HEARTLAND DENTAL OFFICE & RETAIL

Traffic Impact Study

E Emory Road (SR 131)

Knoxville, TN

A Traffic Impact Study for the Proposed Heartland Dental Office & Retail Building

Submitted to

Knoxville – Knox County Metropolitan Planning Commission

Revised May 29, 2018
April 30, 2018
FMA Project No. 615.001

Submitted By:

FULGHUM MACINDOE & ASSOCIATES, INC.

10330 HARDIN VALLEY ROAD SUITE 201 KNOXVILLE, TN 37932 T 865.690.6419 F 865.690.6448 www.fulghummacindoe.com

TABLE OF CONTENTS

FIGURES

ATTACHMENTS

Executive Summary

Professional Resource Development, Inc. is proposing a development with a dental office building and retail building in Knox County. The project is located north of the intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71). The development will consist of a 4,280 SF dental office and a 5,000 SF retail building. The proposed site access will connect to the established ALDI parking lot which has an existing driveway connection to both E. Emory Road (SR 131) and Norris Freeway (SR 71). Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2021.

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) @ Existing Driveway Connection
After the completion of the Heartland Dental Office and Retail Building the eastbound approach will continue to operate at a LOS A and the southbound approach will operate at a LOS B during the AM peak and PM peak hours.

It is estimated based on field observations that the existing driveway connection is blocked by the traffic from the signalized intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) approximately 20% during the AM peak hour and 10% during the PM peak hour.

The existing eastbound left turn lane on E. Emory Road (SR 131) measures 50 feet with enough storage space for approximately 2 vehicles. The unsignalized intersection capacity analyses show a 95% queue length of less than one vehicle during both the AM and PM peak hour after the completion of the Heartland Dental Office and Retail Building, therefore; the existing geometry of the intersection will be adequate.

Norris Freeway (SR 71) @ Existing Driveway Connection
After the completion of the Heartland Dental Office and Retail Building the westbound approach will operate at a LOS B during the AM peak and a LOS C during the PM peak hour and the southbound approach will continue to operate at a LOS A during both the AM and PM peak hours.

A left turn lane on Norris Freeway (SR 71) is met during the PM peak hour for both the background conditions and after the full buildout of the Heartland Dental Office and Retail Building.

E Emory Road (SR 131) @ Norris Freeway (SR 71)

After the completion of the Heartland Dental and Retail Building the signalized intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) will operate at a LOS D during AM peak hour and a LOS E during the PM peak hour using the existing signal timing provided by Knox County.

1 Introduction

1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the proposed Heartland Dental Office and Retail Building. The project is located north of the intersection of E. Emory Road at Norris Freeway (SR 71) in Knox County. The location of the site is shown in Figure 1.

The development will consist of a 4,280 SF dental office and a 5,000 SF retail building. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2021.

The development will connect to the existing ALDI parking lot. The ALDI has an existing driveway connection to both E. Emory Road (SR 131) and Norris Freeway (SR 71). ALDI is currently open for business and typically operates from 9:00 AM to 8:00 PM daily. The traffic from the Heartland Dental Office and Retail Building will enter and exit the site using the existing driveway connections. 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 development.

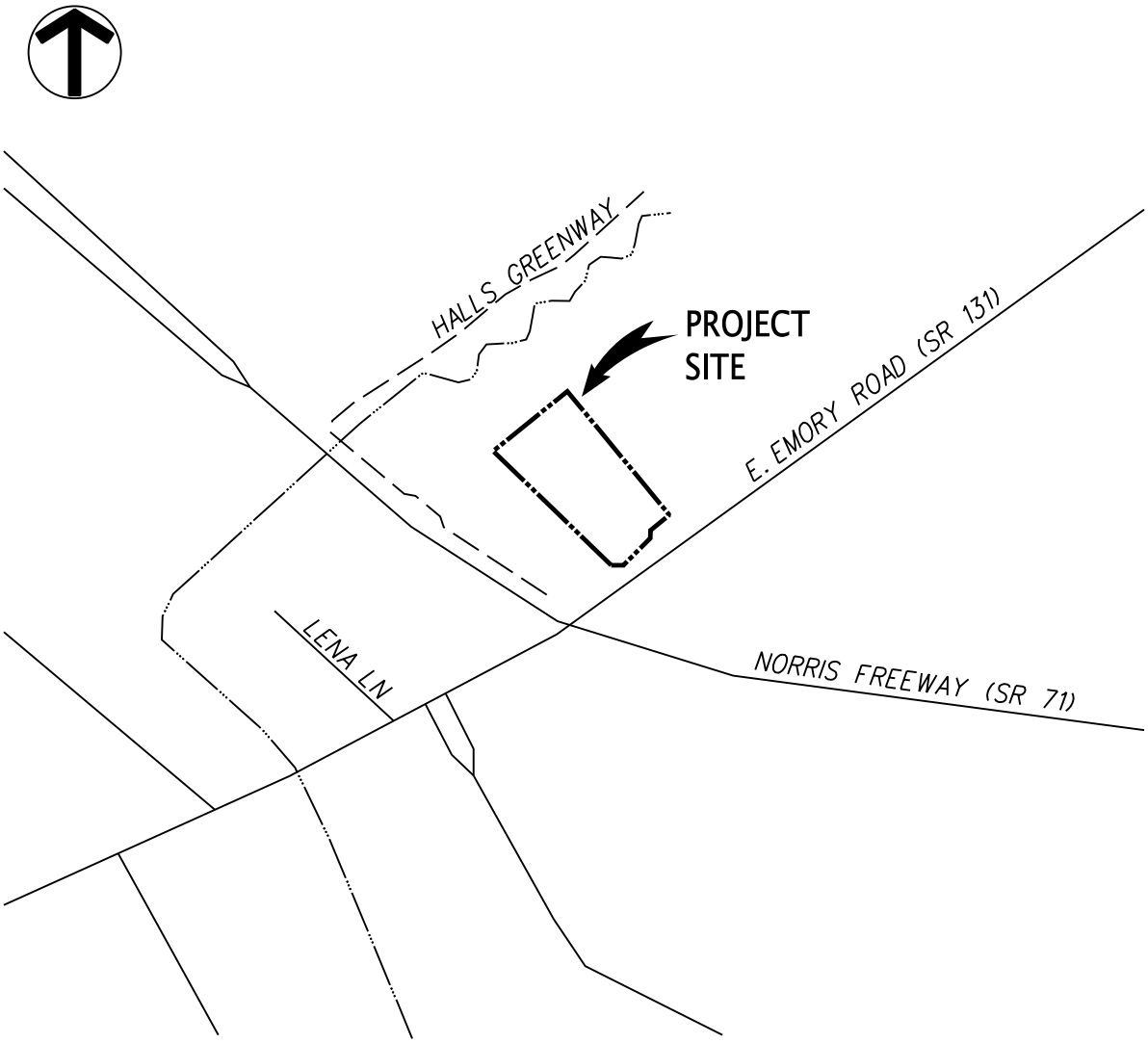


Figure 1: Location Map

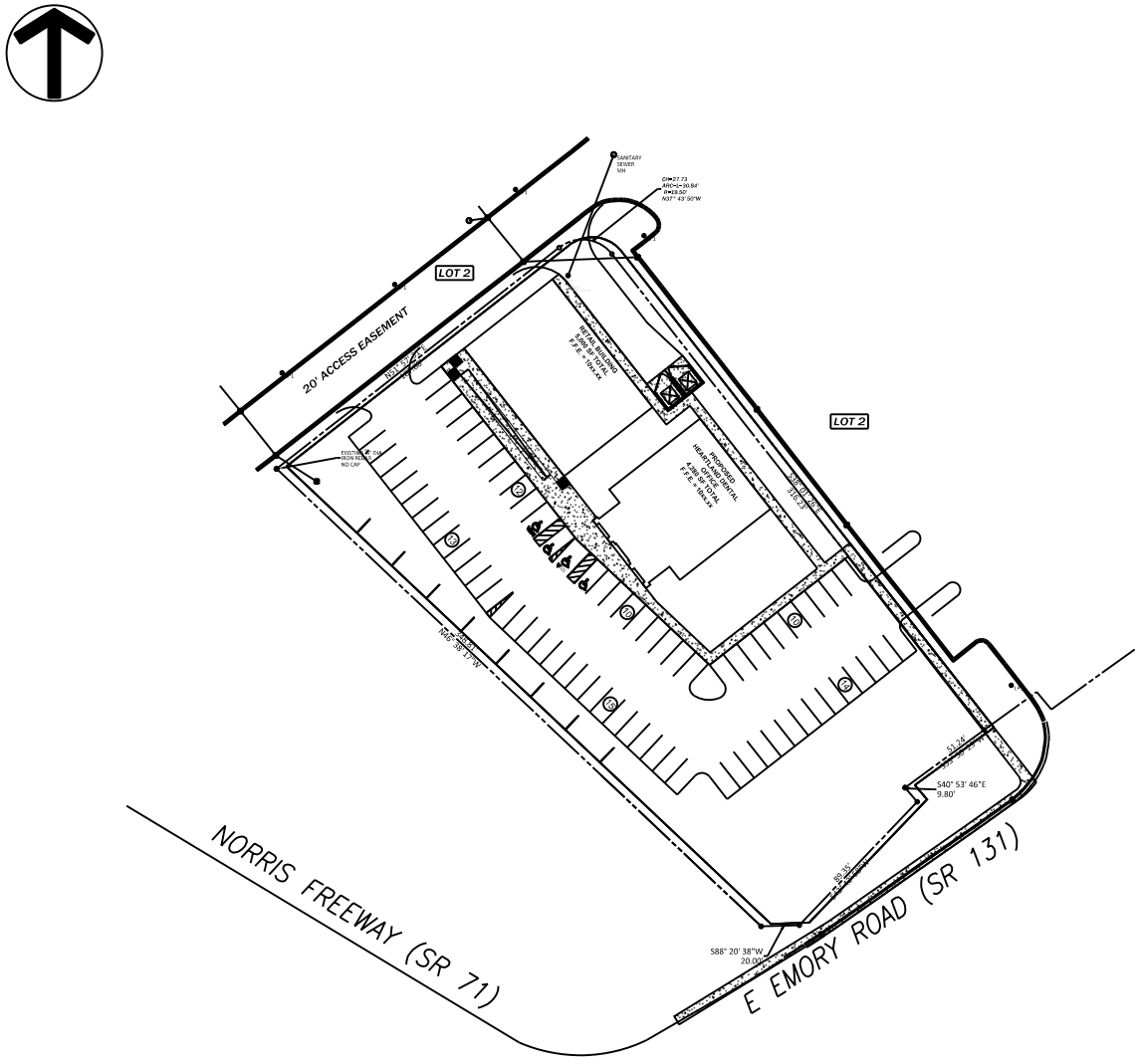


Figure 2: Site Plan

1.2 Existing Site Conditions

The proposed site access will connect to the established ALDI parking lot which has an existing driveway connection to both E. Emory Road (SR 131) and Norris Freeway (SR 71).

The existing driveway connection to E. Emory Road (SR 131) is located approximately 315 feet northeast of the intersection with Norris Freeway (SR 71). The existing driveway has a width of 30 feet. Located at the intersection of E. Emory Road (SR 131) and the driveway has a right turn lane on E. Emory Road (SR 131) with a storage length of 100 feet and a left turn lane on E. Emory Road (SR 131) with a storage length of 50 feet. The intersection sight distance at the existing driveway connection to E. Emory Road (SR 131) was measured at approximately 475 feet east and greater than 500 feet west of the intersection.

The existing driveway connection to Norris Freeway (SR 71) is located approximately 400 feet northwest of the intersection with E. Emory Road (SR 131). The existing driveway has a width of 30 feet. The Halls Greenway intersects the driveway including an existing crosswalk. The intersection sight distance at the existing driveway connection to Norris Freeway (SR 71) was measured at greater than 600 feet north and approximately 525 feet south of the intersection.

E. Emory Road (SR 131) is a two-lane road northeast of the intersection of Norris Freeway (SR 71). The Knoxville-Knox County Metropolitan Planning Commission classifies E. Emory Road (SR 131) between Heiskell Avenue and Maynardville Pike as a major arterial per the Major Road Plan. The posted speed limit on E. Emory Road (SR 131) is 40 mph.

Norris Freeway (SR 71) is a three-lane road at the existing driveway connection and transitions to a four-lane road past the driveway connection. The Knoxville-Knox County Metropolitan Planning Commission classifies Norris Freeway (SR 71) from Maynardville Pike to the Anderson County Line as a minor arterial per the Major Road Plan. The posted speed limit on Norris Freeway (SR 71) is 50 mph.

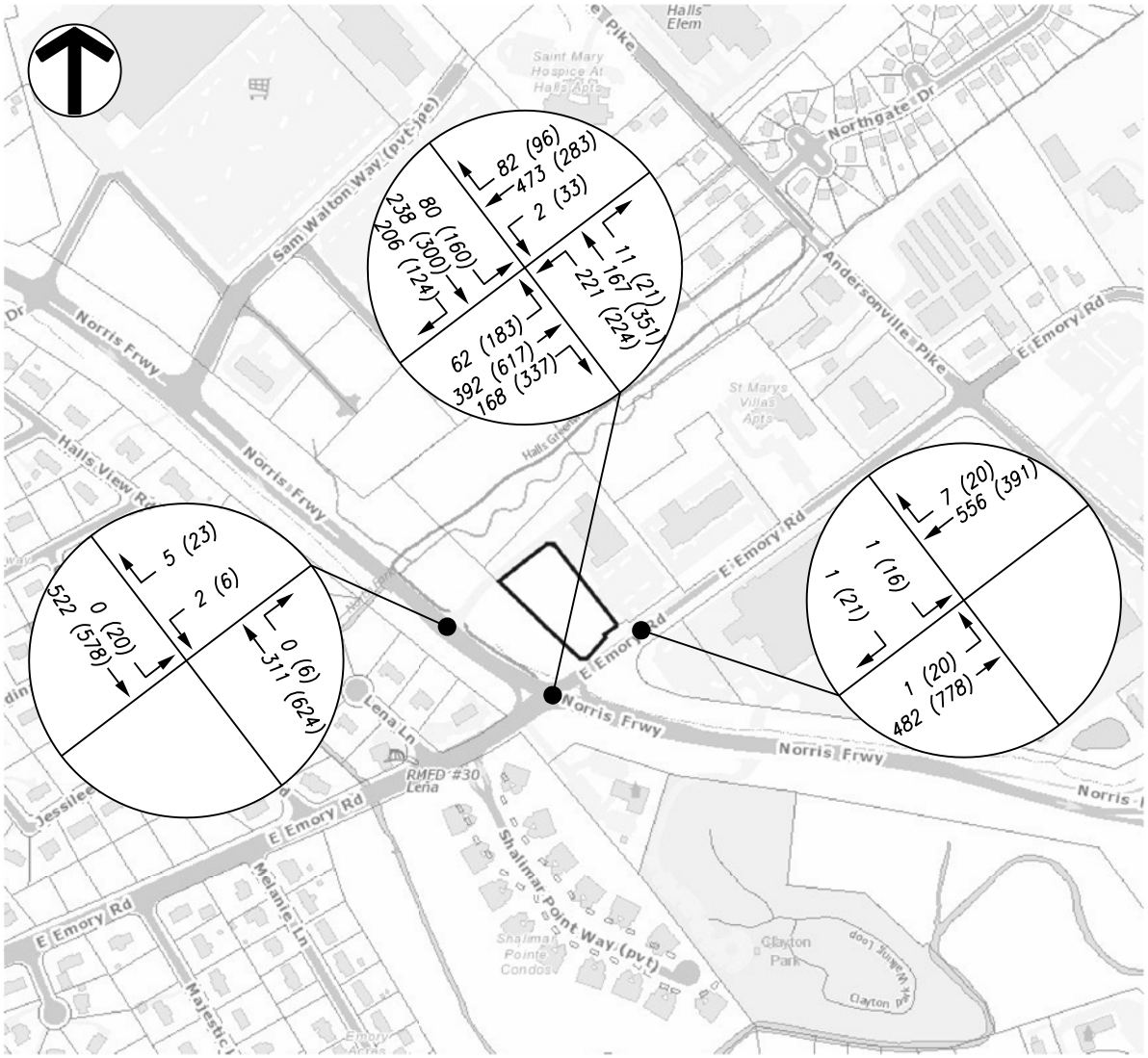
Attachment 9 shows aerial photos of the intersections of E. Emory Road (SR 131) at Norris Freeway (SR 71), E. Emory Road (SR 131) at the existing ALDI driveway connection and Norris Freeway (SR 71 at the existing ALDI driveway connection.

2 Existing Traffic Volumes

FMA conducted a turning movement count at the intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) on Wednesday April 18, 2018. FMA also conducted a turning movement count at the intersection of E. Emory Road (SR 131) at the existing ALDI driveway connection and Norris Freeway (SR 71) at the existing ALDI driveway connection on Wednesday April 18, 2018. The ALDI was open for business during the PM peak hour therefore; the existing traffic volumes include any traffic generated by the ALDI's.

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 Norris Freeway (SR 71) the AM peak hour occurred between 7:15 am and 8:15 am, and the PM peak hour occurred between 5:00 pm and 6:00 pm.

The existing volumes including the AM and PM peak hour traffic volumes at the count locations are shown in Figure 3, and the count data collected is included in Attachment 1.



LEGEND:

5 (16) TURNING MOVEMENT VOLUME AM (PM)

Figure 3: 2018 Existing Peak Hour Traffic

3 Background Growth

The Tennessee Department of Transportation (TDOT) maintains count stations for each direction of the studied intersection of E Emory Road (SR 131) at Norris Freeway (SR 71).

Count station #000022 is located on Norris Freeway (SR 71) southeast of the intersection of E Emory Road (SR 131). The annual traffic growth rate for this station over the last ten years is approximately 2.00%.

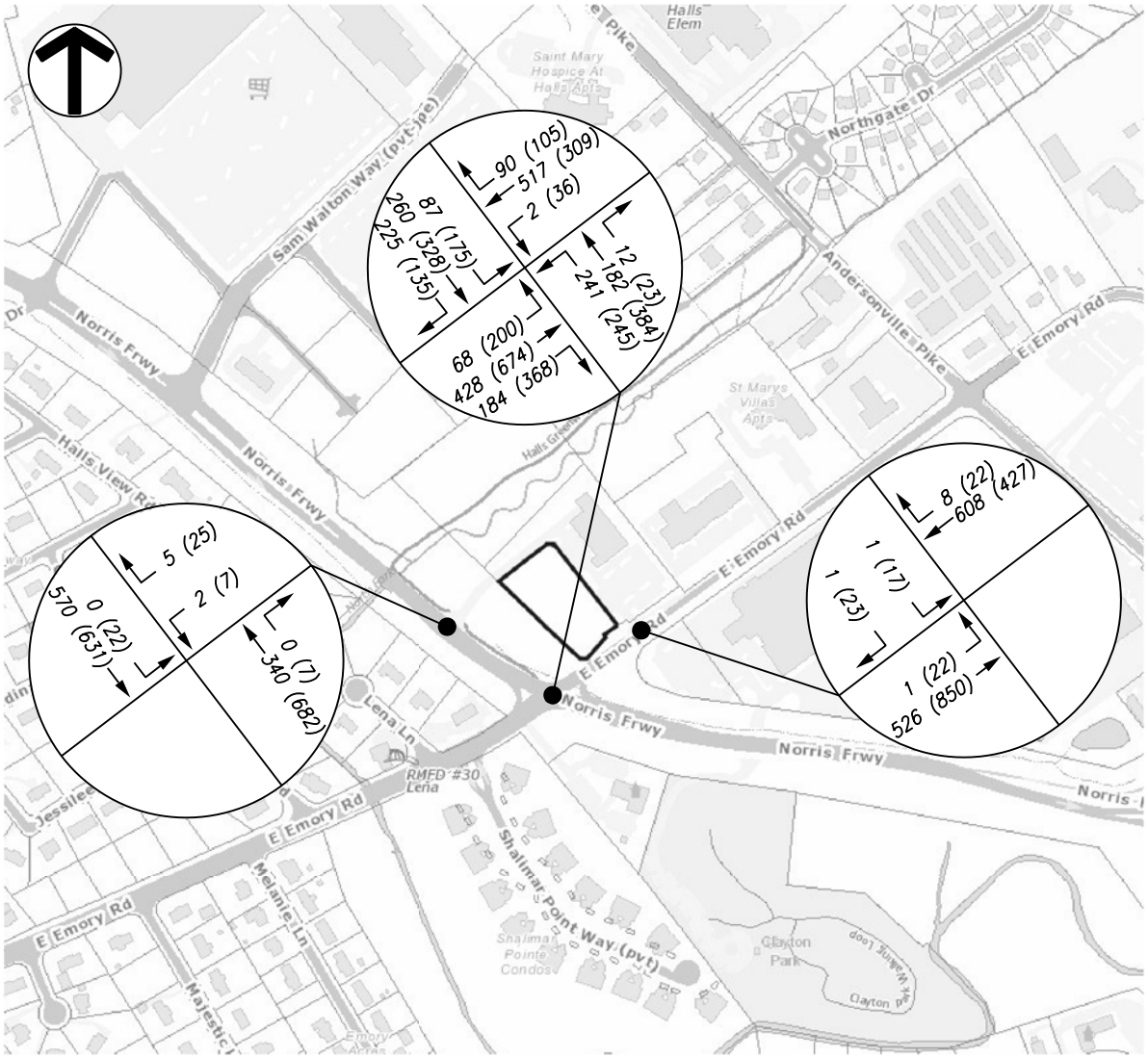
Count station #000023 is located on Norris Freeway (SR 171) west of the intersection of E Emory Road (SR 131) and south of Freeway Heights Road. The annual growth rate for this station over the last ten years is approximately 0.83%.

Count station #000024 is located on E Emory Road (SR 131) south of the intersection with Norris Freeway (SR 71) and west of Lena Lane. The annual growth rate for this station over the last ten years is approximately 5.43%. The higher than average growth rate is caused by a spike in the graph because of the 2016 ADT of 18,793. If this data point is removed then the annual growth rate over the last ten years would be 3.64%.

Count station #000477 is located on E Emory Road (SR 131) northeast of the intersection with Norris Freeway (SR 71). The annual growth rate for this station over the last seven years (TDOT added this station in 2010) is approximately 2.13%.

For the purpose of this study, an annual growth rate of 3.0% was assumed for traffic at the intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) and for traffic entering/exiting the existing ALDI driveway connections until full occupancy is reached in 2021. Attachment 2 shows the trend line growth charts for the TDOT count stations.

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



LEGEND:

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

Figure 4: 2021 Background Peak Hour Traffic

4 Trip Generation and Trip Distribution

Medical-Dental Office Building or Land Use 720 was used to calculate site trips for the proposed Heartland Dental Office and Specialty Retail Center or Land Use 826 was used to calculate the site trips for the proposed retail building using the average rate and the fitted curve equations from *Trip Generation, 9th Edition,* published by the Institute of Transportation Engineers. The land use worksheets are included in Attachment 3

The Medical-Dental Office Building weekday trips were calculated using the average rate instead of the fitted curve equation because the equation resulted in a negative number. The Specialty Retail Center did not provide data for the AM peak because this type of retail typically does not open until after the AM peak hour.

The total combined trips generated by the Heartland Dental Office and Retail Building was estimated to be 369 daily trips. The estimated trips are 10 trips during the AM peak hour and 50 trips during the PM peak hour. A trip generation summary is shown in Table 4-1.

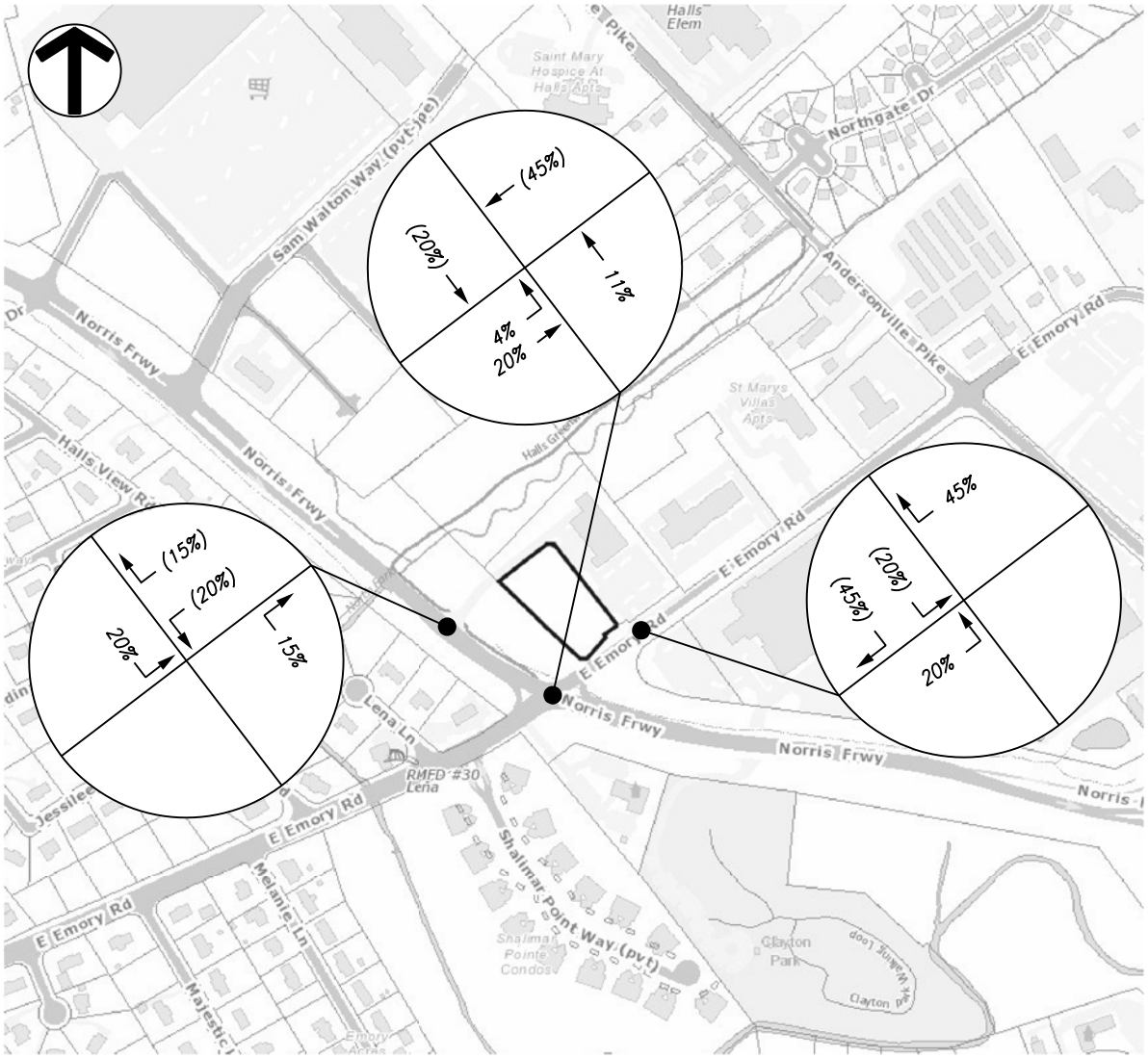
Table 4-1
Heartland Dental
Trip Generation Summary

	Total New Trips	% Entering	%Exiting	Number Entering	Number Exiting
Heartland Dental Office 4,280 SF (Land Use 720)					
Weekday	155	50	50	78	78
A.M. Peak	10	79	21	8	2
P.M. Peak	17	28	72	5	12
Retail Building 5,000 SF (Land Use 826)					
Weekday	214	50	50	107	107
P.M. Peak	33	44	56	15	18
Total Combined Trips					
Weekday	369			185	185
A.M. Peak	10			8	2
P.M. Peak	50			20	30

The directional distribution of the traffic generated by the Heartland Dental Office and Retail Building was determined using the existing traffic volumes. Because of the low AM peak hour volume of traffic at the existing ALDI driveway connections the AM peak hour trip distribution was calculated based on the volume of traffic on E. Emory Road (SR 131) and Norris Freeway (71). The AM peak hour has a trip distribution of 20% eastbound and 45% westbound on E. Emory Road (SR 131) and 15% northbound and 20% southbound on Norris Freeway (SR 71). Figure 5 shows the AM peak hour trip distribution.

The PM peak hour trip distribution was calculated based on the existing entering and exiting traffic volumes at the ALDI driveway connections. The PM peak hour has a trip distribution for traffic entering the site of 30% eastbound and 30% westbound on E. Emory Road (SR 131) and 10% northbound and 30% southbound on Norris Freeway (SR 71) and for the traffic exiting the site of 32% eastbound and 24% westbound on E. Emory Road (SR 131) and 34% northbound and 10% southbound on Norris Freeway (SR 71). Figure 6 shows the PM peak hour trip distribution.

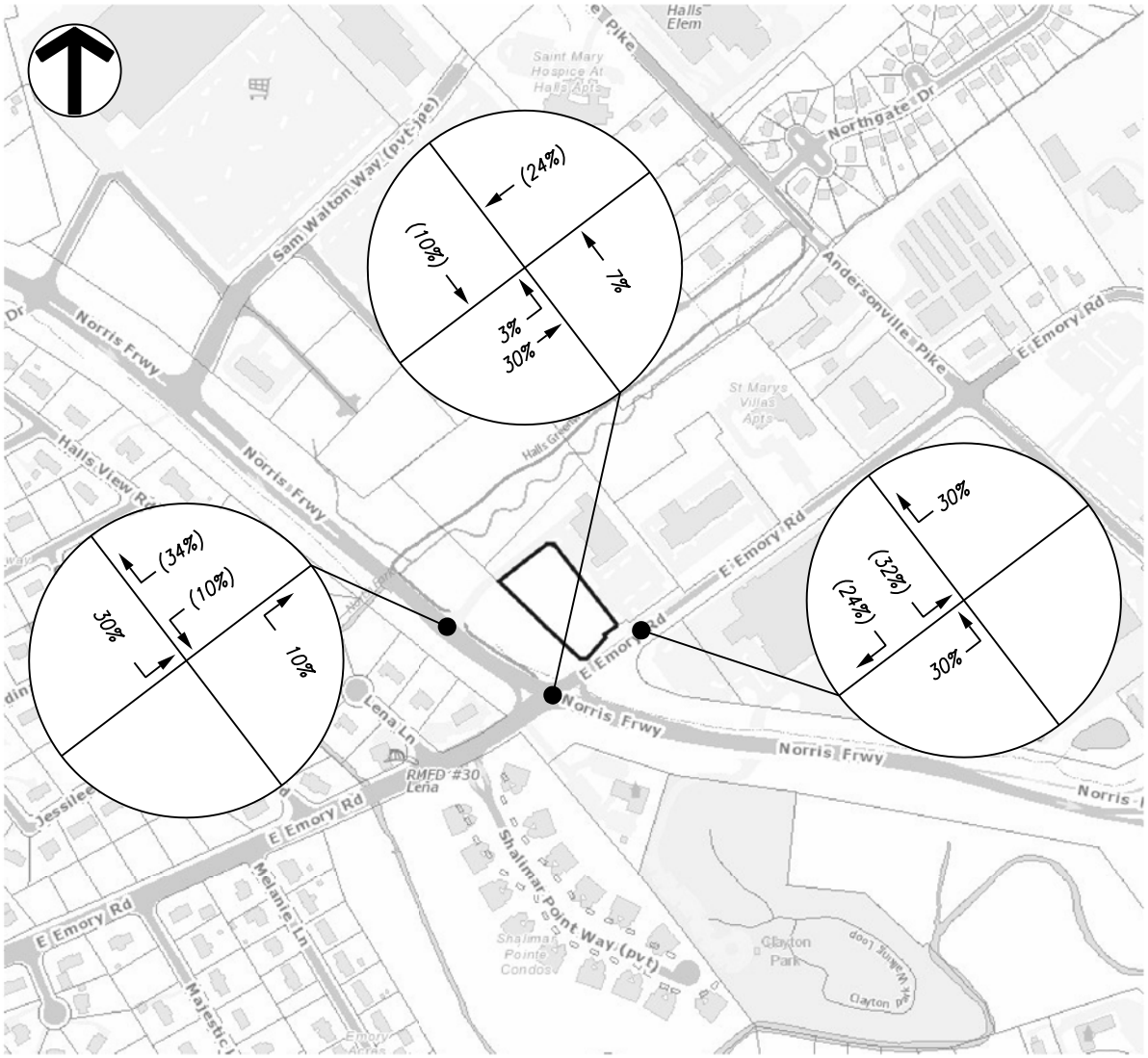
Figure 7 shows the peak hour site traffic from the Dental Office and Retail Building and Figure 8 shows the full buildout peak hour traffic.



LEGEND:

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

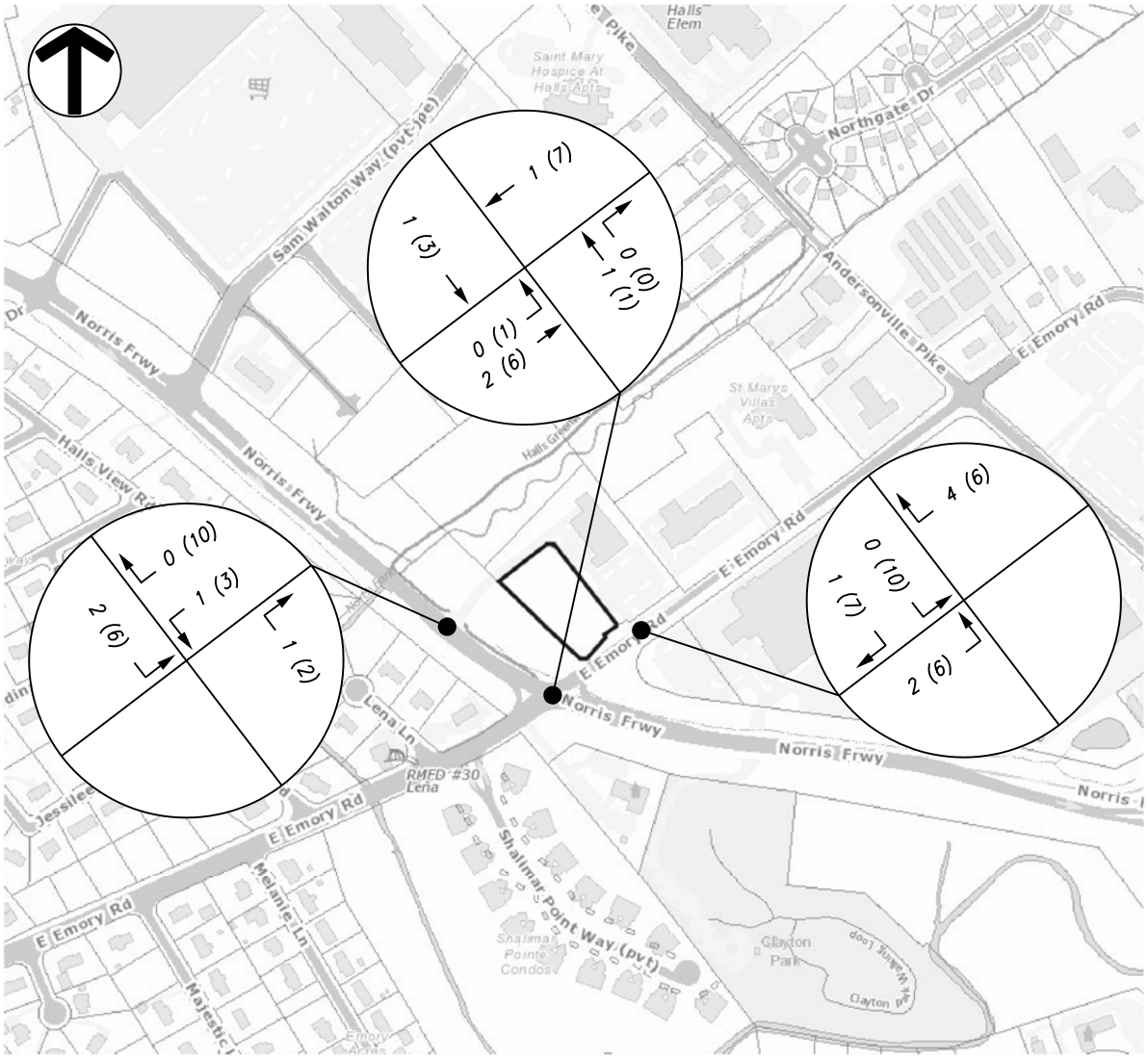
Figure 5: AM Peak Hour Trip Distribution



LEGEND:

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

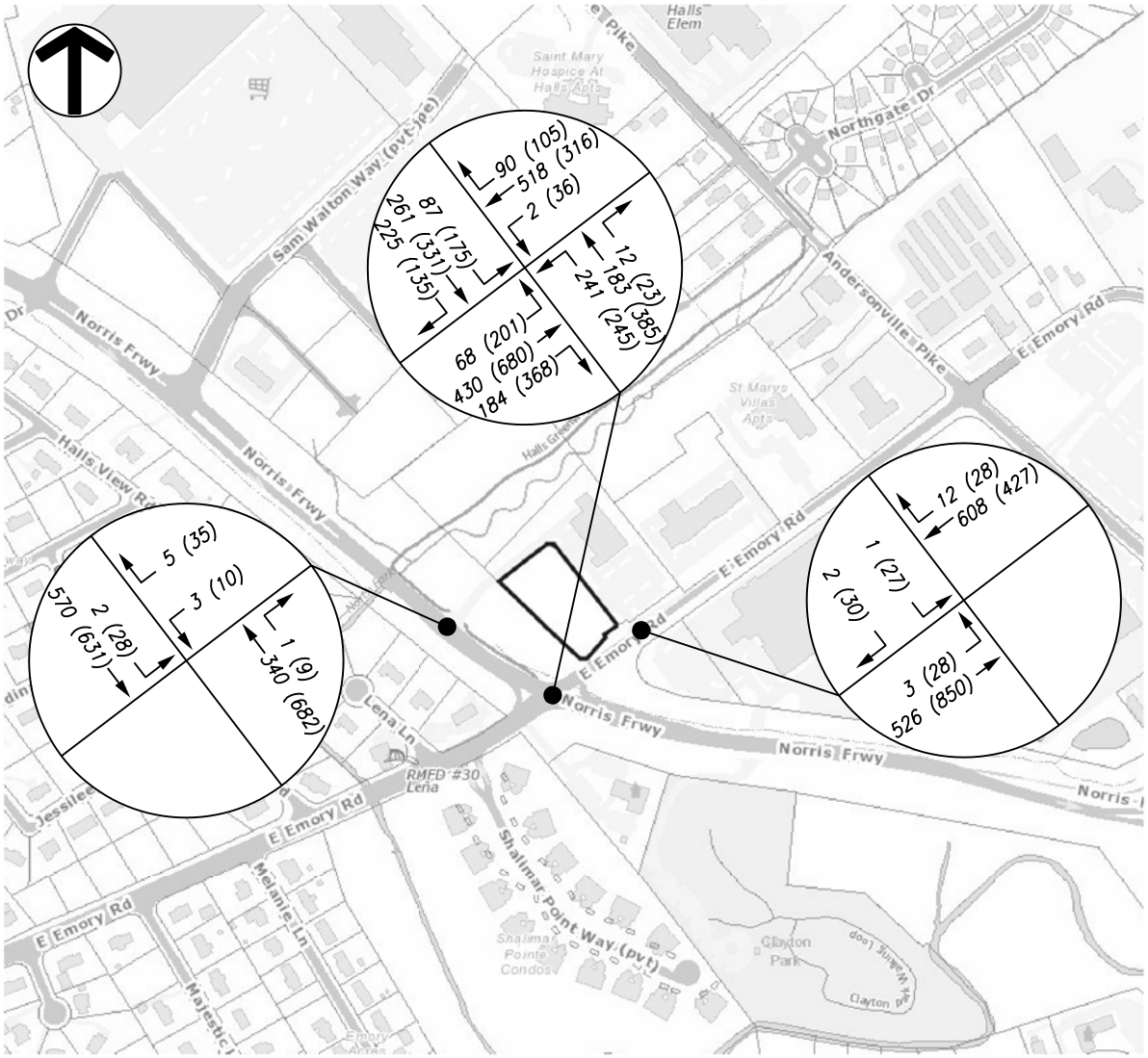
Figure 6: PM Peak Hour Trip Distribution



LEGEND:

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

Figure 7: Peak Hour Site Traffic



LEGEND:

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

Figure 8: Peak Hour Full Buildout Traffic

5 Projected Capacity and Level of Service

Unsignalized intersection capacity analyses were performed using the Highway Capacity Software (HCS7) for the AM and PM peak hours to evaluate the traffic conditions at the intersections of E. Emory Road (SR 131) at the existing ALDI driveway connection and Norris Freeway (SR 71) at the existing ALDI driveway connection.

Signalized intersection capacity analyses were performed using Highway Capacity Software (HCS7) with the existing signal timing for the AM and PM peak hours to evaluate the traffic conditions at the intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71). The existing signal timing was provided by Knox County and is included in Attachment 4.

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
Phase 1 - Intersection Analysis
Level of Service (LOS) Summary

		Delay (sec)/LOS
E Emory Road (SR 131) @ Norris Freeway (SR 71) (Existing 2018)		
AM Peak	Intersection	36.2 / D
PM Peak	Intersection	47.5 / D
E Emory Road (SR 131) @ ALDI Driveway (Existing 2018)		
AM Peak	EB Approach SB Approach	8.9 / A 12.6 / B
PM Peak	EB Approach SB Approach	8.3 / A 13.3 / B
Norris Freeway (SR 71) @ ALDI Driveway (Existing 2018)		
AM Peak	WB Approach SB Approach	10.6 / B 8.0 / A
PM Peak	WB Approach SB Approach	13.5 / B 9.1 / A
E Emory Road (SR 131) @ Norris Freeway (SR 71) (Background 2021)		
AM Peak	Intersection	38.7 / D
PM Peak	Intersection	56.1 / E
E Emory Road (SR 131) @ ALDI Driveway (Background 2021)		
AM Peak	EB Approach SB Approach	9.1 / A 13.3 / B
PM Peak	EB Approach SB Approach	8.5 / A 14.0 / B
Norris Freeway (SR 71) @ ALDI Driveway (Background 2021)		
AM Peak	WB Approach SB Approach	10.9 / B 8.0 / A
PM Peak	WB Approach SB Approach	14.6 / B 9.3 / A

E Emory Road (SR 131) @ Norris Freeway (SR 71) (Full Buildout 2021)		
AM Peak	Intersection	38.8 / D
PM Peak	Intersection	56.8 / E
E Emory Road (SR 131) @ ALDI Driveway (Full Buildout 2021)		
AM Peak	EB Approach SB Approach	9.1 / A 12.9 / B
PM Peak	EB Approach SB Approach	8.5 / A 15.0 / B
Norris Freeway (SR 71) @ ALDI Driveway (Full Buildout 2021)		
AM Peak	WB Approach SB Approach	11.4 / B 8.0 / A
PM Peak	WB Approach SB Approach	15.1 / C 9.4 / A

6 Turn Lane Warrant Analysis

The intersection of Norris Freeway (SR 71) at the existing ALDI driveway connection was evaluated to determine if a right turn lane or a 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 left turn lane on Norris Freeway (SR 71) is met during the PM peak hour for both the background conditions and after the full buildout of the Heartland Dental Office and Retail Building. The turn lane warrant worksheets and analysis are included in Attachment 8.

7 Conclusions and Recommendations

7.1 E Emory Road (SR 131) @ Existing Driveway Connection

Currently at the intersection of E. Emory Road (SR 131) at the existing driveway connection the eastbound approach operates at a LOS A during both the AM and PM peak hours and the southbound approach operates at a LOS B during both the AM and PM peak hours. After the completion of the Heartland Dental Office and Retail Building the eastbound approach will continue to operate at a LOS A during both the AM and PM peak hours and the southbound approach will continue to operate at a LOS B during the both the AM peak and PM peak hours.

It is estimated based on field observations that the existing driveway connection is blocked by the traffic from the signalized intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) approximately 20% during the AM peak hour and 10% during the PM peak hour.

The existing eastbound left turn lane on E. Emory Road (SR 131) measures 50 feet with enough storage space for approximately 2 vehicles. The unsignalized intersection capacity analyses show a 95% queue length of less than one vehicle during both the AM and PM peak hour after the completion of the Heartland Dental Office and Retail Building, therefore; the existing geometry of the intersection will be adequate.

7.2 Norris Freeway (SR 71) @ Existing Driveway Connection

Currently at the intersection of Norris Freeway (SR 71) at the existing driveway connection the westbound approach operates at a LOS B during both the AM and PM peak hours and the southbound approach operates at a LOS A during both the AM and PM peak hours. After the completion of the Heartland Dental Office and Retail Building the westbound approach will operate at a LOS B during the AM peak and a LOS C during the PM peak hour and the southbound approach will continue to operate at a LOS A during both the AM and PM peak hours.

A left turn lane on Norris Freeway (SR 71) is met during the PM peak hour for both the background conditions and after the full buildout of the Heartland Dental Office and Retail Building. The reason that a left turn lane warrant is met is a combination of the high volume of northbound traffic during the PM peak hour and the high number of existing left turns from the ALDI's. Due to physical constraints on Norris Freeway and the recent upgrades to the intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) FMA recommends that a left turn lane be coordinated with

Knox County Engineering & Public Works as well as any surrounding property owners.

7.3 E Emory Road (SR 131) @ Norris Freeway (SR 71)

The existing traffic conditions at the signalized intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) operate at a LOS D during both the AM and PM peak hours using the existing signal timing provided by Knox County.

The background traffic conditions at the signalized intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) operate at a LOS D during AM peak hour and a LOS E during the PM peak hour using the existing signal timing provided by Knox County.

After the completion of the Heartland Dental and Retail Building the signalized intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71) will operate at a LOS D during AM peak hour and a LOS E during the PM peak hour using the existing signal timing provided by Knox County.

The LOS E during the PM peak hour is partly due to the high volume-to-capacity ratio of both the northbound thru lane (0.941) and the eastbound thru lane (0.962) when using the existing signal timing. If the signal timing is optimized the intersection would operate with less delay during the PM peak hour; however since this signal is coordinated with several others in the Halls area I would not recommend altering the signal timing at this time.

Attachment 1
Traffic Counts

Project: Heartland Dental Office
Intersection: E Emory Rd (SR 131) at Norris Freeway (SR 71)
Date Conducted: 04/18/2018

	E Emory Road (SR 131) Eastbound				E Emory Road (SR 131) Westbound				Norris Freeway (SR 71) Northbound				Norris Freeway (SR 71) Southbound				
Start	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Int. Total
7:00 AM	9	57	22	88	0	162	17	179	33	28	1	62	9	47	51	107	436
7:15 AM	13	81	24	118	0	98	20	118	54	47	1	102	19	61	63	143	481
7:30 AM	20	78	51	149	0	125	29	154	50	48	1	99	18	58	57	133	535
7:45 AM	17	110	51	178	0	123	19	142	57	44	6	107	25	80	49	154	581
Total	59	326	148	533	0	508	85	593	194	167	9	370	71	246	220	537	2033
8:00 AM	12	123	42	177	2	127	14	143	60	28	3	91	18	39	37	94	505
8:15 AM	13	68	38	119	2	122	30	154	59	36	0	95	14	49	41	104	472
8:30 AM	20	52	28	100	3	92	17	112	58	55	2	115	11	43	26	80	407
8:45 AM	20	74	40	134	3	87	10	100	35	32	4	71	10	37	34	81	386
Total	65	317	148	530	10	428	71	509	212	151	9	372	53	168	138	359	1770
3:00 PM	46	113	81	240	6	76	0	82	25	84	7	116	36	89	36	161	599
3:15 PM	36	125	62	223	7	60	0	67	69	85	9	163	36	68	27	131	584
3:30 PM	31	104	74	209	9	97	0	106	71	97	7	175	22	66	31	119	609
3:45 PM	36	73	66	175	6	111	0	117	75	105	4	184	41	80	28	149	625
Total	149	415	283	847	28	344	0	372	240	371	27	638	135	303	122	560	2417
4:00 PM	48	124	68	240	8	88	27	123	74	87	8	169	36	90	32	158	690
4:15 PM	45	102	59	206	8	73	16	97	71	78	5	154	34	75	35	144	601
4:30 PM	50	136	61	247	11	88	25	124	55	105	5	165	27	77	29	133	669
4:45 PM	49	140	57	246	5	68	22	95	68	106	4	178	44	69	26	139	658
Total	192	502	245	939	32	317	90	439	268	376	22	666	141	311	122	574	2618
5:00 PM	50	153	75	278	10	83	26	119	57	93	3	153	33	87	35	155	705
5:15 PM	60	156	89	305	8	70	12	90	53	90	5	148	47	70	24	141	684
5:30 PM	37	169	104	310	7	59	29	95	57	78	3	138	26	66	30	122	665
5:45 PM	36	139	69	244	8	71	29	108	57	90	10	157	54	77	35	166	675
Total	183	617	337	1137	33	283	96	412	224	351	21	596	160	300	124	584	2729
Grand Total	648	2177	1161	3986	103	1880	342	2325	1138	1416	88	2642	560	1328	726	2614	11567
Approach %	16.3	54.6	29.1		4.4	80.9	14.7		43.1	53.6	3.3		21.4	50.8	27.8		
Total %	5.6	18.8	10.0	34.5	0.9	16.3	3.0	20.1	9.8	12.2	0.8	22.8	4.8	11.5	6.3	22.6	

Project: Heartland Dental Office
Date Conducted: 4/18/2018

AM Peak Hour	7:15 AM - 8:15 AM	2102
PM Peak Hour	5:00 PM - 6:00 PM	2729

	E Emory Road (SR 131) Eastbound				E Emory Road (SR 131) Westbound				Norris Freeway (SR 71) Northbound				Norris Freeway (SR 71) Southbound				
Start	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis from 7:00 AM to 9:00 AM																	
AM Peak Hour begins at 7:30 AM																	
7:15 AM	13	81	24	118	0	98	20	118	54	47	1	102	19	61	**63**	143	481
7:30 AM	**20**	78	**51**	149	0	125	**29**	154	50	**48**	1	99	18	58	57	133	535
7:45 AM	17	110	51	178	0	123	19	142	57	44	**6**	107	**25**	**80**	49	154	**581**
8:00 AM	12	**123**	42	177	**2**	**127**	14	143	**60**	28	3	91	18	39	37	94	505
Total Volume	62	392	168	622	2	473	82	557	221	167	11	399	80	238	206	524	2102
Future (3% over 3 yrs)	68	428	184		2	517	90		241	182	12		87	260	225		2297
PHF	0.78	0.80	0.82		0.25	0.93	0.71		0.92	0.87	0.46		0.80	0.74	0.82		0.90
Peak Hour Analysis from 3:00 PM to 6:00 PM																	
PM Peak Hour begins at 5:00 PM																	
5:00 PM	50	153	75	278	**10**	**83**	26	119	**57**	**93**	3	153	33	**87**	**35**	155	**705**
5:15 PM	**60**	156	89	305	8	70	12	90	53	90	5	148	47	70	24	141	684
5:30 PM	37	**169**	**104**	310	7	59	**29**	95	57	78	3	138	26	66	30	122	665
5:45 PM	36	139	69	244	8	71	29	108	57	90	**10**	157	**54**	77	35	166	675
Total Volume	183	617	337	1137	33	283	96	412	224	351	21	596	160	300	124	584	2729
Future (3% over 3 yrs)	200	674	368		36	309	105		245	384	23		175	328	135		2982
PHF	0.76	0.91	0.81		0.83	0.85	0.83		0.98	0.94	0.53		0.74	0.86	0.89		0.97

Project: Heartland Dental Office
Intersection: E Emory Rd (SR 131) at ALDI Driveway
Date Conducted: 04/18/2018

	E. Emory Road Eastbound			E. Emory Road Westbound			ALDI Driveway Southbound			
Start	Left	Thru	Total	Thru	Right	Total	Left	Right	Total	Int. Total
7:15 AM	0	0	0	0	2	2	0	0	0	2
7:30 AM	1	0	1	0	0	0	0	1	1	2
7:45 AM	0	0	0	0	4	4	0	0	0	4
8:00 AM	0	0	0	0	1	1	1	0	1	2
Total	1	0	1	0	7	7	1	1	2	10
5:00 PM	5	0	5	0	3	3	5	6	11	19
5:15 PM	3	0	3	0	6	6	4	4	8	17
5:30 PM	3	0	3	0	9	9	3	5	8	20
5:45 PM	9	0	9	0	2	2	4	6	10	21
Total	20	0	20	0	20	20	16	21	37	77
Grand Total	21	0	21	0	27	27	17	22	39	87
Approach %	100.0	0.0		0.0	100.0		43.6	56.4		
Total %	24.1	0.0	24.1	0.0	31.0	31.0	19.5	25.3	44.8	

Project: Heartland Dental Office
Date Conducted: 4/18/2018

	E. Emory Road Eastbound			E. Emory Road Westbound			ALDI Driveway Southbound			
Start	Left	Thru	App. Total	Thru	Right	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:15 AM										
7:15 AM	0	0	0	0	2	2	0	0	0	2
7:30 AM	**1**	0	1	0	0	0	0	**1**	1	2
7:45 AM	0	0	0	0	**4**	4	0	0	0	**4**
8:00 AM	0	0	0	0	1	1	**1**	0	1	2
Total Volume	1	0	1	0	7	7	1	1	2	10
Future (3% over 3 yrs)	1	0	1	0	8	8	1	1	2	11
PHF	0.25	-		-	0.44		0.25	0.25		0.63
Peak Hour Analysis from 3:00 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
5:00 PM	5	0	5	0	3	3	**5**	**6**	11	19
5:15 PM	3	0	3	0	6	6	4	4	8	17
5:30 PM	3	0	3	0	**9**	9	3	5	8	20
5:45 PM	**9**	0	9	0	2	2	4	6	10	**21**
Total Volume	20	0	20	0	20	20	16	21	37	77
Future (3% over 3 yrs)	22	0		0	22		17	23		84
PHF	0.56	-		-	0.56		0.80	0.88		0.92

Project: Heartland Dental Office
Intersection: Norris Freeway (SR 71) at ALDI Driveway
Date Conducted: 04/18/2018

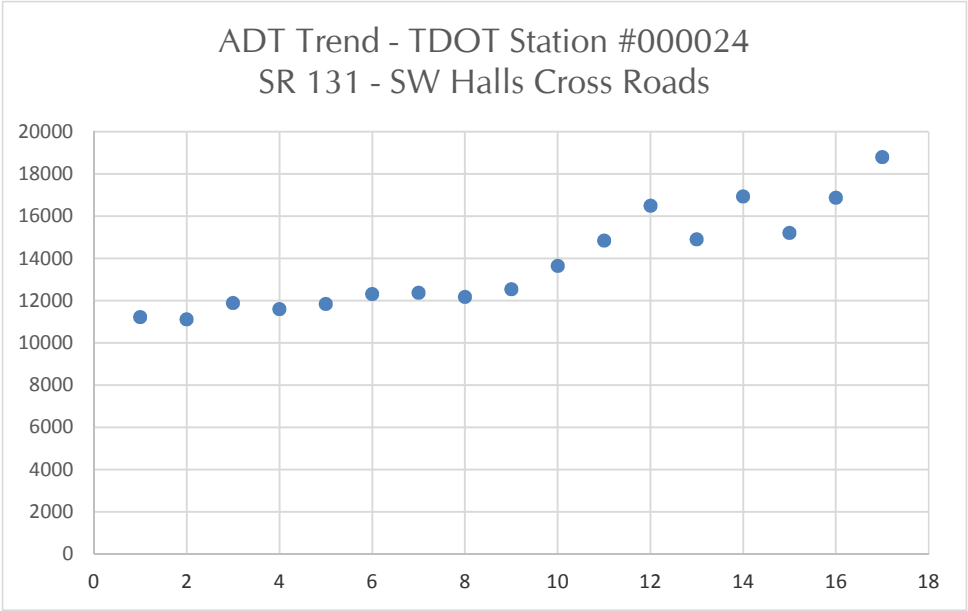
	ALDI Driveway Westbound			Norris Freeway Northbound			Norris Freeway Southbound			
Start	Left	Right	Total	Thru	Right	Total	Left	Thru	Total	Int. Total
7:15 AM	1	1	2	0	0	0	0	0	0	2
7:30 AM	0	0	0	0	0	0	0	0	0	0
7:45 AM	1	3	4	0	0	0	0	0	0	4
8:00 AM	0	1	1	0	0	0	0	0	0	1
Total	2	5	7	0	0	0	0	0	0	7
5:00 PM	2	8	10	0	1	1	3	0	3	14
5:15 PM	0	2	2	0	3	3	4	0	4	9
5:30 PM	1	6	7	0	0	0	4	0	4	11
5:45 PM	3	7	10	0	2	2	9	0	9	21
Total	6	23	29	0	6	6	20	0	20	55
Grand Total	8	28	36	0	6	6	20	0	20	62
Approach %	22.2	77.8		0.0	100.0		100.0	0.0		
Total %	12.9	45.2	58.1	0.0	9.7	9.7	32.3	0.0	32.3	

Project: Heartland Dental Office
Date Conducted: 4/18/2018

	ALDI Driveway Westbound			Norris Freeway Northbound			Norris Freeway Southbound			
Start	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:15 AM										
7:15 AM	**1**	1	2	0	0	0	0	0	0	2
7:30 AM	0	0	0	0	0	0	0	0	0	0
7:45 AM	1	**3**	4	0	0	0	0	0	0	**4**
8:00 AM	0	1	1	0	0	0	0	0	0	1
Total Volume	2	5	7	0	0	0	0	0	0	7
Future (3% over 3 yrs)	2	5		0	0		0	0		8
PHF	0.50	0.42		-	-		-	-		0.44
Peak Hour Analysis from 3:00 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
5:00 PM	2	**8**	10	0	1	1	**3**	**0**	3	14
5:15 PM	0	2	2	0	**3**	3	4	0	4	9
5:30 PM	1	6	7	0	0	0	4	0	4	11
5:45 PM	**3**	7	10	0	2	2	9	0	9	**21**
Total Volume	6	23	29	0	6	6	20	0	20	55
Future (3% over 3 yrs)	7	25		0	7		22	0		60
PHF	0.50	0.72		-	0.50		0.56	-		0.65

Attachment 2
ADT Trends

	Year	Adjusted Average Daily Traffic
1	2000	11218
2	2001	11104
3	2002	11880
4	2003	11595
5	2004	11835
6	2005	12304
7	2006	12367
8	2007	12176
9	2008	12541
10	2009	13645
11	2010	14836
12	2011	16487
13	2012	14905
14	2013	16931
15	2014	15201
16	2015	16869
17	2016	18793



Most Recent Trend Line Growth

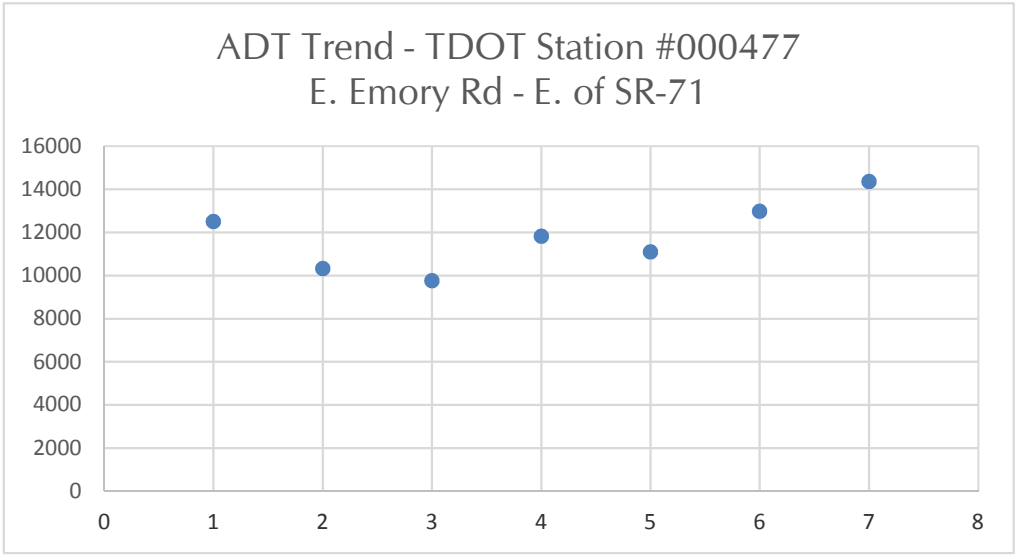
Year	ADT
2007	12176
2016	18793

Annual Percent Growth **5.43%**

Year	ADT
2006	12367
2015	16869

Annual Percent Growth **3.64%**

	Year	Adjusted Average Daily Traffic
1	2010	12500
2	2011	10328
3	2012	9756
4	2013	11826
5	2014	11091
6	2015	12979
7	2016	14367

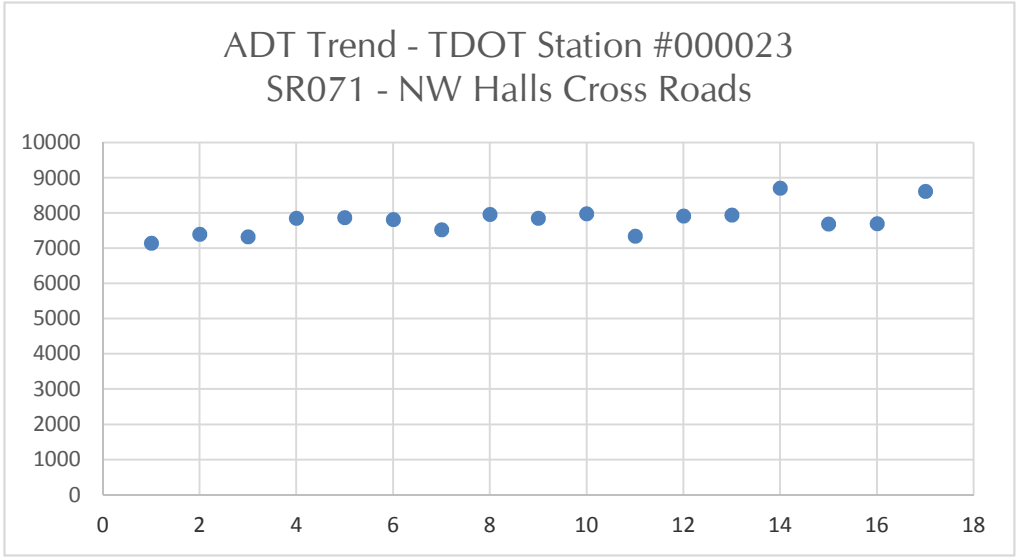


Most Recent Trend Line Growth

Year	ADT
2010	12500
2016	14367

Annual Percent Growth **2.13%**

	Year	Adjusted Average Daily Traffic
1	2000	7145
2	2001	7402
3	2002	7324
4	2003	7851
5	2004	7875
6	2005	7816
7	2006	7529
8	2007	7959
9	2008	7850
10	2009	7984
11	2010	7348
12	2011	7921
13	2012	7944
14	2013	8712
15	2014	7693
16	2015	7701
17	2016	8618

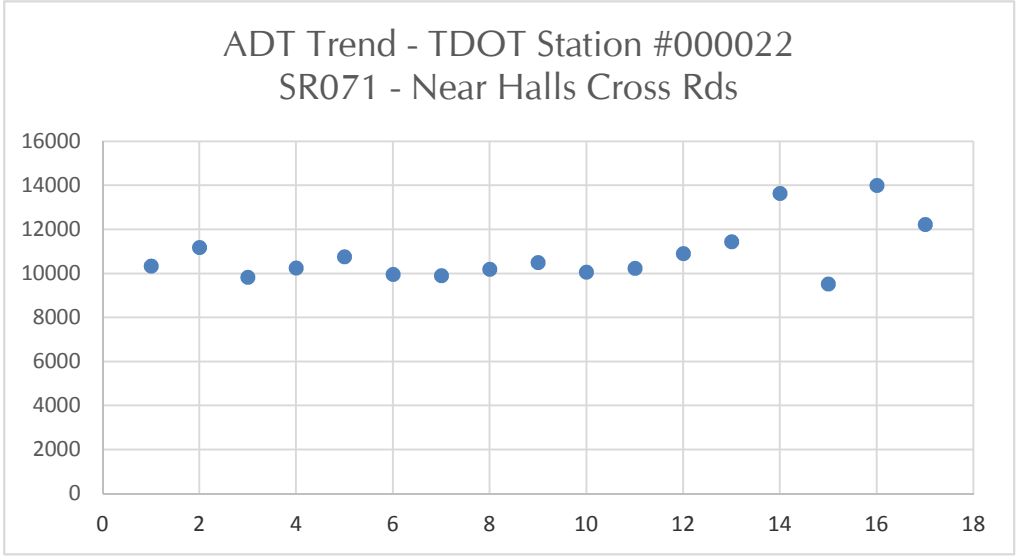


Most Recent Trend Line Growth

Year	ADT
2007	7959
2016	8618

Annual Percent Growth **0.83%**

	Year	Adjusted Average Daily Traffic
1	2000	10344
2	2001	11187
3	2002	9833
4	2003	10255
5	2004	10766
6	2005	9970
7	2006	9900
8	2007	10192
9	2008	10498
10	2009	10068
11	2010	10237
12	2011	10910
13	2012	11445
14	2013	13645
15	2014	9531
16	2015	14010
17	2016	12231



Most Recent Trend Line Growth

Year	ADT
2007	10192
2016	12231

Annual Percent Growth **2.00%**

Attachment 3
Trip Generation

Project: Heartland Dental Office
Date Conducted: 4/19/2018

Medical-Dental Office Building (Land Use 720)
4,300 SF

Average Daily Traffic
Average Rate = 36.13
T = 36.13 x (4.3 SF)
T = 155

Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.
Average Rate = 2.39
T = 2.39 x (4.3 SF)
T = 10

Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.
Average Rate = 3.57
T = 3.57 x (4.3 SF)
T = 15

		Percent		Number	
Time Period	Total Trips	Enter	Exit	Enter	Exit
Weekday (24 hours)	155	50%	50%	78	78
AM Peak Hour	10	79%	21%	8	2
PM Peak Hour	15	28%	72%	4	11

Project: Heartland Dental Office
Date Conducted: 5/22/2018

Specialty Retail Center (Land Use 826)
5,000 SF

Average Daily Traffic
T = 42.78 (X) + 37.66
T = 42.78 (5) + 37.66
T = 214

Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.
T = 2.40 (X) + 21.48
T = 2.40 (5) + 21.48
T = 33

Time Period	Total Trips	Percent		Number	
		Enter	Exit	Enter	Exit
Weekday (24 hours)	214	50%	50%	107	107
PM Peak Hour	33	44%	56%	15	18

Medical-Dental Office Building
(720)

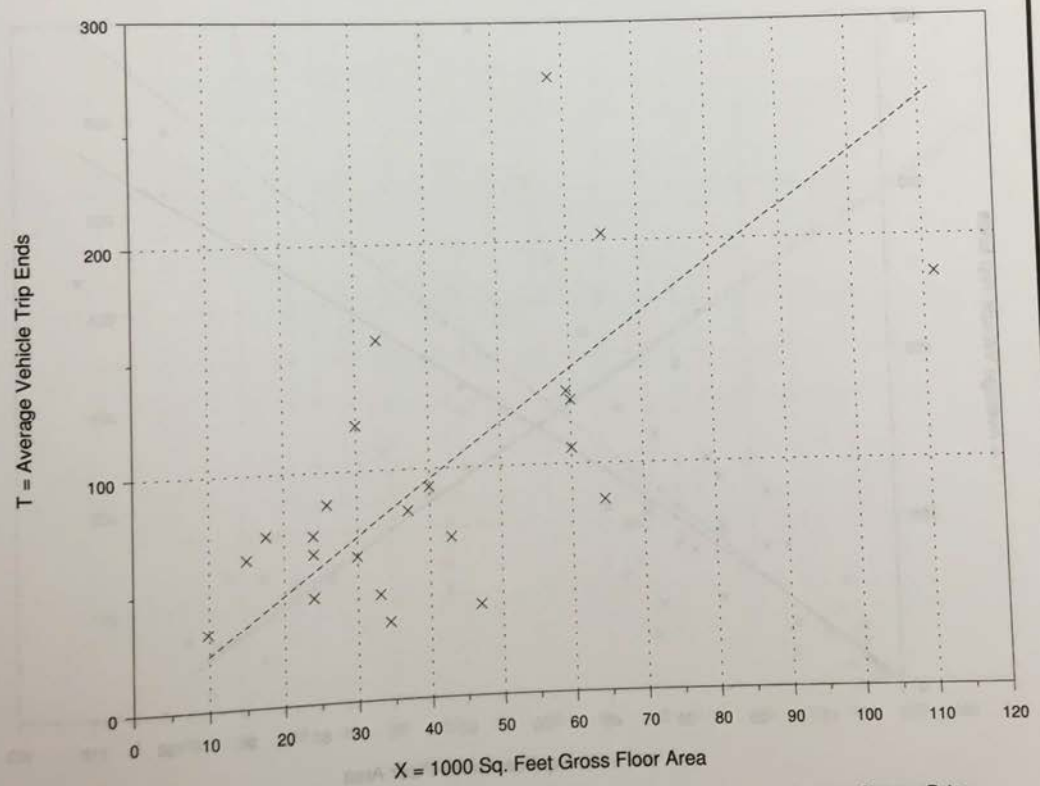
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 23
Average 1000 Sq. Feet GFA: 41
Directional Distribution: 79% entering, 21% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
2.39	0.85 - 4.79	1.89

Data Plot and Equation



Fitted Curve Equation: Not given

Medical-Dental Office Building
(720)

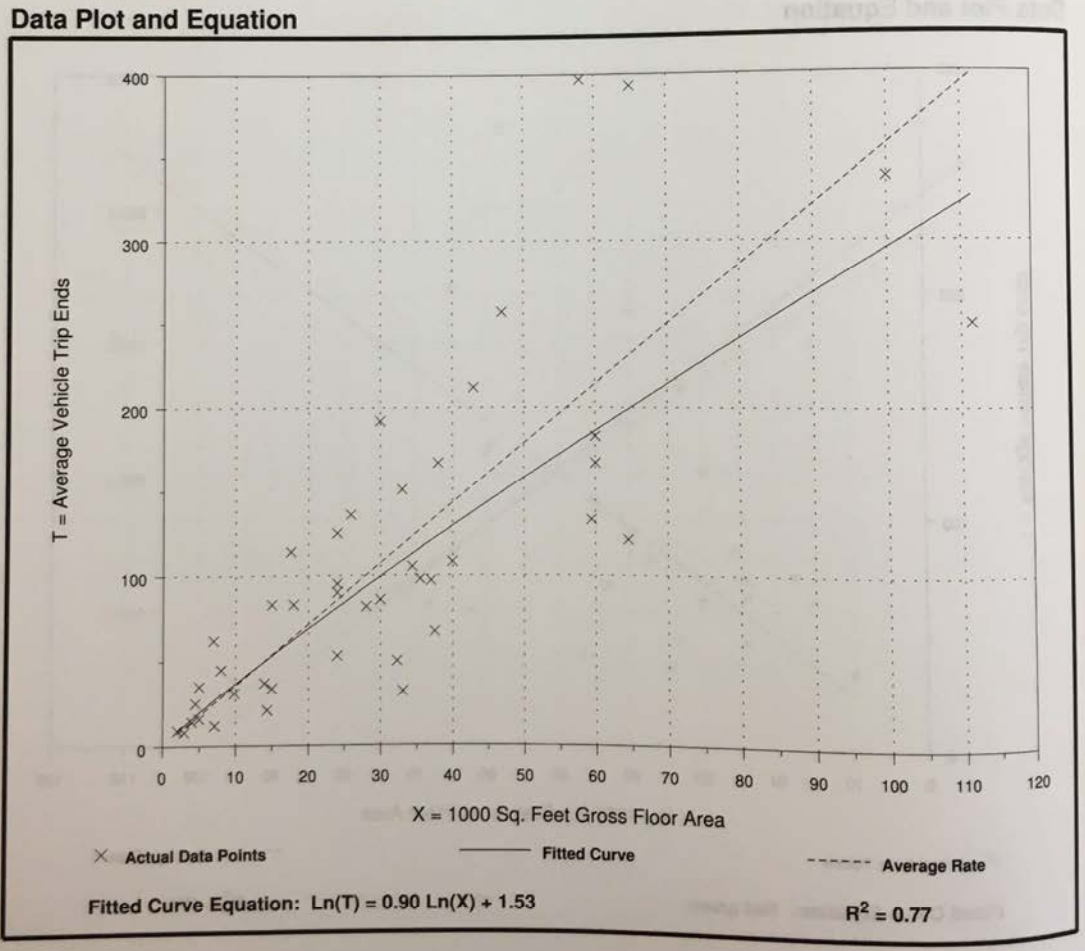
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 43
Average 1000 Sq. Feet GFA: 31
Directional Distribution: 28% entering, 72% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
3.57	0.97 - 8.86	2.47

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.90\ Ln(X) + 1.53$

$R^2 = 0.77$

Medical-Dental Office Building
(720)

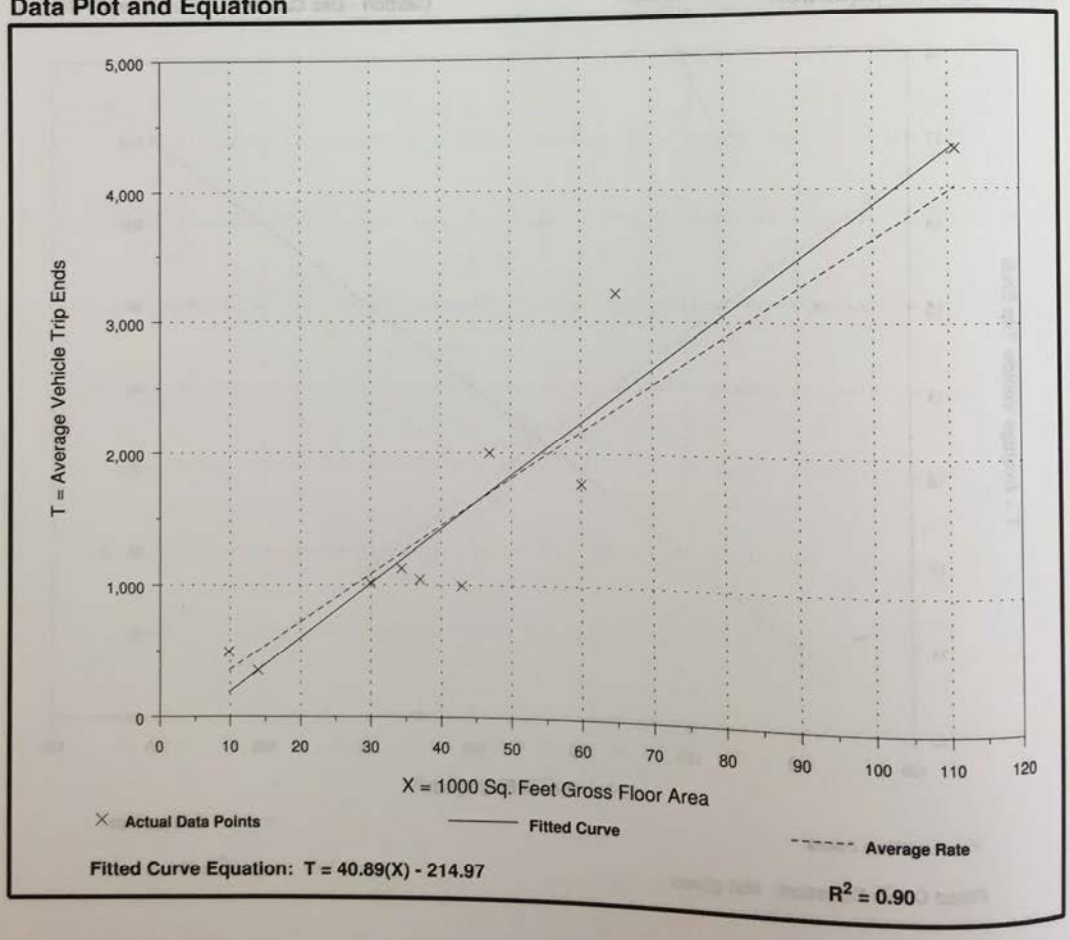
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday

Number of Studies: 10
Average 1000 Sq. Feet GFA: 45
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
36.13	23.16 - 50.51	10.18

Data Plot and Equation



Fitted Curve Equation: T = 40.89(X) - 214.97

R^2 = 0.90

Specialty Retail Center
(826)

Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area
On a: Weekday

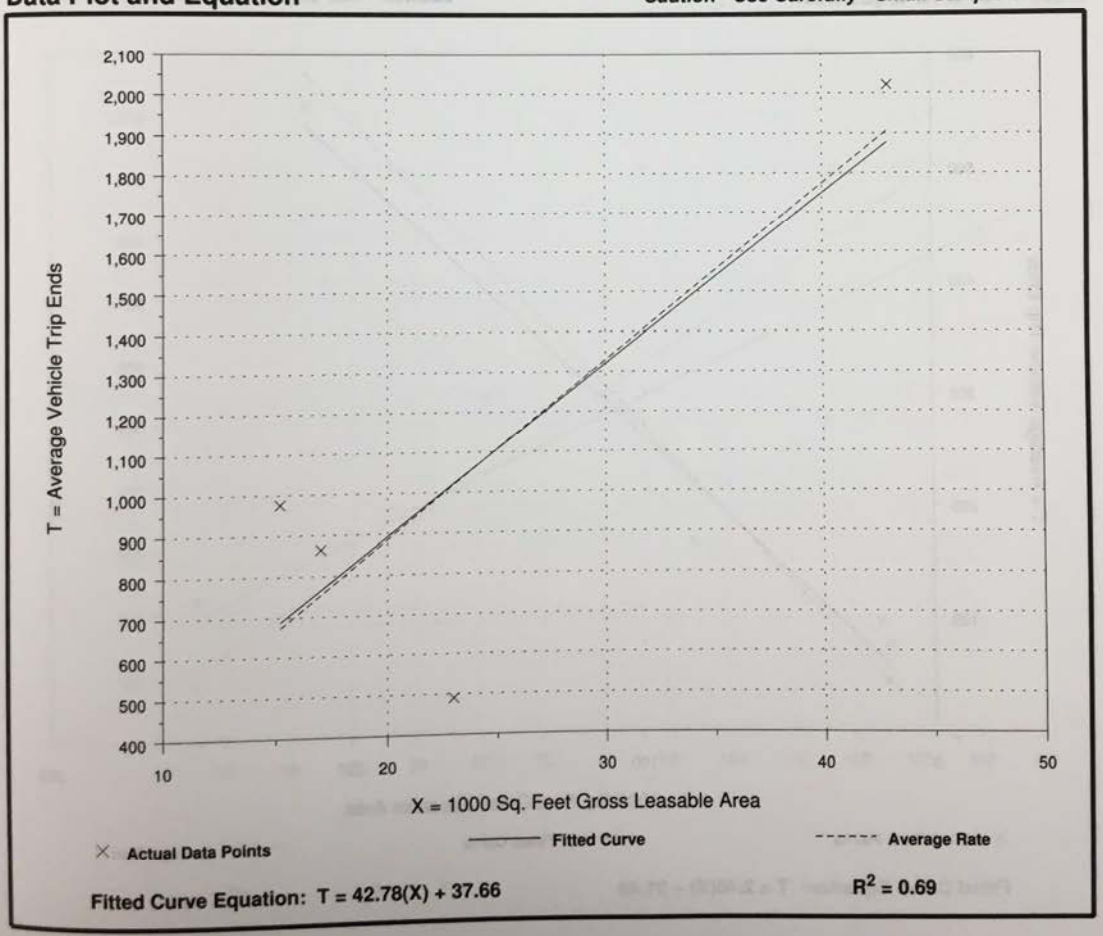
Number of Studies: 4
Average 1000 Sq. Feet GLA: 25
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
44.32	21.30 - 64.21	15.52

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: T = 42.78(X) + 37.66

R^2 = 0.69

Specialty Retail Center
(826)

Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Leasable Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

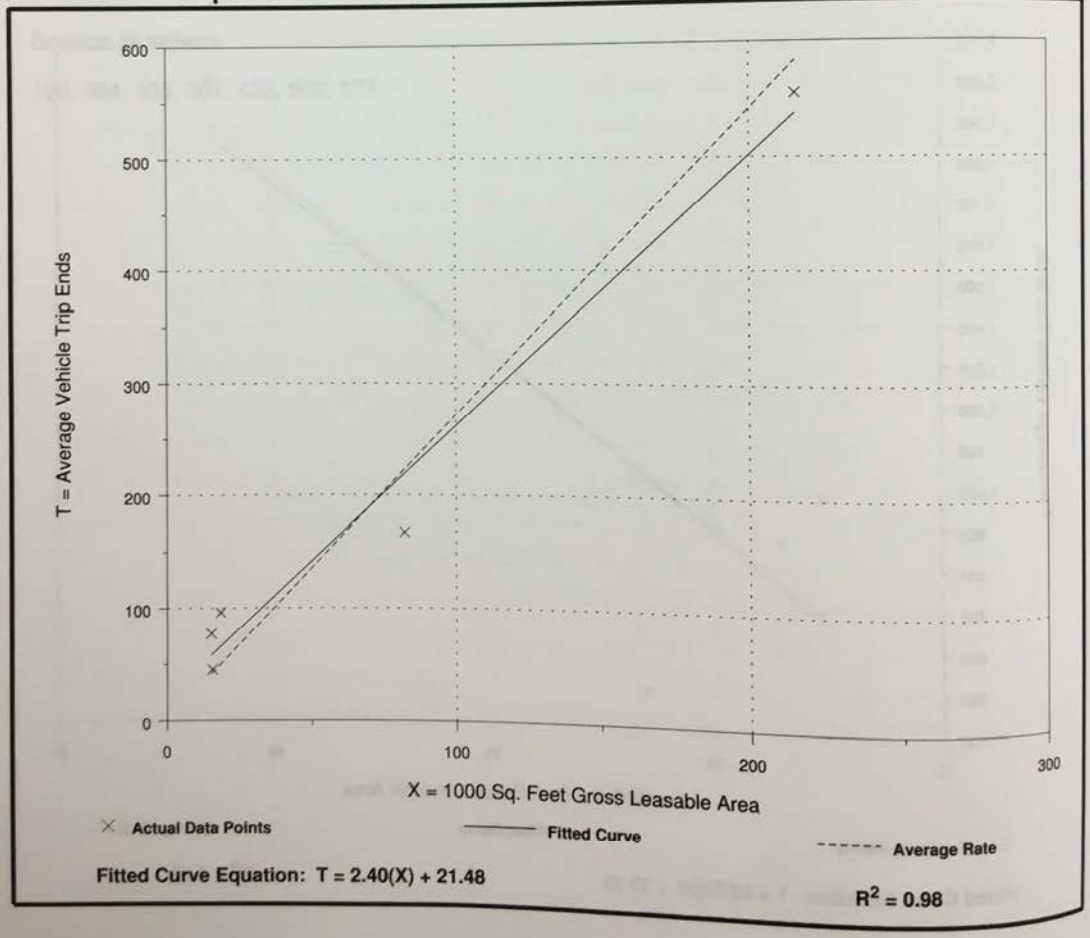
Number of Studies: 5
Average 1000 Sq. Feet GLA: 69
Directional Distribution: 44% entering, 56% exiting

Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
2.71	2.03 - 5.16	1.83

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: T = 2.40(X) + 21.48

R^2 = 0.98

Attachment 4
Signal Timing

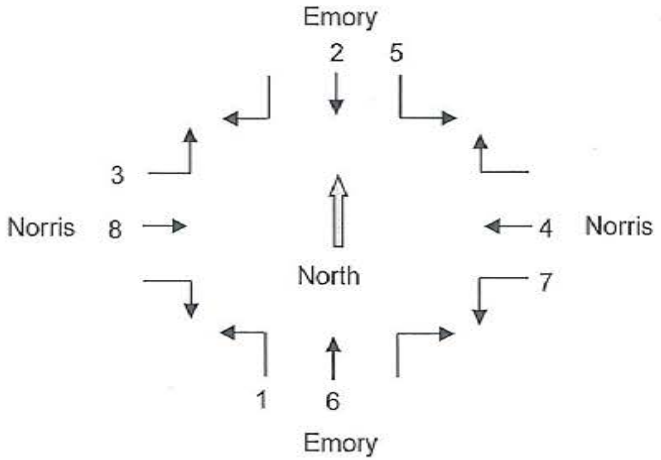
McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

2.1 Phase Parameters	Set 1	1	2	3	4	5	6	7	8
Min. Green		6	15	6	10	6	15	6	10
Passage/10	2.5	25	20	25	20	25	20	25	20
Max. 1		10	40	15	40	10	40	15	40
Max. 2		10	40	15	40	10	40	15	40
Yel/10	3.5	35	50	40	50	40	50	45	50
Red/10	2.5	25	25	40	10	25	25	35	10
Walk			7		7		7		7
Pedestrian Clear			12		10		15		17
Walk									
Pedestrian Clear									
Add In/10									
Max. Initial									
TBR									
CBR									
TTR									
Reduce/10									
Min Gp/10									
DM Limit									
Dm Step/10									
Red Revert/10									
CS Min									
Alt Min Green									
Alt Passage/10									
Alt Walk									
Adv Walk									
Delay Walk									
St Dly/10									
Green Clr/10									

PHASING SCHEMATIC



McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

2.2 Phase Options	Set 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Phase Omit																	
Ped Omit																	
Min Recall			X				X										
Max Recall																	
Soft Recall																	
Ped Recall																	
Pedestrian Recycle																	
Condition Service																	
Detector Lock																	
Dual Entry																	
Simultaneous Gap																	
Guaranteed Passage																	
Added Initial Calc																	
Walk Rest																	
Red Rest																	
Flash Entry																	
Flash Exit																	
CNA-1																	
CNA-2																	
No Backup																	
Max Walk																	
Max Extension																	
Sequential Timing																	
No Min Yellow																	
FDW PED Recycle																	

McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

5.1 Coordination Constants	
Correction Mode	Shortway
Max Cycles Trans	3
Coord Max Mode	Max Inhibit
Coord Force Mode	Floating
Perm Strategy	Maximum
Omit Strategy	Minimum
Sync Point	End Green
No Early Return	Disable
Sync Ref Time	0

5.2 Pattern Parameters	1	2	3	4	5	6	7	8
Cycle Time	120	110	120	120	140	130		
Offset Time	20	41	95	80	73	54		
Split	1	2	3	4	5	6		
Sequence								
Phase Timing Set	1	1	1	1	1	1	1	1
Phase Option Set	1	1	1	1	1	1	1	1
Vehicle Overlap Set	1	1	1	1	1	1	1	1
PED Overlap Set	1	1	1	1	1	1	1	1
Transit Priority Set	1	1	1	1	1	1	1	1
Vehicle Detector Set	1	1	1	1	1	1	1	1
PED Detector Set	1	1	1	1	1	1	1	1
Vehicle Det. Diag Set	1	1	1	1	1	1	1	1
Ped Det. Diag Set	1	1	1	1	1	1	1	1
Detector Reset								
Max 2 Phases								
Correction Mode								
Coord Max Mode								
Coord Force Mode								
Perm Strategy								
Omit Strategy								
No Early Return								
TX Diamond Type								

← See Split tables, pp 4-5

McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

5.3 Split Table 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)	15	53	22	30	15	53	18	34								
Mode	NONE	MAXV	NONE	NONE	NONE	MAXV	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase		X				X										
Manual Permit																
Manual Omit																

5.3 Split Table 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)	18	42	20	30	15	45	20	30								
Mode	NONE	MAXV	NONE	NONE	NONE	MAXV	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase		X				X										
Manual Permit																
Manual Omit																

5.3 Split Table 3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)	20	45	20	35	15	50	25	30								
Mode	NONE	MAXV	NONE	NONE	NONE	MAXV	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase		X				X										
Manual Permit																
Manual Omit																

5.3 Split Table 4

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)	22	43	22	33	15	50	18	37								
Mode	NONE	MAXV	NONE	NONE	NONE	MAXV	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase		X				X										
Manual Permit																
Manual Omit																

McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

5.3 Split Table 5

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)	15	60	25	40	15	60	40	25								
Mode	NONE	MAXV	NONE	NONE	NONE	MAXV	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase		X				X										
Manual Permit																
Manual Omit																

5.3 Split Table 6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)	19	45	21	45	19	45	21	45								
Mode	NONE	MAXV	NONE	NONE	NONE	MAXV	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase		X				X										
Manual Permit																
Manual Omit																

5.3 Split Table 7

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)																
Mode	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase																
Manual Permit																
Manual Omit																

5.3 Split Table 8

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Time (sec)																
Mode	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Coord. Phase																
Manual Permit																
Manual Omit																

McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

6.2 Time Zone	Global DST: Enable DST	Standard Time Zone (+/- hr): -8

6.4 Sched	Month												Days Of Week							Date																															Day Plan
	J	F	M	A	M	J	J	A	S	O	N	D	S	M	T	W	T	F	S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
1	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1
2	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	2
3	X	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
4																																																			
5																																																			
6																																																			
7																																																			
8																																																			
9																																																			
10																																																			
11																																																			
12																																																			
13																																																			
14																																																			
15																																																			
16																																																			
17																																																			
18																																																			
19																																																			
20																																																			
21																																																			
22																																																			
23																																																			
24																																																			
25																																																			

McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

Weekday

6.5 DayPlan	1		
Event	Hour	Minute	Action
1	0	00	127
2	6	00	5
3	9	30	2
4	15	00	3
5	16	30	4
6	20	00	127
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			

Pattern Parameters
140 s. cycle
Offset = 73 s.
Split Table 5

Saturday

6.5 DayPlan	2		
Event	Hour	Minute	Action
1	0	00	127
2	8	00	2
3	9	30	6
4	18	30	2
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			

Sunday

6.5 DayPlan	3		
Event	Hour	Minute	Action
1	0	00	127
2	10	00	2
3	12	00	6
4	17	00	2
5	23	00	127
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			

McCain
A Company of the SWARCO Group
ATC eX Series

Zone: A
INTERSECTION NUMBER: 12
INTERSECTION: Norris Freeway at Emory Road

Date Prepared: 10/27/2017 By: TQH
Date Implemented: By:

6.6 Action Parameters	1	2	3	4	5	6	7	8
Pattern	1	2	3	4	5	6		
Auxiliary Function								
Special Function								
Detector Reset								
Detector VOS Log								
Speed Trap Log								
Cycle MOE Log								
Hi-Res Log								

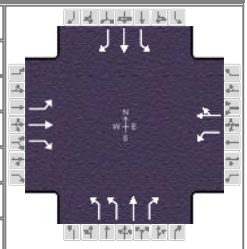
6.6 Action Parameters	9	10	11	12	13	14	15	16
Pattern								
Auxiliary Function								
Special Function								
Detector Reset								
Detector VOS Log								
Speed Trap Log								
Cycle MOE Log								
Hi-Res Log								

6.6 Action Parameters	17	18	19	20	21		127	128
Pattern							254	255
Auxiliary Function								
Special Function								
Detector Reset								
Detector VOS Log								
Speed Trap Log								
Cycle MOE Log								
Hi-Res Log								

Attachment 5
Intersection Worksheets – Existing AM/PM Peaks

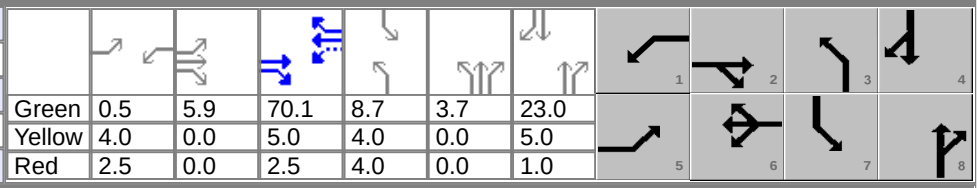
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	4/25/2018	Area Type	Other
Jurisdiction	Knox County	Time Period	Existing AM Peak	PHF	0.90
Urban Street	E Emory Road (SR 131)	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	E Emory Road at Norris…	File Name	Existing AM Peak_Emory at Norris.xus		
Project Description	615.001 Heartland Dental Office				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	62	392	168	2	473	82	221	167	11	80	238	206

Signal Information			
Cycle, s	140.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.5	5.9	70.1	8.7	3.7	23.0
Yellow	4.0	0.0	5.0	4.0	0.0	5.0
Red	2.5	0.0	2.5	4.0	0.0	1.0

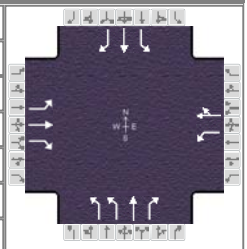
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	12.9	83.6	7.0	77.6	20.4	32.7	16.7	29.0
Change Period, ($Y+R_c$), s	6.0	7.5	6.5	7.5	8.0	6.0	8.0	6.0
Max Allow Headway (*MAH*), s	3.6	0.0	3.6	0.0	3.6	3.1	3.6	3.1
Queue Clearance Time (g_s), s	7.4		2.1		11.7	14.5	8.9	21.8
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.7	1.3	0.1	1.2
Phase Call Probability	0.93		0.08		1.00	1.00	0.97	1.00
Max Out Probability	0.00		0.00		0.00	0.00	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	69	436	187	2	617		246	186	12	89	264	229
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1585	1781	1822		1730	1870		1781	1870	
Queue Service Time (g_s), s	5.4	19.4	8.5	0.1	35.7		9.7	12.5		6.9	19.3	
Cycle Queue Clearance Time (g_c), s	5.4	19.4	8.5	0.1	35.7		9.7	12.5		6.9	19.3	
Green Ratio (*g/C*)	0.05	0.54	0.54	0.50	0.50		0.09	0.19		0.06	0.16	
Capacity (*c*), veh/h	88	1017	861	430	913		307	357		111	307	
Volume-to-Capacity Ratio (*X*)	0.779	0.428	0.217	0.005	0.676		0.799	0.520		0.803	0.862	
Back of Queue (*Q*), ft/ln (95 th percentile)	121.9	339	145.7	1.6	573.1		198.9	248.9		155.1	363.2	
Back of Queue (*Q*), veh/ln (95 th percentile)	4.8	13.3	5.7	0.1	22.6		7.8	9.8		6.1	14.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00	0.00	0.01	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	65.8	19.0	16.5	18.1	26.3		62.6	50.9		64.8	57.0	
Incremental Delay (d_2), s/veh	10.4	1.3	0.6	0.0	4.0		3.6	0.4		9.6	3.6	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	76.2	20.3	17.1	18.1	30.3		66.1	51.3	0.0	74.4	60.6	0.0
Level of Service (LOS)	E	C	B	B	C		E	D	A	E	E	A
Approach Delay, s/veh / LOS	25.0	C		30.3	C		58.1	E		38.9	D	
Intersection Delay, s/veh / LOS	36.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.4	B	2.3	B	2.9	C
Bicycle LOS Score / LOS	1.6	B	1.5	B	1.2	A	1.4	A

HCS7 Signalized Intersection Results Summary

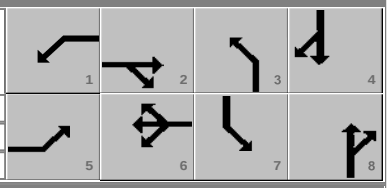
General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	4/25/2018	Area Type	Other
Jurisdiction	Knox County	Time Period	Existing PM Peak	PHF	0.97
Urban Street	E Emory Road (SR 131)	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	E Emory Road at Norris…	File Name	Existing PM Peak_Emory at Norris.xus		
Project Description	615.001 Heartland Dental Office				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	183	617	337	33	283	96	224	351	21	160	300	124

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

Green	4.1	4.1	39.6	9.9	3.0	25.4	
Yellow	4.0	3.5	5.0	4.5	0.0	5.0	
Red	2.5	2.5	2.5	3.5	0.0	1.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	20.6	57.1	10.6	47.1	17.9	31.4	20.9	34.4
Change Period, ($Y+R_c$), s	6.0	7.5	6.5	7.5	8.0	6.0	8.0	6.0
Max Allow Headway (*MAH*), s	3.6	0.0	3.6	0.0	3.6	3.0	3.6	3.0
Queue Clearance Time (g_s), s	14.5		3.5		9.9	24.7	12.9	20.1
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0	0.0	0.7	0.0	1.3
Phase Call Probability	1.00		0.68		1.00	1.00	1.00	1.00
Max Out Probability	0.57		0.00		1.00	0.86	1.00	0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	189	636	347	34	391		231	362	22	165	309	128
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1585	1781	1789		1730	1870		1781	1870	
Queue Service Time (g_s), s	12.5	36.3	19.8	1.5	22.5		7.9	22.7		10.9	18.1	
Cycle Queue Clearance Time (g_c), s	12.5	36.3	19.8	1.5	22.5		7.9	22.7		10.9	18.1	
Green Ratio (*g/C*)	0.12	0.41	0.41	0.36	0.33		0.08	0.21		0.11	0.24	
Capacity (*c*), veh/h	217	773	655	195	590		285	396		192	443	
Volume-to-Capacity Ratio (*X*)	0.869	0.823	0.530	0.174	0.662		0.811	0.914		0.860	0.698	
Back of Queue (*Q*), ft/ln (95 th percentile)	275.7	623.9	313.3	29.1	400.2		181.8	468.9		261.6	339.2	
Back of Queue (*Q*), veh/ln (95 th percentile)	10.9	24.6	12.3	1.1	15.8		7.2	18.5		10.3	13.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00	0.00	0.19	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	51.7	31.3	26.4	28.2	34.5		54.1	46.2		52.7	41.9	
Incremental Delay (d_2), s/veh	19.2	9.6	3.1	0.3	5.8		15.3	21.3		26.6	3.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	71.0	40.9	29.5	28.6	40.3		69.4	67.5	0.0	79.2	44.9	0.0
Level of Service (LOS)	E	D	C	C	D		E	E	A	E	D	A
Approach Delay, s/veh / LOS	42.4	D		39.3	D		65.8	E		44.8	D	
Intersection Delay, s/veh / LOS	47.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.4	B	2.3	B	2.8	C
Bicycle LOS Score / LOS	2.4	B	1.2	A	1.5	B	1.5	A

HCS7 Two-Way Stop-Control Report

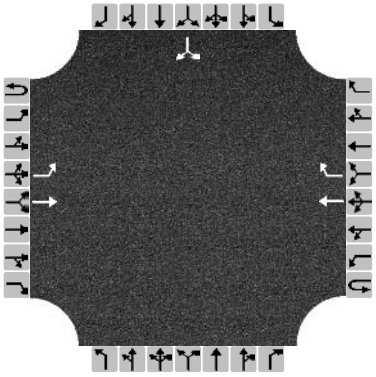
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2018
Time Analyzed	Existing AM Peak
Intersection Orientation	East-West
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	E Emory Rd at ALDI Drive
Jurisdiction	Knox County
East/West Street	E Emory Road
North/South Street	ALDI Driveway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

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	1	1	0	0	0	1	1		0	0	0		0	1	0
Configuration		L	T				T	R							LR	
Volume, V (veh/h)		1	482				556	7						1		1
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked		0.200												0.200		0.200
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								2						

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)		1													2	
Capacity, c (veh/h)		934													474	
v/c Ratio		0.00													0.00	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		8.9													12.6	
Level of Service, LOS		A													B	
Approach Delay (s/veh)		0.0												12.6		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

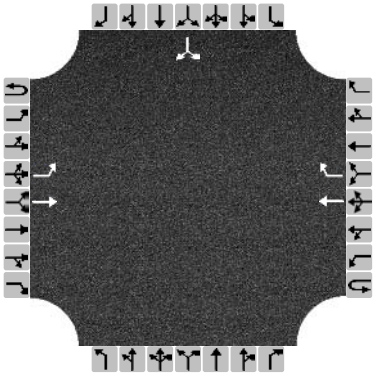
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2018
Time Analyzed	Existing PM Peak
Intersection Orientation	East-West
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	E Emory Rd at ALDI Drive
Jurisdiction	Knox County
East/West Street	E Emory Road
North/South Street	ALDI Driveway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

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	1	1	0	0	0	1	1		0	0	0		0	1	0
Configuration		L	T				T	R							LR	
Volume, V (veh/h)		20	778				391	20						16		21
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked		0.100												0.100		0.100
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								2						

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)		22													40	
Capacity, c (veh/h)		1106													476	
v/c Ratio		0.02													0.08	
95% Queue Length, Q_{95} (veh)		0.1													0.3	
Control Delay (s/veh)		8.3													13.3	
Level of Service, LOS		A													B	
Approach Delay (s/veh)		0.2												13.3		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

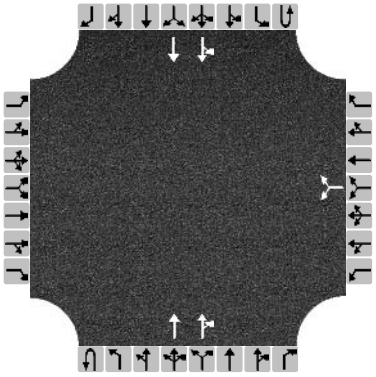
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2018
Time Analyzed	Existing AM Peak
Intersection Orientation	North-South
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	Norris Fwy at ALDI Drive
Jurisdiction	Knox County
East/West Street	ALDI Driveway
North/South Street	Norris Freeway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	2	0	0	0	2	0
Configuration							LR				T	TR		LT	T	
Volume, V (veh/h)						2		5			311	0		0	522	
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						7.5		6.9						4.1		
Critical Headway (sec)						6.84		6.94						4.14		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.52		3.32						2.22		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							7							0		
Capacity, c (veh/h)							655							1218		
v/c Ratio							0.01							0.00		
95% Queue Length, Q_{95} (veh)							0.0							0.0		
Control Delay (s/veh)							10.6							8.0		
Level of Service, LOS							B							A		
Approach Delay (s/veh)						10.6								0.0		
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

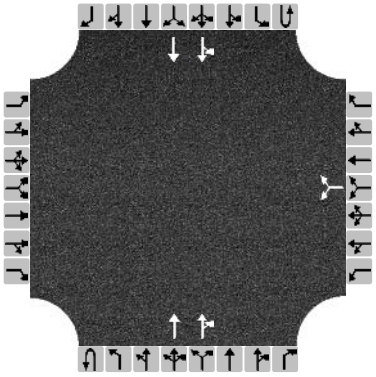
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2018
Time Analyzed	Existing PM Peak
Intersection Orientation	North-South
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	Norris Fwy at ALDI Drive
Jurisdiction	Knox County
East/West Street	ALDI Driveway
North/South Street	Norris Freeway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	2	0	0	0	2	0
Configuration							LR				T	TR		LT	T	
Volume, V (veh/h)						6		23			624	6		20	578	
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						7.5		6.9						4.1		
Critical Headway (sec)						6.84		6.94						4.14		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.52		3.32						2.22		

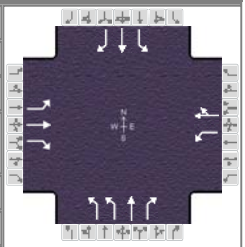
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							32							22		
Capacity, c (veh/h)							457							904		
v/c Ratio							0.07							0.02		
95% Queue Length, Q_{95} (veh)							0.2							0.1		
Control Delay (s/veh)							13.5							9.1		
Level of Service, LOS							B							A		
Approach Delay (s/veh)						13.5								0.5		
Approach LOS						B										

Attachment 6
Intersection Worksheets – Background AM/PM Peaks

HCS7 Signalized Intersection Results Summary

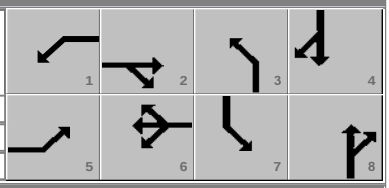
General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	4/25/2018	Area Type	Other
Jurisdiction	Knox County	Time Period	Background AM Peak	PHF	0.90
Urban Street	E Emory Road (SR 131)	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	E Emory Road at Norris…	File Name	Background AM Peak_Emory at Norris.xus		
Project Description	615.001 Heartland Dental Office				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	68	428	184	2	517	90	241	182	12	87	260	225

Signal Information			
Cycle, s	140.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.5	0.6	66.7	9.4	4.0	24.9	
Yellow	4.0	3.5	5.0	4.0	0.0	5.0	
Red	2.5	2.5	2.5	4.0	0.0	1.0	



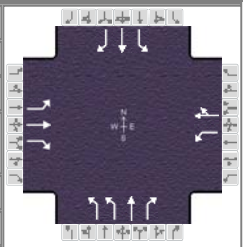
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	13.5	80.8	7.0	74.2	21.4	34.9	17.4	30.9
Change Period, ($Y+R_c$), s	6.0	7.5	6.5	7.5	8.0	6.0	8.0	6.0
Max Allow Headway (*MAH*), s	3.6	0.0	3.6	0.0	3.6	3.1	3.6	3.1
Queue Clearance Time (g_s), s	7.9		2.1		12.6	15.5	9.5	23.6
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.8	1.4	0.1	1.3
Phase Call Probability	0.95		0.08		1.00	1.00	0.98	1.00
Max Out Probability	0.00		0.00		0.00	0.00	0.01	0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	76	476	204	2	674		268	202	13	97	289	250
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1585	1781	1822		1730	1870		1781	1870	
Queue Service Time (g_s), s	5.9	22.8	9.9	0.1	43.1		10.6	13.5		7.5	21.0	
Cycle Queue Clearance Time (g_c), s	5.9	22.8	9.9	0.1	43.1		10.6	13.5		7.5	21.0	
Green Ratio (*g/C*)	0.05	0.52	0.52	0.48	0.48		0.10	0.21		0.07	0.18	
Capacity (*c*), veh/h	96	979	829	376	868		331	386		119	332	
Volume-to-Capacity Ratio (*X*)	0.787	0.486	0.247	0.006	0.777		0.810	0.524		0.811	0.870	
Back of Queue (*Q*), ft/ln (95 th percentile)	132.8	391	170.6	1.7	690.1		212.6	264.3		168.1	399.5	
Back of Queue (*Q*), veh/ln (95 th percentile)	5.2	15.4	6.7	0.1	27.2		8.4	10.4		6.6	15.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00	0.00	0.01	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	65.4	21.3	18.3	20.1	30.5		62.1	49.4		64.4	56.0	
Incremental Delay (d_2), s/veh	10.0	1.7	0.7	0.0	6.8		3.6	0.4		9.3	7.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	75.5	23.1	19.0	20.1	37.2		65.6	49.9	0.0	73.8	63.0	0.0
Level of Service (LOS)	E	C	B	C	D		E	D	A	E	E	A
Approach Delay, s/veh / LOS	27.2	C		37.2	D		57.2	E		39.9	D	
Intersection Delay, s/veh / LOS	38.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.4	B	2.3	B	2.9	C
Bicycle LOS Score / LOS	1.7	B	1.6	B	1.3	A	1.5	B

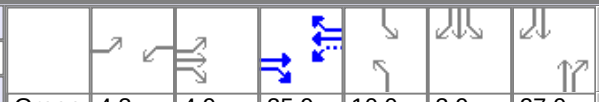
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	4/25/2018	Area Type	Other
Jurisdiction	Knox County	Time Period	Background PM Peak	PHF	0.97
Urban Street	E Emory Road (SR 131)	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	E Emory Road at Norris…	File Name	Background PM Peak_Emory at Norris.xus		
Project Description	615.001 Heartland Dental Office				

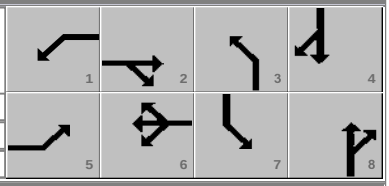


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	674	368	36	309	105	245	384	23	175	328	135

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



Green	4.3	4.9	35.9	10.0	3.9	27.0
Yellow	4.0	3.5	5.0	4.5	0.0	5.0
Red	2.5	2.5	2.5	3.5	0.0	1.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	21.7	54.3	10.8	43.4	18.0	33.0	21.9	36.9
Change Period, ($Y+R_c$), s	6.0	7.5	6.5	7.5	8.0	6.0	8.0	6.0
Max Allow Headway (*MAH*), s	3.6	0.0	3.6	0.0	3.6	3.0	3.6	3.0
Queue Clearance Time (g_s), s	15.7		3.7		10.7	27.0	14.0	21.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Phase Call Probability	1.00		0.71		1.00	1.00	1.00	1.00
Max Out Probability	1.00		0.13		1.00	1.00	1.00	0.08

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	206	695	379	37	427		253	396	24	180	338	139
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1585	1781	1789		1730	1870		1781	1870	
Queue Service Time (g_s), s	13.7	43.3	23.0	1.7	26.4		8.7	25.0		12.0	19.7	
Cycle Queue Clearance Time (g_c), s	13.7	43.3	23.0	1.7	26.4		8.7	25.0		12.0	19.7	
Green Ratio (*g/C*)	0.13	0.39	0.39	0.33	0.30		0.08	0.23		0.12	0.26	
Capacity (*c*), veh/h	233	730	618	133	535		288	421		207	482	
Volume-to-Capacity Ratio (*X*)	0.887	0.952	0.614	0.279	0.797		0.876	0.941		0.873	0.702	
Back of Queue (*Q*), ft/ln (95 th percentile)	317.2	800.1	361.5	34	479.1		209.1	531.7		287.8	364.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	12.5	31.5	14.2	1.3	18.9		8.2	20.9		11.3	14.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00	0.00	0.23	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	51.3	35.5	29.3	32.3	38.7		54.4	45.7		52.2	40.4	
Incremental Delay (d_2), s/veh	29.6	23.5	4.5	0.8	11.7		24.4	28.9		30.4	3.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	80.9	59.0	33.8	33.1	50.4		78.7	74.6	0.0	82.6	44.2	0.0
Level of Service (LOS)	F	E	C	C	D		E	E	A	F	D	A
Approach Delay, s/veh / LOS	55.1	E		49.0	D		73.5	E		45.4	D	
Intersection Delay, s/veh / LOS	56.1						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.4	B	2.3	B	2.8	C
Bicycle LOS Score / LOS	2.6	C	1.3	A	1.6	B	1.6	B

HCS7 Two-Way Stop-Control Report

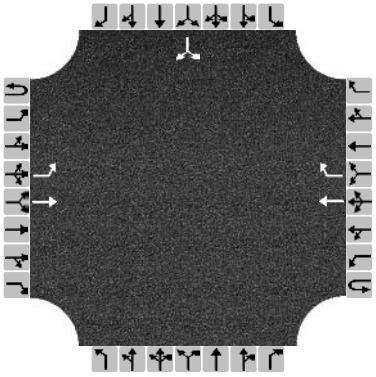
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2021
Time Analyzed	Background AM Peak
Intersection Orientation	East-West
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	E Emory Rd at ALDI Drive
Jurisdiction	Knox County
East/West Street	E Emory Road
North/South Street	ALDI Driveway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

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	1	1	0	0	0	1	1		0	0	0		0	1	0
Configuration		L	T				T	R							LR	
Volume, V (veh/h)		1	526				608	8						1		1
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked		0.200												0.200		0.200
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								2						

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)		1													2	
Capacity, c (veh/h)		879													435	
v/c Ratio		0.00													0.00	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		9.1													13.3	
Level of Service, LOS		A													B	
Approach Delay (s/veh)		0.0												13.3		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

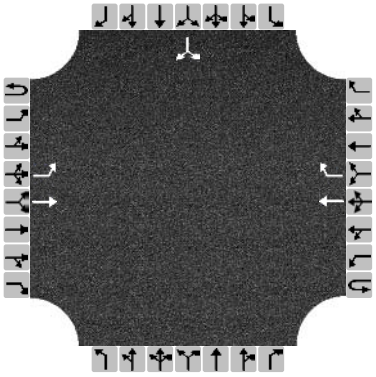
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2021
Time Analyzed	Background PM Peak
Intersection Orientation	East-West
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	E Emory Rd at ALDI Drive
Jurisdiction	Knox County
East/West Street	E Emory Road
North/South Street	ALDI Driveway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

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	1	1	0	0	0	1	1		0	0	0		0	1	0
Configuration		L	T				T	R							LR	
Volume, V (veh/h)		22	850				427	22						17		23
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked		0.100												0.100		0.100
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								2						

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)		24													43	
Capacity, c (veh/h)		1064													442	
v/c Ratio		0.02													0.10	
95% Queue Length, Q_{95} (veh)		0.1													0.3	
Control Delay (s/veh)		8.5													14.0	
Level of Service, LOS		A													B	
Approach Delay (s/veh)		0.2												14.0		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

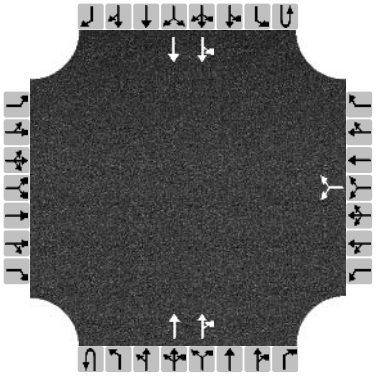
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2021
Time Analyzed	Background AM Peak
Intersection Orientation	North-South
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	Norris Fwy at ALDI Drive
Jurisdiction	Knox County
East/West Street	ALDI Driveway
North/South Street	Norris Freeway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	2	0	0	0	2	0
Configuration							LR				T	TR		LT	T	
Volume, V (veh/h)						2		5			340	0		0	570	
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						7.5		6.9						4.1		
Critical Headway (sec)						6.84		6.94						4.14		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.52		3.32						2.22		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							7							0		
Capacity, c (veh/h)							622							1185		
v/c Ratio							0.01							0.00		
95% Queue Length, Q_{95} (veh)							0.0							0.0		
Control Delay (s/veh)							10.9							8.0		
Level of Service, LOS							B							A		
Approach Delay (s/veh)						10.9								0.0		
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

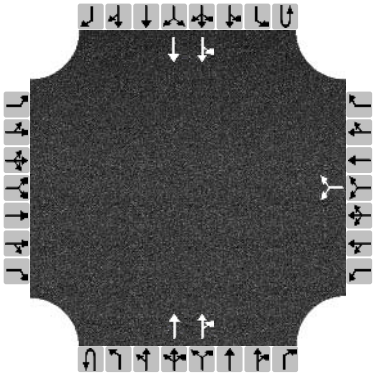
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	4/28/2018
Analysis Year	2021
Time Analyzed	Background PM Peak
Intersection Orientation	North-South
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	Norris Fwy at ALDI Drive
Jurisdiction	Knox County
East/West Street	ALDI Driveway
North/South Street	Norris Freeway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	2	0	0	0	2	0
Configuration							LR				T	TR		LT	T	
Volume, V (veh/h)						7		25			682	7		22	631	
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						7.5		6.9						4.1		
Critical Headway (sec)						6.84		6.94						4.14		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.52		3.32						2.22		

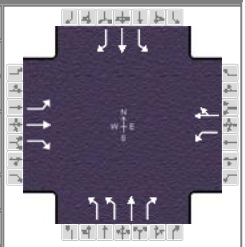
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							35							24		
Capacity, c (veh/h)							410							856		
v/c Ratio							0.09							0.03		
95% Queue Length, Q_{95} (veh)							0.3							0.1		
Control Delay (s/veh)							14.6							9.3		
Level of Service, LOS							B							A		
Approach Delay (s/veh)						14.6								0.5		
Approach LOS						B										

Attachment 7
Intersection Worksheets – Full Buildout AM/PM Peaks

HCS7 Signalized Intersection Results Summary

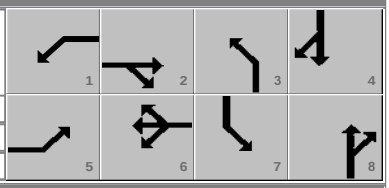
General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	4/25/2018	Area Type	Other
Jurisdiction	Knox County	Time Period	Full Buildout AM Peak	PHF	0.90
Urban Street	E Emory Road (SR 131)	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	E Emory Road at Norris…	File Name	Full Buildout AM Peak_Emory at Norris.xus		
Project Description	615.001 Heartland Dental Office				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	68	430	184	2	518	90	241	183	12	87	261	225

Signal Information			
Cycle, s	140.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.5	0.6	66.7	9.4	4.0	24.9	
Yellow	4.0	3.5	5.0	4.0	0.0	5.0	
Red	2.5	2.5	2.5	4.0	0.0	1.0	



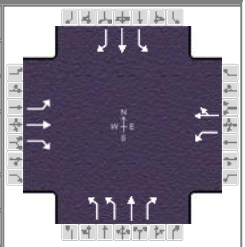
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	13.5	80.8	7.0	74.2	21.4	34.9	17.4	30.9
Change Period, ($Y+R_c$), s	6.0	7.5	6.5	7.5	8.0	6.0	8.0	6.0
Max Allow Headway (*MAH*), s	3.6	0.0	3.6	0.0	3.6	3.1	3.6	3.1
Queue Clearance Time (g_s), s	7.9		2.1		12.6	15.6	9.5	23.6
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.8	1.4	0.1	1.3
Phase Call Probability	0.95		0.08		1.00	1.00	0.98	1.00
Max Out Probability	0.00		0.00		0.00	0.00	0.01	0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	76	478	204	2	676		268	203	13	97	290	250
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1585	1781	1822		1730	1870		1781	1870	
Queue Service Time (g_s), s	5.9	22.9	9.9	0.1	43.2		10.6	13.6		7.5	21.1	
Cycle Queue Clearance Time (g_c), s	5.9	22.9	9.9	0.1	43.2		10.6	13.6		7.5	21.1	
Green Ratio (*g/C*)	0.05	0.52	0.52	0.48	0.48		0.10	0.21		0.07	0.18	
Capacity (*c*), veh/h	96	979	829	374	868		331	386		119	332	
Volume-to-Capacity Ratio (*X*)	0.787	0.488	0.247	0.006	0.778		0.810	0.527		0.811	0.873	
Back of Queue (*Q*), ft/ln (95 th percentile)	132.8	393	170.6	1.7	692.5		212.6	265.4		168.1	402	
Back of Queue (*Q*), veh/ln (95 th percentile)	5.2	15.5	6.7	0.1	27.3		8.4	10.4		6.6	15.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00	0.00	0.01	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	65.4	21.4	18.3	20.2	30.5		62.1	49.5		64.4	56.0	
Incremental Delay (d_2), s/veh	10.0	1.7	0.7	0.0	6.8		3.6	0.4		9.3	7.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	75.5	23.1	19.0	20.2	37.3		65.6	49.9	0.0	73.8	63.3	0.0
Level of Service (LOS)	E	C	B	C	D		E	D	A	E	E	A
Approach Delay, s/veh / LOS	27.2	C		37.3	D		57.2	E		40.1	D	
Intersection Delay, s/veh / LOS	38.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.4	B	2.3	B	2.9	C
Bicycle LOS Score / LOS	1.7	B	1.6	B	1.3	A	1.5	B

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	4/25/2018	Area Type	Other
Jurisdiction	Knox County	Time Period	Full Buildout PM Peak	PHF	0.97
Urban Street	E Emory Road (SR 131)	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	E Emory Road at Norris…	File Name	Full Buildout PM Peak_Emory at Norris.xus		
Project Description	615.001 Heartland Dental Office				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	201	680	368	36	316	105	245	385	23	175	331	135

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

Green	4.3	5.0	35.8	10.0	3.9	27.1	1	2	3	4		
Yellow	4.0	3.5	5.0	4.5	0.0	5.0	5	6	7	8		
Red	2.5	2.5	2.5	3.5	0.0	1.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	21.7	54.3	10.8	43.3	18.0	33.1	21.9	37.0
Change Period, ($Y+R_c$), s	6.0	7.5	6.5	7.5	8.0	6.0	8.0	6.0
Max Allow Headway (*MAH*), s	3.6	0.0	3.6	0.0	3.6	3.0	3.6	3.0
Queue Clearance Time (g_s), s	15.7		3.7		10.7	27.0	14.0	21.9
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Phase Call Probability	1.00		0.71		1.00	1.00	1.00	1.00
Max Out Probability	1.00		0.14		1.00	1.00	1.00	0.09

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	207	701	379	37	434		253	397	24	180	341	139
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1585	1781	1790		1730	1870		1781	1870	
Queue Service Time (g_s), s	13.7	43.9	23.0	1.7	27.0		8.7	25.0		12.0	19.9	
Cycle Queue Clearance Time (g_c), s	13.7	43.9	23.0	1.7	27.0		8.7	25.0		12.0	19.9	
Green Ratio (*g/C*)	0.13	0.39	0.39	0.33	0.30		0.08	0.23		0.12	0.26	
Capacity (*c*), veh/h	233	729	618	129	534		288	422		207	483	
Volume-to-Capacity Ratio (*X*)	0.888	0.962	0.614	0.289	0.813		0.876	0.941		0.873	0.707	
Back of Queue (*Q*), ft/ln (95 th percentile)	319.4	818.6	361.7	34.1	492.4		209.1	534.2		287.8	368.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	12.6	32.2	14.2	1.3	19.4		8.2	21.0		11.3	14.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00	0.00	0.23	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	51.3	35.7	29.4	32.5	39.0		54.4	45.7		52.2	40.4	
Incremental Delay (d_2), s/veh	30.0	25.2	4.5	0.9	12.7		24.4	29.1		30.4	4.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	81.2	60.9	33.9	33.4	51.7		78.7	74.8	0.0	82.6	44.4	0.0
Level of Service (LOS)	F	E	C	C	D		E	E	A	F	D	A
Approach Delay, s/veh / LOS	56.2	E		50.3	D		73.6	E		45.5	D	
Intersection Delay, s/veh / LOS	56.8						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.4	B	2.3	B	2.8	C
Bicycle LOS Score / LOS	2.6	C	1.3	A	1.6	B	1.6	B

HCS7 Two-Way Stop-Control Report

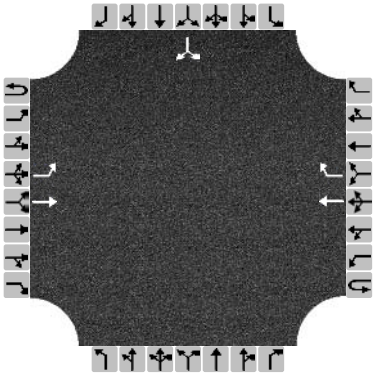
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	5/24/2018
Analysis Year	2021
Time Analyzed	Full Buildout AM Peak
Intersection Orientation	East-West
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	E Emory Rd at ALDI Drive
Jurisdiction	Knox County
East/West Street	E Emory Road
North/South Street	ALDI Driveway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

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	1	1	0	0	0	1	1		0	0	0		0	1	0
Configuration		L	T				T	R							LR	
Volume, V (veh/h)		3	526				608	12						1		26
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked		0.200												0.200		0.200
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								2						

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													29	
Capacity, c (veh/h)		874													482	
v/c Ratio		0.00													0.06	
95% Queue Length, Q_{95} (veh)		0.0													0.2	
Control Delay (s/veh)		9.1													12.9	
Level of Service, LOS		A													B	
Approach Delay (s/veh)		0.0												12.9		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

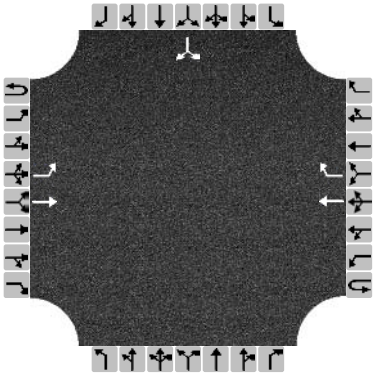
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	5/24/2018
Analysis Year	2021
Time Analyzed	Full Buildout PM Peak
Intersection Orientation	East-West
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	E Emory Rd at ALDI Drive
Jurisdiction	Knox County
East/West Street	E Emory Road
North/South Street	ALDI Driveway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

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	1	1	0	0	0	1	1		0	0	0		0	1	0
Configuration		L	T				T	R							LR	
Volume, V (veh/h)		28	850				427	28						27		30
Percent Heavy Vehicles (%)		2												2		2
Proportion Time Blocked		0.100												0.100		0.100
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								2						

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)		30													62	
Capacity, c (veh/h)		1058													423	
v/c Ratio		0.03													0.15	
95% Queue Length, Q_{95} (veh)		0.1													0.5	
Control Delay (s/veh)		8.5													15.0	
Level of Service, LOS		A													B	
Approach Delay (s/veh)		0.3												15.0		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

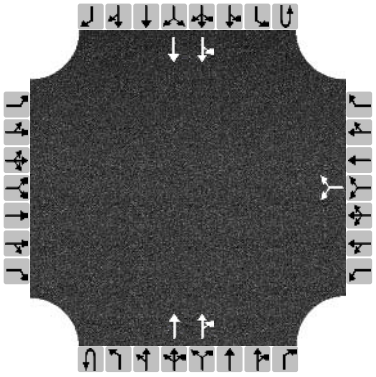
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	5/24/2018
Analysis Year	2021
Time Analyzed	Full Buildout AM Peak
Intersection Orientation	North-South
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	Norris Fwy at ALDI Drive
Jurisdiction	Knox County
East/West Street	ALDI Driveway
North/South Street	Norris Freeway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	2	0	0	0	2	0
Configuration							LR				T	TR		LT	T	
Volume, V (veh/h)						3		5			340	1		2	570	
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						7.5		6.9						4.1		
Critical Headway (sec)						6.84		6.94						4.14		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.52		3.32						2.22		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							8							2		
Capacity, c (veh/h)							575							1184		
v/c Ratio							0.01							0.00		
95% Queue Length, Q_{95} (veh)							0.0							0.0		
Control Delay (s/veh)							11.4							8.0		
Level of Service, LOS							B							A		
Approach Delay (s/veh)						11.4								0.0		
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

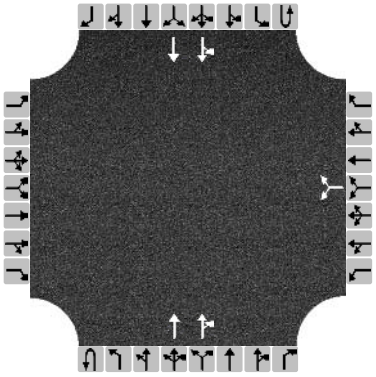
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	5/24/2018
Analysis Year	2021
Time Analyzed	Full Buildout PM Peak
Intersection Orientation	North-South
Project Description	615.001 Heartland Dental Office

Site Information

Intersection	Norris Fwy at ALDI Drive
Jurisdiction	Knox County
East/West Street	ALDI Driveway
North/South Street	Norris Freeway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	2	0	0	0	2	0
Configuration							LR				T	TR		LT	T	
Volume, V (veh/h)						10		35			682	9		28	631	
Percent Heavy Vehicles (%)						2		2						2		
Proportion Time Blocked						0.000		0.000						0.000		
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)						7.5		6.9						4.1		
Critical Headway (sec)						6.84		6.94						4.14		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.52		3.32						2.22		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)							49							30		
Capacity, c (veh/h)							407							854		
v/c Ratio							0.12							0.04		
95% Queue Length, Q_{95} (veh)							0.4							0.1		
Control Delay (s/veh)							15.1							9.4		
Level of Service, LOS							C							A		
Approach Delay (s/veh)						15.1								0.6		
Approach LOS						C										

Attachment 8
Turn Lane Warrant Analysis

Project: Heartland Dental and Retail

Norris Freeway (SR 71) at ALDI Driveway VOLUMES

LEFT TURN	Opposing	Thru	LT	LT MAX	Warrant Met
AM	341	299*	2	50	NO
PM	691	331*	28	20	YES

Norris Freeway (SR 71) at ALDI Driveway VOLUMES

RIGHT TURN	Thru	RT	RT MAX	Warrant Met
AM	340	1	199	NO
PM	682	9	24	NO

* The volume per lane was multiplied by 1.05 in accordance with the Knox County Department of Engineering and Public Works "Access Control and Driveway Design Policy"

Norris Freeway (SR 71)
at ALDI Driveway

TABLE 6A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 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	200	140	100	75	60	50
150 - 199	175	120	85	65	55	45
200 - 249	150	100	75	60	50	40
250 - 299	130	85	65	55	45	35
300 - 349	110	75	60	50	40	30
350 - 399	95	65	55	45	35	25
400 - 449	80	60	50	40	30	25
450 - 499	70	55	45	35	25	20
500 - 549	60	50	40	30	25	20
550 - 599	50	45	35	25	20	20
600 - 649	45	40	30	20	20	20
650 - 699	40	35	30	20	20	20
700 - 749	35	35	25	20	20	15
750 or More	35	35	25	20	15	15

AM Peak 2 LT

PM Peak 28 LT

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

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

Norris Freeway (SR 71)
at ALDI Driveway

TABLE 6B

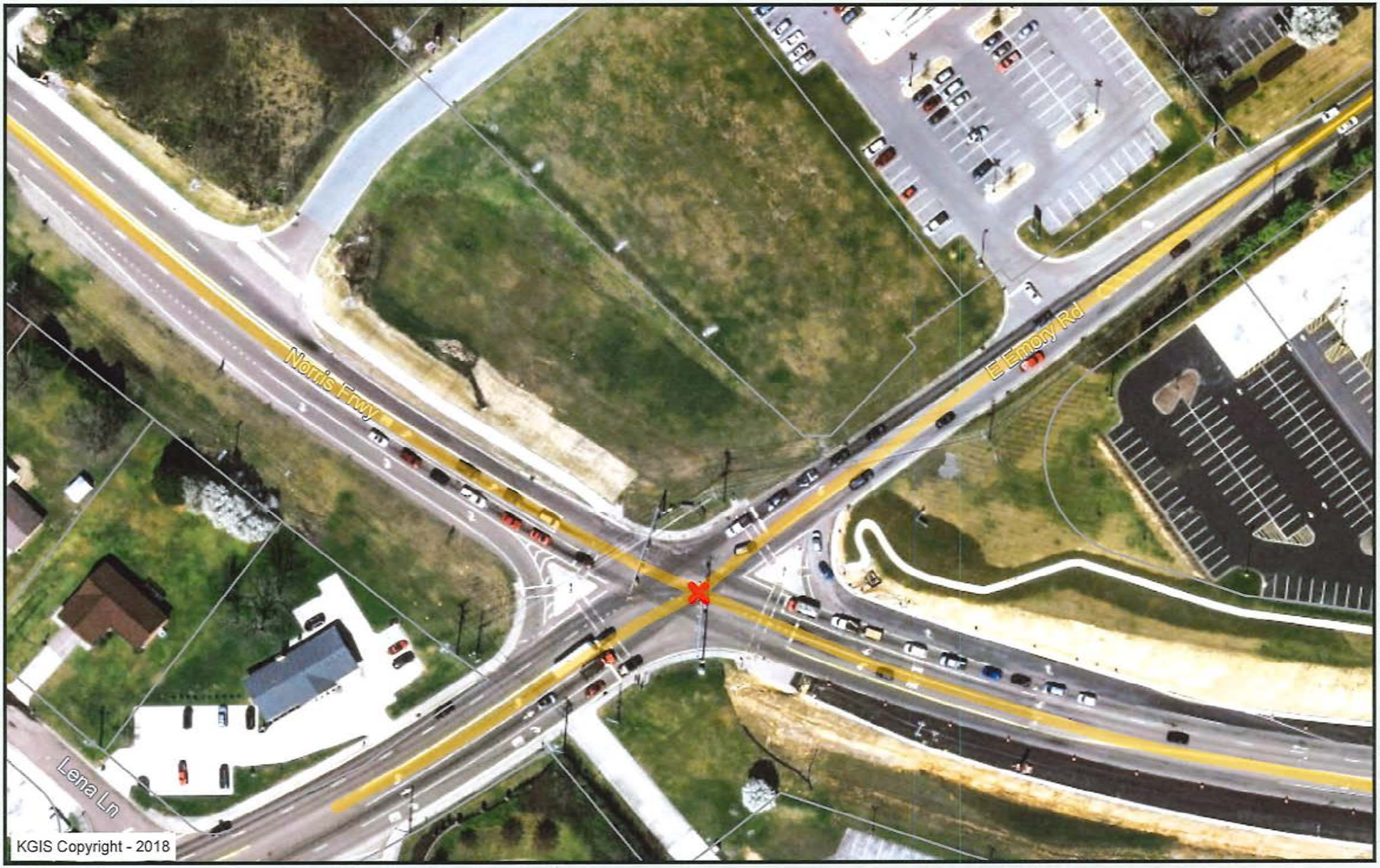
RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 46 TO 55 MPH

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				AM Peak RT 1		
100 - 149 150 - 199						Yes
200 - 249 250 - 299				Yes	Yes Yes	Yes Yes
300 - 349 350 - 399			Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		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

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			Yes	PM Peak RT 9 Yes Yes	Yes Yes	Yes Yes
100 - 149 150 - 199	Yes	Yes 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.

Attachment 9
Aerial Photos



Letter Landscape

Printed: 5/21/2018 at 4:43:10 PM

0 50 100 200

ft

Knoxville - Knox County - KUB Geographic Information System

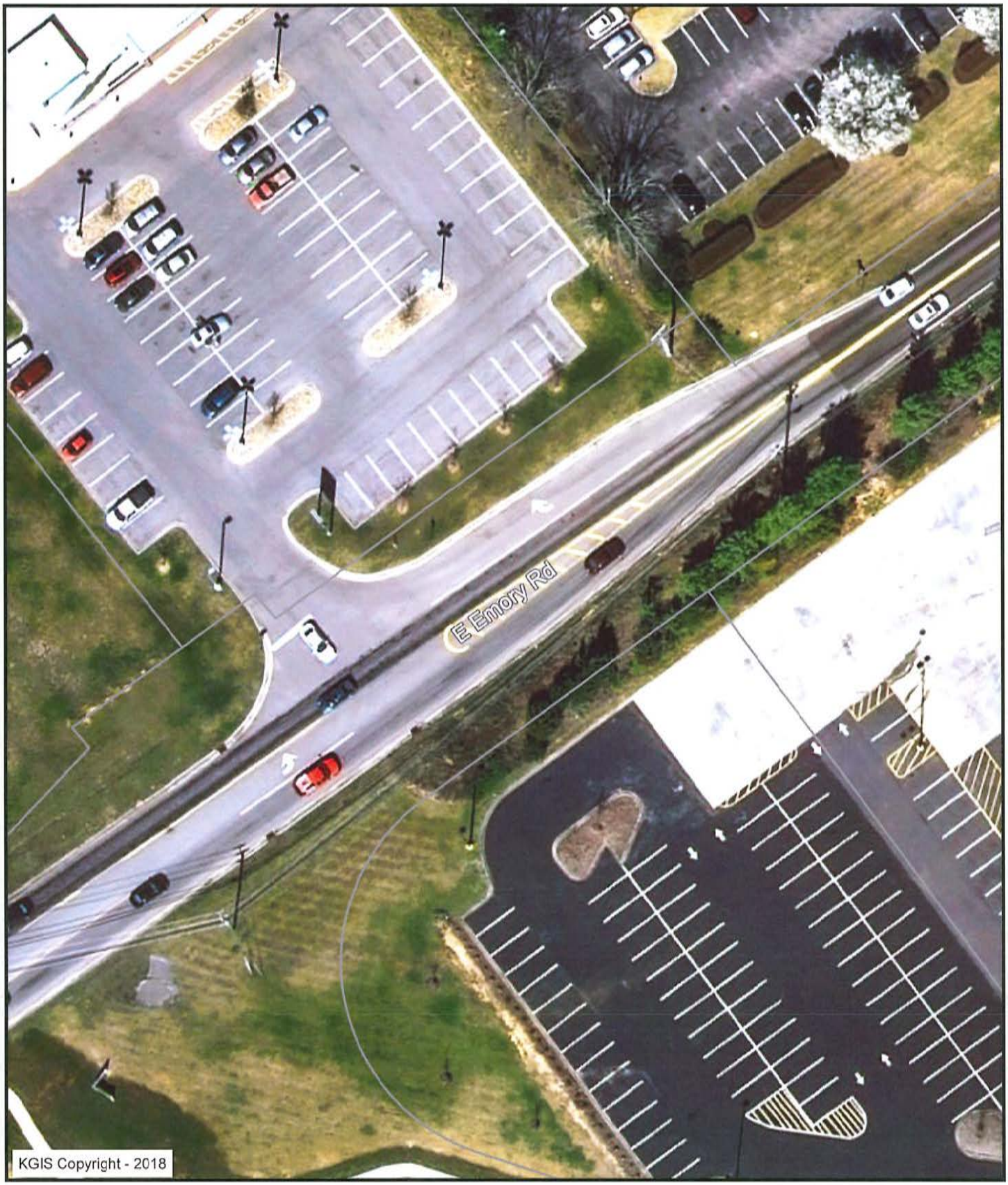
Letter Portrait

Printed: 5/16/2018 at 3:44:35 PM

0 25 50 100

ft

Knoxville - Knox County - KUB Geographic Information System



Letter Portrait

Printed: 5/16/2018 at 3:45:14 PM

0 25 50 100

ft

Knoxville - Knox County - KUB Geographic Information System

Date: May 29, 2018

Project Name: Heartland Dental & Retail

To: MPC, Knox County and TDOT

Subject: TIS Comment Response Document for Heartland Dental & Retail (6-C-18-UR)
Review Comments Dated May 21, 2018.

Dear MPC, Knox County and TDOT staff,

The following comment response document is submitted to address comments dated May 21, 2018:

Reviewer Comment: Through review of the turn-lane warrant analysis, it was discovered that a left turn lane is warranted at the Norris Freeway driveway for the development in the PM condition. Also, the turn lane analysis for the right-turn lane at the same intersection needs to be reevaluated. It seems as though the wrong values for the turn lane threshold was circled. (Section 6, page 20 & the Appendix)

Response: Revised Section 6, page 20 & the Appendix to reflect updates to the turn lane warrant analysis.

Reviewer Comment: On page 7 second paragraph 4th line, it should read "and the driveway has a right turn lane" instead of "and the driveway is a right turn lane".

Response: Revised to read "and the driveway has a right turn lane"

Reviewer Comment: On this same page, please add an evaluation of sight distance for both access points.

Response: Added an approximate sight distance for both access points.

Reviewer Comment: On page 10 sixth paragraph last line, it should read "TDOT count stations" instead of "TDOT count station".

Response: Revised to read "TDOT count stations"

Reviewer Comment: On this same page, please mention whether or not the Aldi's was included in the background since it is existing on the site.

Response: Added "The ALDI was open for business therefore; the existing traffic volumes include any traffic generated by the ALDI's." to Section 2 Existing Traffic

Volumes. The background growth rate was applied to both of the existing ALDI driveway connections as well as the intersection of E. Emory Road (SR 131) at Norris Freeway (SR 71).

Reviewer Comment: On page 12, was there a reason why the Shopping Center land use was used and not the Specialty Retail land use?

Response: The land use for the Retail Building was changed to Specialty Retail Center (LUC 826).

Reviewer Comment: Please justify the second paragraph to the right-side.

Response: Revised formatting for the second paragraph on page 12.

Reviewer Comment: In Table 4-1, add the square footage to each of the land use headings.

Response: Revised Table 4-1 to add square footage of the buildings.

Reviewer Comment: On pages 13-15, clarify what you mean by the splits for trip distribution. It was hard to follow what was going on. Also, where is the discussion about Figure 6 distribution?

Response: Removed irrelevant information and added a discussion paragraph for Figure 6 PM peak hour trip distribution.

Reviewer Comment: Within your evaluation of the development, please add an aerial photo of the intersection being affected by this development.

Response: Added aerial photos of the intersections of E. Emory Road (SR 131) at Norris Freeway (SR 71), E. Emory Road (SR 131) at the existing ALDI driveway connection and Norris Freeway (SR 71) at the existing ALDI driveway connection in an Attachment 9 – Aerial Photos.

Reviewer Comment: In reference to Table 5-1, are there any recommended improvements to any of the intersections that would improve the LOS E of E Emory Rd at Norris Fwy?

Response: "The LOS E during the PM peak hour is partly due to the high volume-to-capacity ratio of both the northbound thru lane (0.941) and the eastbound thru lane (0.962) when using the existing signal timing. If the signal timing is optimized the intersection would operate with less delay during the PM peak hour; however since this signal is coordinated with several others in the Halls area I would not recommend altering the signal timing at this time."

Reviewer Comment: In the Conclusions & Recommendations section (page 21), please correct the left turn lane requirement for the intersection of Norris Fwy at the Existing Driveway connection.

Response: Added "A left turn lane on Norris Freeway (SR 71) is met during the PM peak hour for both the background conditions and after the full buildout of the Heartland Dental Office and Retail Building." to the conclusions & recommendations.

Reviewer Comment: When printing this study, please either use double-sided or single sided, not both.

Response: I will specify that the print shop print the report single sided for the revised copies and in the future.

Reviewer Comment: Figure 7 is more appropriately titled Peak Hour Site Traffic. "Combined Traffic" implies the total of site plus background traffic.

Response: Revised title of Figure 7 to "Peak Hour Site Traffic"

Reviewer Comment: Under "E Emory Road (SR 131) @ Existing Driveway Connection", first paragraph, second line insert "during both the AM and PM peak hours" after LOS A.

Response: Added "during both the AM and PM peak hours"

Reviewer Comment: Under "Norris Freeway (SR 71) @ Existing Driveway Connection", first paragraph, third line insert "during both the AM and PM peak hours" after LOS A.

Response: Added "during both the AM and PM peak hours"

Reviewer Comment: Please add a statement or note that the weekday trip generation for the dental office uses the average rate instead of the regression equation because the equation results in a negative number.

Response: Added "The Medical-Dental Office Building weekday trips were calculated using the average rate instead of the fitted curve equation because the equation resulted in a negative number."

Reviewer Comment: In Table 4-1, the PM peak trip generation for the dental office is based on the average rate instead of the regression equation. We typically prefer to use the equation when it is available unless there is a clear reason not to do so. The resulting number of trips is 17 instead of 15 with 5 entering and 12 exiting. Please correct in table, figures and elsewhere as pertinent in the report.

Response: Revised the PM trip generation for LUC 720 using the fitted curve equation instead of the average rate. Table 4-1, Attachment 3 and Figures 7 & 8 were revised and the report was updated to reflect the revised trips.

Reviewer Comment: The turn lane warrant analysis for the driveway on Norris Freeway has some errors. The only movement that should be averaged over two lanes is the southbound thru traffic. The northbound thru and right turn volumes are restricted to a single lane at the driveway. See attached markups of analysis worksheets. As a result, a left-turn lane is warranted at the driveway.

Response: Revised Section 6, page 20 & the Appendix to reflect updates to the turn lane warrant analysis.

Sincerely,

Addie Kirkham, P.E.