

7865 SOUTH HURSTBOURNE DEVELOPMENT

LOUISVILLE, KENTUCKY

TRAFFIC IMPACT STUDY

JUNE 2019

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INTRODUCTION

Qk4 was retained to perform a Traffic Impact Study (TIS) for the proposed 7865 South Hurstbourne Development located in east of Fegenbush Lane and west of S. Watterson Trail in Louisville, Kentucky. The approximate location of the proposed development can be seen on Figure I below.



Figure I: Proposed Development Location

PROPOSED DEVELOPMENT

The proposed development will consist of two land uses: 27,500 square feet of commercial buildings and 304 multi-family home units. Note, the square footage of the proposed development has been reduced on the latest site plan; however, this larger development plan was used for analysis as a worst case scenario.

Figure 2 below shows the general layout of the development boundaries and roadway system. The development would provide access to S. Hurstbourne Pkwy via a proposed entrance to the new development as well as a connection to Vassel Rd which also accesses S. Hurstbourne Pkwy.

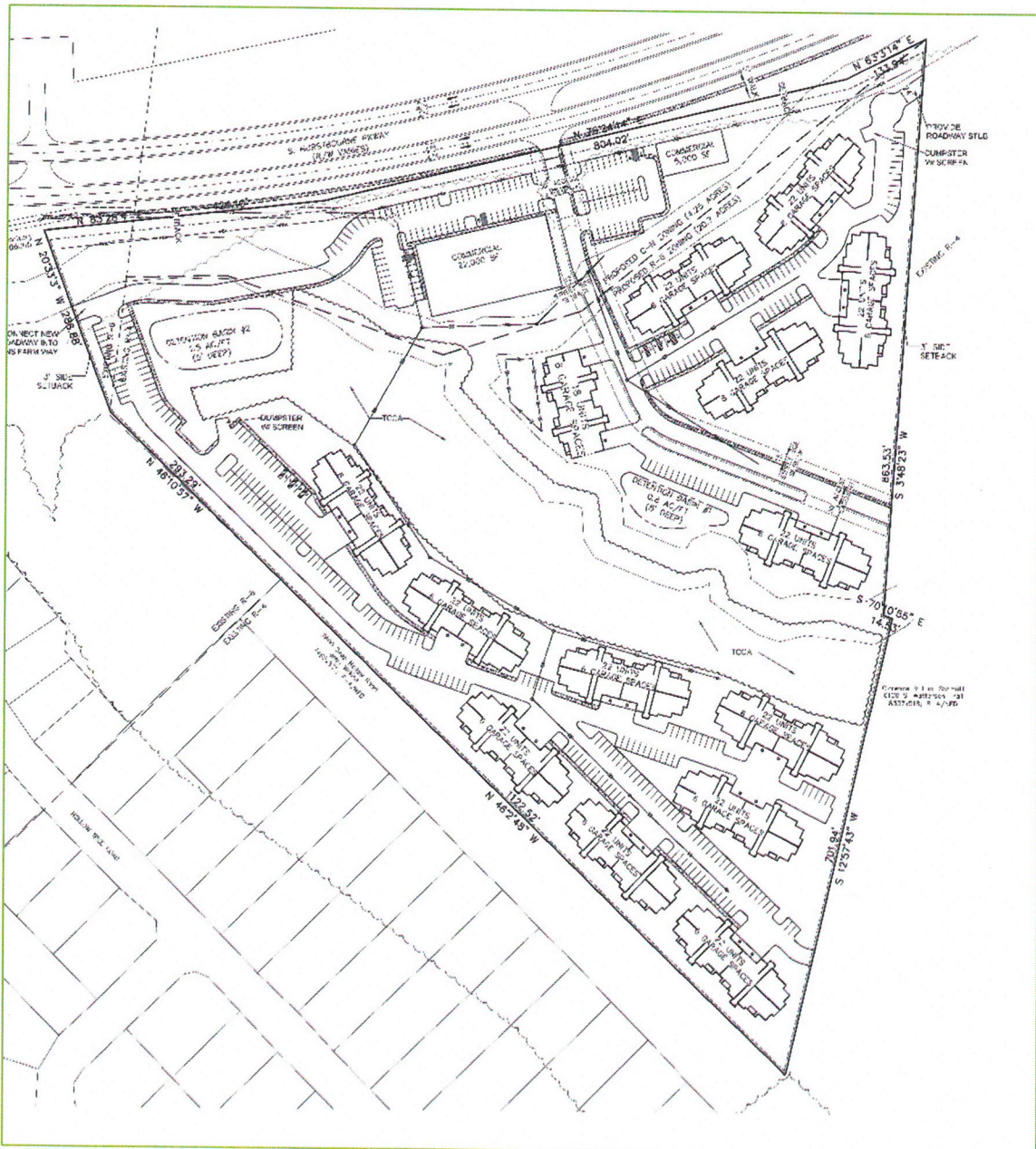


Figure 2: Proposed Development General Layout

EXISTING CONDITIONS

STUDY AREA

The study area for this traffic impact study will include the following intersection with S. Hurstbourne Pkwy (1) Vassel Rd, (2) Proposed Site Entrance, and (3) S. Watterson Trail.

The site entrance on S. Hurstbourne Pkwy is approximately 1,300 east of the S. Hurstbourne Pkwy intersection with Vassel Rd and 3,000 feet west of the S. Hurstbourne Pkwy intersection with S. Watterson Trail.



Figure 3: Study Area Intersections

Intersection I) S. Hurstbourne Pkwy & Vassel Rd

The intersection of S. Hurstbourne Pkwy and Vassel Rd is currently stop controlled with the northbound approach required to stop. The northbound approach to the intersection consists of a shared left/right lane. The westbound approach has a left turn lane and two thru lanes. The eastbound approach has two thru lanes and a right turn lane.



Figure 4: Intersection I; S. Hurstbourne Pkwy & Vassel Rd

Intersection 2) S. Hurstbourne Pkwy & Proposed Site Entrance

There is an existing curb cut where the proposed Site Entrance will be located. The proposed northbound approach will have left and right turn lanes. The configuration of the east and westbound approaches will be determined via this study.



Figure 5: Intersection 2; S. Hurstbourne Pkwy & Proposed Site Entrance

Intersection 3) S. Hurstbourne Pkwy & S. Watterson Trail

The intersection of S. Hurstbourne Pkwy & S. Watterson Trail is currently signalized. The northbound approach to the intersection consists of a left turn lane, a thru lane and a right turn lane. The westbound approach has a left turn lane, two thru lanes and a right turn lane. The southbound approach has a left turn lane, a thru lane and a right turn lane. The eastbound approach has a left turn lane, two thru lanes and a right turn lane.

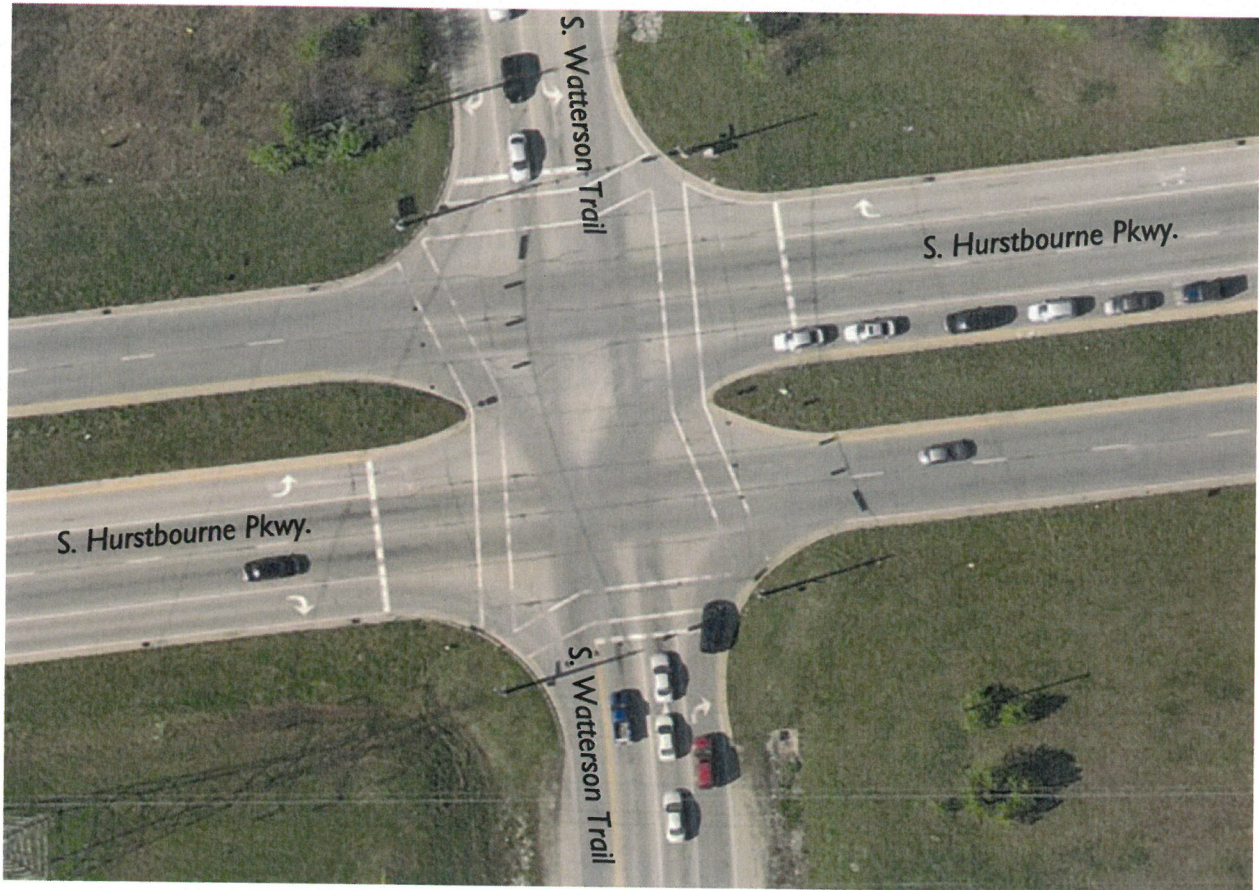


Figure 6: Intersection 3; S. Hurstbourne Pkwy & S. Watterson Trail

TURNING MOVEMENT COUNTS

Turning movement counts were conducted for S. Hurstbourne Pkwy and Vassel Rd on March 28, 2019 and S. Hurstbourne Pkwy and S. Watterson Trail on April 30, 2019. These counts covered the peak hours of 7AM to 9AM and 4PM to 6PM. All intersections were counted with Miovision data collection units. Truck data was collected independently of passenger car data to determine truck percentages for all intersections. Peak hour summaries for all study area intersections follows. This existing turning movement data is summarized graphically on Figures 8 and 9.

Study Name Hurstbourne Pkwy & Vassel Rd
 Start Date Thursday, March 28, 2019 7:00 AM
 End Date Thursday, March 28, 2019 6:00 PM
 Site Code

Report Summary

Time Period	Class.	Westbound					Northbound					Eastbound					Total
		T	L	U	I	O	R	L	U	I	O	R	T	U	I	O	
Peak 1	Lights	849	6	0	855	563	22	9	0	31	9	3	541	0	544	858	1430
Specified Period	%	98%	100%	0%	99%	96%	100%	100%	0%	100%	100%	100%	96%	0%	96%	99%	97%
7:00 AM - 9:15 AM	Other Vehicle:	13	0	0	13	25	0	0	0	0	0	0	25	0	25	13	38
One Hour Peak	%	2%	0%	0%	1%	4%	0%	0%	0%	0%	0%	0%	4%	0%	4%	1%	3%
7:00 AM - 8:00 AM	Total	862	6	0	868	588	22	9	0	31	9	3	566	0	569	871	1468
	PHF	0.86	0.75	0	0.86	0.88	0.69	0.75	0	0.78	0.56	0.38	0.88	0	0.88	0.86	0.9
	Approach %				59%	40%				2%	1%				39%	59%	
Peak 2	Lights	774	20	1	795	1169	11	5	0	16	34	14	1157	0	1171	779	1982
Specified Period	%	98%	100%	100%	98%	99%	92%	83%	0%	89%	100%	100%	99%	0%	99%	98%	99%
4:00 PM - 6:15 PM	Other Vehicle:	14	0	0	14	10	1	1	0	2	0	0	9	0	9	15	25
One Hour Peak	%	2%	0%	0%	2%	1%	8%	17%	0%	11%	0%	0%	1%	0%	1%	2%	1%
4:45 PM - 5:45 PM	Total	788	20	1	809	1179	12	6	0	18	34	14	1166	0	1180	794	2007
	PHF	0.95	0.56	0.25	0.96	0.94	0.75	0.75	0	0.75	0.77	0.5	0.94	0	0.93	0.95	0.97
	Approach %				40%	59%				1%	2%				59%	40%	

Study Name Hurstbourne Pkwy & S Watterson Trail
 Start Date Tuesday, April 30, 2019 7:00 AM
 End Date Tuesday, April 30, 2019 6:00 PM
 Site Code

Report Summary

		Southbound						Westbound						Northbound						Eastbound							
Time Period	Class.	R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	Total	
Peak 1	Lights	39	56	10	0	105	238	9	807	156	0	972	1093	525	222	278	0	1025	278	66	558	7	0	631	1124	2733	
Specified Period	%	95%	100%	83%	0%	96%	98%	90%	99%	98%	0%	98%	97%	99%	99%	99%	0%	99%	97%	92%	96%	88%	0%	95%	99%	96%	
7:00 AM - 9:00 AM	Other Vehicle:	2	0	2	0	4	5	1	12	3	0	16	31	5	3	3	0	11	9	6	24	1	0	31	17	62	
One Hour Peak	%	5%	0%	17%	0%	4%	2%	10%	1%	2%	0%	2%	3%	1%	1%	1%	0%	1%	3%	8%	4%	13%	0%	5%	1%	2%	
7:00 AM - 8:00 AM	Total	41	56	12	0	109	243	10	819	159	0	988	1124	530	225	281	0	1036	287	72	582	8	0	662	1141	2795	
	PHF	0.68	0.7	0.75	0	0.8	0.82	0.5	0.86	0.8	0	0.85	0.93	0.97	0.82	0.66	0	0.85	0.84	0.95	0.91	0.5	0	0.92	0.81	0.88	
	Approach %					4%	9%					35%	40%					37%	10%					24%	41%		
Peak 2	Lights	30	218	15	0	263	146	16	697	423	0	1136	1202	281	98	65	0	444	882	241	906	32	0	1179	792	3022	
Specified Period	%	100%	100%	100%	0%	100%	100%	100%	99%	100%	0%	99%	99%	99%	100%	100%	0%	100%	100%	100%	99%	100%	0%	99%	99%	99%	
4:00 PM - 6:00 PM	Other Vehicle:	0	1	0	0	1	0	0	10	2	0	12	14	2	0	0	0	2	3	0	12	0	0	0	12	10	27
One Hour Peak	%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	1%	1%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	1%	1%	
5:00 PM - 6:00 PM	Total	30	219	15	0	264	146	16	707	425	0	1148	1216	283	98	65	0	446	885	241	918	32	0	1191	802	3049	
	PHF	0.68	0.78	0.54	0	0.77	0.89	0.67	0.95	0.92	0	0.94	0.89	0.86	0.84	0.71	0	0.87	0.91	0.9	0.9	0.8	0	0.95	0.95	0.95	
	Approach %					9%	5%					38%	40%					15%	29%					39%	26%		

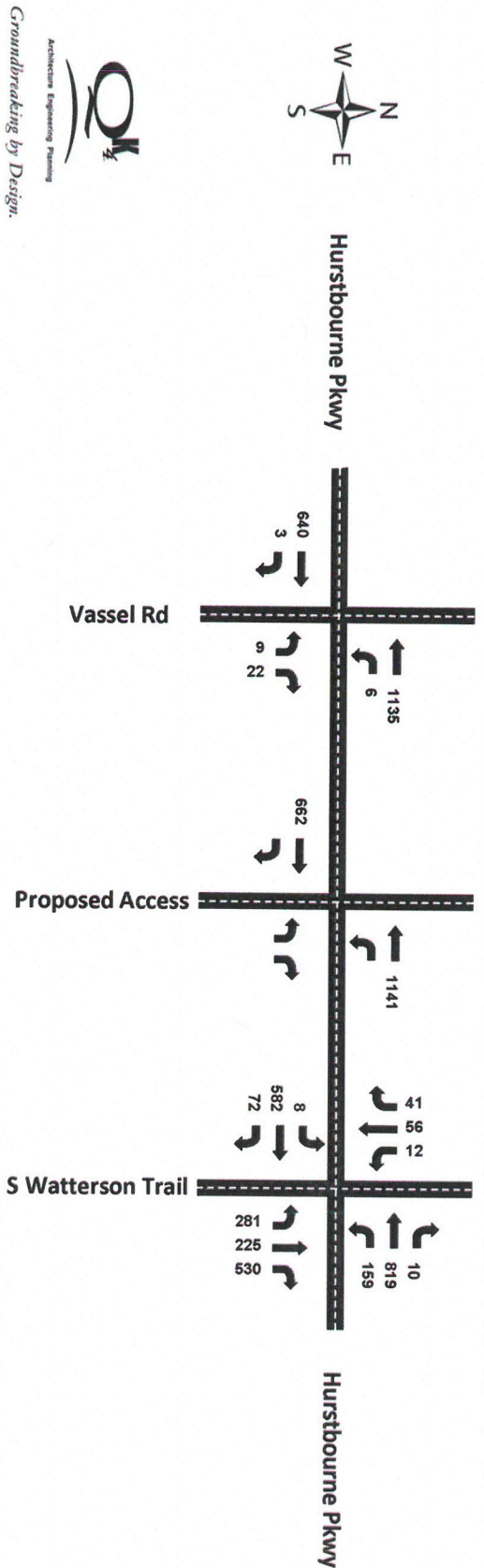


Figure 7: 2019 Existing AM Peak Hour Turning Movements

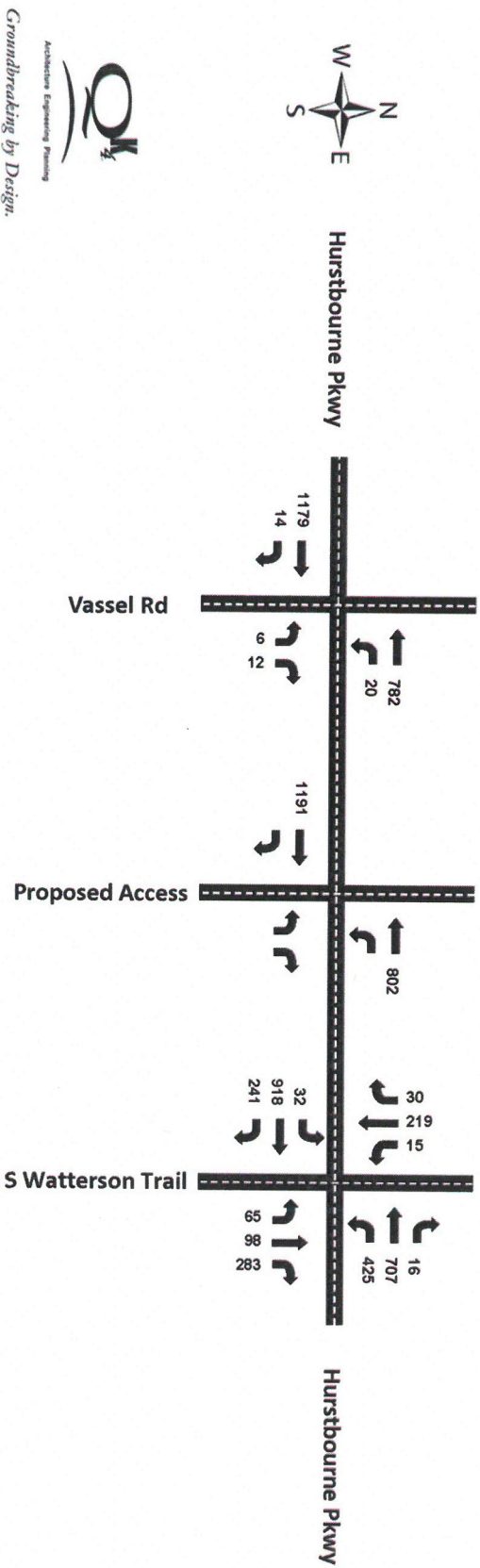


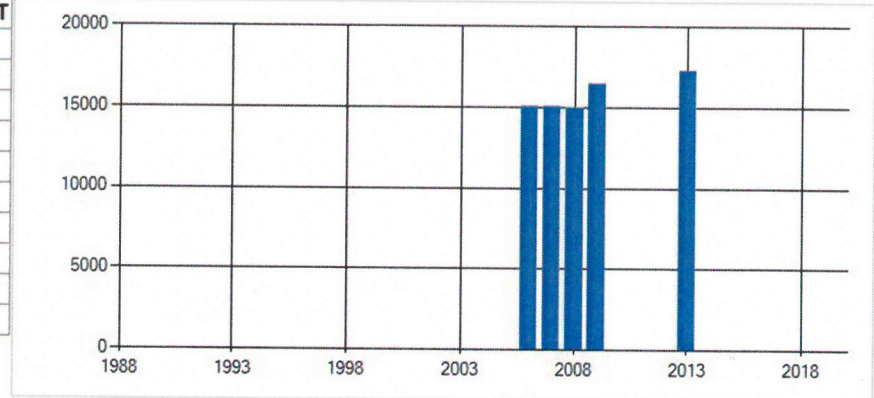
Figure 8: 2019 Existing PM Peak Hour Turning Movements

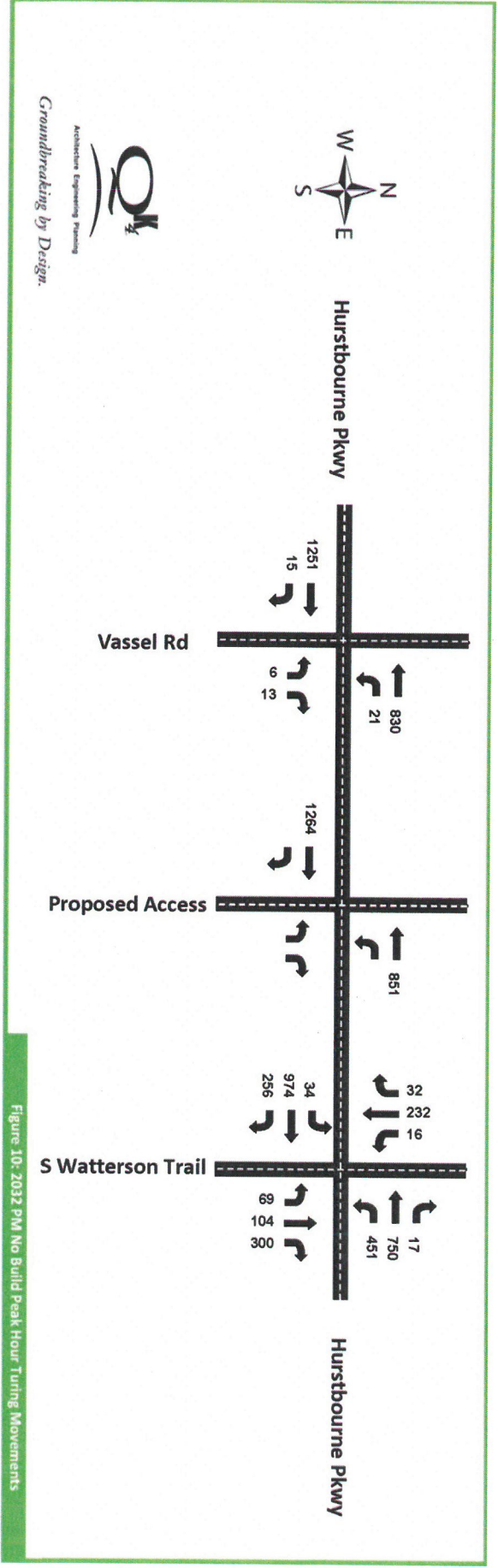
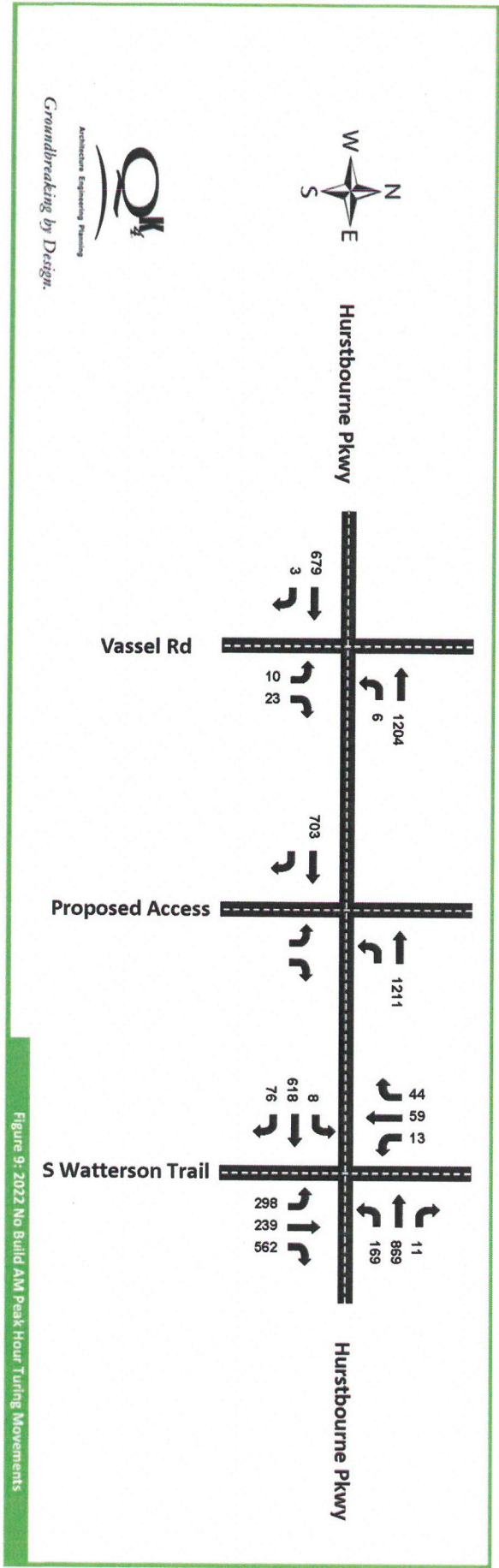
PROJECTED TRAFFIC

BACKGROUND TRAFFIC GROWTH

Existing volumes were grown by 2% to the future years of 2022 and 2032 (build-out of 2022 + 10 years growth). This growth rate was found by analyzing historic counts at KYTC count station Q03 on Hurstbourne Pkwy. The graph below shows this data. 2022 AM and PM no build turning movements can be seen on Figures 9 and 10. 2032 AM and PM no build turning movements can be seen on Figures 11 and 12.

Year	AADT	Year	AADT	Year	AADT
2019		2009	16500	1999	
2018		2008	15000	1998	
2017		2007	15100	1997	
2016		2006	15100	1996	
2015		2005		1995	
2014		2004		1994	
2013	17276	2003		1993	
2012		2002		1992	
2011		2001		1991	
2010		2000		1990	





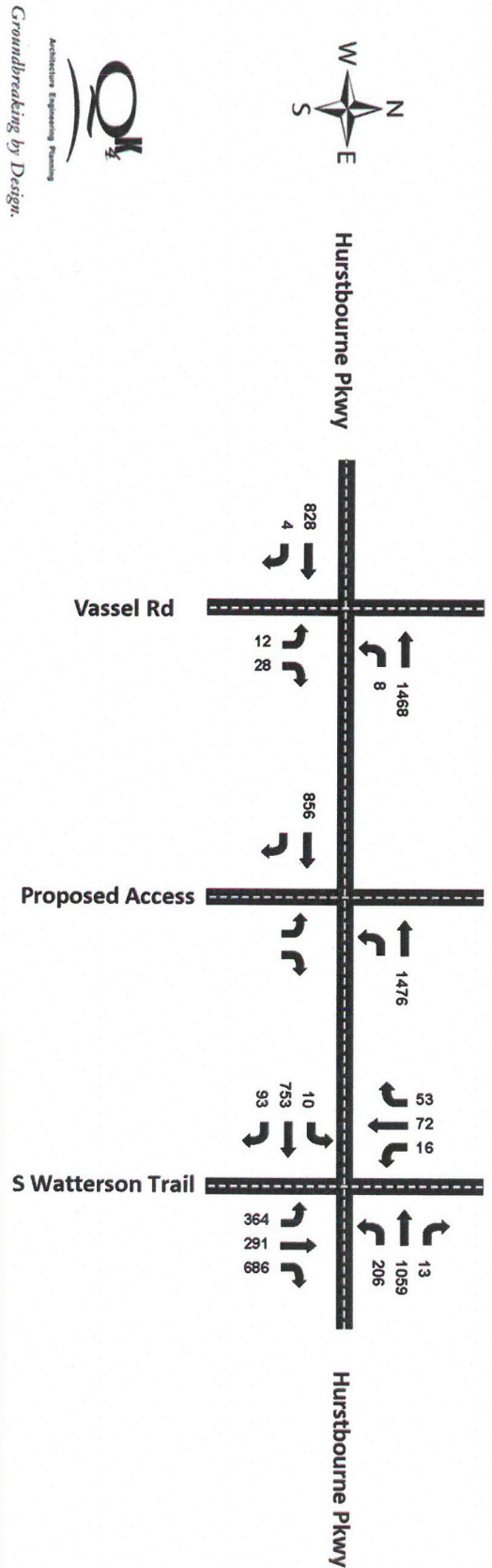


Figure 11: 2032 No Build AM Peak Hour Turning Movements

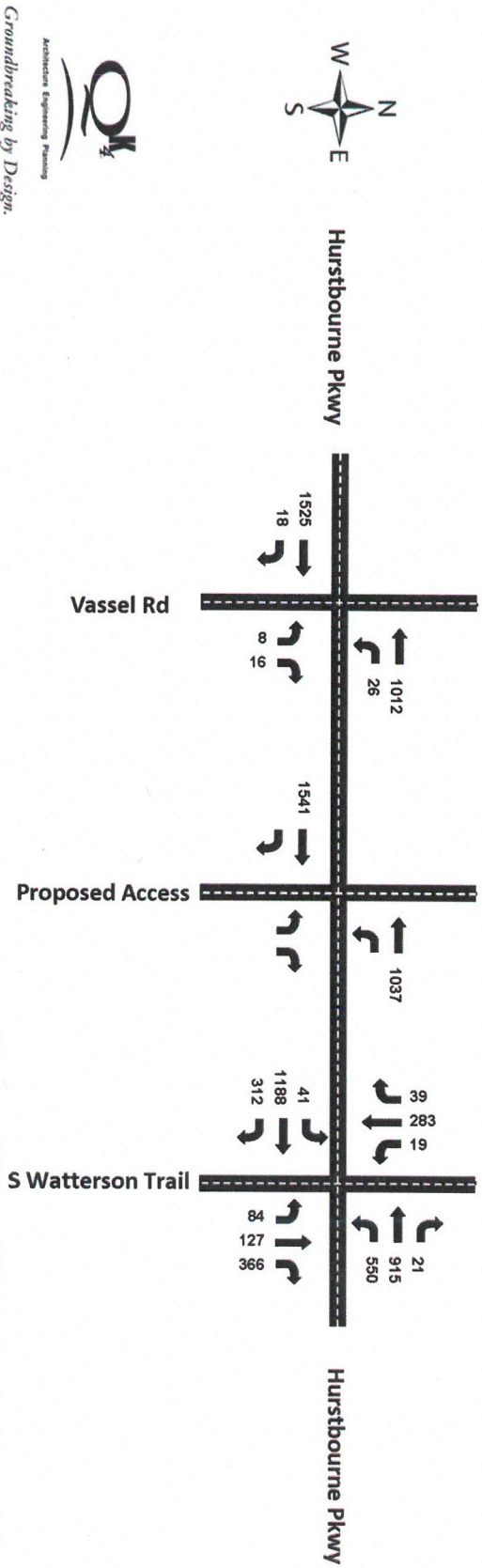


Figure 12: 2032 PM No Build Peak Hour Turning Movements

TRIP GENERATION

Trips were generated using the latest version of the Trip Generation Manual. Trip generation calculations are summarized below.

ITE SITE CODE 940 Bread/Donut/Bagel Shop with Drive-Through Window 5,000 Square Feet	
Pass-By Percentage	50%
Daily Trips	n/a
Daily Trips (in)	n/a
Daily Trips (out)	n/a
AM Trips	163
AM Trips (in)	82
AM Trips (out)	82
AM Primary Trips (In)	41
AM Primary Trips (Out)	41
AM Pass-By Trips (In)	41
AM Pass-By Trips (Out)	41
PM Trips	102
PM Trips (in)	50
PM Trips (out)	52
PM Primary Trips (In)	25
PM Primary Trips (Out)	26
PM Pass-By Trips (In)	25
PM Pass-By Trips (Out)	26

ITE SITE CODE 850 Super Market 16,500 Square Feet	
Pass-By Percentage	36%
Daily Trips	2382
Daily Trips (in)	1191
Daily Trips (out)	1191
AM Trips	63
AM Trips (in)	38
AM Trips (out)	25
AM Primary Trips (In)	24
AM Primary Trips (Out)	16
AM Pass-By Trips (In)	14
AM Pass-By Trips (Out)	9
PM Trips	203
PM Trips (in)	103
PM Trips (out)	99
PM Primary Trips (In)	66
PM Primary Trips (Out)	64
PM Pass-By Trips (In)	37
PM Pass-By Trips (Out)	36

ITE SITE CODE 932 High Turnover Sit-Down Restaurant 6,000 Square Feet	
Pass-By Percentage	43%
Daily Trips	785
Daily Trips (in)	393
Daily Trips (out)	393
AM Trips	60
AM Trips (in)	33
AM Trips (out)	27
AM Primary Trips (In)	19
AM Primary Trips (Out)	15
AM Pass-By Trips (In)	14
AM Pass-By Trips (Out)	12
PM Trips	59
PM Trips (in)	36
PM Trips (out)	22
PM Primary Trips (In)	21
PM Primary Trips (Out)	13
PM Pass-By Trips (In)	16
PM Pass-By Trips (Out)	10

ITE SITE CODE 221 Multifamily Housing (Mid-Rise) 304 Dwelling Units	
Daily Trips	1652
Daily Trips (in)	826
Daily Trips (out)	826
AM Trips	102
AM Trips (in)	26
AM Trips (out)	75
PM Trips	129
PM Trips (in)	79
PM Trips (out)	50

Trip Generation Site Summary	
AM Primary Trips (In)	110
AM Primary Trips (Out)	148
PM Primary Trips (In)	191
PM Primary Trips (Out)	153
AM Pass-By Trips (In)	69
AM Pass-By Trips (Out)	61
PM Pass-By Trips (In)	78
PM Pass-By Trips (Out)	71

TRIP DISTRIBUTION / ASSIGNMENT

Traffic was distributed to and from the proposed development based on existing traffic patterns in the study area (specifically the egress/ingress pattern at the Vassel Rd intersection). Figure 13 summarizes trip distributions through the study area. Figures 14 and 15 summarize AM and PM peak hour primary trips generated by the development. Figures 16 and 17 summarize AM and PM peak hour pass-by trips. Figures 18 and 19 summarize 2022 AM and PM peak hour build turning movements. Figures 20 and 21 summarize 2032 AM and PM peak hour build turning movements.

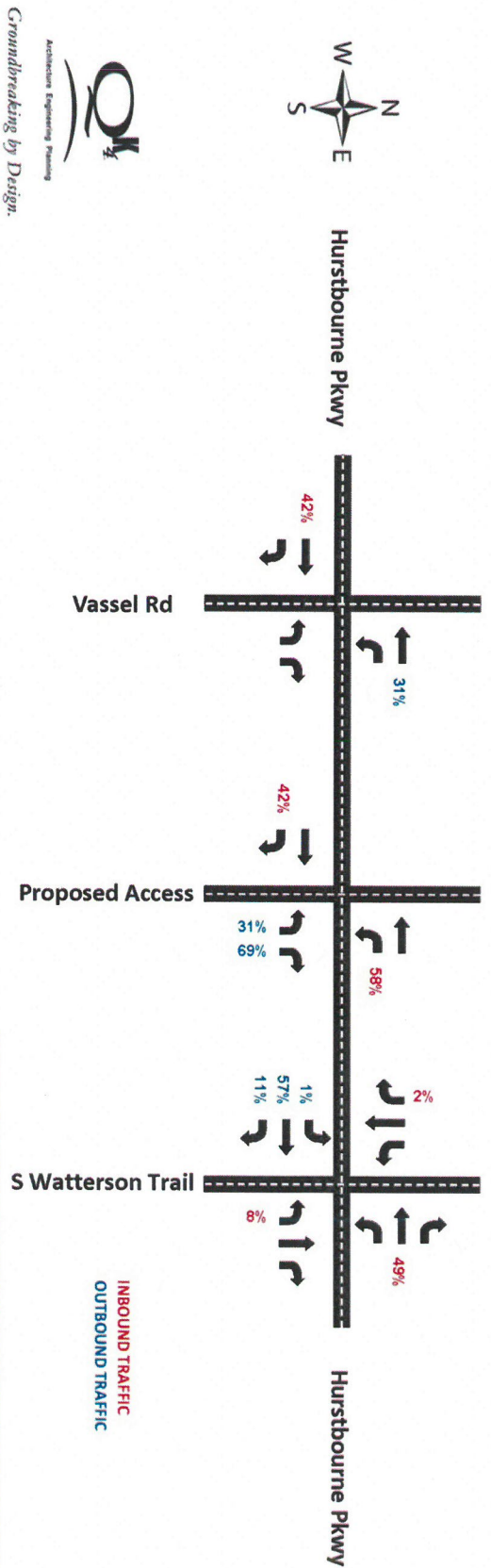


Figure 13: Trip Distributions

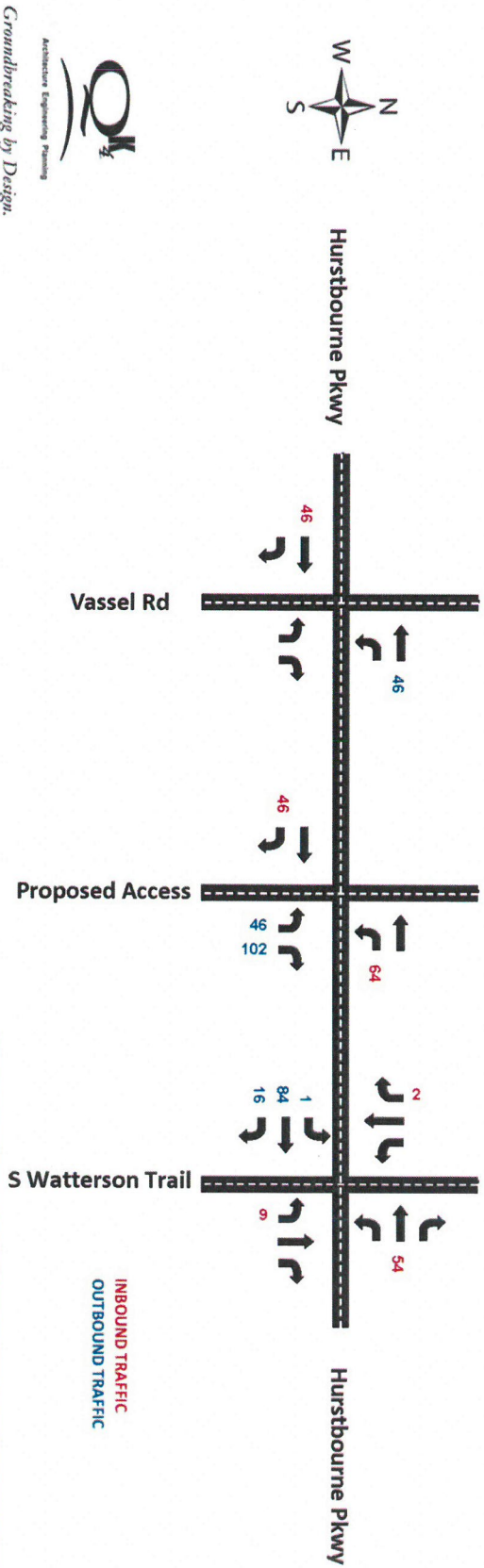


Figure 14: AM Distributed Trips

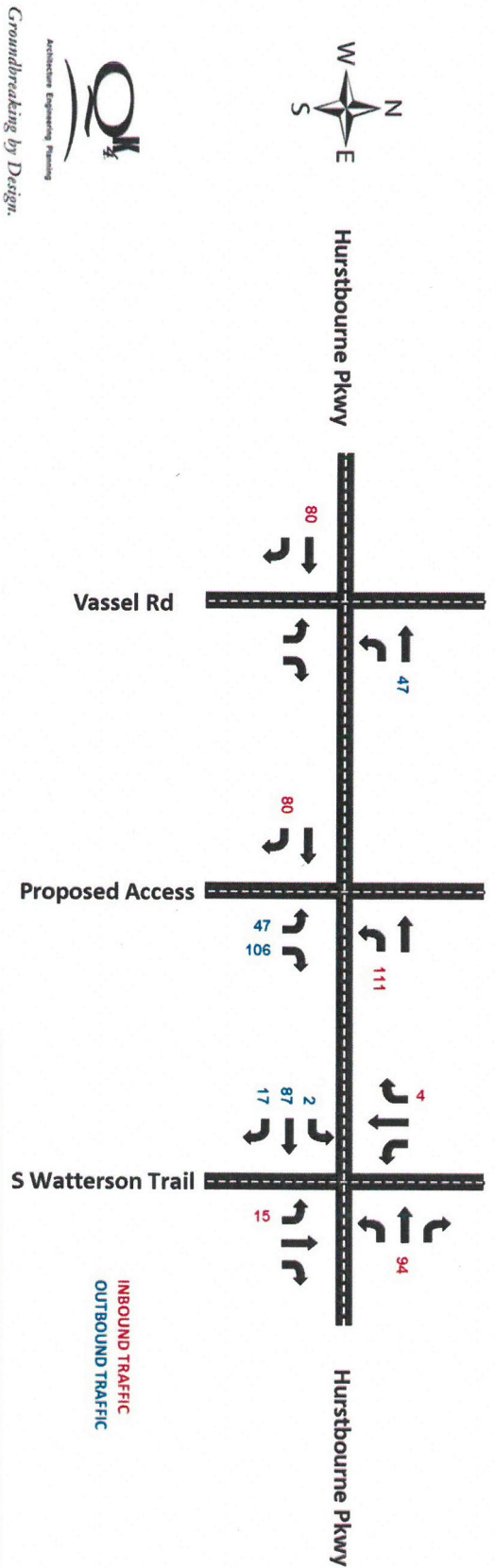


Figure 15: PM Distributed Trips

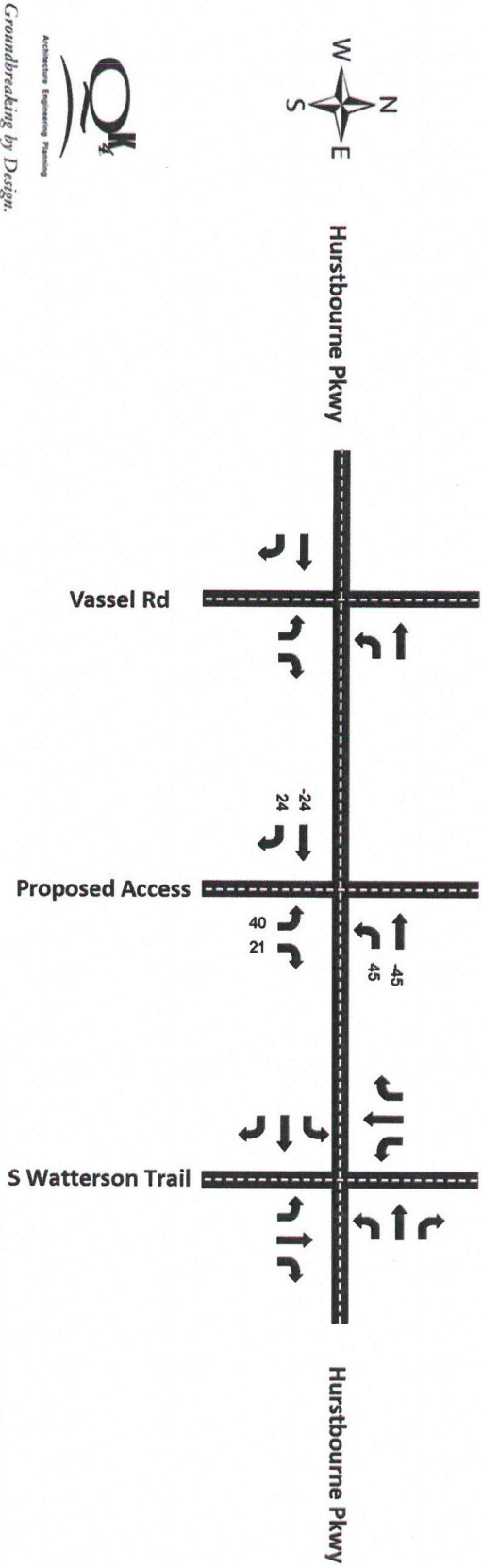


Figure 16: AM Pass-By Trips

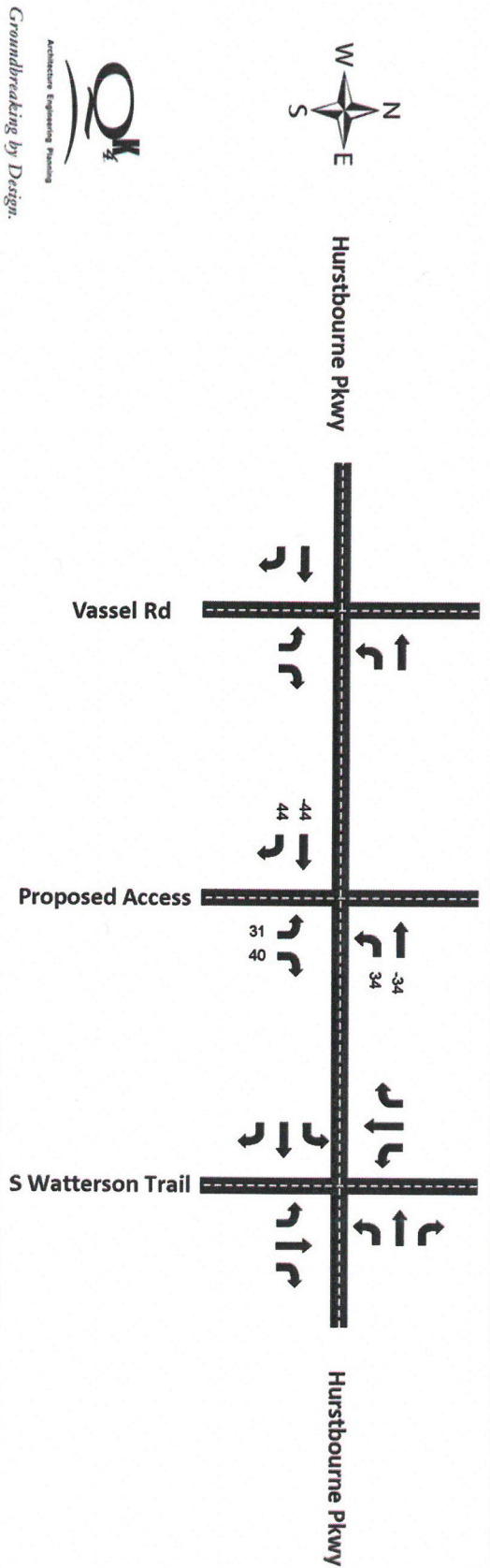


Figure 17: PM Pass-By Trips

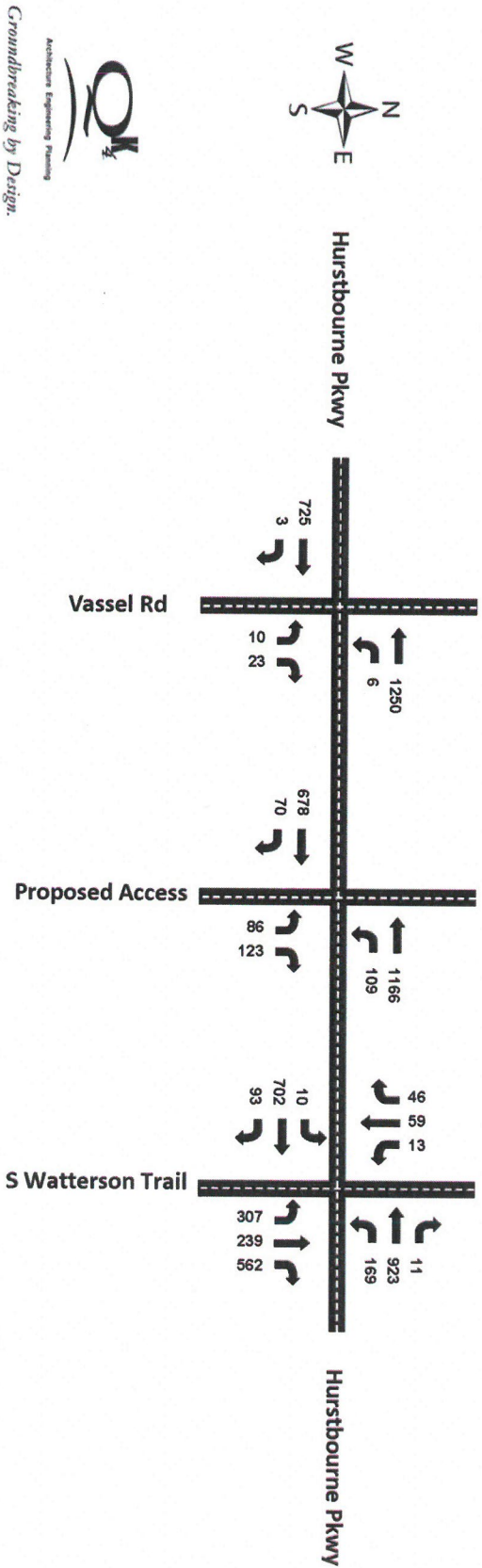


Figure 18: 2022 AM Build Traffic

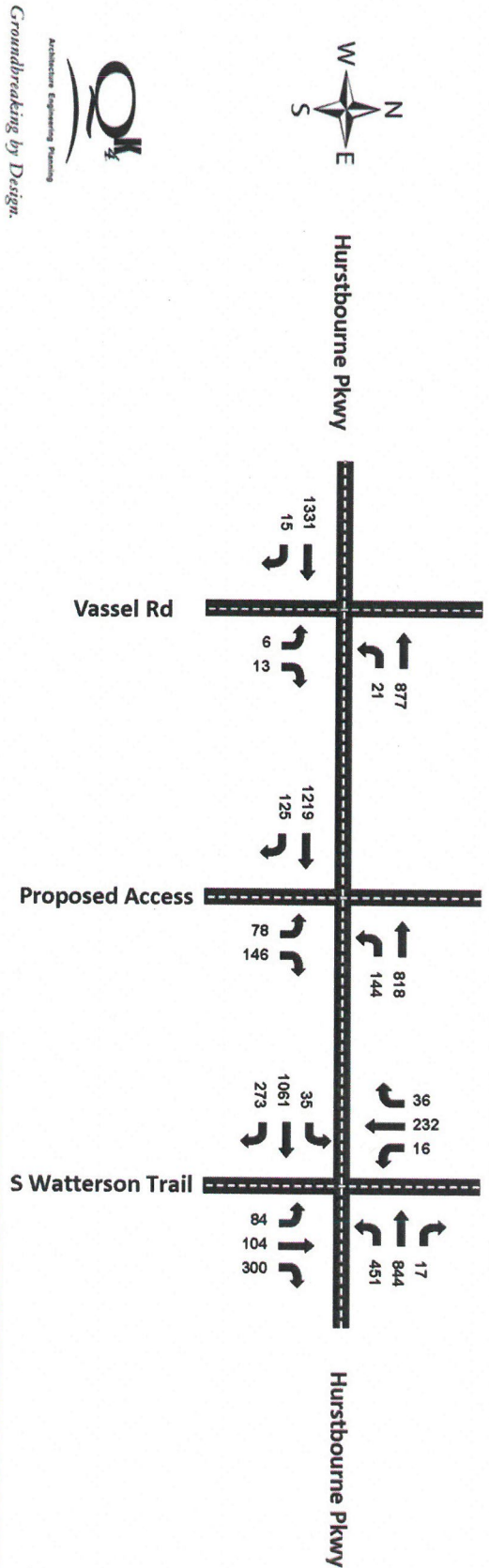


Figure 19: 2022 PM Build Traffic

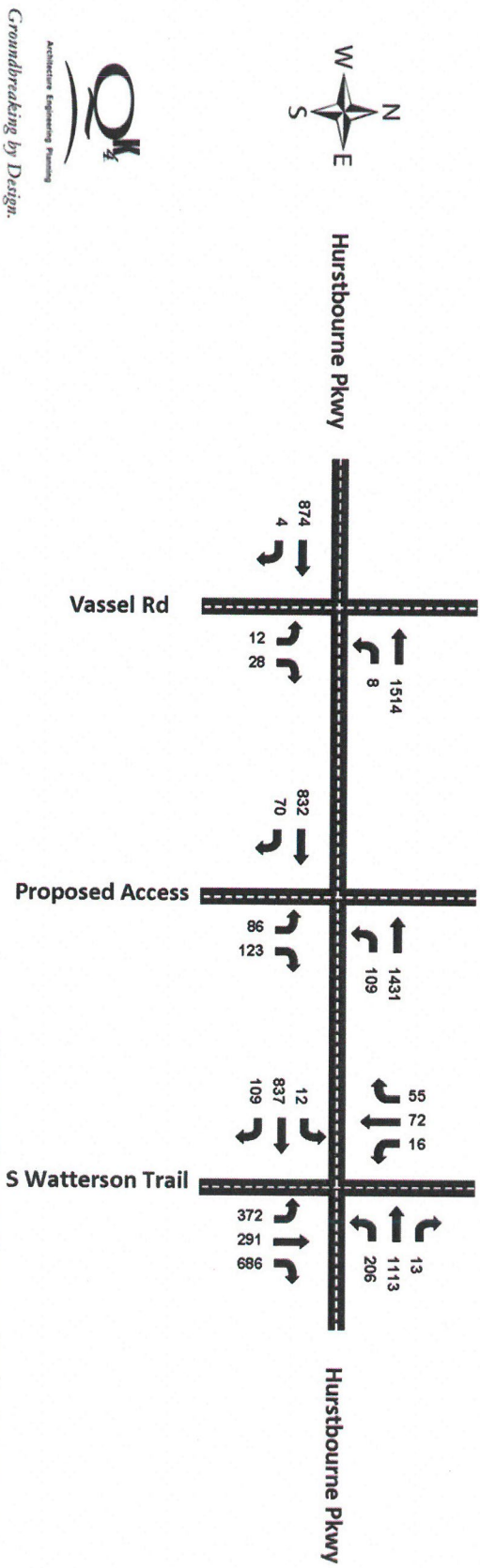


Figure 20: 2032 AM Build Traffic

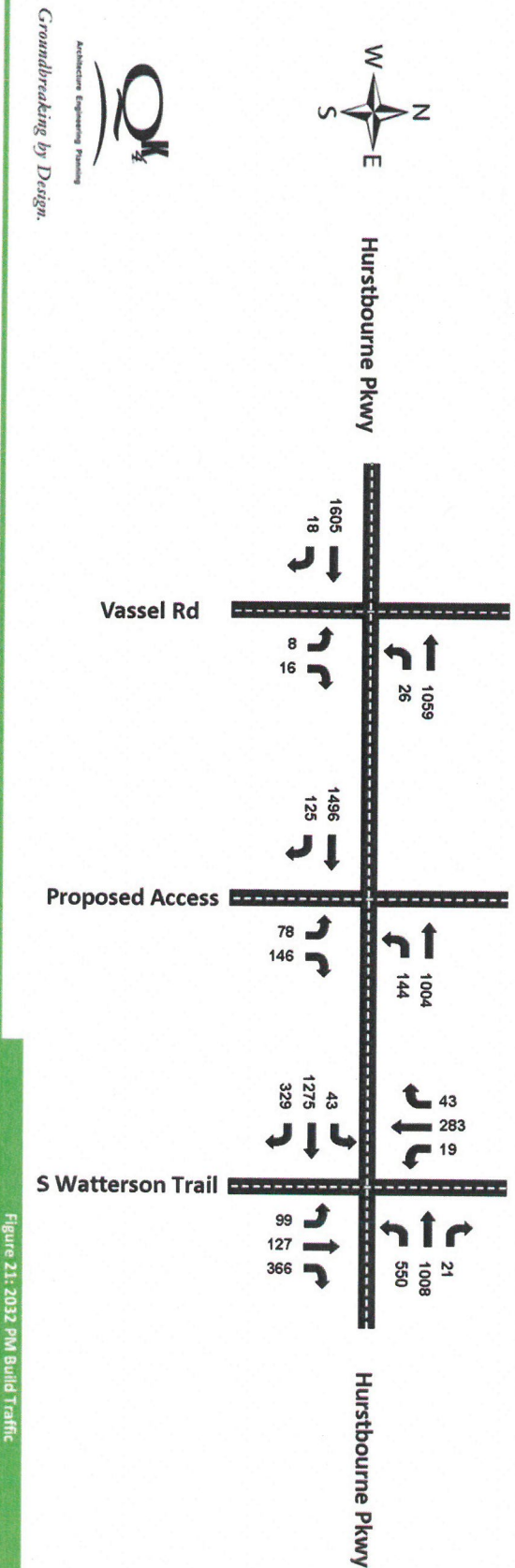


Figure 21: 2032 PM Build Traffic

ANALYSIS

TURN LANE ANALYSIS

Turning movements at all study area intersections were compared to KYTC turn lane warrants to determine if right or left turn lanes would be warranted at the proposed entrance.

RIGHT TURN LANE WARRANTS

Right turn volumes were compared to warrants for the eastbound approach to determine if a right turn lane would be needed. As seen below, this auxiliary lane would be warranted based on projected volumes.

AM PEAK HOUR

Right Turn Volume: 70

Advancing Volume: 902

Warranted: NO

PM PEAK HOUR

Right Turn Volume: 125

Advancing Volume: 1621

Warranted: **YES**

LEFT TURN LANE WARRANTS

Left turn volumes were compared to warrants for the westbound approach to determine if a left turn lane would be needed. As seen below, this auxiliary lane would be warranted based on projected volumes.

AM PEAK HOUR

Left Turn Volume: 109

Advancing Volume: 1540

Opposing Volume: 902

Warranted: **YES**

PM PEAK HOUR

Left Turn Volume: 144

Advancing Volume: 1148

Opposing Volume: 1621

Warranted: **YES**

CAPACITY ANALYSIS

Level of service (LOS) is a term that is commonly used to evaluate roadway functions. Level of service is defined as a qualitative measure of operational conditions and the perception of these conditions by motorists. These conditions are usually defined in terms of factors such as speed and travel time, maneuverability, delay, and safety. There are six levels of service, which are designated by the letters "A" through "F." Level of service "A" represents the best operating conditions, while level of service "F" defines the worst.

The methodology used to analyze the capacity and level of service was based on standard traffic engineering procedures outlined in the *Highway Capacity Manual* (HCM 2010). The analysis was performed using the latest version of the Highway Capacity software. The procedure considers traffic and geometric conditions of the facility, such as traffic volumes, percent of large vehicles, design speed, lane and shoulder widths, grades, and directional distributions to determine the LOS.

Delay is a critical performance measure on interrupted-flow facilities. Delay is measured as the time a vehicle is slowed by a signalized or stop-controlled intersection compared to the average travel time of a vehicle if it were unimpeded by the intersection. Delay includes the time a vehicle decelerates approaching the intersection and accelerating as it leaves the intersection. Although the definition of delay is the same for both signalized and stop-controlled intersections, the thresholds used to determine LOS differ. LOS thresholds for signalized and unsignalized intersections are summarized below.

LOS Threshold for Signalized Intersections		
Delay (sec)	LOS	Description
1-10	A	Free Flow
10-20	B	Reasonable Unimpeded Flow
20-35	C	Stable Operation
35-55	D	*Approaching Unstable Flow
55-80	E	Unstable Flow
>80	F	Congested Flow
LOS Threshold for Unsignalized Intersections		
Delay (sec)	LOS	Description
1-10	A	Free Flow
10-15	B	Reasonable Unimpeded Flow
15-25	C	Stable Operation
25-35	D	*Approaching Unstable Flow
35-50	E	Unstable Flow
>50	F	Congested Flow

Capacity analyses were performed for all study area intersections for both the AM and PM peak hours, including the following scenarios: existing, no build and build. Highway Capacity Software 7 was used to analyze all study area intersections. Note that the capacity analyses included a comparison—expressed as a volume to capacity (v/c) ratio—of the traffic volume to the operating capacity of the road based on its characteristics (number of lanes, shoulder width, grades, etc.). The v/c ratio ranges from zero (0) to 1.0, defined as follows:

- **v/c = 0:** the flow rate is zero—this is the starting point for the comparison.
- **v/c = 0– 0.999:** the volume of traffic is less than the road's capacity to handle it.
- **v/c = 1.0:** the flow rate equals the roadway's capacity; i.e., the road is approaching the limits of its ability (capacity) to handle the traffic volume.
- **v/c = > 1.0:** the traffic volume exceeds the road's capacity, producing unacceptable delays and LOS "F."

95 percentile queue lengths were also report for all intersection movements.

S. HURSTBOURNE PKWY & VASSEL RD

Level of service changes in 2022 with build traffic added:

- Northbound Left/Right drops from a LOS B to LOS C in AM (+6.7 sec of delay)

Level of service changes in 2032 with build traffic added:

- Westbound Left drops from LOS A to LOS B in AM (+0.2 sec of delay)
- Northbound Left/Right drops from a LOS C to a LOS D in AM (+14.4 sec of delay)

Capacity Analysis S. Hurstbourne Pkwy & Vassel Road

Movement	Time Period	v/c Ratio					95% Queue (feet)					Delay (seconds)					Level of Service				
		Existing	2022 No Build	2022 Build	2023 No Build	2023 Build	Existing	2022 No Build	2022 Build	2023 No Build	2023 Build	Existing	2022 No Build	2022 Build	2023 No Build	2023 Build	Existing	2022 No Build	2022 Build	2023 No Build	2023 Build
Westbound, Left	AM	0.01	0.01	0.01	0.01	0.01	25	25	25	25	25	9	9.1	9.3	9.8	10	A	A	A	A	B
	PM	0.04	0.05	0.05	0.07	0.08	25	25	25	25	25	12	12.5	13.1	15	15.9	B	B	B	C	C
Northbound, Left/Right	AM	0.07	0.08	0.13	0.12	0.24	25	25	25	25	25	13.1	13.7	20.4	15.9	30.3	B	B	C	C	D
	PM	0.08	0.08	0.09	0.15	0.17	25	25	25	25	25	20.1	21.1	22.8	29.4	32.3	C	C	C	D	D

S. HURSTBOURNE PKWY & PROPOSED SITE ENTRANCE

The westbound left movement off out of the development would operate at a LOS E or F during both peak hours for both 2022 and 2032 future years. This movement will also exceed 80 seconds of delay in both years during the PM peak hour. Signal warrants would not be met with this development for eight hours of the day. Although this movement would experience delays leaving the development, any queueing would remain on the subject property and no affect operations on S. Hurstbourne Pkwy.

Capacity Analysis S. Hurstbourne Pkwy & Proposed Site Entrance

Movement	Time Period	v/c Ratio					95% Queue (feet)					Delay (seconds)					Level of Service				
		Existing	2022 No Build	2022 Build	2023 No Build	2023 Build	Existing	2022 No Build	2022 Build	2023 No Build	2023 Build	Existing	2022 No Build	2022 Build	2023 No Build	2023 Build	Existing	2022 No Build	2022 Build	2023 No Build	2023 Build
Westbound, Left	AM	---	---	0.15	---	0.17	---	---	25	---	25	---	---	10.3	---	11.3	---	---	B	---	B
	PM	---	---	0.35	---	0.45	---	---	50	---	75	---	---	17.1	---	23.7	---	---	C	---	C
Northbound, Left	AM	---	---	0.46	---	0.6	---	---	75	---	100	---	---	37.5	---	57.1	---	---	E	---	F
	PM	---	---	0.69	---	1.02	---	---	100	---	150	---	---	83.5	---	194.1	---	---	F	---	F
Northbound, Right	AM	---	---	0.21	---	0.24	---	---	25	---	25	---	---	12.3	---	13.6	---	---	B	---	B
	PM	---	---	0.4	---	0.5	---	---	50	---	75	---	---	19.7	---	26.9	---	---	C	---	D

TURN LANE LENGTHS

Turning movement volumes at the intersection of S. Hurstbourne Pkwy with the proposed site entrance warranted both an eastbound right turn lane and a westbound left turn lane off of S. Hurstbourne Pkwy into the site.

Using method 1 in the auxiliary turn lane policy for the uncontrolled eastbound right turn lane and a 45 mph speed on S. Hurstbourne Pkwy, 215 feet would be required for this lane including a 100' bay taper.

For the westbound left turn lane methods 1 and 2 were compared to determine the needed length for this lane. Method 1 would require 215 feet for the posted 45 mph speed limit. Method 2 would require 75 feet for the maximum storage length (output from HCS) and an additional 115 feet, for a total of 190 feet. Using the greater of these two methods, 215' (including a 100' bay taper) would be required for the westbound left turn lane.

CONCLUSIONS

The subject development would cause little impact to S. Hurstbourne Pkwy or nearby intersections.

The northbound left turn movement out of the development would experience significant delay, but this would be internal to the development and would not affect operations on S. Hurstbourne Pkwy. At this time it is not expected that a signal would be warranted at the S. Hurstbourne intersection with the proposed site entrance. The following improvements are recommended for this intersection based on the findings of this study.

- 215' total length eastbound right turn lane (including 100' bay taper)
- 215' total length westbound left turn lane (including 100' bay taper)

APPENDICES

Existing Capacity Analysis

HCS7 Two-Way Stop-Control Report

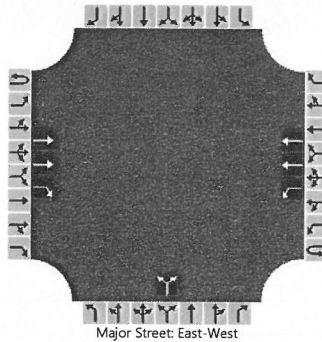
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2019
Time Analyzed	AM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			640	3	0	6	1135			9		22				
Percent Heavy Vehicles (%)					0	0				0		0				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				6.80		6.90				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.50		3.30				

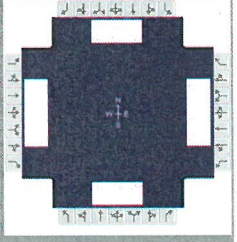
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						7					34					
Capacity, c (veh/h)						907					476					
v/c Ratio						0.01					0.07					
95% Queue Length, Q ₉₅ (veh)						0.0					0.2					
Control Delay (s/veh)						9.0					13.1					
Level of Service (LOS)						A					B					
Approach Delay (s/veh)					0.0				13.1							
Approach LOS									B							

HCS7 Signalized Intersection Results Summary

General Information

Agency		Duration, h	0.25
Analyst		Analysis Date	4/2/2019
Jurisdiction		Time Period	
Urban Street	Hurstbourne Pkwy	Analysis Year	2019
Intersection	S Watterson Trail	File Name	AM S Watterson Trail.xus
Project Description	AM Peak Hour	Analysis Period	1> 7:00



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	8	582	72	159	819	10	281	225	530	12	56	41

Signal Information

Cycle, s	120.7	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	1.5	5.8	40.0	1.4	14.4	19.1		
Force Mode	Fixed	Simult. Gap N/S	Off	Yellow	3.5	3.5	4.3	3.5	3.5	3.6		
				Red	3.0	3.0	1.8	3.0	3.0	2.8		

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	8.0	46.1	20.3	58.4	28.8	46.4	7.9	25.5
Change Period, (Y+R _c), s	6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4
Max Allow Headway (MAH), s	4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.9
Queue Clearance Time (g _s), s	2.6	19.2	13.3	24.2	21.9	42.0	2.9	5.4
Green Extension Time (g _e), s	0.0	2.5	0.6	3.2	0.4	0.0	0.0	0.4
Phase Call Probability	0.25	1.00	1.00	1.00	1.00	1.00	0.35	0.97
Max Out Probability	0.00	0.00	0.02	0.03	1.00	1.00	0.00	0.00

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	9	626	77	171	881	11	302	242	570	13	60	44
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1781	1610	1795	1795	1610	1795	1870	1610	1682	1856	1610
Queue Service Time (g _s), s	0.6	17.2	4.1	11.3	22.2	0.5	19.9	12.0	40.0	0.9	3.4	2.9
Cycle Queue Clearance Time (g _c), s	0.6	17.2	4.1	11.3	22.2	0.5	19.9	12.0	40.0	0.9	3.4	2.9
Green Ratio (g/C)	0.01	0.33	0.33	0.11	0.43	0.43	0.19	0.33	0.33	0.01	0.16	0.16
Capacity (c), veh/h	23	1180	534	205	1554	697	332	620	534	20	293	254
Volume-to-Capacity Ratio (X)	0.381	0.530	0.145	0.835	0.567	0.015	0.909	0.390	1.068	0.658	0.205	0.173
Back of Queue (Q), ft/ln (95 th percentile)	15.5	302.1	72.8	239.3	361.6	7.9	412	231.4	826.8	29.7	72.5	51.8
Back of Queue (Q), veh/ln (95 th percentile)	0.6	11.9	2.9	9.5	14.4	0.3	16.3	9.1	33.1	1.1	2.8	2.1
Queue Storage Ratio (RQ) (95 th percentile)	0.03	0.00	0.16	0.53	0.00	0.02	1.65	0.00	3.31	0.20	0.00	0.35
Uniform Delay (d ₁), s/veh	59.1	32.7	28.3	52.3	25.7	19.5	48.2	31.0	40.3	59.4	44.2	44.0
Incremental Delay (d ₂), s/veh	14.4	1.7	0.6	11.8	1.5	0.0	24.9	0.6	58.3	42.7	0.5	0.5
Initial Queue Delay (d ₃), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	73.5	34.4	28.9	64.2	27.2	19.6	73.1	31.5	98.6	102.0	44.7	44.4
Level of Service (LOS)	E	C	C	E	C	B	E	C	F	F	D	D
Approach Delay, s/veh / LOS	34.3		C	33.1		C	77.1		E	50.9		D
Intersection Delay, s/veh / LOS	50.4						D					

Multimodal Results

	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.12		B	2.11		B	2.44		B	2.46		B
Bicycle LOS Score / LOS	1.07		A	1.36		A	2.33		B	0.68		A

HCS7 Two-Way Stop-Control Report

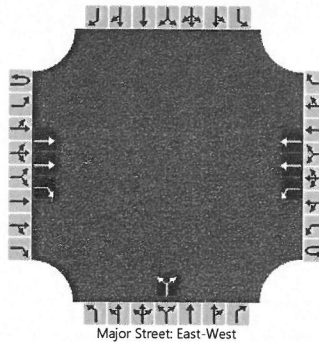
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2019
Time Analyzed	PM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			1191	14	0	20	782			6		12				
Percent Heavy Vehicles (%)					0	0				17		8				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Left + Thru								1			

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				7.14		7.06				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.67		3.38				

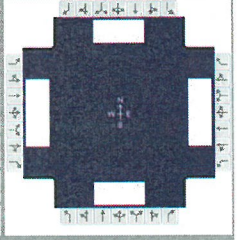
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						22					20					
Capacity, c (veh/h)						535					258					
v/c Ratio						0.04					0.08					
95% Queue Length, Q ₉₅ (veh)						0.1					0.2					
Control Delay (s/veh)						12.0					20.1					
Level of Service (LOS)						B					C					
Approach Delay (s/veh)					0.3				20.1							
Approach LOS									C							

HCS7 Signalized Intersection Results Summary

General Information

Agency		Duration, h	0.25
Analyst		Analysis Date	4/2/2019
Jurisdiction		Time Period	
Urban Street	Hurstbourne Pkwy	Analysis Year	2019
Intersection	S Watterson Trail	File Name	PM S Watterson Trail.xus
Project Description	PM Peak Hour	Analysis Period	1> 7:00



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	32	918	241	425	707	15	65	98	283	15	219	30

Signal Information

Cycle, s	117.8	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	4.1	14.4	40.0	1.6	4.4	21.3		
Force Mode	Fixed	Simult. Gap N/S	Off	Yellow	3.5	3.5	4.3	3.5	0.0	3.6		
				Red	3.0	3.0	1.8	3.0	0.0	2.8		

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	10.6	46.1	31.5	67.0	12.5	32.1	8.1	27.7
Change Period, (Y+R _c), s	6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4
Max Allow Headway (MAH), s	4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.8
Queue Clearance Time (g _s), s	4.2	31.5	27.0	17.4	6.5	23.7	3.0	15.7
Green Extension Time (g _e), s	0.1	3.4	0.0	3.0	0.2	2.0	0.0	1.1
Phase Call Probability	0.68	1.00	1.00	1.00	0.90	1.00	0.41	1.00
Max Out Probability	0.00	0.43	1.00	0.00	0.00	0.02	0.00	0.01

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	34	987	259	457	760	16	70	105	304	16	235	32
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1795	1598	1795	1781	1610	1810	1885	1598	1810	1900	1610
Queue Service Time (g _s), s	2.2	29.5	15.1	25.0	15.4	0.6	4.5	5.5	21.7	1.0	13.7	2.0
Cycle Queue Clearance Time (g _c), s	2.2	29.5	15.1	25.0	15.4	0.6	4.5	5.5	21.7	1.0	13.7	2.0
Green Ratio (g/C)	0.03	0.34	0.34	0.21	0.52	0.52	0.05	0.22	0.22	0.01	0.18	0.18
Capacity (c), veh/h	62	1219	542	381	1842	833	93	411	348	25	343	291
Volume-to-Capacity Ratio (X)	0.552	0.810	0.478	1.200	0.413	0.019	0.755	0.256	0.874	0.640	0.686	0.111
Back of Queue (Q), ft/ln (95 th percentile)	52.3	485.3	253.5	843.4	257.1	9.4	108.4	113.9	363.8	31.3	269.5	35.3
Back of Queue (Q), veh/ln (95 th percentile)	2.1	19.3	10.1	33.5	10.1	0.4	4.3	4.5	14.4	1.3	10.8	1.4
Queue Storage Ratio (RQ) (95 th percentile)	0.12	0.00	0.56	1.87	0.00	0.02	0.43	0.00	1.46	0.21	0.00	0.24
Uniform Delay (d ₁), s/veh	56.0	35.5	30.7	46.4	17.5	13.9	55.2	38.2	44.5	57.8	45.1	40.3
Incremental Delay (d ₂), s/veh	10.4	5.9	3.0	112.5	0.7	0.0	16.1	0.5	11.7	32.5	3.4	0.2
Initial Queue Delay (d ₃), s/veh	0.0	0.0	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	66.4	41.3	33.7	158.9	18.1	13.9	71.3	38.6	56.2	90.3	48.6	40.6
Level of Service (LOS)	E	D	C	F	B	B	E	D	E	F	D	D
Approach Delay, s/veh / LOS	40.5		D	70.2		E	54.5		D	50.0		D
Intersection Delay, s/veh / LOS	54.6						D					

Multimodal Results

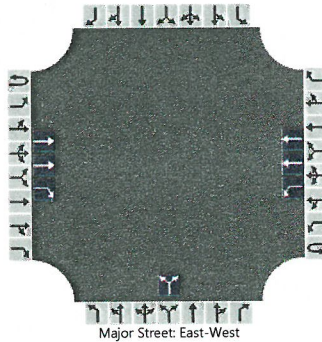
	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.12		B	2.09		B	2.45		B	2.46		B
Bicycle LOS Score / LOS	1.54		B	1.51		B	1.28		A	0.96		A

No Build Capacity Analysis

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst		Intersection	Hurstbourne Pkwy & Vassel
Agency/Co.		Jurisdiction	KYTC
Date Performed	4/2/2019	East/West Street	Hurstbourne Pkwy
Analysis Year	2022	North/South Street	Vassel Rd
Time Analyzed	AM Peak Hour	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Hurstbourne Development		

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			679	3	0	6	1204			10		23				
Percent Heavy Vehicles (%)					0	0				0		0				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Left + Thru				1							

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				6.80		6.90				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.50		3.30				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						7					36					
Capacity, c (veh/h)						875					448					
v/c Ratio						0.01					0.08					
95% Queue Length, Q ₉₅ (veh)						0.0					0.3					
Control Delay (s/veh)						9.1					13.7					
Level of Service (LOS)						A					B					
Approach Delay (s/veh)					0.0				13.7							
Approach LOS									B							

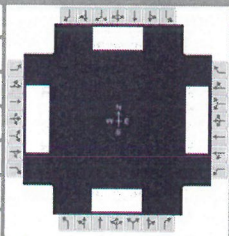
HCS7 Signalized Intersection Results Summary

General Information

Agency	
Analyst	
Jurisdiction	
Urban Street	Hurstbourne Pkwy
Intersection	S Watterson Trail
Project Description	AM Peak Hour No Build

Intersection Information

Duration, h	0.25
Area Type	Other
PHF	0.93
Analysis Period	1> 7:00



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	753	93	206	1059	13	364	291	686	16	72	53

Signal Information

Cycle, s	125.0	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	1.9	9.3	40.0	1.8	16.7	16.8		
Force Mode	Fixed	Simult. Gap N/S	Off	Yellow	3.5	3.5	4.3	3.5	3.5	3.6		
				Red	3.0	3.0	1.8	3.0	3.0	2.8		

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	8.4	46.1	24.2	61.9	31.5	46.4	8.3	23.2
Change Period, (Y+R _c), s	6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4
Max Allow Headway (MAH), s	4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.9
Queue Clearance Time (g _s), s	2.7	27.0	17.1	34.1	27.0	42.0	3.3	6.7
Green Extension Time (g _e), s	0.0	3.0	0.6	2.5	0.0	0.0	0.0	0.6
Phase Call Probability	0.31	1.00	1.00	1.00	1.00	1.00	0.45	0.99
Max Out Probability	0.00	0.08	0.20	0.65	1.00	1.00	0.00	0.00

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	11	810	100	222	1139	14	391	313	738	17	77	57
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1781	1610	1795	1795	1610	1795	1870	1610	1682	1856	1610
Queue Service Time (g _s), s	0.7	25.0	5.6	15.1	32.1	0.6	25.0	17.1	40.0	1.3	4.7	4.0
Cycle Queue Clearance Time (g _c), s	0.7	25.0	5.6	15.1	32.1	0.6	25.0	17.1	40.0	1.3	4.7	4.0
Green Ratio (g/C)	0.01	0.32	0.32	0.14	0.45	0.45	0.20	0.32	0.32	0.01	0.13	0.13
Capacity (c), veh/h	27	1140	515	254	1603	719	359	599	515	24	249	216
Volume-to-Capacity Ratio (X)	0.397	0.711	0.194	0.871	0.710	0.019	1.090	0.523	1.432	0.710	0.310	0.263
Back of Queue (Q), ft/ln (95 th percentile)	19.3	420.7	101.5	314	497.1	10.4	666	311.9	1686.2	39.4	101.8	72.9
Back of Queue (Q), veh/ln (95 th percentile)	0.8	16.6	4.1	12.5	19.7	0.4	26.4	12.3	67.4	1.5	4.0	2.9
Queue Storage Ratio (RQ) (95 th percentile)	0.04	0.00	0.23	0.70	0.00	0.02	2.66	0.00	6.74	0.26	0.00	0.49
Uniform Delay (d ₁), s/veh	61.0	37.4	30.8	52.5	28.0	19.3	50.0	34.7	42.5	61.3	48.9	48.5
Incremental Delay (d ₂), s/veh	12.8	3.8	0.8	17.3	2.7	0.0	73.8	1.1	205.2	42.3	1.0	0.9
Initial Queue Delay (d ₃), s/veh	0.0	0.0	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	73.8	41.2	31.7	69.9	30.7	19.4	123.8	35.8	247.7	103.6	49.9	49.5
Level of Service (LOS)	E	D	C	E	C	B	F	D	F	F	D	D
Approach Delay, s/veh / LOS	40.5		D	36.9		D	168.1		F	55.8		E
Intersection Delay, s/veh / LOS	87.2						F					

Multimodal Results

	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.12		B	2.11		B	2.45		B	2.46		B
Bicycle LOS Score / LOS	1.25		A	1.62		B	2.87		C	0.74		A

HCS7 Two-Way Stop-Control Report

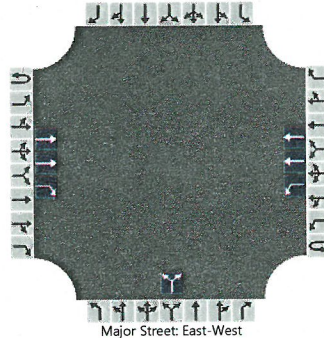
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2032
Time Analyzed	AM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			828	4	0	8	1468			12		28				
Percent Heavy Vehicles (%)					0	0				0		0				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Left + Thru				1							

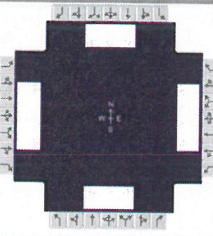
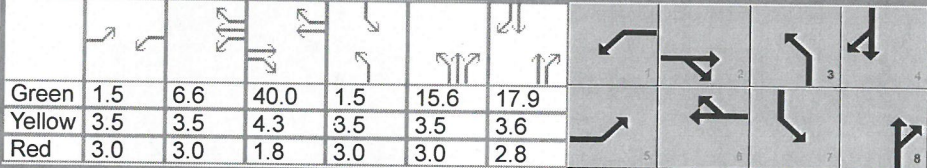
Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				6.80		6.90				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.50		3.30				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						9					43					
Capacity, c (veh/h)						760					374					
v/c Ratio						0.01					0.12					
95% Queue Length, Q ₉₅ (veh)						0.0					0.4					
Control Delay (s/veh)						9.8					15.9					
Level of Service (LOS)						A					C					
Approach Delay (s/veh)					0.1				15.9							
Approach LOS									C							

HCS7 Signalized Intersection Results Summary

General Information						Intersection Information											
Agency						Duration, h		0.25									
Analyst						Analysis Date		4/2/2019									
Jurisdiction						Time Period											
Urban Street		Hurstbourne Pkwy				Analysis Year		2019									
Intersection		S Watterson Trail				File Name		AM 2032 S Watterson Trail.xus									
Project Description		AM Peak Hour No Build															
Demand Information						EB			WB			NB			SB		
Approach Movement						L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h						8	618	76	169	869	11	298	239	562	13	59	44
Signal Information																	
Cycle, s	121.6	Reference Phase	2														
Offset, s	0	Reference Point	End														
Uncoordinated	Yes	Simult. Gap E/W	Off														
Force Mode	Fixed	Simult. Gap N/S	Off														
						Green	1.5	6.6	40.0	1.5	15.6	17.9					
						Yellow	3.5	3.5	4.3	3.5	3.5	3.6					
						Red	3.0	3.0	1.8	3.0	3.0	2.8					
Timer Results						EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase						5	2	1	6	3	8	7	4				
Case Number						2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0				
Phase Duration, s						8.0	46.1	21.1	59.2	30.1	46.4	8.0	24.3				
Change Period, (Y+R _c), s						6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4				
Max Allow Headway (MAH), s						4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.9				
Queue Clearance Time (g _s), s						2.6	20.7	14.1	26.1	23.3	42.0	3.0	5.7				
Green Extension Time (g _e), s						0.0	2.7	0.6	3.3	0.3	0.0	0.0	0.5				
Phase Call Probability						0.25	1.00	1.00	1.00	1.00	1.00	0.38	0.98				
Max Out Probability						0.00	0.01	0.03	0.07	1.00	1.00	0.00	0.00				
Movement Group Results						EB			WB			NB			SB		
Approach Movement						L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement						5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h						9	665	82	182	934	12	320	257	604	14	63	47
Adjusted Saturation Flow Rate (s), veh/h/ln						1810	1781	1610	1795	1795	1610	1795	1870	1610	1682	1856	1610
Queue Service Time (g _s), s						0.6	18.7	4.4	12.1	24.1	0.5	21.3	13.0	40.0	1.0	3.7	3.1
Cycle Queue Clearance Time (g _c), s						0.6	18.7	4.4	12.1	24.1	0.5	21.3	13.0	40.0	1.0	3.7	3.1
Green Ratio (g/C)						0.01	0.33	0.33	0.12	0.44	0.44	0.19	0.33	0.33	0.01	0.15	0.15
Capacity (c), veh/h						23	1171	530	215	1567	703	348	615	530	21	274	237
Volume-to-Capacity Ratio (X)						0.381	0.567	0.154	0.843	0.596	0.017	0.920	0.418	1.141	0.671	0.232	0.199
Back of Queue (Q), ft/ln (95 th percentile)						15.6	325.4	78	252.4	387.1	8.7	442.4	247.6	980.3	32	78.5	57
Back of Queue (Q), veh/ln (95 th percentile)						0.6	12.8	3.1	10.0	15.4	0.3	17.6	9.7	39.2	1.2	3.1	2.3
Queue Storage Ratio (RQ) (95 th percentile)						0.03	0.00	0.17	0.56	0.00	0.02	1.77	0.00	3.92	0.21	0.00	0.38
Uniform Delay (d ₁), s/veh						59.6	33.7	28.8	52.4	26.1	19.4	48.1	31.7	40.8	59.8	45.8	45.5
Incremental Delay (d ₂), s/veh						14.4	2.0	0.6	11.9	1.7	0.0	27.6	0.6	84.2	42.1	0.6	0.6
Initial Queue Delay (d ₃), s/veh						0.0	0.0	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						74.0	35.7	29.5	64.2	27.8	19.5	75.7	32.4	125.0	101.9	46.4	46.1
Level of Service (LOS)						E	D	C	E	C	B	E	C	F	F	D	D
Approach Delay, s/veh / LOS						35.4	D		33.6	C		91.5	F		52.5	D	
Intersection Delay, s/veh / LOS						56.2						E					
Multimodal Results						EB			WB			NB			SB		
Pedestrian LOS Score / LOS						2.12	B		2.11	B		2.44	B		2.46	B	
Bicycle LOS Score / LOS						1.11	A		1.42	A		2.44	B		0.69	A	

HCS7 Two-Way Stop-Control Report

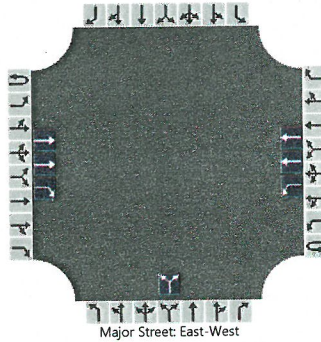
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2022
Time Analyzed	PM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			1251	15	0	21	830			6		13				
Percent Heavy Vehicles (%)					0	0				17		8				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Left + Thru								1			

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				7.14		7.06				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.67		3.38				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						23					21					
Capacity, c (veh/h)						505					245					
v/c Ratio						0.05					0.08					
95% Queue Length, Q ₉₅ (veh)						0.1					0.3					
Control Delay (s/veh)						12.5					21.1					
Level of Service (LOS)						B					C					
Approach Delay (s/veh)					0.3				21.1							
Approach LOS									C							

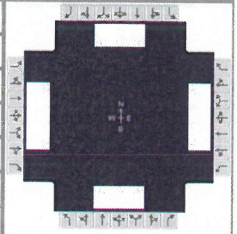
HCS7 Signalized Intersection Results Summary

General Information

Agency	
Analyst	
Jurisdiction	
Urban Street	Hurstbourne Pkwy
Intersection	S Watterson Trail
Project Description	PM Peak Hour No Build

Intersection Information

Duration, h	0.25
Area Type	Other
PHF	0.93
Analysis Period	1> 7:00
File Name	PM 2022 S Watterson Trail.xus



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	34	974	256	451	750	17	69	104	300	16	232	32

Signal Information

Cycle, s	119.6	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	4.2	14.3	40.0	1.7	4.7	22.7		
Force Mode	Fixed	Simult. Gap N/S	Off	Yellow	3.5	3.5	4.3	3.5	0.0	3.6		
				Red	3.0	3.0	1.8	3.0	0.0	2.8		

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	10.7	46.1	31.5	66.9	13.0	33.8	8.2	29.1
Change Period, (Y+R _c), s	6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4
Max Allow Headway (MAH), s	4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.8
Queue Clearance Time (g _s), s	4.4	34.8	27.0	19.2	6.8	25.3	3.1	16.7
Green Extension Time (g _e), s	0.1	2.6	0.0	3.1	0.2	2.0	0.0	1.1
Phase Call Probability	0.70	1.00	1.00	1.00	0.92	1.00	0.44	1.00
Max Out Probability	0.00	0.80	1.00	0.01	0.00	0.05	0.00	0.02

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	37	1047	275	485	806	18	74	112	323	17	249	34
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1795	1598	1795	1781	1610	1810	1885	1598	1810	1900	1610
Queue Service Time (g _s), s	2.4	32.8	16.6	25.0	17.2	0.7	4.8	5.8	23.3	1.1	14.7	2.1
Cycle Queue Clearance Time (g _c), s	2.4	32.8	16.6	25.0	17.2	0.7	4.8	5.8	23.3	1.1	14.7	2.1
Green Ratio (g/C)	0.04	0.33	0.33	0.21	0.51	0.51	0.05	0.23	0.23	0.01	0.19	0.19
Capacity (c), veh/h	64	1200	534	375	1809	818	98	432	366	26	360	305
Volume-to-Capacity Ratio (X)	0.572	0.873	0.515	1.293	0.446	0.022	0.758	0.259	0.882	0.652	0.693	0.113
Back of Queue (Q), ft/ln (95 th percentile)	56.6	544.2	275.7	997.5	283.1	11.1	115.9	121.4	390.9	33.6	286.2	37.8
Back of Queue (Q), veh/ln (95 th percentile)	2.3	21.6	10.9	39.6	11.1	0.4	4.6	4.8	15.5	1.3	11.4	1.5
Queue Storage Ratio (RQ) (95 th percentile)	0.13	0.00	0.61	2.22	0.00	0.02	0.46	0.00	1.56	0.22	0.00	0.25
Uniform Delay (d ₁), s/veh	56.8	37.4	32.0	47.3	18.7	14.6	55.8	37.8	44.6	58.6	45.2	40.2
Incremental Delay (d ₂), s/veh	11.0	8.9	3.5	150.2	0.8	0.1	15.5	0.4	13.3	32.6	3.7	0.2
Initial Queue Delay (d ₃), s/veh	0.0	0.0	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	67.8	46.3	35.5	197.5	19.5	14.7	71.3	38.3	57.8	91.3	49.0	40.4
Level of Service (LOS)	E	D	D	F	B	B	E	D	E	F	D	D
Approach Delay, s/veh / LOS	44.7	D		85.4	F		55.5	E		50.4	D	
Intersection Delay, s/veh / LOS	62.1						E					

Multimodal Results

	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.12	B		2.10	B		2.45	B		2.46	B	
Bicycle LOS Score / LOS	1.61	B		1.57	B		1.33	A		0.98	A	

HCS7 Two-Way Stop-Control Report

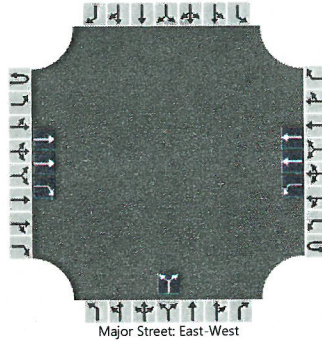
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2032
Time Analyzed	PM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			1525	18	0	26	1012			8		16				
Percent Heavy Vehicles (%)					0	0				17		8				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Left + Thru								1			

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				7.14		7.06				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.67		3.38				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						28					26					
Capacity, c (veh/h)						387					173					
v/c Ratio						0.07					0.15					
95% Queue Length, Q ₉₅ (veh)						0.2					0.5					
Control Delay (s/veh)						15.0					29.4					
Level of Service (LOS)						C					D					
Approach Delay (s/veh)					0.4				29.4							
Approach LOS									D							

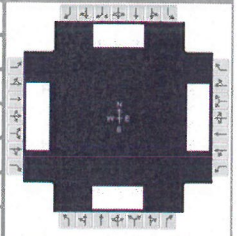
HCS7 Signalized Intersection Results Summary

General Information

Agency	
Analyst	
Jurisdiction	
Urban Street	Hurstbourne Pkwy
Intersection	S Watterson Trail
Project Description	PM Peak Hour No Build

Intersection Information

Duration, h	0.25
Area Type	Other
PHF	0.93
Analysis Period	1> 7:00
File Name	PM 2032 S Watterson Trail.xus



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	41	1188	312	550	915	21	84	127	366	19	283	39

Signal Information

Cycle, s	126.6	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	4.7	13.8	40.0	2.1	6.1	28.0		
Force Mode	Fixed	Simult. Gap N/S	Off	Yellow	3.5	3.5	4.3	3.5	0.0	3.6		
				Red	3.0	3.0	1.8	3.0	0.0	2.8		

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	11.2	46.1	31.5	66.4	14.7	40.5	8.6	34.4
Change Period, (Y+R _c), s	6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4
Max Allow Headway (MAH), s	4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.8
Queue Clearance Time (g _s), s	5.0	42.0	27.0	27.3	8.2	32.3	3.4	20.8
Green Extension Time (g _e), s	0.1	0.0	0.0	3.4	0.3	1.8	0.0	1.1
Phase Call Probability	0.79	1.00	1.00	1.00	0.96	1.00	0.51	1.00
Max Out Probability	0.00	1.00	1.00	0.11	0.00	0.49	0.00	0.17

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	44	1277	335	591	984	23	90	137	394	20	304	42
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1795	1598	1795	1781	1610	1810	1885	1598	1810	1900	1610
Queue Service Time (g _s), s	3.0	40.0	23.0	25.0	25.3	0.9	6.2	7.2	30.3	1.4	18.8	2.6
Cycle Queue Clearance Time (g _c), s	3.0	40.0	23.0	25.0	25.3	0.9	6.2	7.2	30.3	1.4	18.8	2.6
Green Ratio (g/C)	0.04	0.32	0.32	0.20	0.48	0.48	0.06	0.27	0.27	0.02	0.22	0.22
Capacity (c), veh/h	68	1134	505	354	1695	766	117	507	430	29	420	356
Volume-to-Capacity Ratio (X)	0.652	1.127	0.665	1.669	0.581	0.029	0.775	0.269	0.915	0.697	0.725	0.118
Back of Queue (Q), ft/ln (95 th percentile)	73.5	991.4	371.8	1624.5	399.8	16	146.3	150.4	507.5	41.5	358.3	47.1
Back of Queue (Q), veh/ln (95 th percentile)	2.9	39.3	14.8	64.5	15.7	0.6	5.9	6.0	20.1	1.7	14.3	1.9
Queue Storage Ratio (RQ) (95 th percentile)	0.16	0.00	0.83	3.61	0.00	0.04	0.59	0.00	2.03	0.28	0.00	0.31
Uniform Delay (d ₁), s/veh	60.1	43.3	37.5	50.8	24.0	17.6	58.3	36.5	44.9	62.0	45.8	39.5
Incremental Delay (d ₂), s/veh	14.1	68.7	6.8	313.0	1.5	0.1	14.3	0.4	20.5	34.7	5.9	0.2
Initial Queue Delay (d ₃), s/veh	0.0	0.0	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	74.3	112.1	44.3	363.9	25.5	17.7	72.6	36.9	65.3	96.6	51.7	39.7
Level of Service (LOS)	E	F	D	F	C	B	E	D	E	F	D	D
Approach Delay, s/veh / LOS	97.3	F		150.6	F		60.1	E		52.8	D	
Intersection Delay, s/veh / LOS	108.1						F					

Multimodal Results

	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.12	B		2.10	B		2.45	B		2.46	B	
Bicycle LOS Score / LOS	1.85	B		1.81	B		1.51	B		1.09	A	

Build Capacity Analysis

HCS7 Two-Way Stop-Control Report

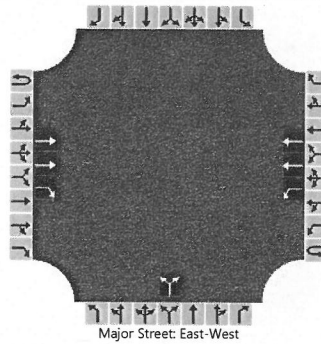
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2022
Time Analyzed	AM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			725	3	0	6	1250			10		23				
Percent Heavy Vehicles (%)					0	0				0		0				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				6.80		6.90				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.50		3.30				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						7					36					
Capacity, c (veh/h)						838					269					
v/c Ratio						0.01					0.13					
95% Queue Length, Q ₉₅ (veh)						0.0					0.5					
Control Delay (s/veh)						9.3					20.4					
Level of Service (LOS)						A					C					
Approach Delay (s/veh)					0.0				20.4							
Approach LOS									C							

HCS7 Two-Way Stop-Control Report

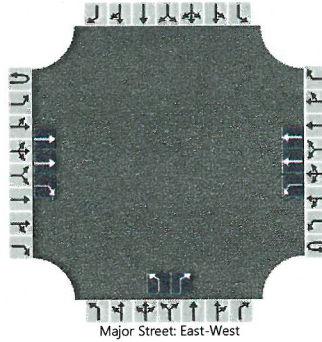
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2022
Time Analyzed	AM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Pkwy Development

Site Information

Intersection	Hurstbourne & Proposed En
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Proposed Entrance
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			678	70	0	109	1166			86		123				
Percent Heavy Vehicles (%)					3	3				3		3				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No								No							
Median Type Storage					Left + Thru				1							

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.16				6.86		6.96				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						118				93		134				
Capacity, c (veh/h)						803				201		626				
v/c Ratio						0.15				0.46		0.21				
95% Queue Length, Q ₉₅ (veh)						0.5				2.2		0.8				
Control Delay (s/veh)						10.3				37.5		12.3				
Level of Service (LOS)						B				E		B				
Approach Delay (s/veh)					0.9				22.7							
Approach LOS									C							

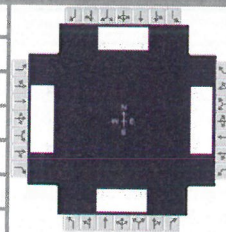
HCS7 Signalized Intersection Results Summary

General Information

Agency	
Analyst	
Jurisdiction	
Urban Street	Hurstbourne Pkwy
Intersection	S Watterson Trail
Project Description	AM Peak Hour Build

Intersection Information

Duration, h	0.25
Area Type	Other
PHF	0.93
Analysis Period	1> 7:00
File Name	2022 AM S Watterson Trail.xus



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	702	93	169	923	11	307	239	562	13	59	46

Signal Information

Cycle, s	121.6	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	Off	Green	1.8	6.3	40.0	1.5	16.1	17.4		
Force Mode	Fixed	Simult. Gap N/S	Off	Yellow	3.5	3.5	4.3	3.5	3.5	3.6		
				Red	3.0	3.0	1.8	3.0	3.0	2.8		

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	8.3	46.1	21.1	58.9	30.6	46.4	8.0	23.8
Change Period, (Y+R _c), s	6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4
Max Allow Headway (MAH), s	4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.9
Queue Clearance Time (g _s), s	2.7	23.9	14.1	28.3	24.0	42.0	3.0	5.7
Green Extension Time (g _e), s	0.0	3.0	0.6	3.3	0.2	0.0	0.0	0.5
Phase Call Probability	0.30	1.00	1.00	1.00	1.00	1.00	0.38	0.98
Max Out Probability	0.00	0.03	0.03	0.14	1.00	1.00	0.00	0.00

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	11	755	100	182	992	12	330	257	604	14	63	49
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1781	1610	1795	1795	1610	1795	1870	1610	1682	1856	1610
Queue Service Time (g _s), s	0.7	21.9	5.4	12.1	26.3	0.5	22.0	13.0	40.0	1.0	3.7	3.3
Cycle Queue Clearance Time (g _c), s	0.7	21.9	5.4	12.1	26.3	0.5	22.0	13.0	40.0	1.0	3.7	3.3
Green Ratio (g/C)	0.02	0.33	0.33	0.12	0.43	0.43	0.20	0.33	0.33	0.01	0.14	0.14
Capacity (c), veh/h	27	1171	530	215	1557	699	356	615	530	21	265	230
Volume-to-Capacity Ratio (X)	0.395	0.644	0.189	0.843	0.637	0.017	0.926	0.418	1.141	0.671	0.239	0.215
Back of Queue (Q), ft/ln (50 th percentile)	10.4	243.8	53.8	151.2	279.8	4.8	311.5	147.3	686.5	17.8	43.9	33.4
Back of Queue (Q), veh/ln (50 th percentile)	0.4	9.6	2.2	6.0	11.1	0.2	12.4	5.8	27.5	0.7	1.7	1.3
Queue Storage Ratio (RQ) (50 th percentile)	0.02	0.00	0.12	0.34	0.00	0.01	1.25	0.00	2.75	0.12	0.00	0.22
Uniform Delay (d ₁), s/veh	59.3	34.7	29.2	52.4	26.9	19.6	47.9	31.7	40.8	59.8	46.3	46.1
Incremental Delay (d ₂), s/veh	12.7	2.7	0.8	11.9	2.0	0.0	28.9	0.6	84.2	42.1	0.7	0.7
Initial Queue Delay (d ₃), s/veh	0.0	0.0	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	72.0	37.5	30.0	64.2	28.9	19.7	76.7	32.4	125.0	101.9	46.9	46.8
Level of Service (LOS)	E	D	C	E	C	B	E	C	F	F	D	D
Approach Delay, s/veh / LOS	37.0	D		34.3	C		91.6	F		52.9	D	
Intersection Delay, s/veh / LOS	56.0						E					

Multimodal Results

	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	2.12	B		2.11	B		2.44	B		2.46	B	
Bicycle LOS Score / LOS	1.20	A		1.47	A		2.45	B		0.70	A	

HCS7 Two-Way Stop-Control Report

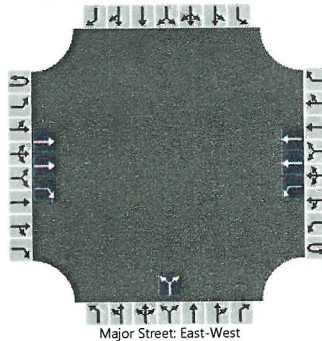
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2032
Time Analyzed	AM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			874	4	0	8	1514			12		28				
Percent Heavy Vehicles (%)					0	0				0		0				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Undivided											

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				6.80		6.90				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.50		3.30				

Delay, Queue Length, and Level of Service

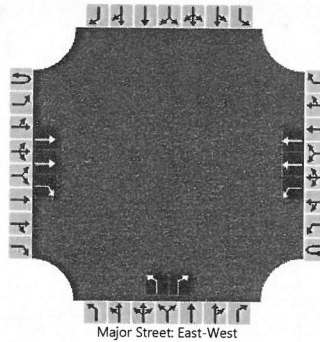
Flow Rate, v (veh/h)						9					43					
Capacity, c (veh/h)						728					185					
v/c Ratio						0.01					0.24					
95% Queue Length, Q ₉₅ (veh)						0.0					0.9					
Control Delay (s/veh)						10.0					30.3					
Level of Service (LOS)						B					D					
Approach Delay (s/veh)					0.1				30.3							
Approach LOS									D							

HCS7 Two-Way Stop-Control Report

General Information

Analyst		Intersection	Hurstbourne & Proposed En
Agency/Co.		Jurisdiction	KYTC
Date Performed	4/2/2019	East/West Street	Hurstbourne Pkwy
Analysis Year	2032	North/South Street	Proposed Entrance
Time Analyzed	AM Peak Hour	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Hurstbourne Pkwy Development		

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			832	70	0	109	1431			86		123				
Percent Heavy Vehicles (%)					3	3				3		3				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No								No							
Median Type Storage					Left + Thru								1			

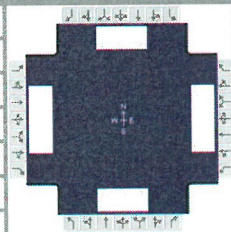
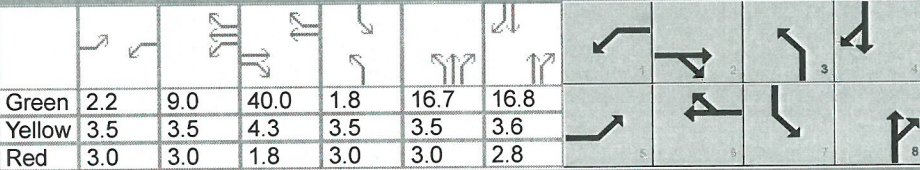
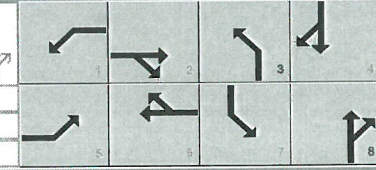
Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.16				6.86		6.96				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						118				93		134				
Capacity, c (veh/h)						694				157		552				
v/c Ratio						0.17				0.60		0.24				
95% Queue Length, Q ₉₅ (veh)						0.6				3.2		0.9				
Control Delay (s/veh)						11.3				57.1		13.6				
Level of Service (LOS)						B				F		B				
Approach Delay (s/veh)					0.8				31.5							
Approach LOS									D							

HCS7 Signalized Intersection Results Summary

General Information						Intersection Information										
Agency						Duration, h		0.25								
Analyst				Analysis Date		4/2/2019		Area Type		Other						
Jurisdiction				Time Period				PHF		0.93						
Urban Street		Hurstbourne Pkwy		Analysis Year		2019		Analysis Period		1> 7:00						
Intersection		S Watterson Trail		File Name		2032 AM S Watterson Trail.xus										
Project Description		AM Peak Hour Build														
Demand Information				EB			WB			NB			SB			
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R	
Demand (v), veh/h				12	837	109	206	1113	13	372	291	686	16	72	55	
Signal Information																
Cycle, s	125.0	Reference Phase	2													
Offset, s	0	Reference Point	End													
Uncoordinated	Yes	Simult. Gap E/W	Off													
Force Mode	Fixed	Simult. Gap N/S	Off													
				Green	2.2	9.0	40.0	1.8	16.7	16.8						
				Yellow	3.5	3.5	4.3	3.5	3.5	3.6						
				Red	3.0	3.0	1.8	3.0	3.0	2.8						
Timer Results				EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT					
Assigned Phase				5	2	1	6	3	8	7	4					
Case Number				2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0					
Phase Duration, s				8.7	46.1	24.2	61.6	31.5	46.4	8.3	23.2					
Change Period, (Y+R c), s				6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4					
Max Allow Headway (MAH), s				4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.9					
Queue Clearance Time (g s), s				2.9	30.7	17.1	36.7	27.0	42.0	3.3	6.7					
Green Extension Time (g e), s				0.0	2.9	0.6	1.7	0.0	0.0	0.0	0.6					
Phase Call Probability				0.36	1.00	1.00	1.00	1.00	1.00	0.45	0.99					
Max Out Probability				0.00	0.27	0.20	1.00	1.00	1.00	0.00	0.00					
Movement Group Results				EB			WB			NB			SB			
Approach Movement				L	T	R	L	T	R	L	T	R	L	T	R	
Assigned Movement				5	2	12	1	6	16	3	8	18	7	4	14	
Adjusted Flow Rate (v), veh/h				13	900	117	222	1197	14	400	313	738	17	77	59	
Adjusted Saturation Flow Rate (s), veh/h/ln				1810	1781	1610	1795	1795	1610	1795	1870	1610	1682	1856	1610	
Queue Service Time (g s), s				0.9	28.7	6.7	15.1	34.7	0.6	25.0	17.1	40.0	1.3	4.7	4.1	
Cycle Queue Clearance Time (g c), s				0.9	28.7	6.7	15.1	34.7	0.6	25.0	17.1	40.0	1.3	4.7	4.1	
Green Ratio (g/C)				0.02	0.32	0.32	0.14	0.44	0.44	0.20	0.32	0.32	0.01	0.13	0.13	
Capacity (c), veh/h				31	1140	515	254	1595	715	359	599	515	24	249	216	
Volume-to-Capacity Ratio (X)				0.411	0.790	0.227	0.871	0.751	0.020	1.114	0.523	1.432	0.710	0.310	0.273	
Back of Queue (Q), ft/ln (50 th percentile)				12.5	329.2	67	198.1	374.5	5.8	479.9	196.1	1113.8	21.9	56.5	42.1	
Back of Queue (Q), veh/ln (50 th percentile)				0.5	13.0	2.7	7.9	14.9	0.2	19.0	7.7	44.6	0.8	2.2	1.7	
Queue Storage Ratio (RQ) (50 th percentile)				0.03	0.00	0.15	0.44	0.00	0.01	1.92	0.00	4.46	0.15	0.00	0.28	
Uniform Delay (d 1), s/veh				60.8	38.7	31.2	52.5	29.0	19.5	50.0	34.7	42.5	61.3	48.9	48.6	
Incremental Delay (d 2), s/veh				11.8	5.6	1.0	17.3	3.3	0.1	81.9	1.1	205.2	42.3	1.0	1.0	
Initial Queue Delay (d 3), s/veh				0.0	0.0	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				72.6	44.3	32.2	69.9	32.3	19.5	131.9	35.8	247.7	103.6	49.9	49.6	
Level of Service (LOS)				E	D	C	E	C	B	F	D	F	F	D	D	
Approach Delay, s/veh / LOS				43.3		D	38.0		D	170.1		F	55.8		E	
Intersection Delay, s/veh / LOS				87.1						F						
Multimodal Results				EB			WB			NB			SB			
Pedestrian LOS Score / LOS				2.12		B	2.11		B	2.45		B	2.46		B	
Bicycle LOS Score / LOS				1.34		A	1.67		B	2.88		C	0.74		A	

HCS7 Two-Way Stop-Control Report

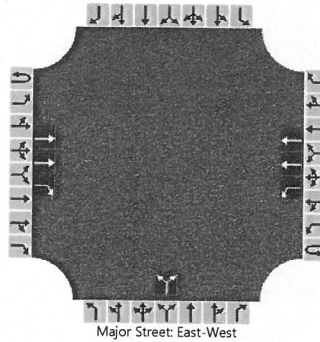
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2032
Time Analyzed	PM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			1331	15	0	21	877			6		13				
Percent Heavy Vehicles (%)					0	0				17		8				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Left + Thru				1							

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				7.14		7.06				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.67		3.38				

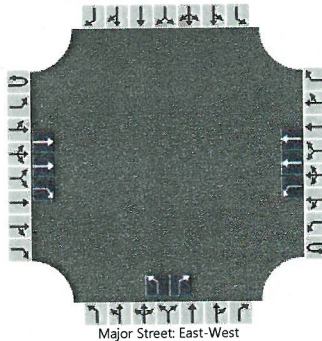
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						23					21					
Capacity, c (veh/h)						468					223					
v/c Ratio						0.05					0.09					
95% Queue Length, Q ₉₅ (veh)						0.2					0.3					
Control Delay (s/veh)						13.1					22.8					
Level of Service (LOS)						B					C					
Approach Delay (s/veh)					0.3				22.8							
Approach LOS									C							

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst		Intersection	Hurstbourne & Proposed En
Agency/Co.		Jurisdiction	KYTC
Date Performed	4/2/2019	East/West Street	Hurstbourne Pkwy
Analysis Year	2022	North/South Street	Proposed Entrance
Time Analyzed	PM Peak Hour	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Hurstbourne Pkwy Development		

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			1219	125	0	144	818			78		146				
Percent Heavy Vehicles (%)					3	3				3		3				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No								No							
Median Type Storage					Left + Thru				1							

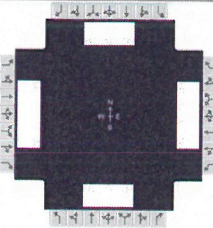
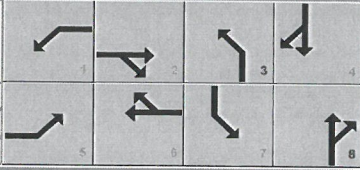
Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.16				6.86		6.96				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						157				85		159				
Capacity, c (veh/h)						454				122		402				
v/c Ratio						0.35				0.69		0.40				
95% Queue Length, Q ₉₅ (veh)						1.5				3.8		1.8				
Control Delay (s/veh)						17.1				83.5		19.7				
Level of Service (LOS)						C				F		C				
Approach Delay (s/veh)					2.6				41.9							
Approach LOS									E							

HCS7 Signalized Intersection Results Summary

General Information						Intersection Information											
Agency						Duration, h		0.25									
Analyst						Analysis Date		4/2/2019									
Jurisdiction						Time Period											
Urban Street		Hurstbourne Pkwy				Analysis Year		2019									
Intersection		S Watterson Trail				File Name		2022 PM S Watterson Trail.xus									
Project Description		PM Peak Hour Build															
Demand Information						EB			WB			NB			SB		
Approach Movement						L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h						35	1061	273	451	844	17	84	104	300	16	232	36
Signal Information																	
Cycle, s	119.6	Reference Phase	2														
Offset, s	0	Reference Point	End														
Uncoordinated	Yes	Simult. Gap E/W	Off														
Force Mode	Fixed	Simult. Gap N/S	Off														
						Green	4.3	14.2	40.0	1.7	6.0	21.4					
						Yellow	3.5	3.5	4.3	3.5	0.0	3.6					
						Red	3.0	3.0	1.8	3.0	0.0	2.8					
Timer Results						EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT				
Assigned Phase						5	2	1	6	3	8	7	4				
Case Number						2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0				
Phase Duration, s						10.8	46.1	31.5	66.8	14.3	33.8	8.2	27.8				
Change Period, (Y+R _c), s						6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4				
Max Allow Headway (MAH), s						4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.8				
Queue Clearance Time (g _s), s						4.4	39.1	27.0	22.1	7.9	25.3	3.1	16.9				
Green Extension Time (g _e), s						0.1	0.6	0.0	3.5	0.3	2.0	0.0	1.1				
Phase Call Probability						0.71	1.00	1.00	1.00	0.95	1.00	0.44	1.00				
Max Out Probability						0.00	1.00	1.00	0.02	0.00	0.05	0.00	0.02				
Movement Group Results						EB			WB			NB			SB		
Approach Movement						L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement						5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h						38	1141	294	485	908	18	90	112	323	17	249	39
Adjusted Saturation Flow Rate (s), veh/h/ln						1810	1795	1598	1795	1781	1610	1810	1885	1598	1810	1900	1610
Queue Service Time (g _s), s						2.4	37.1	17.9	25.0	20.1	0.7	5.9	5.8	23.3	1.1	14.9	2.4
Cycle Queue Clearance Time (g _c), s						2.4	37.1	17.9	25.0	20.1	0.7	5.9	5.8	23.3	1.1	14.9	2.4
Green Ratio (g/C)						0.04	0.33	0.33	0.21	0.51	0.51	0.06	0.23	0.23	0.01	0.18	0.18
Capacity (c), veh/h						65	1200	534	375	1807	817	117	432	366	26	339	288
Volume-to-Capacity Ratio (X)						0.581	0.951	0.550	1.293	0.502	0.022	0.769	0.259	0.882	0.652	0.735	0.135
Back of Queue (Q), ft/ln (50 th percentile)						32.4	460.4	183.2	666.1	204.6	6.2	76.7	67.4	258.6	18.6	181.6	24.1
Back of Queue (Q), veh/ln (50 th percentile)						1.3	18.3	7.3	26.4	8.1	0.2	3.1	2.7	10.3	0.7	7.3	1.0
Queue Storage Ratio (RQ) (50 th percentile)						0.07	0.00	0.41	1.48	0.00	0.01	0.31	0.00	1.03	0.12	0.00	0.16
Uniform Delay (d ₁), s/veh						56.8	38.9	32.5	47.3	19.5	14.7	55.1	37.8	44.6	58.6	46.5	41.4
Incremental Delay (d ₂), s/veh						11.2	16.5	4.0	150.2	1.0	0.1	13.9	0.4	13.3	32.6	4.8	0.3
Initial Queue Delay (d ₃), s/veh						0.0	0.0	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						68.0	55.4	36.5	197.5	20.5	14.7	68.9	38.3	57.8	91.3	51.3	41.7
Level of Service (LOS)						E	E	D	F	C	B	E	D	E	F	D	D
Approach Delay, s/veh / LOS						52.0	D		81.3	F		55.6	E		52.3	D	
Intersection Delay, s/veh / LOS						63.6						E					
Multimodal Results						EB			WB			NB			SB		
Pedestrian LOS Score / LOS						2.12	B		2.10	B		2.45	B		2.46	B	
Bicycle LOS Score / LOS						1.70	B		1.65	B		1.35	A		0.99	A	

HCS7 Two-Way Stop-Control Report

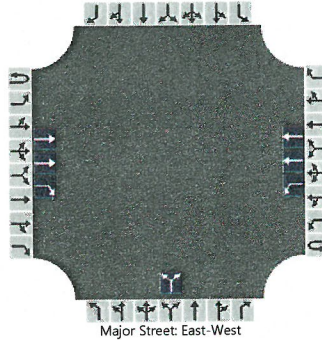
General Information

Analyst	
Agency/Co.	
Date Performed	4/2/2019
Analysis Year	2032
Time Analyzed	PM Peak Hour
Intersection Orientation	East-West
Project Description	Hurstbourne Development

Site Information

Intersection	Hurstbourne Pkwy & Vassel
Jurisdiction	KYTC
East/West Street	Hurstbourne Pkwy
North/South Street	Vassel Rd
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		0	1	0		0	0	0
Configuration			T	R		L	T				LR					
Volume (veh/h)			1605	18	0	26	1059			8		16				
Percent Heavy Vehicles (%)					0	0				17		8				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No															
Median Type Storage					Left + Thru								1			

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.10				7.14		7.06				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.20				3.67		3.38				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						28					26					
Capacity, c (veh/h)						359					158					
v/c Ratio						0.08					0.17					
95% Queue Length, Q ₉₅ (veh)						0.3					0.6					
Control Delay (s/veh)						15.9					32.3					
Level of Service (LOS)						C					D					
Approach Delay (s/veh)					0.4				32.3							
Approach LOS									D							

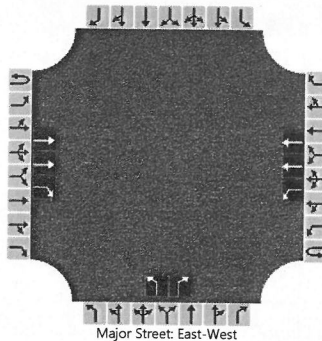
HCS7 Two-Way Stop-Control Report

General Information

Site Information

Analyst		Intersection	Hurstbourne & Proposed En
Agency/Co.		Jurisdiction	KYTC
Date Performed	4/2/2019	East/West Street	Hurstbourne Pkwy
Analysis Year	2032	North/South Street	Proposed Entrance
Time Analyzed	PM Peak Hour	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	Hurstbourne Pkwy Development		

Lanes



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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	1	0	1	2	0		1	0	1		0	0	0
Configuration			T	R		L	T			L		R				
Volume (veh/h)			1496	125	0	144	1004			78		146				
Percent Heavy Vehicles (%)					3	3				3		3				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized	No								No							
Median Type Storage	Left + Thru								1							

Critical and Follow-up Headways

Base Critical Headway (sec)						4.1				7.5		6.9				
Critical Headway (sec)						4.16				6.86		6.96				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.23				3.53		3.33				

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						157				85		159				
Capacity, c (veh/h)						346				83		319				
v/c Ratio						0.45				1.02		0.50				
95% Queue Length, Q ₉₅ (veh)						2.3				5.7		2.6				
Control Delay (s/veh)						23.7				194.1		26.9				
Level of Service (LOS)						C				F		D				
Approach Delay (s/veh)					3.0				85.1							
Approach LOS									F							

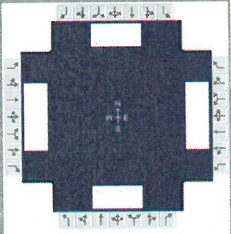
HCS7 Signalized Intersection Results Summary

General Information

Agency	
Analyst	
Jurisdiction	
Urban Street	Hurstbourne Pkwy
Intersection	S Watterson Trail
Project Description	PM Peak Hour Build

Intersection Information

Duration, h	0.25
Area Type	Other
PHF	0.93
Analysis Period	1> 7:00



Demand Information

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	43	1275	329	550	1008	21	99	127	366	19	283	43

Signal Information

Cycle, s	126.6	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off

Timer Results

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	11.3	46.1	31.5	66.3	15.9	40.5	8.6	33.1
Change Period, (Y+R _c), s	6.5	6.1	6.5	6.1	6.5	6.4	6.5	6.4
Max Allow Headway (MAH), s	4.9	3.8	4.9	3.8	4.9	5.0	4.9	4.8
Queue Clearance Time (g _s), s	5.2	42.0	27.0	31.1	9.3	32.3	3.4	21.1
Green Extension Time (g _e), s	0.2	0.0	0.0	3.2	0.3	1.8	0.0	1.1
Phase Call Probability	0.80	1.00	1.00	1.00	0.98	1.00	0.51	1.00
Max Out Probability	0.00	1.00	1.00	0.32	0.00	0.49	0.00	0.20

Movement Group Results

	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	46	1371	354	591	1084	23	106	137	394	20	304	46
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1795	1598	1795	1781	1610	1810	1885	1598	1810	1900	1610
Queue Service Time (g _s), s	3.2	40.0	24.6	25.0	29.1	0.9	7.3	7.2	30.3	1.4	19.1	3.0
Cycle Queue Clearance Time (g _c), s	3.2	40.0	24.6	25.0	29.1	0.9	7.3	7.2	30.3	1.4	19.1	3.0
Green Ratio (g/C)	0.04	0.32	0.32	0.20	0.48	0.48	0.07	0.27	0.27	0.02	0.21	0.21
Capacity (c), veh/h	69	1134	505	354	1692	765	135	507	430	29	400	339
Volume-to-Capacity Ratio (X)	0.671	1.209	0.701	1.669	0.640	0.030	0.789	0.269	0.915	0.697	0.760	0.136
Back of Queue (Q), ft/ln (50 th percentile)	43	835.2	262.8	1051.1	305.6	8.9	94.5	83.5	352.9	23.1	239.6	29.4
Back of Queue (Q), veh/ln (50 th percentile)	1.7	33.1	10.4	41.7	12.0	0.4	3.8	3.3	14.0	0.9	9.6	1.2
Queue Storage Ratio (RQ) (50 th percentile)	0.10	0.00	0.58	2.34	0.00	0.02	0.38	0.00	1.41	0.15	0.00	0.20
Uniform Delay (d ₁), s/veh	60.1	43.3	38.1	50.8	25.1	17.7	57.6	36.5	44.9	62.0	47.0	40.6
Incremental Delay (d ₂), s/veh	14.9	102.6	7.9	313.0	1.9	0.1	13.4	0.4	20.5	34.7	7.3	0.3
Initial Queue Delay (d ₃), s/veh	0.0	0.0	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	75.0	145.9	46.0	363.9	26.9	17.8	71.0	36.9	65.3	96.6	54.3	40.9
Level of Service (LOS)	E	F	D	F	C	B	E	D	E	F	D	D
Approach Delay, s/veh / LOS	124.1	F		144.2	F		60.2	E		55.0	D	
Intersection Delay, s/veh / LOS	116.9						F					

Multimodal Results

	EB	WB	NB	SB
Pedestrian LOS Score / LOS	2.10	B	2.45	B
Bicycle LOS Score / LOS	1.95	B	1.54	A