Parking Activity Adjustment Factor ( $f_p$ )				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Bus Blockage Adjustment Factor ( $f_{bb}$ )				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Area Type Adjustment Factor ( $f_a$ )				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Lane Utilization Adjustment Factor ( $f_{lu}$ )				1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000		
Work Zone Adjustment Factor ( $f_{wz}$ )				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Left-Turn Adjustment Factor ( $f_{lt}$ )				0.952	0.000		0.952	0.000		0.952	0.000		0.952		
Right-Turn Adjustment Factor ( $f_{rt}$ )					0.000			0.000		0.912			0.928		
Left-Turn Pedestrian Adjustment Factor ( $f_{lpb}$ )				1.000			1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor ( $f_{rbp}$ )					1.000			1.000			1.000		1.000		
Movement Saturation Flow Rate (s), veh/h				1774	3662		1740	3627		1691	2629		1740		
Proportion of Vehicles Arriving on Green (P)				0.04	0.21	0.21	0.15	0.32	0.32	0.07	0.40	0.40	0.03		
Incremental Delay Factor (k)				0.14	0.50	0.50	0.11	0.50	0.50	0.23	0.50	0.50	0.11		
Signal Timing / Movement Groups				EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R				
Lost Time ( $t_L$ )				3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0				
Green Ratio ( $g/C$ )				0.25	0.21	0.38	0.32	0.45	0.40	0.40	0.36				
Permitted Saturation Flow Rate ( $s_p$ ), veh/h/ln				836	0	1009	0	627	0	743	0				
Shared Saturation Flow Rate ( $s_{sh}$ ), veh/h/ln															
Permitted Effective Green Time ( $g_p$ ), s				19.2	0.0	21.2	0.0	34.1	0.0	32.6	0.0				
Permitted Service Time ( $g_u$ ), s				15.5	0.0	11.8	0.0	15.3	0.0	20.6	0.0				
Permitted Queue Service Time ( $g_{ps}$ ), s				8.5		3.6		10.2		1.4					
Time to First Blockage ( $g_f$ ), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Queue Service Time Before Blockage ( $g_{fs}$ ), s															
Protected Right Saturation Flow ( $s_R$ ), veh/h/ln					1579		1451								
Protected Right Effective Green Time ( $g_R$ ), s					6.0		3.0								
Multimodal				EB		WB		NB		SB					
Pedestrian $F_w / F_v$				2.107	0.00	2.107	0.00	2.224	0.00	2.224	0.00				
Pedestrian $F_s / F_{delay}$				0.000	0.133	0.000	0.121	0.000	0.112	0.000	0.117				
Pedestrian $M_{corner} / M_{cw}$															
Bicycle $c_b / d_b$				426.45	27.86	644.45	20.67	791.91	16.42	725.25	18.28				
Bicycle $F_w / F_v$				-3.64	0.67	-3.64	0.76	-3.64	0.72	-3.64	0.75				

**--- Messages ---**

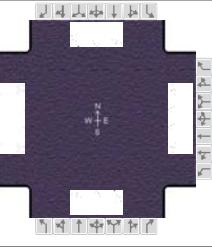
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

**--- Comments ---**

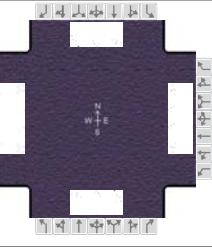
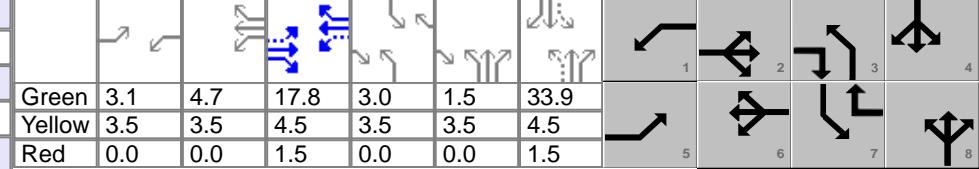
# HCS 2010 Signalized Intersection Input Data

General Information							Intersection Information						
Agency		TranSystems					Duration, h		0.25				
Analyst		R. Jacox		Analysis Date		Sep 9, 2015	Area Type		Other				
Jurisdiction		IDOT/Elmhurst		Time Period		PM Peak Period	PHF		0.95				
Urban Street		IL Route 56 (Butterfield...)		Analysis Year		2040	Analysis Period		1> 7:15				
Intersection		Butterfield/York		File Name		York_Butterfield_2040_PM.xus							
Project Description		2040 Traffic - Existing Geometry											
Demand Information				EB		WB		NB		SB			
Approach Movement				L	T	R	L	T	R	L	T	R	
Demand ( <i>v</i> ), veh/h				200	580	200	220	370	90	265	720	330	
										135	645	155	
Signal Information													
Cycle, s	90.0	Reference Phase	2	3.1	4.7	17.8	3.0	1.5	33.9	1	2		
Offset, s	0	Reference Point	Begin	Green	3.1	4.7	17.8	3.0	1.5	33.9	3	4	
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	3.5	4.5	5	6	
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5	7	8	
Traffic Information				EB		WB		NB		SB			
Approach Movement				L	T	R	L	T	R	L	T	R	
Demand ( <i>v</i> ), veh/h				200	580	200	220	370	90	265	720	330	
Initial Queue ( <i>Q<sub>b</sub></i> ), veh/h				0	0	0	0	0	0	0	0	0	
Base Saturation Flow Rate ( <i>s<sub>0</sub></i> ), veh/h				1900	2000	1900	1900	2000	1900	1900	1900	1900	
Parking ( <i>N<sub>m</sub></i> ), man/h				None		None		None		None			
Heavy Vehicles ( <i>P<sub>HV</sub></i> ), %				4	3	1	2	1	0	1	1	1	
Ped / Bike / RTOR, /h				0	0	0	0	0	0	0	0	0	
Buses ( <i>N<sub>b</sub></i> ), buses/h				0	0	0	0	0	0	0	0	0	
Arrival Type (AT)				3	3	3	3	3	3	3	3	3	
Upstream Filtering (/)				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Lane Width ( <i>W</i> ), ft				12.0	12.0	12.0	12.0	12.0	12.0	11.0	12.0		
Turn Bay Length, ft				270	0	120	95	0	95	235	0	105	
Grade ( <i>P<sub>g</sub></i> ), %					0			0			0		
Speed Limit, mi/h				35	35	35	35	35	35	35	35	35	
Phase Information				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT		
Maximum Green ( <i>G<sub>max</sub></i> ) or Phase Split, s				6.5	17.5	21.0	32.0	11.5	45.0	6.5	40.0		
Yellow Change Interval ( <i>Y</i> ), s				3.5	4.5	3.5	4.5	3.5	4.5	3.5	4.5		
Red Clearance Interval ( <i>R<sub>c</sub></i> ), s				0.0	1.5	0.0	1.5	0.0	1.5	0.0	1.5		
Minimum Green ( <i>G<sub>min</sub></i> ), s				3	3	3	3	3	8	3	8		
Start-Up Lost Time ( <i>l<sub>t</sub></i> ), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		
Extension of Effective Green ( <i>e</i> ), s				2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		
Passage ( <i>PT</i> ), s				3.0	2.0	3.0	2.0	3.0	7.0	3.0	7.0		
Recall Mode				Off	Min	Off	Min	Off	Off	Off	Off		
Dual Entry				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Walk ( <i>Walk</i> ), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Pedestrian Clearance Time ( <i>PC</i> ), s				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Multimodal Information				EB		WB		NB		SB			
85th % Speed / Rest in Walk / Corner Radius				0	No	25	0	No	25	0	No	25	
Walkway / Crosswalk Width / Length, ft				9.0	12	0	9.0	12	0	9.0	12	0	
Street Width / Island / Curb				0	0	No	0	0	No	0	0	No	
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0	
Pedestrian Signal / Occupied Parking				No	0.50		No	0.50		No	0.50		

# HCS 2010 Signalized Intersection Results Summary

General Information							Intersection Information																		
Agency	TranSystems			Duration, h																					
Analyst	R. Jacox		Analysis Date	Sep 9, 2015		Area Type																			
Jurisdiction	IDOT/Elmhurst		Time Period	PM Peak Period		PHF																			
Urban Street	IL Route 56 (Butterfield...)		Analysis Year	2040		Analysis Period																			
Intersection	Butterfield/York		File Name	York_Butterfield_2040_PM.xus																					
Project Description	2040 Traffic - Existing Geometry																								
Demand Information				EB		WB		NB		SB															
Approach Movement				L	T	R	L	T	R	L	T	R													
Demand ( v ), veh/h				200	580	200	220	370	90	265	720	330													
				135	645	155																			
Signal Information																									
Cycle, s	90.0	Reference Phase	2																						
Offset, s	0	Reference Point	Begin	Green	3.1	4.7	17.8	3.0	1.5	33.9															
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	3.5	4.5															
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5															
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT														
Assigned Phase				5	2	1	6	3	8	7	4														
Case Number				1.1	3.0	1.1	3.0	1.1	4.0	1.1	4.0														
Phase Duration, s				6.6	23.8	14.8	32.0	11.5	44.9	6.5	39.9														
Change Period, ( Y+R <sub>c</sub> ), s				3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0														
Max Allow Headway ( MAH ), s				4.0	0.0	4.0	0.0	4.0	11.9	4.0	11.9														
Queue Clearance Time ( g <sub>s</sub> ), s				5.1		10.8		10.0	25.0	5.0	19.1														
Green Extension Time ( g <sub>e</sub> ), s				0.0	0.0	0.4	0.0	0.0	13.9	0.0	14.8														
Phase Call Probability				1.00		1.00		1.00	1.00	1.00	1.00														
Max Out Probability				1.00		0.17		1.00	1.00	1.00	1.00														
Movement Group Results				EB		WB		NB		SB															
Approach Movement				L	T	R	L	T	R	L	T	R													
Assigned Movement				5	2	12	1	6	16	3	8	18													
Adjusted Flow Rate ( v ), veh/h				211	611	211	232	389	95	279	583	522													
Adjusted Saturation Flow Rate ( s ), veh/h/ln				1740	1849	1594	1774	1885	1610	1792	1881	1680													
Queue Service Time ( g <sub>s</sub> ), s				3.1	14.3	9.8	8.8	7.4	3.8	8.0	23.0	23.0													
Cycle Queue Clearance Time ( g <sub>c</sub> ), s				3.1	14.3	9.8	8.8	7.4	3.8	8.0	23.0	23.0													
Green Ratio ( g/C )				0.23	0.20	0.29	0.35	0.29	0.32	0.49	0.43	0.43													
Capacity ( c ), veh/h				319	733	458	334	1089	519	362	813	726													
Volume-to-Capacity Ratio ( X )				0.660	0.833	0.460	0.694	0.358	0.183	0.771	0.717	0.719													
Available Capacity ( c <sub>a</sub> ), veh/h				319	733	458	459	1089	519	362	815	728													
Back of Queue ( Q ), veh/ln ( 95 th percentile)				5.7	11.7	7.2	6.8	6.0	2.7	7.5	15.9	14.7													
Queue Storage Ratio ( RQ ) ( 95 th percentile)				0.55	0.00	1.51	1.81	0.00	0.71	0.80	0.00	0.00													
Uniform Delay ( d <sub>1</sub> ), s/veh				32.7	34.7	26.4	24.1	25.4	22.0	18.5	21.0	21.0													
Incremental Delay ( d <sub>2</sub> ), s/veh				4.9	10.8	3.3	2.7	0.9	0.8	9.8	5.4	6.0													
Initial Queue Delay ( d <sub>3</sub> ), s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0													
Control Delay ( d ), s/veh				37.6	45.4	29.7	26.8	26.3	22.7	28.3	26.4	27.1													
Level of Service (LOS)				D	D	C	C	C	C	C	C	C													
Approach Delay, s/veh / LOS				40.6	D	26.0	C			27.0	C	27.9													
Intersection Delay, s/veh / LOS						30.5				C															
Multimodal Results				EB		WB		NB		SB															
Pedestrian LOS Score / LOS				2.8	C	2.8	C	2.9	C	2.9	C														
Bicycle LOS Score / LOS				1.3	A	1.1	A	1.6	A	1.3	A														

# HCS 2010 Signalized Intersection Intermediate Values

General Information							Intersection Information						
Agency		TranSystems					Duration, h		0.25				
Analyst		R. Jacox		Analysis Date		Sep 9, 2015	Area Type		Other				
Jurisdiction		IDOT/Elmhurst		Time Period		PM Peak Period	PHF		0.95				
Urban Street		IL Route 56 (Butterfield...)		Analysis Year		2040	Analysis Period		1> 7:15				
Intersection		Butterfield/York		File Name		York_Butterfield_2040_PM.xus							
Project Description		2040 Traffic - Existing Geometry											
Demand Information				EB		WB		NB		SB			
Approach Movement				L	T	R	L	T	R	L	T	R	
Demand ( $v$ ), veh/h				200	580	200	220	370	90	265	720	330	
										135	645	155	
Signal Information													
Cycle, s	90.0	Reference Phase	2										
Offset, s	0	Reference Point	Begin	Green	3.1	4.7	17.8	3.0	1.5	33.9			
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	4.5	3.5	3.5	4.5			
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5			
Saturation Flow / Delay				EB		WB		NB		SB			
				L	T	R	L	T	R	L	T	R	
Lane Width Adjustment Factor ( $f_w$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Heavy Vehicle Adjustment Factor ( $f_{hv}$ )	0.962	0.971	0.990	0.980	0.990	1.000	0.990	0.990	1.000	0.990	0.980	1.000	
Approach Grade Adjustment Factor ( $f_g$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Parking Activity Adjustment Factor ( $f_p$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Bus Blockage Adjustment Factor ( $f_{bb}$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Area Type Adjustment Factor ( $f_a$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Lane Utilization Adjustment Factor ( $f_{lu}$ )	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Work Zone Adjustment Factor ( $f_{wz}$ )	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Left-Turn Adjustment Factor ( $f_{lt}$ )	0.952	0.000		0.952	0.000		0.952	0.000		0.952	0.000		
Right-Turn Adjustment Factor ( $f_{rt}$ )		0.000			0.000			0.893			0.933		
Left-Turn Pedestrian Adjustment Factor ( $f_{lpb}$ )	1.000			1.000			1.000			1.000			
Right-Turn Ped-Bike Adjustment Factor ( $f_{rbp}$ )			1.000			1.000			1.000			1.000	
Movement Saturation Flow Rate ( $s$ ), veh/h	1740	3697		1774	3770		1792	2443		1792	2903		
Proportion of Vehicles Arriving on Green ( $P$ )	0.03	0.20	0.20	0.13	0.29	0.29	0.09	0.43	0.43	0.03	0.38	0.38	
Incremental Delay Factor ( $k$ )	0.23	0.50	0.50	0.11	0.50	0.50	0.32	0.50	0.50	0.23	0.50	0.50	
Signal Timing / Movement Groups				EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R		
Lost Time ( $t_L$ )		3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0	3.5	6.0		
Green Ratio ( $g/C$ )		0.23	0.20	0.35	0.29	0.49	0.43	0.41	0.38				
Permitted Saturation Flow Rate ( $s_p$ ), veh/h/ln		971	0	808	0	657	0	513	0				
Shared Saturation Flow Rate ( $s_{sh}$ ), veh/h/ln													
Permitted Effective Green Time ( $g_p$ ), s		17.8	0.0	19.8	0.0	35.9	0.0	33.9	0.0				
Permitted Service Time ( $g_u$ ), s		16.6	0.0	3.6	0.0	16.8	0.0	13.9	0.0				
Permitted Queue Service Time ( $g_{ps}$ ), s		13.2		3.6		16.1		13.9					
Time to First Blockage ( $g_f$ ), s		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Queue Service Time Before Blockage ( $g_{fs}$ ), s													
Protected Right Saturation Flow ( $s_R$ ), veh/h/ln			1594		1610								
Protected Right Effective Green Time ( $g_R$ ), s			8.0		3.0								
Multimodal				EB		WB		NB		SB			
Pedestrian $F_w / F_v$		2.107	0.00	2.107	0.00	2.224	0.00	2.224	0.00				
Pedestrian $F_s / F_{delay}$		0.000	0.135	0.000	0.125	0.000	0.107	0.000	0.115				
Pedestrian $M_{corner} / M_{cw}$													
Bicycle $c_b / d_b$		396.27	28.93	577.78	22.76	864.77	14.50	753.66	17.48				
Bicycle $F_w / F_v$		-3.64	0.85	-3.64	0.59	-3.64	1.14	-3.64	0.81				

**--- Messages ---**

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

**--- Comments ---**

**York Street at IL Route 56 (Butterfield Rd)**  
**2040 Traffic**

**AM Peak Period**

Lane Group	Truck % (decimal) T	Green time (sec) g	Unopposed Green Interval $g_u$	Green time (sec)	Cycle Length (sec) C.L.	Green Ratio g/C.L.	Volume DHV	No. of Lanes N	Cycles/ hr. (3600/C.L.) C	Queue Length (feet)	Storage Length (feet)	95th Percentile BOQ units	95th Percentile Length (feet)	BDE 36-3I Min Storage Length (feet)	Required Storage Length (feet)
EB LT	2%	3.4	15.5	18.9	90	0.21	150	1	40	151	155	2.8	70	125	155
EB TH	4%	19.2		19.2	90	0.21	330	2	40	169	170	6.1	155	125	170
EB RT	2%	28.7		28.7	90	0.32	290	1	40	251	255	10.9	275	125	275
WB LT	4%	13.2	11.8	25	90	0.28	265	1	40	248	250	7.6	190	125	250
WB TH	5%	29.0		29	90	0.32	545	2	40	242	245	8.6	215	125	245
WB RT	11%	32.0		32	90	0.36	70	1	40	63	65	2.0	50	125	125
NB LT	7%	9.5	15.3	24.8	90	0.28	185	1	40	178	180	5.0	125	125	180
NB TH*	2%	35.6		36	90	0.40	335	1	40	258	260	9.6	240	125	260
NB TH/RT*	5%	35.6		35.6	90	0.40	310	1	40	245	250	9.1	230	125	250
SB LT	4%	3.0	20.6	23.6	90	0.26	75	1	40	72	75	1.8	45	125	125
SB TH	1%	32.6		33	90	0.36	410	1	40	331	335	12.7	320	125	335
SB TH/RT	2%	32.6		33	90	0.36	380	1	40	309	310	12.1	305	125	310

**PM Peak Period**

Lane Group	Truck % (decimal) T	Green time (sec) g	Unopposed Green Interval $g_u$	Green time (sec)	Cycle Length (sec) C.L.	Green Ratio g/C.L.	Volume DHV	No. of Lanes N	Cycles/ hr. (3600/C.L.) C	Queue Length (feet)	Storage Length (feet)	95th Percentile BOQ units	95th Percentile Length (feet)	BDE 336-3I Min Storage Length (feet)	Required Storage Length (feet)
EB LT	4%	3.1	16.6	19.7	90	0.22	200	1	40	202	205	5.7	145	125	205
EB TH	3%	17.8		17.8	90	0.20	580	2	40	298	300	11.7	295	125	300
EB RT	1%	25.8		25.8	90	0.29	200	1	40	180	185	7.2	180	125	185
WB LT	2%	11.3	3.6	14.9	90	0.17	220	1	40	235	235	6.8	170	125	235
WB TH	1%	26.0		26	90	0.29	370	2	40	166	170	6.0	150	125	170
WB RT	0%	34.0		34	90	0.38	90	1	40	70	70	2.7	70	125	125
NB LT	1%	8.0	16.8	24.8	90	0.28	265	1	40	242	245	7.5	190	125	245
NB TH*	1%	38.9		38.9	90	0.43	555	1	40	399	400	15.9	400	125	400
NB TH/RT*	1%	38.9		38.9	90	0.43	495	1	40	356	360	14.7	370	125	370
SB LT	1%	3.0	13.9	16.9	90	0.19	135	1	40	138	140	3.4	85	125	140
SB TH	2%	33.9		33.9	90	0.38	415	1	40	329	330	12.5	315	125	330
SB TH/RT	2%	33.9		33.9	90	0.38	385	1	40	307	310	11.9	300	125	310

\* - Lane Group DHV determined by using the adjusted flow rate for each lane group and multiplying it by the peak hour factor of 0.95