HARDIN VALLEY
ACE TRU VALUE HARDWARE
Knox County

TRAFFIC IMPACT STUDY

Prepared for :
GBS ENGINEERING

CDM Smith

November 2017
Revised January 2018

HARDIN VALLEY
ACE HARDWARE
Knox County, Tennessee

TRAFFIC IMPACT STUDY

Prepared for

GBS Engineering
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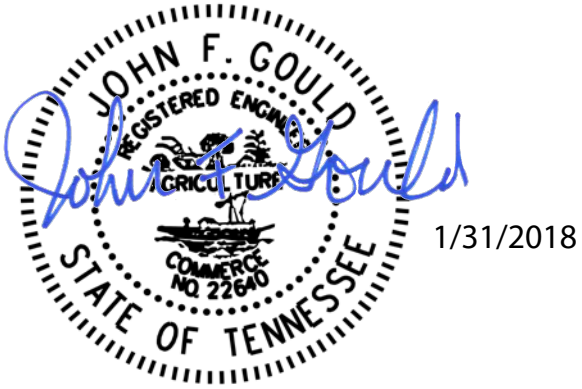
Knoxville TN 37909



1/31/2018

November 2017
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Project No. 224163

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This study was commissioned to address the impact and access of a commercial development in Knox County, Tennessee. The study required the collection of traffic data, generation of anticipated traffic volumes from the proposed site and development of projected traffic volumes from normal growth and from the development site. Analyses of the existing and projected future traffic were conducted to determine the capacity and levels of service for the proposed site access. This study will develop measures necessary to mitigate traffic impacts including improved roadway geometrics and traffic control devices within the environs of the proposed development. The study will address the Knoxville/Knox County MPC requirements for a Level 1 traffic impact assessment, addressing the proposed development access with the adjacent Hardin Valley Road.

Proposed Site Uses

The proposed development is on approximately 2.8 acres. Current zoning of the study property is commercial (PC). The proposed site is for a 17,000 square-foot hardware store. **Figure 1** illustrates the concept site plan for the development. Access will be a driveway opposite the intersection of Windflower Way and a restricted right-turn access to the east. The proposed full access will align with the existing median opening at Windflower Way which has a left-turn lane to access the site from Hardin Valley Road. This development will also share the median access with an adjacent Hardin Valley Animal Hospital.

Site Location

The location of the site is in Knox County, north of Hardin Valley Road at the intersection of Windflower Way. The site is east of the Hardin Valley Road interchange with Pellissippi Parkway (I-140) The site is located northwest of the Knoxville central business district (CBD). **Figure 2** is a vicinity map illustrating the site relative to local and regional access.

SITE PLAN

Hardin Valley ACE Hardware

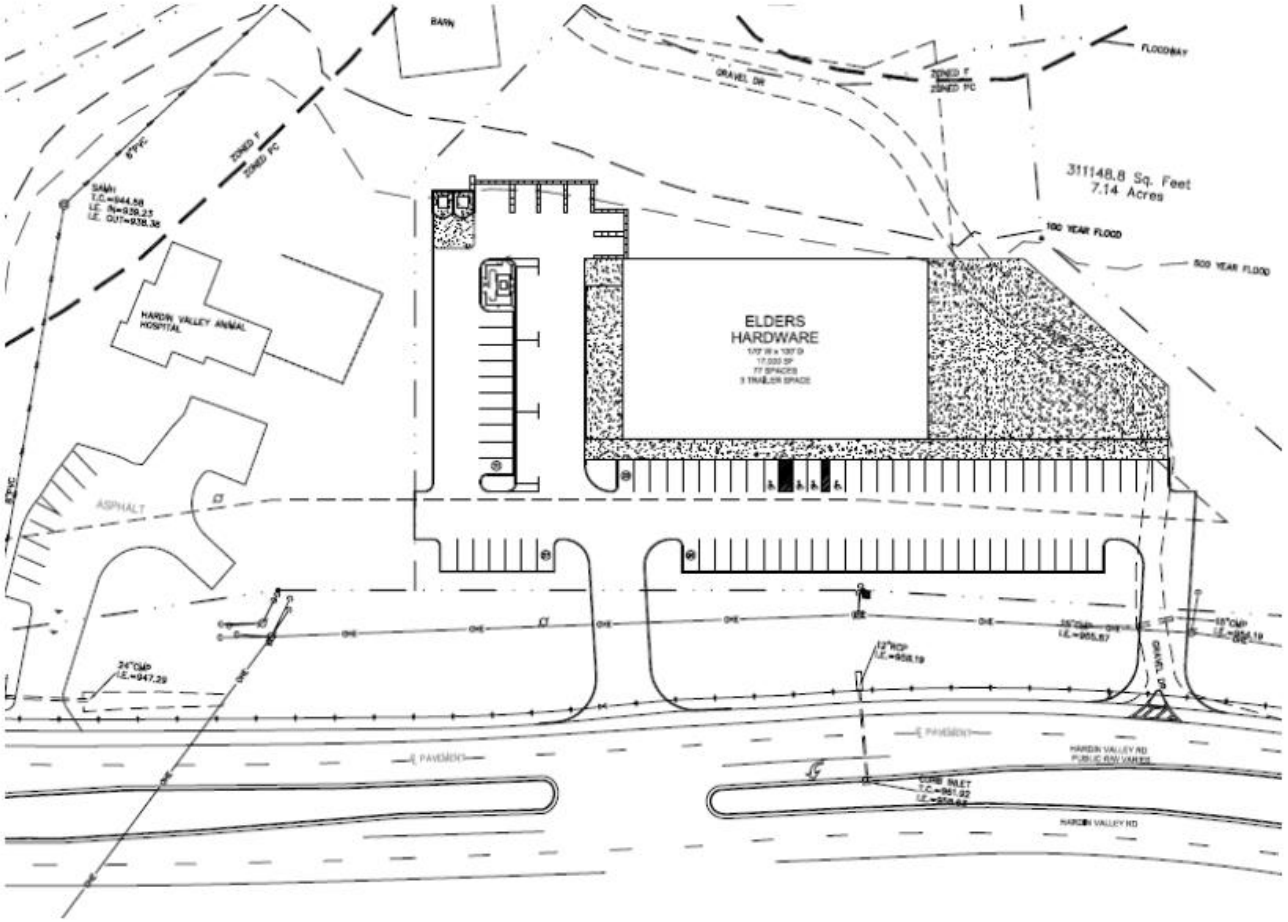

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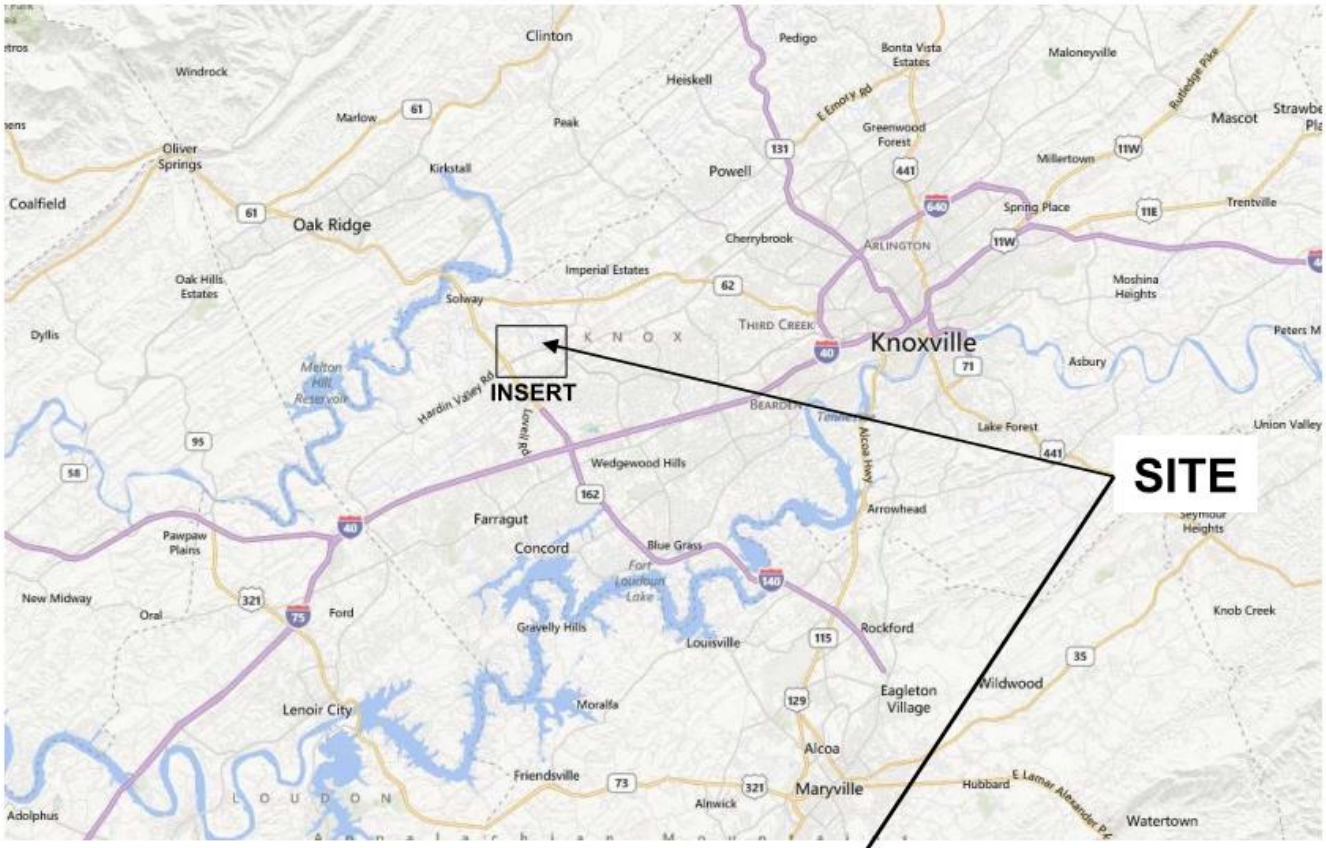
Figure 1

VICINITY MAP

Hardin Valley ACE Hardware



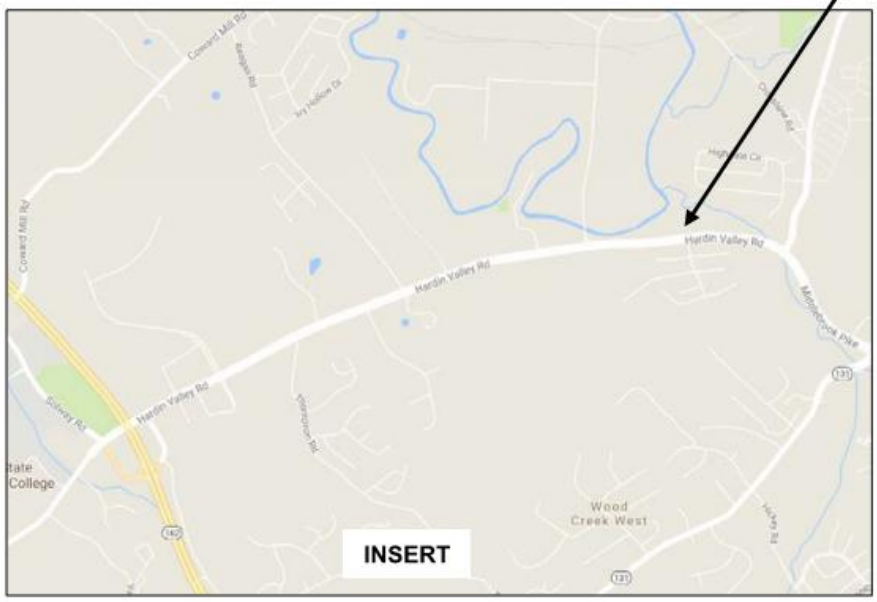


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Figure 2

LOCAL AND REGIONAL ACCESS

The proposed development will add trips to both the local and regional facilities. Intersections between these facilities will be evaluated to determine the development's impact on them. A brief description of these facilities is provided in this section.

Local Access

Access to the site will be from driveway intersections with Hardin Valley Road. The 2016 average daily traffic (ADT) on Hardin Valley Road is approximately 22,520 east of Pellissippi Parkway. Hardin Valley Road is an east-west 4-lane divided arterial highway extending from Middlebrook Pike to the east at Ball Camp Byington Road and Lovell Road (S.R. 131) and to Hickory Creek Road to the west. Hardin Valley Road intersects Pellissippi Parkway to the west of the site and has an interchange access.

Regional Access

Ball Camp Byington Road (S.R. 131), to the north, intersects Byington Solway Road, which to the east, intersects Byington Beaver Ridge Road which extends north to Oak Ridge Highway (SR 62), an east-west state highway from Knoxville to Oak Ridge. From Middlebrook Pike, State Route 131 continues to Kingston Pike as Lovell Road intersecting Pellissippi Parkway (S.R. 162) and Interstate 40/75. Ball Camp Byington Road has a 2016 ADT of approximately 9,630.

Plans exist for the connection of Karns Valley Drive north and south of Oak Ridge Highway, providing an improved connection from Hardin Valley Road via Westcott Boulevard north to West Emory Road, intersecting Oak Ridge Highway. Westcott Boulevard intersects Hardin Valley Road to the west of the site and is signalized.

North of the site, Oak Ridge Highway (S.R. 62) is a two-lane primary state route extending east to Knoxville with an interchange at Interstate 640 and west to Pellissippi Parkway (S.R. 162) which extends into Oak Ridge. The 2016 average daily traffic (ADT) on the Oak Ridge Highway is 11,920.

Pellissippi Parkway (S.R. 162) is a 4-lane divided expressway with an ADT of 45,680 extending north to Oak Ridge and south of Hardin Valley Road with an ADT of 59,260 becoming I-140 with an interchange with Interstate 40/75. To the south, S.R. 131 also intersects Pellissippi Parkway (S.R. 162). Interstates 40 and 75 provide regional access throughout Tennessee, I-40 extends east and west from Memphis to Asheville, North Carolina, and I-75 extending north and south

connects Lexington, Kentucky and Chattanooga, Tennessee through Knoxville. South of the site, east of Pellissippi Parkway, the 2016 ADT is 179,910.

EXISTING TRAFFIC CONDITIONS

Existing Traffic Volumes and Intersection Geometry

Turning movement counts (TMC) were conducted in November of 2017 for the intersection of Windflower Way with Hardin Valley Road and the right-turning trips to and from the Hardin Valley Animal Hospital access. The counts were conducted early November 2017, 7:00-9:00AM and 3:00-6:00PM. The AM and PM peak hours were found between 7:30-8:30AM and 5:00-6:00PM, respectively. The posted speed limit for Hardin Valley Road is 45mph. Left-turn lanes are provided for both the eastbound and westbound traffic on Hardin Valley Road at Windflower Way. The eastbound traffic accesses the left-turn lane for U-turn movements. **Figure 3** illustrates the existing peak-hour traffic volumes.

Existing Capacity and Level of Service

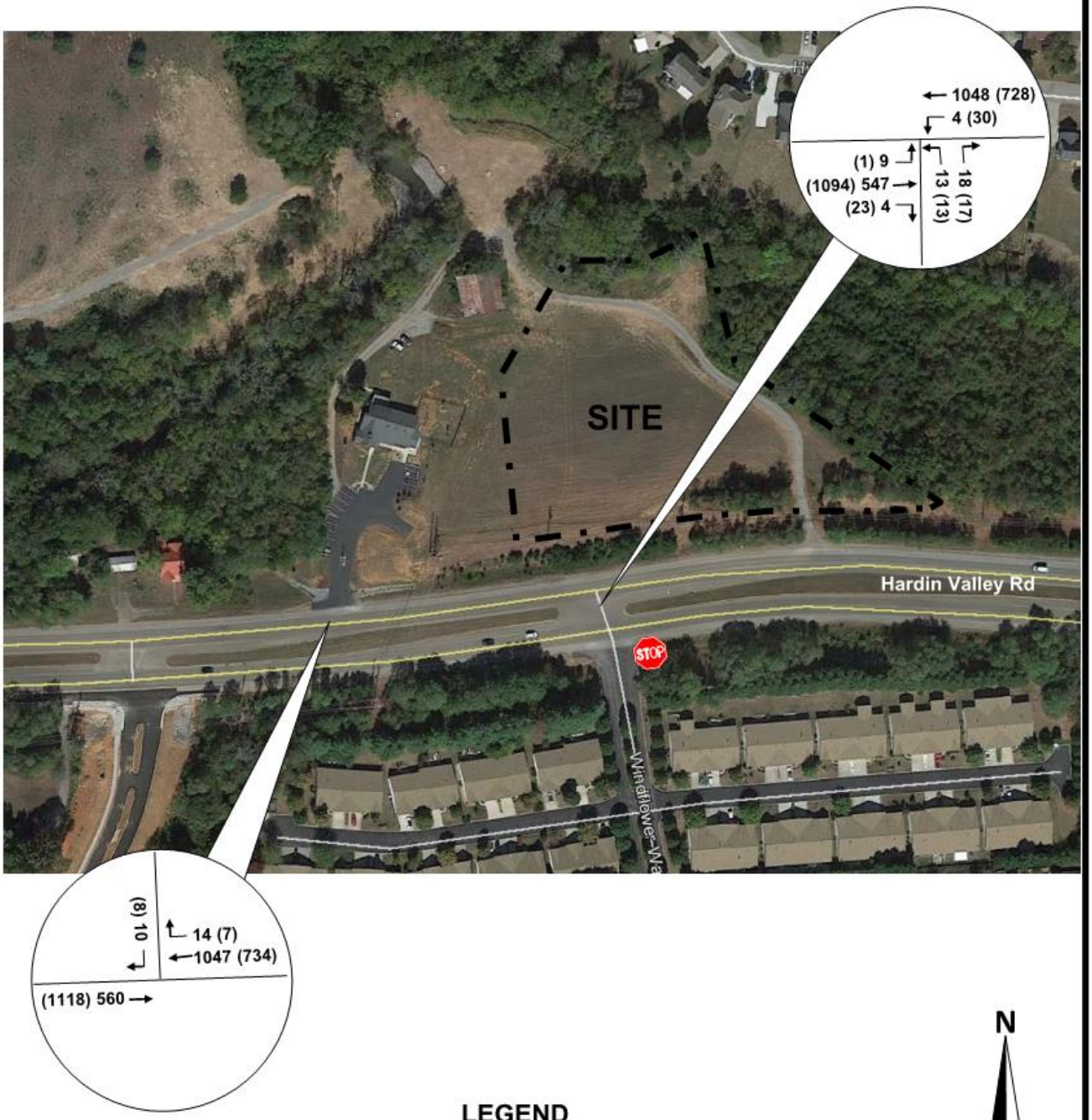
In order to evaluate the current operations of the traffic control devices, capacity and level of service were calculated using the unsignalized analysis from the **2000 Highway Capacity Manual, Special Report 209** published by the Transportation Research Board (TRB). Signalized and unsignalized intersections are evaluated based on estimated intersection delays, which may be related to level of service (LOS).

Level of service and capacity are the measurements of an intersection's ability to accommodate traffic volumes. Levels of service for intersections range from A to F. LOS A is the best, and LOS F is failing. For signalized intersections, a LOS of A has an average estimated intersection delay of less than 10 seconds, and LOS F has an estimated delay of greater than 80 seconds. A LOS of C and D are typical design values. Within urban areas, a LOS D, delay between 35 and 55 seconds, is considered acceptable by the Institute of Transportation Engineers (ITE) for signalized intersections.

Unsignalized intersection levels of service have lower thresholds of delays. A LOS of F exceeds estimated delays of 50 seconds. For urban arterials, minor approaches may frequently experience levels of service E. A full level of service description for unsignalized intersections is presented in **Table 1**.

Analyses of existing conditions are conducted using the Synchro, Version 9, software, developed by Trafficware. **Table 2** presents the analyses of the study intersections.

2017 EXISTING TRAFFIC
Hardin Valley ACE Hardware



LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 3

Table 1
LEVEL-OF-SERVICE (LOS) DESCRIPTION
FOR TWO-WAY STOP INTERSECTIONS

Level of Service	Average Control Delay per Vehicle (seconds)
A	≤ 10.0
B	> 10.0 and ≤ 15.0
C	> 15.0 and ≤ 25.0
D	> 25.0 and ≤ 35.0
E	> 35.0 and ≤ 50.0
F	> 50.0

SOURCE: Highway Capacity Manual, TRB Special Report 209

Table 2
2017 Capacity and Level of Service

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	DELAY	LOS
Hardin Valley Road &	STOP	AM	0.12	14.9	B
Windflower Way	NB	PM	0.23	26.9	D
Hardin Valley Road &	STOP	AM	0.02	13.0	B
Hardin Valley Animal Hospital	SB	PM	0.02	11.1	B
Hardin Valley Road &	STOP				
ACE Hardware RT Access	SB				

Note: Average vehicle delay estimated in seconds. STOP control analyses are presented by total minor approaches.

Analyses determined that the existing AM peak hour traffic conditions are acceptable with a LOS B during the AM peak hour and LOS D during the PM peak hour. Hardin Valley Road traffic is exceeding 1,800 vehicles during the PM peak with a directional flow eastbound of over 1,100 vehicles.

BACKGROUND TRAFFIC CONDITIONS

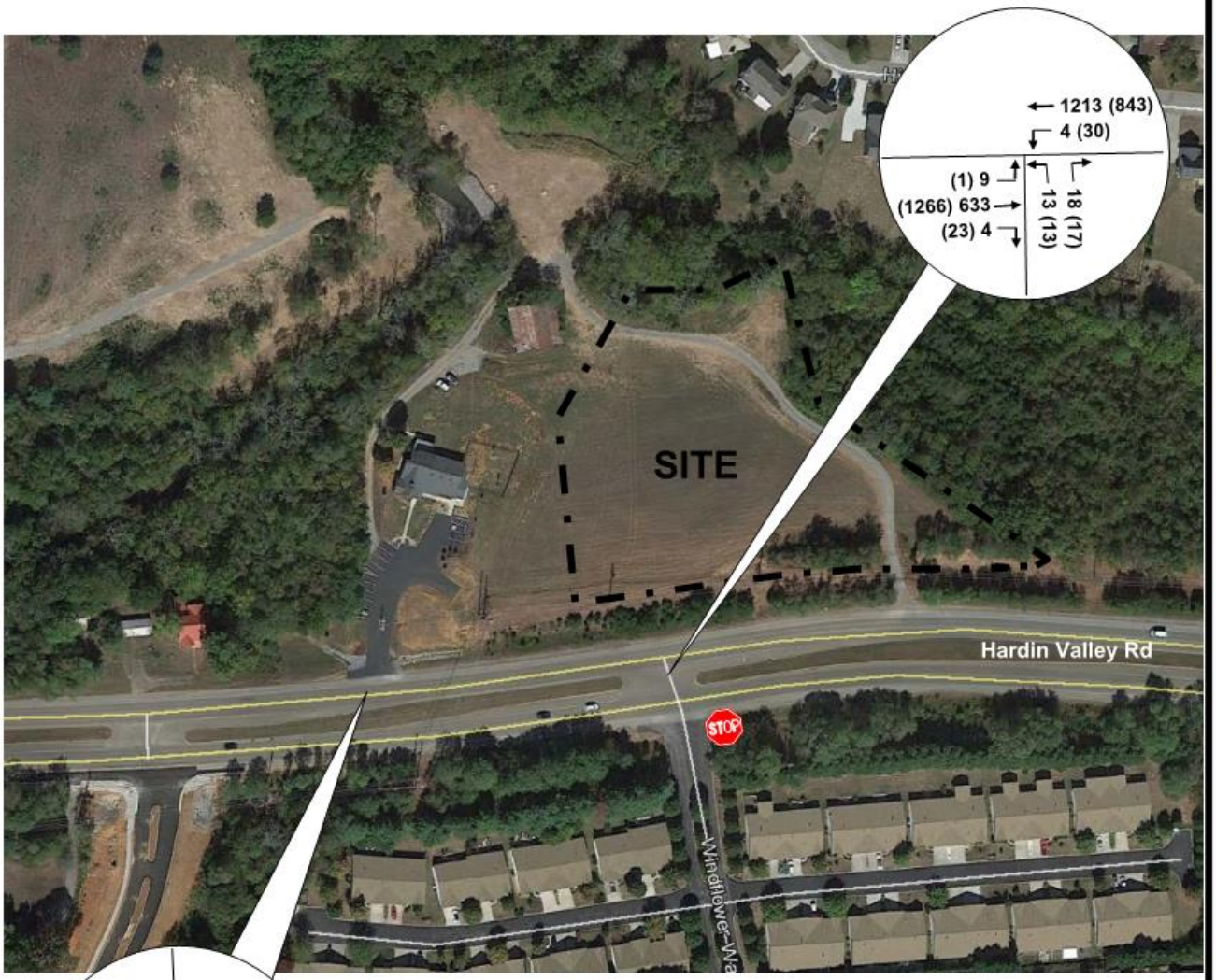
Future traffic conditions or background conditions are the anticipated conditions regardless of the proposed development and is the study baseline. Traffic through the study area should continue to grow as the region develops.

Background Traffic Volumes

The count history available through the Knox County count station located on Hardin Valley Road east of the Pellissippi Parkway interchange and west of the site indicates a 5-percent annual growth rate from 2010 to 2016. The completion of the site development is assumed to occur by 2020. Using the horizon year of 2020, the growth rate for Hardin Valley Road, background traffic was estimated for the transportation system. An annual compounded growth rate of 5-percent results in a growth factor of 1.158 for 2020 background traffic. This growth was applied to the through traffic on Hardin Valley Road. Background traffic is illustrated in **Figure 4**.

2020 BACKGROUND TRAFFIC

Hardin Valley ACE Hardware



LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 4

Background Capacity and Level of Service

The study intersection of Hardin Valley Road and Windflower Way was again evaluated for capacity and level of service. **Table 3** presents the intersection 2020 background LOS summary.

Table 3
2020 Background
Capacity and Levels of Service

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	DELAY	LOS
Hardin Valley Road &	STOP	AM	0.13	17.3	C
Windflower Way	NB	PM	0.29	35.2	E
Hardin Valley Road &	STOP	AM	0.03	14.2	B
Hardin Valley Animal Hospital	SB	PM	0.02	11.7	B

Note: Average vehicle delay estimated in seconds. STOP control analyses are presented by total minor approaches.

The analyses found that the study intersection of Hardin Valley Road with Windflower Way will be impacted by the traffic growth of Hardin Valley Road indicated by level of service lowered and with increased estimated approach delays. The unsignalized approach to Hardin Valley Road from Windflower Way will deteriorate to a LOS E during the PM peak hour as traffic increases on Hardin Valley Road, but this LOS is typical for many unsignalized approaches to an arterial.

PROJECT IMPACTS

Trip Generation

Project traffic was estimated using the data and methodologies of the publication, **Trip Generation, 9th Edition**. This reference is published by the Institute of Transportation Engineers (ITE) and represents national data collected for many different land uses including industrial, residential and commercial uses. It is an essential tool in estimating the volume of traffic likely to be generated by a proposed development. This study generates trips using the hardware store land use (L.U.C. 816). Because Trip Generation does not have an AM entering and exiting distribution, the AM peak hour entering and exiting distribution was assumed to be the same as a retail use (L.U.C. 820).

Some trip generation studies have included surveys addressing pass-by traffic and internal traffic. Studies conducted for pass-by traffic have suggested that a percentage of the traffic generated by commercial retail may originate from the existing traffic flow; therefore, the project does not necessarily introduce all new traffic to the transportation system. In addition to the pass-by traffic, the internal traffic, characteristic of mixed-use developments, accounts for the interaction between varying land uses. Internal traffic is sometimes described as multi-purpose trips.

Pass-by traffic varies relative to specific land uses and their densities. Some studies have shown varied results; however, the ITE publications, **Transportation and Land Development** by Virgil G. Stover and Frank J. Koepke and **Trip Generation**, has combined these studies to suggest uniform rates. These rates range from 14-percent for hardware stores to 60-percent for neighborhood shopping centers, gross leaseable area less than 100,000 square feet. Service stations and fast-food restaurants also exhibit high pass-by rates of 58-percent and 45-percent, respectively.

The study estimated traffic for a 17,000 square foot hardware store. **Table 4** presents the trip generation for the site. The trip generation for the site is approximately 870 daily trips, and the peak hour trip generation is 83 trips occurring during the PM peak hour. The trip generation of this site assumed a 15-percent reduction for pass-by. With the site trip generation adjusted to reflect 15-percent pass-by trips, the trip generation for the site is approximately 740 daily trips and 70 peak-hour trips generated during the PM peak hour.

Table 4
TRIP GENERATION

Land Use	LUC	Density (sqft)	Weekday				
			Daily	AM PEAK		PM PEAK	
				Enter	Exit	Enter	Exit
Hardware Store	816	17,000	872	11	7	39	44
Primary Trips	85%		741	9	6	33	37
Passby Trips	15%		131	2	1	6	7

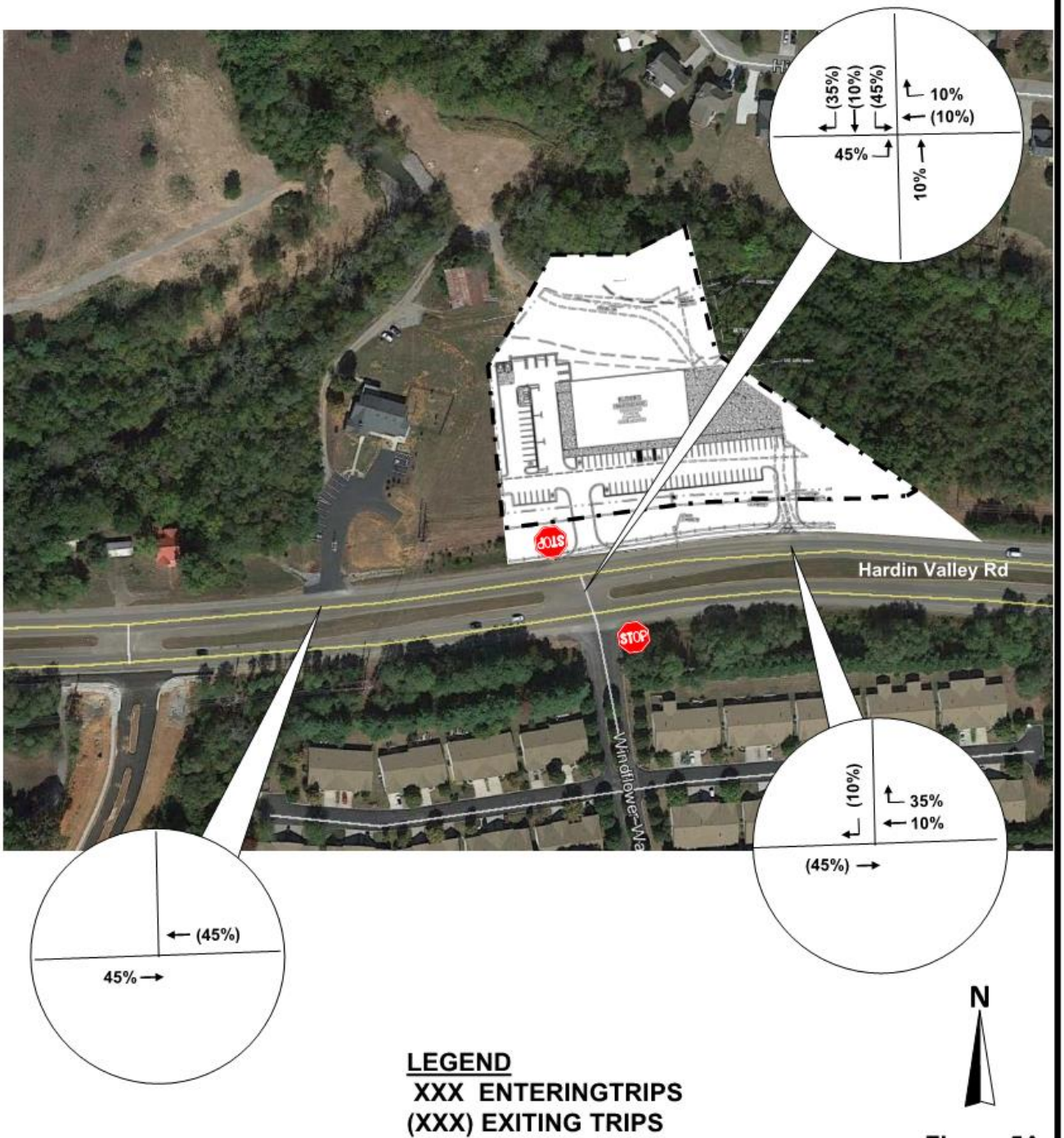
Note: Trips generated using **Trip Generation, 9th Edition**, published by ITE.

Trip Distribution And Assignment

The distribution and assignment was assumed based on the surrounding land uses and the subdivisions in the site vicinity. **Figure 5A** illustrates the primary trip distribution for the site, and **Figure 5B** illustrates the pass-by trip distribution. Trips were distributed with 45-percent to and from the east and west of the site and 10-percent from the Windflower subdivision. Pass-by trips were distributed 50-percent east and west of the site.

PRIMARY DISTRIBUTION & ASSIGNMENT

Hardin Valley ACE Hardware

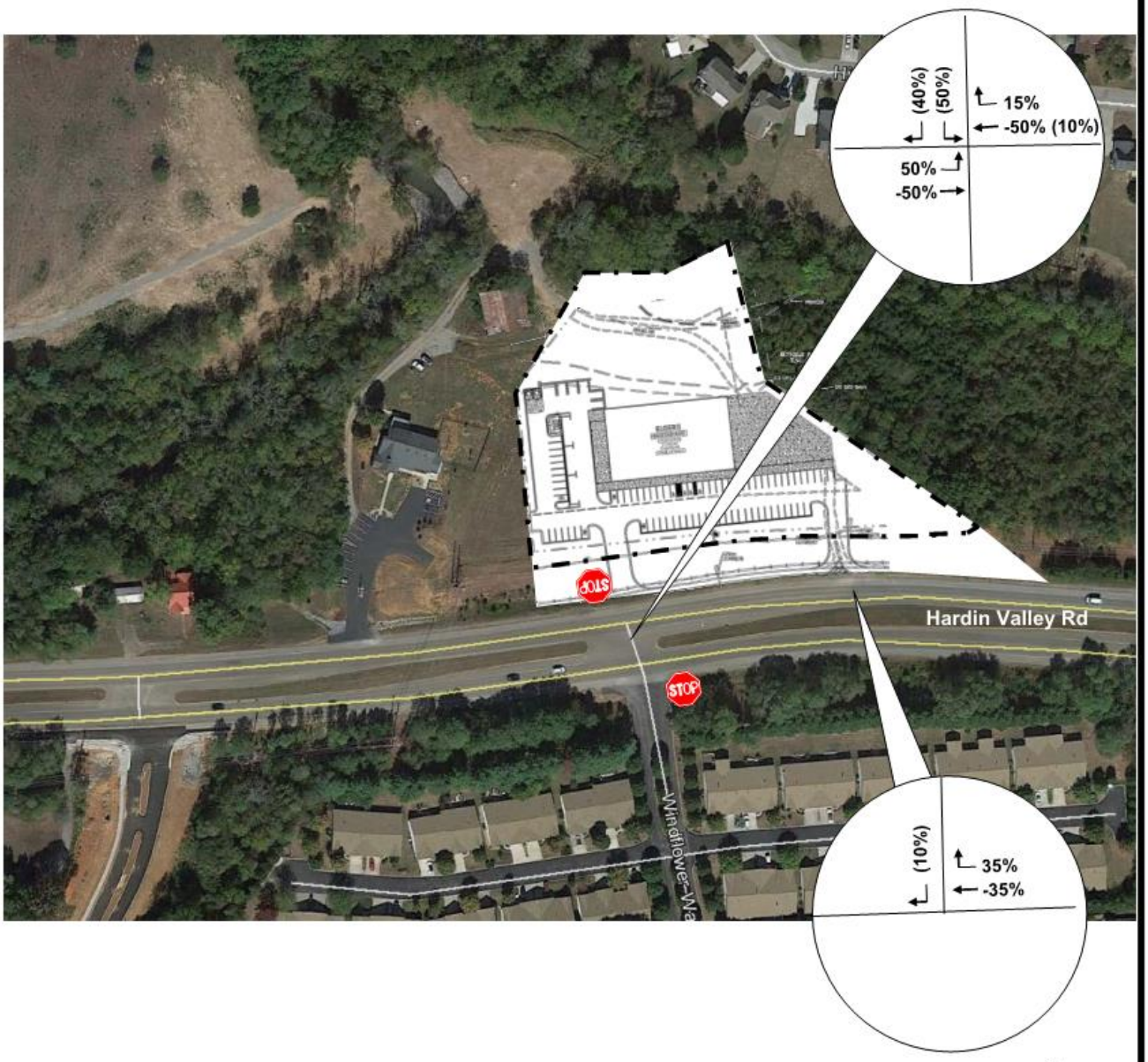


LEGEND
XXX ENTERINGTRIPS
(XXX) EXITING TRIPS

Figure 5A

PASS-BY DISTRIBUTION & ASSIGNMENT

Hardin Valley
ACE Hardware



LEGEND
XXX ENTERINGTRIPS
(XXX) EXITING TRIPS

Figure 5B

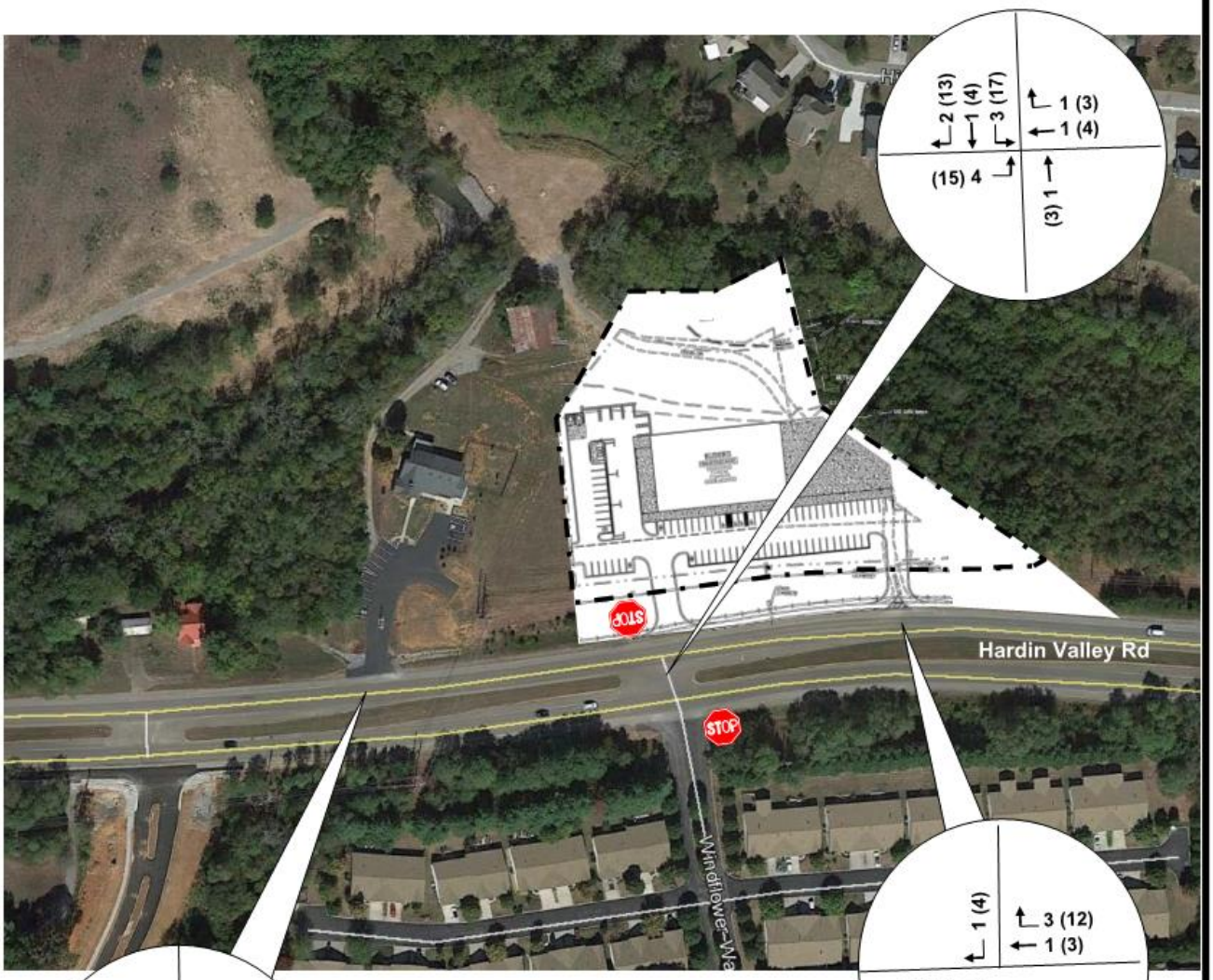
By multiplying the assumed intersection trip distribution with the trip generation, project associated trips were determined. **Figure 6A** illustrates the proposed primary trips for the ACE Hardware store, and **Figure 6B** illustrates the pass-by trips. The total trip assignment for the proposed store is illustrated in **Figure 7**.

Projected Traffic Volumes

The proposed ACE Hardware site will share the median access with the adjacent animal hospital; therefore, projected traffic includes a reassignment of half of the existing exiting trips from the hospital driveway to the left-turn from the proposed ACE Hardware driveway to eastbound Hardin Valley Road. **Figure 8** illustrates this reassignment. With the addition of project trips and the reassignment of existing Hardin Valley Animal Hospital trips to background traffic for the 2020 horizon year, the projected traffic volumes were obtained. **Figure 9** illustrates the projected traffic for the 2020 horizon year. The projected intersection volumes were used to analyze the intersection's future capacity and LOS.

PRIMARY TRIPS

Hardin Valley ACE Hardware

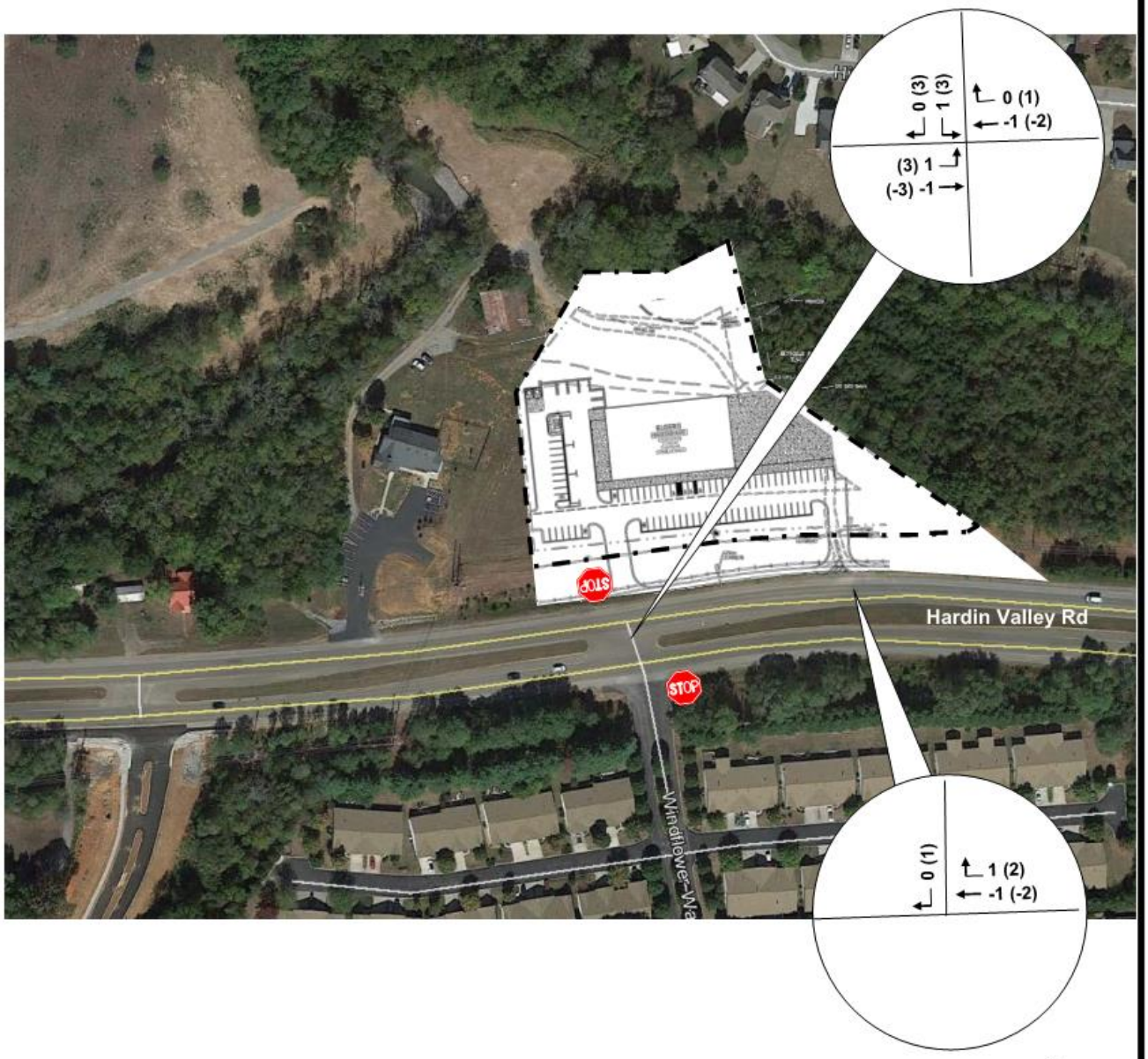


LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 6A

PASS-BY TRIPS

Hardin Valley ACE Hardware

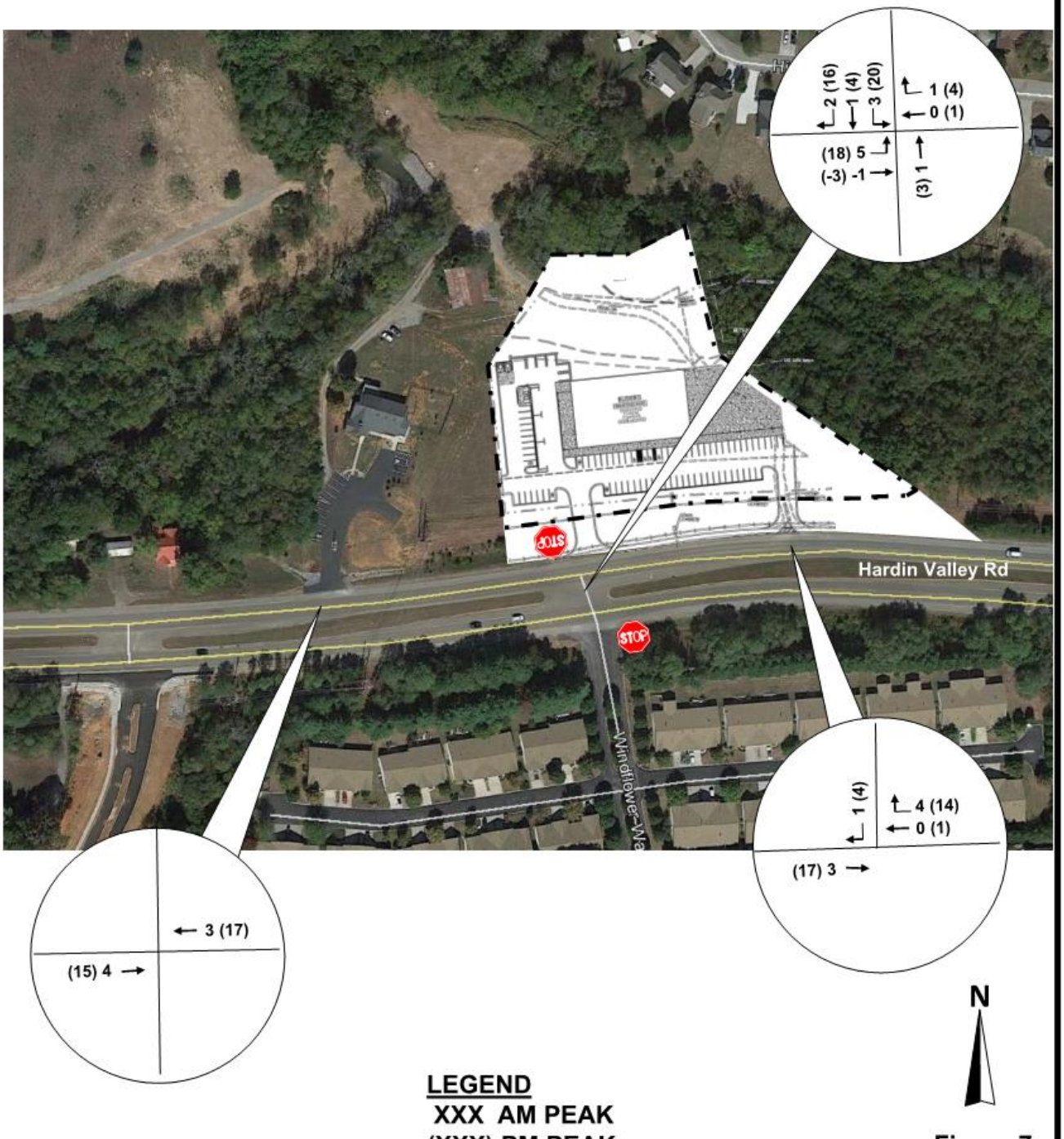


LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 6B

TOTAL TRIPS

Hardin Valley ACE Hardware

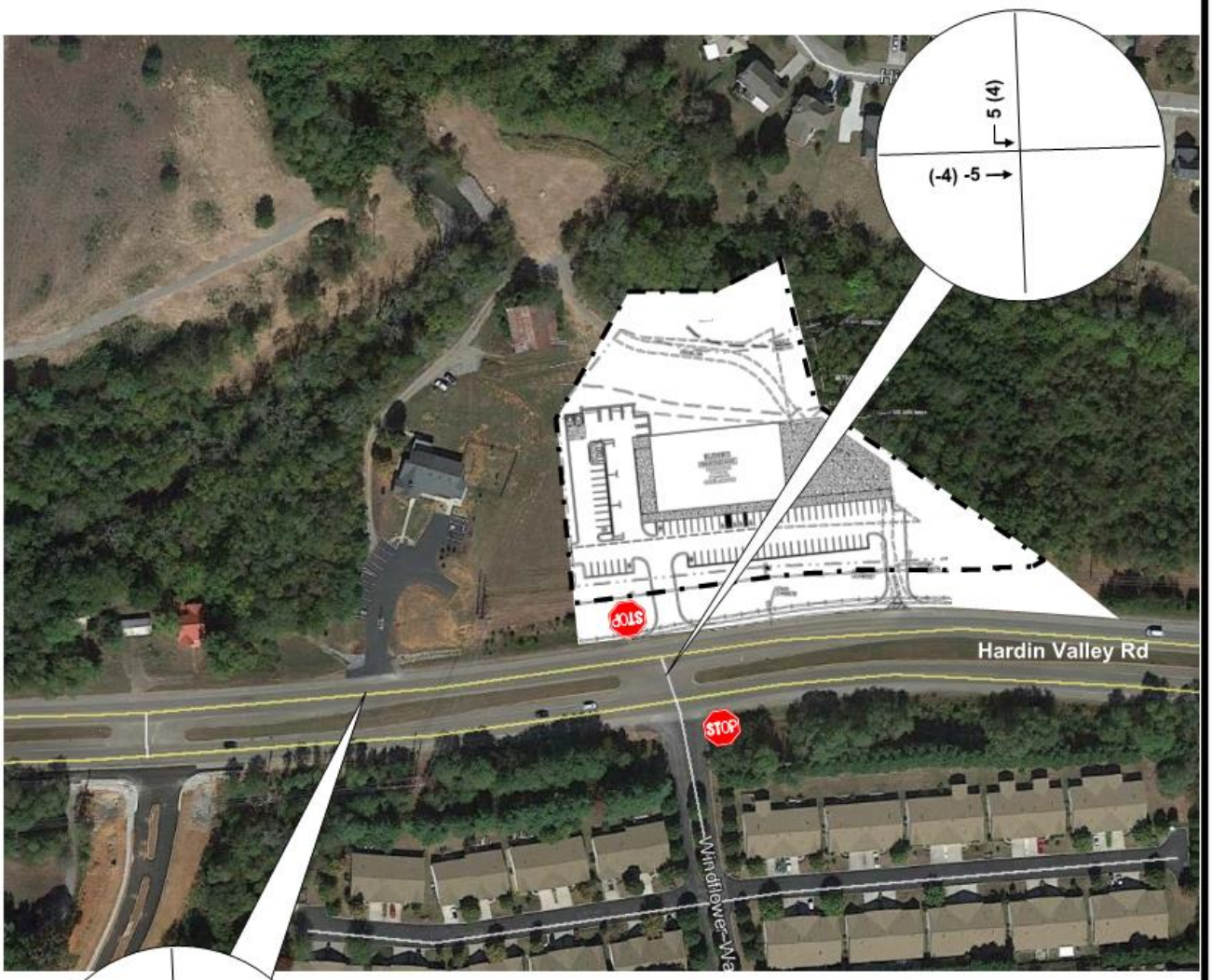


LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 7

HARDIN VALLEY ANIMAL HOSPITAL REASSIGNMENT

Hardin Valley ACE Hardware

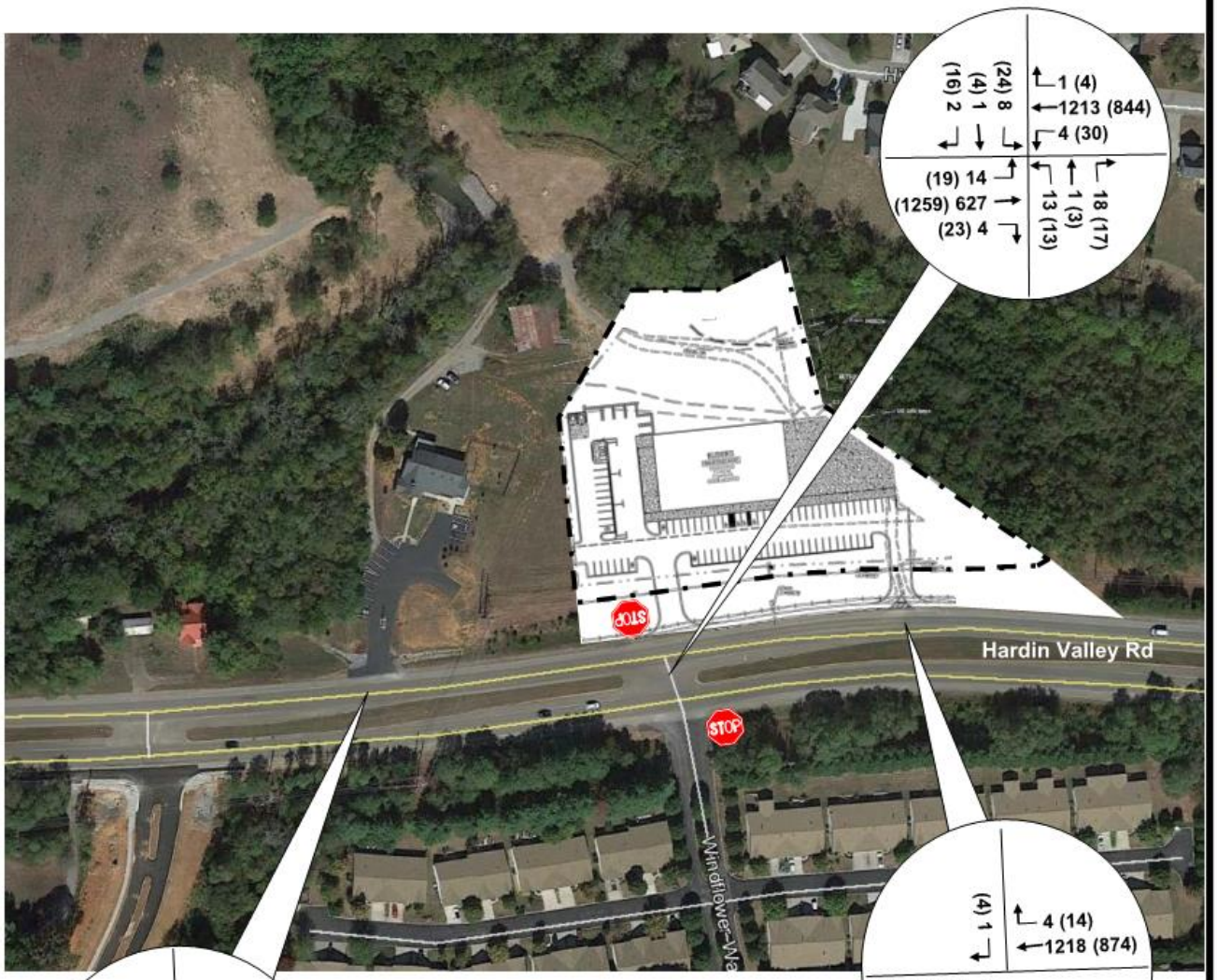


LEGEND
XXX AM PEAK
(XXX) PM PEAK

N

Figure 8

2020 PROJECTED TRAFFIC
Hardin Valley ACE Hardware



LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 9

Projected Capacity and Level of Service

Traffic is analyzed with the proposed development to again determine the capacity and LOS for the site access and study intersections. **Table 5** presents the results of the 2020 analyses and **Table 6** summarizes the analyses conducted for this study.

Table 5
2020 Projected
Capacity and Levels of Service

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	DELAY	LOS
Hardin Valley Road & Windflower Way	STOP NB/SB	AM PM	0.14 / 0.09 0.34 / 0.27	18.3 / 35.0 40.2 / 35.6	C / D E / E
Hardin Valley Road & Hardin Valley Animal Hospital	STOP SB	AM PM	0.01 0.01	14.1 11.8	B B
Hardin Valley Road & ACE Hardware RT Access	STOP SB	AM PM	0.00 0.01	14.0 11.8	B B

Note: Average vehicle delay estimated in seconds. STOP control analyses are presented by total minor approaches.

For the buildout of the site and a horizon year of 2020, the intersection of Hardin Valley Road with Windflower Way and the proposed ACE driveway approach levels of service will be a LOS E during the PM peak hour. Unsignalized access to Hardin Valley Road will experience greater delays as traffic continues to grow on Hardin Valley Road. A level of service E is a typical LOS for unsignalized approaches to many arterials.

Site Access

The proposed access is located at an existing median opening on Hardin Valley Road opposite Windflower Way with the existing left-turn lanes provided from Hardin Valley Road. Projected westbound right-turn volumes, less than 25vph for both proposed accesses to the site, are below the threshold volumes for the requirement of right-turn lanes. The access intersects Hardin Valley Road at locations where there are not any roadway geometric impediments restricting the necessary line of sight. For the posted speed limit of 45mph, the corner sight-distance required in Knox County is 450 feet which can be exceeded for the proposed accesses but will require the appropriate grading and site clearance insuring this minimum line of sight. The line of sight from the proposed driveway will exceed 1,000 feet to the east and west.

Table 6
SUMMARY OF
CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2017 TRAFFIC V/C	2017 TRAFFIC DELAY	2017 TRAFFIC LOS	2020 BACKGROUND V/C	2020 BACKGROUND DELAY	2020 BACKGROUND LOS	2020 PROJECTED V/C	2020 PROJECTED DELAY	2020 PROJECTED LOS
Hardin Valley Road &	STOP	AM	0.12	14.9	B	0.13	17.3	C	0.14 / 0.09	18.3 / 35.0	C / D
Windflower Way	NB/SB	PM	0.23	26.9	D	0.29	35.2	E	0.34 / 0.27	40.2 / 35.6	E / E
Hardin Valley Road &	STOP	AM	0.02	13.0	B	0.03	14.2	B	0.01	14.1	B
Hardin Valley Animal Hospital	SB	PM	0.02	11.1	B	0.02	11.7	B	0.01	11.8	B
Hardin Valley Road &	STOP	AM							0.00	14.0	B
ACE Hardware RT Access	SB	PM							0.01	11.8	B

Note: Average vehicle delay estimated in seconds. STOP control analyses are presented by total minor approaches.

RECOMMENDED IMPROVEMENTS

The projected traffic volumes, analyses conducted, and Knox County policies identified the following improvements necessary for the proposed site access:

1. Minimize landscaping, using low growing vegetation and signing at the planned accesses to insure safe sight-distance is maintained.

2. Provide separate left- and right-turn lanes from the proposed site full access driveway.

3. Roadway and intersection design should conform to the recommended standards and practices adopted by the Institute of Transportation Engineers (ITE), American Association of State and Highway Officials (AASHTO), and Knox County.

CONCLUSION

The proposed hardware store development is located in northwest Knox County, Tennessee. The study included traffic counts and projected traffic with and without the proposed development. Background traffic, which may be anticipated regardless of the proposed development, was determined using a 5.0-percent compounded annual growth rate until the horizon year of 2020.

Trips for the site were generated using ITE trip generation rates. The trip generation for the 17,000 square-foot store was found to be approximately 740 daily trips, 20 AM peak-hour trips, and 70 PM peak-hour trips. These trips, adjusted for 15-percent pass-by trips, were distributed to the proposed site access intersections with Hardin Valley Road.

Using the identified turning movements for the existing and projected traffic conditions, with and without the proposed development, capacity and level of service analyses conforms to the **2000 Highway Capacity Manual**. The PM peak for the intersection of Hardin Valley Road with Windflower Way will deteriorate some as traffic grows on Hardin Valley Road. For the buildout of the site and a horizon year of 2020, the intersection of Hardin Valley Road with Windflower Way and the proposed ACE driveway access may operate with a LOS E during the peak hour. Unsignalized access to Hardin Valley Road will experience greater delays as traffic continues to grow on Hardin Valley Road. Levels of service E are often experienced from unsignalized minor approaches to an arterial with average daily traffic exceeding 20,000. Driveway delays will be longer during peak hours but with the existing left-turn lanes and the required line of sight, the driveway operation should be acceptable.

APPENDIX

Trip Generation
Capacity & LOS Analyses
Traffic Count Data
Right-Turn Lane Analysis

11/15/2017,

TRIP GENERATION

15-Nov-17

LAND USE	L.U.C	SIZE	AVERAGE DAILY TRAFFIC	AM PEAK ENTER	AM PEAK EXIT	AM PEAK TOTAL	PM PEAK ENTER	PM PEAK EXIT	PM PEAK TOTAL
HARDWARE/PAINT	816	17,000	872	11	7	18	39	44	82
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0
			872	11	7	18	39	44	82

LAND USE	L.U.C	SIZE	REGRESSION DAILY TRAFFIC	AM PEAK ENTER	AM PEAK EXIT	AM PEAK TOTAL	PM PEAK ENTER	PM PEAK EXIT	PM PEAK TOTAL
HARDWARE/PAINT	816	17,000	N/A	N/A	N/A	N/A	39	44	84
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0
			0	0	0	0	39	44	84

LAND USE	L.U.C	SIZE	SATURDAY DAILY TRAFFIC	SATURDAY PEAK ENTER	SATURDAY PEAK EXIT	SATURDAY PEAK TOTAL	SUNDAY DAILY TRAFFIC	SUNDAY PEAK ENTER	SUNDAY PEAK EXIT	SUNDAY PEAK TOTAL
HARDWARE/PAINT	816	17,000	1,403	N/A	N/A	190	1,167	N/A	N/A	167
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0	0
			1,403	0	0	190	1,167	0	0	167

Hardware/Paint Store
(816)

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

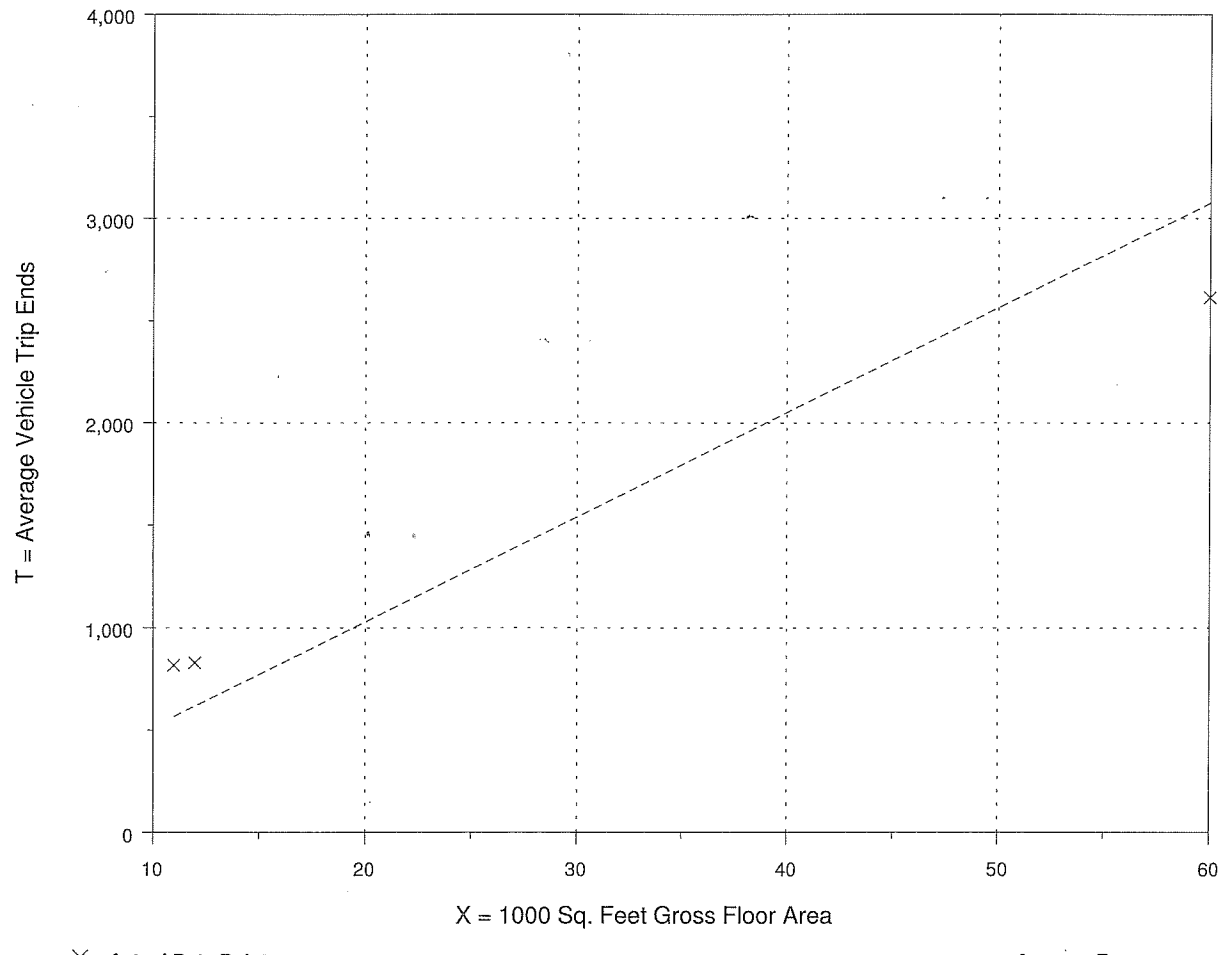
Number of Studies: 3
Average 1000 Sq. Feet GFA: 28
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
51.29	43.58 - 74.09	14.43

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Not given

R^2 = ****

Hardware/Paint Store
(816)

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

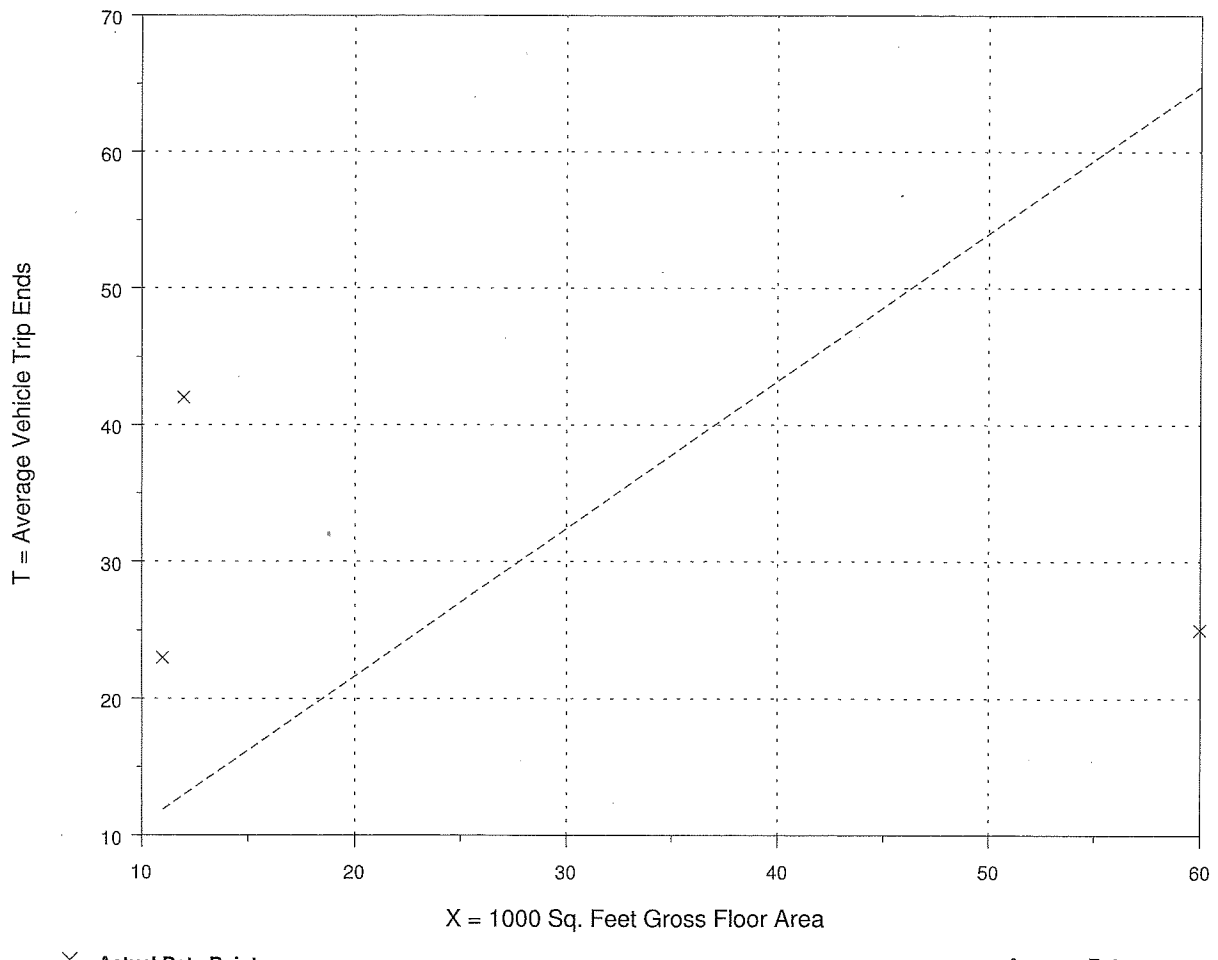
Number of Studies: 3
Average 1000 Sq. Feet GFA: 28
Directional Distribution: Not available

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.08	0.42 - 3.50	1.53

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Not given

R^2 = ****

Hardware/Paint Store
(816)

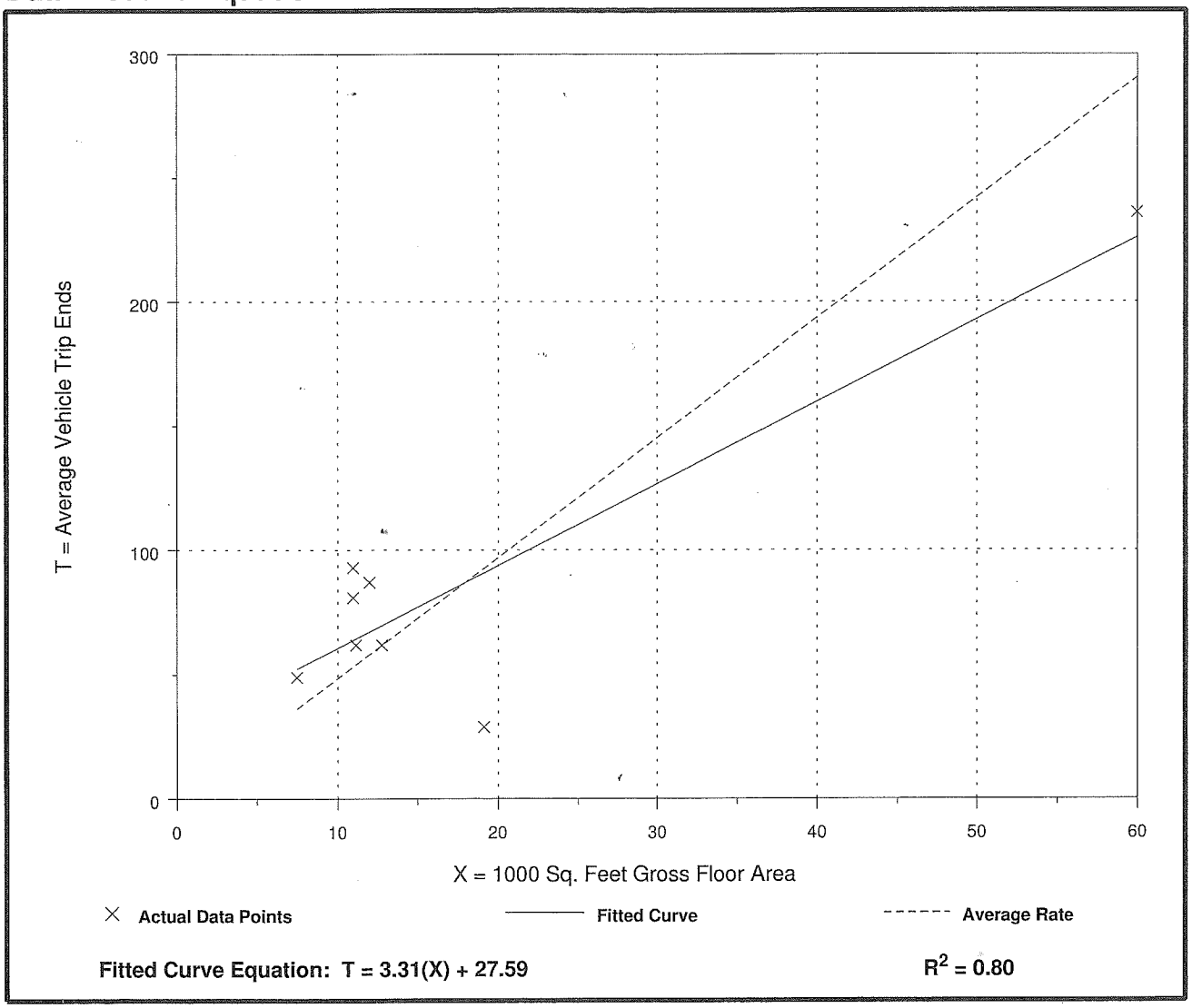
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 8
Average 1000 Sq. Feet GFA: 18
Directional Distribution: 47% entering, 53% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
4.84	1.52 - 8.45	2.92

Data Plot and Equation



Fitted Curve Equation: T = 3.31(X) + 27.59

R^2 = 0.80

Shopping Center
(820)

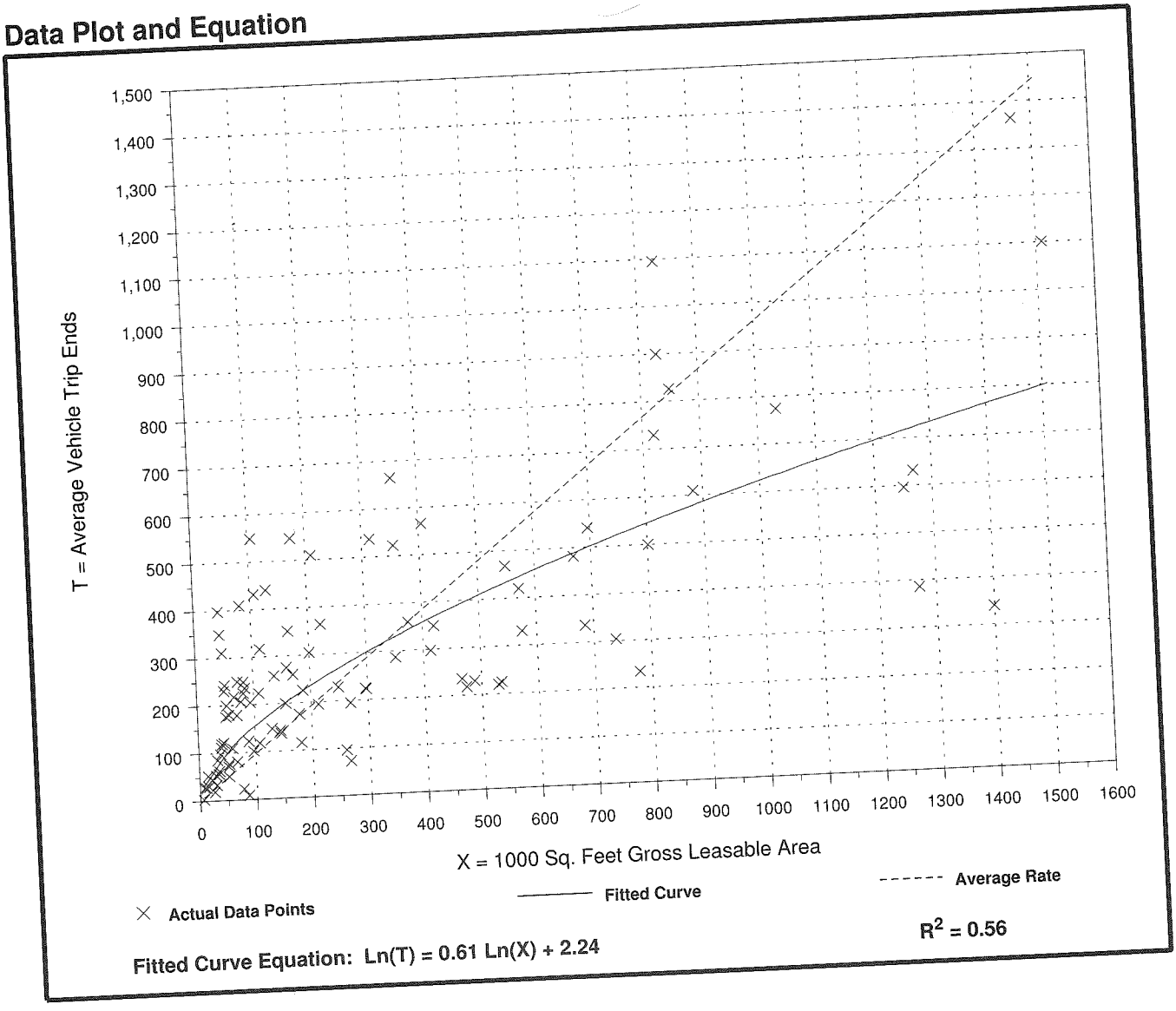
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 104
Average 1000 Sq. Feet GLA: 310
Directional Distribution: 62% entering, 38% exiting

Trip Generation per 1000 Sq. Feet Gross Leasable Area

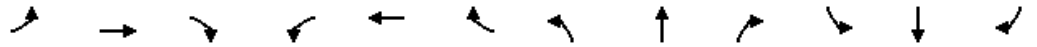
Average Rate	Range of Rates	Standard Deviation
0.96	0.10 - 9.05	1.31

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.61 Ln(X) + 2.24

R^2 = 0.56



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	547	4	4	1048	0	13	0	18	0	0	0
Future Volume (Veh/h)	9	547	4	4	1048	0	13	0	18	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.56	0.94	0.50	0.50	0.86	0.58	0.65	0.92	0.58	0.92	0.92	0.92
Hourly flow rate (vph)	16	582	8	8	1219	0	20	0	31	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1219			590			1244	1853	295	1589	1857	610
vC1, stage 1 conf vol							618	618		1235	1235	
vC2, stage 2 conf vol							626	1235		354	622	
vCu, unblocked vol	1219			590			1244	1853	295	1589	1857	610
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			92	100	96	100	100	100
cM capacity (veh/h)	568			982			252	168	701	149	174	438

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	16	388	202	8	610	610	51	0
Volume Left	16	0	0	8	0	0	20	0
Volume Right	0	0	8	0	0	0	31	0
cSH	568	1700	1700	982	1700	1700	413	1700
Volume to Capacity	0.03	0.23	0.12	0.01	0.36	0.36	0.12	0.00
Queue Length 95th (ft)	2	0	0	1	0	0	10	0
Control Delay (s)	11.5	0.0	0.0	8.7	0.0	0.0	14.9	0.0
Lane LOS	B			A			B	A
Approach Delay (s)	0.3			0.1			14.9	0.0
Approach LOS							B	A

Intersection Summary				
Average Delay	0.5			
Intersection Capacity Utilization	39.0%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑↱			↱
Traffic Volume (veh/h)	0	560	1047	14	0	10
Future Volume (Veh/h)	0	560	1047	14	0	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	609	1138	15	0	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1153				1450	576
vC1, stage 1 conf vol					1146	
vC2, stage 2 conf vol					304	
vCu, unblocked vol	1153				1450	576
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	98
cM capacity (veh/h)	602				217	460

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	304	304	759	394	11
Volume Left	0	0	0	0	0
Volume Right	0	0	0	15	11
cSH	1700	1700	1700	1700	460
Volume to Capacity	0.18	0.18	0.45	0.23	0.02
Queue Length 95th (ft)	0	0	0	0	2
Control Delay (s)	0.0	0.0	0.0	0.0	13.0
Lane LOS					B
Approach Delay (s)	0.0		0.0		13.0
Approach LOS					B

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	39.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	1094	23	30	728	0	13	0	17	0	0	0
Future Volume (Veh/h)	1	1094	23	30	728	0	13	0	17	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.25	0.85	0.96	0.58	0.87	0.58	0.65	0.92	0.61	0.92	0.92	0.92
Hourly flow rate (vph)	4	1287	24	52	837	0	20	0	28	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	837			1311			1830	2248	656	1620	2260	418
vC1, stage 1 conf vol							1307	1307		941	941	
vC2, stage 2 conf vol							522	941		680	1319	
vCu, unblocked vol	837			1311			1830	2248	656	1620	2260	418
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			90			84	100	93	100	100	100
cM capacity (veh/h)	793			524			127	135	408	157	115	583

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	4	858	453	52	418	418	48	0
Volume Left	4	0	0	52	0	0	20	0
Volume Right	0	0	24	0	0	0	28	0
cSH	793	1700	1700	524	1700	1700	212	1700
Volume to Capacity	0.01	0.50	0.27	0.10	0.25	0.25	0.23	0.00
Queue Length 95th (ft)	0	0	0	8	0	0	21	0
Control Delay (s)	9.6	0.0	0.0	12.6	0.0	0.0	26.9	0.0
Lane LOS	A			B			D	A
Approach Delay (s)	0.0			0.7			26.9	0.0
Approach LOS							D	A

Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	41.0%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑↱			↱
Traffic Volume (veh/h)	0	1118	734	7	0	8
Future Volume (Veh/h)	0	1118	734	7	0	8
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1215	798	8	0	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	806				1410	403
vC1, stage 1 conf vol					802	
vC2, stage 2 conf vol					608	
vCu, unblocked vol	806				1410	403
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	98
cM capacity (veh/h)	814				262	597

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	608	608	532	274	9
Volume Left	0	0	0	0	0
Volume Right	0	0	0	8	9
cSH	1700	1700	1700	1700	597
Volume to Capacity	0.36	0.36	0.31	0.16	0.02
Queue Length 95th (ft)	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	11.1
Lane LOS					B
Approach Delay (s)	0.0		0.0		11.1
Approach LOS					B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	633	4	4	1213	0	13	0	18	0	0	0
Future Volume (Veh/h)	9	633	4	4	1213	0	13	0	18	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.56	0.94	0.50	0.50	0.86	0.58	0.65	0.92	0.75	0.92	0.92	0.92
Hourly flow rate (vph)	16	673	8	8	1410	0	20	0	24	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1410			681			1430	2135	340	1818	2139	705
vC1, stage 1 conf vol							709	709		1426	1426	
vC2, stage 2 conf vol							721	1426		392	713	
vCu, unblocked vol	1410			681			1430	2135	340	1818	2139	705
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			91	100	96	100	100	100
cM capacity (veh/h)	480			907			212	133	655	115	140	379

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	16	449	232	8	705	705	44	0
Volume Left	16	0	0	8	0	0	20	0
Volume Right	0	0	8	0	0	0	24	0
cSH	480	1700	1700	907	1700	1700	335	1700
Volume to Capacity	0.03	0.26	0.14	0.01	0.41	0.41	0.13	0.00
Queue Length 95th (ft)	3	0	0	1	0	0	11	0
Control Delay (s)	12.8	0.0	0.0	9.0	0.0	0.0	17.3	0.0
Lane LOS	B			A			C	A
Approach Delay (s)	0.3			0.1			17.3	0.0
Approach LOS							C	A

Intersection Summary				
Average Delay	0.5			
Intersection Capacity Utilization	43.5%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑↱			↱
Traffic Volume (veh/h)	0	648	1212	14	0	10
Future Volume (Veh/h)	0	648	1212	14	0	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	704	1317	15	0	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1332				1676	666
vC1, stage 1 conf vol					1324	
vC2, stage 2 conf vol					352	
vCu, unblocked vol	1332				1676	666
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	97
cM capacity (veh/h)	514				174	402

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	352	352	878	454	11
Volume Left	0	0	0	0	0
Volume Right	0	0	0	15	11
cSH	1700	1700	1700	1700	402
Volume to Capacity	0.21	0.21	0.52	0.27	0.03
Queue Length 95th (ft)	0	0	0	0	2
Control Delay (s)	0.0	0.0	0.0	0.0	14.2
Lane LOS					B
Approach Delay (s)	0.0		0.0		14.2
Approach LOS					B

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	43.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	1266	23	30	843	0	13	0	17	0	0	0
Future Volume (Veh/h)	1	1266	23	30	843	0	13	0	17	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.25	0.85	0.96	0.58	0.87	0.58	0.65	0.92	0.61	0.92	0.92	0.92
Hourly flow rate (vph)	4	1489	24	52	969	0	20	0	28	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	969			1513			2098	2582	756	1854	2594	484
vC1, stage 1 conf vol							1509	1509		1073	1073	
vC2, stage 2 conf vol							588	1073		780	1521	
vCu, unblocked vol	969			1513			2098	2582	756	1854	2594	484
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			88			79	100	92	100	100	100
cM capacity (veh/h)	707			438			96	106	350	124	86	528

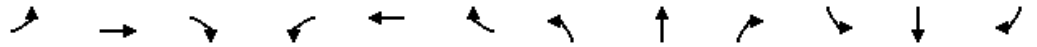
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	4	993	520	52	484	484	48	0
Volume Left	4	0	0	52	0	0	20	0
Volume Right	0	0	24	0	0	0	28	0
cSH	707	1700	1700	438	1700	1700	166	1700
Volume to Capacity	0.01	0.58	0.31	0.12	0.28	0.28	0.29	0.00
Queue Length 95th (ft)	0	0	0	10	0	0	28	0
Control Delay (s)	10.1	0.0	0.0	14.3	0.0	0.0	35.2	0.0
Lane LOS	B			B			E	A
Approach Delay (s)	0.0			0.7			35.2	0.0
Approach LOS							E	A

Intersection Summary				
Average Delay	1.0			
Intersection Capacity Utilization	45.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑↱			↱
Traffic Volume (veh/h)	0	1294	850	7	0	8
Future Volume (Veh/h)	0	1294	850	7	0	8
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1407	924	8	0	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	932				1632	466
vC1, stage 1 conf vol					928	
vC2, stage 2 conf vol					704	
vCu, unblocked vol	932				1632	466
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	98
cM capacity (veh/h)	730				220	543

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	704	704	616	316	9
Volume Left	0	0	0	0	0
Volume Right	0	0	0	8	9
cSH	1700	1700	1700	1700	543
Volume to Capacity	0.41	0.41	0.36	0.19	0.02
Queue Length 95th (ft)	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	11.7
Lane LOS					B
Approach Delay (s)	0.0		0.0		11.7
Approach LOS					B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	627	4	4	1213	1	13	1	18	8	1	2
Future Volume (Veh/h)	14	627	4	4	1213	1	13	1	18	8	1	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.56	0.94	0.50	0.50	0.86	0.58	0.65	0.92	0.75	0.92	0.92	0.92
Hourly flow rate (vph)	25	667	8	8	1410	2	20	1	24	9	1	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1412			675			1444	2149	338	1835	2152	706
vC1, stage 1 conf vol							721	721		1427	1427	
vC2, stage 2 conf vol							724	1428		408	725	
vCu, unblocked vol	1412			675			1444	2149	338	1835	2152	706
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	95			99			90	99	96	92	99	99
cM capacity (veh/h)	479			912			203	127	658	114	138	378

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1	SB 2
Volume Total	25	445	230	8	940	472	45	10	2
Volume Left	25	0	0	8	0	0	20	9	0
Volume Right	0	0	8	0	0	2	24	0	2
cSH	479	1700	1700	912	1700	1700	315	116	378
Volume to Capacity	0.05	0.26	0.14	0.01	0.55	0.28	0.14	0.09	0.01
Queue Length 95th (ft)	4	0	0	1	0	0	12	7	0
Control Delay (s)	12.9	0.0	0.0	9.0	0.0	0.0	18.3	39.1	14.6
Lane LOS	B			A			C	E	B
Approach Delay (s)	0.5			0.1			18.3	35.0	
Approach LOS							C	D	

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	50.2%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑↱			↱
Traffic Volume (veh/h)	0	646	1215	14	0	5
Future Volume (Veh/h)	0	646	1215	14	0	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	702	1321	15	0	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1336				1680	668
vC1, stage 1 conf vol					1328	
vC2, stage 2 conf vol					351	
vCu, unblocked vol	1336				1680	668
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	99
cM capacity (veh/h)	512				173	401

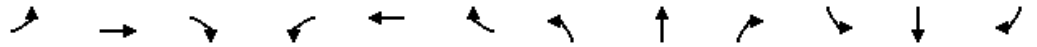
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	351	351	881	455	5
Volume Left	0	0	0	0	0
Volume Right	0	0	0	15	5
cSH	1700	1700	1700	1700	401
Volume to Capacity	0.21	0.21	0.52	0.27	0.01
Queue Length 95th (ft)	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	14.1
Lane LOS					B
Approach Delay (s)	0.0		0.0		14.1
Approach LOS					B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	654	1218	4	0	1
Future Volume (Veh/h)	0	654	1218	4	0	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	711	1324	4	0	1
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	1328				1682	664
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1328				1682	664
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	516				85	403

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	356	356	883	445	1
Volume Left	0	0	0	0	0
Volume Right	0	0	0	4	1
cSH	1700	1700	1700	1700	403
Volume to Capacity	0.21	0.21	0.52	0.26	0.00
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	14.0
Lane LOS					B
Approach Delay (s)	0.0		0.0		14.0
Approach LOS					B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	1259	23	30	844	4	13	3	17	24	4	16
Future Volume (Veh/h)	19	1259	23	30	844	4	13	3	17	24	4	16
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.85	0.96	0.58	0.87	0.92	0.65	0.92	0.61	0.92	0.92	0.92
Hourly flow rate (vph)	21	1481	24	52	970	4	20	3	28	26	4	17
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	974			1505			2143	2613	752	1888	2623	487
vC1, stage 1 conf vol							1535	1535		1076	1076	
vC2, stage 2 conf vol							608	1078		812	1547	
vCu, unblocked vol	974			1505			2143	2613	752	1888	2623	487
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			88			77	97	92	78	95	97
cM capacity (veh/h)	704			441			88	100	353	118	81	526

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1	SB 2
Volume Total	21	987	518	52	647	327	51	30	17
Volume Left	21	0	0	52	0	0	20	26	0
Volume Right	0	0	24	0	0	4	28	0	17
cSH	704	1700	1700	441	1700	1700	152	111	526
Volume to Capacity	0.03	0.58	0.30	0.12	0.38	0.19	0.34	0.27	0.03
Queue Length 95th (ft)	2	0	0	10	0	0	34	25	2
Control Delay (s)	10.3	0.0	0.0	14.3	0.0	0.0	40.2	48.9	12.1
Lane LOS	B			B			E	E	B
Approach Delay (s)	0.1			0.7			40.2	35.6	
Approach LOS							E	E	

Intersection Summary				
Average Delay	1.8			
Intersection Capacity Utilization	50.8%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑↱			↱
Traffic Volume (veh/h)	0	1302	866	7	0	4
Future Volume (Veh/h)	0	1302	866	7	0	4
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1415	941	8	0	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	949				1652	474
vC1, stage 1 conf vol					945	
vC2, stage 2 conf vol					708	
vCu, unblocked vol	949				1652	474
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	99
cM capacity (veh/h)	719				216	536

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	708	708	627	322	4
Volume Left	0	0	0	0	0
Volume Right	0	0	0	8	4
cSH	1700	1700	1700	1700	536
Volume to Capacity	0.42	0.42	0.37	0.19	0.01
Queue Length 95th (ft)	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	11.8
Lane LOS					B
Approach Delay (s)	0.0		0.0		11.8
Approach LOS					B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	1300	874	14	0	4
Future Volume (Veh/h)	0	1300	874	14	0	4
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1413	950	15	0	4
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	965				1664	482
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	965				1664	482
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	99
cM capacity (veh/h)	709				88	530

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	706	706	633	332	4
Volume Left	0	0	0	0	0
Volume Right	0	0	0	15	4
cSH	1700	1700	1700	1700	530
Volume to Capacity	0.42	0.42	0.37	0.20	0.01
Queue Length 95th (ft)	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	11.8
Lane LOS					B
Approach Delay (s)	0.0		0.0		11.8
Approach LOS					B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

CDM SMITH Inc.
1100 Marion Street, Suite 300
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File Name : hardinvalley_windflower
Site Code : 00000000
Start Date : 11/9/2017
Page No : 1

Groups Printed- Unshifted

	WINDFLOWER WAY Southbound				HARDIN VALLEY RD Westbound				WINDFLOWER WAY Northbound				HARDIN VALLEY RD Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	129	2	131	7	0	8	15	0	101	1	102	248
07:15 AM	0	0	0	0	2	180	4	186	3	0	8	11	1	103	1	105	302
07:30 AM	0	0	0	0	2	237	4	243	5	0	4	9	4	123	1	128	380
07:45 AM	0	0	0	0	0	273	2	275	3	0	5	8	2	145	1	148	431
Total	0	0	0	0	4	819	12	835	18	0	25	43	7	472	4	483	1361
08:00 AM	0	0	0	0	1	306	6	313	4	0	3	7	2	146	2	150	470
08:15 AM	0	0	0	0	1	232	2	235	1	0	6	7	1	133	0	134	376
08:30 AM	0	0	0	0	2	201	0	203	6	0	5	11	2	114	1	117	331
08:45 AM	0	0	0	0	3	270	1	274	3	0	2	5	1	107	1	109	388
Total	0	0	0	0	7	1009	9	1025	14	0	16	30	6	500	4	510	1565
*** BREAK ***																	
03:00 PM	0	0	0	0	8	115	4	127	0	0	5	5	0	147	4	151	283
03:15 PM	0	0	0	0	3	109	0	112	2	0	5	7	0	147	4	151	270
03:30 PM	0	0	0	0	12	160	1	173	2	0	1	3	0	276	5	281	457
03:45 PM	0	0	0	0	2	124	2	128	3	0	2	5	1	212	6	219	352
Total	0	0	0	0	25	508	7	540	7	0	13	20	1	782	19	802	1362
04:00 PM	0	0	0	0	4	145	2	151	0	0	3	3	1	255	3	259	413
04:15 PM	0	0	0	0	6	137	2	145	0	0	3	3	3	209	4	216	364
04:30 PM	0	0	0	0	3	140	0	143	1	0	2	3	0	273	4	277	423
04:45 PM	0	0	0	0	4	163	2	169	5	0	3	8	0	228	3	231	408
Total	0	0	0	0	17	585	6	608	6	0	11	17	4	965	14	983	1608
05:00 PM	0	0	0	0	5	166	2	173	2	0	3	5	1	321	6	328	506
05:15 PM	0	0	0	0	13	161	1	175	1	0	5	6	0	269	5	274	455
05:30 PM	0	0	0	0	9	210	1	220	5	0	7	12	0	268	6	274	506
05:45 PM	0	0	0	0	3	191	3	197	5	0	2	7	0	236	6	242	446
Total	0	0	0	0	30	728	7	765	13	0	17	30	1	1094	23	1118	1913
Grand Total	0	0	0	0	83	3649	41	3773	58	0	82	140	19	3813	64	3896	7809
Apprch %	0	0	0		2.2	96.7	1.1		41.4	0	58.6		0.5	97.9	1.6		
Total %	0	0	0	0	1.1	46.7	0.5	48.3	0.7	0	1.1	1.8	0.2	48.8	0.8	49.9	

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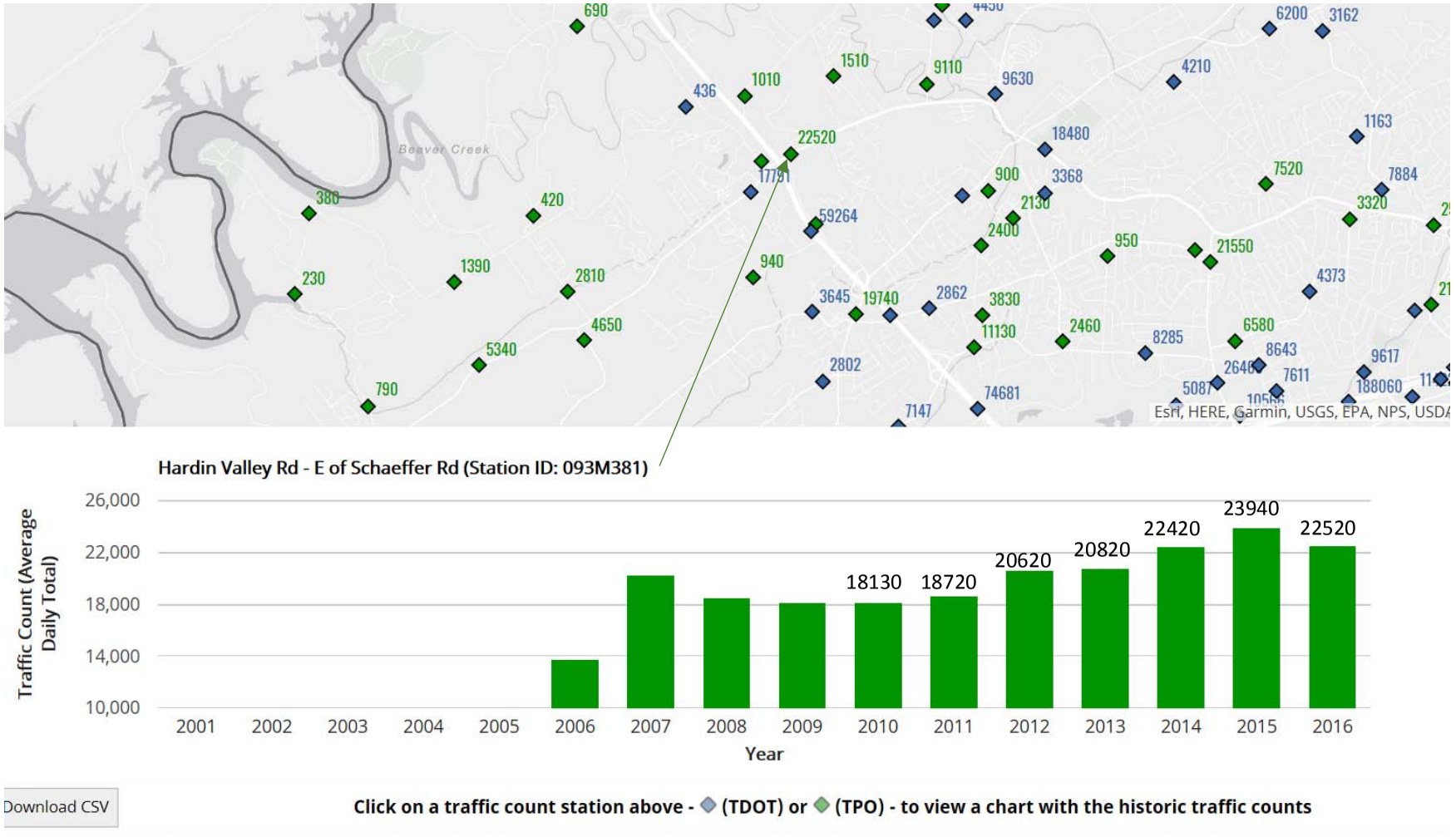
File Name : hardinvalley_windflower
Site Code : 00000000
Start Date : 11/9/2017

	WINDFLOWER WAY Southbound				HARDIN VALLEY RD Westbound				WINDFLOWER WAY Northbound				HARDIN VALLEY RD Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	0	0	0	**2**	237	4	243	**5**	0	4	**9**	**4**	123	1	128	380
07:45 AM	0	0	0	0	0	273	2	275	3	0	5	8	2	145	1	148	431
08:00 AM	0	0	0	0	1	**306**	**6**	**313**	4	0	3	7	2	**146**	**2**	**150**	**470**
08:15 AM	0	0	0	0	1	232	2	235	1	0	**6**	7	1	133	0	134	376
Total Volume	0	0	0	0	4	1048	14	1066	13	0	18	31	9	547	4	560	1657
% App. Total	0	0	0		0.4	98.3	1.3		41.9	0	58.1		1.6	97.7	0.7		
PHF	.000	.000	.000	.000	.500	.856	.583	.851	.650	.000	.750	.861	.563	.937	.500	.933	.881
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	0	0	0	0	5	166	2	173	2	0	3	5	**1**	**321**	**6**	**328**	**506**
05:15 PM	0	0	0	0	**13**	161	1	175	1	0	5	6	0	269	5	274	455
05:30 PM	0	0	0	0	9	**210**	1	**220**	**5**	0	**7**	**12**	0	268	6	274	506
05:45 PM	0	0	0	0	3	191	**3**	197	5	0	2	7	0	236	6	242	446
Total Volume	0	0	0	0	30	728	7	765	13	0	17	30	1	1094	23	1118	1913
% App. Total	0	0	0		3.9	95.2	0.9		43.3	0	56.7		0.1	97.9	2.1		
PHF	.000	.000	.000	.000	.577	.867	.583	.869	.650	.000	.607	.625	.250	.852	.958	.852	.945



5% Average Annual Growth Rate

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

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


CDM
Smith