

March 11, 2021

Mr. Mike Conger, P.E.  
Transportation Engineer  
Knoxville-Knox County Planning  
City/County Building, Suite 403  
400 Main Street  
Knoxville, TN 37902

RE: Left-Turn Lane Evaluation for Proposed Subdivision on Murphy Road  
Knox County, Tennessee

Dear Mr. Conger:

This correspondence provides a summary of a traffic evaluation that was performed for a proposed 66-unit single family subdivision that is proposed for Murphy Road, in east Knox County. It is to be constructed across Murphy Road from the existing Shannon Valley Farms subdivision and immediately to the south of the Pebblestone townhomes development. FIGURE 1 is a Site Location map that shows the proposed project site in relation to major roadways in the area.

The purpose of this evaluation was to assess the anticipated traffic impacts resulting from the additional traffic that will result from the proposed development. Primary emphasis is given to the need for a left-turn lane on Murphy Road at the project site entrance.

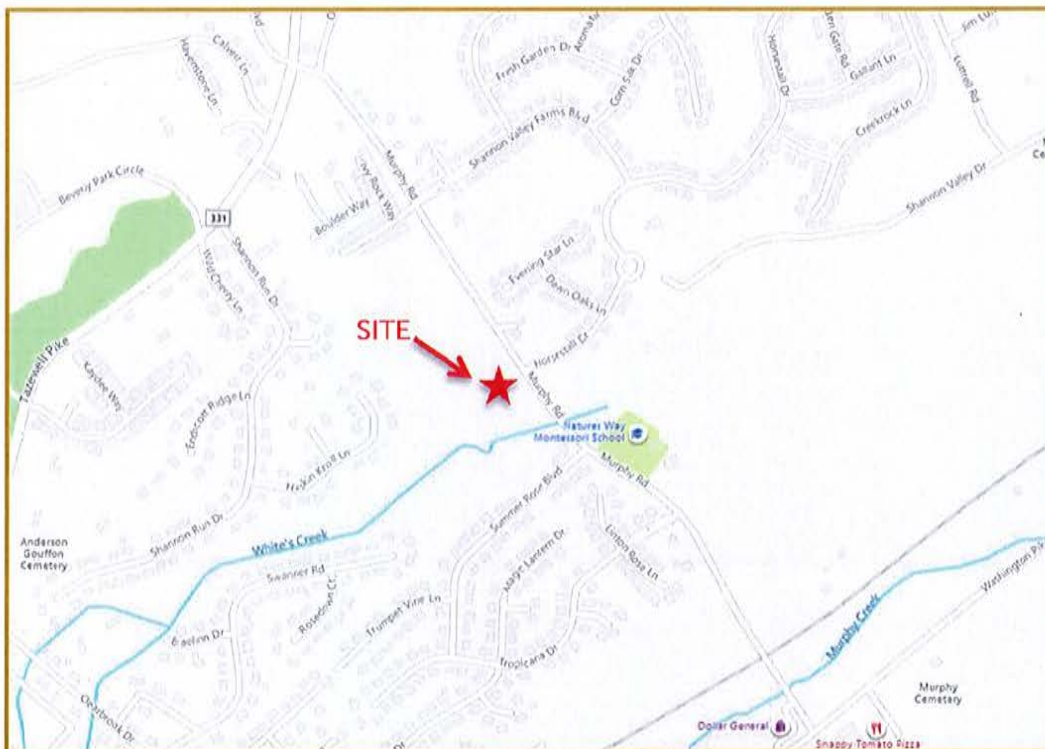


FIGURE 1 - LOCATION MAP

Existing and Background Traffic Volumes

Existing peak hour turning movement traffic counts were conducted at the study intersection specifically for this study on Tuesday, February 23, 2021. In addition, annual average daily traffic (AADT) history data was obtained from the Tennessee Department of Transportation (TDOT) for a nearby count station (No. 462) located on Murphy Road south of the project site. Two sheets summarizing the collected peak hour traffic data are contained in the attached SUPPLEMENTAL INFORMATION, as is a sheet summarizing TDOT AADT data for count station No. 462.

For purposes of evaluation, it was assumed that this project will reach full build-out in year 2024. Therefore, year 2024 was established as the primary evaluation year for this study. As a first step in evaluating future conditions, a 3.0% annual growth rate, determined from the historical TDOT AADT data, was applied to the existing traffic volumes to grow them from 2021 to a 2024 basis. These are the volumes that would be expected to exist in 2024 if the proposed development does not take place. FIGURE 2 contains the existing (2024) volumes and background (2024) traffic projected for the study intersection.

Future Traffic Volumes

In order to evaluate likely traffic conditions with the proposed development, trip generation using the methods and data published by the Institute of Transportation Engineers (ITE) was utilized. Specifically, trip generation rates for ITE Land Use Code 210 (Single-Family Detached Housing) were employed to develop estimates of the traffic generated by the proposed development. See TABLE 1 for a summary of the traffic generated for this development at full build-out and operation. FIGURE 2 shows these trips distributed to the study intersection with the same directional orientation as a nearby existing subdivision entrance (Horsestall Drive). Printouts of the current *ITE Trip Generation Manual* rates for Land Use Code 210 are also contained in the attached SUPPLEMENTAL INFORMATION.

TABLE 1: TRIP GENERATION SUMMARY

LAND USE	ITE CODE	SIZE	WEEKDAY (TRIPS/DAY)	AM PEAK HOUR (TRIPS/HOUR)	PM PEAK HOUR (TRIPS/HOUR)
Single-Family Detached Housing	210	66 units	710	52	68
Entering Trips			355 (50%)	13 (25%)	43 (63%)
Exiting Trips			355 (50%)	39 (75%)	25 (37%)

The future anticipated traffic volumes are shown at the bottom of FIGURE 2, which are the 2024 Combined Traffic volumes. These volumes include existing traffic, background growth traffic and new traffic generated by the proposed project. This traffic was then evaluated to see if the additional site related traffic results in the need for a left-turn lane for the 2024 analysis year.

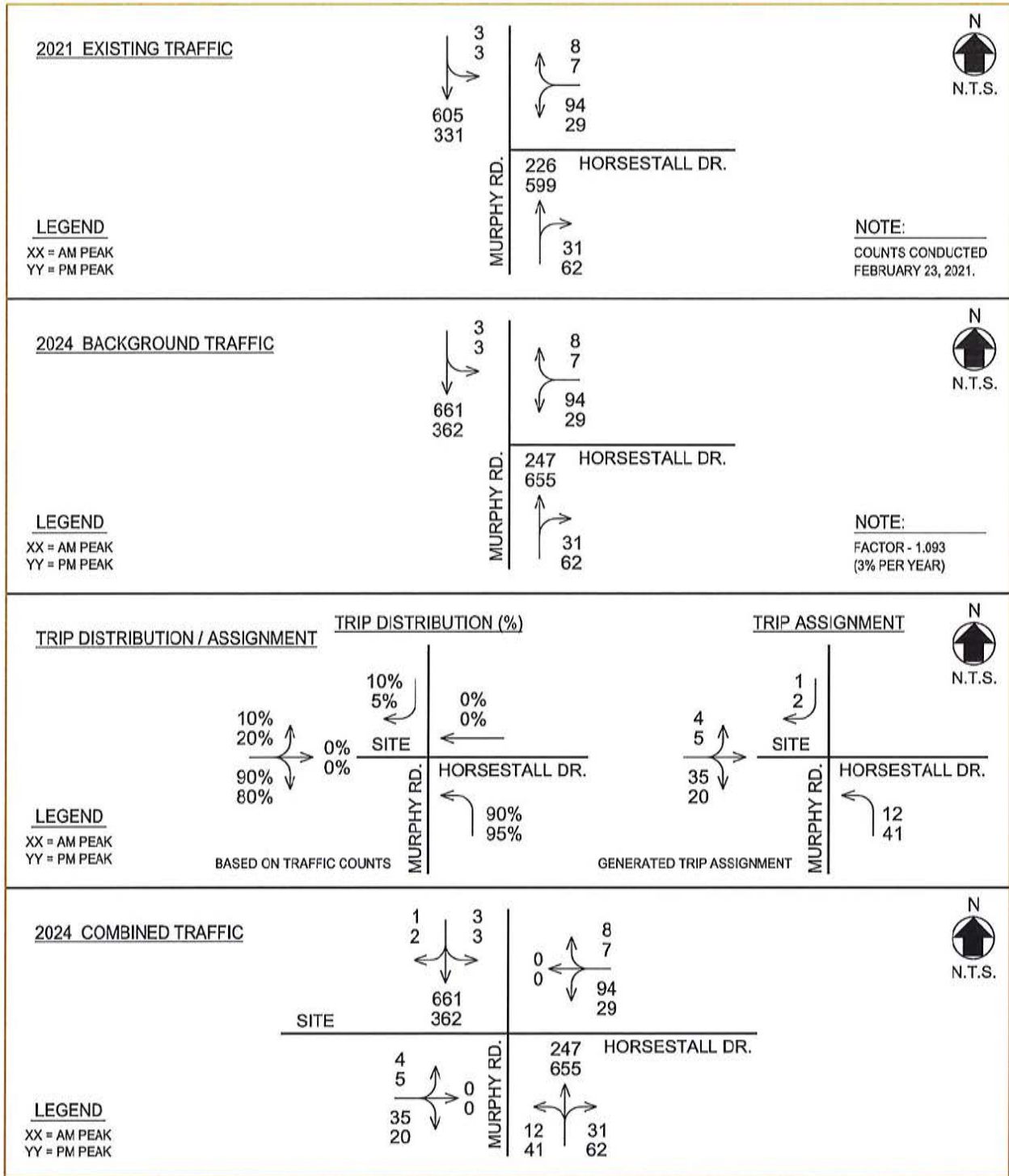


FIGURE 2  
EXISTING VOLUMES (2021), BACKGROUND VOLUMES (2024), TRIP DISTRIBUTION /  
ASSIGNMENT, & COMBINED VOLUMES (2024)



Left-Turn Lane Requirements

Table 5A from the Knox County *Access Control and Driveway Design Policy* was used to determine whether or not a left-turn lane will be warranted for the site access intersection. This table, which is provided in the attached SUPPLEMENTAL INFORMATION, indicates that a left-turn lane will indeed be warranted, especially for PM peak hour traffic conditions.

Regarding the required storage length for the proposed left-turn lane, intersection capacity analyses were performed using the methods of the Highway Capacity Manual, which among other things provides estimates of queue length. Using the "95% Queue Length" values, the results show less than one vehicle in the queue for both AM and PM peak periods. In addition, there is potential for property behind the proposed subdivision to be developed in the future. Therefore, capacity analyses were also performed assuming up to 125 units, which also indicated "95% Queue Length" values of less than one vehicle in the queue. The capacity summary sheets for these analyses are provided in the attached SUPPLEMENTAL INFORMATION.

Recommendations

In accordance with the results in the preceding section, it is recommended that a left-turn lane be provided for the proposed site access intersection. The storage length for this lane is recommended to be 75 feet, which is a well-accepted minimum value. As noted in the preceding section, this storage length will be adequate for both the initial development, as well as a possible expansion to 125 units. Regarding the widening for the turn lane, it is recommended that this be accomplished by adding six feet of pavement to each side of the roadway, with approach/departure tapers based on a design speed of 40 mph, yielding lengths of 160 feet.

Please do not hesitate to contact us with any questions you may have or if you require additional information.

Sincerely,



Alan L. Childers, P.E.  
Senior Transportation Engineer

cc: Project File: 00773-0015



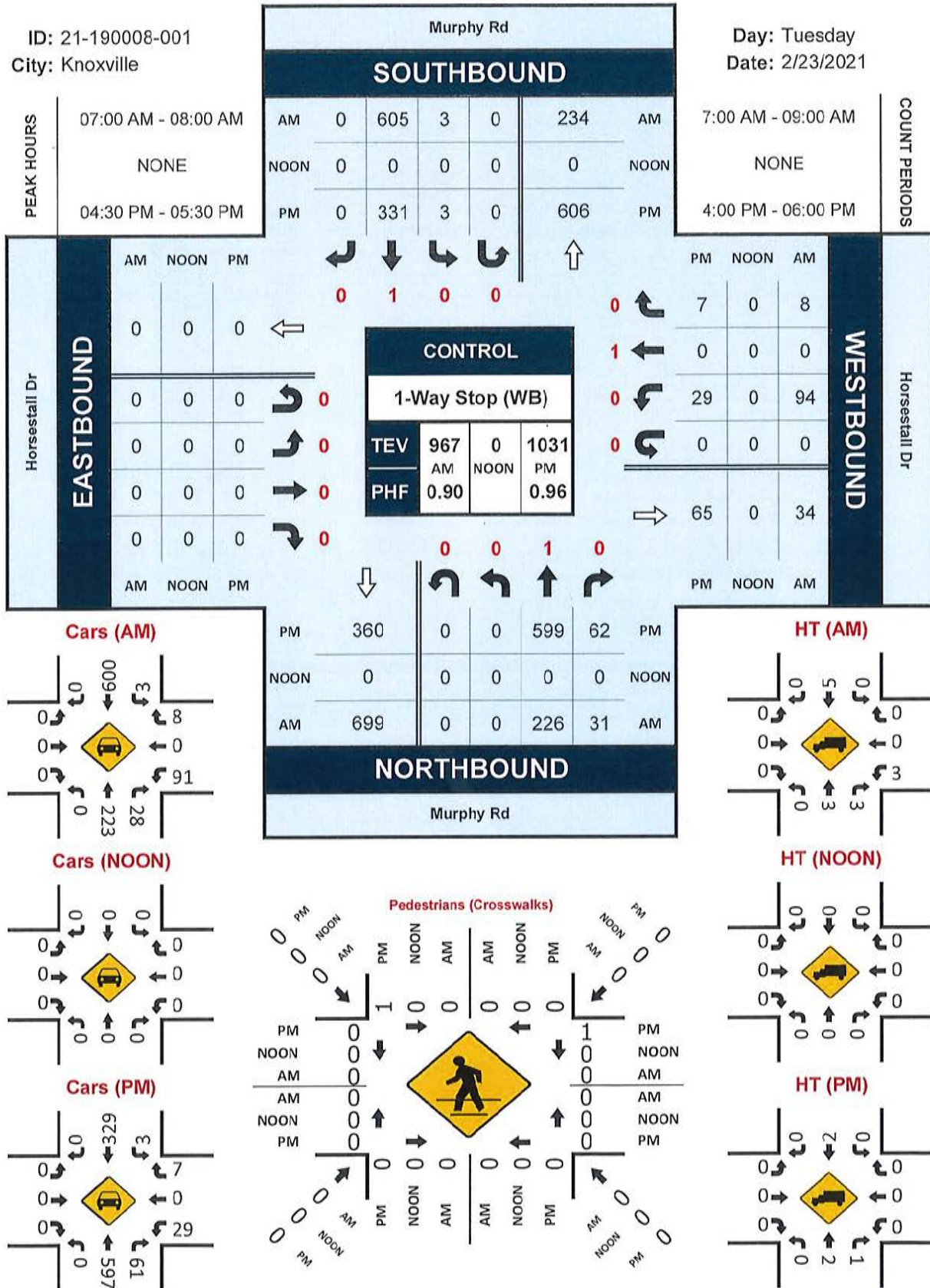
SUPPLEMENTAL INFORMATION

# Murphy Rd & Horsestall Dr

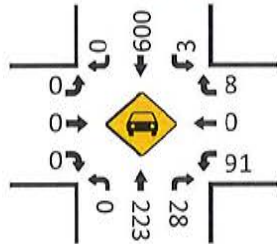
## Peak Hour Turning Movement Count

ID: 21-190008-001  
City: Knoxville

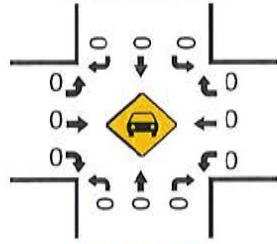
Day: Tuesday  
Date: 2/23/2021



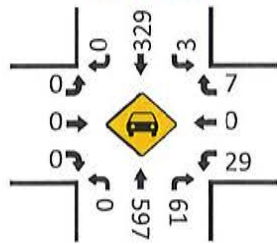
Cars (AM)



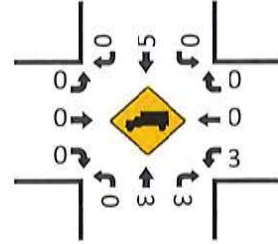
Cars (NOON)



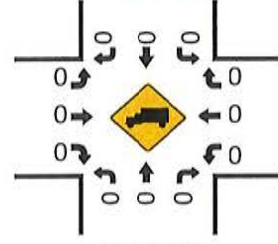
Cars (PM)



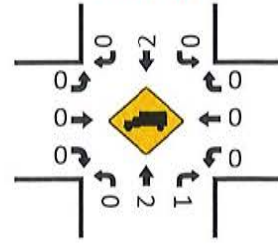
HT (AM)



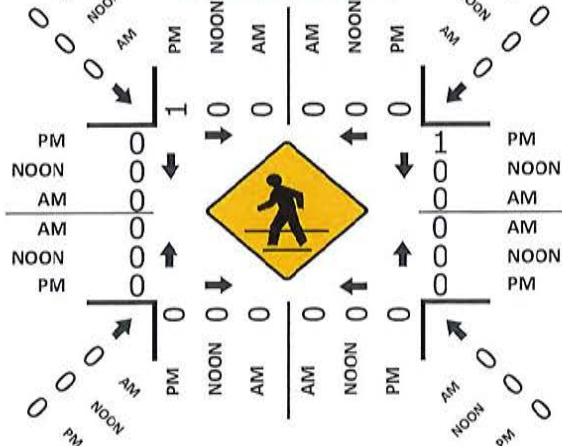
HT (NOON)



HT (PM)



Pedestrians (Crosswalks)





# National Data & Surveying Services Intersection Turning Movement Count

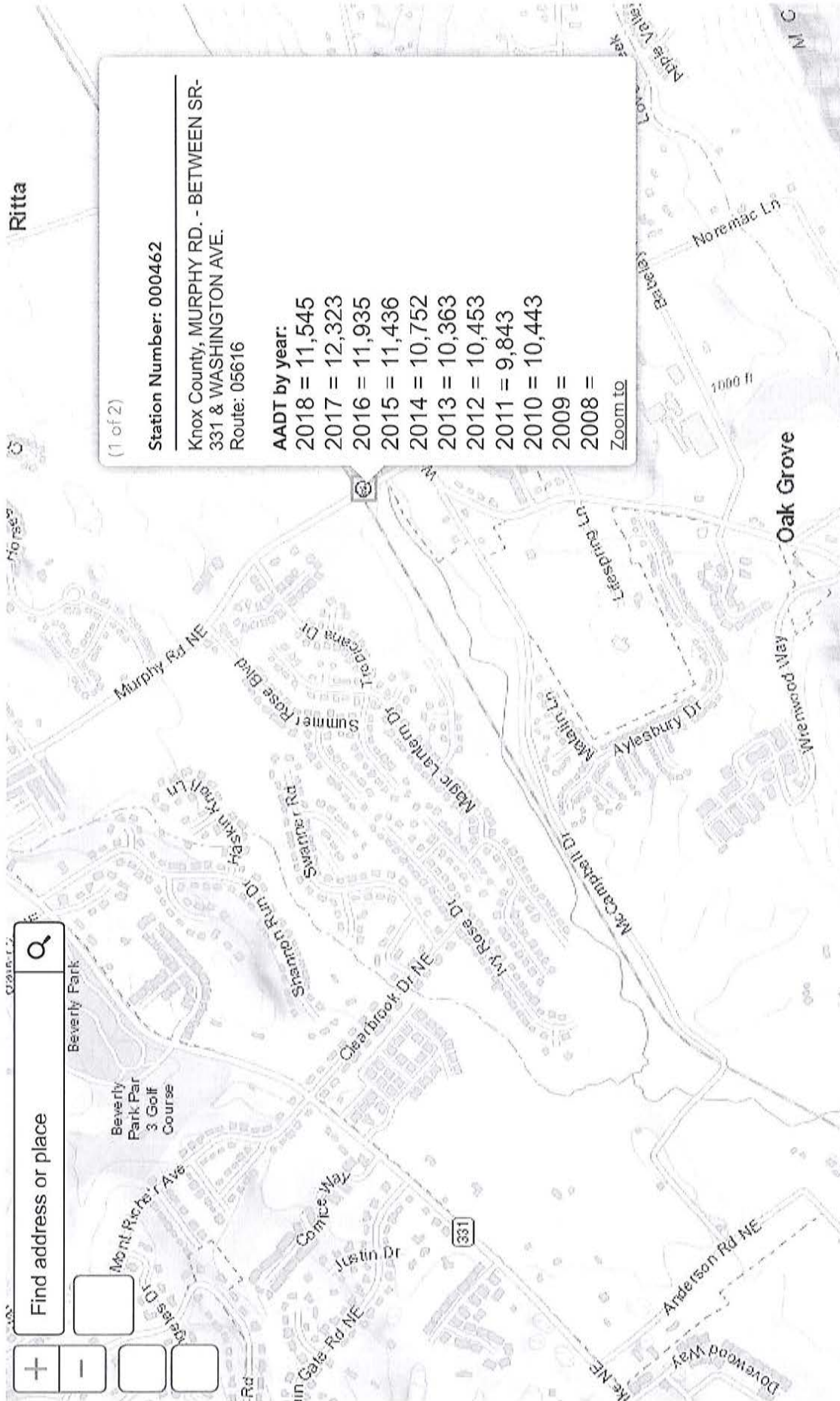
Location: Murphy Rd & Horrestall Dr  
 City: Knoxville  
 Control: 1-Way Stop (WB)

Project ID: 21-190008-001  
 Date: 2/23/2021

## Data - Total

NS/EW Streets:	Murphy Rd				Murphy Rd				Horrestall Dr				Horrestall Dr				TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
AM	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	TOTAL
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	
7:00 AM	0	44	3	0	1	145	0	0	0	0	0	0	25	0	2	0	220
7:15 AM	0	59	10	0	0	157	0	0	0	0	0	0	30	0	2	0	258
7:30 AM	0	65	10	0	1	165	0	0	0	0	0	0	24	0	3	0	268
7:45 AM	0	58	8	0	1	138	0	0	0	0	0	0	15	0	1	0	221
8:00 AM	0	66	4	0	0	111	0	0	0	0	0	0	15	0	4	0	200
8:15 AM	0	53	3	0	1	102	0	0	0	0	0	0	7	0	1	0	167
8:30 AM	0	47	6	0	1	101	0	0	0	0	0	0	10	0	1	0	166
8:45 AM	0	40	3	0	2	81	0	0	0	0	0	0	7	0	1	0	134
<b>TOTAL VOLUMES :</b>	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
	0	432	47	0	7	1000	0	0	0	0	0	0	133	0	15	0	1634
<b>APPROACH %'s :</b>	0.00%	90.19%	9.81%	0.00%	0.70%	99.30%	0.00%	0.00%					89.86%	0.00%	10.14%	0.00%	
<b>PEAK HR :</b>	<b>07:00 AM - 08:00 AM</b>																<b>TOTAL</b>
<b>PEAK HR VOL :</b>	0	226	31	0	3	605	0	0	0	0	0	0	94	0	6	0	967
<b>PEAK HR FACTOR :</b>	0.000	0.869	0.775	0.000	0.750	0.517	0.000	0.000	0.000	0.000	0.000	0.000	0.783	0.000	0.667	0.000	0.902
	0.857				0.916				0.797								
PM	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	TOTAL
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	
4:00 PM	0	120	9	0	2	99	0	0	0	0	0	0	10	0	1	0	241
4:15 PM	0	133	9	0	2	100	0	0	0	0	0	0	9	0	0	0	253
4:30 PM	0	153	14	0	0	79	0	0	0	0	0	0	9	0	3	0	258
4:45 PM	0	150	15	0	1	97	0	0	0	0	0	0	5	0	1	0	269
5:00 PM	0	139	15	0	1	77	0	0	0	0	0	0	9	0	1	0	242
5:15 PM	0	157	18	0	1	78	0	0	0	0	0	0	6	0	2	0	262
5:30 PM	0	135	17	0	1	77	0	0	0	0	0	0	2	0	0	0	232
5:45 PM	0	141	10	0	1	88	0	0	0	0	0	0	6	0	1	0	247
<b>TOTAL VOLUMES :</b>	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
	0	1128	107	0	9	695	0	0	0	0	0	0	56	0	9	0	2004
<b>APPROACH %'s :</b>	0.00%	91.34%	8.66%	0.00%	1.28%	98.72%	0.00%	0.00%					86.15%	0.00%	13.85%	0.00%	
<b>PEAK HR :</b>	<b>04:30 PM - 05:30 PM</b>																<b>TOTAL</b>
<b>PEAK HR VOL :</b>	0	599	62	0	3	331	0	0	0	0	0	0	29	0	7	0	1031
<b>PEAK HR FACTOR :</b>	0.000	0.954	0.861	0.000	0.750	0.853	0.000	0.000	0.000	0.000	0.000	0.000	0.806	0.000	0.583	0.000	0.958
	0.944				0.852				0.750								

# Traffic History



(1 of 2)

**Station Number: 000462**

**Knox County, MURPHY RD. - BETWEEN SR-331 & WASHINGTON AVE.**  
Route: 05616

**AA DT by year:**

2018 =	11,545
2017 =	12,323
2016 =	11,935
2015 =	11,436
2014 =	10,752
2013 =	10,363
2012 =	10,453
2011 =	9,843
2010 =	10,443
2009 =	
2008 =	

Zoom to



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# Single-Family Detached Housing (210)

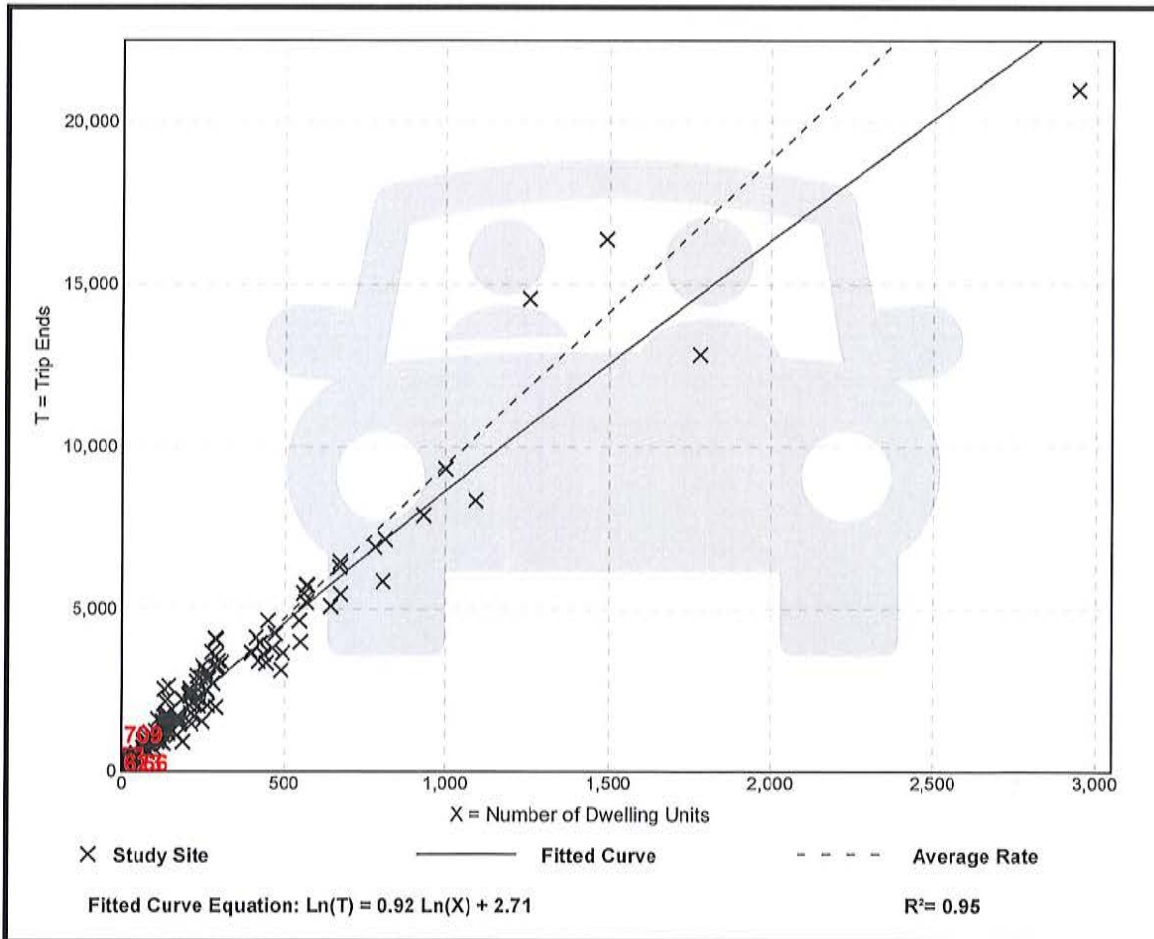
Vehicle Trip Ends vs: Dwelling Units  
On a: Weekday

Setting/Location: General Urban/Suburban  
Number of Studies: 159  
Avg. Num. of Dwelling Units: 264  
Directional Distribution: 50% entering, 50% exiting

## Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.44	4.81 - 19.39	2.10

## Data Plot and Equation



Trip Gen Manual, 10th Edition • Institute of Transportation Engineers

710 Trips (66 units)  
1277 (125 units)

# Single-Family Detached Housing (210)

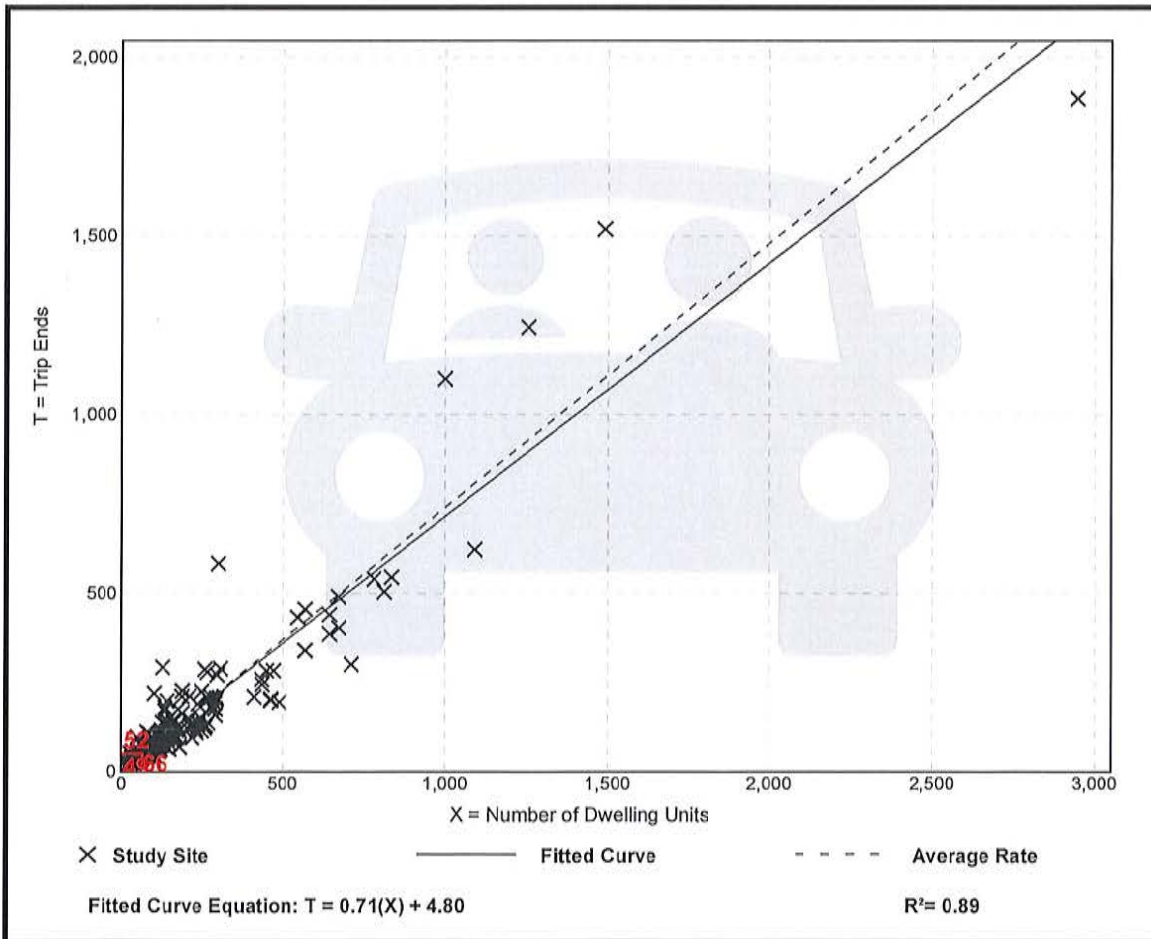
**Vehicle Trip Ends vs: Dwelling Units**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 7 and 9 a.m.**

**Setting/Location: General Urban/Suburban**  
 Number of Studies: 173  
 Avg. Num. of Dwelling Units: 219  
 Directional Distribution: 25% entering, 75% exiting

## Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.74	0.33 - 2.27	0.27

## Data Plot and Equation



*Trip Gen Manual, 10th Edition • Institute of Transportation Engineers*

52 Trips (66 units)  
 94 (125 units)

# Single-Family Detached Housing (210)

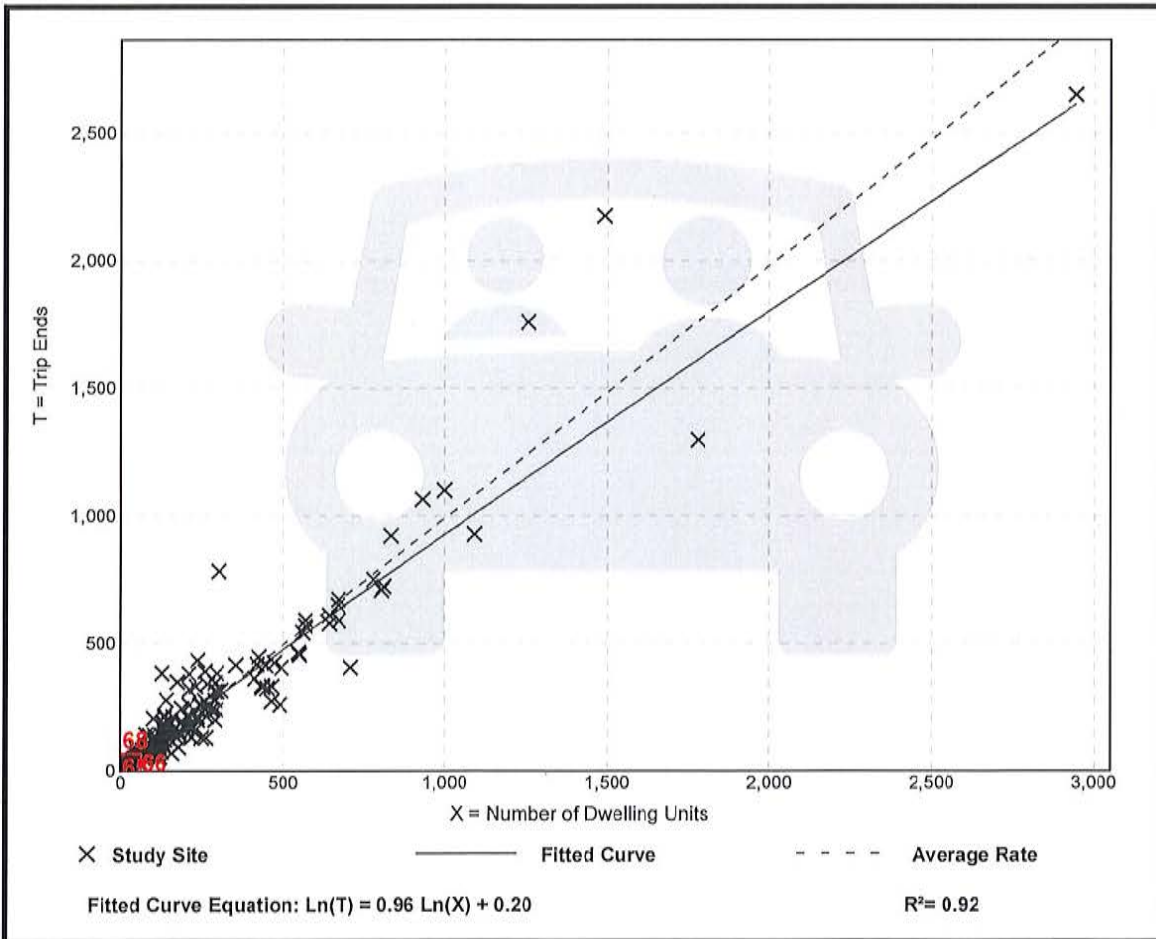
**Vehicle Trip Ends vs: Dwelling Units**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 4 and 6 p.m.**

**Setting/Location: General Urban/Suburban**  
 Number of Studies: 190  
 Avg. Num. of Dwelling Units: 242  
 Directional Distribution: 63% entering, 37% exiting

## Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.99	0.44 - 2.98	0.31

## Data Plot and Equation



*Trip Gen Manual, 10th Edition • Institute of Transportation Engineers*

68 Trips (66 units)  
 126 (125 units)



<b>TABLE 5A</b> <b>KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS</b> <b>FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH</b>	Project No: 00773-0015 Project Name: Murphy Road TIS Notes:
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(If the left-turn volume exceeds the table value a left-turn lane is needed)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160	115	85	75	65	55
250 - 299	130	100	75	65	60	50
300 - 349	110	90	70	60	55	45
350 - 399	100	80	65	55	50	40
400 - 449	90	70	60	50	45	35
450 - 499	80	65	55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599	65	55	40	35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	AM - 30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	25	25
350 - 399	40	35	30	25	25	AM - 20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	15	15	15
750 or More	20	20	20	15	15	15

\* Or through volume only if a right-turn lane exists

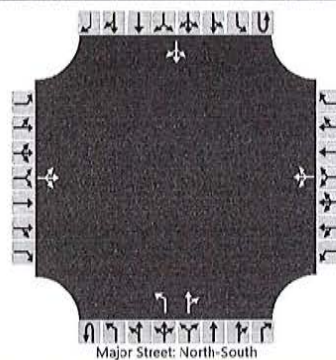
Intersection	Time Period	Opposing Volume	Through Volume	Left-Turn Volume	Warrant Threshold	Left-Turn Lane Warranted (Yes / No)
Murphy Road	AM Peak	662	278	12	30	No
at Site	PM Peak	364	717	41	20	Yes
Northbound						
Left-turn						



# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	ALC			Intersection	Murphy Rd & Site		
Agency/Co.	CCI			Jurisdiction	Knox County		
Date Performed	3/2/2021			East/West Street	Site		
Analysis Year	2024			North/South Street	Murphy Road		
Time Analyzed	AM Peak - 4 leg			Peak Hour Factor	0.90		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Murphy Road TIS (66 units)						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	1	0		0	1	0		0	1	0	
Configuration			LTR				LTR			L		TR			LTR		
Volume (veh/h)		4	0	35		94	0	8		12	247	31		3	661	1	
Percent Heavy Vehicles (%)		3	3	3		3	3	3		3				3			
Proportion Time Blocked																	
Percent Grade (%)		0				0											
Right Turn Channelized																	
Median Type   Storage		Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.13	6.53	6.23		7.13	6.53	6.23		4.13				4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		3.53	4.03	3.33		2.23				2.23		

## Delay, Queue Length, and Level of Service

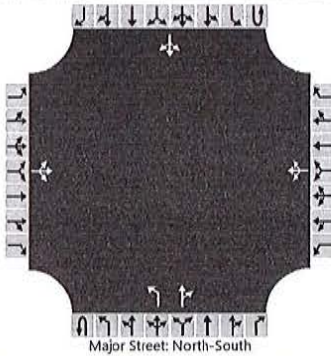
Flow Rate, v (veh/h)			43				113				13				3		
Capacity, c (veh/h)			374				185				865				1246		
v/c Ratio			0.12				0.61				0.02				0.00		
95% Queue Length, Q <sub>95</sub> (veh)			0.4				3.4				0.0				0.0		
Control Delay (s/veh)			15.9				51.0				9.2				7.9		
Level of Service (LOS)			C				F				A				A		
Approach Delay (s/veh)		15.9				51.0				0.4				0.1			
Approach LOS		C				F											



# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	ALC	Intersection	Murphy Rd & Site				
Agency/Co.	CCI	Jurisdiction	Knox County				
Date Performed	3/2/2021	East/West Street	Site				
Analysis Year	2024	North/South Street	Murphy Road				
Time Analyzed	PM Peak - 4 leg	Peak Hour Factor	0.95				
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25				
Project Description	Murphy Road TIS (66 units)						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	1	0	0	1	1	0	0	0	1	0	
Configuration			LTR				LTR			L		TR			LTR		
Volume (veh/h)		5	0	20		29	0	7		41	655	62		3	362	2	
Percent Heavy Vehicles (%)		3	3	3		3	3	3		3				3			
Proportion Time Blocked																	
Percent Grade (%)		0				0											
Right Turn Channelized																	
Median Type   Storage		Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.13	6.53	6.23		7.13	6.53	6.23		4.13				4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		3.53	4.03	3.33		2.23				2.23		

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			26				38				43				3		
Capacity, c (veh/h)			398				171				1170				851		
v/c Ratio			0.07				0.22				0.04				0.00		
95% Queue Length, Q <sub>95</sub> (veh)			0.2				0.8				0.1				0.0		
Control Delay (s/veh)			14.7				32.0				8.2				9.2		
Level of Service (LOS)			B				D				A				A		
Approach Delay (s/veh)		14.7				32.0				0.4				0.1			
Approach LOS		B				D											



# HCS7 Two-Way Stop-Control Report

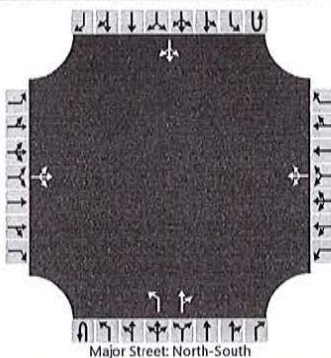
## General Information

Analyst	ALC
Agency/Co.	CCI
Date Performed	3/2/2021
Analysis Year	2026
Time Analyzed	AM Peak - 4 leg
Intersection Orientation	North-South
Project Description	Murphy Road TIS (125 units)

## Site Information

Intersection	Murphy Rd & Site
Jurisdiction	Knox County
East/West Street	Site
North/South Street	Murphy Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	1	0	0	1	1	0	0	0	1	0	
Configuration			LTR				LTR			L		TR			LTR		
Volume (veh/h)		7	0	64		94	0	8		22	262	31		3	701	2	
Percent Heavy Vehicles (%)		3	3	3		3	3	3		3				3			
Proportion Time Blocked																	
Percent Grade (%)		0				0											
Right Turn Channelized																	
Median Type   Storage		Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.13	6.53	6.23		7.13	6.53	6.23		4.13				4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		3.53	4.03	3.33		2.23				2.23		

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			79				113				24				3		
Capacity, c (veh/h)			348				142				832				1229		
v/c Ratio			0.23				0.80				0.03				0.00		
95% Queue Length, Q <sub>95</sub> (veh)			0.9				5.0				0.1				0.0		
Control Delay (s/veh)			18.4				90.6				9.5				7.9		
Level of Service (LOS)			C				F				A				A		
Approach Delay (s/veh)		18.4				90.6				0.7				0.1			
Approach LOS		C				F											



# HCS7 Two-Way Stop-Control Report

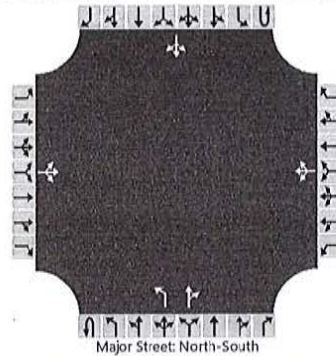
## General Information

Analyst	ALC
Agency/Co.	CCI
Date Performed	3/2/2021
Analysis Year	2026
Time Analyzed	PM Peak - 4 leg
Intersection Orientation	North-South
Project Description	Murphy Road TIS (125 units)

## Site Information

Intersection	Murphy Rd & Site
Jurisdiction	Knox County
East/West Street	Site
North/South Street	Murphy Road
Peak Hour Factor	0.95
Analysis Time Period (hrs)	0.25

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	1	0		0	1	0		0	1	1	0		0	1	0
Configuration			LTR				LTR			L		TR			LTR		
Volume (veh/h)		9	0	37		29	0	7		75	688	62		3	384	4	
Percent Heavy Vehicles (%)		3	3	3		3	3	3		3				3			
Proportion Time Blocked																	
Percent Grade (%)		0				0											
Right Turn Channelized																	
Median Type   Storage		Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.13	6.53	6.23		7.13	6.53	6.23		4.13				4.13		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		3.53	4.03	3.33		2.23				2.23		

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			48				38				79				3	
Capacity, c (veh/h)			349				132				1145				826	
v/c Ratio			0.14				0.29				0.07				0.00	
95% Queue Length, Q <sub>95</sub> (veh)			0.5				1.1				0.2				0.0	
Control Delay (s/veh)			17.0				43.1				8.4				9.4	
Level of Service (LOS)			C				E				A				A	
Approach Delay (s/veh)		17.0				43.1				0.8				0.1		
Approach LOS		C				E				A				A		