## **MILLER FARM SUBDIVISION**

TRAFFIC IMPACT STUDY

W. EMORY ROAD (SR 131) KNOX COUNTY, TENNESSEE

CCI PROJECT NO. 00773-0013

REV 2



PREPARED FOR: Southland Engineering Consultants 4909 Ball Road Knoxville, TN 37931

#### SUBMITTED BY

Cannon & Cannon, Inc. 8550 Kingston Pike Knoxville, TN 37919 865.670.8555

> REVISED NOVEMBER 23 **2020**

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W. EMORY ROAD (SR 131) KNOX COUNTY, TENNESSEE

#### CCI PROJECT NO. 00773-0013



#### **REVISION 2 (11/23/20)**

This report replaces the previous versions of the traffic impact study dated 06/26/20 and 11/06/20 prepared for this project in their entirety. The associated changes are a result of a revised site plan and site access.

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REVISED **NOVEMBER 23** .....

2020

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#### **EXECUTIVE SUMMARY**

This report provides a summary of a traffic impact study that was performed for a proposed singlefamily residential subdivision to be located on W. Emory Road (SR 131) in north Knox County. The project site is located on the north side of W. Emory Road, approximately two and one-quarter miles west of the intersection of W. Emory with Clinton Highway. The conceptual development plan for this project, Miller Farm Subdivision, proposes a maximum of 95 residential lots. The project is proposed to have a single access roadway onto W. Emory Road.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed Miller Farm Subdivision development upon roadways in the vicinity of the project site. Of particular interest was the intersection of W. Emory Road with the site entrance roadway (Miller Farms Road "A"), which is considered the project study intersection. This intersection was the primary location for intersection evaluations which were conducted in order to determine the anticipated impacts of traffic generated from the project, and whether or not improvements will be justified to mitigate these impacts. These evaluations included intersection capacity analyses, turn lane assessments and a sight distance review.

The primary conclusion of this study is that the traffic generated from the proposed Miller Farm Subdivision will have a relatively minor impact on the study intersection of W. Emory Road and Miller Farms Road "A", which is the proposed single access point to this development. The primary impact will be the need for an eastbound left-turn lane on W. Emory Road.

The following listing is a summary of improvement recommendations that resulted from this study:

- 1. Install a 30-inch STOP sign on the Miller Farms Road "A" southbound approach to W. Emory Road in accordance with the requirements of the *Manual on Uniform Traffic Control Devices*.
- 2. Ensure that the intersection corner sight distances at the study intersection are maintained along W. Emory Road via the removal of any conflicting vegetation and the installation of all project signage and landscaping in proper locations.
- 3. Construct an eastbound left-turn lane on W. Emory Road at the study intersection with a minimum storage length of seventy-five feet and proper tapers in accordance with TDOT and Knox County standards. In addition, TDOT requests that a paved shoulder be constructed on the westbound side for the right-turn movement into the site. A sketch is provided in APPENDIX D showing these proposed improvements, including recommended dimensions.



#### **INTRODUCTION & PURPOSE OF STUDY**

This report provides a summary of a traffic impact study that was performed for a proposed singlefamily residential subdivision to be located on W. Emory Road (SR 131) in north Knox County. The project site is located on the north side of W. Emory Road, approximately two and one-quarter miles west of the intersection of W. Emory with Clinton Highway. FIGURE 1 is a location map identifying the major roadways in the vicinity of the site.

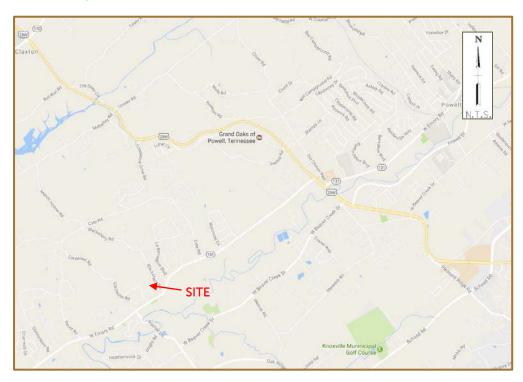


FIGURE 1 LOCATION MAP

The conceptual development plan for this project, Miller Farm Subdivision, proposes a maximum of 95 residential lots. The project is proposed to have a single access roadway onto W. Emory Road. FIGURE 2 is a Conceptual Site Plan which illustrates the proposed site configuration.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed Miller Farm Subdivision development upon roadways in the vicinity of the project site. Of particular interest was the intersection of W. Emory Road with the site entrance roadway (Miller Farms Road "A"), which is considered the project study intersection. This intersection was the primary location for intersection evaluations which were conducted in order to determine the anticipated impacts of traffic generated from the project, and whether or not improvements will be justified to mitigate these impacts. These evaluations included intersection capacity analyses, turn lane assessments and a sight distance review.



#### SECTION 2 INTRODUCTION & PURPOSE OF STUDY

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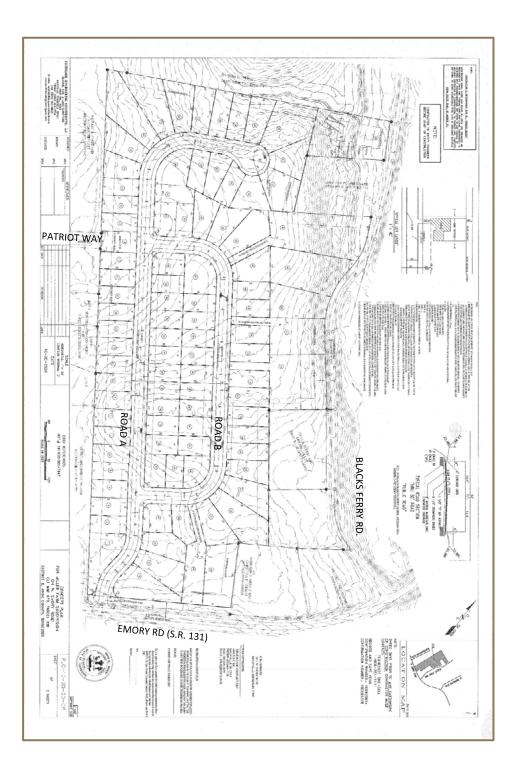


FIGURE 2 CONCEPTUAL SITE PLAN



#### **EXISTING CONDITIONS**

#### **EXISTING ROADWAY CONDITIONS**

W. Emory Road (SR 131) is a TDOT maintained state highway that is classified as a Major Arterial roadway by Knox County and the Knoxville/Knox County MPC. In the vicinity of the proposed development, the roadway consists of one through asphalt travel lane in each direction with a width of approximately eleven feet each. Varying shoulders that average about two feet on each side are also present. The speed limit in the vicinity of the proposed project is posted as 40 mph.

#### **EXISTING SITE CONDITIONS**

The existing site is located on the north side of W. Emory Road, approximately two and one-quarter miles west of Clinton Highway. Blacks Ferry Road lies just to the east. The site is currently mostly undeveloped and is covered by some pasture land with some small areas of trees and brush. A few small structures are also located on the site. It is bordered to the west and south by Northampton Commons subdivision, with the general vicinity consisting of large lot single-family homes, small farms and other subdivisions. FIGURE 3 provides an overview of the study site and immediate surrounding area.



FIGURE 3 EXISTING SITE CONDITIONS



#### EXISTING TRAFFIC DATA

Available traffic volume data was gathered for this study, including annual average daily traffic (AADT) data collected by the Tennessee Department of Transportation (TDOT). Two count stations were found in the vicinity of the project site that were felt to have particular relevance for this study. The most currently available data from these stations are contained in Table 1.

COUNT YEAR	TDOT COUNT STATION 0047* SR 131 NEAR ANDERSON CO. LINE	TDOT COUNT STATION 0468** KARNS VALLEY DRIVE JUST N. OF SR 62
2019	10,440	6,814
2018	10,161	4,894
2017	10,620	4,336
2016	9,985	4,258
2015	10,074	4,216
2014	8,866	4,183
2013	9,480	4,061
2012	9,336	3,943

#### TABLE 1: ANNUAL AVERAGE DAILY TRAFFIC COUNT SUMMARY

\* This station is located on S.R. 131 about one and one-half miles east of the project site. \*\* This station is located on an extension of S.R. 131 about three and one-half miles west of the site.

In addition to the available AADT data, intersection turning movement traffic counts are typically collected for these types of studies. Because of the nationwide COVID-19 pandemic, it was determined that any counts taken during the time frame of this study would not be reflective of normal conditions. Therefore, it was decided to derive estimated traffic volumes for the study intersection by taking the most recent area traffic counts from a nearby study and "transferring" this data to the study intersection. This was done by starting with the old counts factored by an annual growth rate, then applying trip generation data for the subdivisions and housing located between the previously counted location and the study intersection. This process was used to establish the existing volumes at the study intersection and to establish trip distribution patterns. The existing traffic counts derived for the study intersection are summarized on FIGURE 4. The raw data traffic count summary sheets and sheets summarizing the traffic volume derivation process are contained in APPENDIX A.



#### **SECTION 3**

**EXISTING CONDITIONS** 

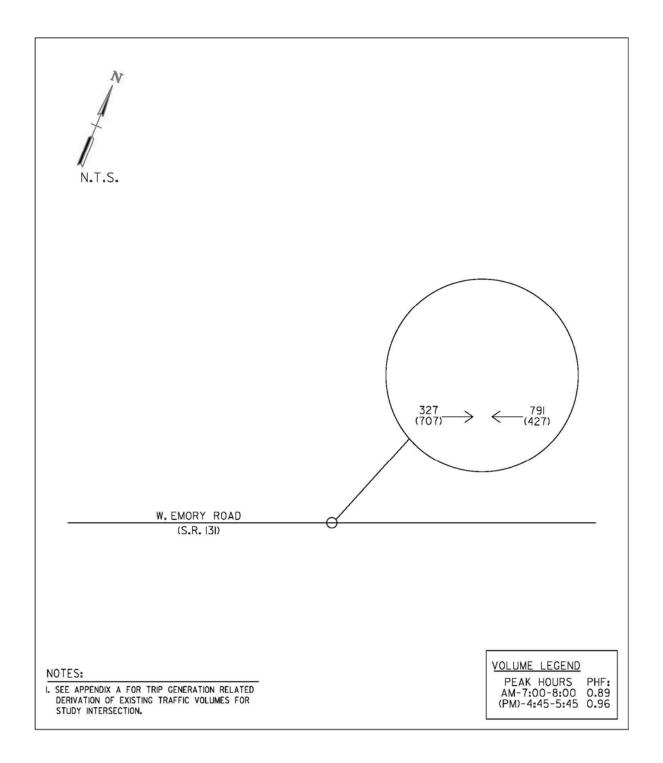


FIGURE 4 **EXISTING TRAFFIC VOLUMES (2020)** 



#### **BACKGROUND CONDITIONS**

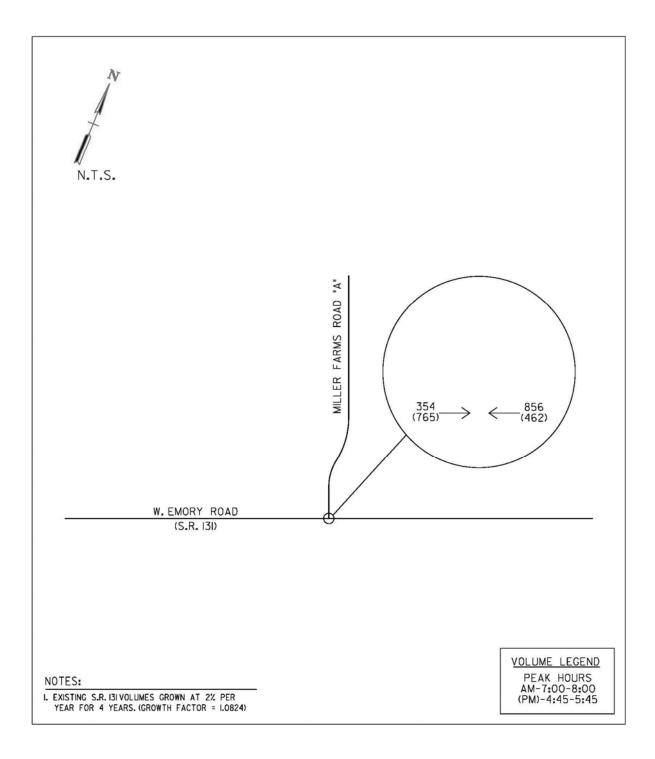
#### BACKGROUND TRAFFIC GROWTH

The proposed single-family subdivision development is anticipated to be constructed in one general phase with anticipated completion in approximately four years. Therefore, year 2024 was established as the appropriate analysis year for this study. In order to determine traffic volumes resulting solely from background traffic growth to year 2024, it was necessary to establish an annual growth rate for existing traffic. Based on the TDOT ADT traffic counts, as well as knowledge of the area, a background annual traffic growth rate of 2.0% was established. Figure 5 contains the background traffic volumes that would result from a 2.0% annual growth rate from year 2020, which is the existing traffic volume year, to year 2024. The background traffic volumes shown on FIGURE 5 represent year 2024 background growth conditions without traffic related to the proposed development.



#### **SECTION 4**

BACKGROUND CONDITIONS



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FIGURE 5 BACKGROUND TRAFFIC VOLUMES (2024)



#### **FUTURE CONDITIONS**

#### TRIP GENERATION

In order to estimate the expected traffic volumes to be generated by the proposed development, the procedures recommended by the Institute of Transportation Engineers (ITE) were utilized. Trip generation rates developed by ITE for single-family detached housing were employed to generate the estimated trips for the proposed subdivision. The generated traffic volumes were determined based on the data for the peak hours of adjacent street traffic. See TABLE 2 for a summary of the traffic generated for this project. More detailed information is contained in APPENDIX B.

#### TABLE 2: TRIP GENERATION SUMMARY

LAND USE	NO. UNITS	TRIP DESCRIPTION	WEEKDAY (TRIPS/DAY)	AM PEAK HOUR (TRIPS/HR)	PM PEAK HOUR (TRIPS/HR)
Single Family Detached Housing (ITE CODE 210)	95	Entering Trips <u>Exiting Trips</u> TOTAL	496 (50%) <u>496 (50%)</u> 992	18 (25%) <u>54 (75%)</u> 72	61 (63%) <u>36 (37%)</u> 97

#### TRIP DISTRIBUTION AND ASSIGNMENT

FIGURE 6 provides a summary of how the above site generated trips would be assigned to the study intersection. The basic trip distribution patterns were taken from the 2017 W. Emory Road at Cate Road traffic counts.

#### FUTURE TRAFFIC VOLUMES

Future projected traffic volumes for the study intersection were developed by adding the generated and assigned trips shown in FIGURE 6 to the 2024 W. Emory Road background traffic volumes developed in the previous section and shown in FIGURE 5. These combined year 2024 volumes reflect the existing traffic, the background traffic growth, and the generated traffic from the proposed subdivision. These future volumes are shown on FIGURE 7, and are the combined volumes used in the analyses of future conditions with the proposed development.

#### FUTURE CAPACITY ANALYSES / LEVELS-OF-SERVICE

Capacity analyses employing the methods of the Highway Capacity Manual (HCM2010) were conducted for the combined A.M. and P.M. peak hour traffic and existing roadway conditions at the study intersection of W. Emory Road and Miller Farms Road "A". The results of these analyses are contained in the EVALUATIONS section of this report, along with discussion of the implications of the results.



#### **SECTION 5** FUTURE CONDITIONS

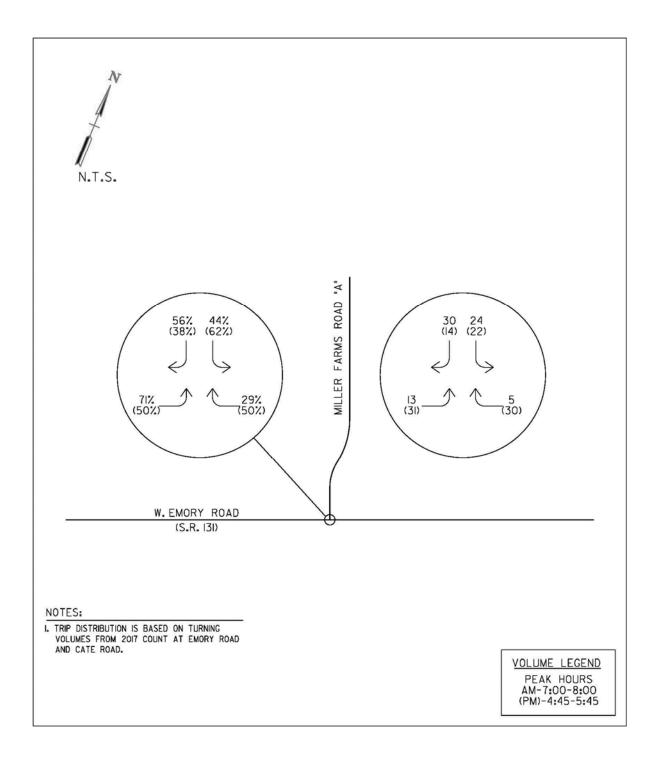


FIGURE 6 TRIP DISTRIBUTION AND ASSIGNMENT



## **SECTION 5**

FUTURE CONDITIONS

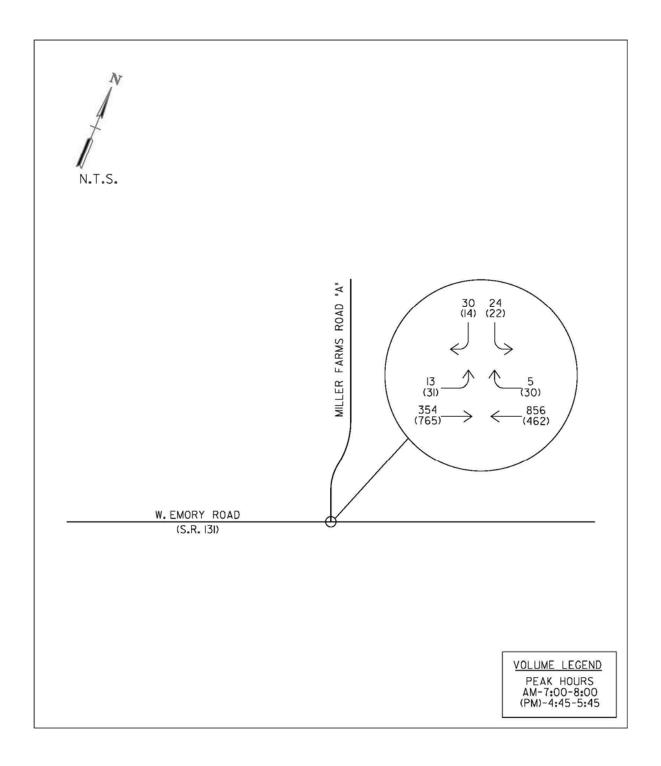


FIGURE 7 COMBINED TRAFFIC VOLUMES (2024)



#### **EVALUATIONS**

#### INTERSECTION CAPACITY ANALYSES

As discussed in the preceding section of this report, capacity analyses employing the methods of the Highway Capacity Manual (HCM) were conducted for the study intersection, for the combined traffic conditions. These analyses employed the existing roadway conditions, with the Miller Farms Road "A" added. A second set of analyses were also conducted which added an eastbound left-turn lane. A summary of the capacity analyses results is shown in TABLE 3.

INTERSECTION	TIME PERIOD	YEAR 2024 COMBINED NO LEFT TURN LANE (LOS - DELAY)	YEAR 2024 COMBINED WITH EBLT LANE (LOS - DELAY)
W. Emory Road (SR 131) at Miller Farms Road "A" (SIDE-STREET STOP CONTROLLED) <sup>1</sup>	A.M. P.M.	D - 28.8 s. D - 25.2 s.	D - 28.7 s. C - 24.7 s.

#### TABLE 3: CAPACITY ANALYSES SUMMARY

<sup>1</sup>SIDE-STREET STOP CONTROLLED – Level-of-service and Average Vehicular Delay (seconds) for the southbound side street approach utilizing HCM methodology.

See Appendix C for detailed computer print-out summaries and discussion of Capacity and Level-of-Service concepts.

#### SIGHT DISTANCE ASSESSMENT

A sight distance field review was performed and the sight distance appears to be more than adequate. The subdivision designer has placed the study intersection as far to the west on the project site as possible in order to maximize the sight distance looking east. Field measurements found that looking east from the study intersection the sight distance exceeds 450 feet, while looking west the sight distance is significantly greater. The posted speed limit is 40 mph, which makes the required minimum sight distance in accordance with Knoxville-Knox County MPC regulations to be 400 feet.

#### TURN LANE ASSESSMENT

Left-turn lane and right-turn lane volume thresholds were evaluated for the study intersection using the combined traffic volumes shown in FIGURE 7, which assumes full build-out of the proposed development. These analyses employed TABLE 5A and TABLE 5B from the *Knox County Access Control and Driveway Design Policy*, which is based on turn lane criteria developed by Harmelink. The results were that an eastbound left-turn lane on W. Emory Road is anticipated to be justified, while a westbound right-turn lane is not. The turn lane warrant worksheets are located in APPENDIX C.



#### **CONCLUSIONS & RECOMMENDATIONS**

The primary conclusion of this study is that the traffic generated from the proposed Miller Farm Subdivision will have a relatively minor impact on the study intersection of W. Emory Road and Miller Farms Road "A", which is the proposed single access point to this development. The primary impact will be the need for an eastbound left-turn lane on W. Emory Road.

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### SECTION 8 APPENDICES

**APPENDICES** 

APPENDIX A - TRAFFIC DATA

APPENDIX B - TRIP GENERATION

APPENDIX C - ANALYSES

APPENDIX D - TURN LANE IMPROVEMENTS



APPENDIX A	
TRAFFIC DAT/	4
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APPENDIX A - TRAFFIC DATA



#### Cannon & Cannon, Inc. Consulting Engineers - Field Surveyors 8550 Kingston Pike Knoxville, TN 37919

CCI Project Name: Emory Brooke TIS CCI Project Number: 773-0008 Intersection: Emory @ Cate Counted By: CCI

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07:00 AM	20	0	27	0	47	0	117	1	0	118	0	0	0	0	0	4	59	0	0	63	22
07:15 AM	22	0	43	0	65	0	146	4	0	150	0	0	0	0	0	10	68	0	0	78	29
07:30 AM	17	0	16	0	33	0	164	3	0	167	0	0	0	0	0	5	95	0	0	100	30
07:45 AM	20	0	16	0	36	0	128	2	0	130	0	0	0	0	0	6	76	0	0	82	24
Total	79	0	102	0	181	0	555	10	0	565	0	0	0	0	0	25	298	0	0	323	106
08:00 AM	13	0	23	0	36	0	89	7	0	96	0	0	0	0	0	5	64	O	0	69	20
08:15 AM	8	0	8	õ	16	0	77	4	0	81	0	0	0	0	0	2	63	0	0	65	16
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04:30 PM	5	0	13	0	18	0	76	15	0	91	0	0	0	0	0	13	116	0	0	129	23
04:45 PM	10	0	6	0	16	0	96	19	0	115	0	0	0	0	0	18	146	0	0	164	29
Total	32	0	27	0	59	0	333	66	0	399	0	0	0	0	0	58	474	0	0	532	99
05:00 PM	7	0	8	0	15	0	100	12	0	112	0	0	0	0	0	23	131	0	0	154	28
05:15 PM	14	0	9	0	23	0	109	23	0	132	0	0	0	0	0	19	132	0	0	151	30
05:30 PM	19	0	7	0	26	0	101	23	0	124	0	0	0	0	0	17	130	0	0	147	29
05:45 PM	8	0	9	0	17	0	90	8	0	98	0	0	0	0	0	21	111	0	0	132	24
Total	48	0	33	0	81	0	400	66	0	466	0	0	0	0	0	80	504	0	0	584	113
Grand Total	203	0	217	0	420	0	156 8	160	0	1728	0	0	0	0	0	175	151 9	0	0	1694	384
Apprch %	48. 3	0.0	51. 7	0.0		0.0	90. 7	9.3	0.0		0.0	0.0	0.0	0.0		10. 3	89. 7	0.0	0.0		
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#### Cannon & Cannon, Inc. Consulting Engineers - Field Surveyors 8550 Kingston Pike Knoxville, TN 37919

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#### Cannon & Cannon, Inc. Consulting Engineers - Field Surveyors 8550 Kingston Pike Knoxville, TN 37919

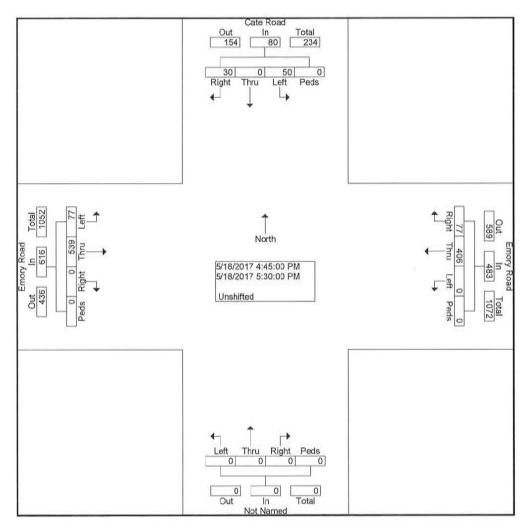
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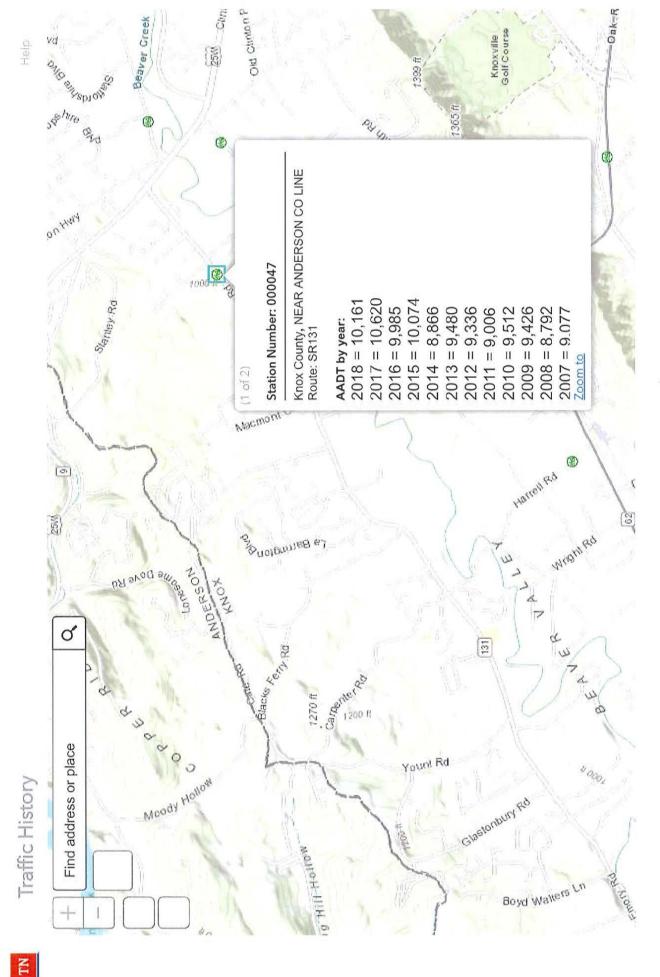
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Factor	05.20					05:15										04:45	DM				0.,
High Int. Volume	05:30 19		7	0	26	05:18	109	23	0	132	0	0	0	0	0	18	146	0	0	164	
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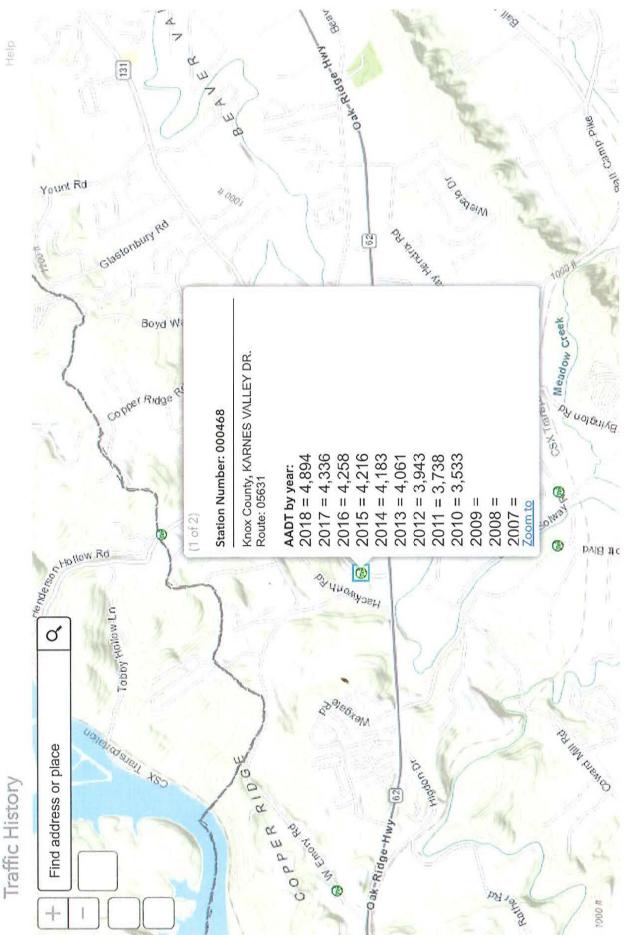
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A-5

0.4mi

NI





-84.136 35.983 Degrees

A-6

0.4mi

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Sheet Derivation of Traffic Volumes for Study Intersection I of 4/20/20 by Dec Begin W/ Emory & Cate Data: \* Taken 5/18/2017 Cate Road AM Peak - 7:00-8:00 (PM Peak-4:45-5:45) 102 > (50) (30) 4 10 PHF: (77) Emory Road AM - 0.89 25 (77) 555 PM - 0.96 (539)(406) \* MPC requested off these traffic counts Cate Road Derive 2020 Existing 84 108 o unes" (32) (53) (82) 27 10 2 Steps (0) Emory 589 316 Road 1) Expand above (431) (572) counts to 2020 3 (0) (0) (20) Using 2.0%/yr. growth 91 (19) for 3 years (1.0612)-20 15 14) (9) 2) Add Emory Brooke Trip Emory Brooke Assignment - New 4th Leg of Subdivision Intersection-Built after count. (See ) Emory Brooke - Trip Assignment Brooke - Trip Distribution Emory SecTrip 71% 29% 9 20) Gen, below (50%) (50%) (19)560% 44-9% (62.5%) (37.5%) 15 20 Distribution to be used (9) (14) For all subdivisions Single Emory Brook Trip Generation (60 Units): Family Exit Total Enter 650-50% enter, 50% exit 325 650 325 Weekday -47 35 47 -25% enter 75% exit Peak-AM 39 62 62 - 63% enter. 37% exit 23 PM Poak-See Sheet 2 For continuation of derivation A-7

Sheet 5/4/20 Continuation of Derivation for 2 of 3by Del Project Study Intersection 2020 Existing Volumes PROJECT Site Road "A" -> USE MPC recommended 327 6 SITE (707) (Future) 1791 methodology - See 1) at (427) bottom of this sheet 13 Side Street Volumes \* (13) Blacks Ferry Enter/Exit 514 (16) From Knox. County TMC Count Blacks Ferry 312 Road (691) 778 11 (414) (10) 319 Direct Emory Access Trip Gen 789 (424) 35 Enter Exit 318 14 AM-4 781 6 (421) 8 PM-13 784 324 (695) 54 Barrington Subd. Trip Gen. (24) (55) 30 Exit Enter 42 (640) (40 Barnington See 96 Subdivision Sheet 3 AM -32 (54) 64 For Trip 109 PM-Generation 343 739 For each 458) Subdivision Barrington Villas - Trip Gen. 26 (26) 332 Exit Enter (654) 4-6 15 AM-(19) Burrington 30 PM-5 Villas 4 (25) 447) Brooke Subd. - Trip Gen, Emory 717 (472) 352 Enter Exit 673) 35 12 AM 108 23 39 (82) (32) PM -0 4  $(\circ)$ 316 84. Emory Brooke Cate 1) Start here w/2020 20 Road Subdivision 589 Existing Volumes (Sheet (431) 3 00 >0 (20) (82) Trip Gen. for units in exist. 15 (14) developments & some distribution. **A-8** 

Sheet 3 of: 3 4/30/20 Volumes \* Generation Summary for Deriving Miller Forms by all Irip Weekday AM Peak No, Units Tota Exit Exit Enter Tota) Enter 8 74 56 98 511 510 Miller Farms 1021 35 47 325 325 Emory Brooke 650 60 419 837 418 61 46 5 Barrington Villa 79 96 32 866 28 74 731 865 Barrington Subd. 18 4 4 113 Direct Emory Access 19 226 13 35 26 9 234 234 42 468 Northhampton Commons Peak PM PM Peak: 37 63 Miller 00 Enter / Exit Farms 70: Enter Exit 23 mory Brooke 39 62 Weekday -50% 50% 5 25% Barrington Villos 75% 81 30 AM Peak -73 Barrington Subl 09 3700 63000 PM Peak-8 21 13 Direct Emory Access 28 16 44 North hampton Commis Northampton Subdivisions Miller Forms & Combined PM Peak Enter Enter Exit Exit Tota Total Exit Total Enter No. Units 88 52 140 26 78 140 709 104 1417 708 98+42 \* as directed by MPC Method A-9

**APPENDIX B - TRIP GENERATION** 



## Land Use: 210 Single-Family Detached Housing

#### Description

Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.

#### Additional Data

The number of vehicles and residents had a high correlation with average weekday vehicle trip ends. The use of these variables was limited, however, because the number of vehicles and residents was often difficult to obtain or predict. The number of dwelling units was generally used as the independent variable of choice because it was usually readily available, easy to project and had a high correlation with average weekday vehicle trip ends.

This land use included data from a wide variety of units with different sizes, price ranges, locations and ages. Consequently, there was a wide variation in trips generated within this category. As expected, dwelling units that were larger in size, more expensive, or farther away from the central business district (CBD) had a higher rate of trip generation per unit than those smaller in size, less expensive, or closer to the CBD. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Single-family detached units had the highest trip generation rate per dwelling unit of all residential uses because they were the largest units in size and had more residents and more vehicles per unit than other residential land uses; they were generally located farther away from shopping centers, employment areas and other trip attractors than other residential land uses; and they generally had fewer alternate modes of transportation available because they were typically not as concentrated as other residential land uses.

The peak hour of the generator typically coincided with the peak hour of the adjacent street traffic.

The sites were surveyed between the late 1960s and the 2000s throughout the United States and Canada.

#### Source Numbers

1, 4, 5, 6, 7, 8, 11, 12, 13, 14, 16, 19, 20, 21, 26, 34, 35, 36, 38, 40, 71, 72, 84, 91, 98, 100, 105, 108, 110, 114, 117, 119, 157, 167, 177, 187, 192, 207, 211, 246, 275, 283, 293, 300, 319, 320, 357, 384, 435, 550, 552, 579, 598, 601, 603, 611, 614, 637

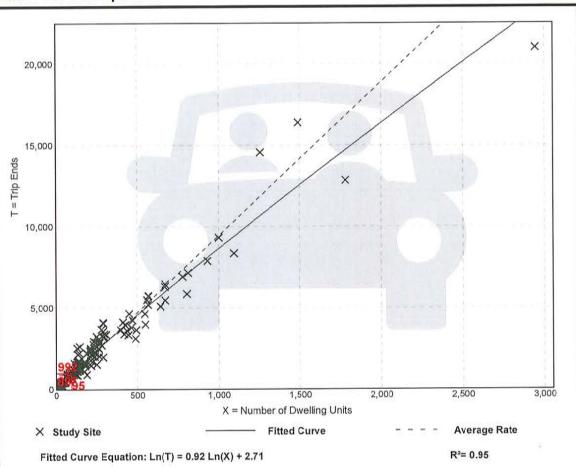
**B-2** 

## Single-Family Detached Housing

Vehicle Trip Ends vs: On a:	
Setting/Location:	General Urban/Suburban
Number of Studies:	159
Avg. Num. of Dwelling Units:	264
Directional Distribution:	

#### Vehicle Trip Generation per Dwelling Unit

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

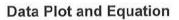


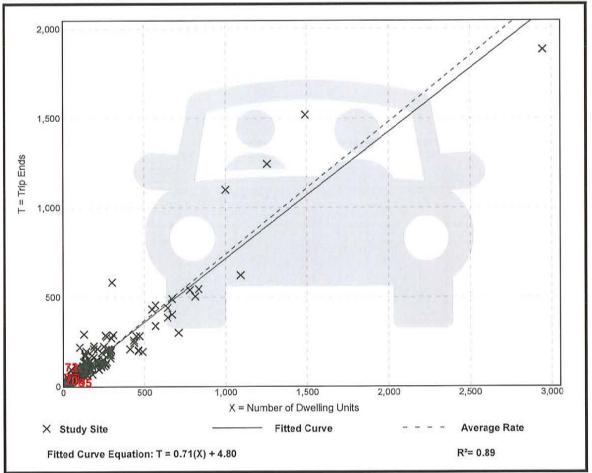
#### **Data Plot and Equation**

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

	etached Housing
Vehicle Trip Ends vs:	Dwelling Units
On a:	· 같은 것은
	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





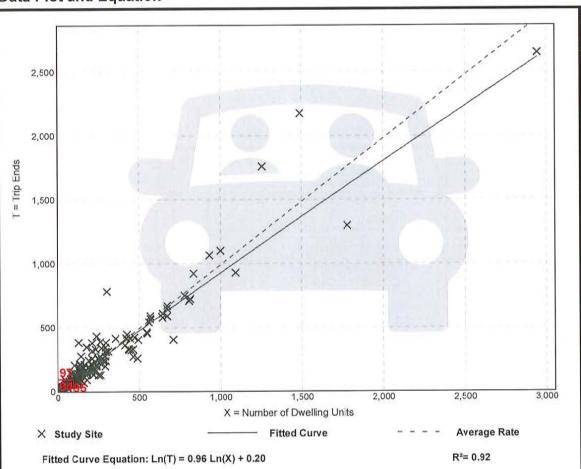
Trip Gen Manual, 10th Edition • Institute of Transportation Engineers

## Single-Family Detached Housing

 (2	10)	
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

11/2 /								
4/30/20 by all	Trip Genera	tion.	Sum	nary for	Derluir	g Mille	r Farms	Volumes
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	Barrington Subd.	174	173	865	866	128	32	96
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				Subdi		P	M Peal	<
	Enter/Exit %:				- Farms	100	63	37
	Weekday - 5000	Exit 50%	-	a de la constanción de la constancincincinción de la constanción de la constanción de la constanción d	Brooke	62	39	23
	AM Peak - 25 %	75%			ton Villos	81	51	30
and the second sec	PM Peak - 63000	370	0		ton Subl	173	109	64
	Trend			Direct Er		21	13	8
				Northhamp		44	Z8	16
						Contraction of the local distance of the loc		
	Combined Miller	Farm	8 2	Northa	noton	Subdiv	isions	
5	No. Units Total Ent	A COLORED TO A COL			Pag le	xit   Tot	PM P Entr	eak Exit
	140 1417 70		29	and the second	26 7			52
	(98,42)	<u> </u>		, , , , , , , , , , , , , , , , , , , ,				14
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								B-6

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#### **APPENDIX C ANALYSES**

APPENDIX C - ANALYSES



#### CAPACITY AND LEVEL-OF-SERVICE CONCEPTS

In a general sense, a roadway is similar to a pipeline or other material carrying conduit in that it has a certain capacity for the amount of material (vehicles) that it can efficiently carry. As the number of vehicles in a given time period gradually increases, the quality of traffic flow gradually decreases. On roadway sections this results in increasing turbulence in the traffic stream, and at intersections it results in increasing stops and delay. As the volumes begin to approach the capacity of the facility, these problems rapidly magnify, with resulting serious levels of congestion, stops, delay, excess fuel consumption, pollutant emissions, etc.

The Transportation Research Board has published the <u>Year 2010 Highway Capacity Manual</u> (<u>HCM2010</u>), which establishes theoretical techniques to quantify the capacity conditions on all types of roadways, intersections, ramps, pedestrian facilities, etc. A basic concept that is applicable to most of these techniques is the idea of level of service (LOS). This concept establishes a rating system that quantifies the quality of traffic flow, as perceived by motorists and/or passengers. The general system is similar to a school grade scale, and is outlined as follows:

Level of Service (LOS)	General Quality of Traffic Flow	Description of Corresponding Conditions
A	Excellent	Roadways – Free flow, high maneuverability Intersections – Very few stops, very low delay
В	Very Good	Roadways – Free flow, slightly lower maneuverability Intersections – Minor stops, low delay
С	Good	Roadways – Stable flow, restricted maneuverability Intersections – Significant stops, significant delay
D	Fair	Roadways – Marginally stable flow, congestion seriously restricts maneuverability Intersections – High stops, long but tolerable delay
E	Poor	Roadways – Unstable flow*, lower operating speeds, congestion severely restricts maneuverability Intersections – All vehicles stop, very long queues and very long intolerable delay
F	Very Poor	Roadways – Forced flow, stoppages may be lengthy, congestion severely restricts maneuverability Intersections – All vehicles stop, extensive queues and extremely long intolerable delay

\*Unstable flow is such that minor fluctuations or disruptions can result in rapid degradation to LOS F.

12

100	c	ONTROL DELAY (S/VEH	)		
LOS	SIGNALIZED	UNSIGNALIZED	ROUNDABOU		
А	≤10	≤10	≤10		
В	>10-20	>10-15	>10-15		
С	>20-35	>15-25	>15-25		
D	>35-55	>25-35	>25-35		
E	>55-80	>35-50	>35-50		
F	>80	>50	>50		

#### LOS CRITERIA: SIGNALIZED & UNSIGNALIZED INTERSECTIONS

Another measure of intersection capacity that is often used in the evaluation of intersection operations is the volume to capacity (V/C) ratio. This ratio is defined as "the ratio of flow rate to capacity", and is a good measure of how much of an intersection's available capacity has been used up by the analysis volumes. Conversely, it also provides an indication of the reserve capacity available for future growth in traffic volumes.

The Intersection Capacity Utilization (ICU) is another measure that expresses a value similar to the V/C ratio. Specifically, the ICU method "sums the amount of the time required to serve all movements at saturation for a given cycle length and divides by that reference cycle length." The ICU is considered a more accurate measure of volume to capacity conditions for a signalized intersection, primarily because it accounts for the effects of the signal timing on intersection capacity.

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Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage <b>Critical and Follow-up H</b> Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) <b>Delay, Queue Length, an</b> Flow Rate, v (veh/h)	eadwa	LT 31 3 ys 4.1 4.13 2.2 2.23 I of S 32	765	Undi				TR						22 3 7.1 6.43 3.5	LR 0 0 38	14 3 6.2 3.3
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Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage <b>Critical and Follow-up H</b> Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) <b>Delay, Queue Length, an</b> Flow Rate, v (veh/h) Capacity, c (veh/h) v/c Ratio	eadwa	LT 31 3 ys 4.1 4.13 2.2 2.23 I of S 32 1048 0.03	765	Undi				TR						22 3 7.1 6.43 3.5	LR 	14 3 6.2 3.3
Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehides (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage <b>Critical and Follow-up H</b> Base Critical Headway (sec) Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) Follow-Up Headway (sec) Follow-Up Headway (sec) Follow-Up Headway (sec) Follow-Up Headway (sec) Follow-Up Headway (sec) Critical Headway (sec) Critical Headway (sec) Follow-Up Headway (sec) Follow-Up Headway (sec) Capacity, c (veh/h) v/c Ratio	eadwa	LT 31 3 4.1 4.13 2.2 2.23 1 of S 32 1048 0.03 0.1	765	Undi				TR						22 3 7.1 6.43 3.5	LR 	14

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General Information	100	1.00	1.22	Ser in the			Sito	Inform	natio				12.8.10					
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Agency/Co.	CCI			1. 44	_	_	Jurisd				Knox County Emory Road							
Date Performed	11/5/2	2020			East/West Street							Emory Road Miller Farms Road "A"						
Analysis Year	2024	1.0		-			_				-	r Farms I	Koad "A"					
Time Analyzed	-		mbined					Hour Fac		1	0.89							
Intersection Orientation	East-V			TI	_		Analy	sis lime	Period (	nrs)	0.25		-		100			
Project Description	Miller	Farms	TIS - EBL	Lane		1.1.10	Constant Press			1								
Lanes		1151	S. Carrow				- 10- In	-			1							
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The market was shown and show a second of the first			_													_		
Approach		Eastk	bound			West	bound			North	bound			South	bound			
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Movement Priority Number of Lanes	100	L	Т		170	L	Т	6 0	U	L	Т	-	U	L	T 11 1	1000		
Movement Priority Number of Lanes Configuration	10	L 1 1 L	T 2 1 T	3	4U	L 4	T 5 1	6 0 TR	U	L 7	Т 8	9	U	L 10 0	T 11	12 0		
Movement Priority Number of Lanes Configuration Volume (veh/h)	10	L 1 1 L 13	T 2 1	3	4U	L 4	T 5	6 0	U	L 7	Т 8	9	U	L 10 0 24	T 11 1	12 0 30		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%)	10	L 1 1 L	T 2 1 T	3	4U	L 4	T 5 1	6 0 TR	U	L 7	Т 8	9		L 10 0	T 11 1	12 0		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked	10	L 1 1 L 13	T 2 1 T	3	4U	L 4	T 5 1	6 0 TR	U	L 7	Т 8	9		L 10 0 24 3	T 11 1 LR	12 0 30		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%)	10	L 1 1 L 13	T 2 1 T	3	4U	L 4	T 5 1	6 0 TR	U	L 7	Т 8	9		L 10 0 24 3	T 11 1	12 0 30		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized	10	L 1 1 L 13	T 2 1 T	3	4U 0	L 4	T 5 1	6 0 TR	U	L 7	Т 8	9		L 10 0 24 3	T 11 1 LR	12 0 30		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage		L 1 L 13 3	T 2 1 T	3	4U	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3	T 11 1 LR	12 0 30		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage Critical and Follow-up Heave		L 1 L 13 3	T 2 1 T	3	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3	T 11 1 LR	12 0 30 3		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage Critical and Follow-up Heading		L 1 L 13 3 	T 2 1 T	3	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3	T 11 1 LR	12 0 30 3 3		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage <b>Critical and Follow-up He</b> Base Critical Headway (sec)		L 1 13 3 9 9 8 4.1 4.13	T 2 1 T	3	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 7.1 6.43	T 11 1 LR	12 0 30 3 6.2 6.2		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage <b>Critical and Follow-up He</b> Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec)		L 1 1 13 3 3 <b>ys</b> 4.1 4.13 2.2	T 2 1 T	3	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 3 7.1 6.43 3.5	T 11 1 LR	12 0 30 3 3 6.2 6.23 3.3		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage <b>Critical and Follow-up He</b> Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec)	1U 0	L 1 1 13 3 3 <b>ys</b> 4.1 4.13 2.2 2.23	T 2 1 354	3 0 Undi	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 7.1 6.43	T 11 1 LR	12 0 30 3 6.2 6.23 3.3		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Proportion Time Blocked	1U 0	L 1 1 13 3 3 4.1 4.13 2.2 2.23 I of So	T 2 1 354	3 0 Undi	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 3 7.1 6.43 3.5	T 11 LR 0	12 0 30 3 6.2 6.2		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage Critical and Follow-up He Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) Delay, Queue Length, an Flow Rate, v (veh/h)	1U 0	L 1 1 13 3 3 4.1 4.13 2.2 2.23 I of So 15	T 2 1 354	3 0 Undi	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 3 7.1 6.43 3.5	T 11 LR 0	12 0 30 3 3 6.2 6.23 3.3		
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Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage Critical And Follow-up He Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec) Critical A follow for the	1U 0	L 1 1 13 3 3 4.1 4.13 2.2 2.23 1 of So 15 708 0.02	T 2 1 354	3 0 Undi	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 3 7.1 6.43 3.5	T 11 1 LR 0	12 0 300 3 3 6.2 6.2 3.3		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage Critical and Follow-up He Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec) Critical Actio Poss (veh/h) v/c Ratio PS% Queue Length, Q <sub>95</sub> (veh)	1U 0	L 1 1 13 3 3 4.1 4.13 2.2 2.23 1 of S 15 708 0.02 0.1	T 2 1 354	3 0 Undi	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 3 7.1 6.43 3.5	T 11 1 LR 0	12 0 30 3 3 6.2 6.23 3.3		
Movement Priority Number of Lanes Configuration Volume (veh/h) Percent Heavy Vehicles (%) Proportion Time Blocked Percent Grade (%) Right Turn Channelized Median Type   Storage Critical And Follow-up He Base Critical Headway (sec) Critical Headway (sec) Base Follow-Up Headway (sec) Critical A follow for the	1U 0	L 1 1 13 3 3 4.1 4.13 2.2 2.23 1 of So 15 708 0.02	T 2 1 354	3 0 Undi	4U 0	L 4	T 5 1	6 0 TR		L 7	Т 8	9		L 10 0 24 3 3 7.1 6.43 3.5	T 11 1 LR 0	12 0 300 3 3 6.2 6.2 3.3		



Concurl Information		-				-	Sito	Inform	natio		-	-	-			1.5
General Information	-		_	1					nation	•	-	<b>D</b>	Dead			
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Time Analyzed	6.000.0	eak - Co	mbined		1-1-1-1			Hour Fac						territes.	110-11-	
Intersection Orientation	East-\					100	Analy	sis Time	Period (	nrs)	0.25		-	-		
Project Description	Miller	Farms I	TIS - EBLT	Lane	1	-	and the second	A REAL PROPERTY					-			-
Lanes												1				
	r 2			24 1 4 4 4 F F	Ŀ Maje	÷۲. or Street: Ea	t tr r ist-West	412426								
Vehicle Volumes and Ad	justme	nts					1	191	100	19-14		1		0.21	1998	
Approach		Easth	oound			West	bound			North	bound			South		
Movement	U	L	Т	R	U	L	T	R	U	L	Т	R	U	L	Т	R
Priority	10	1	2	3	40	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		0	1	0
Configuration	_	L	T				-	TR							LR	
Volume (veh/h)		31	765				462	30						22		14
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)						_									0	
Right Turn Channelized			Land 1	-				-							6.10	
Median Type   Storage				Undi	vided						_					
<b>Critical and Follow-up H</b>	leadwa	ys	3.3.16			i										
Base Critical Headway (sec)	_	4.1												7.1		6.2
		1.12					-							6.43		6.2
Critical Headway (sec)		4.13									-			3.5		3.3
a service of the serv		4.13												3.5		125 1347
Critical Headway (sec)														3.5		3.3
Critical Headway (sec) Base Follow-Up Headway (sec)	ıd Leve	2.2 2.23	ervice											-		3.3
Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec)	nd Leve	2.2 2.23	ervice											-	38	3.3
Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) Delay, Queue Length, ar	Id Leve	2.2 2.23 of S	ervice											-	38 220	3.3
Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) <b>Delay, Queue Length, ar</b> Flow Rate, v (veh/h)	nd Leve	2.2 2.23 of S 32	ervice											-		3.3
Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) Delay, Queue Length, ar Flow Rate, v (veh/h) Capacity, c (veh/h)	nd Leve	2.2 2.23 <b>of S</b> 32 1048	ervice											-	220	3.3
Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) <b>Delay, Queue Length, ar</b> Flow Rate, v (veh/h) Capacity, c (veh/h) v/c Ratio	nd Leve	2.2 2.23 of S 32 1048 0.03	ervice											-	220 0.17	3.3
Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) <b>Delay, Queue Length, ar</b> Flow Rate, v (veh/h) Capacity, c (veh/h) v/c Ratio 95% Queue Length, Q <sub>95</sub> (veh)	nd Leve	2.2 2.23 <b>of S</b> 32 1048 0.03 0.1	ervice											-	220 0.17 0.6	3.3
Critical Headway (sec) Base Follow-Up Headway (sec) Follow-Up Headway (sec) Delay, Queue Length, ar Flow Rate, v (veh/h) Capacity, c (veh/h) v/c Ratio 95% Queue Length, Q <sub>95</sub> (veh) Control Delay (s/veh)	nd Leve	2.2 2.23 1 of S 32 1048 0.03 0.1 8.5 A	ervice											3.53 	220 0.17 0.6 24.7	3.3

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TABLE 5A	Project No: 00773-0013
KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLDS	Project Name: Miller Farm TIS
FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Notes:

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *							
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	<u> 350 - 399</u>		
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	30	25	20		
						and the second se		

700 - 749

750 or More

(If the left-turn volume exceeds the table value a left-turn lane is needed)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *						
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	<u>= / &gt; 600</u>	
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	20	
400 - 449	35	30	30	25	20	20	
450 - 499	30	25	25	20	20	<u> 20 - PM</u>	
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)
Study	AM Peak	861	354	13	20	No
Study	PM Peak	492	765	31	20	Yes

Source: Knox County Department of Engineering and Public Works "Access Control and Driveway Design Policy"

<u> 20 - AM</u>

TABLE 5B	Project No: (	00773-0013
KNOX COUNTY RIGHT-TURN LANE VOLUME THRESHOLDS	Project Name:	Miller Farm TIS
FOR 2-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH	Notes:	

RIGHT-TURN	THROUGH VOLUME PLUS LEFT-TURN VOLUME *							
	< 100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399		
Fewer Than 25								
25 - 49								
50 - 99								
100 - 149								
150 - 199								
200 - 249						Yes		
250 - 299					Yes	Yes		
300 - 349				Yes	Yes	Yes		
350 - 399			Yes	Yes	Yes	Yes		
400 - 449			Yes	Yes	Yes	Yes		
450 - 499		Yes	Yes	Yes	Yes	Yes		
500 - 549		Yes	Yes	Yes	Yes	Yes		
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes		
600 or More	Yes	Yes	Yes	Yes	Yes	Yes		

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *						
	350 - 399	400 - 449	<u>450 - 499</u>	500 - 549	550 - 599	<u>= / &gt; 600</u>	
Fewer Than 25						<u>X - AM</u>	
<u> 25 - 49</u>			<u>X - PM</u>		Yes	Yes	
50 - 99				Yes	Yes	Yes	
100 - 149			Yes	Yes	Yes	Yes	
150 - 199		Yes	Yes	Yes	Yes	Yes	
200 - 249	Yes	Yes	Yes	Yes	Yes	Yes	
250 - 299	Yes	Yes	Yes	Yes	Yes	Yes	
300 - 349	Yes	Yes	Yes	Yes	Yes	Yes	
350 - 399	Yes	Yes	Yes	Yes	Yes	Yes	
400 - 449	Yes	Yes	Yes	Yes	Yes	Yes	
450 - 499	Yes	Yes	Yes	Yes	Yes	Yes	
500 - 549	Yes	Yes	Yes	Yes	Yes	Yes	
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes	
600 or More	Yes	Yes	Yes	Yes	Yes	Yes	

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

Intersection	Time Period	Through Volume	Right-Turn Volume	Right-Turn Lane Warranted (Yes / No)
Study	AM Peak	856	5	No
Study	PM Peak	462	30	No

#### **TURN LANE IMPROVEMENTS**

**APPENDIX D - TURN LANE IMPROVEMENTS** 



