

ISABEL ESTATES
Transportation Impact Analysis
E Emory Road (SR 131)
Knoxville, TN

**A Transportation Impact Analysis for the Isabel Estates
Subdivision**

Submitted to

Knoxville - Knox County Planning

Revised September 23, 2021
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FMA Project No. 588.012

Submitted By:



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Executive Summary

Mesana Invesements, LLC is proposing a residential development located in Knox County, TN. The project is located north of the intersection of E Emory Road (SR 131) at Brackett Road. The full build out of the development will consist of a 122 single family lots. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2024.

The proposed driveway will connect to Brackett Road north of the intersection of E Emory Road (SR 131).

In order to maintain or provide an acceptable level-of-service for each of the intersections studied, some recommendations are presented.

E Emory Road (SR 131) @ Brackett Road

After the completion of the Isabel Estates residential development the southbound approach (Brackett Road) will operate at a LOS C during the AM peak hour and a LOS D during the PM peak hour. LOS D generally is considered the minimum acceptable condition in urban areas.

A westbound right turn lane on E Emory Road (SR 131) is not warranted and an eastbound left turn lane is warranted during the PM peak hour per the Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy."

FMA recommends that no more than 66 single family lots be built before re-evaluating the warrant for a left turn lane. The need for a left turn lane will be mitigated as long as the TDOT road widening project on E Emory Road (SR 131) remains active and on schedule.

Brackett Road @ Driveway Connection Road "A"

The southbound sight distance at the proposed intersection of Brackett Road at Driveway Connection Road "A" is partially blocked due to the existing trees and vegetation located within the right-of-way. FMA recommends that the sight distance be re-evaluated in the field after the completion of the proposed Isabel Estates residential development to ensure that the sight distance complies with the requirements for Knox County Engineering and Public Works.

Brackett Road

The existing width of Brackett Road between E Emory Road and the driveway connection (Road "A") varies between 18 feet and 20 feet and the length of Brackett Road between Bell Road and E Emory Road (SR 131) is 6,540 LF.

1 Introduction

1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the Isabel Estates Subdivision. The project is located north of the intersection of E Emory road (SR 131) at Brackett Road in Knox County, Tennessee. The location of the site is shown in Figure 1.

The full build out of the residential development will include 122 single family lots. Construction is proposed to take place this year, and this study assumes full build out for the development will occur in 2024.

The concept plan shows a single driveway connection at the intersection of Brackett Road at Road "A". The driveway connection (Road "A") is located approximately 2,210 feet north of E Emory Road (SR 131). Brackett Road and Road "A" are both two-lane two-way roads with no additional turn lanes for storage. The proposed site layout is shown in Figure 2.

The purpose of this study is to evaluate the impacts to the traffic conditions caused by the proposed residential development.

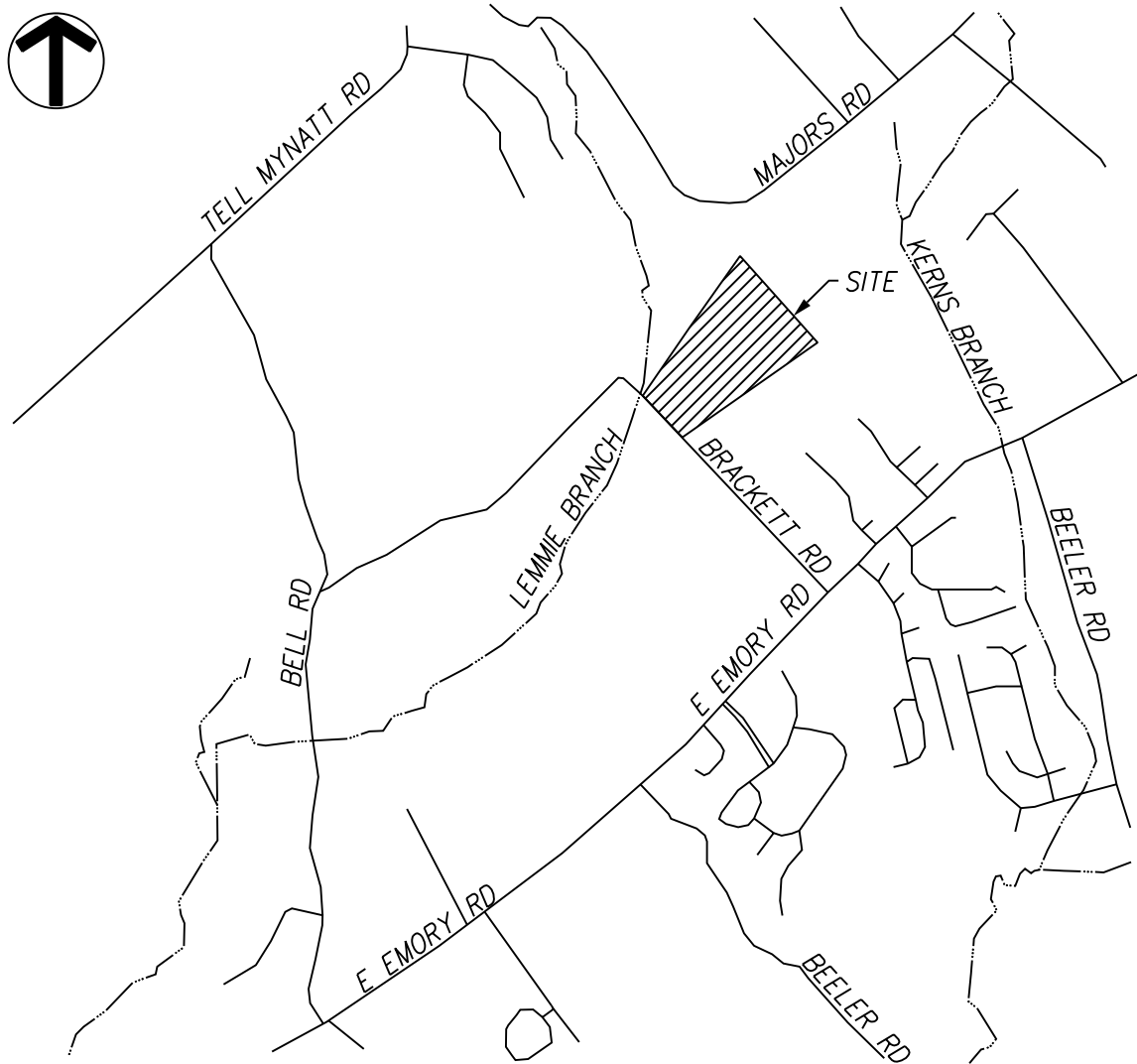


Figure 1: Location Map

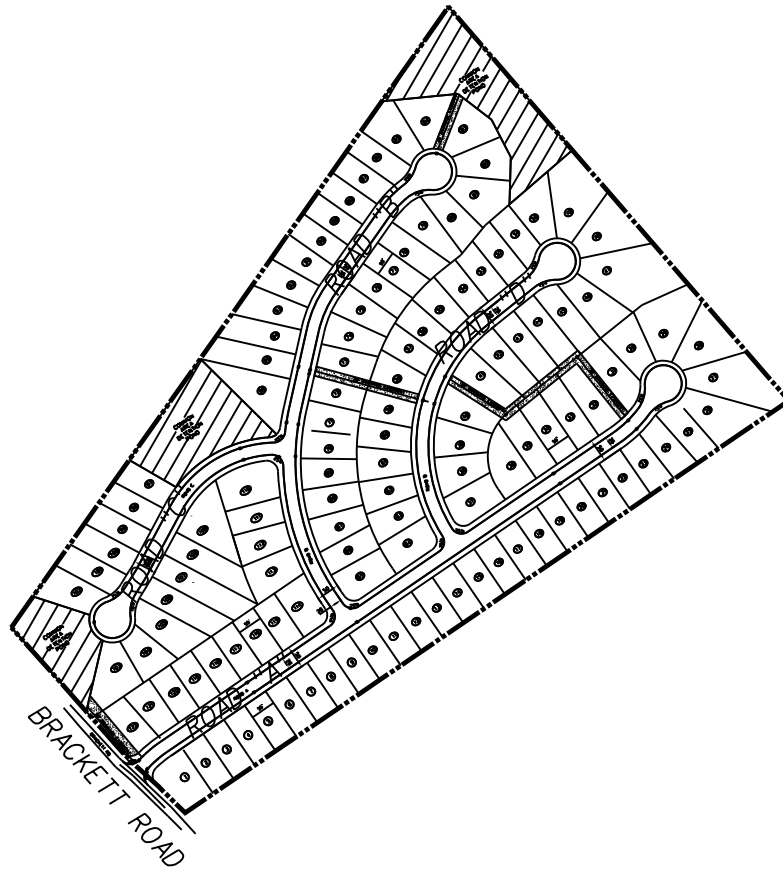


Figure 2: Site Plan

1.2 Existing Site Conditions

E Emory Road (SR 131) is a two-lane road with an approximate width of 22 feet at the intersection with Brackett Road. Knoxville-Knox County Planning classifies E Emory Road (SR 131) as a Major Arterial between Powell Drive and the Grainger County line with a 100 foot right-of-way per the Major Road Plan. The posted speed limit on E Emory Road (SR 131) is 45 mph.

Brackett Road is a two-lane road with an approximate width that varies between 18 feet and 20 feet. The approximate length of Brackett Road between Bell Road and E Emory Road (SR 131) is 6,540 LF. Knoxville-Knox County Planning does not classify Brackett Road; therefore, it is considered a local street. The posted speed limit on Brackett Road is 25 mph.

There are no existing sidewalks or designated bike lanes along E Emory Road (SR 131) or in the vicinity of the proposed development.

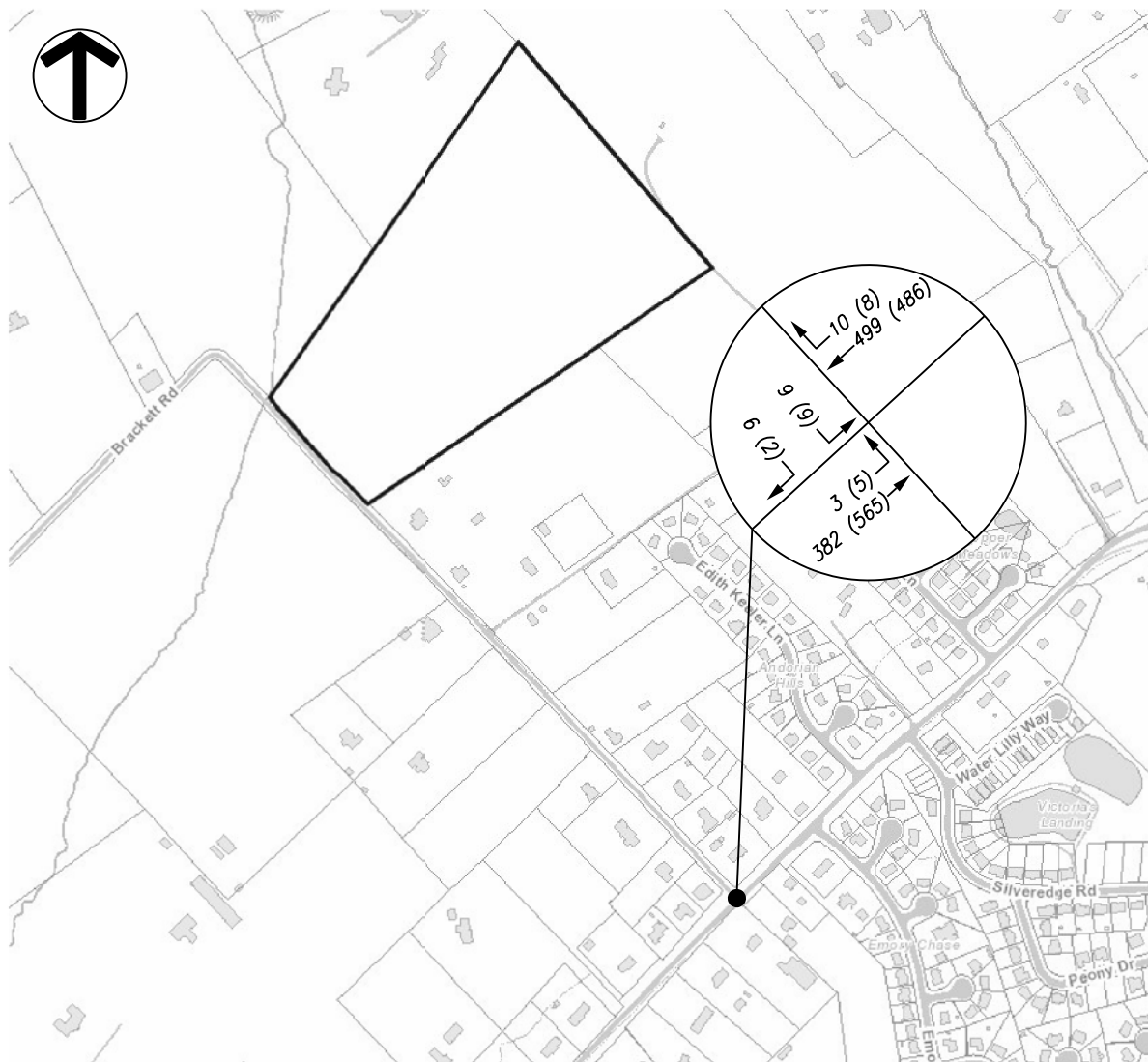
An aerial photo of the existing intersection is included in Attachment 1.

2 Existing Traffic Volumes

FMA conducted a peak hour turning movement count at the intersection of E Emory Road (SR 131) at Brackett Road on Wednesday August 18, 2021.

The current AM peak hour and PM peak hour were determined using the turning movement count that FMA conducted. At the intersection of E Emory Road (SR 131) at Brackett Road the AM peak hour occurred between 7:00 a.m. and 8:00 a.m., and the PM peak hour occurred between 3:45 p.m. and 4:45 p.m.

The existing volumes including the AM and PM peak hour traffic volumes at the count location are shown in Figure 3, and the count data collected is included in Attachment 2.



LEGEND:

← 5 (16) TURNING MOVEMENT VOLUME AM (PM)

Figure 3: 2021 Existing Peak Hour Traffic

3 Background Growth

The Tennessee Department of Transportation (TDOT) maintains count stations along E Emory Road (SR 131) in the vicinity of the proposed development.

TDOT count station # 000019 is located on E Emory Road (SR 131) northeast of Halls Crossroads and east of Willow Fork Lane. The annual growth rate for this station over the last ten years is approximately 1.18% and the 2019 ADT was 12,604 vehicles per day.

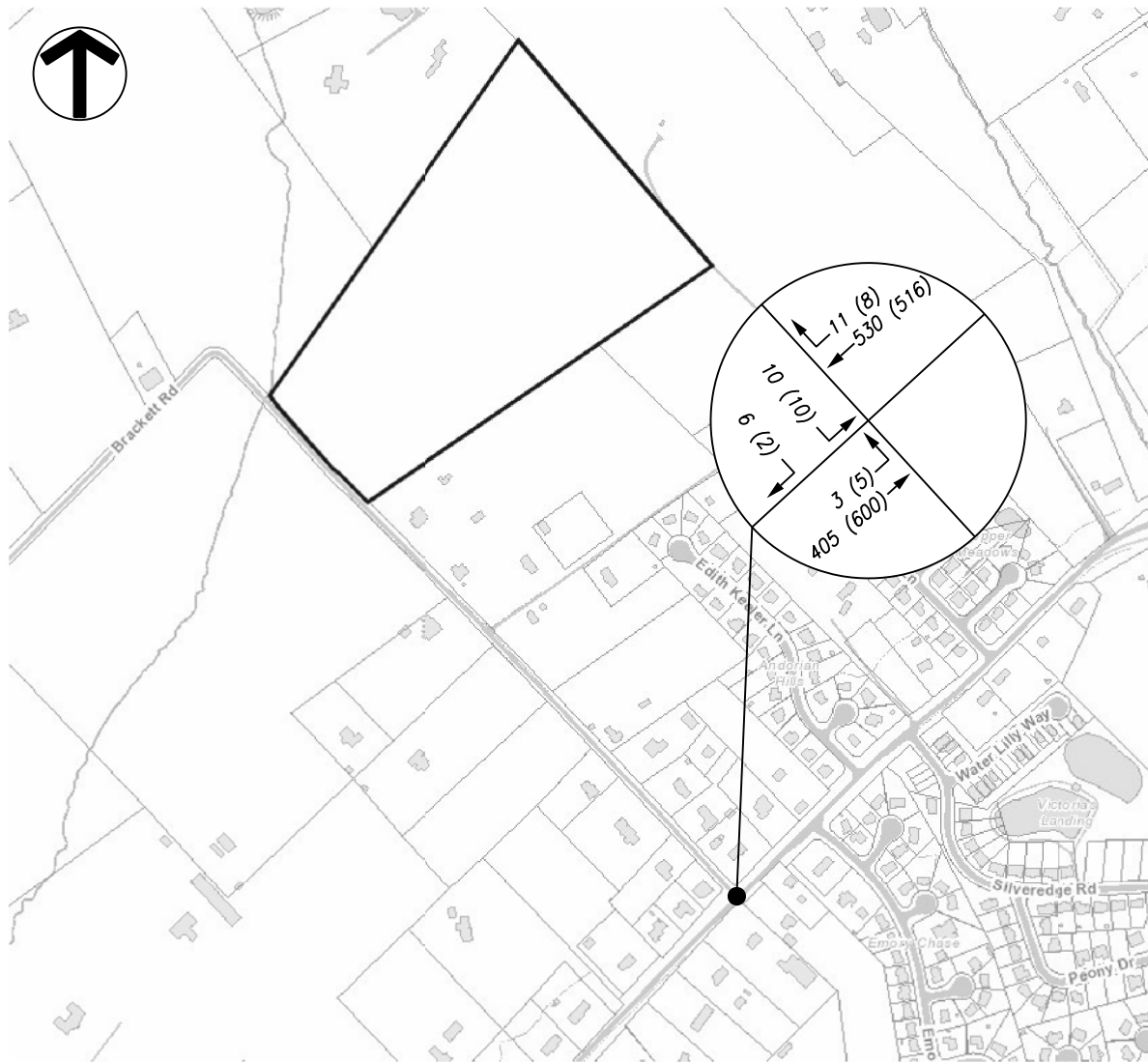
TDOT count station # 000009 is located on E Emory Road (SR 331) east of Tazewell Pike (SR 331). The annual growth rate for this station over the last ten years is approximately 2.51% and the 2019 ADT was 6,312 vehicles per day.

For the purpose of this study, an annual growth rate of 2.0% was assumed for the traffic at the intersection of E Emory Road (SR 131) at Brackett Road until full occupancy is reached in 2024. Attachment 3 shows the trend line growth charts for the TDOT count stations.

Figure 4 demonstrates the projected background peak hour volumes at the studied intersections after applying the background growth rate to the existing conditions.

3.1 TDOT Roadway Project

The Tennessee Department of Transportation is proposing a future road widening project on E Emory Road (SR 131) between Tazewell Pike (SR 131) and Maynardville Pike NE (SR 33). The scope of work for the project will include widening two lanes to four lanes with a median and/or center turn lane including bicycle and pedestrian facilities. The project is currently in the preliminary engineering phase and has a proposed letting date of the 4th quarter of 2025.



LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

Figure 4: 2024 Background Peak Hour Traffic

4 Trip Generation and Trip Distribution

The Isabel Estates residential development proposes a subdivision with 122 single-family lots. Single-Family Detached Housing or Land Use 210 was used to calculate site trips for the development using the fitted curve equations from the *Trip Generation, 10th Edition*, published by the Institute of Transportation Engineers. The land use worksheets are included in Attachment 4.

The total trips generated by the full buildout of the Isabel Estates subdivision was estimated to be 1,249 daily trips. The estimated trips are 91 trips during the AM peak hour and 123 trips during the PM peak hour. A trip generation summary is shown in Table 4-1.

Table 4-1
Isabel Estates
Trip Generation Summary

Land Use	Density	Daily Trips	AM Peak Hour		PM Peak Hour	
			Enter	Exit	Enter	Exit
Single-Family Detached Housing (Land Use 210)	122 lots	1,249	23	68	77	46

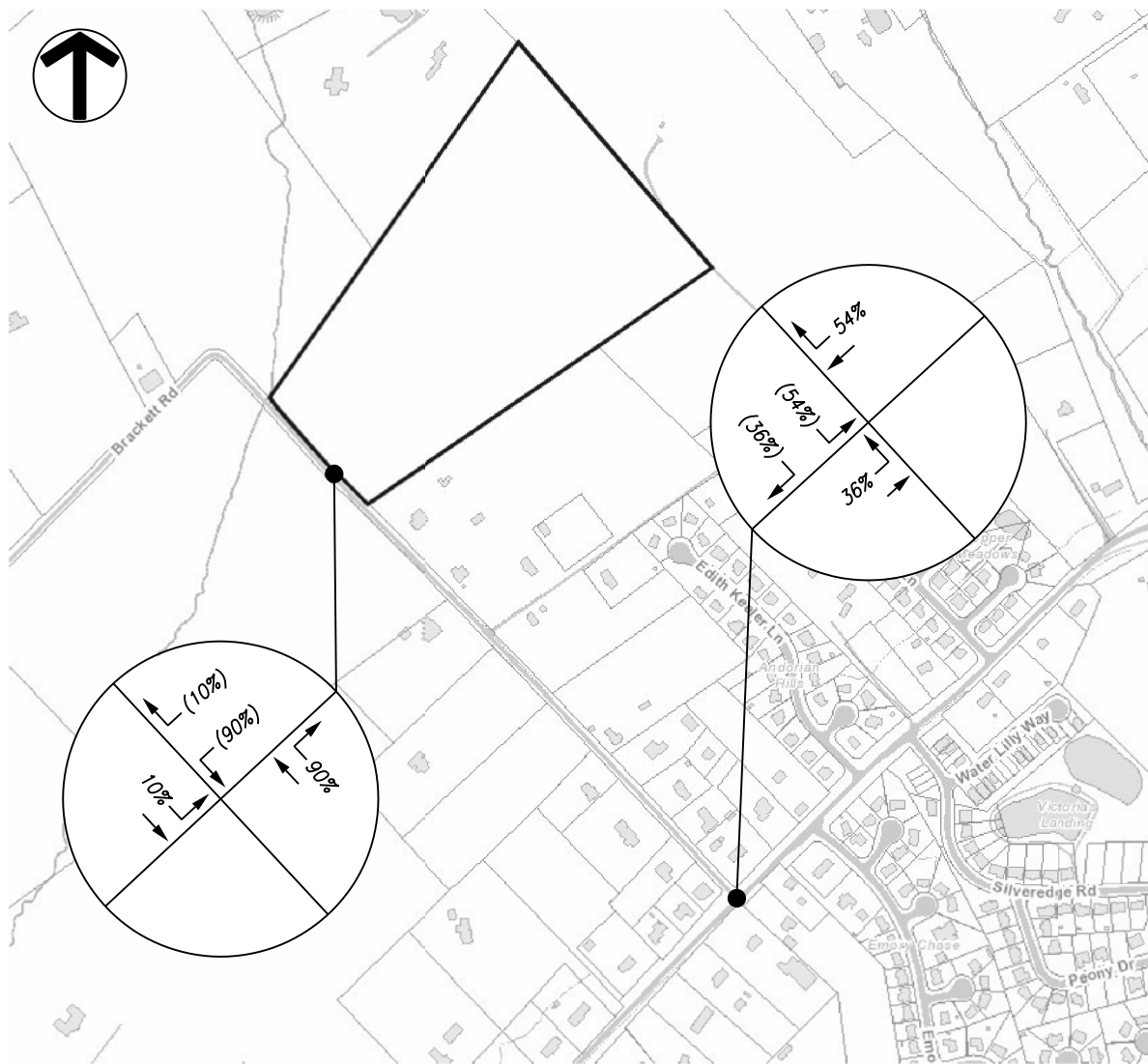
The existing distribution of traffic on E Emory Road (SR 131) at the intersection with Brackett Road is approximately 45% eastbound and 55% westbound during the AM peak hour and 55% eastbound and 45% westbound during the PM peak hour.

The existing entering/exiting distribution of traffic at the intersection of E Emory Road (SR 131) at Brackett Road is higher to/from the eastbound direction. E Emory Road (SR 131) eastbound leads to the intersection with Tazewell Pike (SR 331) and the Gibbs Elementary School, Gibbs Middle School and Gibbs High School and E Emory Road (SR 131) westbound leads to the intersection with Maynardville Pike (SR 33).

The directional distribution of the traffic generated by the Isabel Estates residential development was determined using the existing traffic volumes at the intersection of E Emory Road (SR 131) at Brackett Road in combination with the concept plan layout. FMA assumed that 90% of traffic from the proposed development would enter/exit from the intersection of E Emory Road (SR 131) at Brackett Road and that 10% of traffic would enter/exit from the intersection of Bell Road at Brackett Road.

Figure 5 shows the AM and PM peak hour trip distribution for the Isabel Estates subdivision. Figure 6 shows the AM and PM peak hour site trips generated by the Isabel Estates Subdivision.

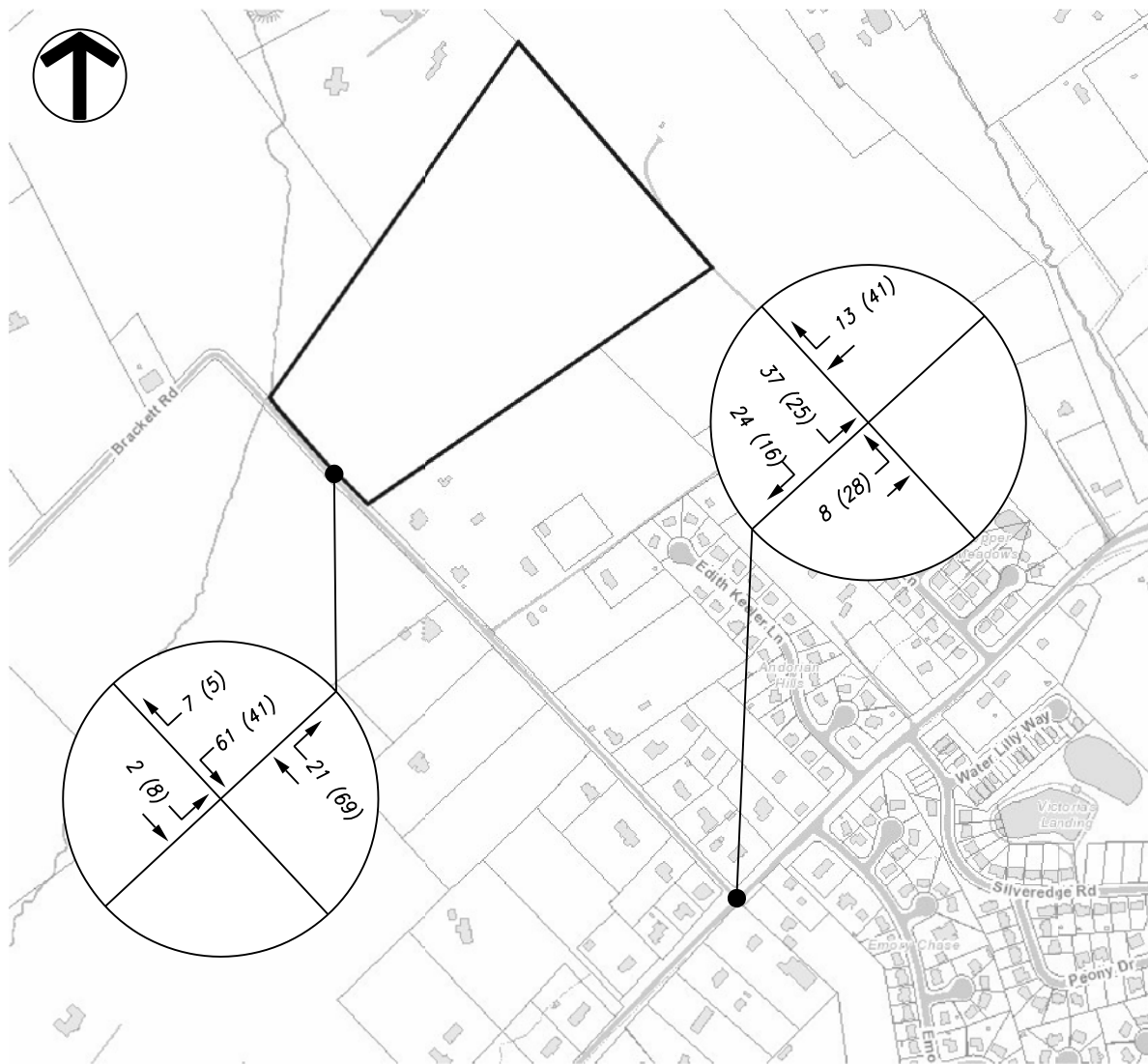
Figure 7 shows the 2024 full buildout peak hour traffic including the background traffic data and the peak hour site trips for the Isabel Estates.



LEGEND:

← 50% (50%) TRIP DISTRIBUTION ENTERING (EXITING)

Figure 5: Peak Hour Trip Distribution

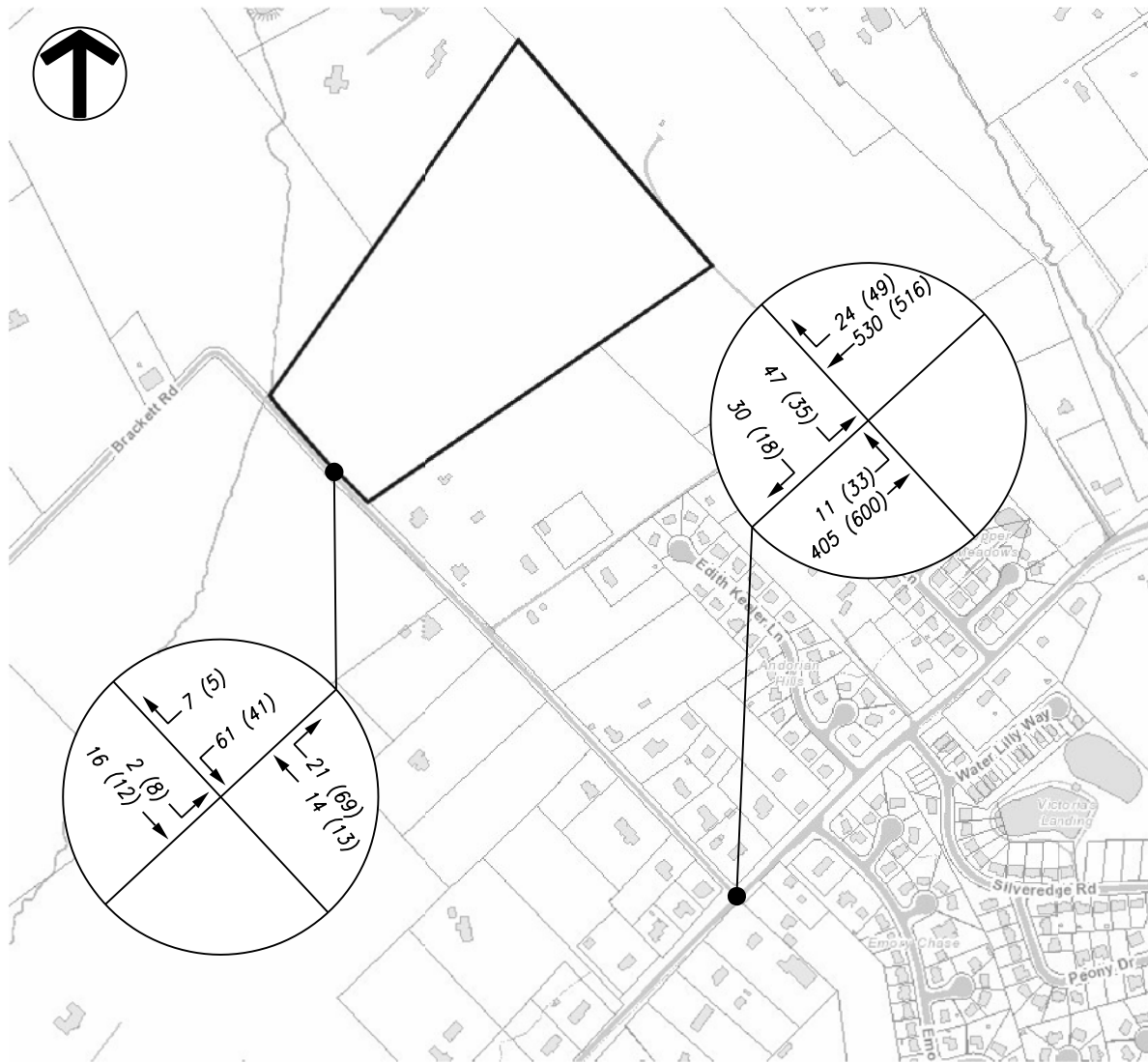


LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

Figure 6: Isabel Estates Peak Hour Site Trips



LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

Figure 7: 2024 Full Buildout Peak Hour Traffic

5 Projected Capacity and Level of Service

The existing intersection of E Emory Road (SR 131) at Brackett Road is a three-legged intersection with a stop sign for southbound traffic on Brackett Road.

Unsignalized intersection capacity analyses were performed using the Highway Capacity Software (HCS7) for the AM and PM peak hours to evaluate the existing, background and full buildout conditions at the intersection of E Emory Road (SR 131) at Brackett Road.

The results from the analyses are expressed with a term “level of service” (LOS), which is based on the amount of delay experienced at the intersection. The LOS index ranges from LOS A, indicating excellent traffic conditions with minimal delay, to LOS F indicating very congested conditions with excessive delay. LOS D generally is considered the minimum acceptable condition in urban areas. The HCS7 worksheets are included in Attachments 5, 6 and 7.

Table 5-1 shows the results of the capacity analyses.

**Table 5-1
Intersection Analysis
Level of Service (LOS) Summary**

Delay (sec)/LOS		
E Emory Road (SR 131) @ Brackett Road (Existing 2021)		
AM Peak	EB Left Turn	8.6 / A
	SB Approach	16.0 / C
PM Peak	EB Left Turn	8.6 / A
	SB Approach	21.4 / C
E Emory Road (SR 131) @ Brackett Road (Background 2024)		
AM Peak	EB Left Turn	8.7 / A
	SB Approach	17.1 / C
PM Peak	EB Left Turn	8.7 / A
	SB Approach	23.4 / C
E Emory Road (SR 131) @ Brackett Road (Full Buildout 2024)		
AM Peak	EB Left Turn	8.8 / A
	SB Approach	21.3 / C
PM Peak	EB Left Turn	8.9 / A
	SB Approach	28.8 / D

6 Turn Lane Warrant Analysis

The intersection of E Emory Road (SR 131) at Brackett Road was evaluated to determine if a westbound right turn lane or an eastbound left turn lane are warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information.

A westbound right turn lane is not warranted during either the AM or PM peak hour after the full buildout of the Isabel Estates.

An eastbound left turn lane is warranted during the PM peak hour due to the high volume of existing traffic on E Emory Road (SR 131). During the PM peak hour the through volume on E Emory Road (SR 131) is 600 vehicles per hour which puts the maximum allowed left turns before a warrant is met to between 15 left turns and 20 left turns depending on the assumption for the background growth rate. FMA assumed a conservative 2% growth rate but anything less than 2% would result in an estimated through volume on E Emory Road (SR 131) to be less than 600.

FMA calculated that 44 single family lots will increase the left turns to 15 and 66 single family lots will increase the left turns to 20; therefore, no more than 66 single family homes can be built before a left turn lane will be required at the intersection of E Emory Road (SR 131) at Brackett Road.

The turn lane warrant worksheets and analysis are included in Attachment 8.

7 Conclusions and Recommendations

7.1 E Emory Road (SR 131) @ Brackett Road

The existing, background and full buildout conditions at the unsignalized intersection of E Emory Road (SR 131) at Brackett Road were analyzed using the Highway Capacity Software (HCS7).

The existing and background traffic conditions for the eastbound left turn movement (E Emory Road (SR 131)) operate at a LOS A during both the AM and PM peak hours and the southbound approach (Brackett Road) operates at a LOS C during both the AM and PM peak hours.

After the completion of the Isabel Estates residential development the full buildout traffic conditions for the intersection of E Emory Road (SR 131) at Brackett Road will operate as follows. The eastbound left turn movement (E Emory Road (SR 131)) will

operate at a LOS A during both the AM and PM peak hours. The southbound approach (Brackett Road) will operate at a LOS C during the AM peak hour and a LOS D during the PM peak hour.

The 95% queue length is defined as the queue length that has only a 5-percent probability of being exceeded during the analysis time period. The 95% queue length is typically used to determine the length of turning lanes in order to minimize the risk of blockage.

The unsignalized intersection capacity analysis shows the full buildout 95% queue length for the southbound approach (Brackett Road) of 1.1 car lengths during both the AM and PM peak hours. The distance between E Emory Road (SR 131) and the first driveway connection on Brackett Road is approximately 70 feet, which will allow up to three cars to queue before blocking the driveway connection. Based on the HCS7 queue analysis the existing storage at the intersection of E Emory Road (SR 131) at Brackett Road is adequate and no improvements to the intersection are necessary in order to accommodate the Isabel Estates residential development.

A westbound right turn lane on E Emory Road (SR 131) is not warranted and an eastbound left turn lane is warranted during the PM peak hour per the Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy."

FMA recommends that no more than 66 single family lots be built before re-evaluating the warrant for a left turn lane. The need for a left turn lane will be mitigated as long as the TDOT road widening project on E Emory Road (SR 131) remains active and on schedule.

The minimum required sight distance for a road with a posted speed limit of 45 mph is 450 feet in each direction in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020. FMA measured the sight distance at the existing intersection of E Emory Road (SR 131) at Brackett Road in September 2021. At 15 feet from the edge of pavement the existing sight distance is 400 feet eastbound and 450 feet westbound. The inadequate sight distance eastbound is caused by the existing roadway profile.

7.2 Brackett Road @ Driveway Connection Road "A"

Brackett Road is not classified by the Major Road Plan; therefore, it is considered a local street. The minimum intersection spacing required on a local street is 125 feet per the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020. The Driveway Connection Road "A" is located approximately 2,210 feet

north of the intersection with E Emory Road (SR 131) and exceeds the typical minimum separation on a local street; therefore, no change is necessary.

The minimum required sight distance for a road with a posted speed limit of 25 mph is 250 feet in each direction in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020. FMA measured the sight distance at the proposed intersection of Brackett Road at Driveway Connection Road "A" in August 2021. At 15 feet from the edge of pavement the sight distance at the proposed intersection is greater than 250 feet northbound and southbound; however, the southbound sight distance is partially blocked due to the existing trees and vegetation located within the right-of-way.

FMA recommends that the sight distance be re-evaluated in the field after the completion of the proposed Isabel Estates residential development to ensure that the sight distance complies with the requirements for Knox County Engineering and Public Works.

Road "A", Road "B", Road "C" and Road "D" will have a width of 26 feet in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020.

Any required sight distance easements for the internal subdivision intersections of Road "A", Road "B", Road "C" and Road "D" should be coordinated with Knox County Engineering and Public Works and included on the final design drawings prior to construction of the subdivision.

7.3 Brackett Road

Per AASHTO "Guidelines for Geometric Design of Low-Volume Roads" Brackett Road is classified as a Rural Minor Access Road with its sole function to provide access to adjacent property. The minimum required roadway width for a minor access road with a 25 mph design speed is 18 feet. All low-volume roads have a maximum average daily traffic volume of 2,000 vehicles per day or less.

The existing width of Brackett Road between E Emory Road and the driveway connection (Road "A") varies between 18 feet and 20 feet and the length of Brackett Road between Bell Road and E Emory Road (SR 131) is 6,540 LF.

Attachment 1
Aerial Photo



E Emory Rd at Brackett Rd

Knoxville - Knox County - KUB Geographic Information System



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Attachment 2

Traffic Counts

Project: Isabel Estates

Intersection: E Emory Road (SR 131) @ Brackett Road

Date Conducted: 8/18/2021

	E Emory Road (SR 131) Eastbound			E Emory Road (SR 131) Westbound			Brackett Road Southbound			
Start	Left	Thru	Total	Thru	Right	Total	Left	Right	Total	Int. Total
7:00 AM	0	90	90	115	1	116	2	0	2	208
7:15 AM	3	91	94	136	3	139	3	2	5	238
7:30 AM	0	111	111	97	3	100	2	1	3	214
7:45 AM	0	90	90	151	3	154	2	3	5	249
Total	3	382	385	499	10	509	9	6	15	909
8:00 AM	1	79	80	116	1	117	2	2	4	201
8:15 AM	1	65	66	103	0	103	1	1	2	171
8:30 AM	0	41	41	105	1	106	3	1	4	151
8:45 AM	0	57	57	76	0	76	0	1	1	134
Total	2	242	244	400	2	402	6	5	11	657
2:00 PM	1	92	93	62	0	62	1	0	1	156
2:15 PM	1	104	105	62	0	62	2	0	2	169
2:30 PM	1	96	97	64	1	65	0	0	0	162
2:45 PM	4	108	112	76	0	76	4	2	6	194
Total	7	400	407	264	1	265	7	2	9	681
3:00 PM	1	93	94	79	4	83	2	2	4	181
3:15 PM	1	109	110	79	1	80	1	0	1	191
3:30 PM	0	108	108	116	0	116	1	1	2	226
3:45 PM	1	140	141	151	1	152	3	1	4	297
Total	3	450	453	425	6	431	7	4	11	895
4:00 PM	0	134	134	119	3	122	4	0	4	260
4:15 PM	1	149	150	101	2	103	2	1	3	256
4:30 PM	3	142	145	115	2	117	0	0	0	262
4:45 PM	0	184	184	110	0	110	0	0	0	294
Total	4	609	613	445	7	452	6	1	7	1072
5:00 PM	0	160	160	75	0	75	2	1	3	238
5:15 PM	4	146	150	77	1	78	1	0	1	229
5:30 PM	2	159	161	87	1	88	0	1	1	250
5:45 PM	4	137	141	104	3	107	2	2	4	252
Total	10	602	612	343	5	348	5	4	9	969
6:00 PM	1	144	145	114	3	117	3	2	5	267
6:15 PM	1	161	162	97	1	98	3	2	5	265
6:30 PM	1	146	147	96	1	97	2	0	2	246
6:45 PM	0	104	104	98	1	99	0	0	0	203
Total	3	555	558	405	6	411	8	4	12	981
Grand Total	25	2840	2865	2517	36	2553	41	24	65	5483
Approach %	0.9	99.1		98.6	1.4		63.1	36.9		
Total %	0%	52%	52%	46%	1%	47%	1%	0%	1%	

Project: Isabel Estates

Intersection: E Emory Road (SR 131) @ Brackett Road

Date Conducted: 8/18/2021

AM Peak Hour	7:00 AM - 8:00 AM	909
PM Peak Hour	3:45 PM - 4:45 PM	1075

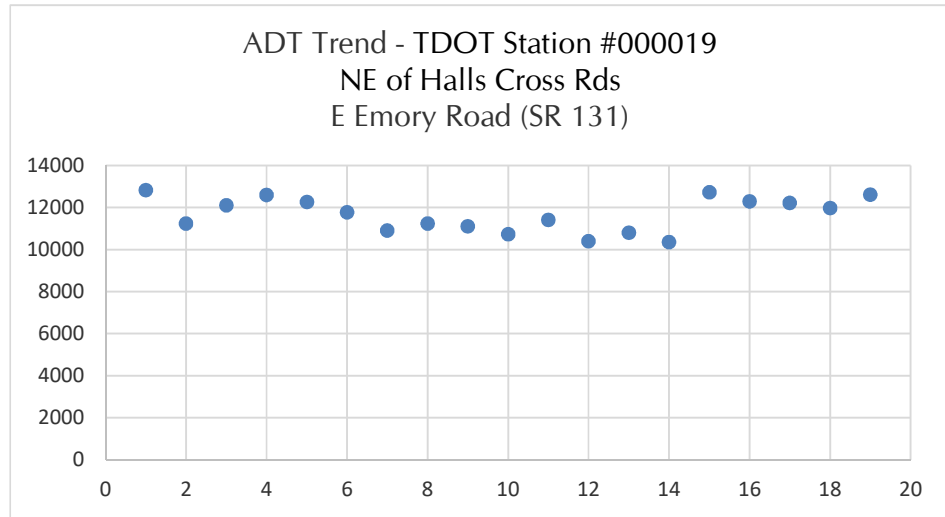
	E Emory Road (SR 131) Eastbound			E Emory Road (SR 131) Westbound			Brackett Road Southbound			
Start	Left	Thru	Total	Thru	Right	Total	Left	Right	Total	Int. Total
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:30 AM										
7:00 AM	0	90	90	115	1	116	2	0	2	208
7:15 AM	3	91	94	136	3	139	3	2	5	238
7:30 AM	0	111	111	97	3	100	2	1	3	214
7:45 AM	0	90	90	151	3	154	2	3	5	249
Total Volume	3	382	385	499	10	509	9	6	15	909
Future (2% over 3 yrs)	3	405		530	11		10	6		965
PHF	0.25	0.86		0.83	0.83		0.75	0.50		0.91
Peak Hour Analysis from 2:30 PM to 7:00 PM										
PM Peak Hour begins at 5:15 PM										
3:45 PM	1	140	141	151	1	152	3	1	4	297
4:00 PM	0	134	134	119	3	122	4	0	4	260
4:15 PM	1	149	150	101	2	103	2	1	3	256
4:30 PM	3	142	145	115	2	117	0	0	0	262
Total Volume	5	565	570	486	8	494	9	2	11	1075
Future (2% over 3 yrs)	5	600		516	8		10	2		1141
PHF	0.42	0.95		0.80	0.67		0.56	0.50		0.90

Attachment 3

ADT Trends

Adjusted
Average Daily

Year	Traffic
2001	12829
2002	11236
2003	12105
2004	12600
2005	12267
2006	11770
2007	10909
2008	11236
2009	11112
2010	10728
2011	11406
2012	10403
2013	10806
2014	10363
2015	12727
2016	12299
2017	12222
2018	11976
2019	12604

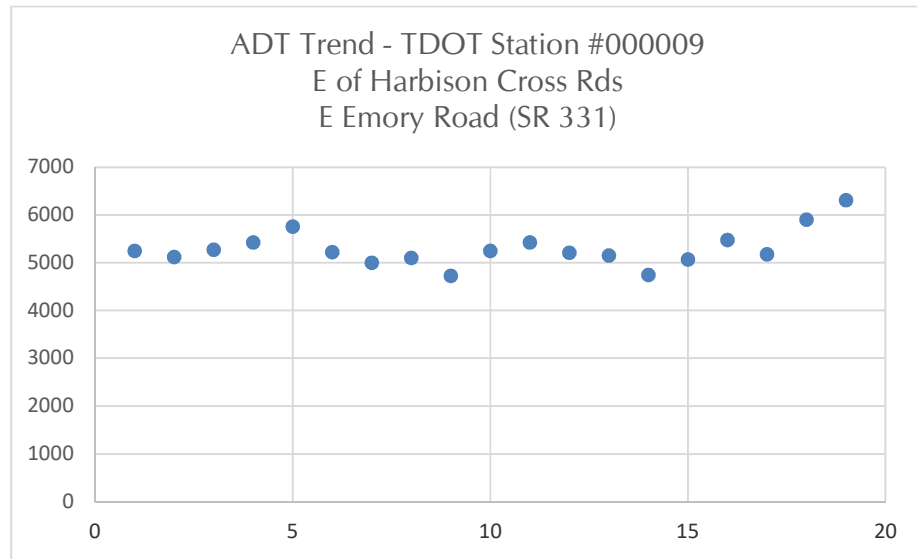


Most Recent Trend Line Growth

Year	ADT
2009	11112
2019	12604

Annual Percent Growth	1.18%
-----------------------	-------

Year	Adjusted Average Daily Traffic
2001	5250
2002	5122
2003	5276
2004	5429
2005	5761
2006	5222
2007	4998
2008	5104
2009	4729
2010	5249
2011	5430
2012	5208
2013	5156
2014	4749
2015	5072
2016	5480
2017	5180
2018	5905
2019	6312



Most Recent Trend Line Growth

Year	ADT
2009	4729
2019	6312

Annual Percent Growth	2.51%
------------------------------	--------------

E of Tazewell Pike

Attachment 4

Trip Generation

Project: Isabel Estates

Date Conducted: 8/22/2021

Single-Family Detached Housing (LUC 210)

122 Single Family Lots

Average Daily Traffic

$$\ln(T) = 0.92\ln(X) + 2.71$$

$$\ln(T) = 0.92\ln(122) + 2.71$$

$$T = 1249$$

Peak Hour of Adjacent Street Traffic

One Hour Between 7 and 9 a.m.

$$T = 0.71(X) + 4.80$$

$$T = 0.71(122) + 4.80$$

$$T = 91$$

Peak Hour of Adjacent Street Traffic

One Hour Between 4 and 6 p.m.

$$\ln(T) = 0.96\ln(X) + 0.20$$

$$\ln(T) = 0.96\ln(122) + 0.20$$

$$T = 123$$

Time Period	Total Trips	Percent		Number	
		Enter	Exit	Enter	Exit
Weekday (24 hours)	1249	50%	50%	625	625
AM Peak Hour	91	25%	75%	23	68
PM Peak Hour	123	63%	37%	77	46

Single-Family Detached Housing (210)

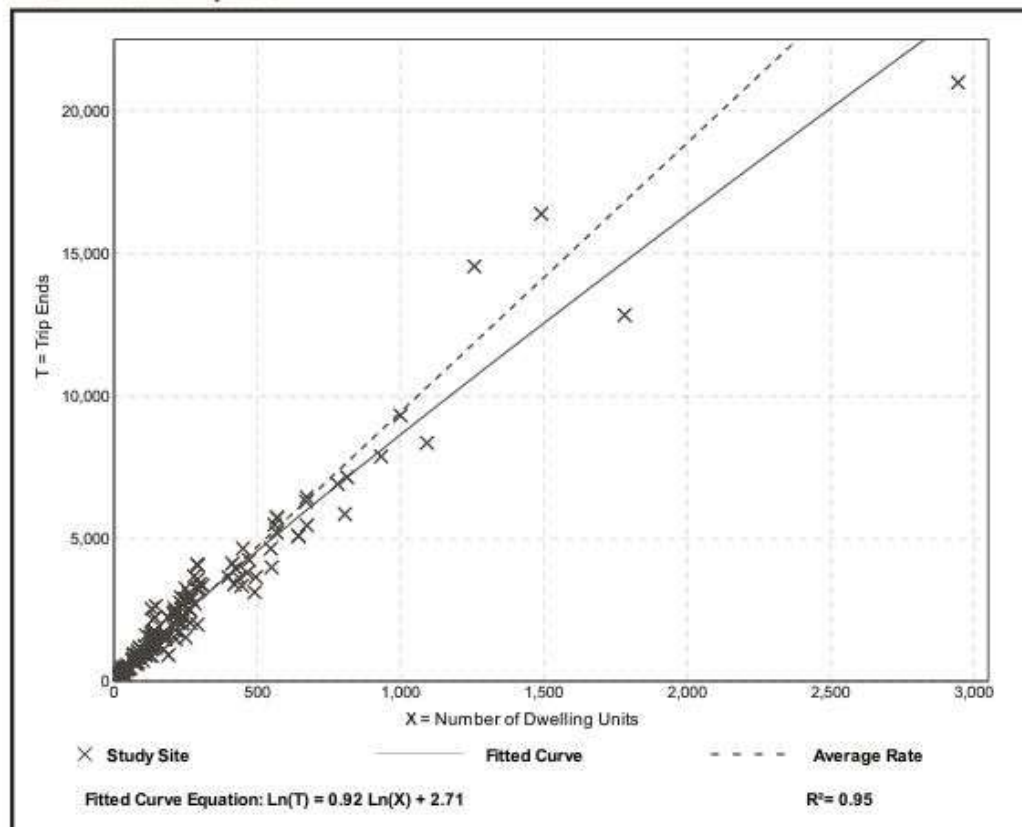
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

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



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

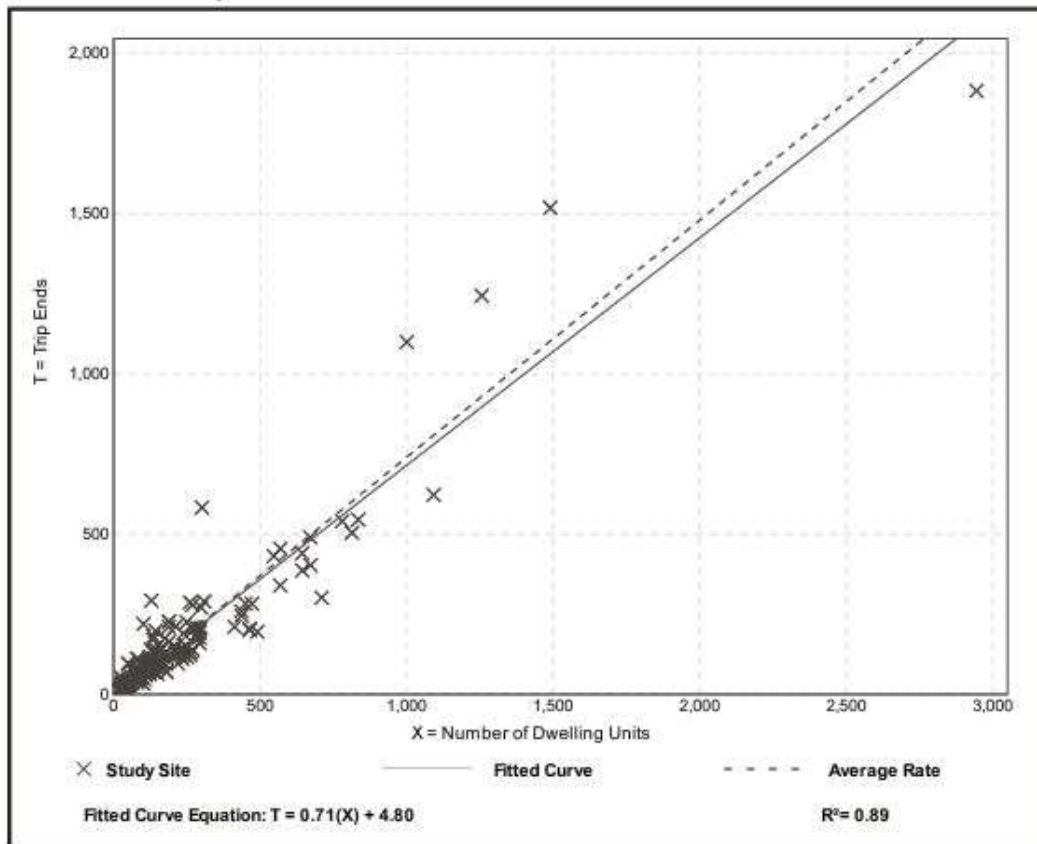
Avg. Num. of Dwelling Units: 219

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



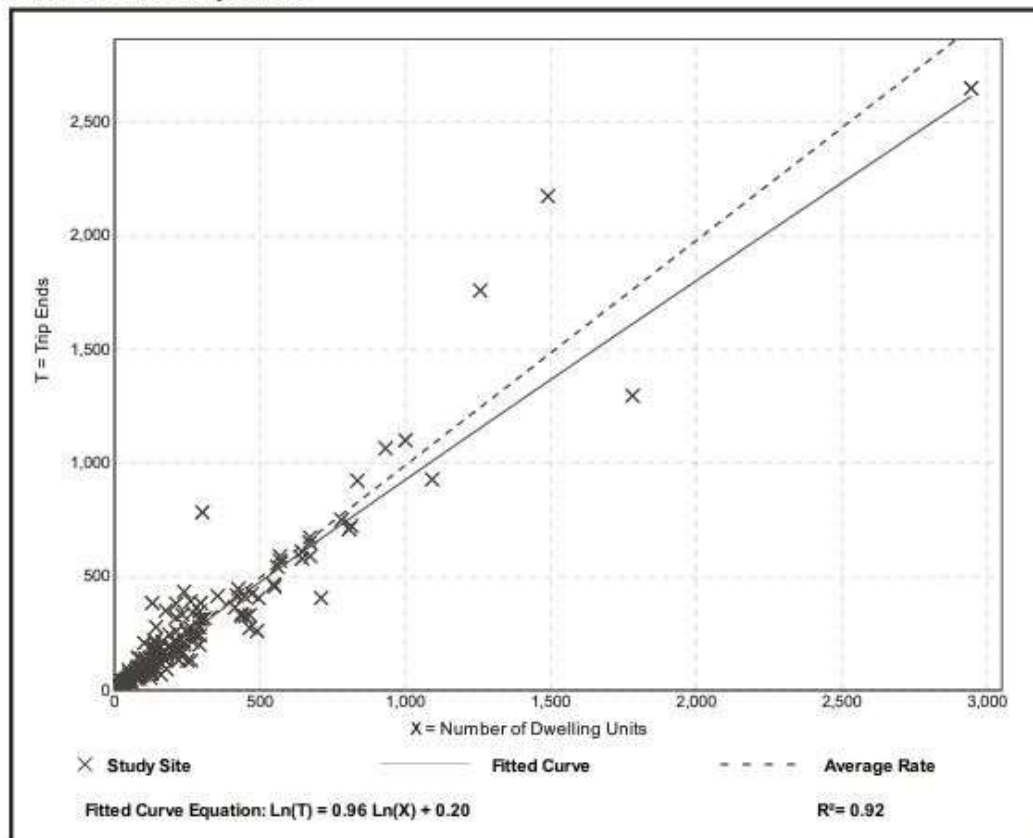
Single-Family Detached Housing (210)

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



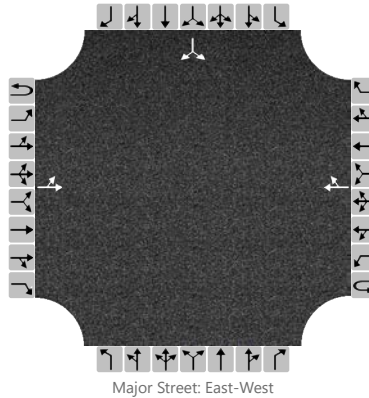
Attachment 5
Intersection Worksheets – Existing AM/PM Peaks

HCS7 Two-Way Stop-Control Report

General Information

Analyst	Addie Kirkham	Intersection	E Emory Rd at Brackett Rd
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	8/25/2021	East/West Street	E Emory Road (SR 131)
Analysis Year	2021	North/South Street	Brackett Road
Time Analyzed	Existing AM Peak	Peak Hour Factor	0.91
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	588.012 - Isabel Estates		

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		3	382				499	10						9		6
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.12												6.42		6.22
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.22												3.52		3.32

Delay, Queue Length, and Level of Service

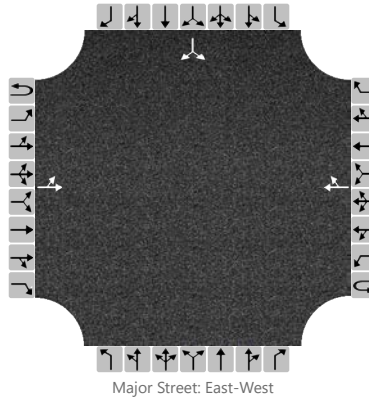
Flow Rate, v (veh/h)		3													17	
Capacity, c (veh/h)		1011													344	
v/c Ratio		0.00													0.05	
95% Queue Length, Q ₉₅ (veh)		0.0													0.2	
Control Delay (s/veh)		8.6													16.0	
Level of Service, LOS		A													C	
Approach Delay (s/veh)	0.1												16.0			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	Addie Kirkham	Intersection	E Emory Rd at Brackett Rd
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	8/25/2021	East/West Street	E Emory Road (SR 131)
Analysis Year	2021	North/South Street	Brackett Road
Time Analyzed	Existing PM Peak	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	588.012 - Isabel Estates		

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		5	565				486	8						9		2
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.12												6.42		6.22
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.22												3.52		3.32

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		6													12	
Capacity, c (veh/h)		1020													232	
v/c Ratio		0.01													0.05	
95% Queue Length, Q ₉₅ (veh)		0.0													0.2	
Control Delay (s/veh)		8.6													21.4	
Level of Service, LOS		A													C	
Approach Delay (s/veh)	0.2												21.4			
Approach LOS													C			

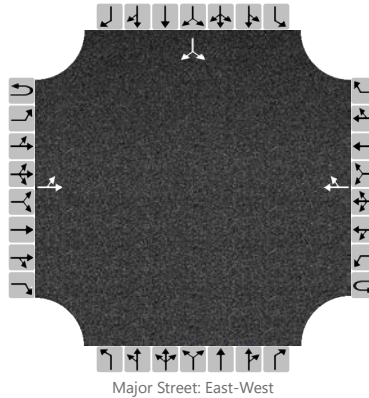
Attachment 6
Intersection Worksheets – Background AM/PM Peaks

HCS7 Two-Way Stop-Control Report

General Information

Analyst	Addie Kirkham	Intersection	E Emory Rd at Brackett Rd
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	8/25/2021	East/West Street	E Emory Road (SR 131)
Analysis Year	2024	North/South Street	Brackett Road
Time Analyzed	Background AM Peak	Peak Hour Factor	0.91
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	588.012 - Isabel Estates		

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		3	405				530	11						10		6
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.12												6.42		6.22
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.22												3.52		3.32

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		3													18	
Capacity, c (veh/h)		982													316	
v/c Ratio		0.00													0.06	
95% Queue Length, Q ₉₅ (veh)		0.0													0.2	
Control Delay (s/veh)		8.7													17.1	
Level of Service, LOS		A													C	
Approach Delay (s/veh)	0.1												17.1			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

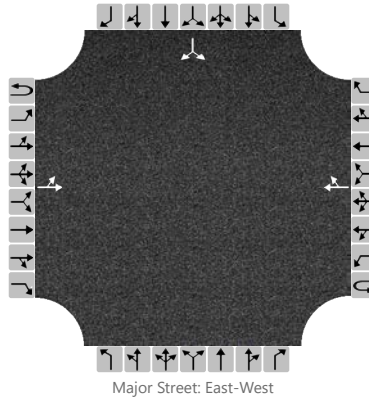
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	8/25/2021
Analysis Year	2024
Time Analyzed	Background PM Peak
Intersection Orientation	East-West
Project Description	588.012 - Isabel Estates

Site Information

Intersection	E Emory Rd at Brackett Rd
Jurisdiction	Knox County
East/West Street	E Emory Road (SR 131)
North/South Street	Brackett Road
Peak Hour Factor	0.90
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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		5	600				516	8						10		2
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.12												6.42		6.22
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.22												3.52		3.32

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		6													13	
Capacity, c (veh/h)		992													208	
v/c Ratio		0.01													0.06	
95% Queue Length, Q ₉₅ (veh)		0.0													0.2	
Control Delay (s/veh)		8.7													23.4	
Level of Service, LOS		A													C	
Approach Delay (s/veh)	0.2												23.4			
Approach LOS													C			

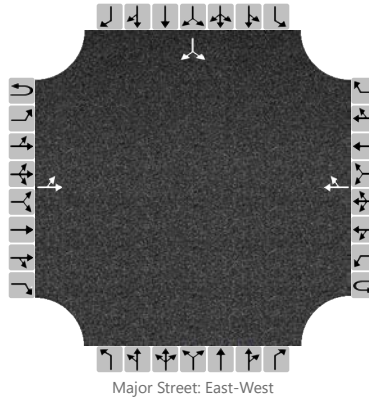
Attachment 7
Intersection Worksheets – Full Buildout AM/PM Peaks

HCS7 Two-Way Stop-Control Report

General Information

Analyst	Addie Kirkham	Intersection	E Emory Rd at Brackett Rd
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	8/25/2021	East/West Street	E Emory Road (SR 131)
Analysis Year	2024	North/South Street	Brackett Road
Time Analyzed	Full Buildout AM Peak	Peak Hour Factor	0.91
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	588.012 - Isabel Estates		

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		11	405				530	24						47		30
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.12												6.42		6.22
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.22												3.52		3.32

Delay, Queue Length, and Level of Service

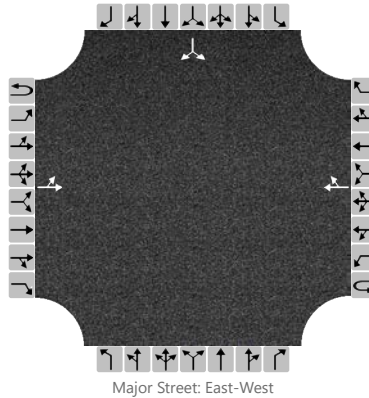
Flow Rate, v (veh/h)		12													85	
Capacity, c (veh/h)		970													305	
v/c Ratio		0.01													0.28	
95% Queue Length, Q ₉₅ (veh)		0.0													1.1	
Control Delay (s/veh)		8.8													21.3	
Level of Service, LOS		A													C	
Approach Delay (s/veh)	0.4												21.3			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

General Information

Analyst	Addie Kirkham	Intersection	E Emory Rd at Brackett Rd
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	8/25/2021	East/West Street	E Emory Road (SR 131)
Analysis Year	2024	North/South Street	Brackett Road
Time Analyzed	Full Buildout PM Peak	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	588.012 - Isabel Estates		

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	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		33	600				516	49						35		18
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.12												6.42		6.22
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.22												3.52		3.32

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		37													59	
Capacity, c (veh/h)		954													210	
v/c Ratio		0.04													0.28	
95% Queue Length, Q ₉₅ (veh)		0.1													1.1	
Control Delay (s/veh)		8.9													28.8	
Level of Service, LOS		A													D	
Approach Delay (s/veh)	1.0												28.8			
Approach LOS													D			

Attachment 8
Turn Lane Warrant Analysis

Attachment 8

Turn Lane Warrant Analysis

Project: Isabel Estates

E Emory Road (SR 131) at Brackett Road

**E Emory Road (SR 131)
at Brackett Road** VOLUMES

LEFT TURN	Opposing	Thru	LT	LT MAX	Warrant Met
AM	554	405	11	20	NO
PM	565	600	33	15/20	YES

**E Emory Road (SR 131)
at Brackett Road** VOLUMES

RIGHT TURN	Thru	RT	RT MAX	Warrant Met
AM	530	24	100	NO
PM	516	49	100	NO

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

(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	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	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	AM Peak 11 LT		20	PM Peak 33 LT	
650 - 699	20		20	20		
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

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

RIGHT-TURN VOLUME	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 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399			Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	Yes Yes	Yes Yes	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	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99			AM Peak 24 RT PM Peak 49 RT	8 Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	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.



Date: September 23, 2021

Project Name: Isabel Estates

To: Knoxville-Knox County Planning

Subject: TIA Review for Isabel Estates (10-SC-21-C / 10-E-21-UR)

Dear Knoxville-Knox County Planning staff,

The following comment response document is submitted to address comments dated September 17, 2021:

- 1. Reviewer Comment:** The Existing Site Conditions listed on Page 7 reference an incorrect posted speed limit for E. Emory Road. The speed limit for this section of E. Emory Road is 45 mph instead of the 35 mph that was indicated. The subsequent analyses that were performed including sight distance evaluation and turn lane warrants need to be updated to reflect a 45 mph posted speed limit.

Response: Updated the speed limit to 45 mph on Page 7 and adjusted the sight distance and turn lane requirements.

- 2. Reviewer Comment:** With the update to 45 mph posted speed limit it appears that turn lanes will be warranted on E. Emory Rd at Brackett Rd. Your analysis should include a specific trigger point in terms of the projected number of new single family units that can be built prior to the warrant(s) being met. This may allow for some development to occur prior to needing turn lanes to be constructed and also allow for more information on the projected timeframe of the planned TDOT widening project on E. Emory Rd.

Response: Added the following statement to the Conclusions and Recommendations on Page 20. "FMA recommends that no more than 66 single family lots be built before re-evaluating the warrant for a left turn lane. The need for a left turn lane will be mitigated as long as the TDOT road widening project on E Emory Road (SR 131) remains active and on schedule."

- 3. Reviewer Comment:** The TIS should reference that this section of E. Emory Road (SR-131) is listed on TDOT's IMPROVE Act project list for future widening. The project is in the early Preliminary Engineering stages but is currently proposed as a 4 or 5-lane cross section with bike and pedestrian facilities.

Response: Added section 3.1 TDOT Roadway Project to include the preliminary information for the roadway widening project on E Emory Road (SR 131).

Mr. Conger
September 23, 2021
Page 2 of 2

Sincerely,



Addie Kirkham, P.E.