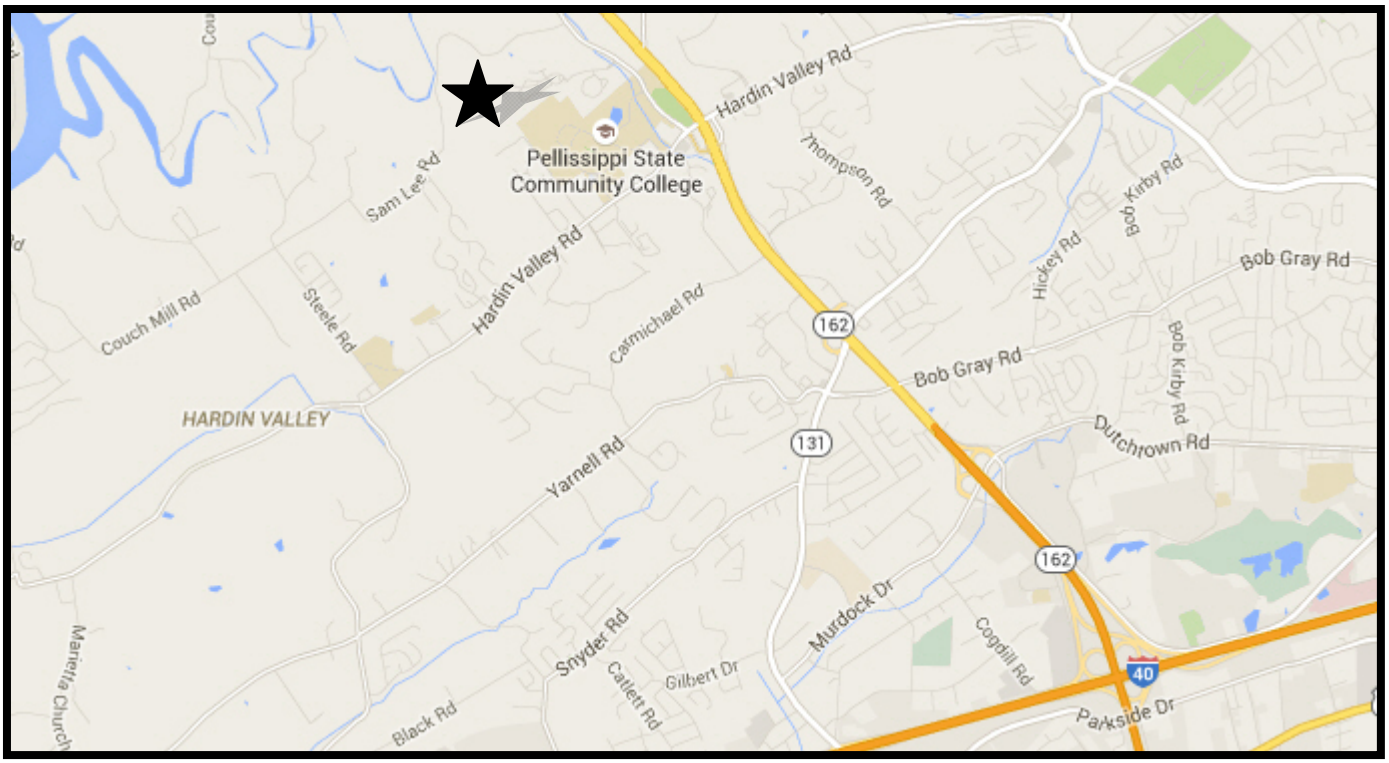

TRAFFIC IMPACT STUDY
SAFE HARBOUR DEVELOPMENT
KNOX COUNTY, TENNESSEE

-Prepared For-

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Revised August 2015

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INTRODUCTION

The purpose of this traffic study is to analyze the traffic impacts of a new proposed residential subdivision in Knox County, Tennessee. At this point in the concept stage, this development is named and identified as Safe Harbour Development. This development is being proposed to the west of Solway Road and adjacent to Sam Lee Road in west Knox County. This traffic impact study follows the procedures and standards as outlined for a Level 1 study developed by the Knoxville/Knox County Metropolitan Planning Commission.

In this traffic impact study the following analyses/methodologies were employed:

- A review of the operating characteristics of the existing roadway system that will provide access to the proposed site.
- The trips that are expected to be generated by the proposed development were determined and applied to the existing road system.
- The impacted road locations were then re-evaluated to determine the potential traffic impacts of the proposed development.
- The projected traffic volumes are also coupled with identifiable recommendations of road or intersection improvements that would mitigate the expected increase in traffic volume.

PROJECT DESCRIPTION

The proposed location of this new development is shown on a map in Figure 1. The development is to be located adjacent to Sam Lee Road beginning approximately 1000 feet to the west of the intersection of Sam Lee Road and Solway Road. Immediate access to the development will be provided solely by Sam Lee Road. In the adjacent vicinity of this study area, there are a couple of other residential subdivisions, apartments, individual residences, and farm properties. The existing site primarily consists of undeveloped woods and pasture land. The proposed subdivision is expected to be comprised of several new internal drives on approximately 109 acres. At this stage of design, it is shown that the subdivision will contain 261 single family residential lots. The property parcel currently resides on both sides of Sam Lee Road with a total acreage of approximately 216 acres, but at this time, only the 109 acres shown on the southern and eastern side of Sam Lee Road is proposed to be developed.

Figure 1

Location Map
Safe Harbour Development

The proposed plan layout given and designed by David Harbin, PE with Batson, Himes, Norvell & Poe is shown in Figures 2a and 2b on two pages. The figures shown for this report are not to scale and show the portions of the northern and southern development respectively. As can be seen in Figures 2a and 2b, there are two proposed entrance roads that will tie into Sam Lee Road. One new entrance will be located on the north and eastern side of the development at Road "B" and Sam Lee Road and another new entrance will be located on the south and western side of the property at Road "K" and Sam Lee Road.

The actual schedule for completion of this new residential development is dependent on economic factors. However, the current market in this area of Knox County is experiencing renewed rapid growth. This project is also contingent on permitting, design, and other issues. However, for the purposes of this study, it was assumed that the total construction build-out of the development will occur by the year 2020.

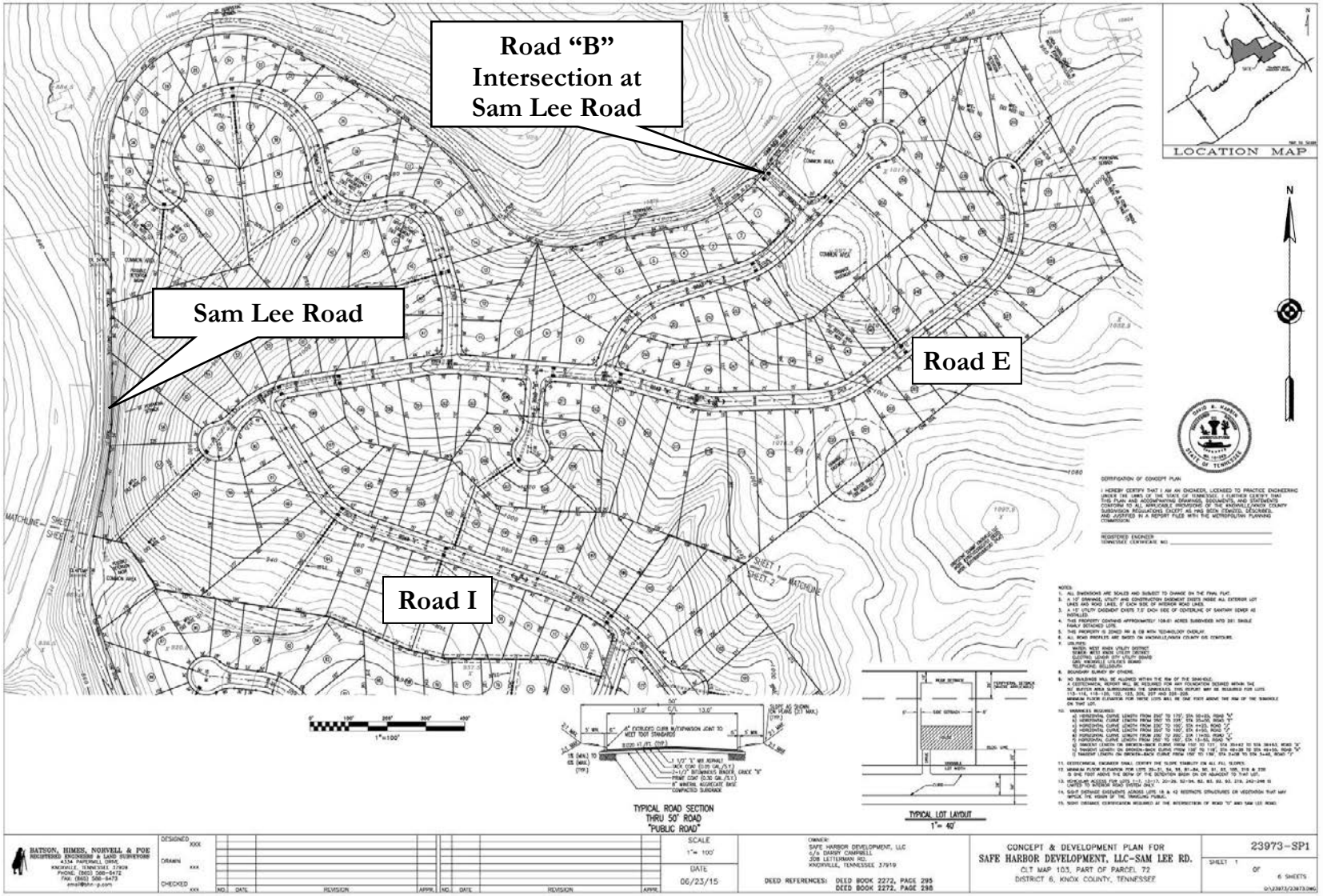


Figure 2a
Proposed Plan Layout
Safe Harbour Development

Figure 2b
Proposed Plan Layout
Safe Harbour Development

EXISTING CONDITIONS

Sam Lee Road is classified as a Major Collector and traverses in a general northeast-southwest direction. Sam Lee Road is a winding circuitous road that has many horizontal and vertical curves. Sam Lee Road currently consists of a 2-lane pavement section approximately 18 feet wide with approximately 9 foot lanes with minimal clearance outside the pavement surface. The roadway speed limit is posted at 30 mph.

Sam Lee Road intersects Solway Road on the northeastern end and at the southwestern end it continues for a short distance past the intersection of Steele Road/Swafford Road. Solway Road and Steele Road will provide the secondary level access for the majority of the generated traffic by the development to surrounding destinations. Both Solway Road and Steele Road run in a northwest/southeast direction and both provide access to Hardin Valley Road to the south. Refer to Figure 3 below for clarification of the current existing road system.

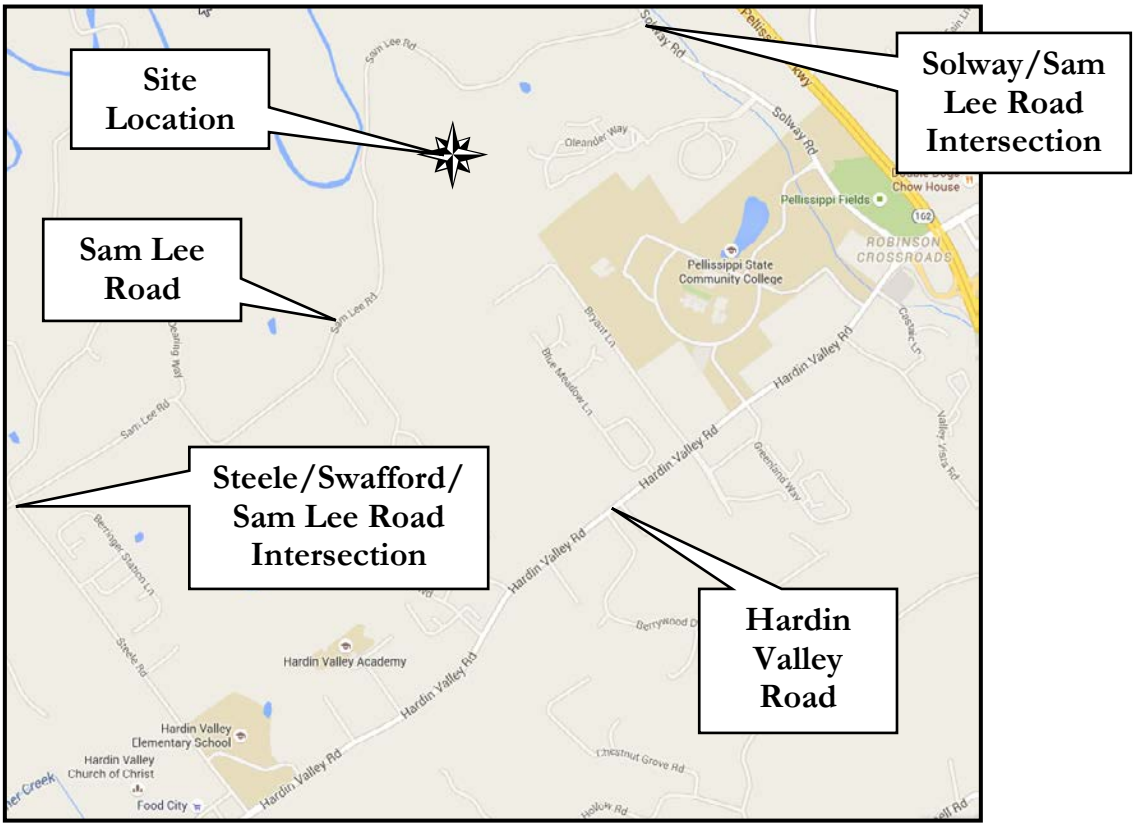
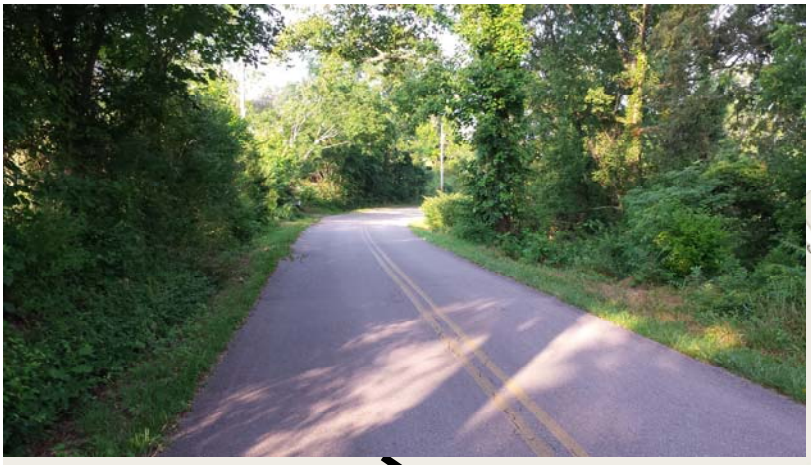


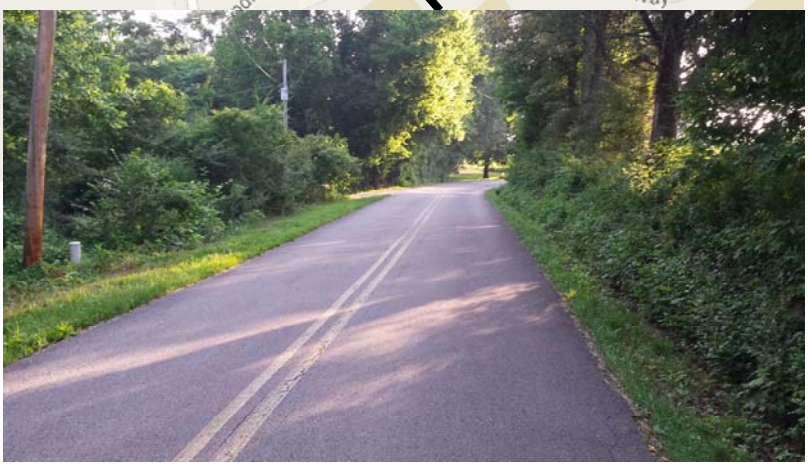
Figure 3
Existing Conditions Map
Safe Harbour Development

The speed limit is posted at 40 mph on Solway Road, 30 mph on Steele Road, and Hardin Valley Road is posted at 40 mph. Average Daily Traffic (ADT) on Sam Lee Road in the vicinity of this development was reported by the Knoxville-Knox County Metropolitan Planning Commission (MPC) at 270 vehicles per day in 2013 (Station #M278). In 2011, the ADT at this station was tabulated at 260 vehicles.

PHOTO REFERENCES



View at Proposed Entrance Road "B" at Sam Lee Road
(Looking West)



View at Proposed Entrance Road "B" at Sam Lee Road
(Looking East)

PHOTO REFERENCES (continued)

View at Proposed Entrance Road "K" at Sam Lee Road
(Looking "East")

View at Proposed Entrance Road "K" at Sam Lee Road
(Looking "West")

EXISTING TRAFFIC VOLUMES

In order to analyze the traffic impacts associated with the proposed future development, traffic counts were obtained along Sam Lee Road near the proposed northern intersection of Road "B". The traffic counts were obtained on Wednesday, June 17th, 2015 during the morning and afternoon peak periods. Very little traffic was observed on Sam Lee Road during these periods. The local schools were not in session when the traffic count was conducted. The AM peak hour was observed at 7:45 - 8:45 and the PM peak hour from 4:45 – 5:45.

Due to the low volumes tabulated during the traffic count and to take into account unobserved school traffic, it was assumed for this study that the Average Daily Traffic (ADT) on Sam Lee Road that was reported by the MPC at 270 vehicles per day in 2013 (Station #M278) would include a better representation of a typical day with school traffic. The following explains how this ADT was converted into peak hour volumes.

The annual rate of traffic growth at Station #M278 is reported at 1.9% per year (see Appendix A). Applying the growth factor of 1.9% to the ADT of 270 from the year 2013 would result in an upward adjusted ADT of 280 for the current year 2015. From the AASHTO Green Book (A Policy on Geometric Design of Highways and Streets), for a typical rural road, the design hourly volume is about 15% of ADT and the maximum hourly volume is about 25% of the ADT. Therefore, given this rural setting for this study, it is estimated that 20% of the ADT would arrive during each peak hour. Using an ADT of 280 for the year 2015 with a 20% factor would result in approximately 56 vehicles in the AM and PM peak hour. During the field traffic counts, it was determined that during the AM peak hour, 25% was headed west and 75% was headed east. During the PM peak hour of traffic, 45% of traffic was headed west and 55% was headed east. These observed directions were applied to the calculated 56 vehicles to determine the existing traffic volumes in the AM and PM peaks. The traffic counts from the field study can be reviewed in Appendix B and the calculated existing peak hour volumes based on ADT and observed directional distribution are shown in Figure 4.

Even though the existing traffic counts that were conducted are not being used to establish the existing volumes on Sam Lee Road, they are being utilized in the study to reflect the future directional distribution of traffic in the AM and PM peak hours as described later in the report.

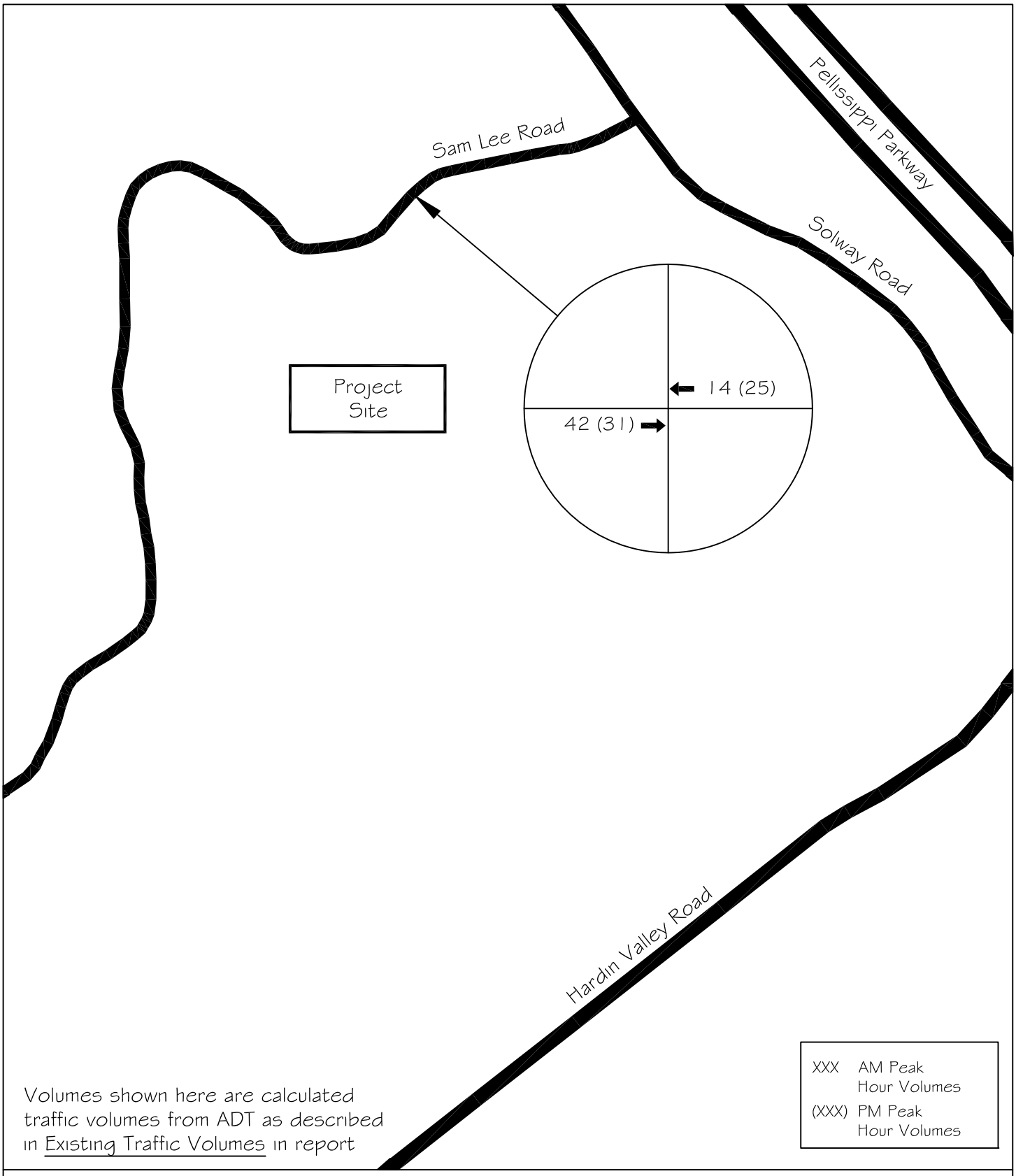


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FIGURE 4

SAFE HARBOUR DEVELOPMENT

2015 Peak Hour Traffic Volumes - EXISTING

BACKGROUND TRAFFIC VOLUMES

Background traffic volumes are estimates of non-site related traffic for a particular horizon or design year. These background traffic volume estimates represent the future base condition for which the proposed study area is subject to even without the project being developed.

As previously stated, the build-out year for the proposed new residential subdivision was assumed to occur in 2020. Background traffic volumes for this project were calculated by applying the 1.9% annual growth rate to the calculated existing traffic volumes shown in Figure 4. This growth rate was obtained by analyzing the existing traffic count in the area provided by the Knoxville/Knox County MPC. This 1.9% growth is used to take into account any future development in the area and rising travel volumes from the current time frame to the year 2020. The results of this growth rate application to the existing traffic volumes can be seen in Figure 5 for the year 2020.

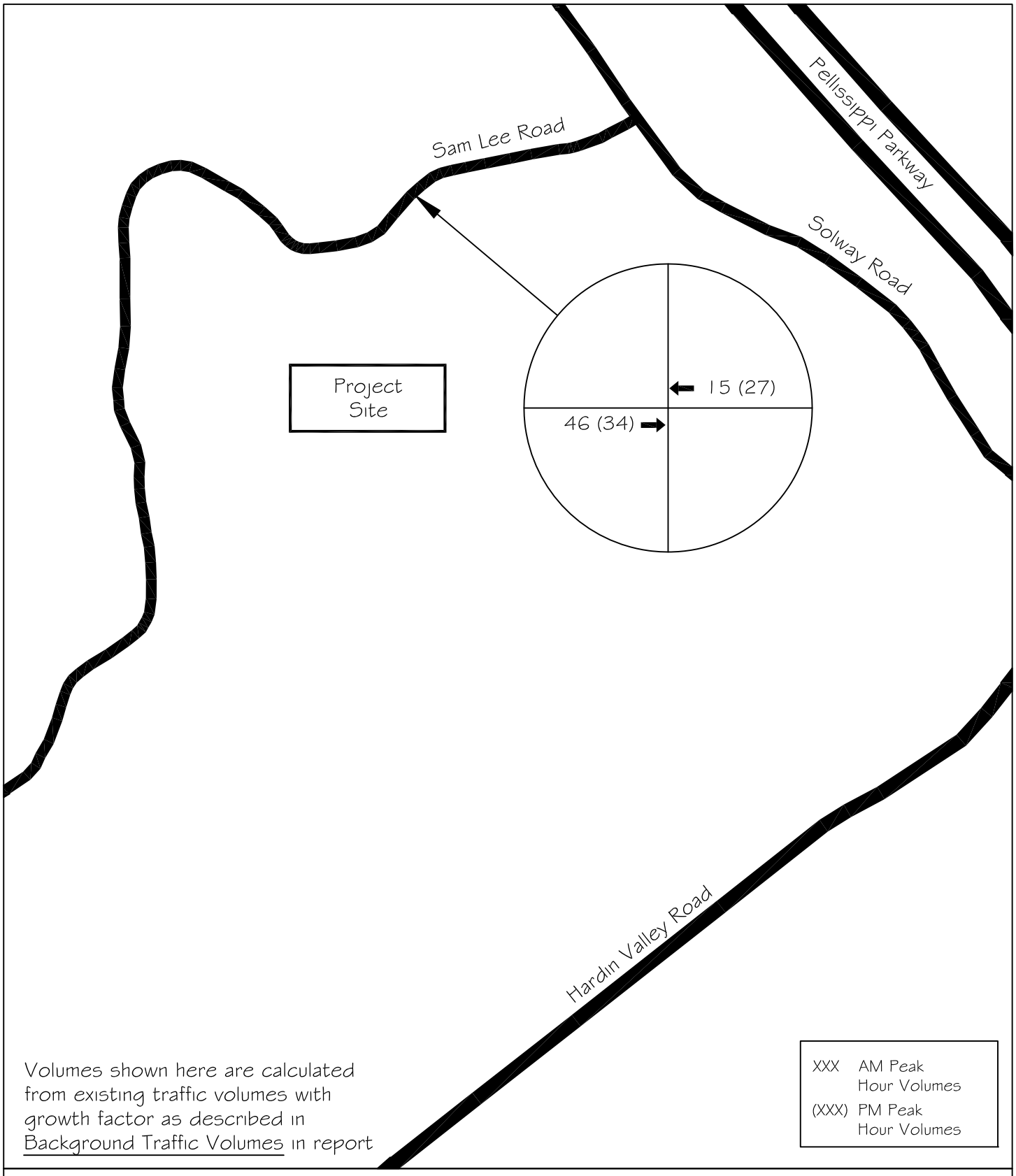

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FIGURE 5

SAFE HARBOUR DEVELOPMENT

2020 Peak Hour Traffic Volumes - BACKGROUND

TRIP GENERATION

The estimated amount of traffic that will be generated by the proposed development was calculated based upon equations for peak hour trips provided by Trip Generation, 7th Edition, a publication of the Institute of Transportation Engineers (ITE). A generated trip is a single or one-direction vehicle movement that is either entering or exiting the study site. This data from ITE is shown in Appendix C. A summary of this information is presented in the following:

- ITE Trip Generation Land Use Code #210 (Single-Family Detached Housing)
- Average Vehicle Trip Ends vs. Dwelling Units

TABLE 1
TRIP GENERATION FOR SAFE HARBOUR DEVELOPMENT

LAND USE	SIZE	AVERAGE DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
			ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
			25%	75%		63%	37%	
Dwelling Units	261 units	2,514	48	145	193	161	94	255
TOTALS			**48**	**145**	**193**	**161**	**94**	**255**

Based on these calculations, it can be expected that 48 vehicles will enter the development during the AM Peak Hour, 145 will exit, for a total of 193 new generated trips during the AM Peak Hour (7:45 AM – 8:45 AM) in the year 2020 at full development.

Similarly, it can be expected that 161 vehicles will enter the development during the PM Peak Hour, 94 will exit, for a total of 255 new generated trips during the PM Peak Hour (4:45 PM – 5:45 PM) at full development. Additionally, the calculated trips generated for an average day can be expected to be approximately 2,514 vehicles for the entire development.

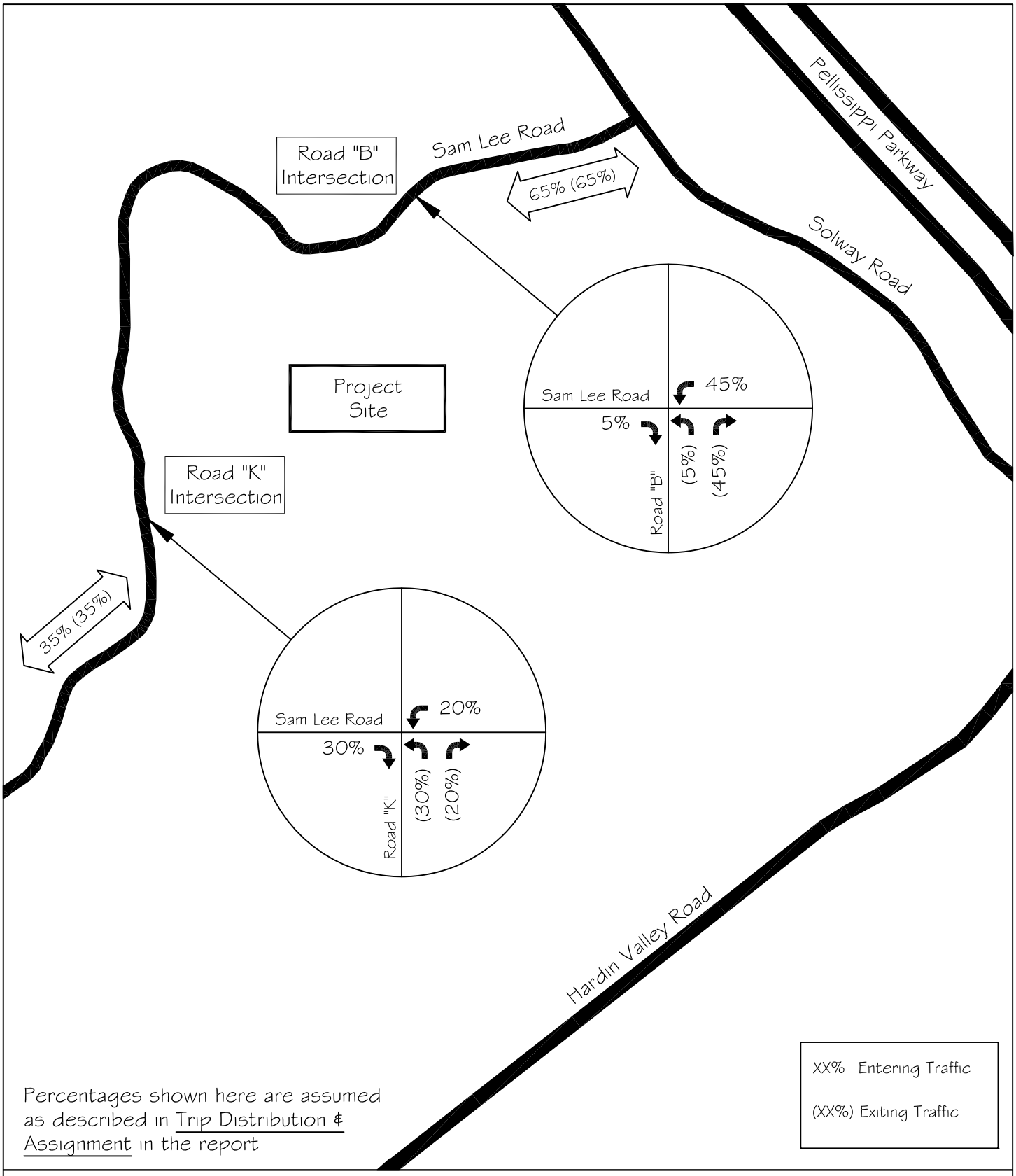
TRIP DISTRIBUTION & ASSIGNMENT

The directional distribution of trips that will be generated by the proposed development were surmised and are shown in Figure 6. Figure 6 shows the projected distribution for traffic entering/exiting the new residential subdivision during the future peak hours at both of the new proposed road entrances/exits on Sam Lee Road. The percentages shown only pertain to the new trips generated by the new residential dwellings in the subdivision.

There are a variety of nearby developments that will potentially "attract" the projected generated traffic to and from the new subdivision, the largest being the Hardin Valley Academy (high school), Hardin Valley Elementary School, Pellissippi State Community College, and the nearby highway, Pellissippi Parkway. In addition, it has been recently reported that an additional school will be built nearby the Hardin Valley Academy for a new middle school by the year 2018. Currently all middle school students in the study area attend Karns Middle School on Oak Ridge Highway which is located several miles away to the north and east of the proposed subdivision. Besides Karns Middle School, all of the other current destinations are located to the south of the proposed neighborhood and are directly off of Hardin Valley Road. Pellissippi Parkway will be the major adjacent access for further destinations in the surrounding Knoxville area.

The projected trip distributions are based on the existing traffic movements at the examined roadway and also surmised from the aforementioned surrounding concentrations of development and population. The traffic distributions shown and portioned at the two proposed intersections on Sam Lee Road were also based on assumed internal travel times, and distances and the layout of the individual lots within the development. Also, since the original traffic count that was used for determining the existing traffic volumes was not conducted when the local schools were open, a greater weight was assigned to westbound traffic for the peak periods than was observed in the actual field counts.

Figure 7 shows the Traffic Assignment of the computed trips that will be generated by the development (as shown in Table 1) that is applied to the various intersection movements based on the assumed distribution of trips shown in Figure 6.



Percentages shown here are assumed as described in Trip Distribution & Assignment in the report

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FIGURE 6

SAFE HARBOUR DEVELOPMENT

Directional Distribution of Generated Traffic

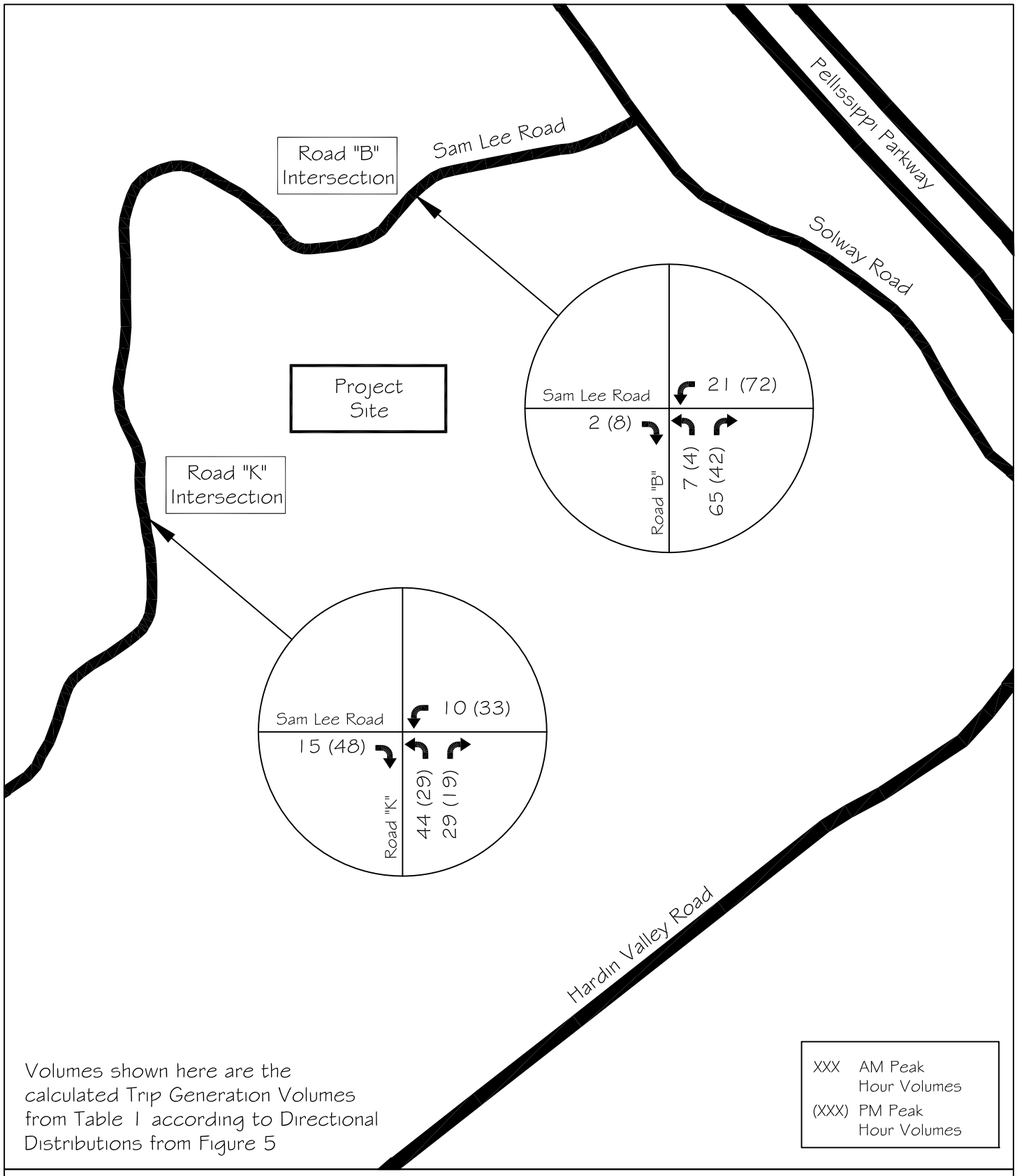

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FIGURE 7

SAFE HARBOUR DEVELOPMENT

Traffic Assignment of Generated Traffic

PROJECTED TRAFFIC VOLUMES

To calculate the total future projected traffic volumes, application of the calculated peak hour traffic (from Table 1) generated by the new proposed Safe Harbour Development were added to the 2020 background traffic volumes (shown in Figure 5) in accordance to the predicted directional distributions and assignments (shown in Figure 6 and 7). This procedure was necessary to obtain the total projected traffic volumes at the time the development is fully operational by the year 2020.

Capacity analyses were undertaken to determine the existing Level of Service (LOS) for the proposed intersections. The capacity analyses were calculated by following the methods outlined in the Highway Capacity Manual and using Synchro Traffic Software (Version 8). Figure 8 shows the projected AM and PM peak hour volumes at the studied intersections for the year 2020. Appendix D includes the worksheets for these capacity analyses.

LOS is an indication of how well an intersection or roadway performs, and LOS designations include LOS A through LOS F. The designation of LOS A signifies a roadway or intersection operating at best, while LOS F signifies road operations at the worst. The Highway Capacity Manual lists level of service criteria for unsignalized intersections and is presented in this report as Table 2. For unsignalized intersections, Level of Service is measured in terms of delay (in seconds). This measure is an attempt to quantify delay that includes lost travel time, driver discomfort, and fuel consumption. Level of Service for unsignalized intersections are only calculated for turning movements associated with stop or yield control and also for left turns on "un-controlled" major streets. Generally, for most instances, LOS D is considered the lowest limit of acceptable delay.

(Source: FDOT)

TABLE 2

LEVEL OF SERVICE AND DELAY FOR UNSIGNALIZED INTERSECTIONS

LEVEL OF SERVICE	DESCRIPTION	DELAY RANGE (sec/veh)
A	Little or no delay	≤ 10
B	Short Traffic Delays	>10 and ≤15
C	Average Traffic Delays	>15 and ≤25
D	Long Traffic Delays	>25 and ≤35
E	Very Long Traffic Delays	>35 and ≤50
F	Extreme Traffic Delays	>50

Source: Highway Capacity Manual

The results of the capacity calculations of the projected peak hour traffic can be seen in Table 3 for the intersections. The intersections are shown with a LOS designation for the AM and PM peak hours in the table and delay (in seconds). For the proposed new intersections on Sam Lee Road, the peak hour levels of service are shown to operate at very good levels during both the AM and PM peak hours. Note: For both intersections, the exiting approaches are labeled as northbound and the left turns into the development are labeled as westbound.

TABLE 3
2020 PEAK HOUR LEVEL OF SERVICE & DELAY - PROJECTED

INTERSECTION	TRAFFIC CONTROL	TURNING MOVEMENT	LEVEL OF SERVICE		DELAY (sec)	
			AM PEAK	PM PEAK	AM PEAK	PM PEAK
Sam Lee Road and Road "B"	Unsignalized 	Westbound Left/Thru	A	A	3.4	4.2
		Northbound Left/Right	A	A	9.1	8.9
		Northbound Approach	A	A	-	-
Sam Lee Road and Road "K"	Unsignalized 	Westbound Left/Thru	A	A	2.3	3.9
		Northbound Left/Right	A	A	9.2	9.5
		Northbound Approach	A	A	-	-

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology

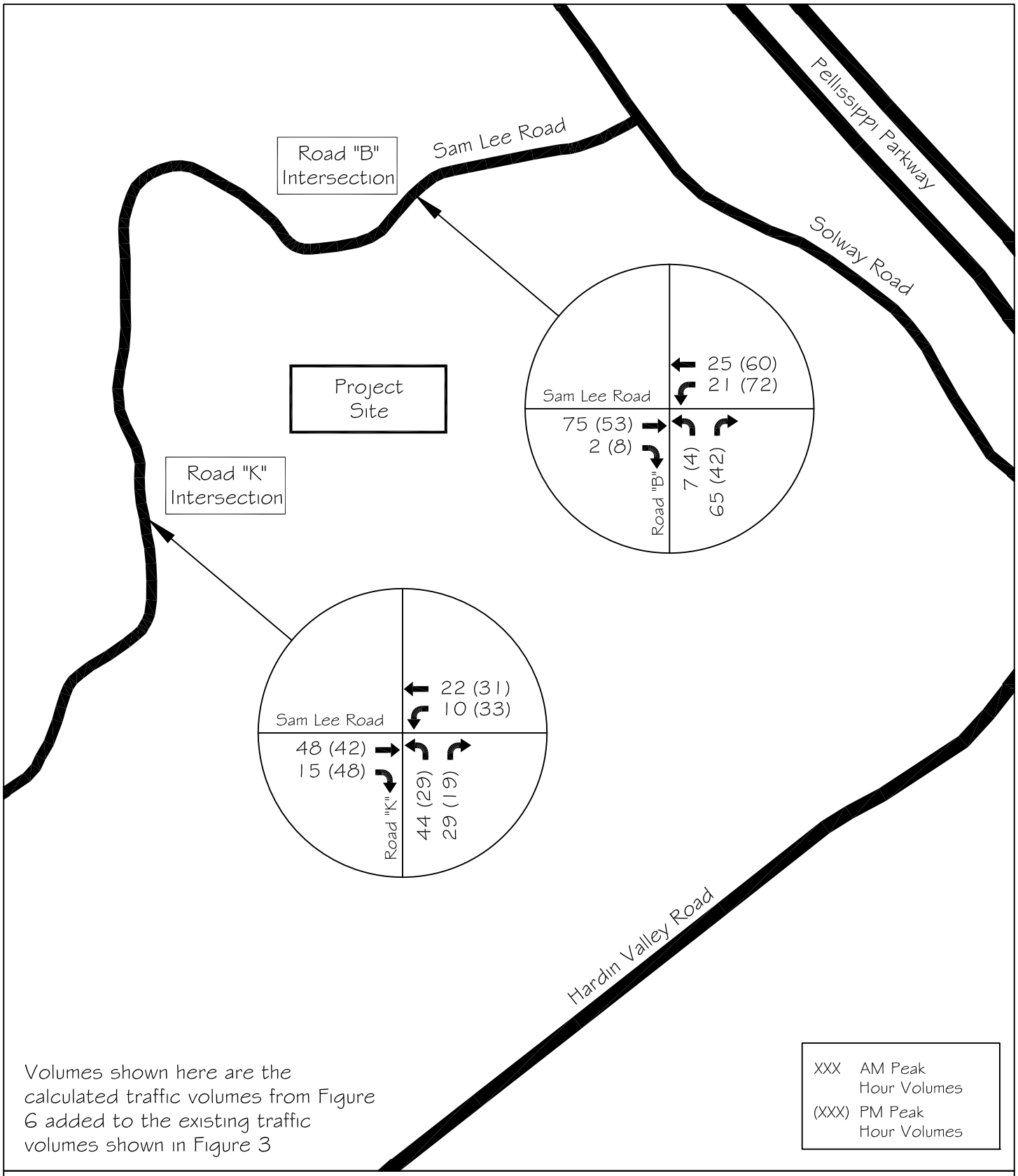

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FIGURE 8

SAFE HARBOUR DEVELOPMENT

2020 Peak Hour Traffic Volumes - PROJECTED

EVALUATION OF TURN LANE THRESHOLDS

The proposed two new intersections located on Sam Lee Road were evaluated for the need for separate left turn and right turn lanes on Sam Lee Road based on the projected traffic volumes. It was determined that the intersections do not warrant separate left turn lanes or right turn lanes on Sam Lee Road for turning traffic due to the very low turning and opposing volumes. Refer to Appendix E for the Knox County Left-Turn Lane Volume Threshold worksheet that relates prevailing speeds of 35 mph or less with the need for left turn lanes.

CONCLUSIONS AND RECOMMENDATIONS

The analyses presented in this study of the proposed new Safe Harbour Development indicate that the calculated traffic generated by this development in tandem with projected future traffic volumes should operate very well at the two new intersections on Sam Lee Road. The following is an overview of recommendations to minimize the traffic impacts of the development with the surrounding road system while achieving an acceptable level of traffic flow, safety, and cost.

1) **Sam Lee Road at Road "B" and Road "K"**: From the capacity calculations, it has been shown (Table 3) that northbound left and right turns out of the development and westbound left turns into the development would operate at LOS A during the AM and PM peak hours once the development becomes fully developed.

   1a) **From the calculations, it does not appear that separate northbound left and right turn lanes are required at the new intersections for exiting vehicles out of the subdivision.** The delays associated with these movements are projected to be minimal to nonexistent.

   1b) **It is recommended that a large curb radius (at Knox County's Engineering Department discretion) be designed and constructed that would facilitate right turns off of and on to Sam Lee Road.** This would allow school busses the opportunity to turn freely without overlapping into opposite traffic lanes.

2) **Safe Harbour Development Internal Drives and Sight Distance**: The current layout plans show 11 new roadways being constructed within the development labeled "Road A" thru "Road M" as shown in Figures 2a and 2b (Road "F" and "G" are not used). "Road B" and "Road K" will be the connecting roads to Sam Lee Road.

2a) **Both of the new proposed entrances at Road "B" and Road "K" must be constructed with a Stop Sign (R1-1) for the northbound approaches at Sam Lee Road. Also, all of the new minor internal roadway "T" intersection approach legs at Roads "A", "E", "I", "K" should be constructed with a Stop Sign (R1-1). Due to the proposed internal road alignments, it is not expected that there should be excessive speeds or cut-thru traffic within the development.**

2b) **Sight distance at the new proposed entrances at Road "B" and Road "K" and at all of the new internal "T" and four-way intersections must not be impacted by new signage, future landscaping or existing vegetation.** Based on a posted speed limit of 30 mph on Sam Lee Road, the recommended stopping sight distance is approximately 200 feet for level conditions and the intersection sight distance requirement is 335 feet. For an assumed posted 25 mph speed for the internal development streets, the recommended stopping sight distance is approximately 155 feet for level conditions and the intersection sight distance requirement is 275 feet. The road layout designer should insure that these sight distance lengths are met, maximized, and they should be labeled on the plans. A cursory examination of the sight distances on Sam Lee Road was performed by the design engineer's survey crew. According to the design engineer, for the proposed entrances on Sam Lee Road, the measured sight distance is approximately 300 feet looking to the east and to the west based on the survey results. Also, according to the design engineer, the required distance should be fully attainable once vegetation during construction is removed. These sight measurements should be verified during construction and after clearing of vegetation and any future growth should be maintained permanently.

Road "B" and Road "K" have been designed on the concept plan intersecting Sam Lee Road at what appears to be advantageous locations where horizontal and

vertical road elements are maximized for sight distance. However, the designer should insure these intersections are given the maximum amount of sight distance to provide clear unobstructed views. Clearing lines on the adjacent corners of the intersections should be shown on the plan in order to provide the necessary sight distance. The overall required sight distance should be measured at the intersections at a minimum of 14.5 feet off of the edge of the traveled way as shown in TDOT Standard Drawing RD01-SD-1.

2c) **All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County Engineering specifications and guidelines to insure proper operation.**

APPENDIX A

HISTORICAL TRAFFIC COUNT DATA

Historical Traffic Counts

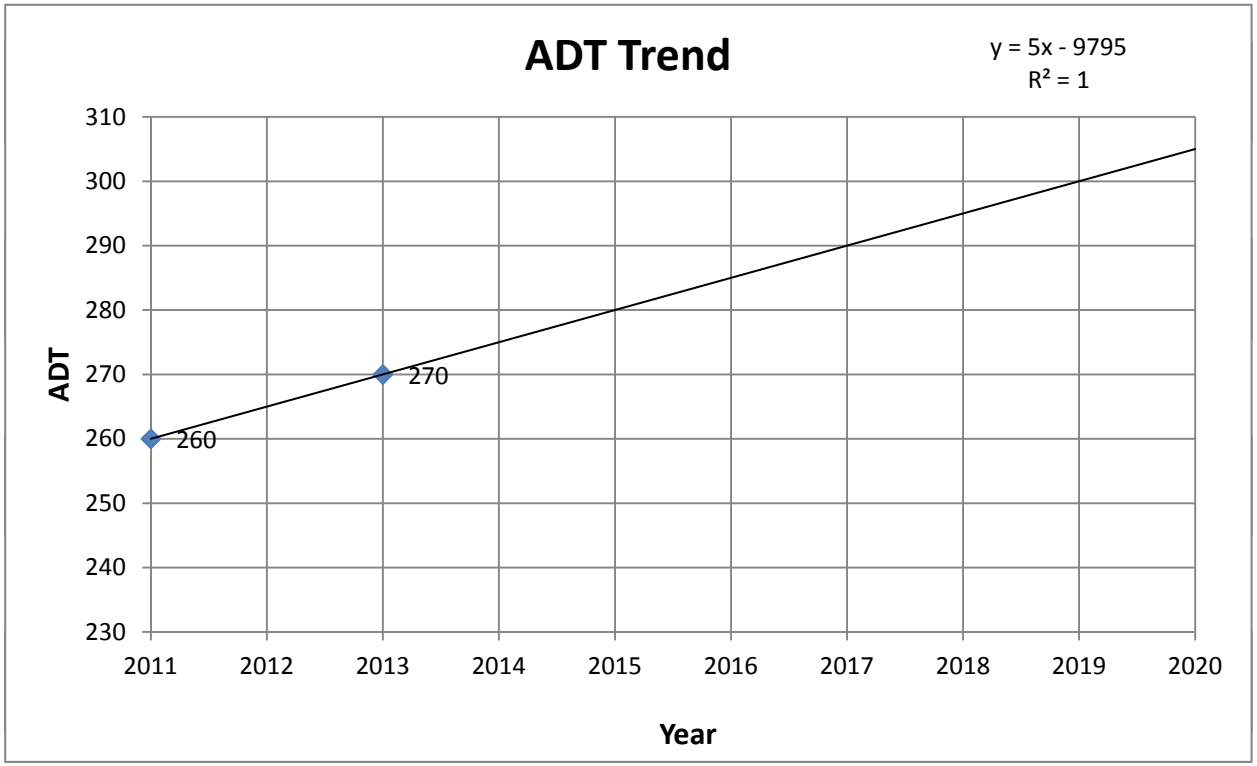
Organization: MPC

Station ID #: M278

Location: Sam Lee Road

YEAR	ADT
2011	260
2013	270
2014	*275*
2015	*280*
2016	*285*
2017	*290*
2018	*295*
2019	*300*
2020	*305*

Trendline



Recent Trend Line Growth

2011	*260*
2013	*270*

Annual % Growth = 1.9%

STATION	STREET	LOCATION	2010	2011	2012	2013
M278	Sam Lee Rd	W of Solway Rd		260		270
M338	Sanders Rd	S of Bob Gray Rd	910		980	
T509	Sanderson Rd	S of Western Ave	4376	4458	4659	4815
M94	Schaad Rd	W of Clinton Hwy	14780	15570	14370	17380
T076	Schaad Rd	NE of Hilda Ln	14575	14232	16296	15224
M339	Schaeffer Rd	S of Hardin Valley Rd	3270		2000	
T310	Sevier Ave	W of Jones Rd	5002	4824	4969	4425
T426	Sevier Ave	E of Gay St	2416	2479	2119	2272
M250	Sevierville Pk	N of Gov John Sevier Hwy				
M251	Sevierville Pk	S of Gov John Sevier Hwy				
M252	Sevierville Pk	N of Chapman Hwy				
T504	Sevierville Pk	Between June St & Redbud Dr	2446	1988	2408	2504
T510	Sherrill Blvd	W of Cedar Bluff Rd	4815	4884	4538	4326
M83	Sherrill Ln	600' E of Hospital Exit	4880			
M234	Shipe Rd	N of Rutledge Pk	680		550	
M235	Shipe Rd	N of Millertown Pk	510		500	
M75	Smith Rd	100' N of Kingston Pk	7980	6790	9450	8230
M76	Smith Rd	200' E of Andover Pl	4440			
T479	Smith Rd	W of Grigsby Chapel Rd	5042	4419	4509	4121
M274	Snyder Dr	W of Lovell Rd		2690		3290
M341	Snyder School Rd	S of Yarnell Dr	360		240	
M22	Solway Rd	N of Hardin Valley Rd	6130	4580	6220	6380
M281	Solway Rd	W of Pellissippi Pkwy		1370		1670
T483	South Haven Ave	S of Island Home Ave	1374	1310	1384	1527
T360	South Knoxville Blvd	N of Sevier Ave	15846	16486	16816	17220
T327	Spence Pl	Island Home Airport	183	150	272	280
T452	SR 61	S of Union County Line	2311	2220	2281	2039
T453	SR 61	W of Grainger County line	2141	1894	2150	1906
T400	Stadium Dr	S of Cumberland Ave	3498	4006	3852	3405
M277	Steele Rd	N of Hardin Valley Rd		2370		2570
M256	Stock Creek Rd	E of Martin Mill Pk				
C327	Strawberry Plains Pk	N of I-40E Ex			18170	
M241	Strawberry Plains Pk	S of Randles Rd	1990		1950	
T059	Strawberry Plains Pk	E of Molly Bright Rd	6238	5934	6399	6094
T067	Strawberry Plains Pk	E of Moshina Rd	7776	8422	7515	7084
T373	Summit Hill Dr	E of Mulvaney St	9796	10112	10415	10257
T392	Summit Hill Dr	W of Walnut St	19063	18544	12405	14015
C083	Sutherland Ave	W of Harry St		12510		12640
T318	Sutherland Ave	E of Concord St	8945	9801	9833	9270
M355	Swafford Rd	N of Sam Lee Rd	350		480	

APPENDIX B

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: Sam Lee Road 6/17/2015
Minor Street: n/a Sunny/Hot

Primary Movement: Vehicles

TIME BEGIN	WESTBOUND THRU	EASTBOUND THRU	VEHICLE TOTAL	PEAK HOUR
7:00 AM	2	2	4	
7:15 AM	0	0	0	
7:30 AM	0	0	0	
7:45 AM	1	2	3	**7:45 AM - 8:45 AM**
8:00 AM	2	3	5	
8:15 AM	0	1	1	
8:30 AM	0	2	2	
8:45 AM	0	2	2	
TOTAL	**5**	**12**	**17**	
3:00 PM	1	2	3	
3:15 PM	2	3	5	
3:30 PM	1	1	2	
3:45 PM	2	0	2	
4:00 PM	3	1	4	
4:15 PM	5	1	6	
4:30 PM	5	0	5	
4:45 PM	4	2	6	**4:45 PM - 5:45 PM**
5:00 PM	7	3	10	
5:15 PM	3	8	11	
5:30 PM	1	5	6	
5:45 PM	3	2	5	
TOTAL	**37**	**28**	**65**	

APPENDIX C

ITE TRIP GENERATION RATES

Single-Family Detached Housing
(210)

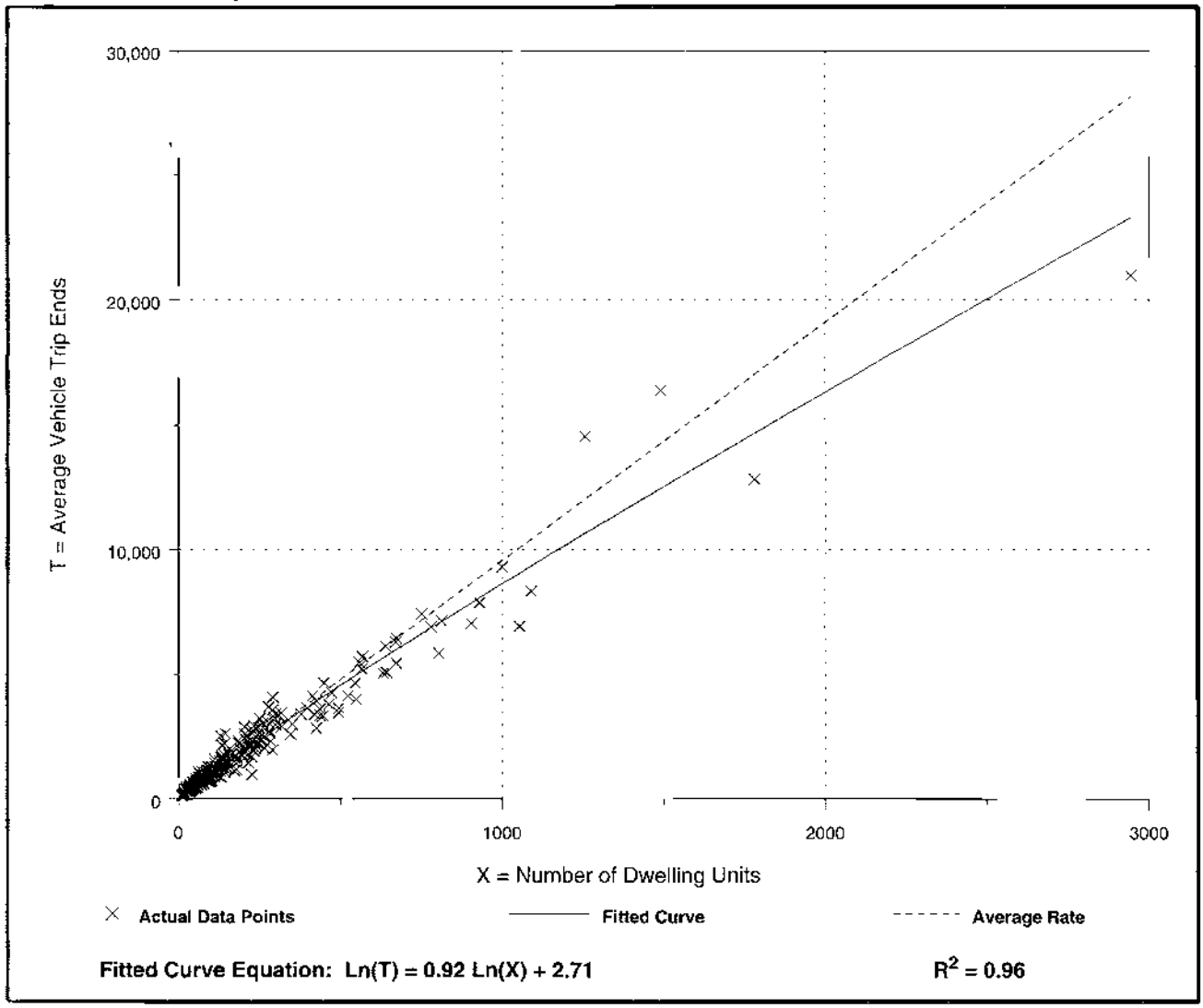
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 350
Avg. Number of Dwelling Units: 197
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.57	4.31 - 21.85	3.69

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.71

R^2 = 0.96

Single-Family Detached Housing
(210)

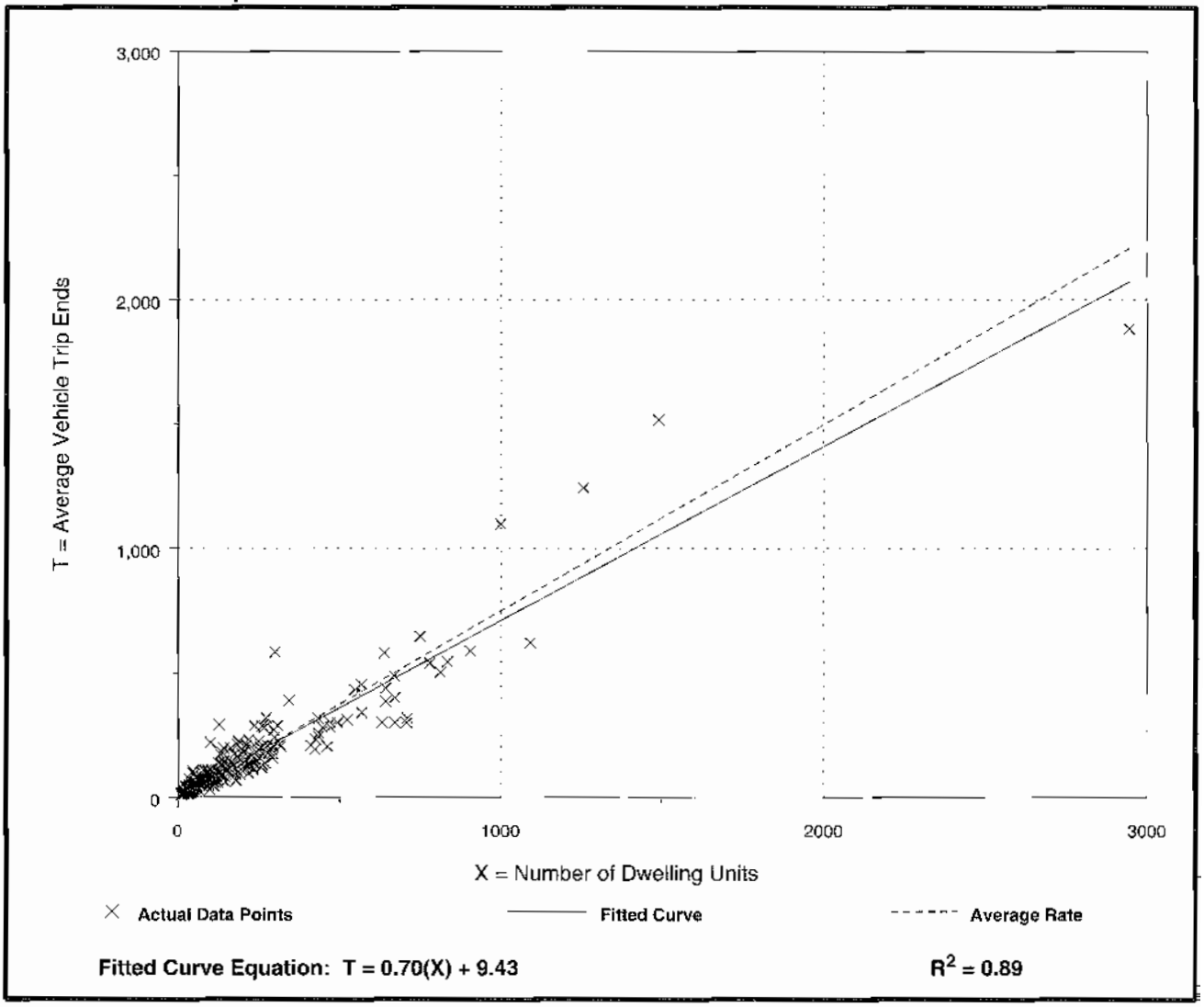
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 274
Avg. Number of Dwelling Units: 201
Directional Distribution: 25% entering, 75% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.75	0.33 - 2.27	0.90

Data Plot and Equation



Fitted Curve Equation: T = 0.70(X) + 9.43

R^2 = 0.89

Single-Family Detached Housing
(210)

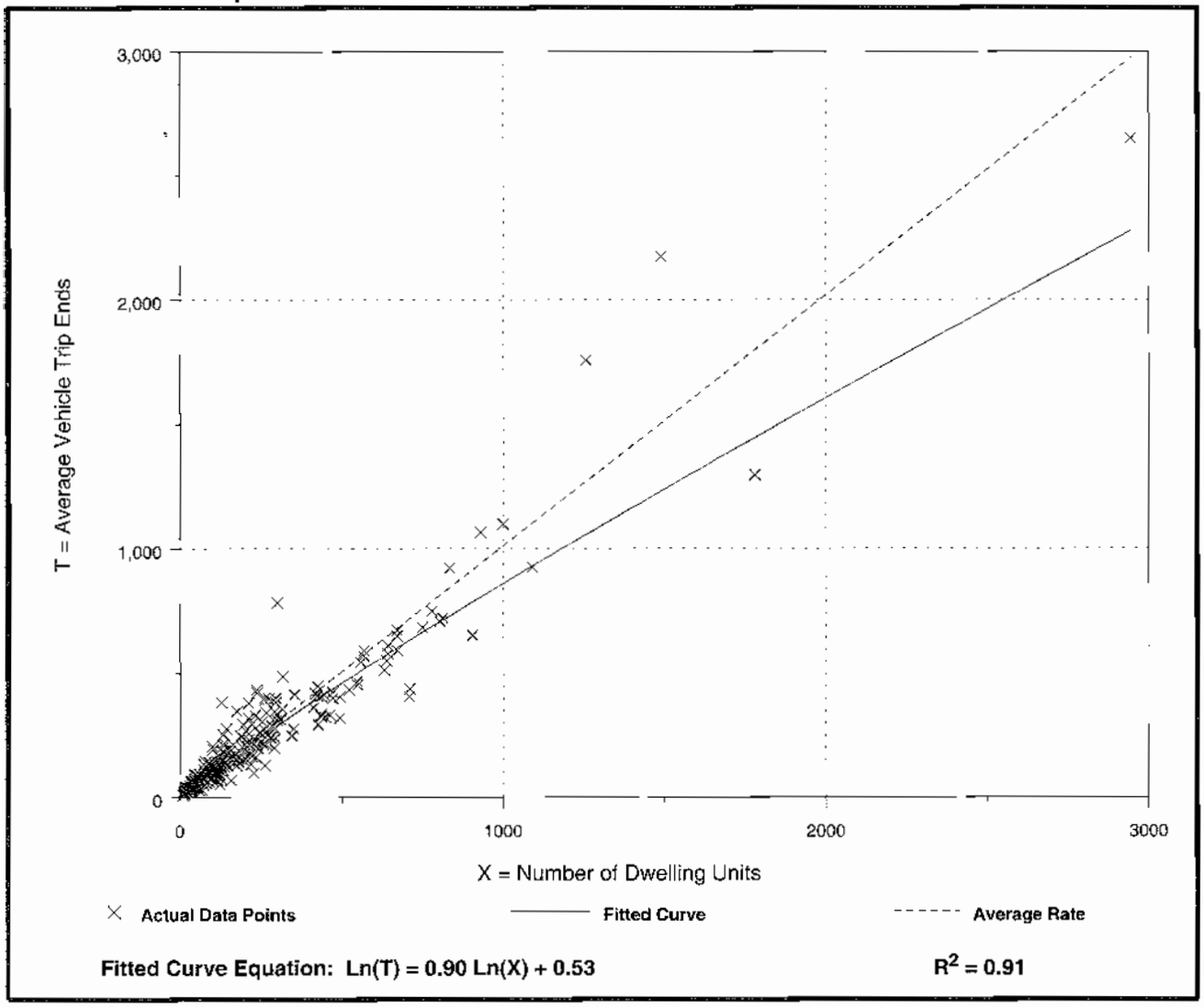
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 302
Avg. Number of Dwelling Units: 214
Directional Distribution: 63% entering, 37% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
1.01	0.42 - 2.98	1.05

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.90 Ln(X) + 0.53

R^2 = 0.91

APPENDIX D

CAPACITY ANALYSES -
HCM WORKSHEETS
(SYNCHRO 8)

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	75	2	21	25	7	65
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	83	2	23	28	8	72
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			86		159	84
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			86		159	84
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		99	93
cM capacity (veh/h)			1524		824	980

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	86	51	80
Volume Left	0	23	8
Volume Right	2	0	72
cSH	1700	1524	962
Volume to Capacity	0.05	0.02	0.08
Queue Length 95th (ft)	0	1	7
Control Delay (s)	0.0	3.4	9.1
Lane LOS		A	A
Approach Delay (s)	0.0	3.4	9.1
Approach LOS			A

Intersection Summary			
Average Delay		4.2	
Intersection Capacity Utilization		20.2%	ICU Level of Service A
Analysis Period (min)		15	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	53	8	72	60	4	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	59	9	80	67	4	47
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			68		290	63
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			68		290	63
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		99	95
cM capacity (veh/h)			1546		668	1007

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	68	147	51
Volume Left	0	80	4
Volume Right	9	0	47
cSH	1700	1546	964
Volume to Capacity	0.04	0.05	0.05
Queue Length 95th (ft)	0	4	4
Control Delay (s)	0.0	4.2	8.9
Lane LOS		A	A
Approach Delay (s)	0.0	4.2	8.9
Approach LOS			A

Intersection Summary			
Average Delay		4.1	
Intersection Capacity Utilization		23.8%	ICU Level of Service A
Analysis Period (min)		15	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	48	15	10	22	44	29
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	53	17	11	24	49	32
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			70		108	62
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			70		108	62
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		94	97
cM capacity (veh/h)			1544		887	1009

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	70	36	81
Volume Left	0	11	49
Volume Right	17	0	32
cSH	1700	1544	932
Volume to Capacity	0.04	0.01	0.09
Queue Length 95th (ft)	0	1	7
Control Delay (s)	0.0	2.3	9.2
Lane LOS		A	A
Approach Delay (s)	0.0	2.3	9.2
Approach LOS			A

Intersection Summary			
Average Delay		4.5	
Intersection Capacity Utilization		19.3%	ICU Level of Service A
Analysis Period (min)		15	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	42	48	33	31	29	19
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	47	53	37	34	32	21
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			100		181	73
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			100		181	73
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		96	98
cM capacity (veh/h)			1505		793	994

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	100	71	53
Volume Left	0	37	32
Volume Right	53	0	21
cSH	1700	1505	862
Volume to Capacity	0.06	0.02	0.06
Queue Length 95th (ft)	0	2	5
Control Delay (s)	0.0	3.9	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	3.9	9.5
Approach LOS			A

Intersection Summary			
Average Delay		3.5	
Intersection Capacity Utilization		20.1%	ICU Level of Service A
Analysis Period (min)		15	

APPENDIX E

KNOX COUNTY LEFT-TURN LANE VOLUME THRESHOLD WORKSHEET

TABLE 4A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

(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	300	235	185	145	120	100
150 - 199	245	200	160	130	110	90
200 - 249	205	170	140	115	100	80
250 - 299	175	150	125	105	90	70
300 - 349	155	135	110	95	80	65
350 - 399	135	120	100	85	70	60
400 - 449	120	105	90	75	65	55
450 - 499	105	90	80	70	60	50
500 - 549	95	80	70	65	55	50
550 - 599	85	70	65	60	50	45
600 - 649	75	65	60	55	45	40
650 - 699	70	60	55	50	40	35
700 - 749	65	55	50	45	35	30
750 or More	60	50	45	40	35	30

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	100	80	70	60	55	50
150 - 199	90	75	65	55	50	45
200 - 249	80	72	460	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

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

TABLE 4B
RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

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
300 - 349					Yes	Yes
350 - 399				Yes	Yes	Yes
400 - 449			Yes	Yes	Yes	Yes
450 - 499			Yes	Yes	Yes	Yes
500 - 549		Yes	Yes	Yes	Yes	Yes
550 - 599		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						Yes
50 - 99					Yes	Yes
100 - 149				Yes	Yes	Yes
150 - 199			Yes	Yes	Yes	Yes
200 - 249		Yes	Yes	Yes	Yes	Yes
250 - 299	Yes	Yes	Yes	Yes	Yes	Yes
300 - 349	Yes	Yes	Yes	Yes	Yes	Yes
350 - 399	Yes	Yes	Yes	Yes	Yes	Yes
400 - 449	Yes	Yes	Yes	Yes	Yes	Yes
450 - 499	Yes	Yes	Yes	Yes	Yes	Yes
500 - 549	Yes	Yes	Yes	Yes	Yes	Yes
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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