final report

March 17, 2017

Traffic Impact Study

7001 Greenbelt Highway
Louisville, KY

Prepared for

Louisville Metro Planning Commission
Kentucky Transportation Cabinet

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INTRODUCTION

The development plan for 7001 Greenbelt Highway (KY 1934) shows a warehouse with 271,250 square feet and 296 employees. **Figure 1** displays a map of the site. Access to the development will be from Greenbelt Highway at two locations. The purpose of this study is to examine the traffic impacts of the development upon the adjacent highway system. For this study the impact area was defined to be the two proposed entrances on Greenbelt Highway.

Figure 1. Site Map

EXISTING CONDITIONS

Greenbelt Highway is a state maintained road (KY 1934) with an estimated 2017 ADT of 20,400 vehicles per day between Greenwood Road and Lower Hunters Trace, as provided by the Kentucky Transportation Cabinet at station G71. The road is a four-lane highway with twelve-foot lanes, ten-foot paved shoulders, and an eighteen-foot raised non-mountable median through the study area. The speed limit is 55 mph. There are no sidewalks. The intersection with Riverport Drive is controlled with a traffic signal. The intersection has a dedicated left turn lane on both approaches.

Peak hour traffic counts for the intersection were obtained on March 7, 2017. The a.m. peak hour occurred between 7:00 and 8:00 a.m. The p.m. peak hour occurred between 4:00 and 5:00 p.m. **Figure 2** illustrates the existing a.m. and p.m. peak hour traffic volumes.

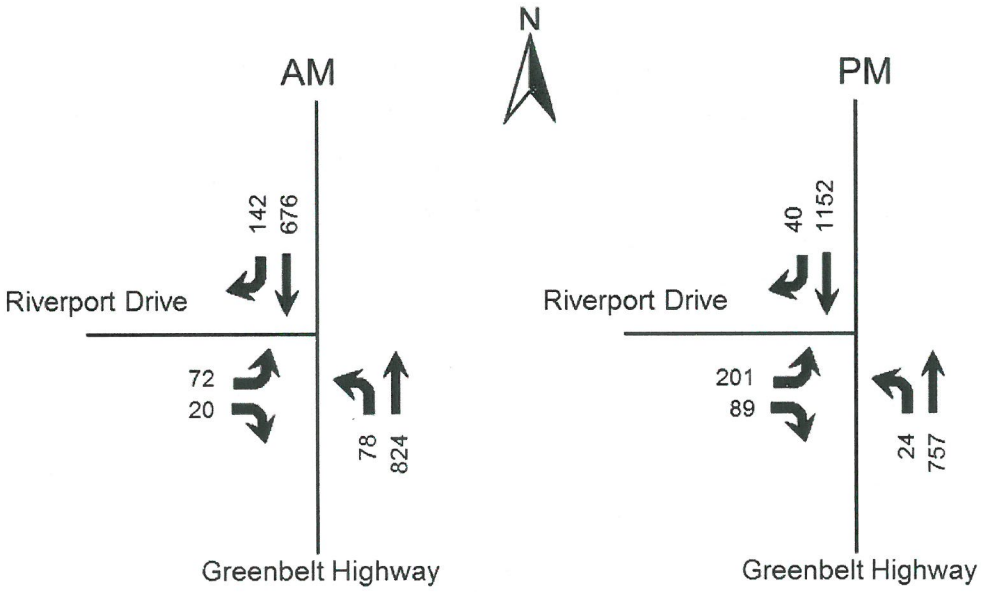


Figure 2. Existing (2017) Peak Hour Volumes

FUTURE CONDITIONS

The requested analysis year for this project is 2029. To predict traffic volumes in 2029, one percent annual growth in traffic was added to the 2017 volumes. This growth is based upon a review of the historical growth at KYTC count station G71. **Figure 3** displays the 2029 No build volumes.

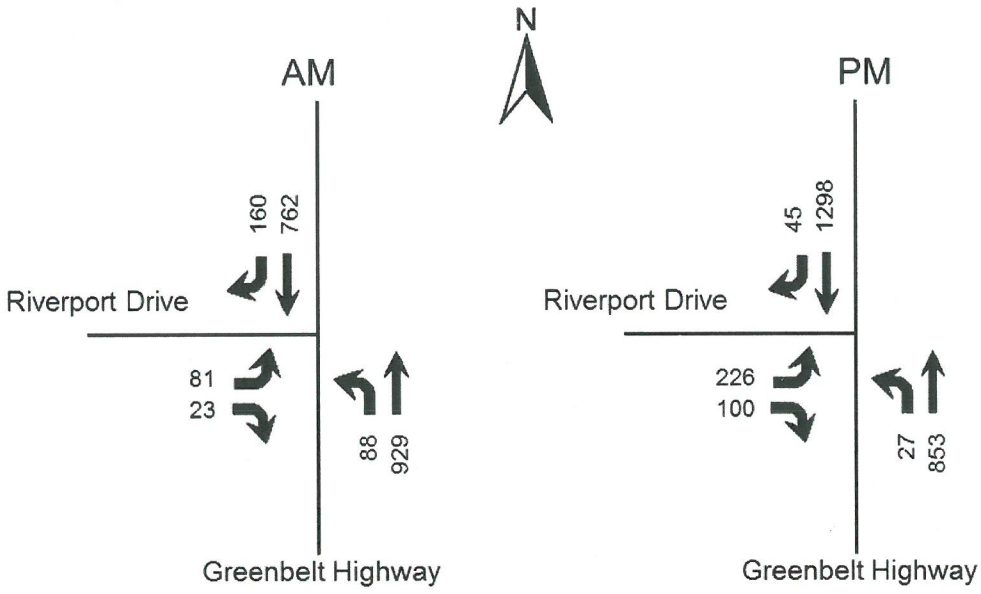


Figure 3. 2029 No Build Peak Hour Volumes

TRIP GENERATION

The Institute of Transportation Engineers Trip Generation Manual, 9th Edition contains trip generation rates for a wide range of developments. The land use of "Warehousing (150)", was reviewed and determined to be the best match. The trip generation results are listed in **Table 1**. Using the trip generation equation yields 234 a.m. peak hour trips and 271 p.m. peak hour trips. The trips were assigned to the highway network with 70 percent to the north and 30 percent to the south. **Figure 4** shows the trips distribution percentages. **Figure 5** shows the trips generated by this development and distributed throughout the road network for the year 2029 during the peak hours. **Figure 6** displays the individual turning movements for the year 2029 for the peak hours when the development is completed.

Table 1. Peak Hour Trips Generated by Site

	A.M. Peak Hour			P.M. Peak Hour		
Land Use	Trips	In	Out	Trips	In	Out
Warehousing (296 employees)	164	118	46	189	66	123

Figure 4. Trip Distribution Percentages

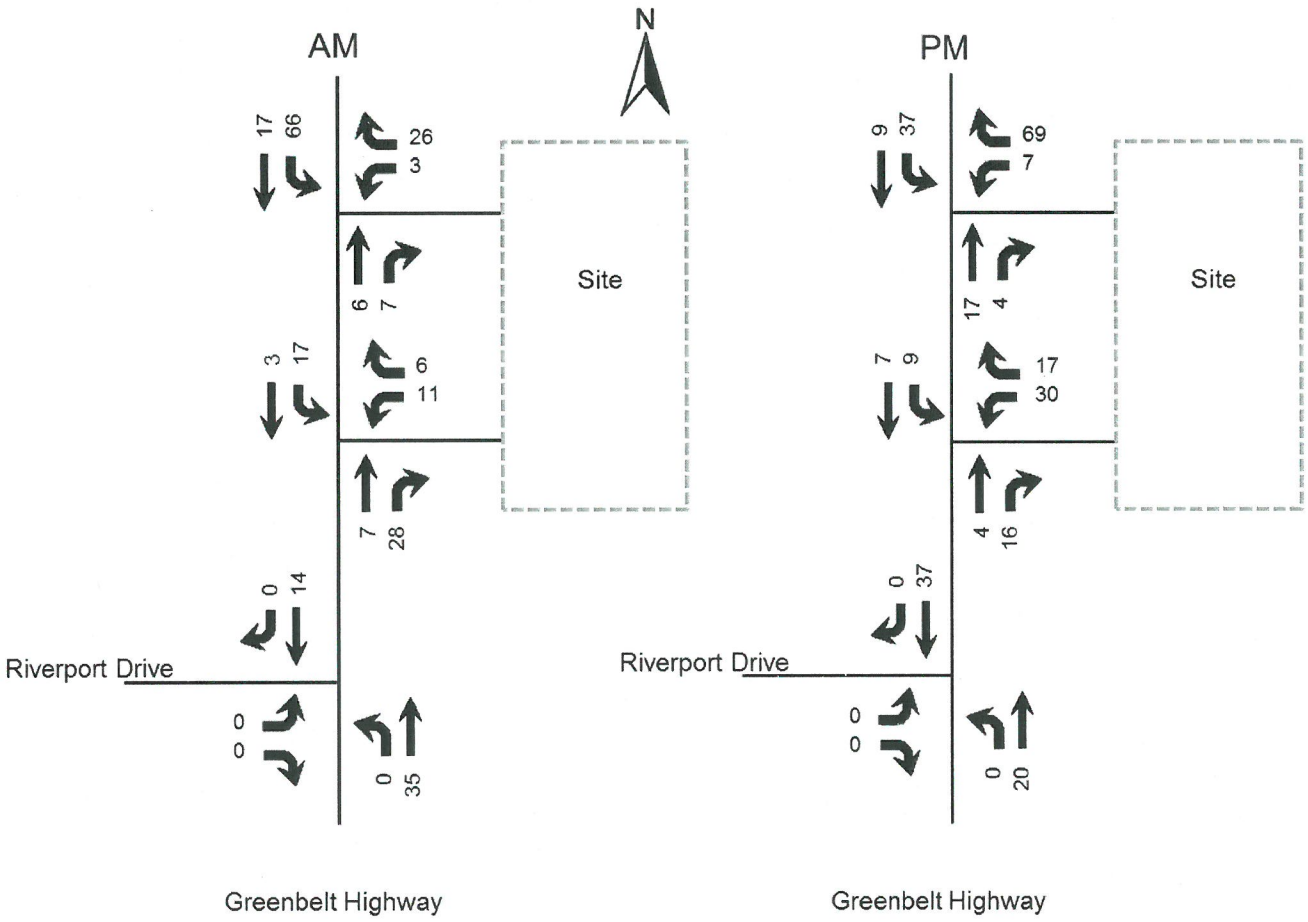


Figure 5. Peak Hour Trips Generated by Site

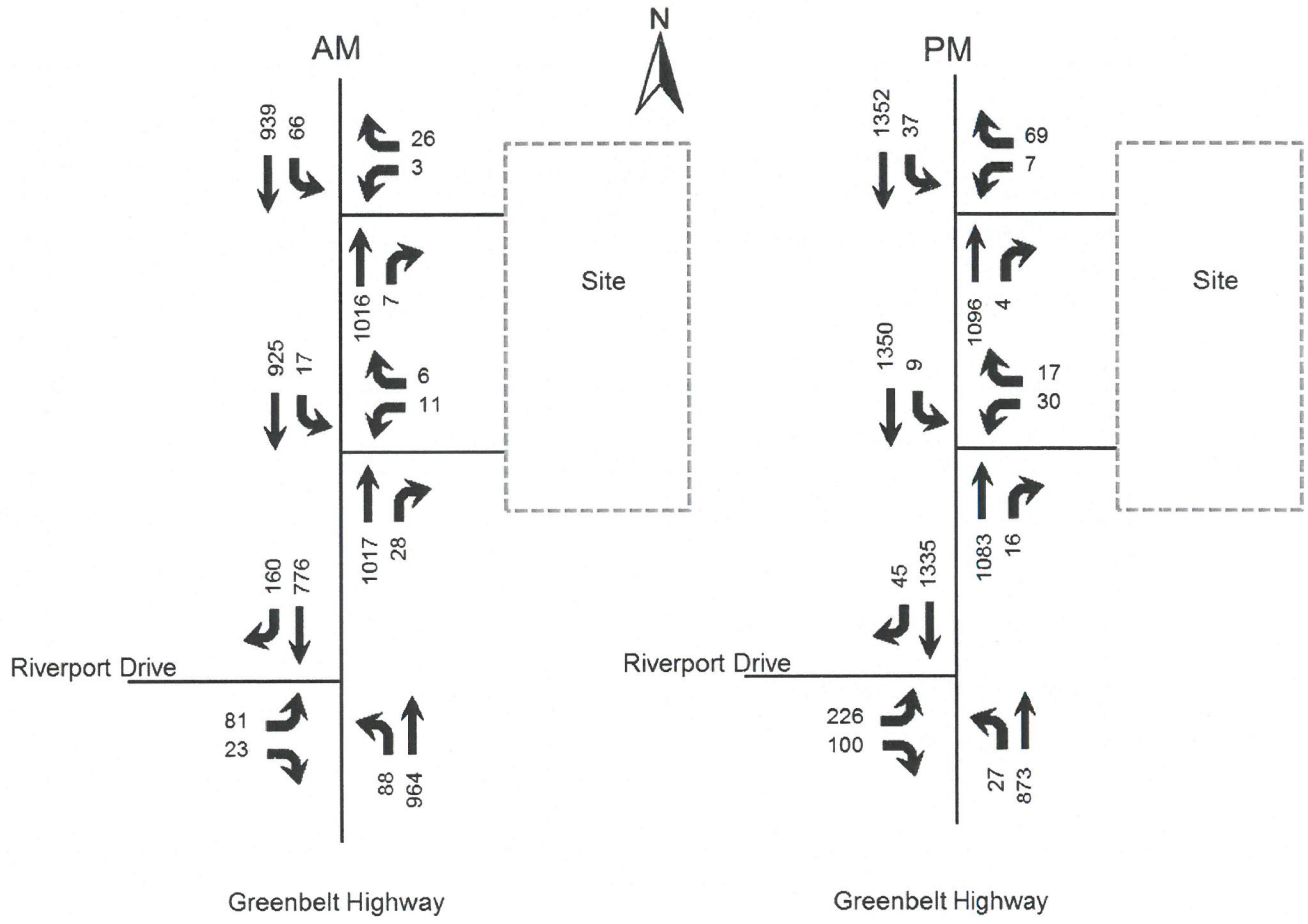


Figure 6. 2029 Peak Hour Build

ANALYSIS

The qualitative measure of operation for a roadway facility or intersection is evaluated by assigning a "Level of Service". Level of Service is a ranking scale from A through F, "A" is the best operating condition and "F" is the worst. Level of Service results depend upon the facility that is analyzed. In this case, the Level of Service is based upon the total delay experienced at an intersection.

To evaluate the impact of the proposed development, the vehicle delays at the intersections were determined using procedures detailed in the Highway Capacity Manual, 2010 edition. Future delays and Level of Service were determined for the intersections using the HCS Streets (version 6.9) software. The delays and Level of Service are summarized in **Table 2**.

Table 2. Peak Hour Level of Service

Approach	A.M.			P.M.		
	2017 Existing	2029 No Build	2029 Build	2017 Existing	2029 No Build	2029 Build
Greenbelt Highway at Riverport Drive	**A 6.0**	**A 6.5**	**A 6.5**	**B 16.7**	**B 19.4**	**B 19.6**
Riverport Drive Eastbound	E 58.9	E 58.2	E 58.2	E 65.1	E 67.8	E 67.8
Greenbelt Highway Northbound	A 3.2	A 3.7	A 3.8	A 7.8	A 9.5	A 9.7
Greenbelt Highway Southbound	A 3.2	A 3.7	A 3.7	B 10.8	B 14.1	B 14.7
Greenbelt Highway at South Entrance						
Entrance Westbound			C 21.2			E 38.2
Greenbelt Highway Southbound (left)			B 11.5			B 13.5
Greenbelt Highway at North Entrance						
Entrance Westbound			B 14.6			C 20.6
Greenbelt Highway Southbound (left)			B 12.0			B 14.3

Key: Level of Service, Delay in seconds per vehicle

The Kentucky Transportation Cabinet evaluates the need and length of auxiliary turn lanes using Auxiliary Turn Lane Policy dated 7/20/2009. Using the volumes in **Figure 5**, left turn lanes will be required at both entrances. Right turn lane will not be required at either entrance.

CONCLUSIONS

Based upon the volume of traffic generated by the development and the amount of traffic forecasted for the year 2029, there will be a minimal impact to the existing highway network. Left turn lanes will be required at both entrances.

APPENDIX

Traffic Counts

Study Name Greenbelt Hwy & Riverport Dr
Start Date 03/07/2017
Start Time 7:00 AM
Site Code

Engineering Planning
Groundbreaking by Design

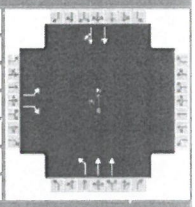
	Greenbelt Southbound			Greenbelt Northbound			Riverport Drive Eastbound			
Start Time	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	Total
7:00 AM	19	149	0	230	15	0	5	30	0	448
7:15 AM	28	156	0	222	19	0	0	9	0	434
7:30 AM	30	177	0	207	15	0	5	11	0	445
7:45 AM	65	194	0	165	29	0	10	22	0	485
8:00 AM	25	144	0	187	5	0	4	14	0	379
8:15 AM	13	133	0	161	12	0	5	14	0	338
8:30 AM	14	141	0	167	11	0	6	12	0	351
8:45 AM	14	111	0	159	7	0	6	9	0	306
4:00 PM	7	287	0	181	10	0	16	49	0	550
4:15 PM	12	256	0	158	7	0	10	32	0	475
4:30 PM	13	345	0	233	5	0	50	93	0	739
4:45 PM	8	264	0	185	2	0	13	27	0	499
5:00 PM	6	260	0	184	5	0	15	40	0	510
5:15 PM	4	267	0	170	4	0	10	19	0	474
5:30 PM	6	235	0	176	1	0	13	12	0	443
5:45 PM	11	248	0	147	1	0	7	8	0	422

	Greenbelt Southbound			Greenbelt Northbound			Riverport Drive Eastbound			
Start Time	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	Total
7:00 AM	19	149	0	230	15	0	5	30	0	448
7:15 AM	28	156	0	222	19	0	0	9	0	434
7:30 AM	30	177	0	207	15	0	5	11	0	445
7:45 AM	65	194	0	165	29	0	10	22	0	485
AM Total	**142**	**676**	**0**	**824**	**78**	**0**	**20**	**72**	**0**	**1812**
4:00 PM	7	287	0	181	10	0	16	49	0	550
4:15 PM	12	256	0	158	7	0	10	32	0	475
4:30 PM	13	345	0	233	5	0	50	93	0	739
4:45 PM	8	264	0	185	2	0	13	27	0	499
PM Total	**40**	**1152**	**0**	**757**	**24**	**0**	**89**	**201**	**0**	**2263**

HCS Reports

HCS 2010 Signalized Intersection Results Summary

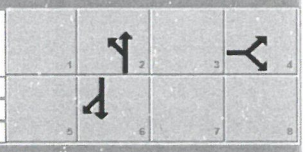
General Information				Intersection Information	
Agency	DB Zimmerman Traffic			Duration, h	0.25
Analyst	DBZ	Analysis Date	Mar 14, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.93
Urban Street	Greenbelt Highway	Analysis Year	2017	Analysis Period	1> 7:00
Intersection	Riverport Road	File Name	Riverport AM 17.xus		
Project Description	7001 Greenbelt				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	72		20				78	824			676	142

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	98.4	8.1	0.0	0.0	0.0	0.0	
Yellow	5.1	3.5	0.0	0.0	0.0	0.0	
Red	1.9	3.0	0.0	0.0	0.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		8.0
Phase Duration, s		14.6				105.4		105.4
Change Period, (*Y+R c*), s		6.5				7.0		7.0
Max Allow Headway (*MAH*), s		3.0				0.0		0.0
Queue Clearance Time (*g s*), s		8.3						
Green Extension Time (*g e*), s		0.1				0.0		0.0
Phase Call Probability		0.96						
Max Out Probability		0.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	77		22				84	886			453	426
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1448		1288				588	1739			1776	1668
Queue Service Time (*g s*), s	6.3		1.9				5.7	7.4			12.6	7.4
Cycle Queue Clearance Time (*g c*), s	6.3		1.9				18.3	7.4			12.6	7.4
Green Ratio (*g/C*)	0.07		0.07				0.82	0.82			0.82	0.82
Capacity (*c*), veh/h	98		87				480	2852			1456	1368
Volume-to-Capacity Ratio (*X*)	0.790		0.247				0.175	0.311			0.311	0.312
Back of Queue (*Q*), ft/ln (50 th percentile)	70.7		18.2				17.1	33.7			38.2	34.7
Back of Queue (*Q*), veh/ln (50 th percentile)	2.4		0.6				0.6	1.3			1.4	1.4
Queue Storage Ratio (*RQ*) (50 th percentile)	0.24		0.03				0.09	0.02			0.02	0.02
Uniform Delay (*d 1*), s/veh	55.1		53.0				5.7	2.6			2.6	2.6
Incremental Delay (*d 2*), s/veh	5.3		0.5				0.8	0.3			0.6	0.6
Initial Queue Delay (*d 3*), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	60.4		53.6				6.5	2.9			3.2	3.2
Level of Service (LOS)	E		D				A	A			A	A
Approach Delay, s/veh / LOS	58.9		E	0.0			3.2		A	3.2		A
Intersection Delay, s/veh / LOS	6.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	0.6	A	2.2	B
Bicycle LOS Score / LOS		F			1.3	A	1.2	A

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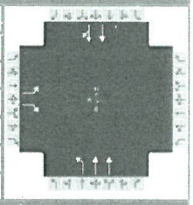
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	DB Zimmerman Traffic			Duration, h	0.25
Analyst	DBZ	Analysis Date	Mar 14, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.93
Urban Street	Greenbelt Highway	Analysis Year	2029 No Build	Analysis Period	1> 7:00
Intersection	Riverport Road	File Name	Riverport AM 29 NB.xus		
Project Description	7001 Greenbelt				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	81		23				88	929			762	160

Signal Information					EB		WB		NB		SB	
Cycle, s	120.0	Reference Phase	2									
Offset, s	0	Reference Point	End	Green	97.5	9.0	0.0	0.0	0.0	0.0		
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.1	3.5	0.0	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.9	3.0	0.0	0.0	0.0	0.0		

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		8.0
Phase Duration, s		15.5				104.5		104.5
Change Period, (*Y+R c*), s		6.5				7.0		7.0
Max Allow Headway (*MAH*), s		3.0				0.0		0.0
Queue Clearance Time (*g s*), s		9.1						
Green Extension Time (*g e*), s		0.1				0.0		0.0
Phase Call Probability		0.98						
Max Out Probability		0.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	87		25				95	999			511	480
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1448		1288				529	1739			1776	1668
Queue Service Time (*g s*), s	7.1		2.2				8.1	9.1			14.8	9.1
Cycle Queue Clearance Time (*g c*), s	7.1		2.2				22.9	9.1			14.8	9.1
Green Ratio (*g/C*)	0.08		0.08				0.81	0.81			0.81	0.81
Capacity (*c*), veh/h	109		97				425	2826			1443	1355
Volume-to-Capacity Ratio (*X*)	0.801		0.256				0.223	0.353			0.354	0.354
Back of Queue (*Q*), ft/ln (50 th percentile)	79.1		20.7				23.5	44.7			50.3	45.2
Back of Queue (*Q*), veh/ln (50 th percentile)	2.6		0.7				0.9	1.7			1.9	1.8
Queue Storage Ratio (*RQ*) (50 th percentile)	0.26		0.03				0.12	0.02			0.03	0.02
Uniform Delay (*d 1*), s/veh	54.6		52.3				7.1	3.0			3.0	3.0
Incremental Delay (*d 2*), s/veh	5.1		0.5				1.2	0.3			0.7	0.7
Initial Queue Delay (*d 3*), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	59.7		52.8				8.3	3.3			3.6	3.7
Level of Service (LOS)	E		D				A	A			A	A
Approach Delay, s/veh / LOS	58.2		E	0.0			3.7		A	3.7		A
Intersection Delay, s/veh / LOS	6.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	0.6	A	2.2	B
Bicycle LOS Score / LOS		F			1.4	A	1.3	A

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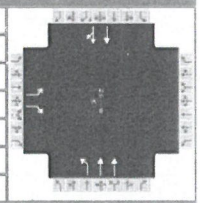
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	DB Zimmerman Traffic			Duration, h	0.25
Analyst	DBZ	Analysis Date	Mar 17, 2017	Area Type	Other
Jurisdiction		Time Period	AM Peak	PHF	0.93
Urban Street	Greenbelt Highway	Analysis Year	2029 Build	Analysis Period	1> 7:00
Intersection	Riverport Road	File Name	Riverport AM 29 B 3.xus		
Project Description	7001 Greenbelt				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	81		23				88	964			776	160

Signal Information					EB			WB			NB			SB		
Cycle, s	120.0	Reference Phase	2		L	T	R	L	T	R	L	T	R	L	T	R
Offset, s	0	Reference Point	End	Green	97.5	9.0		0.0	0.0	0.0	0.0					
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.1	3.5		0.0	0.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.9	3.0		0.0	0.0	0.0	0.0					

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		8.0
Phase Duration, s		15.5				104.5		104.5
Change Period, (*Y+R c*), s		6.5				7.0		7.0
Max Allow Headway (*MAH*), s		3.0				0.0		0.0
Queue Clearance Time (*g s*), s		9.1						
Green Extension Time (*g e*), s		0.1				0.0		0.0
Phase Call Probability		0.98						
Max Out Probability		0.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	87		25				95	1037			519	488
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1448		1288				522	1739			1776	1670
Queue Service Time (*g s*), s	7.1		2.2				8.3	9.6			15.1	9.3
Cycle Queue Clearance Time (*g c*), s	7.1		2.2				23.5	9.6			15.1	9.3
Green Ratio (*g/C*)	0.08		0.08				0.81	0.81			0.81	0.81
Capacity (*c*), veh/h	109		97				418	2826			1443	1357
Volume-to-Capacity Ratio (*X*)	0.801		0.256				0.226	0.367			0.360	0.360
Back of Queue (*Q*), ft/ln (50 th percentile)	79.1		20.7				23.8	46.4			50.8	46
Back of Queue (*Q*), veh/ln (50 th percentile)	2.6		0.7				0.9	1.8			1.9	1.8
Queue Storage Ratio (*RQ*) (50 th percentile)	0.26		0.03				0.12	0.02			0.03	0.02
Uniform Delay (*d 1*), s/veh	54.6		52.3				7.2	3.0			3.0	3.0
Incremental Delay (*d 2*), s/veh	5.1		0.5				1.3	0.4			0.7	0.7
Initial Queue Delay (*d 3*), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	59.7		52.8				8.5	3.4			3.7	3.7
Level of Service (LOS)	E		D				A	A			A	A
Approach Delay, s/veh / LOS	58.2	E		0.0			3.8	A		3.7	A	
Intersection Delay, s/veh / LOS	6.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	0.6	A	2.2	B
Bicycle LOS Score / LOS		F			1.4	A	1.3	A

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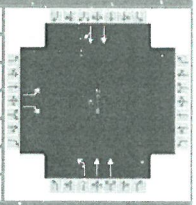
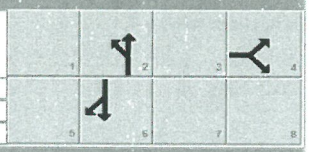
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	DB Zimmerman Traffic			Duration, h	0.25
Analyst	DBZ	Analysis Date	Mar 14, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.77
Urban Street	Greenbelt Highway	Analysis Year	2017	Analysis Period	1> 4:00
Intersection	Riverport Road	File Name	Riverport PM 17.xus		
Project Description	7001 Greenbelt				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	201		89				24	757			1152	40

Signal Information					EB		WB				NB				SB			
Cycle, s	120.0	Reference Phase	2															
Offset, s	0	Reference Point	End	Green	85.6	20.9	0.0	0.0	0.0	0.0								
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.1	3.5	0.0	0.0	0.0	0.0								
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.9	3.0	0.0	0.0	0.0	0.0								



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		8.0
Phase Duration, s		27.4				92.6		92.6
Change Period, (*Y+R c*), s		6.5				7.0		7.0
Max Allow Headway (*MAH*), s		3.0				0.0		0.0
Queue Clearance Time (*g s*), s		20.7						
Green Extension Time (*g e*), s		0.2				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	261		116				31	983			777	771
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1645		1464				280	1706			1810	1788
Queue Service Time (*g s*), s	18.7		8.5				7.8	13.9			27.9	26.1
Cycle Queue Clearance Time (*g c*), s	18.7		8.5				35.7	13.9			27.9	26.1
Green Ratio (*g/C*)	0.17		0.17				0.71	0.71			0.71	0.71
Capacity (*c*), veh/h	287		255				195	2434			1291	1275
Volume-to-Capacity Ratio (*X*)	0.910		0.453				0.160	0.404			0.602	0.605
Back of Queue (*Q*), ft/ln (50 th percentile)	251.7		80.5				16.4	105			216.4	207.9
Back of Queue (*Q*), veh/ln (50 th percentile)	9.3		3.0				0.6	4.0			8.3	8.3
Queue Storage Ratio (*RQ*) (50 th percentile)	0.84		0.13				0.08	0.05			0.11	0.11
Uniform Delay (*d 1*), s/veh	48.6		44.4				18.2	6.9			8.6	8.7
Incremental Delay (*d 2*), s/veh	25.5		0.5				1.8	0.5			2.1	2.1
Initial Queue Delay (*d 3*), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	74.1		44.9				20.0	7.4			10.7	10.8
Level of Service (LOS)	E		D				B	A			B	B
Approach Delay, s/veh / LOS	65.1	E		0.0			7.8	A		10.8	B	
Intersection Delay, s/veh / LOS	16.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	0.7	A	2.2	B
Bicycle LOS Score / LOS		F			1.3	A	1.8	A

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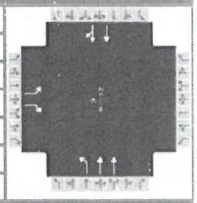
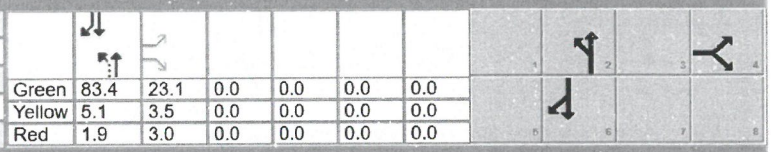
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	DB Zimmerman Traffic			Duration, h	0.25
Analyst	DBZ	Analysis Date	Mar 14, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.77
Urban Street	Greenbelt Highway	Analysis Year	2029 No Build	Analysis Period	1> 4:00
intersection	Riverport Road	File Name	Riverport PM 29 NB.xus		
Project Description	7001 Greenbelt				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	226		100				27	853			1298	45

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB		WB			NB			SB		
Green	83.4	23.1	0.0	0.0	0.0	0.0					
Yellow	5.1	3.5	0.0	0.0	0.0	0.0					
Red	1.9	3.0	0.0	0.0	0.0	0.0					

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		8.0
Phase Duration, s		29.6				90.4		90.4
Change Period, (*Y+R c*), s		6.5				7.0		7.0
Max Allow Headway (*MAH*), s		3.0				0.0		0.0
Queue Clearance Time (*g s*), s		23.0						
Green Extension Time (*g e*), s		0.1				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	294		130				35	1108			874	870
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1645		1464				232	1706			1810	1788
Queue Service Time (*g s*), s	21.0		9.4				12.7	17.6			34.8	34.7
Cycle Queue Clearance Time (*g c*), s	21.0		9.4				47.5	17.6			34.8	34.7
Green Ratio (*g/C*)	0.19		0.19				0.70	0.70			0.70	0.70
Capacity (*c*), veh/h	317		282				154	2372			1258	1243
Volume-to-Capacity Ratio (*X*)	0.927		0.461				0.228	0.467			0.695	0.700
Back of Queue (*Q*), ft/ln (50 th percentile)	294.7		89.1				23.4	137.5			299.7	289.5
Back of Queue (*Q*), veh/ln (50 th percentile)	10.9		3.3				0.8	5.2			11.5	11.6
Queue Storage Ratio (*RQ*) (50 th percentile)	0.98		0.15				0.12	0.07			0.15	0.15
Uniform Delay (*d 1*), s/veh	47.6		42.9				25.0	8.3			10.8	10.9
Incremental Delay (*d 2*), s/veh	31.0		0.4				3.4	0.7			3.2	3.3
Initial Queue Delay (*d 3*), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	78.7		43.4				28.4	8.9			14.0	14.2
Level of Service (LOS)	E		D				C	A			B	B
Approach Delay, s/veh / LOS	67.8	E		0.0			9.5	A		14.1	B	
Intersection Delay, s/veh / LOS	19.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	0.7	A	2.2	B
Bicycle LOS Score / LOS		F			1.4	A	1.9	A

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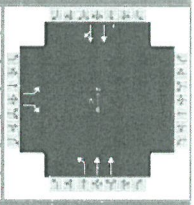
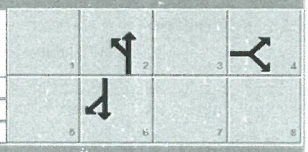
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	DB Zimmerman Traffic			Duration, h	0.25
Analyst	DBZ	Analysis Date	Mar 17, 2017	Area Type	Other
Jurisdiction		Time Period	PM Peak	PHF	0.77
Urban Street	Greenbelt Highway	Analysis Year	2029 Build	Analysis Period	1> 4:00
Intersection	Riverport Road	File Name	Riverport PM 29 B 3.xus		
Project Description	7001 Greenbelt				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	226		100				27	873			1335	45

Signal Information					Green	Yellow	Red					
Cycle, s	120.0	Reference Phase	2		83.4	5.1	1.9	23.1	3.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Offset, s	0	Reference Point	End																	
Uncoordinated	No	Simult. Gap E/W	On																	
Force Mode	Fixed	Simult. Gap N/S	On																	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				6.0		8.0
Phase Duration, s		29.6				90.4		90.4
Change Period, (*Y+R c*), s		6.5				7.0		7.0
Max Allow Headway (*MAH*), s		3.0				0.0		0.0
Queue Clearance Time (*g s*), s		23.0						
Green Extension Time (*g e*), s		0.1				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	294		130				35	1134			898	895
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1645		1464				221	1706			1810	1788
Queue Service Time (*g s*), s	21.0		9.4				13.8	18.2			36.7	36.6
Cycle Queue Clearance Time (*g c*), s	21.0		9.4				50.5	18.2			36.7	36.6
Green Ratio (*g/C*)	0.19		0.19				0.70	0.70			0.70	0.70
Capacity (*c*), veh/h	317		282				146	2372			1258	1243
Volume-to-Capacity Ratio (*X*)	0.927		0.461				0.240	0.478			0.714	0.720
Back of Queue (*Q*), ft/ln (50 th percentile)	294.7		89.1				24.5	143			316.2	307
Back of Queue (*Q*), veh/ln (50 th percentile)	10.9		3.3				0.8	5.5			12.2	12.3
Queue Storage Ratio (*RQ*) (50 th percentile)	0.98		0.15				0.12	0.07			0.16	0.16
Uniform Delay (*d 1*), s/veh	47.6		42.9				26.6	8.4			11.1	11.2
Incremental Delay (*d 2*), s/veh	31.0		0.4				3.8	0.7			3.5	3.6
Initial Queue Delay (*d 3*), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	78.7		43.4				30.4	9.0			14.5	14.8
Level of Service (LOS)	E		D				C	A			B	B
Approach Delay, s/veh / LOS	67.8	E		0.0			9.7	A		14.7	B	
Intersection Delay, s/veh / LOS	19.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	0.7	A	2.2	B
Bicycle LOS Score / LOS		F			1.5	A	2.0	A

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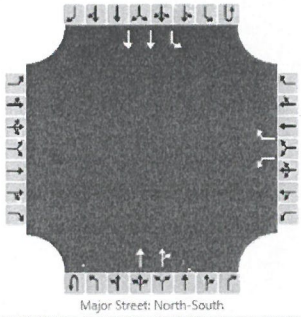
HCS 2010 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Entrance at Greenbelt
Agency/Co.	Diane B. Zimmerman Traffic	Jurisdiction	
Date Performed	3/17/2017	East/West Street	Entrance South
Analysis Year	2029	North/South Street	Greenbelt
Time Analyzed	AM Peak	Peak Hour Factor	0.93
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Greenbelt		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	2	0	0	1	2	0
Configuration						L		R			T	TR		L	T	
Volume, V (veh/h)						11		6			1017	28		17	925	
Percent Heavy Vehicles (%)						10		10						10		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						12		6						18		
Capacity, c (veh/h)						190		451						573		
v/c Ratio						0.06		0.01						0.03		
95% Queue Length, Q_{95} (veh)						0.2		0.0						0.1		
Control Delay (s/veh)						25.2		13.1						11.5		
Level of Service, LOS						D		B						B		
Approach Delay (s/veh)						21.2								0.2		
Approach LOS						C										

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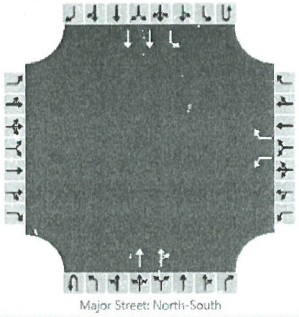
HCS 2010 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Entrance at Greenbelt
Agency/Co.	Diane B. Zimmerman Traffic	Jurisdiction	
Date Performed	3/17/2017	East/West Street	Entrance South
Analysis Year	2029	North/South Street	Greenbelt
Time Analyzed	PM Peak	Peak Hour Factor	0.77
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Greenbelt		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	2	0	0	1	2	0
Configuration						L		R			T	TR		L	T	
Volume, V (veh/h)						30		17			1083	16		9	1350	
Percent Heavy Vehicles (%)						10		10						10		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						39		22						12		
Capacity, c (veh/h)						116		356						434		
v/c Ratio						0.34		0.06						0.03		
95% Queue Length, Q_{95} (veh)						1.3		0.2						0.1		
Control Delay (s/veh)						50.9		15.8						13.5		
Level of Service, LOS						F		C						B		
Approach Delay (s/veh)						38.2								0.1		
Approach LOS						E										

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Entrance PM S.xtw

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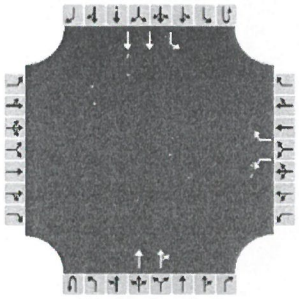
HCS 2010 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	DBZ	Intersection	Entrance at Greenbelt
Agency/Co.	Diane B. Zimmerman Traffic	Jurisdiction	
Date Performed	3/17/2017	East/West Street	Entrance
Analysis Year	2029	North/South Street	Greenbelt
Time Analyzed	AM Peak	Peak Hour Factor	0.93
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Greenbelt		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	2	0	0	1	2	0
Configuration						L		R			T	TR		L	T	
Volume, V (veh/h)						3		26			1016	7		66	939	
Percent Heavy Vehicles (%)						10		10						10		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						3		28						71		
Capacity, c (veh/h)						173		459						586		
v/c Ratio						0.02		0.06						0.12		
95% Queue Length, Q_{95} (veh)						0.1		0.2						0.4		
Control Delay (s/veh)						26.1		13.4						12.0		
Level of Service, LOS						D		B						B		
Approach Delay (s/veh)						14.6								0.8		
Approach LOS						B										

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Entrance AM.xtw

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HCS 2010 Two-Way Stop-Control Report

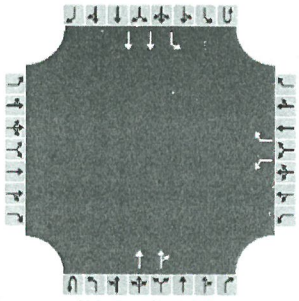
General Information

Analyst	DBZ
Agency/Co.	Diane B. Zimmerman Traffic
Date Performed	3/17/2017
Analysis Year	2029
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	Greenbelt

Site Information

Intersection	Entrance at Greenbelt
Jurisdiction	
East/West Street	Entrance
North/South Street	Greenbelt
Peak Hour Factor	0.77
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	2	0	0	1	2	0
Configuration						L		R			T	TR		L	T	
Volume, V (veh/h)						7		69			1096	4		37	1352	
Percent Heavy Vehicles (%)						10		10						10		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						9		90						48		
Capacity, c (veh/h)						107		356						434		
v/c Ratio						0.08		0.25						0.11		
95% Queue Length, Q_{95} (veh)						0.3		1.0						0.4		
Control Delay (s/veh)						41.8		18.5						14.3		
Level of Service, LOS						E		C						B		
Approach Delay (s/veh)						20.6								0.4		
Approach LOS						C										

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Entrance PM.xtw

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