STEELE LANDING SUBDIVISION

Traffic Impact Study

Hardin Valley Road

Knoxville, TN

A Traffic Impact Study for the Proposed Steele Landing Subdivision

Submitted to

Knoxville – Knox County Planning Commission

Revised October 16, 2019
Revised May 1, 2019
Revised April 23, 2019
March 25, 2019
FMA Project No. 548.001

Submitted By:

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Executive Summary

Hardin Valley Land Partners, Inc. is proposing a residential development (i.e. Steele Landing Subdivision) with attached housing lots in Knox County. The project is located south of the intersection of Hardin Valley Road at Steele Road. The development will consist of 133 townhomes. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2021.

The proposed site access will connect to the existing signalized intersection of Hardin Valley Road at Steele Road.

The parcels of land along Hardin Valley Road will have future access to the signalized intersection of Hardin Valley Road at Steele Road. FMA assumed a 28,500 SF office building and a 7,000 SF dentist office for this future commercial development. The commercial development will not be built as a part of the Steele Landing Subdivision, but is included in the traffic impact study.

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

Hardin Valley Road @ Steele Road
After the completion of the Steele Landing Subdivision the signalized intersection of Hardin Valley Road at Steele Road will operate at a LOS D during AM peak hour and a LOS C during the PM peak hour using the existing signal timing provided by Knox County.

An eastbound right turn lane is not warranted after the full buildout of the Steele Landing Subdivision.

The proposed Steele Landing Subdivision will be within the Parent Responsibility Zone (PRZ) of Hardin Valley Elementary School, Hardin Valley Middle School and Hardin Valley Academy. The PRZ is defined as those who live within one (1) mile from an elementary school or within (1.5) miles for a middle/high school by the shortest route, and are not eligible for transportation service. There are existing sidewalks and crosswalk locations on both Hardin Valley Road and Steele Road near Hardin Valley Elementary School that also extend to Hardin Valley Middle School and Hardin Valley Academy. The Steele Landing Subdivision plans to connect to the existing sidewalk network along Hardin Valley Road.

1 Introduction

1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the proposed Steele Landing Subdivision. The project is located south of the intersection of Hardin Valley Road at Steele Road in Knox County. The location of the site is shown in Figure 1.

The proposed Steele Landing Subdivision will be within the Parent Responsibility Zone (PRZ) of Hardin Valley Elementary School, Hardin Valley Middle School and Hardin Valley Academy. The PRZ is defined as those who live within one (1) mile from an elementary school or within (1.5) miles for a middle/high school by the shortest route, and are not eligible for transportation service.

The Steele Landing Subdivision will consist of 133 townhomes. 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 signalized intersection of Hardin Valley Road at Steele Road. The traffic from the Steele Landing Subdivision will enter and exit the site at the signalized intersection. 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.

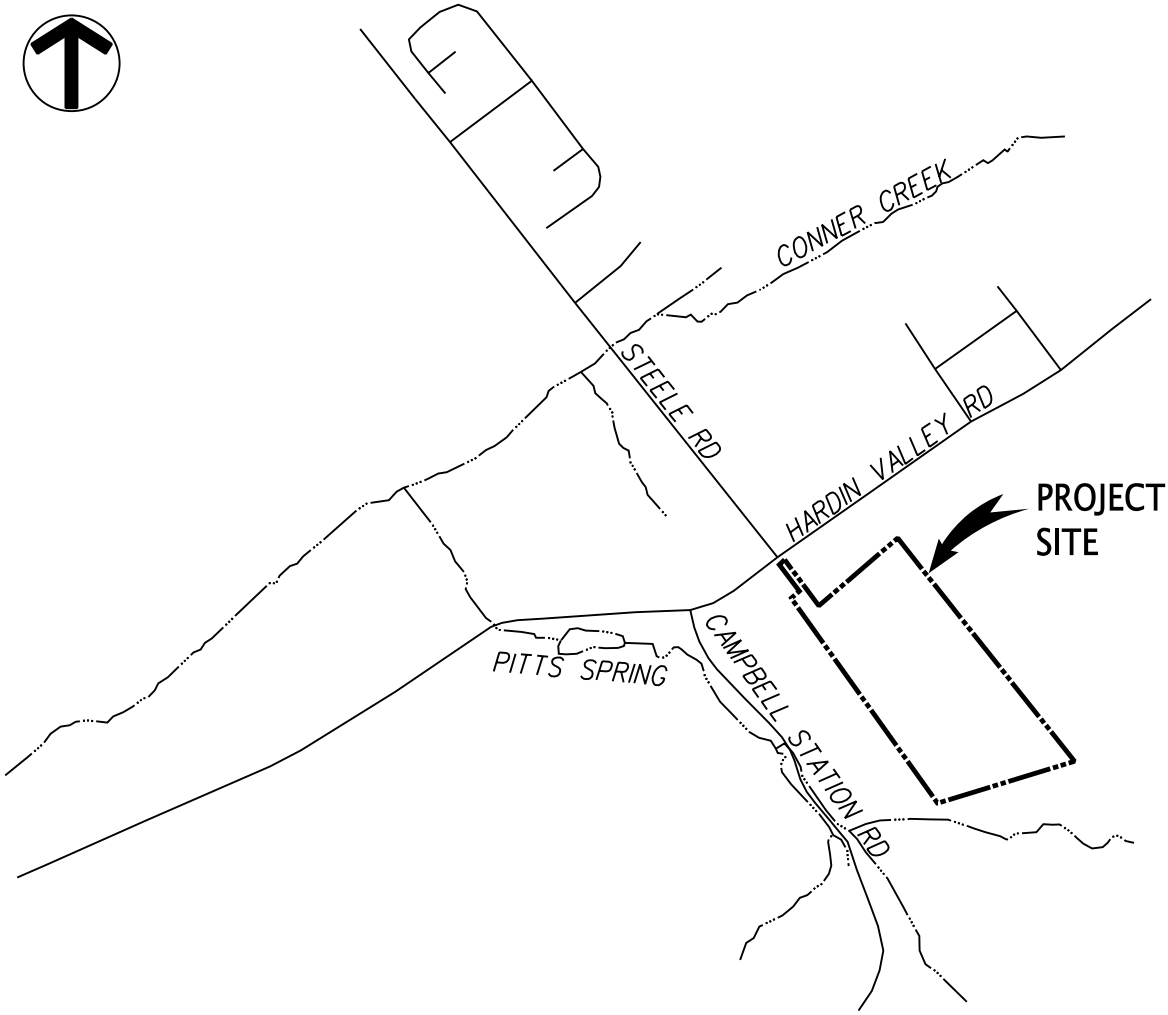


Figure 1: Location Map

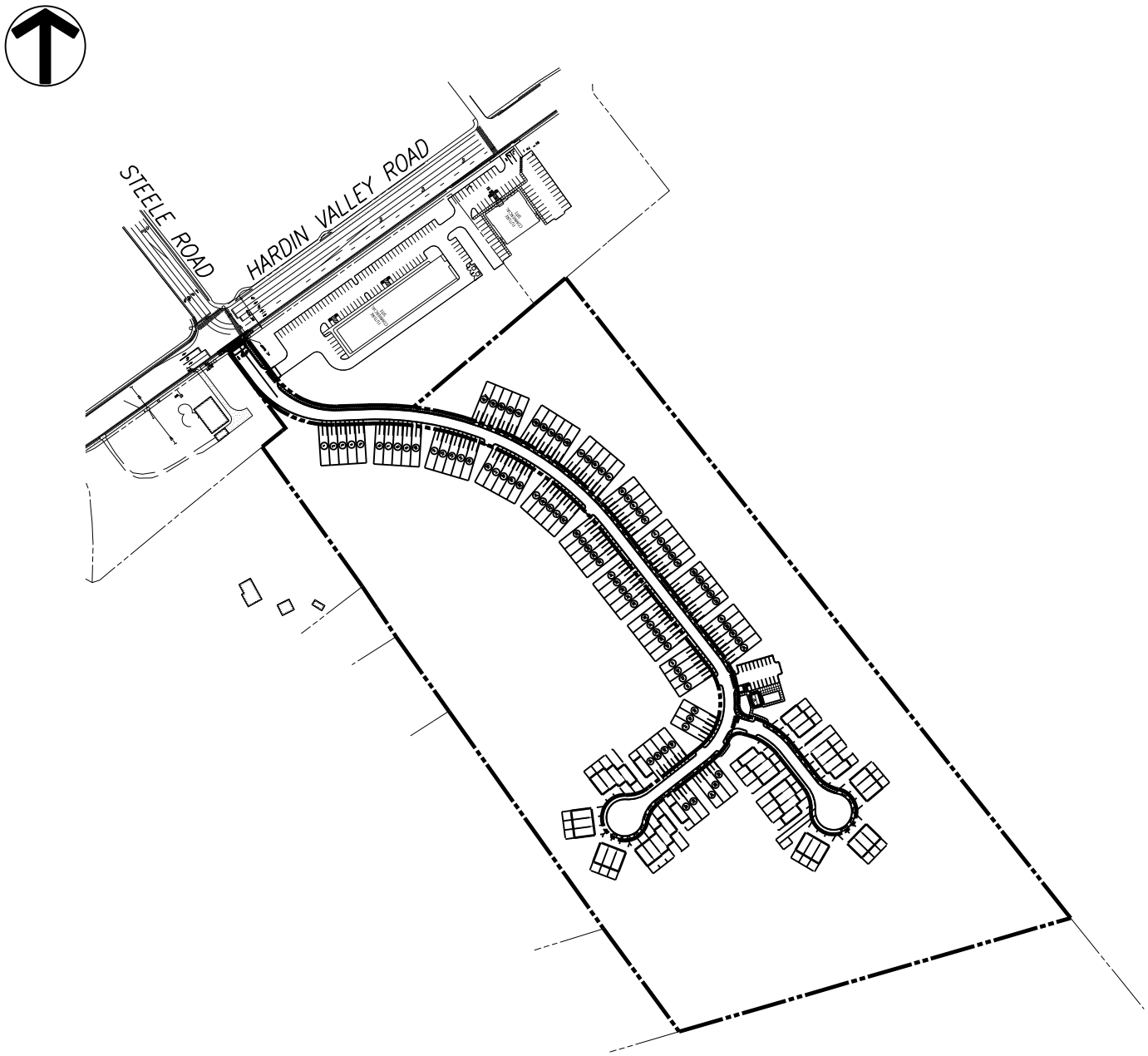


Figure 2: Site Plan

1.2 Existing Site Conditions

The proposed site access will connect to the existing signalized intersection of Hardin Valley Road at Steele Road. An existing westbound left turn lane on Hardin Valley Road has an approximate 215 foot storage length and a 135 foot taper length.

The signalized intersection of Hardin Valley Road at Steele Road is located approximately 640 feet east of the intersection with Campbell Station Road and approximately 750 feet west of the intersection with the Hardin Valley Elementary School Driveway. The existing sight distance at the intersection exceeds 600 feet east and west.

The Knoxville-Knox County Planning Commission classifies Hardin Valley Road at the intersection with Steele Road as a minor arterial per the Major Road Plan with a right-of-way of 88 feet east of the intersection and a 60 feet right-of-way west of Steele Road. The posted speed limit on Hardin Valley Road is 40 mph.

The Knoxville-Knox County Planning Commission classifies Steele Road from Hardin Valley Road to Sam Lee Road as a minor collector per the Major Road Plan with a right-of-way of 60 feet. The posted speed limit on Steele Road is 30 mph.

Hardin Valley Road has existing sidewalks both eastbound and westbound at the intersection with Steele Road. Steele Road has an existing northbound sidewalk that continues past Hardin Valley Elementary School and Hardin Valley Middle School entrances.

There are two crosswalks located at the signalized intersection of Hardin Valley Road at Steele Road. Parents and students will be able to utilize the existing sidewalks and crosswalks to walk to Hardin Valley Elementary School, Hardin Valley Middle School and Hardin Valley Academy from the proposed subdivision.

2 Existing Traffic Volumes

FMA conducted a turning movement count at the intersection of Hardin Valley Road at Steele Road on Thursday October 18, 2018.

The current AM peak hour and PM peak hour were determined using the turning movement count that FMA conducted. At the intersection of Hardin Valley Road at Steele Road the AM peak hour occurred between 7:15 am and 8:15 am, and the PM peak hour occurred between 4:45 pm and 5:45 pm.

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

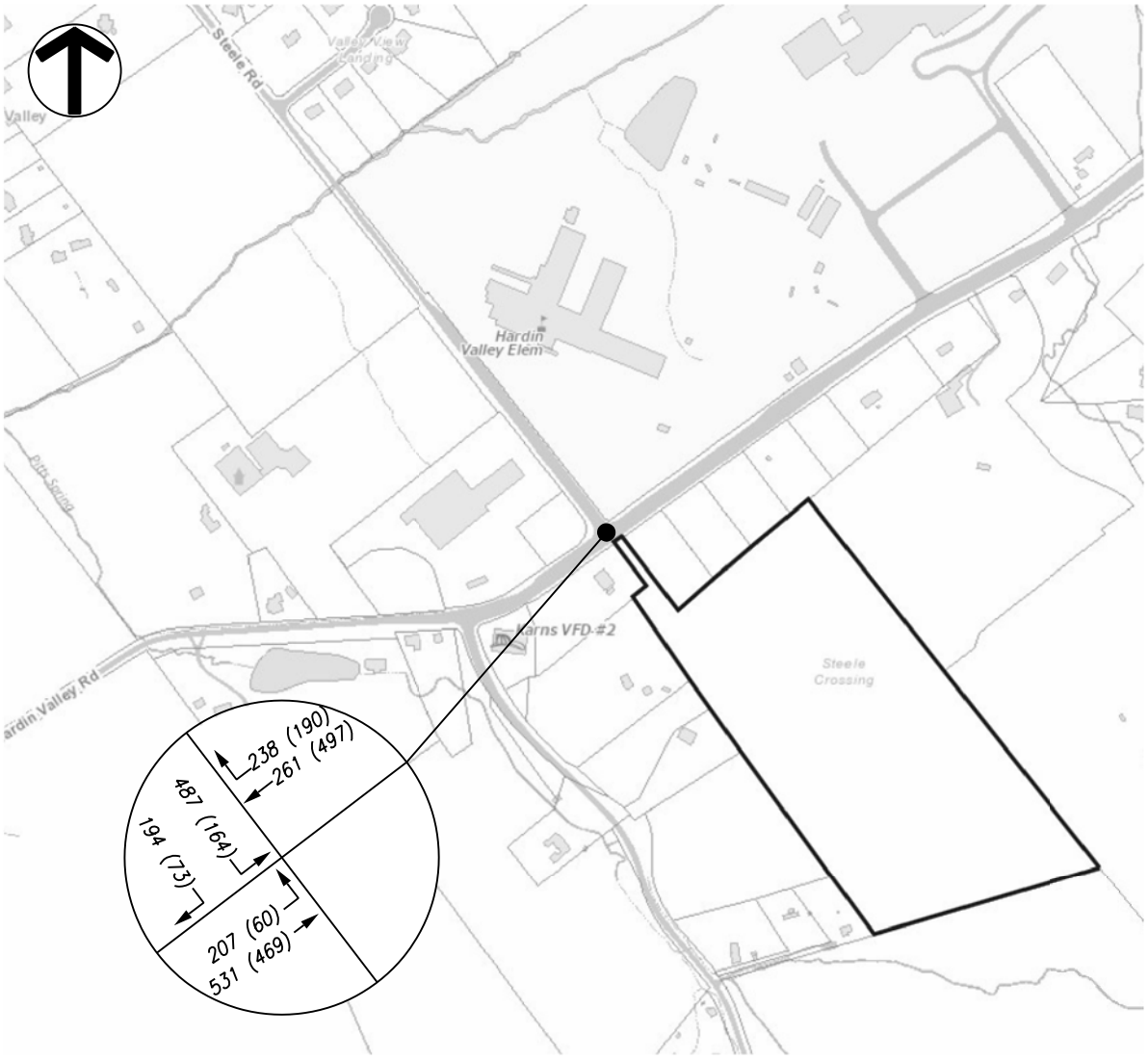


Figure 3: 2018 Existing Peak Hour Traffic

3 Background Growth

The Knoxville Regional Transportation Planning Organization (TPO) maintains count stations on both Steele Road and Hardin Valley Road.

Count station #093M277 is located on Steele Road north of Hardin Valley Road. The annual traffic growth rate for this station over the last ten years is approximately 2.00%.

Count station #093M353 is located on Hardin Valley Road east of Marietta Church Road. The annual growth rate for this station over the last thirteen years is approximately 5.91%.

For the purpose of this study, an annual growth rate of 4.0% was assumed for traffic at the intersection of Hardin Valley Road at Steele Road 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.

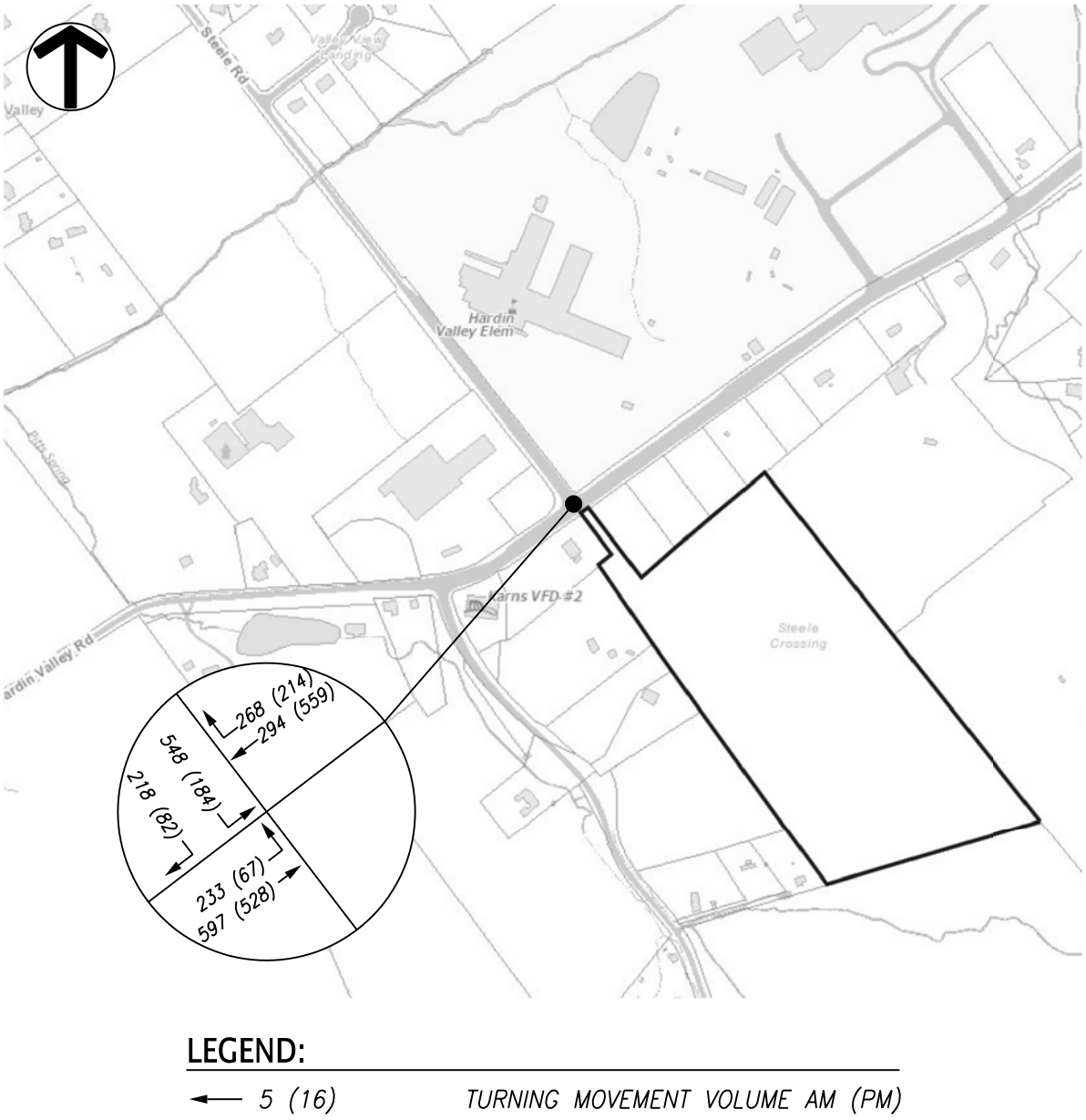


Figure 4: 2021 Background Peak Hour Traffic

4 Trip Generation and Trip Distribution

The Knoxville-Knox County Planning Commission published a memorandum ("Local Trip Generation Rates for Multi-Family Residential Uses", August 14, 2000) for the purpose of providing locally collected data for all multi-family residential developments. The Steele Landing Subdivision will consist of 133 townhomes. The fitted curve equations from the local study were used to calculate site trips for the Steele Landing Subdivision.

For the future commercial development FMA assumed a 28,500 SF office building and a 7,000 SF dentist office. The equations provided in the *Trip Generation, 10th Edition,* published by the Institute of Transportation Engineers were used to calculate the expected site trips using both the General Office Building (Land Use 710) and Medical-Dental Office Building (Land Use 720). The land use worksheets are included in Attachment 3.

The total trips generated by the Steele Landing Subdivision was estimated to be 1,233 daily trips. The estimated trips are 70 trips during the AM peak hour and 99 trips during the PM peak hour. A trip generation summary is shown in Table 4-1.

Table 4-1
Steele Landing Subdivision
Trip Generation Summary

Land Use	Density	Daily Trips	AM Peak Hour Enter	AM Peak Hour Exit	PM Peak Hour Enter	PM Peak Hour Exit
Steele Landing Subdivision (Local Apartment Study)						
Townhomes	133 Units	1,233	15	55	54	45
Future Commercial Development						
Office Building (LUC 710)	28,500 SF	314	46	7	6	29
Dentist Office (LUC 720)	7,000 SF	181	16	5	7	19
Commercial Total		495	62	12	13	48
Combined Total		1,728	77	67	67	93

Hardin Valley Road at the intersection of Steele Road has a trip distribution 60% eastbound and 40% westbound during the AM peak hour and 45% eastbound and 55% westbound during the PM peak hour.

The directional distribution of the traffic generated by the Steele Landing Subdivision was determined using the existing traffic volumes in combination with the concept plan layout. It was assumed that during the AM peak hour 50% of exiting traffic would turn right, 40% of exiting traffic would turn left and that the remaining 10% of traffic would go straight onto Steele Road. During the PM peak hour it was assumed that 65% of exiting traffic would turn right, 25% of exiting traffic would turn left and the remaining 10% of traffic would go straight onto Steele Road.

Figure 5 shows the AM peak hour trip distribution and Figure 6 shows the PM peak hour trip distribution.

Figure 7 shows the peak hour site traffic from the Steele Landing Subdivision and Figure 8 shows the full buildout peak hour traffic.

Figure 9 shows the peak hour commercial traffic and Figure 10 shows the combined peak hour traffic from the Steele Landing Subdivision and the future commercial development.

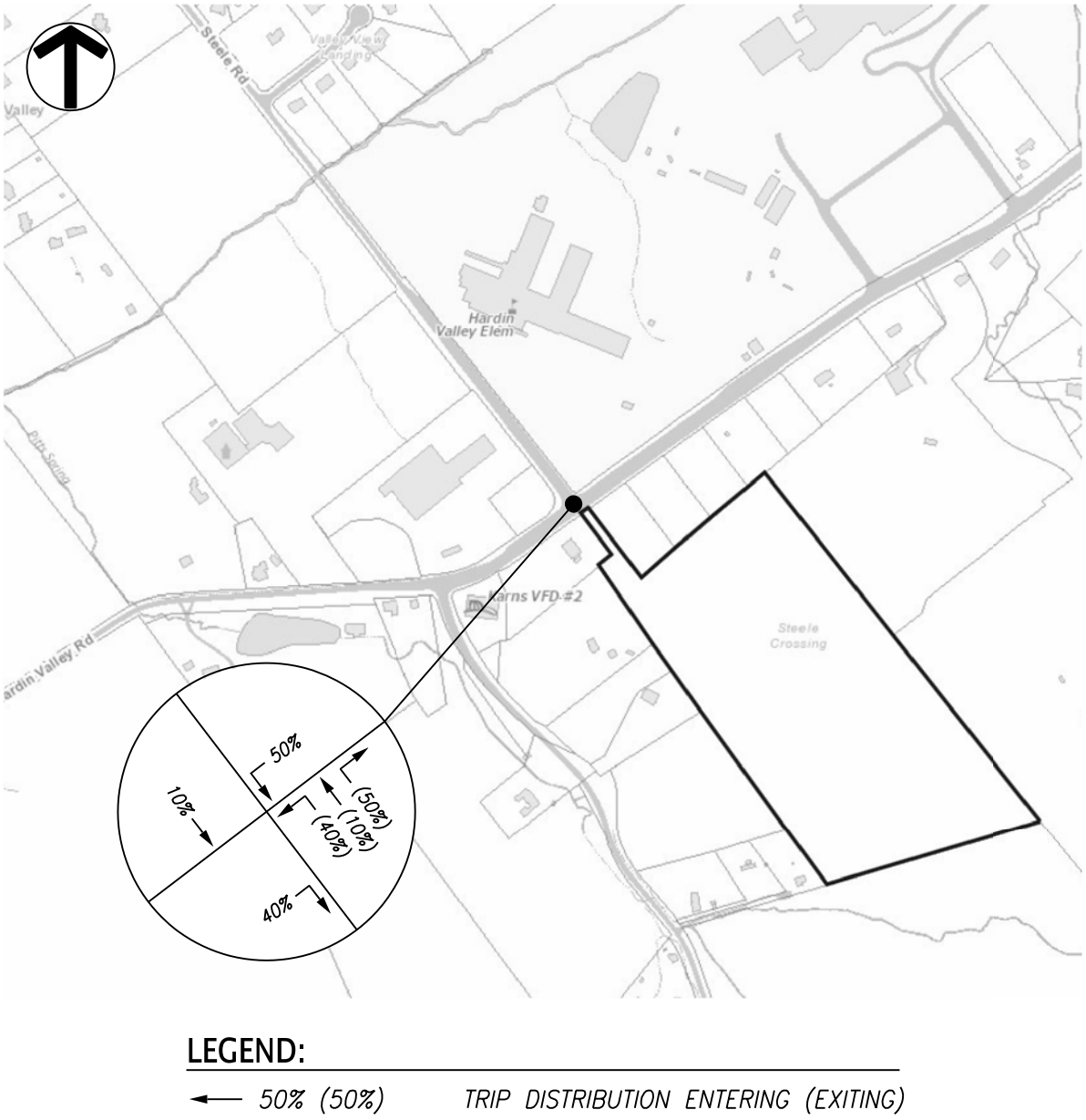


Figure 5: AM Peak Hour Trip Distribution

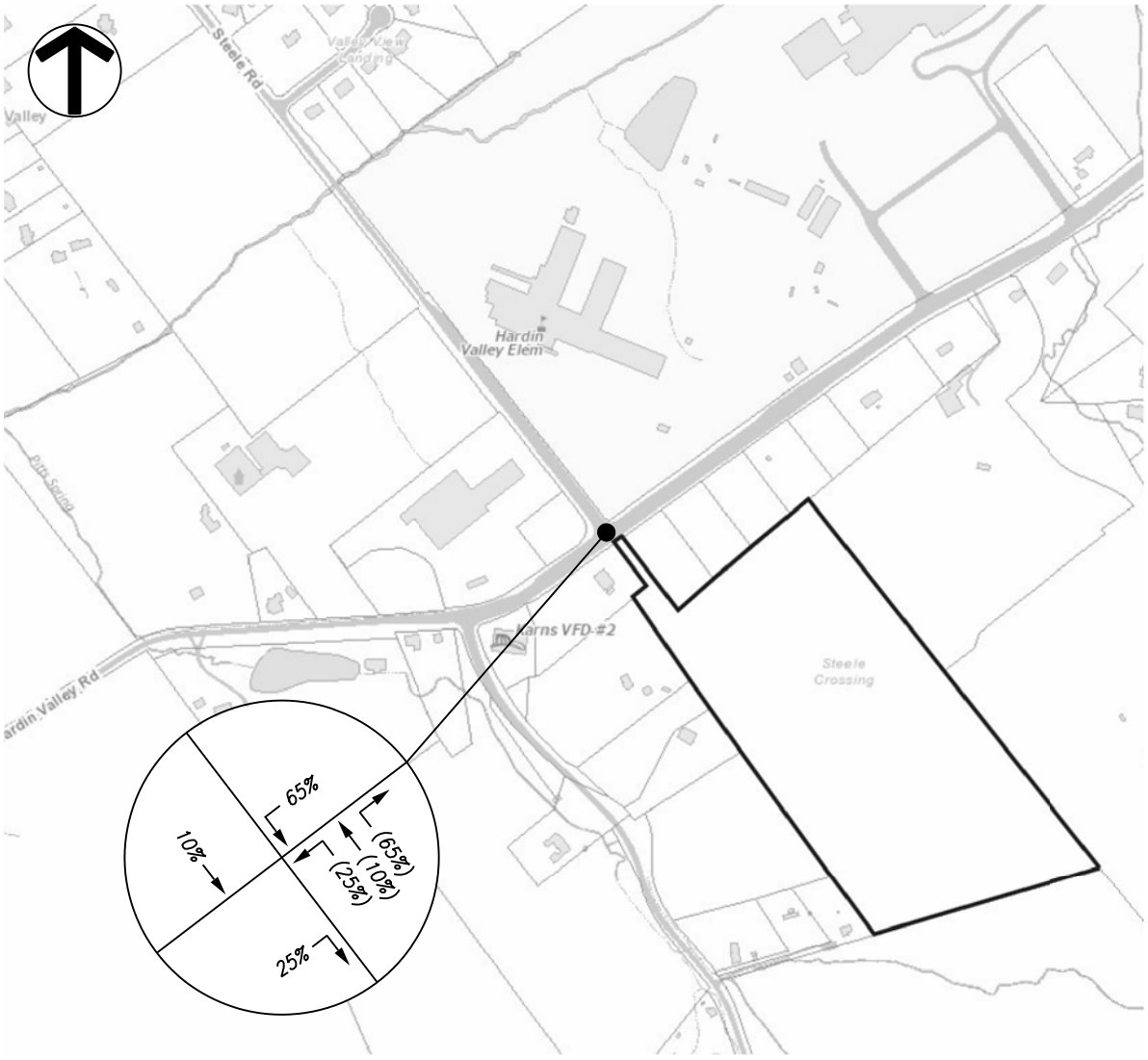


Figure 6: PM Peak Hour Trip Distribution

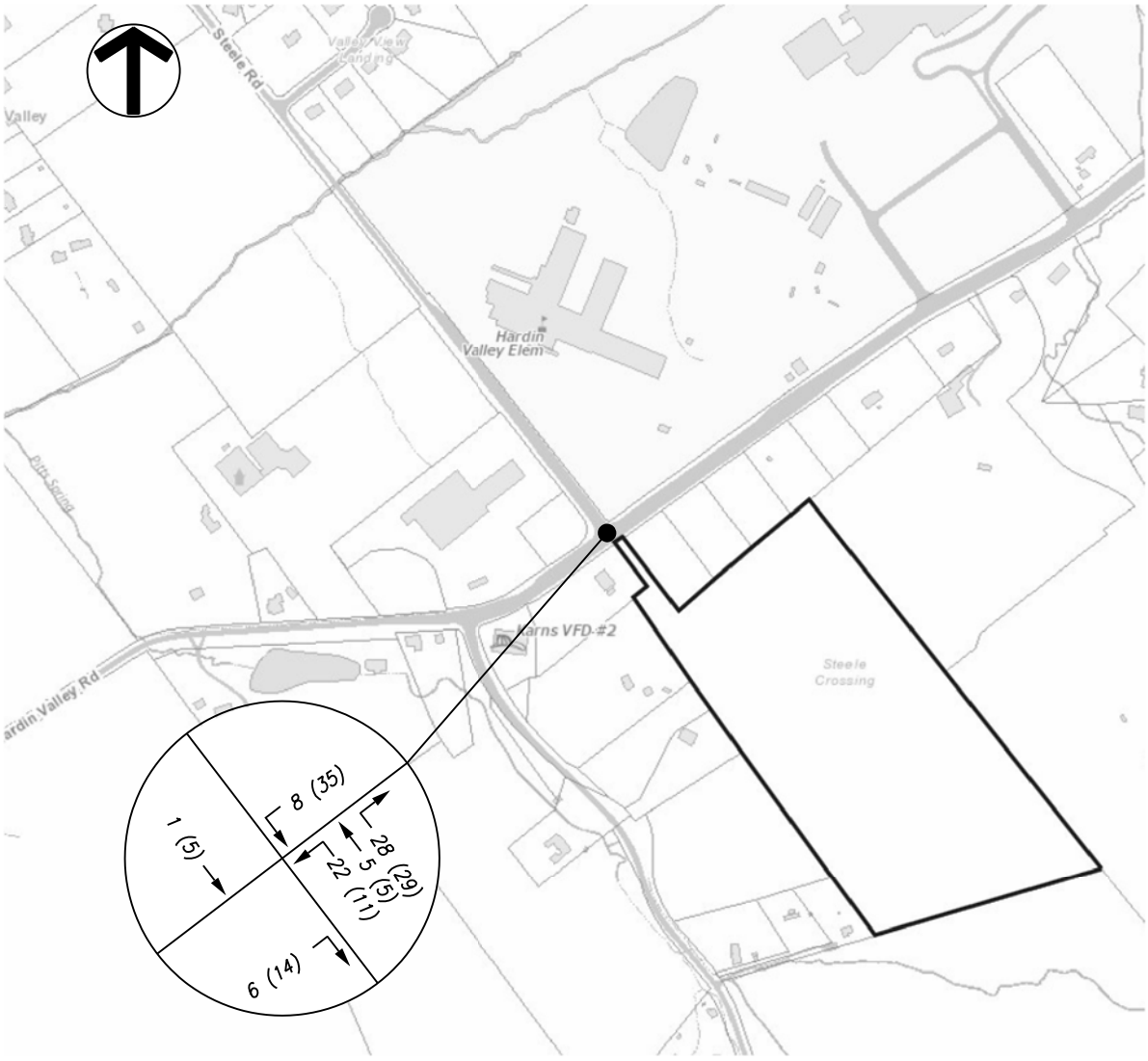


Figure 7: Peak Hour Subdivision Traffic

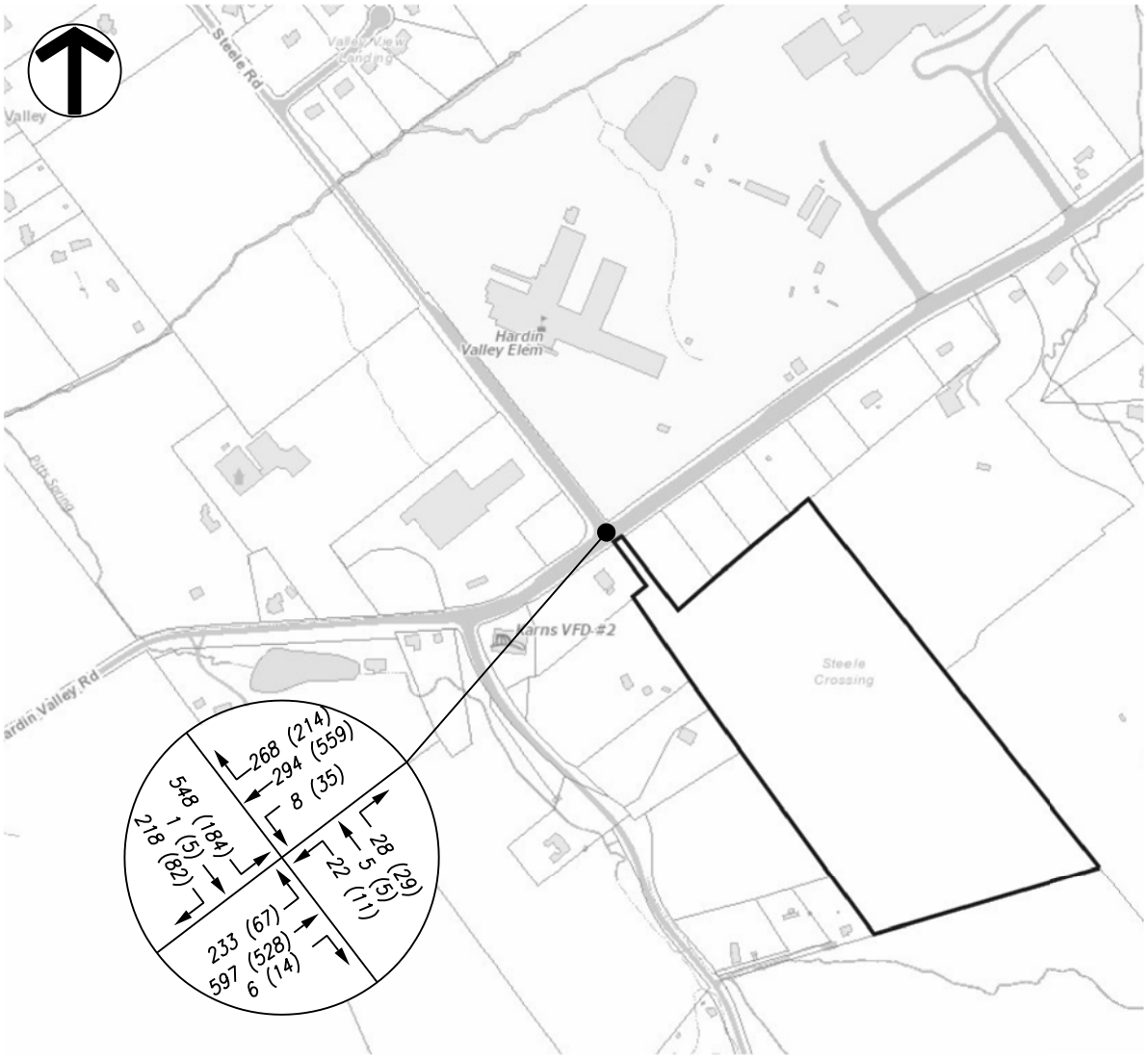


Figure 8: Peak Hour Full Buildout Traffic

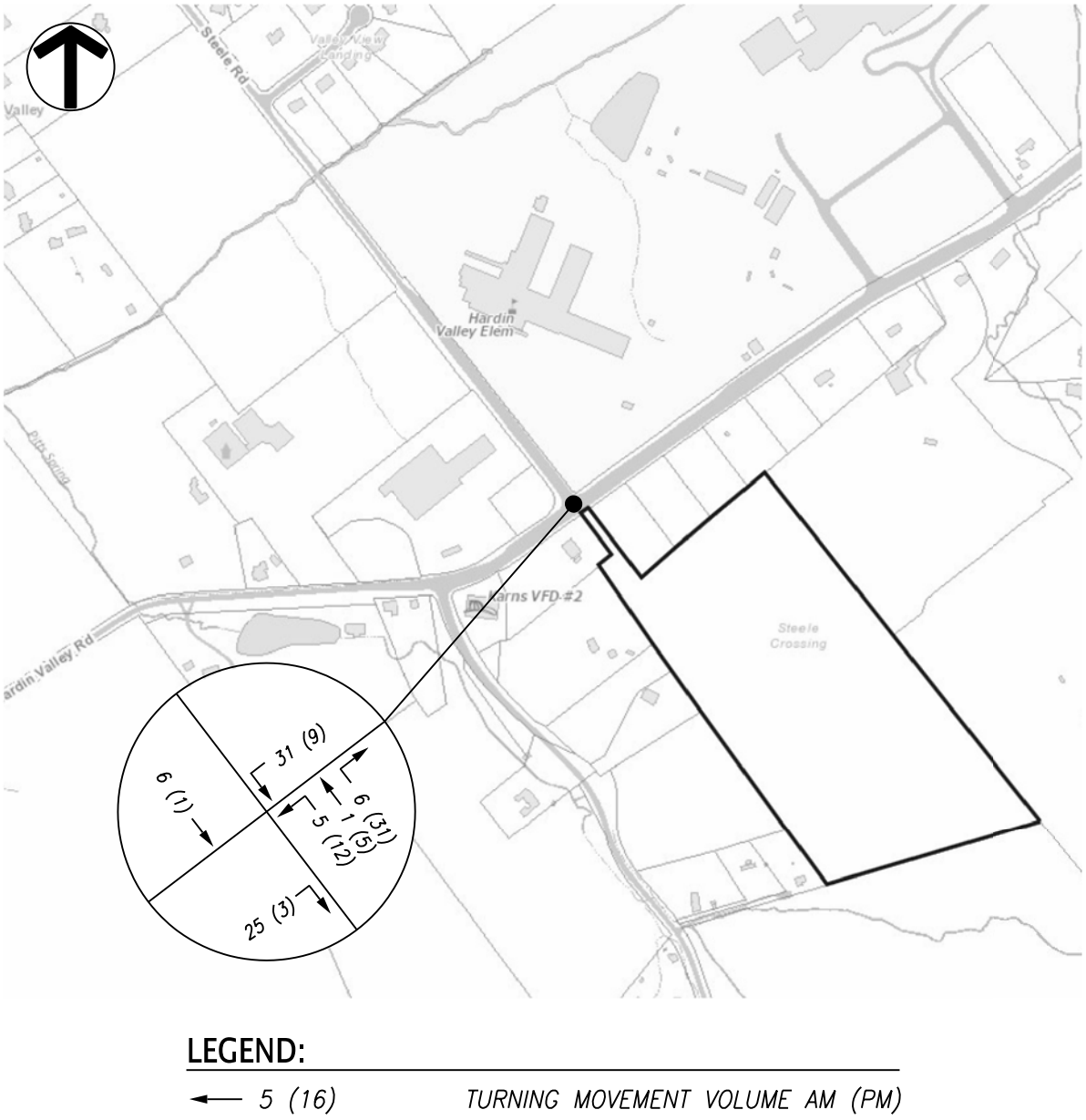


Figure 9: Peak Hour Commercial Traffic

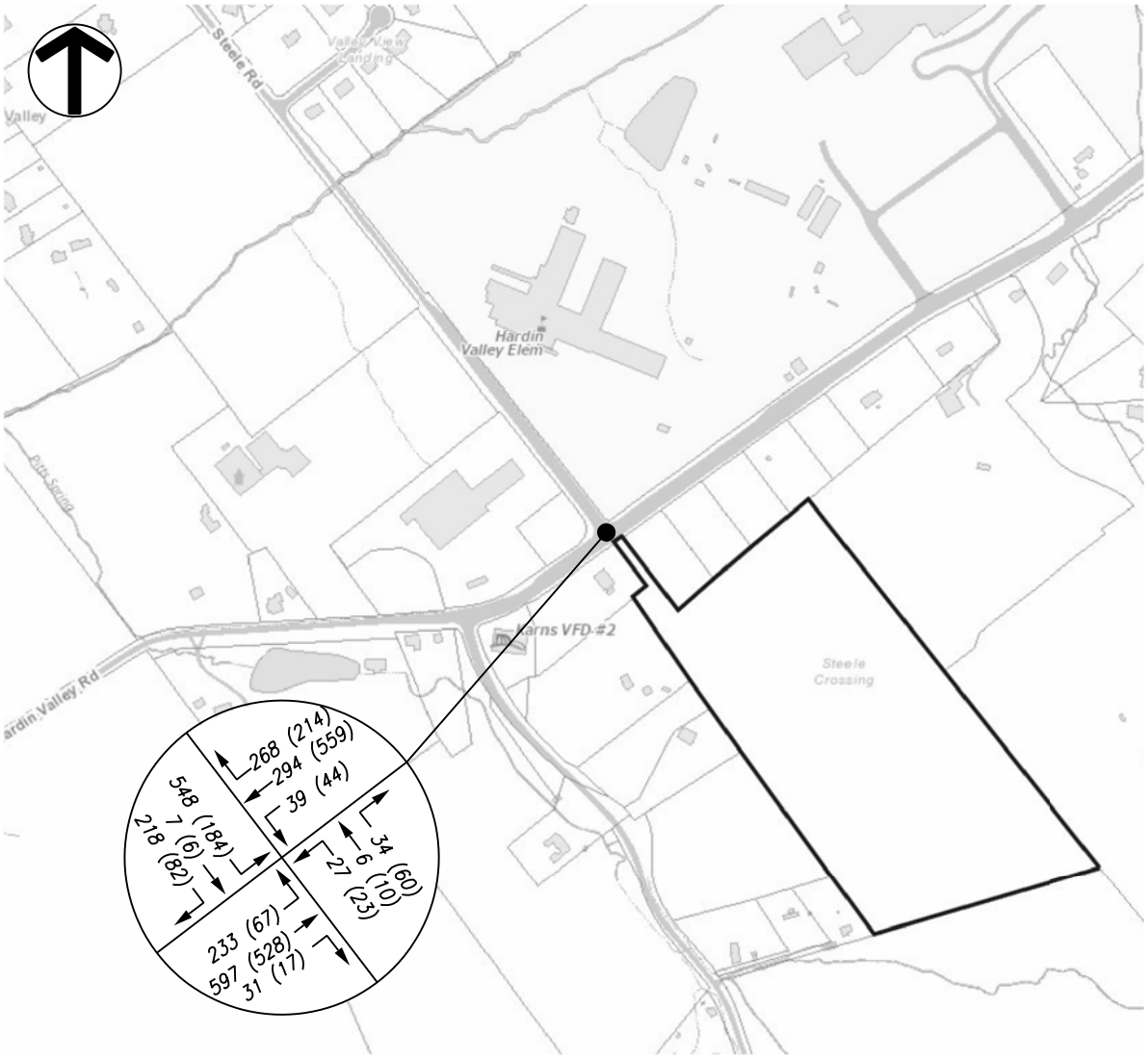


Figure 10: Peak Hour Full Buildout & Commercial Traffic

5 Projected Capacity and Level of Service

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 Hardin Valley Road at Steele Road. The existing signal timing was provided by Knox County and is included in Attachment 4.

The existing signal for the intersection of Hardin Valley Road at Steele Road will be modified to accommodate the addition of the northbound movement from the Steele Landing Subdivision.

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
Hardin Valley Road @ Steele Road (Existing 2018)		
AM Peak	Intersection	21.1 / C
PM Peak	Intersection	14.7 / B
Hardin Valley Road @ Steele Road (Background 2021)		
AM Peak	Intersection	24.9 / C
PM Peak	Intersection	15.5 / B
Hardin Valley Road @ Steele Road (Full Buildout 2021)		
AM Peak	Intersection	46.4 / D
PM Peak	Intersection	23.8 / C
Hardin Valley Road @ Steele Road (Full Buildout & Commercial 2021)		
AM Peak	Intersection	48.9 / D
PM Peak	Intersection	25.8 / C

6 Turn Lane Warrant Analysis

The intersection of Hardin Valley Road at the proposed driveway location was evaluated to determine if a right turn lane is warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information. A right turn lane on Hardin Valley Road is not warranted after the full buildout of the Steele Landing Subdivision. The turn lane warrant worksheets and analysis are included in Attachment 8.

There is an existing westbound left turn lane at the intersection of Hardin Valley Road at Steele Road; therefore a left turn lane warrant was not analyzed.

7 Conclusions and Recommendations

7.1 Hardin Valley Road @ Steele Road

The existing traffic conditions at the signalized intersection of Hardin Valley Road at Steele Road operate at a LOS C during the AM peak hour and a LOS B during the PM peak hour using the existing signal timing provided by Knox County.

The background traffic conditions at the signalized intersection of Hardin Valley Road at Steele Road operate at a LOS C during the AM peak hour and a LOS B during the PM peak hour using the existing signal timing provided by Knox County.

After the completion of the Steele Landing Subdivision the signalized intersection of Hardin Valley Road at Steele Road will operate at a LOS D during AM peak hour and a LOS C during the PM peak hour using the existing signal timing provided by Knox County.

The existing eastbound left turn lane on Hardin Valley Road at the intersection with Steele Road has a storage length of 125 feet (approximately 5 vehicles). The volume to capacity ratio exceeds 1.0 for this turn lane during both the background AM peak hour and the full buildout AM peak hour. The capacity analyses shows a 95% queue length of 5.1 vehicles during the background AM peak hour and a queue length of 9.2 vehicles during the full buildout AM peak hour after the completion of the Steele Landing Subdivision.

The eastbound left turn queue of 9.2 vehicles during the AM peak hour and 1.1 vehicles during the PM peak hour is not expected to block the existing Food City driveway entrance, which is located 225 feet from the intersection of Hardin Valley Road at Steele Road.

The existing westbound left turn lane on Hardin Valley Road at the intersection with Steele Road has a storage length of 215 feet (approximately 8 vehicles) and a taper length of 135 feet. The capacity analysis shows a 95% queue length of less than one car length during both the AM and PM peak hours; therefore the existing storage at the intersection is adequate and no change is necessary.

An eastbound right turn lane is not warranted after the full buildout of the Steele Landing Subdivision.

The proposed Steele Landing Subdivision will be within the Parent Responsibility Zone (PRZ) of Hardin Valley Elementary School, Hardin Valley Middle School and Hardin Valley Academy. The PRZ is defined as those who live within one (1) mile

from an elementary school or within (1.5) miles for a middle/high school by the shortest route, and are not eligible for transportation service. There are existing sidewalks and crosswalk locations on both Hardin Valley Road and Steele Road near Hardin Valley Elementary School that also extend to Hardin Valley Middle School and Hardin Valley Academy. The Steele Landing Subdivision plans to connect to the existing sidewalk network along Hardin Valley Road.

The minimum required sight distance for a road with a posted speed limit of 40 mph is 400 feet in each direction in accordance with the "Subdivision Regulations" for Knoxville and Knox County. FMA measured the sight distance at the proposed intersection of Hardin Valley Road at Driveway Connection. At 15 feet from the edge of pavement the sight distance at the proposed intersection is greater than 600 feet eastbound and 600 feet westbound.

7.2 Future Commercial Development

After the completion of the Future Commercial Development the signalized intersection of Hardin Valley Road at Steele Road will operate at a LOS D during AM peak hour and a LOS C during the PM peak hour using the existing signal timing provided by Knox County.

An eastbound right turn lane is warranted during the AM peak hour after the combined full buildout of the Steele Landing Subdivision and the Future Commercial Development. The need for a turn lane will be mitigated with the design (by others) for the commercial property also being served by this access.

The future commercial development will have a second access on Hardin Valley Road approximately 745 feet east of the intersection with Steele Road and across from the entrance to Hardin Valley Elementary School. This access was not analyzed as a part of the Steele Landing Subdivision traffic impact study.

Attachment 1
Traffic Counts

Project: Steele Landing Subdivision
Intersection: Steele Road / Hardin Valley Road
Date Conducted: 10/18/2018

	Hardin Valley Eastbound			Hardin Valley Westbound			Steele Road Southbound			
Start	Left	Thru	Total	Thru	Right	Total	Left	Right	Total	Int. Total
7:00 AM	36	110	146	32	45	77	99	27	126	349
7:15 AM	76	127	203	51	86	137	153	37	190	530
7:30 AM	62	113	175	62	67	129	135	64	199	503
7:45 AM	33	144	177	77	46	123	110	52	162	462
Total	207	494	701	222	244	466	497	180	677	1844
8:00 AM	36	147	183	71	39	110	89	41	130	423
8:15 AM	16	119	135	76	37	113	53	20	73	321
8:30 AM	5	85	90	36	7	43	29	9	38	171
8:45 AM	6	136	142	49	16	65	17	5	22	229
Total	63	487	550	232	99	331	188	75	263	1144
2:00 PM	9	70	79	135	40	175	31	7	38	292
2:15 PM	21	76	97	92	40	132	27	6	33	262
2:30 PM	14	88	102	77	47	124	23	9	32	258
2:45 PM	20	84	104	64	40	104	70	46	116	324
Total	64	318	382	368	167	535	151	68	219	1136
3:00 PM	20	62	82	81	32	113	60	33	93	288
3:15 PM	14	83	97	78	30	108	34	11	45	250
3:30 PM	26	80	106	136	47	183	74	39	113	402
3:45 PM	7	58	65	146	48	194	64	54	118	377
Total	67	283	350	441	157	598	232	137	369	1317
4:00 PM	10	76	86	94	35	129	68	35	103	318
4:15 PM	7	67	74	117	36	153	41	11	52	279
4:30 PM	15	101	116	123	29	152	37	14	51	319
4:45 PM	21	97	118	114	56	170	32	17	49	337
Total	53	341	394	448	156	604	178	77	255	1253
5:00 PM	14	111	125	130	48	178	54	22	76	379
5:15 PM	15	147	162	133	33	166	41	13	54	382
5:30 PM	10	114	124	120	53	173	37	21	58	355
5:45 PM	14	125	139	106	36	142	38	9	47	328
Total	53	497	550	489	170	659	170	65	235	1444
Grand Total	507	2420	2927	2200	993	3193	1416	602	2018	8138
Approach %	17.3	82.7		68.9	31.1		70.2	29.8		
Total %			36.0			39.2			24.8	

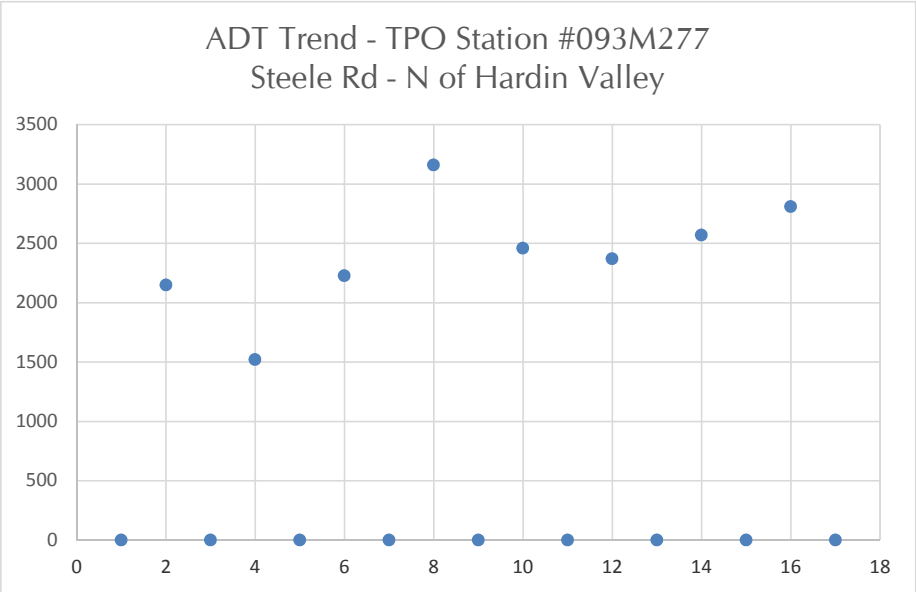
Project: Steele Landing Subdivision
Date Conducted: 10/16/2018

AM Peak Hour	7:15 AM - 8:15 AM	1918
PM Peak Hour	4:45 PM - 5:45 PM	1453

	Hardin Valley Eastbound			Hardin Valley Westbound			Steele Road 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	**76**	127	203	51	**86**	137	**153**	37	190	**530**
7:30 AM	62	113	175	62	67	129	135	**64**	199	503
7:45 AM	33	144	177	**77**	46	123	110	52	162	462
8:00 AM	36	**147**	183	71	39	110	89	41	130	423
Total Volume	207	531	738	261	238	499	487	194	681	1918
Future (4% over 3	233	597		294	268		548	218		2157
PHF	0.68	0.90		0.85	0.69		0.80	0.76		0.90
Peak Hour Analysis from 3:00 PM to 6:00 PM										
PM Peak Hour begins at 5:00 PM										
4:45 PM	**21**	97	118	114	**56**	170	32	17	49	337
5:00 PM	14	111	125	130	48	178	**54**	**22**	76	**379**
5:15 PM	15	**147**	162	**133**	33	166	41	13	54	382
5:30 PM	10	114	124	120	53	173	37	21	58	355
Total Volume	60	469	529	497	190	687	164	73	237	1453
Future (4% over 3	67	528		559	214		184	82		1634
PHF	0.71	0.80		0.93	0.85		0.76	0.83		0.96

Attachment 2
ADT Trends

	Year	Adjusted Average Daily Traffic
1	2000	N/A
2	2001	2150
3	2002	N/A
4	2003	1520
5	2004	N/A
6	2005	2228
7	2006	N/A
8	2007	3160
9	2008	N/A
10	2009	2460
11	2010	N/A
12	2011	2370
13	2012	N/A
14	2013	2570
15	2014	N/A
16	2015	2810
17	2016	N/A

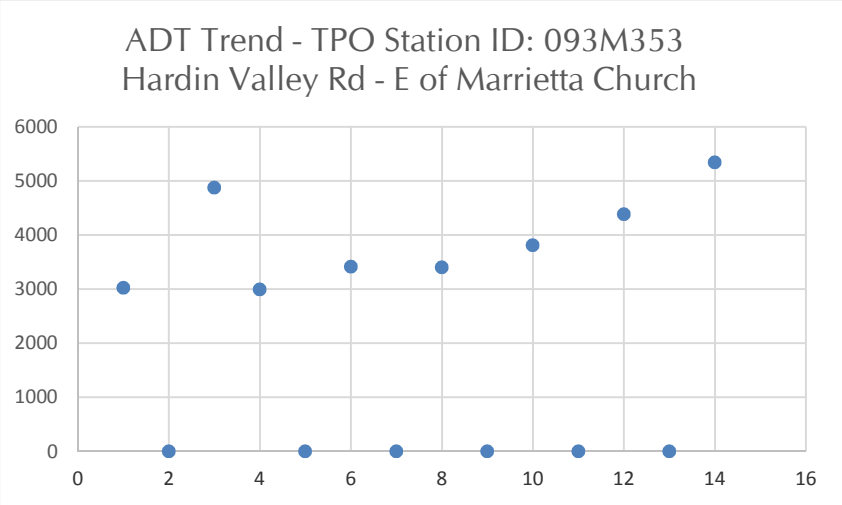


Most Recent Trend Line Growth

Year	ADT
2005	2228
2015	2810

Annual Percent Growth **2.61%**

	Year	Adjusted Average Daily Traffic
1	2003	3020
2	2004	N/A
3	2005	4871
4	2006	2990
5	2007	N/A
6	2008	3410
7	2009	N/A
8	2010	3400
9	2011	N/A
10	2012	3810
11	2013	N/A
12	2014	4380
13	2015	N/A
14	2016	5340



Most Recent Trend Line Growth

Year	ADT
2003	3020
2016	5340

Annual Percent Growth **5.91%**

Attachment 3
Trip Generation

Project: Steele Landing Subdivision
Date Conducted: 10/14/2019

Local Apartment Trip Generation Study
Phase 1 - 133 Units

Average Daily Traffic
T = 15.193 (X)^0.899
T = 15.193 (133) ^0.899
T = 1233

Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.
T = 0.758 (X) ^0.924
T = 0.758 (133) ^0.924
T = 70

Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.
T = 0.669 (X) + 10.069
T = 0.669 (133) + 10.069
T = 99

		Percent		Number	
Time Period	Total Trips	Enter	Exit	Enter	Exit
Weekday (24 hours)	1233	50%	50%	617	617
AM Peak Hour	70	22%	78%	15	55
PM Peak Hour	99	55%	45%	54	45

Project: Steele Landing Subdivision
Date Conducted: 4/17/2019

General Office Building - LUC 710
28,500 SF

Average Daily Traffic
Ln(T) = 0.97*Ln(X)+2.50
Ln(T) = 0.97*Ln(28.5)+2.50
T = 314

Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.
T = 0.94 (X) + 26.49
T = 0.94 (28.5) + 26.49
T = 53

Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.
Ln(T) = 0.95*Ln(X)+0.36
Ln(T) = 0.95*Ln(28.5)+0.36
T = 35

		Percent		Number	
Time Period	Total Trips	Enter	Exit	Enter	Exit
Weekday (24 hours)	314	50%	50%	157	157
AM Peak Hour	53	86%	14%	46	7
PM Peak Hour	35	16%	84%	6	29

Project: Steele Landing Subdivision
Date Conducted: 4/17/2019

High-Turnover (Sit-Down) Restaurant - LUC 932
7,000 SF

Average Daily Traffic
Average Rate = 112.18
T = 112.18 (7.0)
T = 785

Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.
Average Rate = 9.94
T = 9.94 (7.0)
T = 69

Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.
Average Rate = 9.77
T = 9.77 (7.0)
T = 68

Time Period	Total Trips	Percent		Number	
		Enter	Exit	Enter	Exit
Weekday (24 hours)	785	50%	50%	393	393
AM Peak Hour	69	55%	45%	38	31
PM Peak Hour	68	62%	38%	42	26

KNOXVILLE·KNOX COUNTY
MPC
METROPOLITAN
PLANNING
COMMISSION
TENNESSEE

MEMORANDUM

To: Traffic Impact Study Reviewers and Preparers (see attached list)

From: Mike Conger MDC

Date: August 14, 2000

Subject: Local Trip Generation Rates for Multi-Family Residential Uses

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Attached please find a summary of the final report with data plots for the Knox County Local Apartment Trip Generation Study. As you will recall, this report was discussed when the traffic impact study group last convened this past February. A consensus was reached at that meeting that the trip generation rates developed in the local study should be used for new apartment complexes and any other "multi-family" residential uses that are being proposed.

The MPC voted at its July 2000 meeting to officially amend the Traffic Impact Study Guidelines with language which reads that "trip generation rates for proposed uses shall be calculated using the latest edition of the ITE Trip Generation Manual, or using local data when it is available". This amendment allows the full implementation of the new rates, and they should be used for future proposed multi-family developments unless it can be demonstrated otherwise.

Thanks for your assistance and cooperation in this matter, if there are any questions or comments, please let me know.

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KNOX COUNTY
LOCAL APARTMENT TRIP GENERATION STUDY

PURPOSE

A Traffic Impact Study (TIS) is currently required in Knox County when a proposed development is projected to generate in excess of 750 trips per day. The determinations of when the threshold is met as well as all subsequent analyses in the TIS are performed using the rates and equations given in the Institute of Transportation Engineers (ITE) Trip Generation Manual. Local governmental agencies rely heavily on the accuracy of these trip generation rates in order to correctly predict the impacts of a proposed development on the transportation system. Therefore, in certain instances, it is logical to verify whether the "national" rates and equations given in the ITE Trip Generation Manual are appropriate for use in a specific local area or region.

The decision was made to study the local trip-making characteristics of apartments because of the discrepancy between the trip generation rates for apartments and single family residential land uses as given in the ITE Trip Generation Manual. While these two land uses are similar in nature, the Trip Generation Manual predicts about three less trips per dwelling unit generated by apartments for the average weekday. Additionally the Trip Generation Manual points out that due to the age of their database, which dates back to the 1960's, "the rates for apartments probably had changed over time". It is also assumed that some of the ITE data had come from larger metropolitan areas with denser development and greater transit use than Knox County, which would contribute to lower trip generation rates. Therefore, this study will be used to either verify the rates given in the Trip Generation Manual or generate new ones that can be applied to locally proposed apartment developments.

PROCEDURE

The procedures recommended by ITE in conducting local trip generation studies were generally followed for this study, along with some important assumptions that have made. ITE has published a proposed recommended practice entitled "Trip Generation Handbook" which specifically outlines procedures for conducting local trip generation studies and establishing new rates and equations.

The first step in the study was to define the number and location of the sites to be studied, as well as the counting methodology. Initially 14 sites were selected, although one apartment complex – the College Park Apartments – was later omitted due to uncharacteristically high traffic generation numbers. The number of sites used in this study far exceeds the recommended minimum amount suggested by ITE, which is five sites. Traffic counts were taken for week-long periods at 15-minute intervals between July 22, 1996 and August 9, 1996 at the access points to the apartment complexes. A Technical Appendix to this report contains the traffic count data collected at each apartment complex.

RESULTS

The traffic count data was analyzed using spreadsheets in order to determine the weighted average rates and regression equations. In order to be considered valid, the local rates and equations for each time period of analysis that were generated must meet certain statistical criteria. First, the standard deviation of the independent variable (dwelling units) should be no more than 110 percent of the weighted average rate; and secondly, the regression equations require a computed coefficient of determination (R^2) value of at least 0.75 before good data fit is indicated. This statistical criteria is met by the local data results, and in fact it often exceeds the level of data fit given by their counterparts in the ITE Trip Generation Manual. Finally, in order to simplify the use of the local data, plots were generated that appear identical to the actual ones in the ITE Trip Generation Manual.

The resulting rates and equations calculated from the local data indicate that the average weekday trip generation of apartments in this area is well above the national rates reported in the ITE manual. For example, the locally computed average rate for number of trips generated during a weekday is 35% higher than the rate given by ITE (increase from 6.63 trips per dwelling unit to 9.03 trips per dwelling unit). The trip generation rates do not increase as much for the AM and PM peak hours however. The local rate is roughly 8% higher for the AM peak, and 16% higher for the PM peak. The plots from the ITE Trip Generation Manual are included in the Technical Appendix for comparison purposes.

ASSUMPTIONS MADE

Some important assumptions have been made which may affect the results of the local data that was collected:

- It is important to note that the local trip generation rates were computed for the *total* number of dwelling units in the apartment complex, and not necessarily for the number of *occupied* dwelling units. There are several reasons why this was done, chiefly because of the need for comparability with the rates given in ITE Trip Generation Manual, as it does not specify whether the dwelling units are occupied. According to ITE procedures the selected sites must only be of "reasonably full occupancy (i.e. at least 85%)". The Apartment Association of Greater Knoxville (AAGK) publishes quarterly reports on occupancy levels of apartment complexes, and the report covering the period of the data collection was reviewed to determine occupancy levels. According to the AAGK report from July 1, 1996 – September 30, 1996 all of the apartment complexes surveyed in this study met the minimum 85% occupancy level, with an average occupancy rate for all sites studied of 94%.

- The count data that was collected at each apartment complex was used "raw" meaning that it was not factored for possible daily or seasonal variations. Once again, according to an ITE representative it is not known whether the data used in the Trip Generation Manual was factored or not, so therefore in order to be able to compare

local rates to those in the manual you must assume that count data should not be factored. Additionally, it was felt that apartment complexes would generally not be as susceptible to major seasonal fluctuations as other land uses might be. The local rates were also developed using count data that was collected and averaged over an entire week, which should limit some of the daily variations. Finally, reliable local daily and seasonal variation factors do not truly exist.

CONCLUSION

The local apartment study methodology and results were distributed for comment to a group of local transportation professionals who are directly responsible for either preparing or reviewing traffic impact studies. A meeting was held between this group on February 16, 2000 in order to gather comments and discuss the study in greater detail. The following conclusions are based on the discussion and consensus reached at this meeting:

1. The trip generation rates and equations meet statistical requirements and resulted from a study that followed accepted procedures; therefore they should be adopted for future use. Furthermore, the rates and equations are recommended for use in reviewing the traffic impact of any development termed as "multi-family", such as townhouse and condominium developments due to their similarity to apartment complexes.

2. The Traffic Access and Impact Study Guidelines and Procedures adopted by MPC should be amended with the language that local data should be used when available, which will allow the implementation of these new multi-family trip generation rates.

3. The following suggestions were made for future consideration:
   - This study should be updated with data collected from local townhouse and condominium developments in order to further justify the use of the new trip generation rates.
   - A statistical comparison should be made between any newly developed rates and the ITE single family trip generation rates to determine if there is a significant difference. If there is no difference then perhaps ITE single-family rates could be used for any residential development proposed in Knox County.

Local Apartment
Trip Generation Study

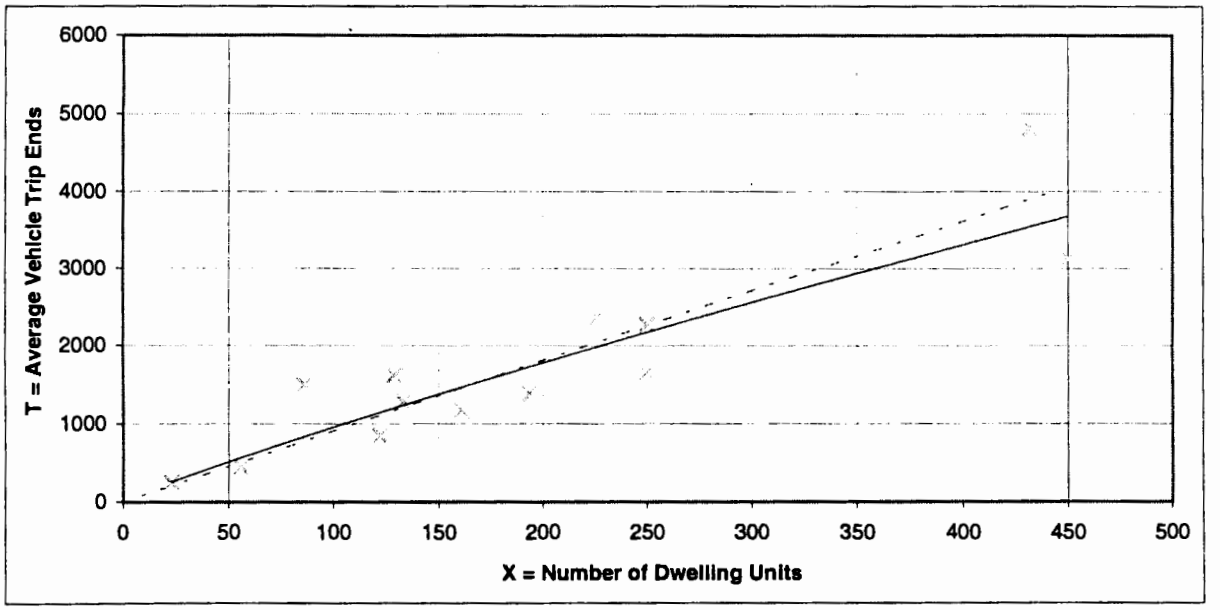
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

Number of Studies: 13
Average Number of Dwelling Units: 193
Directional Distribution: 50% entering, 50% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
9.03	6.59 - 17.41	2.47

Data Plot and Equation



X Actual Data Points ——— Fitted Curve ····· Average Rate

Fitted Curve Equation: $T = 15.193(X)^{0.899}$ $R^2 = 0.88$

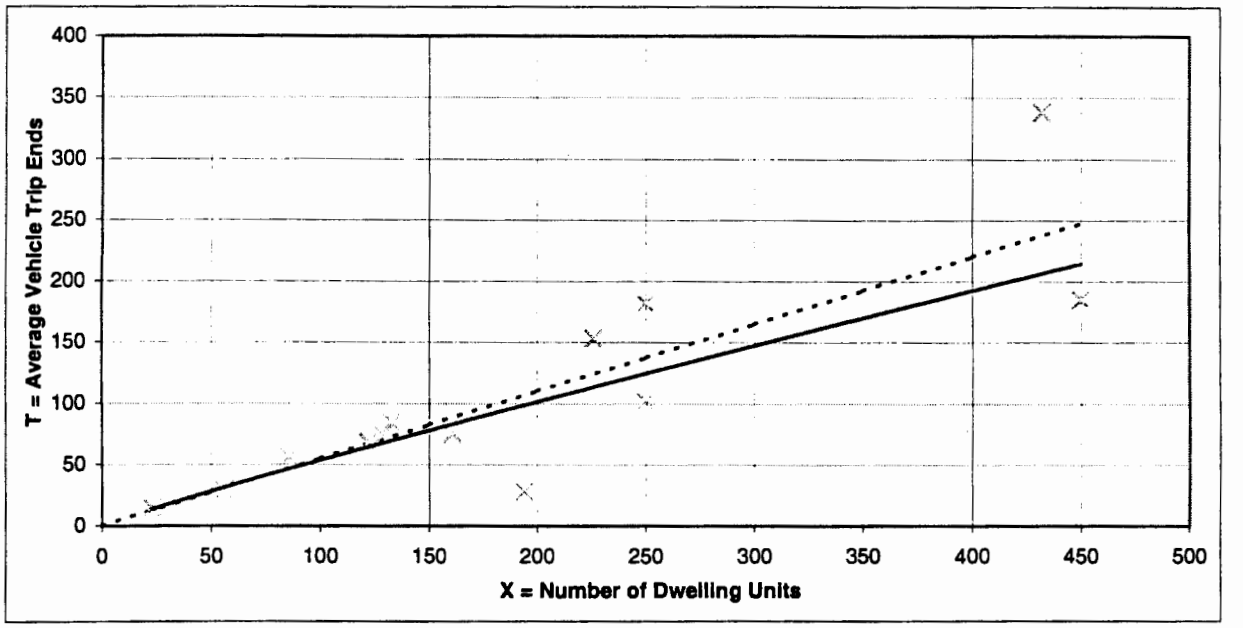
Local Apartment
Trip Generation Study

Average Vehicle Trip Ends vs:	**Dwelling Units**
On a:	**Weekday,** **Peak Hour of Adjacent Street Traffic,** **One Hour Between 7 and 9 a.m.**
Number of Studies:	13
Average Number of Dwelling Units:	193
Directional Distribution:	22% entering, 78% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
0.55	0.14 - 0.78	0.18

Data Plot and Equation



X Actual Data Points ——— Fitted Curve ····· Average Rate

Fitted Curve Equation: $T = 0.758(X)^{0.924}$ $R^2 = 0.75$

Local Apartment
Trip Generation Study

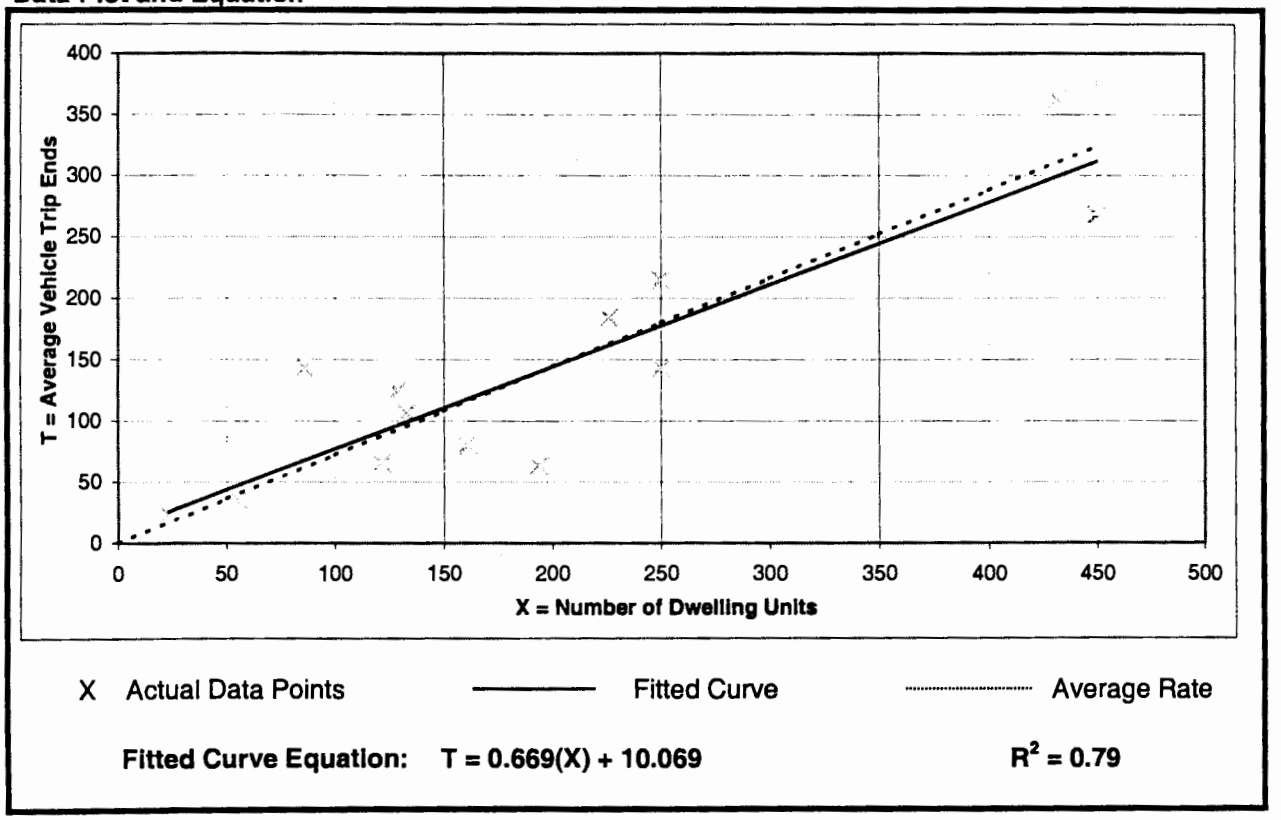
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 13
Average Number of Dwelling Units: 193
Directional Distribution: 55% entering, 45% exiting

Trip Generation Per Dwelling Unit

Average Rate	Ranges of Rates	Standard Deviation
0.72	0.32 - 1.66	0.25

Data Plot and Equation



X Actual Data Points ——— Fitted Curve ····· Average Rate

Fitted Curve Equation: T = 0.669(X) + 10.069 **R^2 = 0.79**

General Office Building
(710)

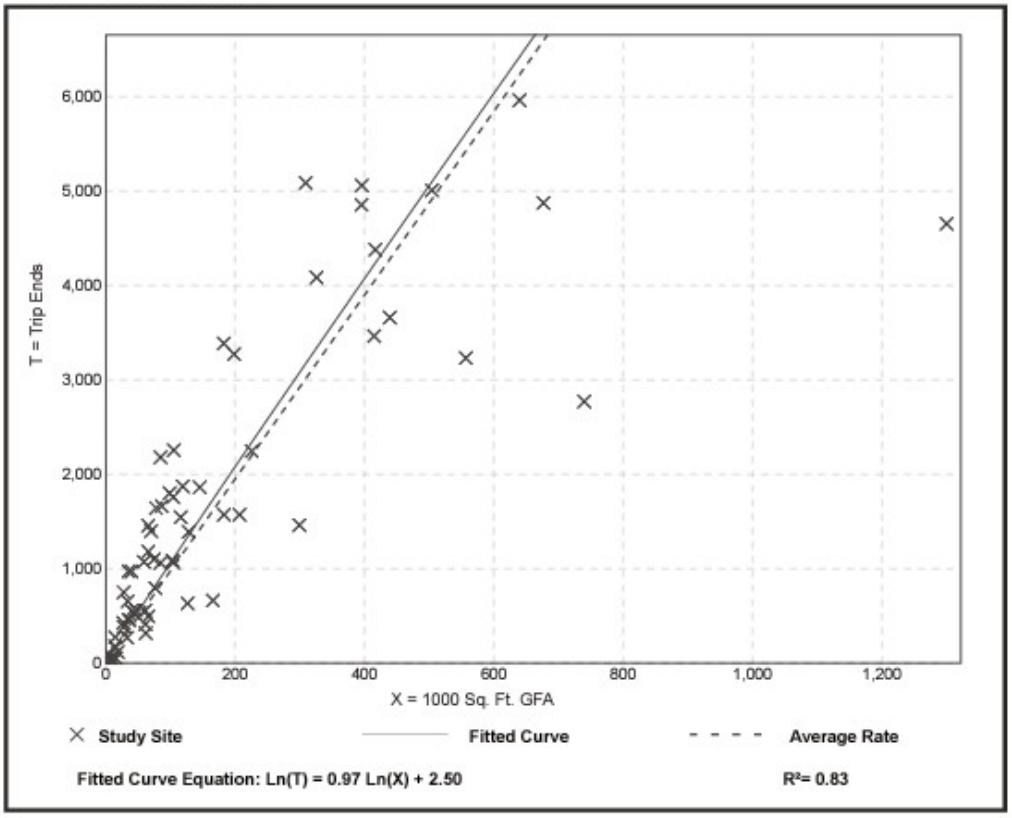
Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 66
1000 Sq. Ft. GFA: 171
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
9.74	2.71 - 27.56	5.15

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.97 Ln(X) + 2.50 **R^2= 0.83**

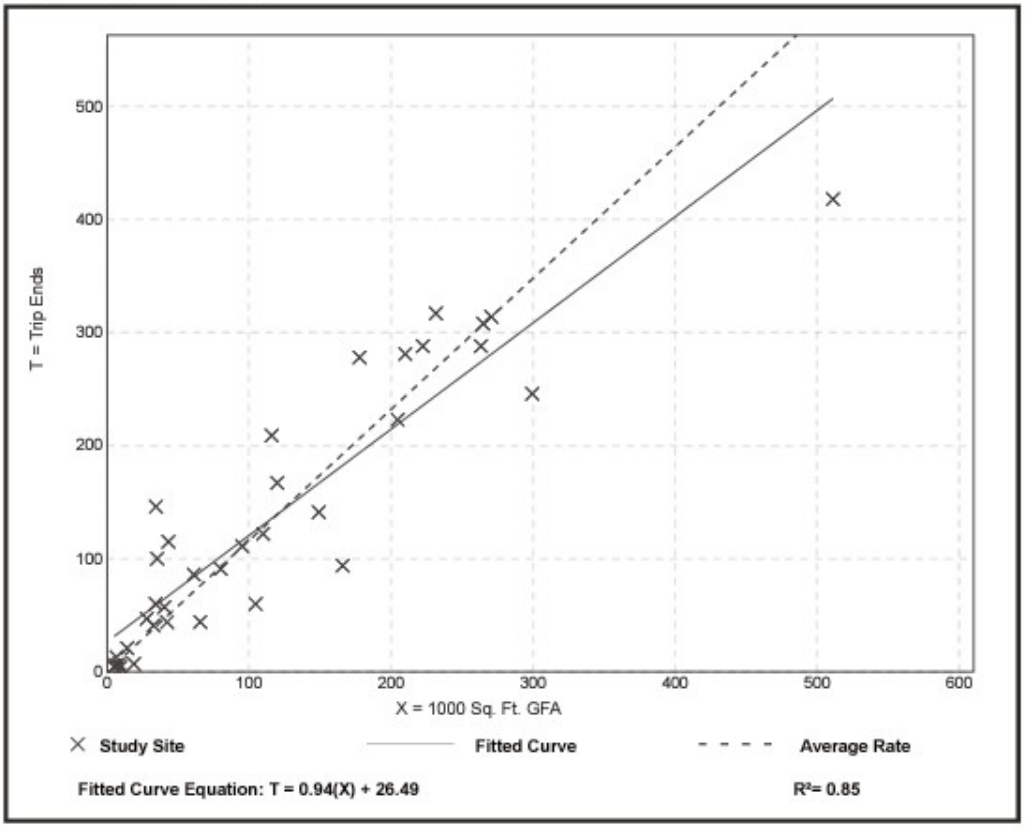
General Office Building
(710)

Vehicle Trip Ends vs:	**1000 Sq. Ft. GFA**
On a:	**Weekday,**
	Peak Hour of Adjacent Street Traffic,
	One Hour Between 7 and 9 a.m.
Setting/Location:	**General Urban/Suburban**
Number of Studies:	35
1000 Sq. Ft. GFA:	117
Directional Distribution:	86% entering, 14% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
1.16	0.37 - 4.23	0.47

Data Plot and Equation



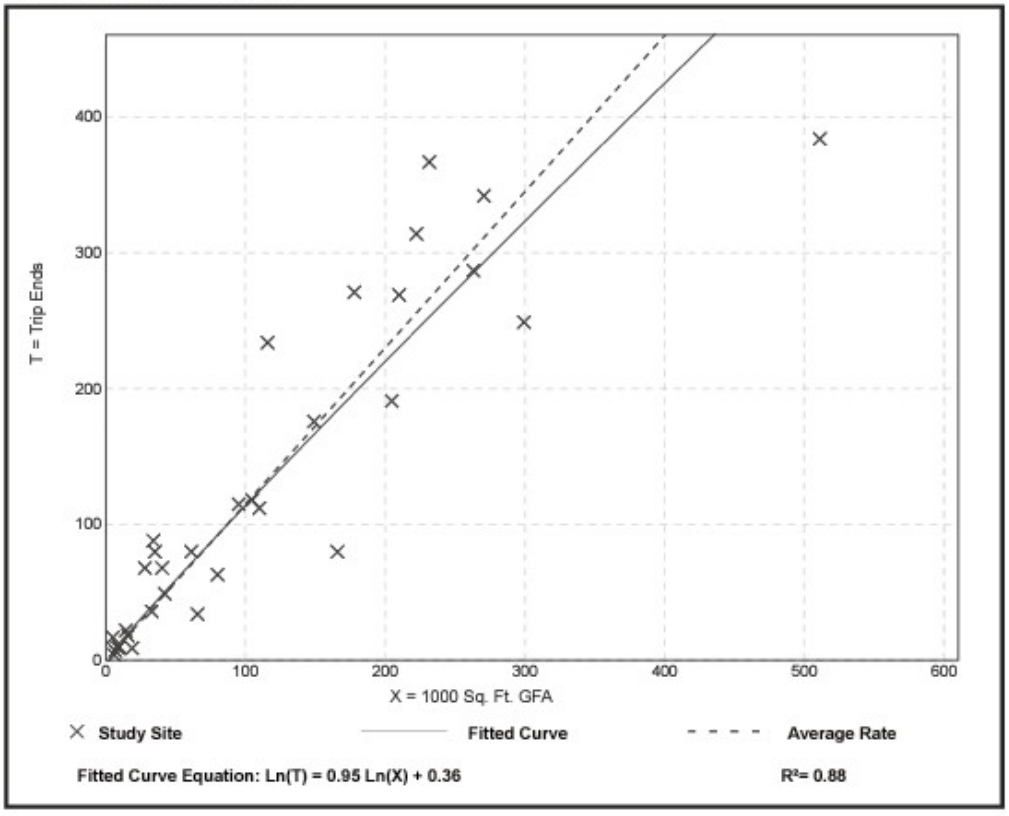
General Office Building
(710)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 32
1000 Sq. Ft. GFA: 114
Directional Distribution: 16% entering, 84% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
1.15	0.47 - 3.23	0.42

Data Plot and Equation



Medical-Dental Office Building
(720)

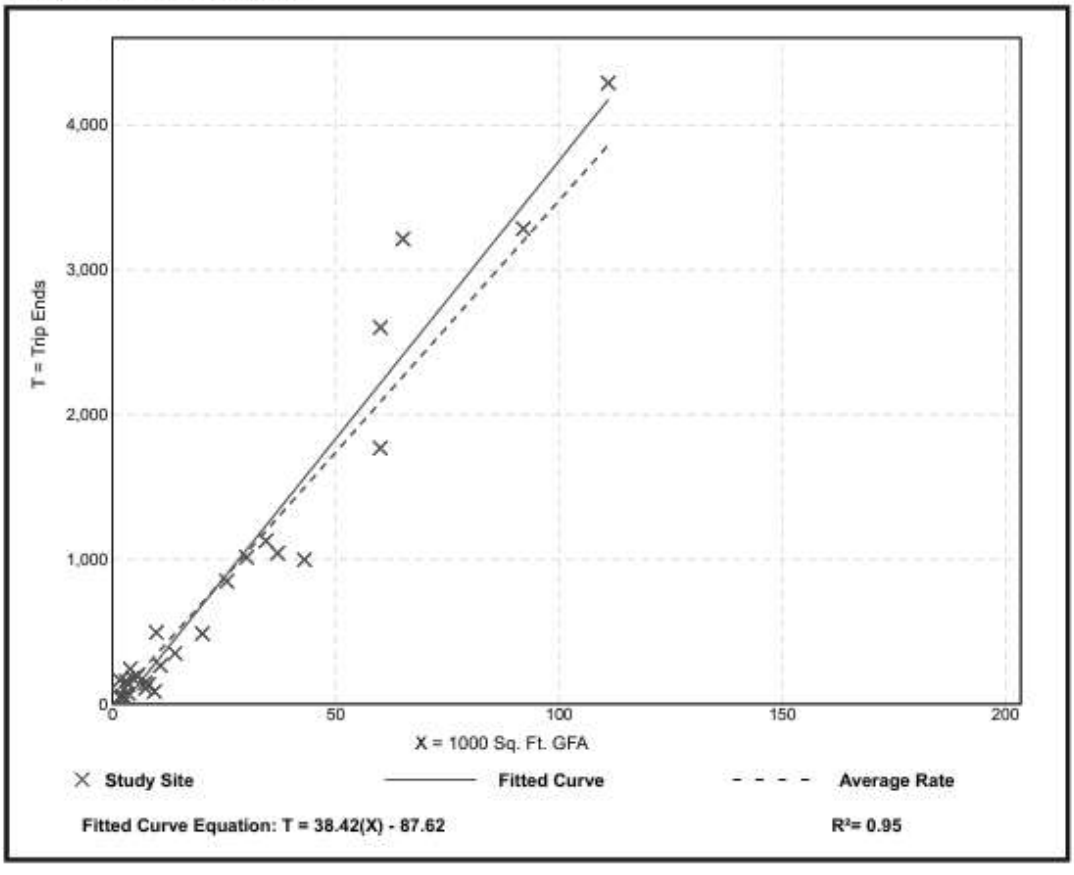
Vehicle Trip Ends vs: 1000 Sq. Ft. GFA
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 28
1000 Sq. Ft. GFA: 24
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
34.80	9.14 - 100.75	9.79

Data Plot and Equation



Fitted Curve Equation: T = 38.42(X) - 87.62

R^2= 0.95

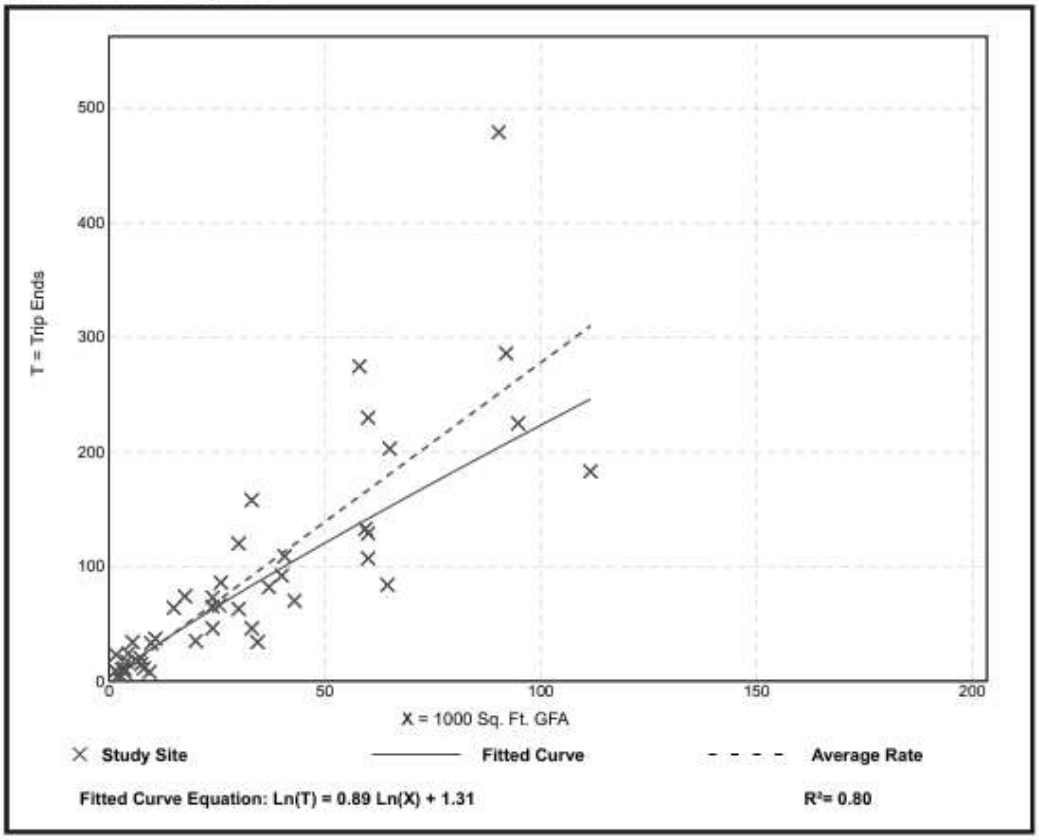
Medical-Dental Office Building
(720)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 44
1000 Sq. Ft. GFA: 32
Directional Distribution: 78% entering, 22% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
2.78	0.85 - 14.30	1.28

Data Plot and Equation



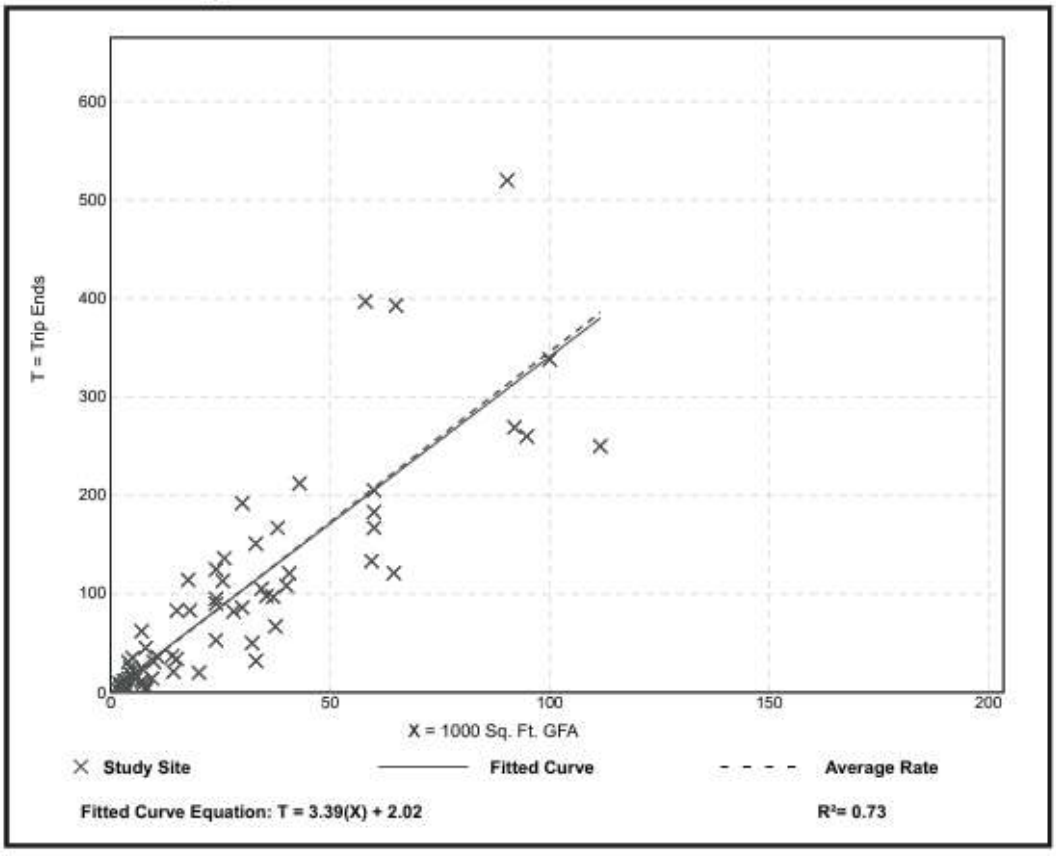
Medical-Dental Office Building
(720)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 65
1000 Sq. Ft. GFA: 28
Directional Distribution: 28% entering, 72% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
3.46	0.25 - 8.86	1.58

Data Plot and Equation

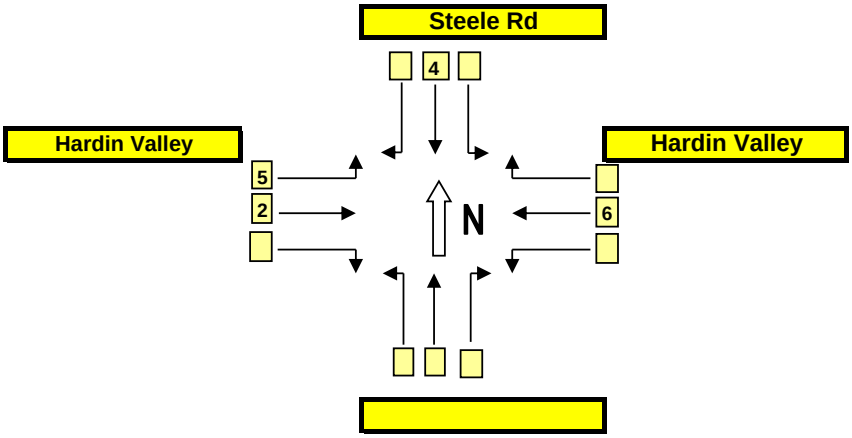


LOCAL CONTROLLER PROGRAMMING

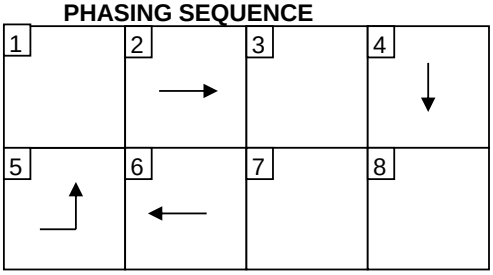
Intersection: Hardin Valley Rd at Steele Rd
Timing changed:
Controller type: Peek 3000

TIME BY PHASE (SEC) & FUNCTIONS

PHASE	1	2	3	4	5	6	7	8
MOVEMENTS	WBLT	EBT	NBLT	SBT	EBLT	WBT	SBLT	NBT
INITIAL		20		10	8	20		
PASSAGE		6		6	2	6		
YELLOW		4.5		4	4.5	4.5		
RED CLEAR		1.5		2.5	1.5	1.5		
WALK				7		7		
PED CLEAR				18		20		
MAX 1		45		45	25	45		
MAX 2		45		45	15	45		
RECALL								



PHASING SEQUENCE

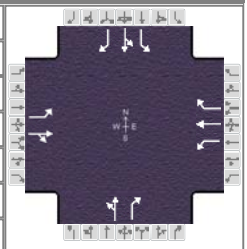


Date:	Initial:	Comment:
4/10/2015	JWS	Increase passage from 4 to 6 seconds for phases 2 and 6, Increased delay for phase 4 from 0 to 6 seconds.
2/11/2016	JWS	Increased MAX for Phases 2 & 6 from 45 to 60 seconds
Fall 2016	Prog	Returned phase times to original (WBRT lane completed)
1/12/2017	JWS	Increased phase 4 (SB) MAX from 25 to 45 seconds

Attachment 5
Intersection Worksheets – Existing AM/PM Peaks

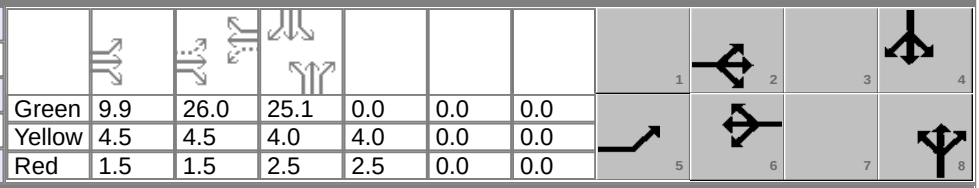
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	3/24/2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Existing AM Peak	PHF	0.92
Urban Street	Hardin Valley Road	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	Hardin Valley at Steele…	File Name	Existing AM Peak.xus		
Project Description	548.001 - Steele Road Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	207	531	0	0	238	261	0	0	0	487	0	194

Signal Information			
Cycle, s	79.5	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.9	26.0	25.1	0.0	0.0	0.0
Yellow	4.5	4.5	4.0	4.0	0.0	0.0
Red	1.5	1.5	2.5	2.5	0.0	0.0

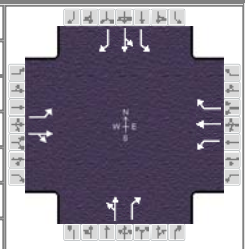
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		5.3		11.0		9.0
Phase Duration, s	15.9	47.9		32.0		0.0		31.6
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	1.1	1.1		1.1		0.0		1.1
Queue Clearance Time (g_s), s	8.0	18.8		13.7				25.0
Green Extension Time (g_e), s	0.0	0.1		0.1		0.0		0.1
Phase Call Probability	0.99	1.00		1.00				1.00
Max Out Probability	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	225	0		0	259	284		0	0	529	0	211
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	0		836	1870	1585		0	1585	1781	1870	1585
Queue Service Time (g_s), s	6.0	0.0		0.0	8.6	11.7		0.0	0.0	23.0	0.0	8.4
Cycle Queue Clearance Time (g_c), s	6.0	0.0		0.0	8.6	11.7		0.0	0.0	23.0	0.0	8.4
Green Ratio (*g/C*)	0.48			0.33	0.33	0.33			0.00	0.32	0.32	0.32
Capacity (*c*), veh/h	557			91	611	518			2	562	590	500
Volume-to-Capacity Ratio (*X*)	0.404	0.000		0.000	0.423	0.548		0.000	0.000	0.941	0.000	0.421
Back of Queue (*Q*), ft/ln (95 th percentile)	97.8	0		0	159.4	184.2		0	0	376.5	0	132.3
Back of Queue (*Q*), veh/ln (95 th percentile)	3.9	0.0		0.0	6.3	7.3		0.0	0.0	14.8	0.0	5.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.78	0.00		0.00	0.00	0.28		0.00	0.00	0.00	0.00	0.53
Uniform Delay (d_1), s/veh	13.4			0.0	20.9	22.0			0.0	26.5	0.0	21.5
Incremental Delay (d_2), s/veh	0.2	0.0		0.0	0.2	0.3		0.0	0.0	5.4	0.0	0.2
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	13.5			0.0	21.1	22.3			0.0	31.9	0.0	21.7
Level of Service (LOS)	B				C	C				C		C
Approach Delay, s/veh / LOS	13.4	B		21.7	C		0.0			29.0	C	
Intersection Delay, s/veh / LOS	21.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.4	B	2.5	B	2.3	B
Bicycle LOS Score / LOS	1.8	B	1.4	A	0.5	A	1.7	B

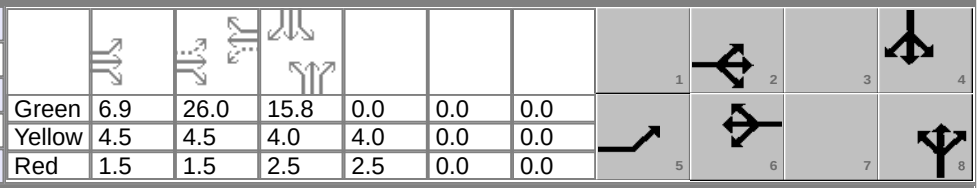
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	3/24/2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Existing PM Peak	PHF	0.96
Urban Street	Hardin Valley Road	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	Hardin Valley at Steele…	File Name	Existing PM Peak.xus		
Project Description	548.001 - Steele Road Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	469	0	0	497	190	0	0	0	164	0	73

Signal Information			
Cycle, s	67.2	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.9	26.0	15.8	0.0	0.0	0.0						
Yellow	4.5	4.5	4.0	4.0	0.0	0.0						
Red	1.5	1.5	2.5	2.5	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		5.3		11.0		9.0
Phase Duration, s	12.9	44.9		32.0		0.0		22.3
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	1.1	1.0		1.0		0.0		1.1
Queue Clearance Time (g_s), s	3.2	12.0		17.8				7.5
Green Extension Time (g_e), s	0.0	0.0		0.0		0.0		0.0
Phase Call Probability	0.69	1.00		1.00				0.99
Max Out Probability	0.00	0.00		0.00				0.00

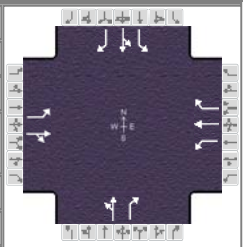
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	63	0		0	518	198		0	0	171	0	76
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	0		908	1870	1585		0	1585	1781	1870	1585
Queue Service Time (g_s), s	1.2	0.0		0.0	15.8	5.9		0.0	0.0	5.5	0.0	2.6
Cycle Queue Clearance Time (g_c), s	1.2	0.0		0.0	15.8	5.9		0.0	0.0	5.5	0.0	2.6
Green Ratio (*g/C*)	0.52			0.39	0.39	0.39			0.00	0.24	0.24	0.24
Capacity (*c*), veh/h	424			107	723	613			2	420	441	373
Volume-to-Capacity Ratio (*X*)	0.148	0.000		0.000	0.716	0.323		0.000	0.000	0.407	0.000	0.204
Back of Queue (*Q*), ft/ln (95 th percentile)	16.9	0		0	251.4	84.6		0	0	95.6	0	40.3
Back of Queue (*Q*), veh/ln (95 th percentile)	0.7	0.0		0.0	9.9	3.3		0.0	0.0	3.8	0.0	1.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.14	0.00		0.00	0.00	0.13		0.00	0.00	0.00	0.00	0.16
Uniform Delay (d_1), s/veh	10.6			0.0	17.5	14.5			0.0	21.7	0.0	20.6
Incremental Delay (d_2), s/veh	0.1	0.0		0.0	0.5	0.1		0.0	0.0	0.2	0.0	0.1
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	0.0
Control Delay (*d*), s/veh	10.7			0.0	18.0	14.6			0.0	22.0	0.0	20.7
Level of Service (LOS)	B				B	B				C		C
Approach Delay, s/veh / LOS	8.5	A		17.0	B		0.0			21.6	C	
Intersection Delay, s/veh / LOS	14.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.4	B	2.5	B	2.3	B
Bicycle LOS Score / LOS	1.4	A	1.7	B	0.5	A	0.9	A

Attachment 6
Intersection Worksheets – Background AM/PM Peaks

HCS7 Signalized Intersection Results Summary

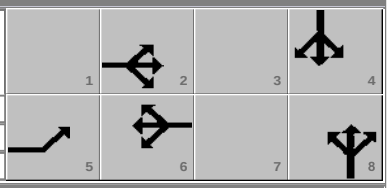
General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	3/24/2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Background AM Peak	PHF	0.92
Urban Street	Hardin Valley Road	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	Hardin Valley at Steele…	File Name	Background AM Peak.xus		
Project Description	548.001 - Steele Road Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	233	597	0	0	294	268	0	0	0	548	0	218

Signal Information			
Cycle, s	84.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.0	26.0	29.5	0.0	0.0	0.0
Yellow	4.5	4.5	4.0	4.0	0.0	0.0
Red	1.5	1.5	2.5	2.5	0.0	0.0



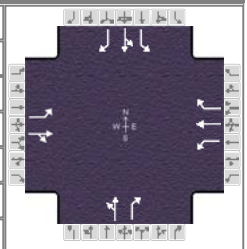
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		5.3		11.0		9.0
Phase Duration, s	16.0	48.0		32.0		0.0		36.0
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	1.1	1.0		1.0		0.0		1.1
Queue Clearance Time (g_s), s	9.6	24.3		15.1				29.4
Green Extension Time (g_e), s	0.0	0.1		0.1		0.0		0.1
Phase Call Probability	1.00	1.00		1.00				1.00
Max Out Probability	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	253	0		0	320	291		0	0	596	0	237
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	0		782	1870	1585		0	1585	1781	1870	1585
Queue Service Time (g_s), s	7.6	0.0		0.0	12.0	13.1		0.0	0.0	27.4	0.0	9.6
Cycle Queue Clearance Time (g_c), s	7.6	0.0		0.0	12.0	13.1		0.0	0.0	27.4	0.0	9.6
Green Ratio (*g/C*)	0.45			0.31	0.31	0.31			0.00	0.35	0.35	0.35
Capacity (*c*), veh/h	473			86	579	490			2	626	657	557
Volume-to-Capacity Ratio (*X*)	0.535	0.000		0.000	0.552	0.594		0.000	0.000	0.951	0.000	0.425
Back of Queue (*Q*), ft/ln (95 th percentile)	129.5	0		0	219	206.7		0	0	465.6	0	151.4
Back of Queue (*Q*), veh/ln (95 th percentile)	5.1	0.0		0.0	8.6	8.1		0.0	0.0	18.3	0.0	6.0
Queue Storage Ratio (*RQ*) (95 th percentile)	1.04	0.00		0.00	0.00	0.32		0.00	0.00	0.00	0.00	0.61
Uniform Delay (d_1), s/veh	16.3			0.0	24.2	24.5			0.0	26.6	0.0	20.8
Incremental Delay (d_2), s/veh	0.4	0.0		0.0	0.3	0.4		0.0	0.0	11.4	0.0	0.2
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	16.6			0.0	24.5	25.0			0.0	38.0	0.0	21.0
Level of Service (LOS)	B				C	C				D		C
Approach Delay, s/veh / LOS	17.3	B		24.7	C		0.0			33.1	C	
Intersection Delay, s/veh / LOS	24.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.4	B	2.5	B	2.3	B
Bicycle LOS Score / LOS	2.0	B	1.5	A	0.5	A	1.9	B

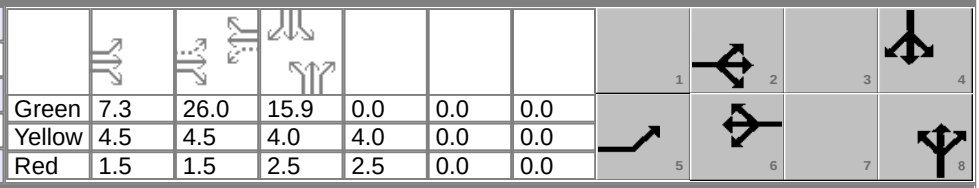
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	3/24/2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Existing PM Peak	PHF	0.96
Urban Street	Hardin Valley Road	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	Hardin Valley at Steele…	File Name	Background PM Peak.xus		
Project Description	548.001 - Steele Road Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	67	528	0	0	559	214	0	0	0	184	0	82

Signal Information			
Cycle, s	67.7	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.3	26.0	15.9	0.0	0.0	0.0
Yellow	4.5	4.5	4.0	4.0	0.0	0.0
Red	1.5	1.5	2.5	2.5	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		5.3		11.0		9.0
Phase Duration, s	13.3	45.3		32.0		0.0		22.4
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	1.1	1.0		1.0		0.0		1.1
Queue Clearance Time (g_s), s	3.3	13.8		20.9				8.2
Green Extension Time (g_e), s	0.0	0.1		0.1		0.0		0.0
Phase Call Probability	0.73	1.00		1.00				0.99
Max Out Probability	0.00	0.00		0.00				0.00

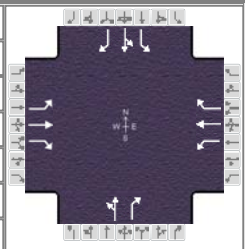
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	70	0		0	582	223		0	0	192	0	85
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	0		858	1870	1585		0	1585	1781	1870	1585
Queue Service Time (g_s), s	1.3	0.0		0.0	18.9	6.8		0.0	0.0	6.2	0.0	3.0
Cycle Queue Clearance Time (g_c), s	1.3	0.0		0.0	18.9	6.8		0.0	0.0	6.2	0.0	3.0
Green Ratio (*g/C*)	0.52			0.38	0.38	0.38			0.00	0.23	0.23	0.23
Capacity (*c*), veh/h	386			106	718	608			2	418	439	372
Volume-to-Capacity Ratio (*X*)	0.181	0.000		0.000	0.811	0.366		0.000	0.000	0.458	0.000	0.229
Back of Queue (*Q*), ft/ln (95 th percentile)	19.1	0		0	292.7	98.7		0	0	110.1	0	46
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	0.0		0.0	11.5	3.9		0.0	0.0	4.3	0.0	1.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.15	0.00		0.00	0.00	0.15		0.00	0.00	0.00	0.00	0.18
Uniform Delay (d_1), s/veh	11.6			0.0	18.7	15.0			0.0	22.2	0.0	21.0
Incremental Delay (d_2), s/veh	0.1	0.0		0.0	0.9	0.1		0.0	0.0	0.3	0.0	0.1
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	0.0
Control Delay (*d*), s/veh	11.7			0.0	19.5	15.1			0.0	22.5	0.0	21.1
Level of Service (LOS)	B				B	B				C		C
Approach Delay, s/veh / LOS	8.9	A		18.3	B		0.0			22.1	C	
Intersection Delay, s/veh / LOS	15.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.4	B	2.5	B	2.3	B
Bicycle LOS Score / LOS	1.5	B	1.8	B	0.5	A	0.9	A

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	Oct 16, 2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Buildout AM Peak	PHF	0.90
Urban Street	Hardin Valley Road	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	Hardin Valley Road at St…	File Name	Buildout AM Peak_split.xus		
Project Description	548.001 Steele Landing Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	233	597	6	8	294	268	22	5	28	548	1	218

Signal Information			
Cycle, s	121.5	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	15.0	30.3	44.2	7.0	0.0	0.0	5	6	7	8
Yellow	4.5	4.5	4.0	4.0	0.0	0.0				
Red	1.5	1.5	2.5	2.5	0.0	0.0				

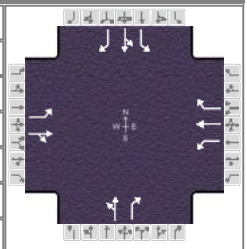
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	3.0		5.3		11.0		9.0
Phase Duration, s	21.0	57.3		36.3		13.5		50.7
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	3.1	7.1		7.1		7.2		7.2
Queue Clearance Time (g_s), s	14.6	40.6		23.1		4.3		42.2
Green Extension Time (g_e), s	0.4	3.7		6.7		0.6		2.0
Phase Call Probability	1.00	1.00		1.00		0.87		1.00
Max Out Probability	0.00	1.00		0.66		0.00		1.00

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	259	663	7	9	327	298		30	31	609	1	242
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1870	1585	772	1870	1585		1797	1585	1781	1870	1585
Queue Service Time (g_s), s	12.6	38.6	0.3	1.3	19.3	21.1		1.9	2.3	40.2	0.0	13.9
Cycle Queue Clearance Time (g_c), s	12.6	38.6	0.3	18.9	19.3	21.1		1.9	2.3	40.2	0.0	13.9
Green Ratio (*g/C*)	0.39	0.42	0.42	0.25	0.25	0.25		0.06	0.06	0.36	0.36	0.36
Capacity (*c*), veh/h	375	790	670	140	467	396		103	91	648	680	576
Volume-to-Capacity Ratio (*X*)	0.691	0.839	0.010	0.063	0.699	0.752		0.290	0.341	0.940	0.002	0.420
Back of Queue (*Q*), ft/ln (95 th percentile)	232.8	663.7	5.2	12.4	375	361.6		47.2	50.7	727.6	1	238.5
Back of Queue (*Q*), veh/ln (95 th percentile)	9.2	26.1	0.2	0.5	14.8	14.2		1.9	2.0	28.6	0.0	9.4
Queue Storage Ratio (*RQ*) (95 th percentile)	1.86	0.00	0.00	0.00	0.00	0.56		0.00	0.60	0.00	0.00	0.95
Uniform Delay (d_1), s/veh	29.0	31.4	20.3	49.2	41.4	42.1		54.9	55.0	37.4	24.6	29.0
Incremental Delay (d_2), s/veh	0.9	9.8	0.0	0.7	6.7	10.0		5.5	7.8	22.9	0.0	1.8
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	0.0	0.0
Control Delay (*d*), s/veh	29.8	41.2	20.4	49.9	48.1	52.1		60.4	62.9	60.2	24.6	30.8
Level of Service (LOS)	C	D	C	D	D	D		E	E	E	C	C
Approach Delay, s/veh / LOS	37.8	D		50.0	D		61.6	E		51.8	D	
Intersection Delay, s/veh / LOS	46.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.5	B	2.5	B	2.5	B
Bicycle LOS Score / LOS	2.0	B	1.5	B	0.6	A	1.9	B

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	Oct 16, 2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Buildout PM Peak	PHF	0.96
Urban Street	Hardin Valley Road	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	Hardin Valley at Steele…	File Name	Buildout PM Peak_split.xus		
Project Description	548.001 - Steele Road Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	67	528	14	35	559	214	11	5	29	184	5	82

Signal Information			
Cycle, s	87.7	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4	
Green	6.5	36.6	14.1	5.5	0.0	0.0	5	6	7	8	
Yellow	4.5	4.5	4.0	4.0	0.0	0.0					
Red	1.5	1.5	2.5	2.5	0.0	0.0					

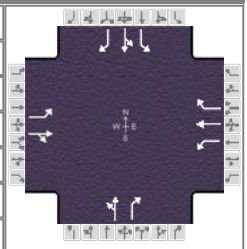
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		5.3		11.0		9.0
Phase Duration, s	12.5	55.1		42.6		12.0		20.6
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	3.1	7.1		7.1		7.2		7.1
Queue Clearance Time (g_s), s	3.7	18.8		25.1		3.6		10.9
Green Extension Time (g_e), s	0.1	17.5		11.0		0.4		3.3
Phase Call Probability	0.82	1.00		1.00		0.68		1.00
Max Out Probability	0.00	0.64		0.74		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	70	565		36	582	223		17	30	192	5	85
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1862		846	1870	1585		1808	1585	1781	1870	1585
Queue Service Time (g_s), s	1.7	16.8		2.5	23.1	8.4		0.8	1.6	8.9	0.2	4.2
Cycle Queue Clearance Time (g_c), s	1.7	16.8		6.8	23.1	8.4		0.8	1.6	8.9	0.2	4.2
Green Ratio (*g/C*)	0.51	0.56		0.42	0.42	0.42		0.06	0.06	0.16	0.16	0.16
Capacity (*c*), veh/h	342	1042		393	780	661		113	99	287	302	256
Volume-to-Capacity Ratio (*X*)	0.204	0.542		0.093	0.747	0.337		0.148	0.306	0.667	0.017	0.334
Back of Queue (*Q*), ft/ln (95 th percentile)	28.7	270		22.8	397.2	137.9		18.1	35.2	199.5	4.4	79.4
Back of Queue (*Q*), veh/ln (95 th percentile)	1.1	10.6		0.9	15.6	5.4		0.7	1.4	7.9	0.2	3.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.23	0.00		0.00	0.00	0.21		0.00	0.42	0.00	0.00	0.32
Uniform Delay (d_1), s/veh	14.7	12.2		18.3	21.7	17.4		38.9	39.3	34.6	30.9	32.6
Incremental Delay (d_2), s/veh	0.1	1.6		0.4	5.4	1.1		2.2	6.2	9.3	0.1	2.8
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	0.0
Control Delay (*d*), s/veh	14.8	13.8		18.7	27.1	18.4		41.1	45.6	43.9	31.0	35.4
Level of Service (LOS)	B	B		B	C	B		D	D	D	C	D
Approach Delay, s/veh / LOS	13.9	B		24.4	C		44.0	D		41.1	D	
Intersection Delay, s/veh / LOS	23.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.4	B	2.5	B	2.3	B
Bicycle LOS Score / LOS	1.5	B	1.9	B	0.6	A	1.0	A

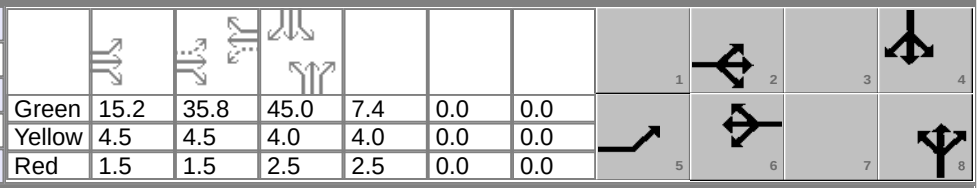
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	Oct 16, 2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Buildout AM Peak	PHF	0.90
Urban Street	Hardin Valley Road	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	Hardin Valley at Steele…	File Name	Commercial AM Peak.xus		
Project Description	548.001 - Steele Road Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	233	597	31	39	294	268	27	6	34	548	7	218

Signal Information			
Cycle, s	128.4	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	15.2	35.8	45.0	7.4	0.0	0.0
Yellow	4.5	4.5	4.0	4.0	0.0	0.0
Red	1.5	1.5	2.5	2.5	0.0	0.0

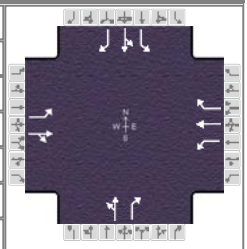
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		5.3		11.0		9.0
Phase Duration, s	21.2	63.0		41.8		13.9		51.5
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	3.1	7.1		7.1		7.2		7.1
Queue Clearance Time (g_s), s	14.8	45.1		30.9		5.0		45.3
Green Extension Time (g_e), s	0.3	0.0		4.9		0.7		0.0
Phase Call Probability	1.00	1.00		1.00		0.93		1.00
Max Out Probability	0.00	1.00		0.84		0.00		1.00

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	259	698		43	327	298		37	38	609	8	242
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1854		748	1870	1585		1797	1585	1781	1870	1585
Queue Service Time (g_s), s	12.8	43.1		7.0	19.6	21.4		2.5	3.0	43.3	0.3	15.0
Cycle Queue Clearance Time (g_c), s	12.8	43.1		28.9	19.6	21.4		2.5	3.0	43.3	0.3	15.0
Green Ratio (*g/C*)	0.41	0.44		0.28	0.28	0.28		0.06	0.06	0.35	0.35	0.35
Capacity (*c*), veh/h	400	822		137	521	442		104	92	624	656	556
Volume-to-Capacity Ratio (*X*)	0.648	0.849		0.316	0.627	0.674		0.352	0.411	0.975	0.012	0.436
Back of Queue (*Q*), ft/ln (95 th percentile)	234	717.6		68.1	370	353.8		61.3	65.6	801.3	7.3	253.3
Back of Queue (*Q*), veh/ln (95 th percentile)	9.2	28.3		2.7	14.6	13.9		2.4	2.6	31.5	0.3	10.0
Queue Storage Ratio (*RQ*) (95 th percentile)	1.87	0.00		0.00	0.00	0.54		0.00	0.78	0.00	0.00	1.01
Uniform Delay (d_1), s/veh	28.3	31.9		54.2	40.5	41.1		58.2	58.4	41.2	27.2	32.0
Incremental Delay (d_2), s/veh	0.7	10.0		4.7	4.4	6.5		7.2	10.4	30.3	0.0	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	29.0	41.9		58.9	44.9	47.6		65.4	68.7	71.4	27.2	33.9
Level of Service (LOS)	C	D		E	D	D		E	E	E	C	C
Approach Delay, s/veh / LOS	38.4	D		47.0	D		67.1	E		60.4	E	
Intersection Delay, s/veh / LOS	48.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.5	B	2.5	B	2.3	B
Bicycle LOS Score / LOS	2.1	B	1.6	B	0.6	A	1.9	B

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	FMA			Duration, h	0.25
Analyst	Addie Kirkham	Analysis Date	Oct 16, 2019	Area Type	Other
Jurisdiction	Knox County	Time Period	Buildout PM Peak	PHF	0.96
Urban Street	Hardin Valley Road	Analysis Year	2021	Analysis Period	1> 7:00
Intersection	Hardin Valley at Steele…	File Name	Commercial PM Peak.xus		
Project Description	548.001 - Steele Road Subdivision				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	67	528	17	44	559	214	23	10	60	184	6	82

Signal Information			
Cycle, s	90.2	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4	
Green	6.6	36.9	14.4	7.3	0.0	0.0	5	6	7	8	
Yellow	4.5	4.5	4.0	4.0	0.0	0.0					
Red	1.5	1.5	2.5	2.5	0.0	0.0					

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		5.3		11.0		9.0
Phase Duration, s	12.6	55.5		42.9		13.8		20.9
Change Period, ($Y+R_c$), s	6.0	6.0		6.0		6.5		6.5
Max Allow Headway (*MAH*), s	3.1	7.1		7.1		7.2		7.1
Queue Clearance Time (g_s), s	3.8	19.9		26.1		5.4		11.1
Green Extension Time (g_e), s	0.1	17.1		10.3		1.0		3.3
Phase Call Probability	0.83	1.00		1.00		0.91		1.00
Max Out Probability	0.00	0.66		0.76		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	70	568		46	582	223		34	63	192	6	85
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1781	1860		844	1870	1585		1807	1585	1781	1870	1585
Queue Service Time (g_s), s	1.8	17.9		3.4	24.1	8.7		1.6	3.4	9.1	0.3	4.3
Cycle Queue Clearance Time (g_c), s	1.8	17.9		8.7	24.1	8.7		1.6	3.4	9.1	0.3	4.3
Green Ratio (*g/C*)	0.50	0.55		0.41	0.41	0.41		0.08	0.08	0.16	0.16	0.16
Capacity (*c*), veh/h	328	1020		375	764	648		146	128	285	299	253
Volume-to-Capacity Ratio (*X*)	0.213	0.556		0.122	0.762	0.344		0.235	0.487	0.673	0.021	0.337
Back of Queue (*Q*), ft/ln (95 th percentile)	30.6	288.6		31.1	416.8	145.3		37	75	204.6	5.5	82.1
Back of Queue (*Q*), veh/ln (95 th percentile)	1.2	11.4		1.2	16.4	5.7		1.5	3.0	8.1	0.2	3.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.25	0.00		0.00	0.00	0.22		0.00	0.89	0.00	0.00	0.33
Uniform Delay (d_1), s/veh	15.7	13.2		20.2	22.9	18.4		38.8	39.7	35.7	31.9	33.7
Incremental Delay (d_2), s/veh	0.1	1.8		0.5	6.0	1.1		2.9	10.1	9.6	0.1	2.8
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	0.0
Control Delay (*d*), s/veh	15.8	15.0		20.7	28.9	19.5		41.8	49.7	45.3	32.0	36.5
Level of Service (LOS)	B	B		C	C	B		D	D	D	C	D
Approach Delay, s/veh / LOS	15.1	B		26.0	C		46.9	D		42.3	D	
Intersection Delay, s/veh / LOS	25.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.4	B	2.5	B	2.3	B
Bicycle LOS Score / LOS	1.5	B	1.9	B	0.6	A	1.0	A

Attachment 8
Turn Lane Warrant Analysis

Project: Steele Landing Subdivision

Intersection: Hardin Valley Road at Steele Road

Steel Landing Subdivision

Hardin Valley Road VOLUMES
at Steele Road

RIGHT TURN	Thru	RT	RT MAX	Warrant Met
AM	597	6	25	NO
PM	528	14	50	NO

Commercial Development

Hardin Valley Road VOLUMES
at Steele Road

RIGHT TURN	Thru	RT	RT MAX	Warrant Met
AM	597	31	25	YES
PM	528	17	50	NO

TABLE 5B

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

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

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99			PM Peak 14 RT	Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

AM Peak 6 RT

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

TABLE 5B

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

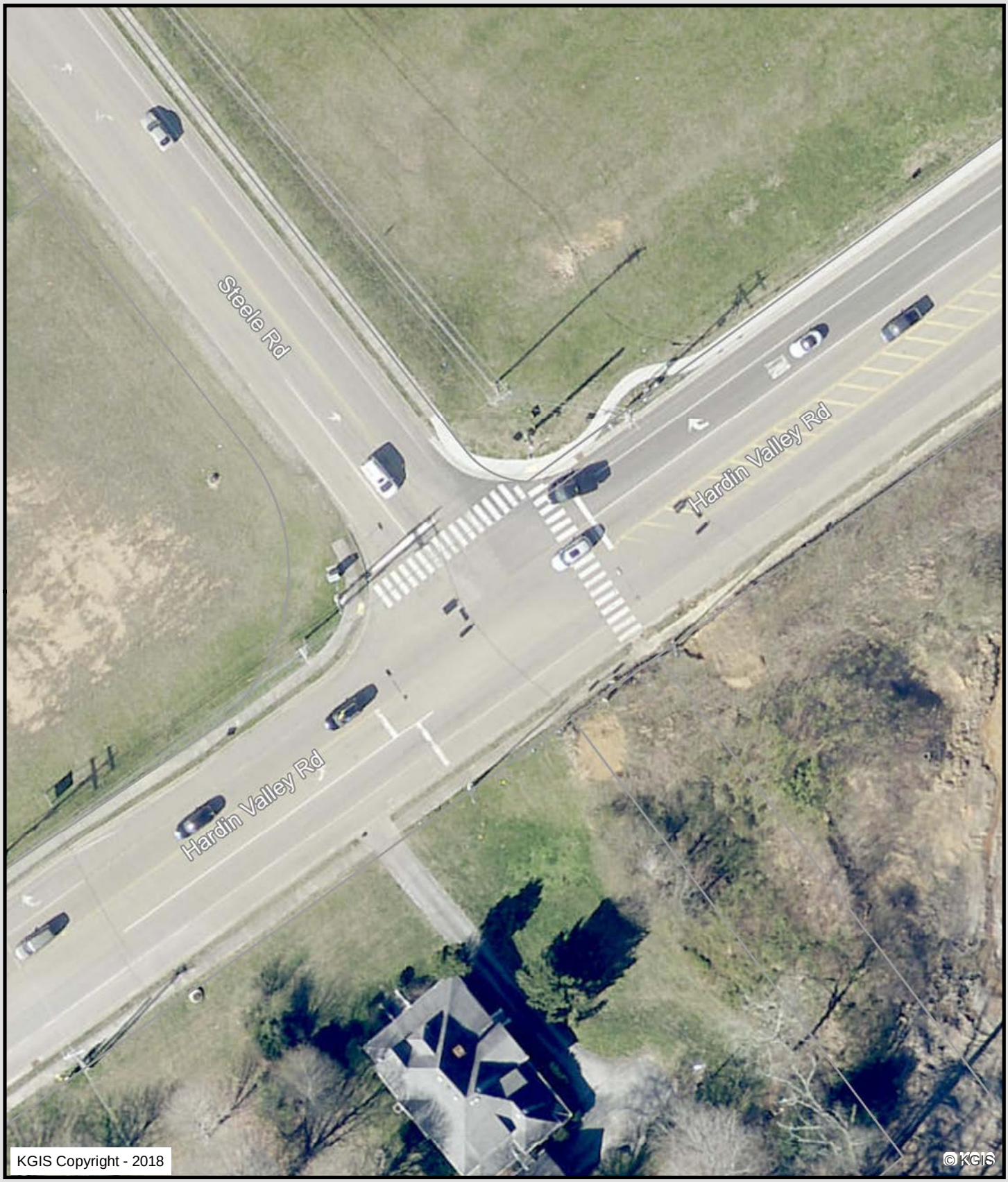
RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	< 100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99						
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399			Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes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

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

PM Peak 17 RT

AM Peak 31 RT

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



Hardin Valley at Steele

Printed: 10/17/2018 at 10:01:59 AM

0 25 50 100

ft

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