

# SILVER CREEK AT HARDIN VALLEY APARTMENTS

Transportation Impact Analysis  
Gliding Hawk Lane  
Knoxville, TN 37932

## A Transportation Impact Analysis for Silver Creek at Hardin Valley Apartments

Submitted to

**Knoxville - Knox County Planning**

Revised June 28, 2023  
May 9, 2022  
FMA Project No. 717.001

Submitted By:



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## **Executive Summary**

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The Cornerstone Group is proposing a residential development located in Knox County, TN. The project is located west of the intersection of Hardin Valley Road at Pellissippi Parkway. The full build out of the development will consist of 274 apartment units and amenities including a clubhouse and a swimming pool. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2027.

The proposed residential development will enter/exit the development via the intersection of Gliding Hawk Lane at Hardin Valley Road and Valley Vista Road at the proposed driveway connection.

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

### **Hardin Valley Road @ Gliding Hawk Lane**

Based on the HCS7 queue analysis the existing storage at the intersection of Hardin Valley Road at Gliding Hawk Lane is adequate; however, there is available width at the existing intersection of Hardin Valley Road at Gliding Hawk Lane to add striping for a separate right and left turn lane with a storage length between one to two vehicles per lane. This would reduce the delay for the northbound approach (Gliding Hawk Lane) to an acceptable LOS D during both the AM and PM peak hours.

An eastbound right turn lane on Hardin Valley Road is not warranted per the Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy."

### **Hardin Valley Road @ Valley Vista Road**

The need for a traffic control signal was analyzed using the "Manual of Uniform Traffic Control Devices" (MUTCD) published by the Federal Highway Administration in 2009. The intersection of Hardin Valley Road at Valley Vista Road during the existing, background and full buildout does meet the conditions for Warrant 1, Eight-Hour Vehicular Volume, Warrant 2, Four-Hour Vehicular Volume and Warrant 3, Peak Hour. According to the MUTCD the "satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal."

Consideration also needs to be made for the 70% of right turns from Valley Vista Road onto Hardin Valley Road during both the AM and PM peak hours. If a portion of the right turn traffic is subtracted from the minor street approach the traffic control warrants may no longer be met. FMA recommends continuing to monitor the need for a traffic signal at the intersection of Hardin Valley Road at Valley Vista Road.

**Valley Vista Road @ Roadway Connection**

The minimum required sight distance for a road with a posted speed limit of 30 mph is 300 feet in each direction in accordance with the “Knoxville-Knox County Subdivision Regulations” amended through February 13, 2020. FMA measured the sight distance at the proposed intersection of Valley Vista Road at the driveway connection in May 2022. At 15 feet from the edge of pavement the sight distance at the proposed intersection is greater than 550 feet looking to the north and greater than 350 feet looking to the south.

A southbound right turn lane on Valley Vista Road at the site access roadway connection is not warranted during either the AM or PM peak hours per the Knox County Department of Engineering and Public Works handbook, “Access Control and Driveway Design Policy.”

# 1 Introduction

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## 1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the Silver Creek at Hardin Valley Apartments. The project is located west of the intersection of Hardin Valley Road at Pellissippi Parkway in Knox County, Tennessee. The location of the site is shown in Figure 1.

The full build out of Silver Creek at Hardin Valley Apartments proposed 274 apartment units with amenities including a club house and a swimming pool. Construction is proposed to take place this year, and this study assumes full build out for the development will occur in 2027.

The proposed residential development will enter/exit the roadway network via the intersection of Gliding Hawk Lane at Hardin Valley Road and Valley Vista Road at the proposed driveway connection. Both entrances to the development will be gated.

The concept plan shows an extension of the existing Gliding Hawk Lane and a proposed driveway connection to Valley Vista Road with an internal roadway that connects the apartments. The driveway connection to Valley Vista Road is located approximately 565 feet north of Carmichael Road and approximately 760 feet south of the intersection of Greystone Vista Way. Valley Vista Road is a three-lane roadway with a two-way left turn lane. The proposed site layout is shown in Figure 2.

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

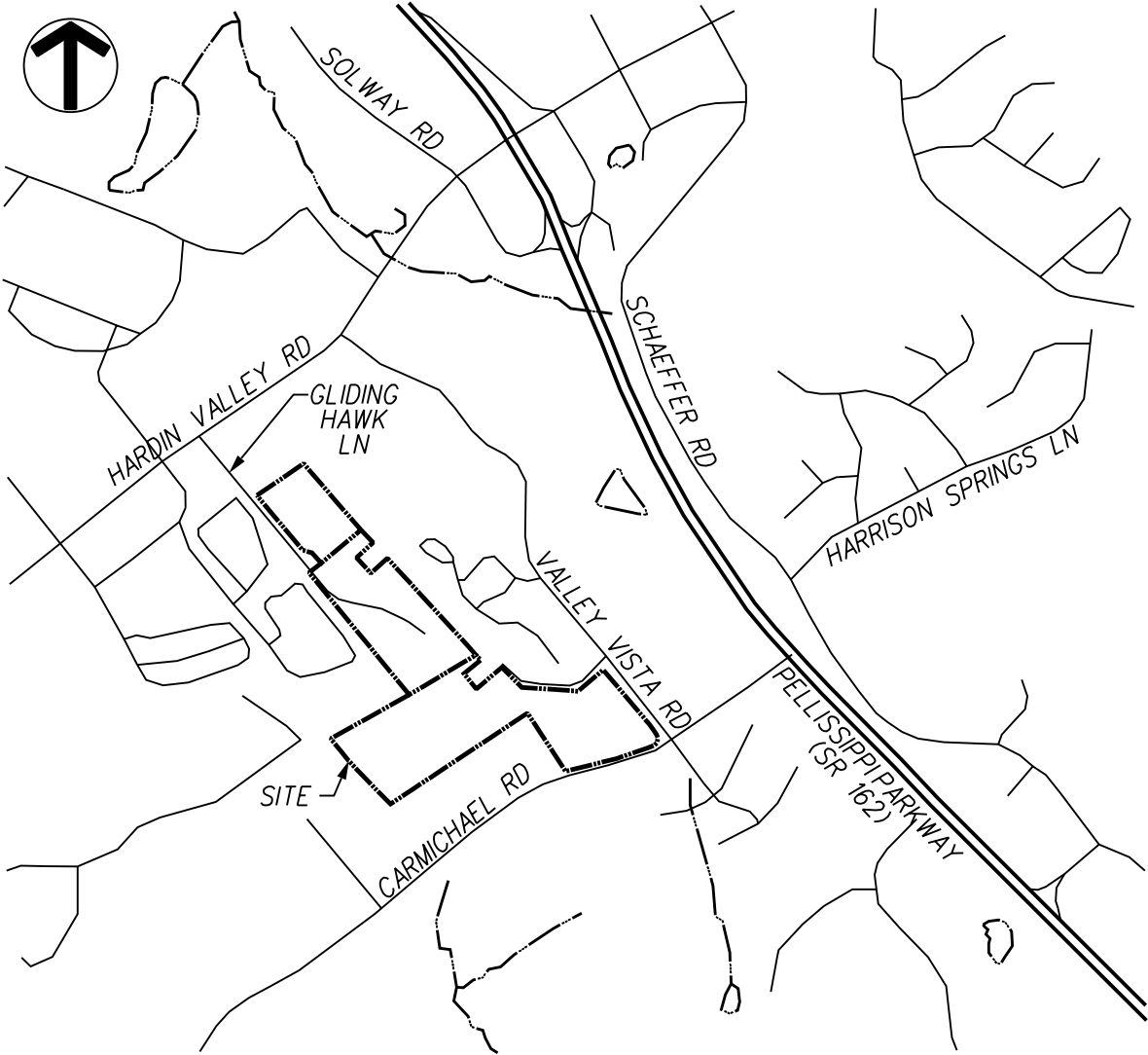


Figure 1: Location Map

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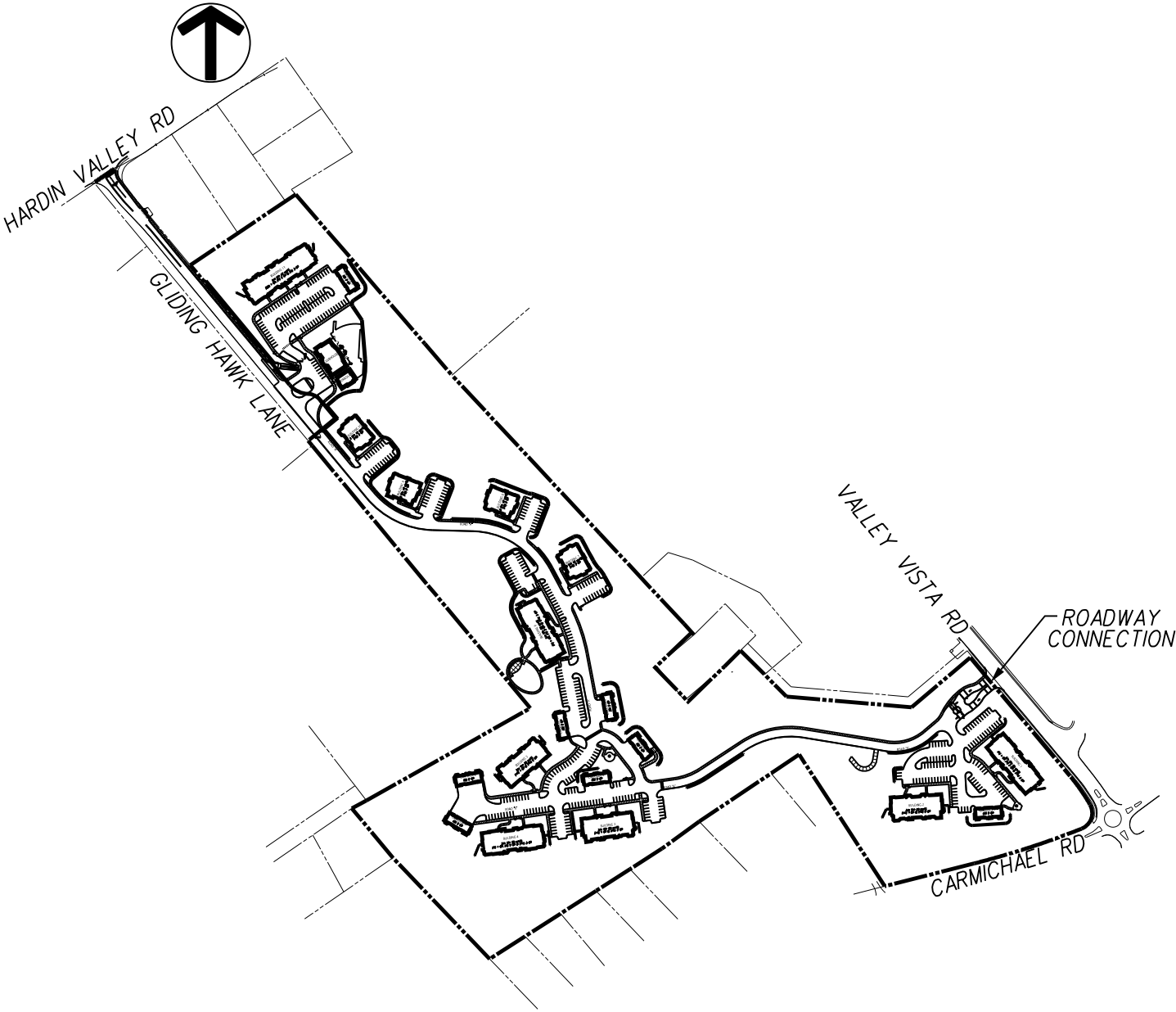


Figure 2: Site Plan



## **1.2 Existing Site Conditions**

Hardin Valley Road is a three-lane road with a two-way left turn lane between Gliding Hawk Lane and Valley Vista Road with an approximate width of 50 feet. Knoxville-Knox County Planning classifies Hardin Valley Road as a Minor Arterial between Solway Road and Steele Road with an 88-foot right-of-way per the Major Road Plan. The posted speed limit on Hardin Valley Road is 40 mph.

Valley Vista Road is a three-lane road with a two-way left turn lane and an approximate width of 55 feet. Knoxville-Knox County Planning classifies Valley Vista Road as a Minor Collector between Hardin Valley Road and Carmichael Road with a 70-foot right-of-way per the Major Road Plan. The posted speed limit on Valley Vista Road is 30 mph.

Gliding Hawk Lane is a two-lane, dead-end road with an approximate width of 26 feet and an existing length of 1,950 LF. Knoxville-Knox County Planning does not classify Gliding Hawk Lane; therefore, it is considered a local street. There is no posted speed limit on Gliding Hawk Lane.

Hardin Valley Road has sidewalks on both sides of the street. Existing crosswalks are located at all four directions at the signalized intersection of Hardin Valley Road at Performing Arts Way/Greenland Way and at each of the driveway connections to Hardin Valley Road between Valley Vista Road and Gliding Hawk Lane. There are no existing sidewalks on Gliding Hawk Lane.

There are no designated bike lanes along Hardin Valley Road or in the vicinity of the proposed development. The Pellissippi Greenway is located east of the proposed development.

An aerial photo of the proposed driveway connection with Valley Vista Road, the intersection of Hardin Valley Road at Valley Vista Road, and the intersection of Hardin Valley Road at Gliding Hawk Lane are included in Attachment 1.

## 2 Existing Traffic Volumes

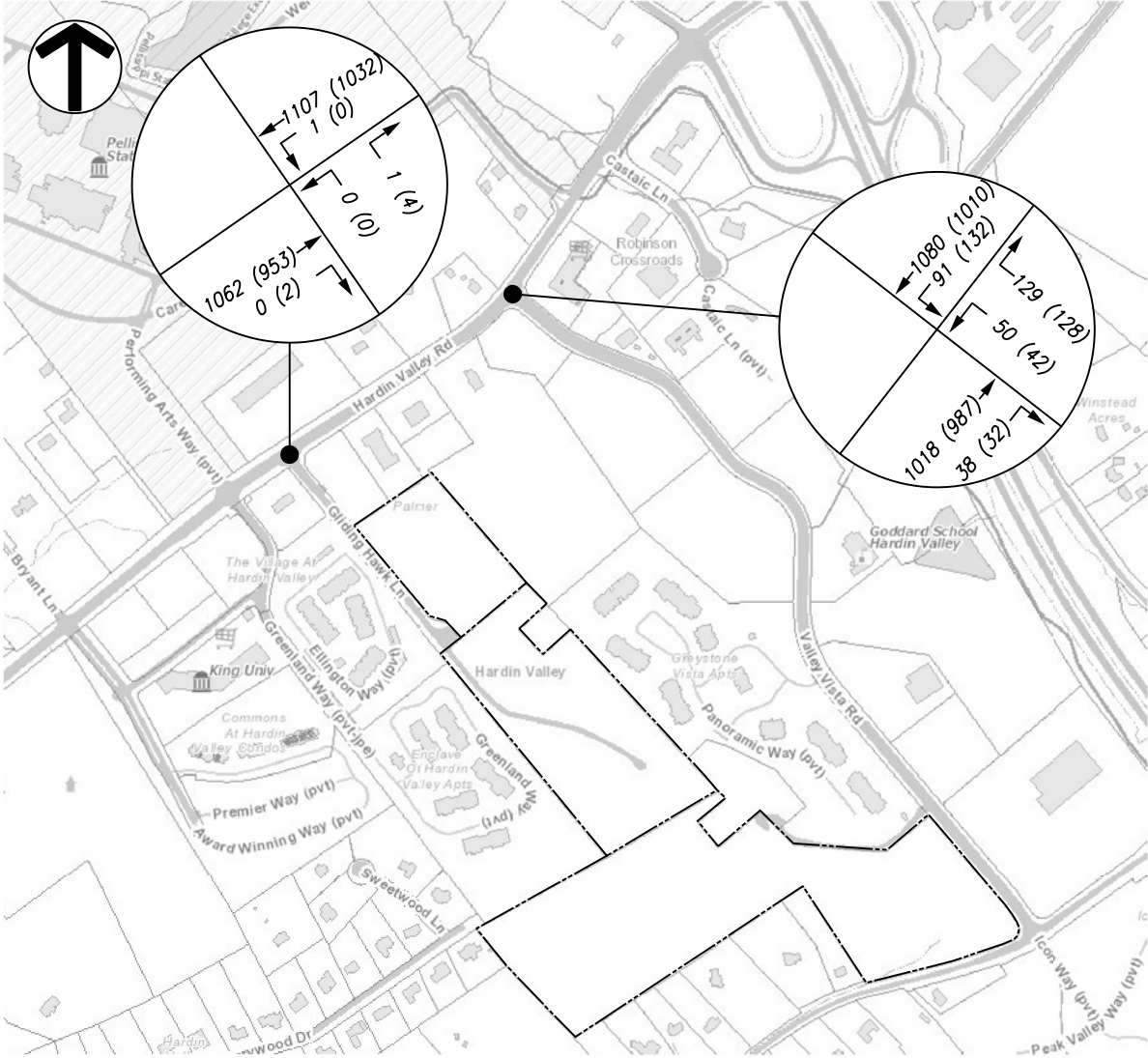
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FMA conducted a 13-hour turning movement count at the intersection of Hardin Valley Road at Gliding Hawk Lane on Tuesday, April 29, 2022. The AM peak hour occurred between 7:30 a.m. and 8:30 a.m. with an AM PHF of 0.94. The PM peak hour occurred between 4:45 p.m. and 5:45 p.m. with a PM PHF of 0.95.

FMA conducted a 13-hour turning movement count at the intersection of Hardin Valley Road at Valley Vista Road on Tuesday, April 29, 2022. The AM peak hour occurred between 7:30 a.m. and 8:30 a.m. with an AM PHF of 0.96. The PM peak hour occurred between 4:45 p.m. and 5:45 p.m. with a PM PHF of 0.95.

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

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**LEGEND:**

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

Figure 3: 2022 Existing Peak Hour Traffic

### 3 Background Growth

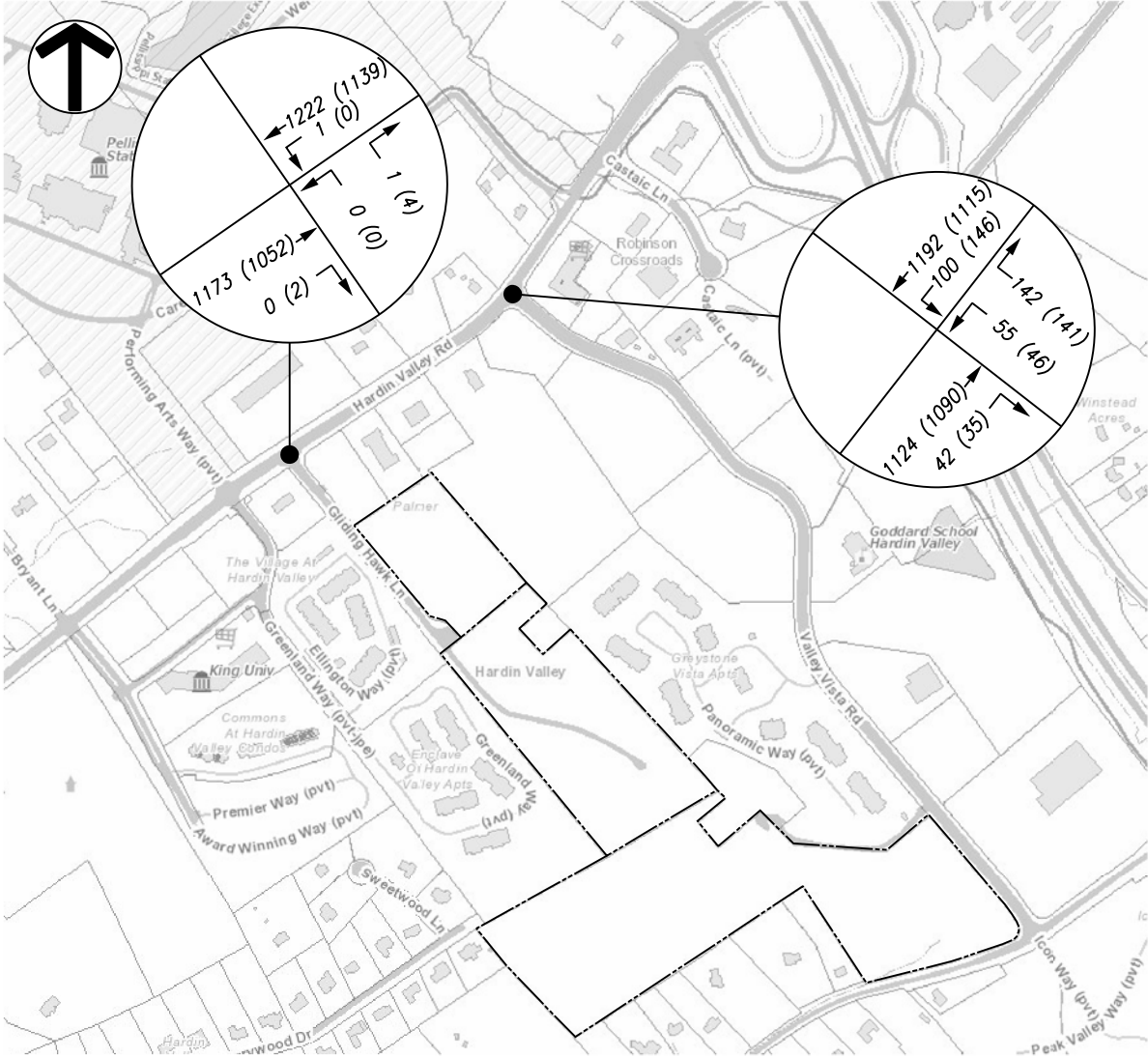
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The Tennessee Department of Transportation (TDOT) maintains a count station in the vicinity of the proposed development.

TDOT count station #47000084 is located on Hardin Valley Road west of Pellissippi Parkway and near the intersection with Valley Vista Road. The annual growth rate for this station over the last ten years is approximately 0.06% and the 2022 ADT was 17,908 vehicles per day.

For the purpose of this study, an annual growth rate of 2.0% was assumed for the traffic at the intersections of Hardin Valley Road at Gliding Hawk Lane and Hardin Valley Road at Valley Vista Road until full occupancy is reached in 2027. A trend line growth chart for the TDOT count station is included in Attachment 3.

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



**LEGEND:**

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

Figure 4: 2027 Background Peak Hour Traffic

## **4 Trip Generation and Trip Distribution**

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Silver Creek at Hardin Valley Apartments proposed 274 apartment units with amenities including a clubhouse and a swimming pool. 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 fitted curve equations from the local study were used to calculate site trips for the Silver Creek at Hardin Valley Apartments. The land use worksheets are included in Attachment 4.

The total trips generated by the full buildout of Silver Creek at Hardin Valley Apartments was estimated to be 2,330 daily trips. The estimated trips are 134 trips during the AM peak hour and 191 trips during the PM peak hour. A trip generation summary is shown in Table 4-1.

**Table 4-1  
Silver Creek at Hardin Valley Apartments  
Trip Generation Summary**

Land Use	Density	Daily Trips	AM Peak Hour		PM Peak Hour	
			Enter	Exit	Enter	Exit
Apartments (Local Trip Gen Study)	274 units	2361	30	106	106	87

The existing distribution of traffic on Hardin Valley Road at the intersection with Valley Vista Road is approximately 50% eastbound and 50% westbound during both the AM and PM peak hour.

The directional distribution of the traffic generated by Silver Creek at Hardin Valley Apartments was determined using the existing traffic volumes in combination with the concept plan layout. During the AM peak hour the entering traffic was assumed to be 25% Hardin Valley Road eastbound, 70% Hardin Valley Road westbound and 5% Carmichael Road and the exiting trip distribution was assumed to be 25% Hardin Valley Road westbound, 70% Hardin Valley Road eastbound and 15% Carmichael Road. During the PM peak hour the entering traffic was assumed to be 20% Hardin Valley Road eastbound, 75% Hardin Valley Road westbound and 5% Carmichael Road and the exiting trip distribution was assumed to be 20% Hardin Valley Road westbound, 60% Hardin Valley Road eastbound and 20% Carmichael Road.

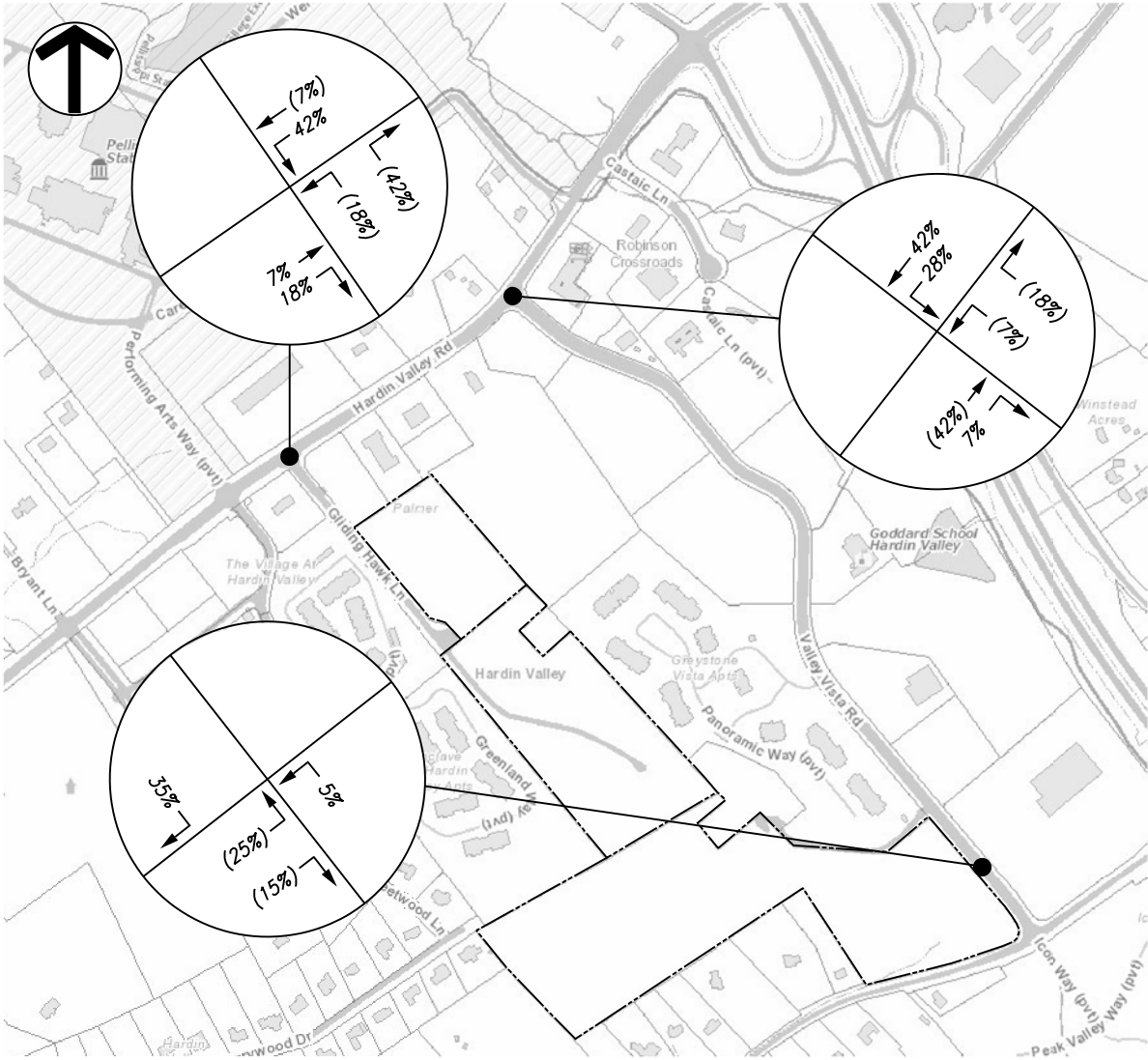
FMA assumed that 60% of traffic would enter/exit the development to/from the existing intersection of Hardin Valley Road at Gliding Hawk Lane and that 40% of

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traffic would enter/exit the development to/from the intersection of Valley Vista Road at the driveway connection.

Figure 5 shows the AM peak hour trip distribution and Figure 6 shows the PM peak hour trip distribution for Silver Creek at Hardin Valley Apartments. Figure 7 shows the apartment peak hour site trips and Figure 8 shows the 2027 full buildout peak hour traffic including the background traffic data combined with the peak hour site trips for Silver Creek at Hardin Valley Apartments.

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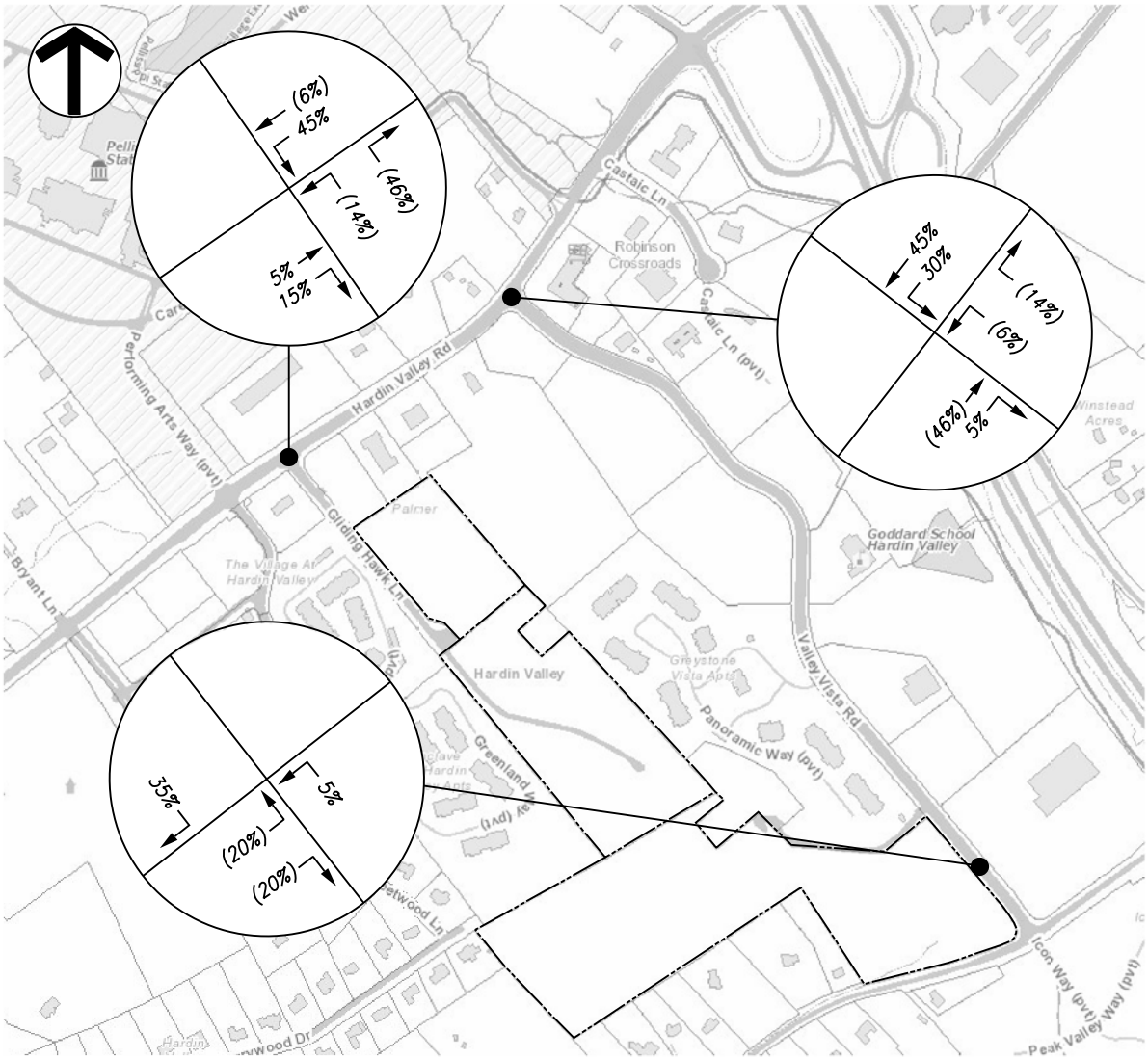
**LEGEND:**

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

Figure 5: AM Peak Hour Trip Distribution



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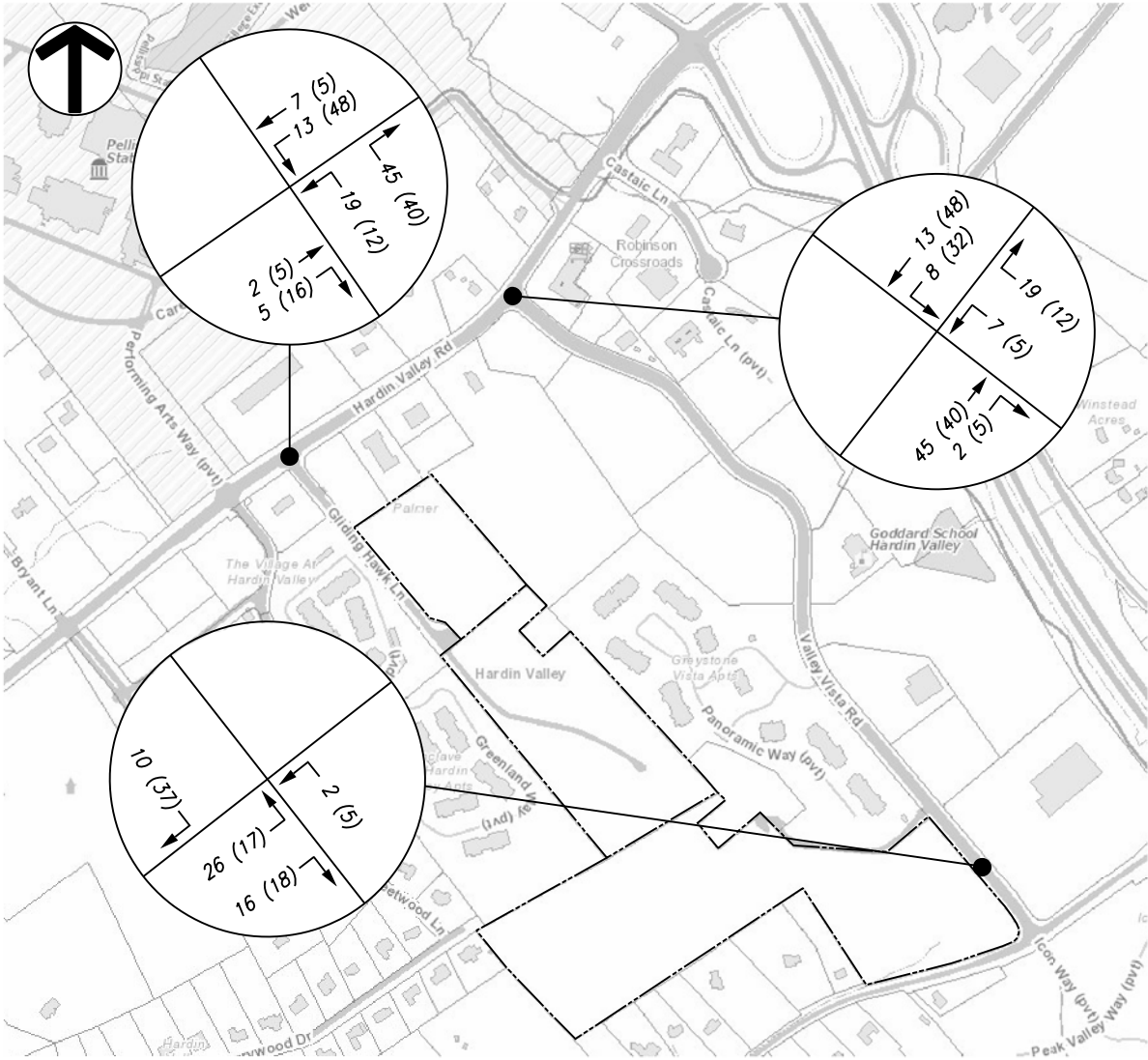


**LEGEND:**

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

Figure 6: PM Peak Hour Trip Distribution

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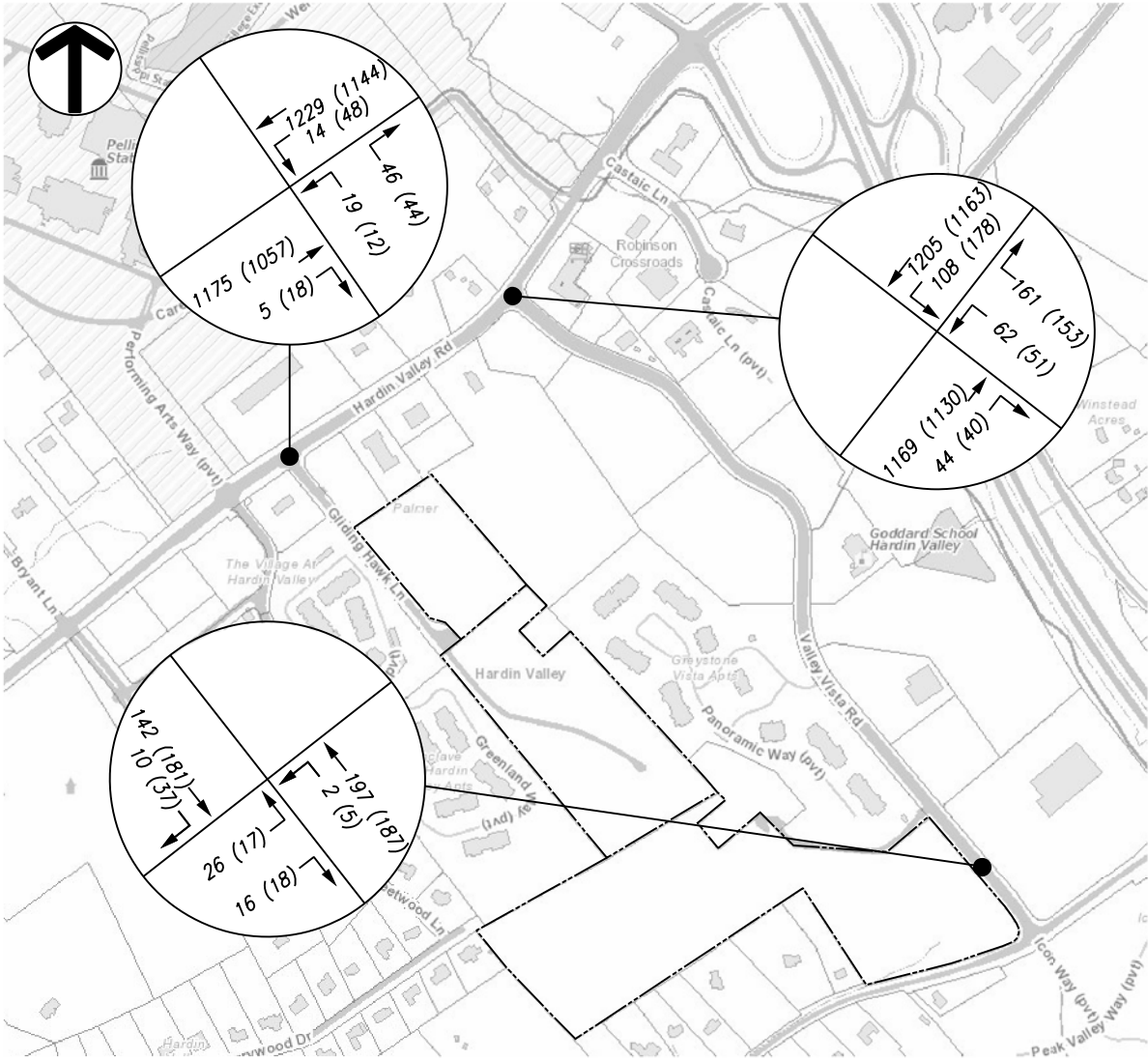


**LEGEND:**

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

Figure 7: Apartment Peak Hour Site Trips

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**LEGEND:**

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

Figure 8: 2027 Full Buildout Site Traffic

## 5 Projected Capacity and Level of Service

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The existing intersection of Hardin Valley Road at Gliding Hawk Lane is a three-legged intersection with a stop sign for northbound traffic on Gliding Hawk Lane. Hardin Valley Road has an existing two-way left turn lane.

Unsignalized intersection capacity analyses were performed using the Highway Capacity Software (HCS7) for the AM and PM peak hours to evaluate the existing, background and full buildout conditions at the intersection of Hardin Valley Road at Gliding Hawk Lane.

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.

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

Delay (sec)/LOS		
<b>Hardin Valley Road @ Gliding Hawk Lane (Existing 2022)</b>		
AM Peak	WB Left Turn	10.8 / B
	NB Approach	19.6 / C
PM Peak	WB Left Turn	10.2 / B
	NB Approach	17.4 / C
<b>Hardin Valley Road @ Gliding Hawk Lane (Background 2027)</b>		
AM Peak	WB Left Turn	11.5 / B
	NB Approach	22.1 / C
PM Peak	WB Left Turn	10.7 / B
	NB Approach	19.3 / C
<b>Hardin Valley Road @ Gliding Hawk Lane (Full Buildout 2027)</b>		
AM Peak	WB Left Turn	11.7 / B
	NB Approach	37.9 / E
PM Peak	WB Left Turn	11.4 / B
	NB Approach	28.4 / D
<b>Hardin Valley Road @ Gliding Hawk Lane (Full Buildout 2027)**</b>		
AM Peak	WB Left Turn	11.7 / B
	NB Approach	30.5 / D
PM Peak	WB Left Turn	11.4 / B
	NB Approach	25.1 / D

\*\* Updated the northbound approach to include separate left and right turn lanes.

## **6 Turn Lane Warrant Analysis**

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The intersection of Hardin Valley Road at Gliding Hawk Lane was evaluated to determine if an eastbound right turn lane or a westbound left turn lane are warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information.

Hardin Valley Road at the intersection of Gliding Hawk Lane has an existing two-way left turn lane.

A westbound left turn lane is warranted during the PM peak hour and an eastbound right turn lane is not warranted during either the AM or PM peak hour after the full buildout of Silver Creek at Hardin Valley Apartments.

The intersection of Valley Vista Road at the site access roadway connection was evaluated to determine if a southbound right turn lane is warranted. Valley Vista Road at the intersection of the proposed site access roadway connection has an existing two-way left turn lane.

A southbound right turn lane at the intersection of Valley Vista Road at the proposed site access roadway connection is not warranted during either the AM or PM peak hours after the full buildout of the Silver Creek at Hardin Valley Apartments.

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

## **7 Signal Warrant Analysis**

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The intersection of Hardin Valley Road at Valley Vista Road was evaluated to determine if a traffic signal is warranted for the existing, background and full buildout conditions. The "Manual of Uniform Traffic Control Devices" (MUTCD) published by the Federal Highway Administration in 2009 was used to determine if the intersection met a warrant for a signal. The volume-based warrants including Warrant 1, Eight-Hour Vehicular Volume, Warrant 2, Four-Hour Vehicular Volume and Warrant 3, Peak Hour were evaluated based on existing, background and full buildout conditions. The traffic signal warrant worksheet is included in Attachment 9.

The intersection of Hardin Valley Road at Valley Vista Road does meet the requirements for Warrant 1, Eight-Hour Vehicular Volume, Warrant 2, Four-Hour Vehicular Volume and Warrant 3, Peak Hour for the existing, background and full buildout conditions. No reduction for right turning traffic on the minor approach was included in the analysis.

## 8 Conclusions and Recommendations

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### 8.1 Hardin Valley Road @ Gliding Hawk Lane

Gliding Hawk Lane at the intersection with Hardin Valley Road is a three-leg intersection with a stop sign on the minor approach. Hardin Valley Road has an existing two-way left turn lane.

The existing traffic conditions for the westbound left turn movement (Hardin Valley Road) operate at a LOS B during both the AM and PM peak hours and the northbound approach (Gliding Hawk Lane) operates at a LOS C during both the AM and PM peak hours.

The background traffic conditions for the westbound left turn movement (Hardin Valley Road) operate at a LOS B during both the AM and PM peak hours and the northbound approach (Gliding Hawk Lane) operates at a LOS C during both the AM and PM peak hours.

After the completion of the Silver Creek at Hardin Valley Apartments residential development the full buildout traffic conditions for the intersection of Hardin Valley Road at Gliding Hawk Lane will operate as follows. The westbound left turn movement (Hardin Valley Road) will continue to operate at a LOS B during both the AM and PM peak hours. The northbound approach (Gliding Hawk Lane) will operate at a LOS E during the AM peak hour and a LOS D during the PM peak hour.

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

The existing two-way left turn lane has an available storage length of approximately 125 feet (5 vehicles) before the queue would block the intersection of the strip plaza driveway. The unsignalized intersection capacity analysis shows the full buildout 95% queue length for the westbound left turn lane (Hardin Valley Road) of less than one vehicle during both the AM and PM peak hours.

The unsignalized intersection capacity analysis shows the full buildout 95% queue length for the northbound approach (Gliding Hawk Lane) of 1.7 vehicles during the AM peak hour and 1.1 vehicles during the PM peak hour. Based on the HCS7 queue

analysis the existing storage at the intersection of Hardin Valley Road at Gliding Hawk Lane is adequate; however, there is available width at the existing intersection of Hardin Valley Road at Gliding Hawk Lane to add striping for a separate right and left turn lane with a storage length between one to two vehicles per lane. This would reduce the delay for the northbound approach (Gliding Hawk Lane) to an acceptable LOS D during both the AM and PM peak hours.

An eastbound right turn lane on Hardin Valley Road is not warranted during either the AM or PM peak hours per the Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy."

## **8.2 Hardin Valley Road @ Valley Vista Road**

The need for a traffic control signal was analyzed using the "Manual of Uniform Traffic Control Devices" (MUTCD) published by the Federal Highway Administration in 2009. The intersection of Hardin Valley Road at Valley Vista Road during the existing, background and full buildout does meet the conditions for Warrant 1, Eight-Hour Vehicular Volume, Warrant 2, Four-Hour Vehicular Volume and Warrant 3, Peak Hour. According to the MUTCD the "satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal."

Consideration also needs to be made for the 70% of right turns from Valley Vista Road onto Hardin Valley Road during both the AM and PM peak hours. If a portion of the right turn traffic is subtracted from the minor street approach the traffic control warrants may no longer be met. FMA recommends continuing to monitor the need for a traffic signal at the intersection of Hardin Valley Road at Valley Vista Road.

## **8.3 Valley Vista Road at Roadway Connection**

Valley Vista Road is classified as a Minor Collector per the Major Road Plan. The minimum intersection spacing required on a collector is 300 feet per the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020. The roadway connection is located approximately 565 feet north of the intersection with Carmichael Road and approximately 760 feet south of the intersection with Greystone Vista Way and exceeds the typical minimum separation on a collector; therefore, no change is necessary.

The minimum required sight distance for a road with a posted speed limit of 30 mph is 300 feet in each direction in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020. FMA measured the sight distance at the proposed intersection of Valley Vista Road at the driveway connection in May 2022. At 15 feet from the edge of pavement the sight distance at



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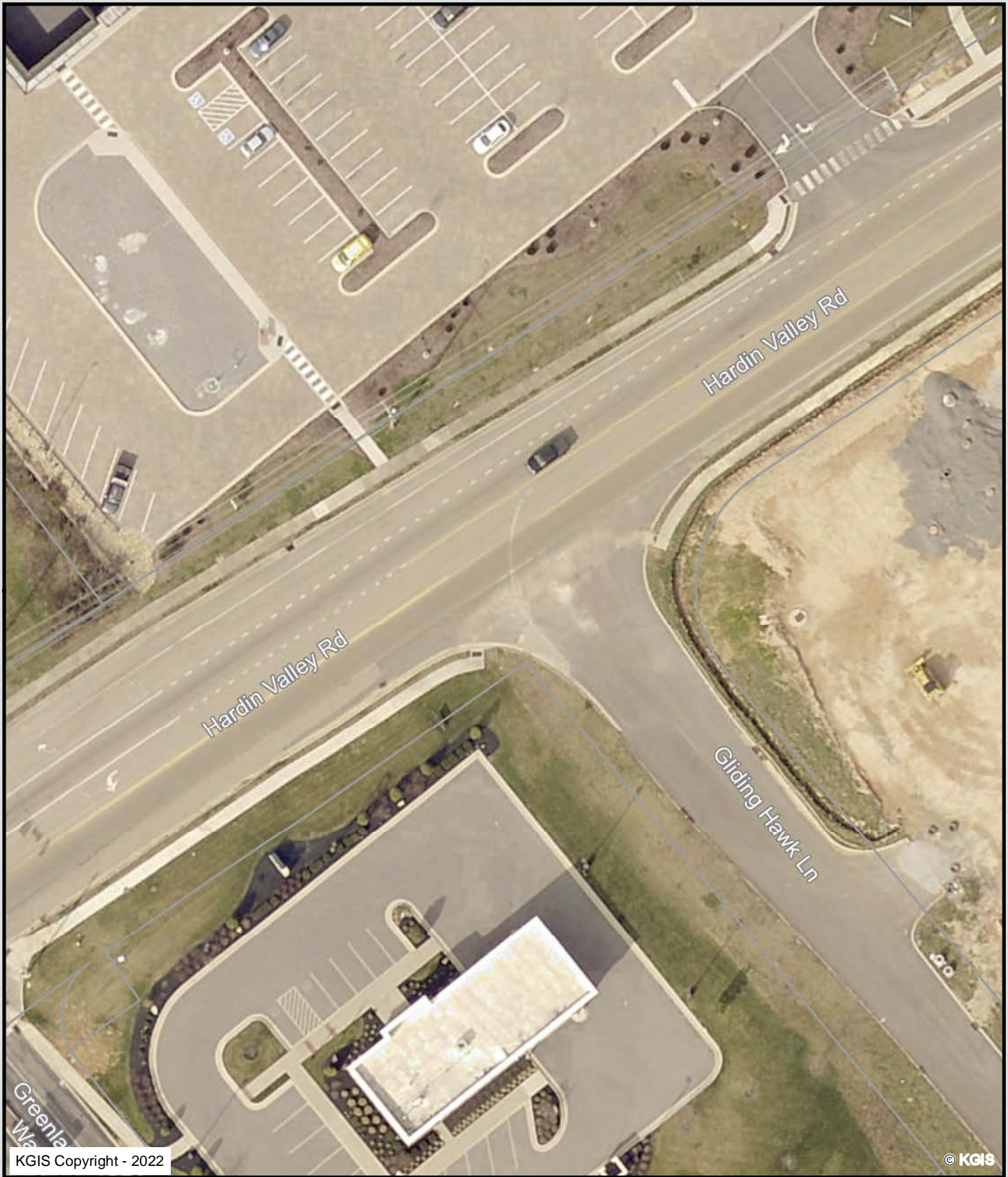
the proposed intersection is greater than 550 feet looking to the north and greater than 350 feet looking to the south. Attachment 10 shows photos of the sight distance at the proposed intersection.

A southbound right turn lane at the intersection of Valley Vista Road at the site access roadway connection is not warranted during either the AM or PM peak hours per the Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy."

The width of the proposed internal roadways will have a width of 26 feet in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020.

**Attachment 1**  
**Aerial Photos**

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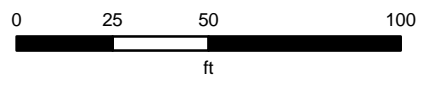


### Hardin Valley at Gliding Hawk

**Knoxville - Knox County - KUB Geographic Information System**

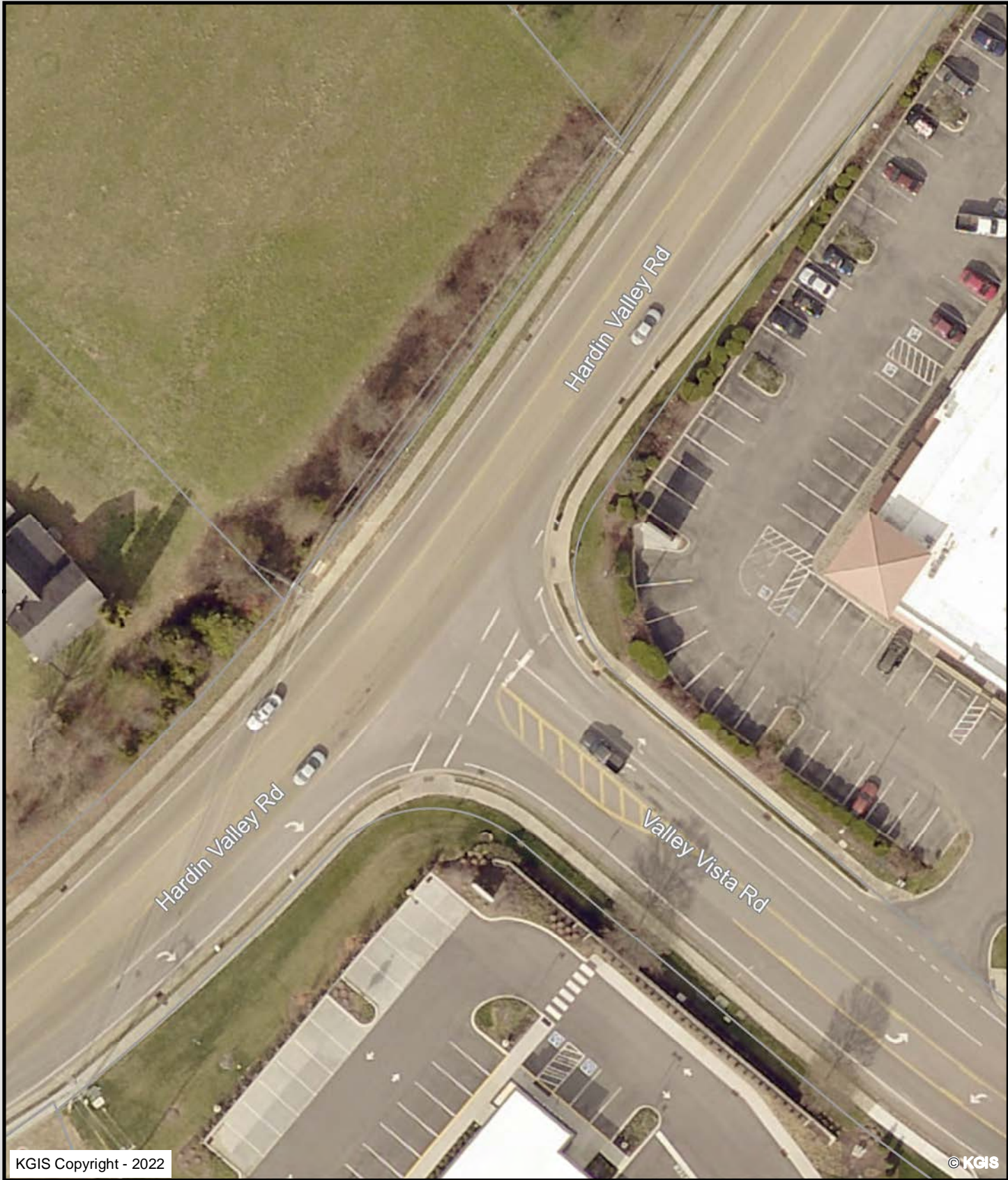


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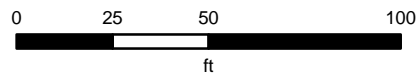
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## Hardin Valley at Valley Vista

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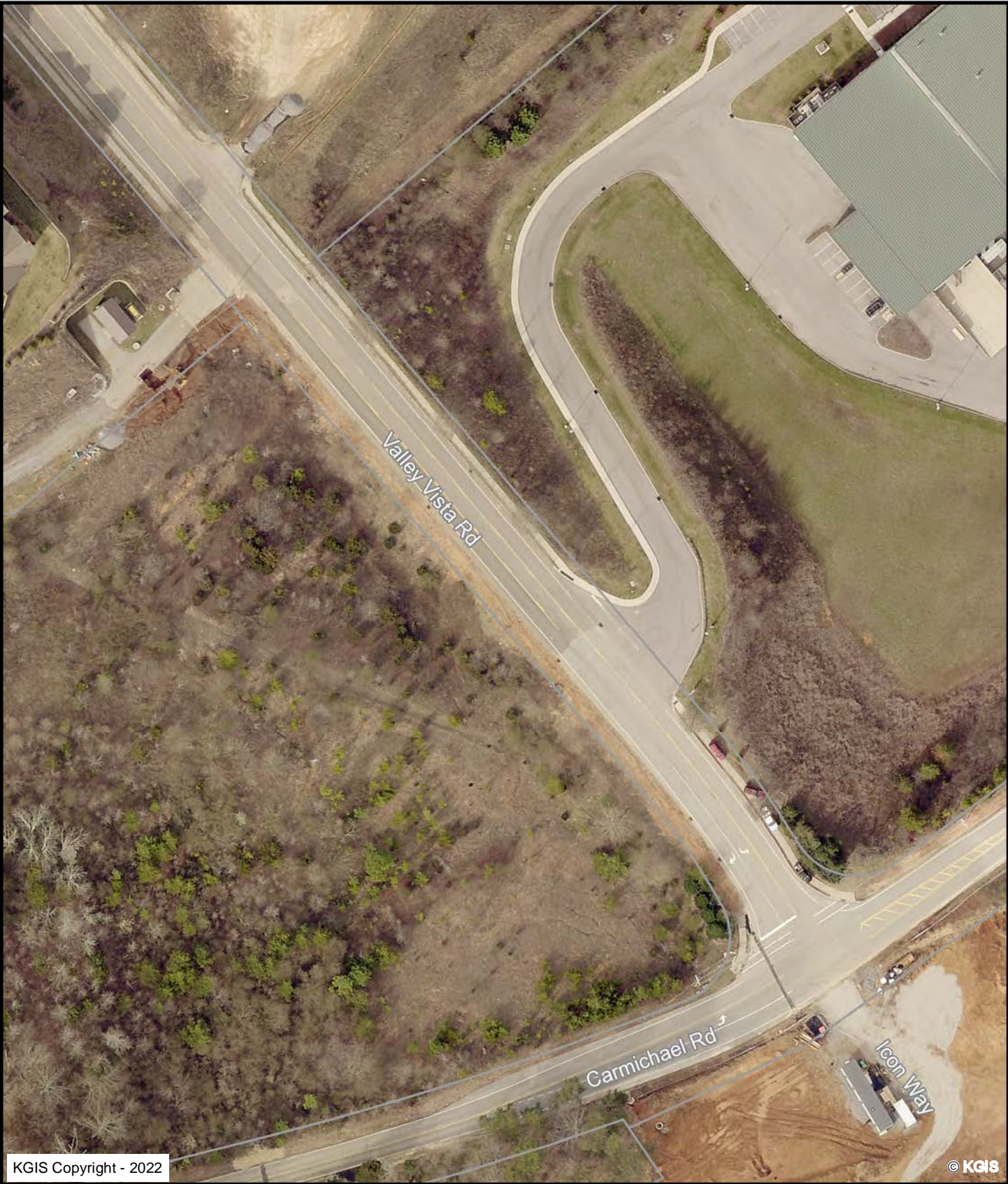


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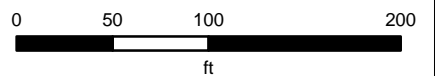


### Valley Vista at Driveway

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**Attachment 2**  
**Traffic Counts**

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**Project: Silver Creek at Hardin Valley Apartments**  
**Intersection: Hardin Valley Road at Gliding Hawk Lane**  
**Date Conducted: Tuesday, April 19, 2022**

Start	Hardin Valley Road Westbound			Gliding Hawk Lane Northbound			Hardin Valley Road Eastbound			Int. Total
	Left	Thru	Total	Left	Right	Total	Thru	Right	Total	
7:00 AM	0	200	200	0	0	0	189	0	189	389
7:15 AM	0	215	215	0	0	0	265	0	265	480
7:30 AM	0	236	236	0	0	0	295	0	295	531
7:45 AM	1	293	294	0	1	1	266	0	266	561
Total	1	944	945	0	1	1	1015	0	1015	1961
8:00 AM	0	333	333	0	0	0	247	0	247	580
8:15 AM	0	245	245	0	0	0	254	0	254	499
8:30 AM	0	139	139	0	0	0	220	0	220	359
8:45 AM	0	138	138	0	0	0	155	0	155	293
Total	0	855	855	0	0	0	876	0	876	1731
9:00 AM	1	164	165	0	1	1	132	0	132	298
9:15 AM	0	118	118	0	0	0	154	0	154	272
9:30 AM	1	108	109	0	1	1	112	0	112	222
9:45 AM	0	111	111	0	0	0	124	0	124	235
Total	2	501	503	0	2	2	522	0	522	1027
10:00 AM	0	90	90	0	0	0	109	0	109	199
10:15 AM	0	104	104	0	0	0	131	0	131	235
10:30 AM	0	131	131	0	0	0	194	0	194	325
10:45 AM	0	127	127	0	0	0	135	0	135	262
Total	0	452	452	0	0	0	569	0	569	1021
11:00 AM	0	115	115	0	0	0	123	0	123	238
11:15 AM	0	87	87	0	0	0	135	0	135	222
11:30 AM	2	128	130	0	0	0	180	0	180	310
11:45 AM	0	155	155	1	0	1	175	0	175	331
Total	2	485	487	1	0	1	613	0	613	1101
12:00 PM	0	141	141	0	1	1	214	0	214	356
12:15 PM	0	130	130	0	0	0	164	0	164	294
12:30 PM	0	140	140	0	1	1	170	1	171	312
12:45 PM	0	160	160	0	0	0	165	0	165	325
Total	0	571	571	0	2	2	713	1	714	1287
1:00 PM	0	145	145	0	1	1	154	0	154	300
1:15 PM	3	138	141	0	3	3	163	0	163	307
1:30 PM	0	144	144	0	0	0	201	0	201	345
1:45 PM	0	154	154	0	0	0	216	0	216	370
Total	3	581	584	0	4	4	734	0	734	1322
2:00 PM	1	162	163	0	0	0	152	0	152	315
2:15 PM	0	168	168	0	0	0	138	1	139	307

2:30 PM	1	169	170	0	4	4	149	1	150	324
2:45 PM	0	170	170	0	0	0	171	0	171	341
Total	2	669	671	0	4	4	610	2	612	1287
3:00 PM	0	193	193	0	0	0	188	0	188	381
3:15 PM	1	205	206	0	1	1	192	0	192	399
3:30 PM	0	200	200	0	0	0	235	0	235	435
3:45 PM	0	187	187	0	1	1	235	0	235	423
Total	1	785	786	0	2	2	850	0	850	1638
4:00 PM	2	193	195	0	0	0	259	0	259	454
4:15 PM	1	218	219	0	1	1	243	0	243	463
4:30 PM	0	233	233	0	0	0	231	0	231	464
4:45 PM	0	274	274	0	3	3	193	1	194	471
Total	3	918	921	0	4	4	926	1	927	1852
5:00 PM	0	264	264	0	0	0	254	0	254	518
5:15 PM	0	229	229	0	1	1	248	1	249	479
5:30 PM	0	265	265	0	0	0	258	0	258	523
5:45 PM	1	241	242	0	0	0	211	0	211	453
Total	1	999	1000	0	1	1	971	1	972	1973
6:00 PM	1	237	238	1	0	1	207	1	208	447
6:15 PM	0	204	204	0	0	0	197	0	197	401
6:30 PM	0	207	207	0	2	2	165	1	166	375
6:45 PM	0	200	200	0	0	0	122	0	122	322
Total	1	848	849	1	2	3	691	2	693	1545
Grand Total	16	8608	8624	2	22	24	9090	7	9097	17745
Approach %	0.2	99.8		8.3	91.7		99.9	0.1		
Total %	0.1	48.5	48.6	0.0	0.1	0.1	51.2	0.0	51.3	



**Project: Silver Creek at Hardin Valley Apartments**  
**Intersection: Hardin Valley Road at Gliding Hawk Lane**  
**Date Conducted: Tuesday, April 19, 2022**

AM Peak Hour	7:30 AM - 8:30 AM	0.94
PM Peak Hour	4:45 PM - 5:45 PM	0.95

Start	Hardin Valley Road Westbound			Gliding Hawk Lane Northbound			Hardin Valley Road Eastbound			Int. Total
	Left	Thru	Total	Left	Right	Total	Thru	Right	Total	
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:30 AM										
7:30 AM	0	236	236	0	0	0	<b>295</b>	0	295	531
7:45 AM	<b>1</b>	293	294	0	<b>1</b>	1	266	0	266	561
8:00 AM	0	<b>333</b>	333	0	0	0	247	0	247	<b>580</b>
8:15 AM	0	245	245	0	0	0	254	<b>0</b>	254	499
Total Volume	1	1107	1108	0	1	1	1062	0	1062	2171
Future (2% over 5 yrs)	1	1222		0	1		1173	0		2397
PHF	0.25	0.83		-	0.25		0.90	-		0.94
Peak Hour Analysis from 2:00 PM to 6:00 PM										
PM Peak Hour begins at 4:45 PM										
4:45 PM	0	<b>274</b>	274	0	<b>3</b>	3	193	<b>1</b>	194	471
5:00 PM	0	264	264	0	0	0	254	0	254	518
5:15 PM	0	229	229	0	1	1	248	1	249	479
5:30 PM	0	265	265	0	0	0	<b>258</b>	0	258	<b>523</b>
Total Volume	0	1032	1032	0	4	4	953	2	955	1991
Future (2% over 5 yrs)	0	1139		0	4		1052	2		2198
PHF	-	0.94		-	0.33		0.92	0.50		0.95

**Project: Silver Creek at Hardin Valley Apartments**  
**Intersection: Hardin Valley Road at Valley Vista Road**  
**Date Conducted: Tuesday, April 19, 2022**

Start	Hardin Valley Road Westbound			Valley Vista Road Northbound			Hardin Valley Road Eastbound			Int. Total
	Left	Thru	Total	Left	Right	Total	Thru	Right	Total	
7:00 AM	17	188	205	9	19	28	180	7	187	420
7:15 AM	11	215	226	8	24	32	252	10	262	520
7:30 AM	26	244	270	5	41	46	269	11	280	596
7:45 AM	22	301	323	5	21	26	266	13	279	628
Total	76	948	1024	27	105	132	967	41	1008	2164
8:00 AM	17	311	328	24	29	53	239	5	244	625
8:15 AM	26	224	250	16	38	54	244	9	253	557
8:30 AM	20	144	164	5	25	30	212	11	223	417
8:45 AM	38	148	186	2	21	23	163	6	169	378
Total	101	827	928	47	113	160	858	31	889	1977
9:00 AM	27	168	195	5	26	31	126	4	130	356
9:15 AM	19	115	134	10	28	38	155	2	157	329
9:30 AM	22	112	134	7	13	20	120	4	124	278
9:45 AM	19	120	139	5	20	25	127	3	130	294
Total	87	515	602	27	87	114	528	13	541	1257
10:00 AM	19	91	110	3	14	17	111	5	116	243
10:15 AM	19	115	134	5	11	16	143	5	148	298
10:30 AM	20	128	148	5	13	18	188	6	194	360
10:45 AM	23	130	153	7	13	20	129	5	134	307
Total	81	464	545	20	51	71	571	21	592	1208
11:00 AM	16	128	144	13	10	23	138	7	145	312
11:15 AM	18	110	128	4	12	16	140	10	150	294
11:30 AM	24	150	174	13	22	35	176	17	193	402
11:45 AM	32	188	220	8	22	30	175	14	189	439
Total	90	576	666	38	66	104	629	48	677	1447
12:00 PM	36	171	207	5	20	25	243	10	253	485
12:15 PM	24	146	170	8	27	35	186	11	197	402
12:30 PM	18	157	175	10	16	26	196	6	202	403
12:45 PM	24	166	190	10	17	27	183	8	191	408
Total	102	640	742	33	80	113	808	35	843	1698
1:00 PM	31	161	192	9	15	24	164	9	173	389
1:15 PM	29	131	160	12	14	26	176	6	182	368
1:30 PM	19	158	177	6	12	18	207	9	216	411
1:45 PM	38	143	181	8	30	38	220	11	231	450
Total	117	593	710	35	71	106	767	35	802	1618
2:00 PM	25	163	188	5	20	25	153	8	161	374
2:15 PM	19	175	194	8	22	30	138	9	147	371
2:30 PM	21	175	196	3	14	17	165	4	169	382
2:45 PM	28	161	189	7	20	27	172	16	188	404
Total	93	674	767	23	76	99	628	37	665	1531

3:00 PM	34	201	235	11	21	32	190	12	202	469
3:15 PM	24	220	244	8	15	23	197	5	202	469
3:30 PM	37	213	250	3	17	20	240	8	248	518
3:45 PM	38	180	218	7	25	32	242	8	250	500
Total	133	814	947	29	78	107	869	33	902	1956
4:00 PM	26	199	225	9	24	33	254	6	260	518
4:15 PM	31	218	249	11	23	34	243	11	254	537
4:30 PM	28	243	271	7	26	33	230	8	238	542
4:45 PM	34	278	312	13	34	47	211	6	217	576
Total	119	938	1057	40	107	147	938	31	969	2173
5:00 PM	19	239	258	9	33	42	263	10	273	573
5:15 PM	37	227	264	11	36	47	250	7	257	568
5:30 PM	42	266	308	9	25	34	263	9	272	614
5:45 PM	36	243	279	11	30	41	218	6	224	544
Total	134	975	1109	40	124	164	994	32	1026	2299
6:00 PM	28	221	249	10	30	40	211	8	219	508
6:15 PM	26	200	226	7	25	32	201	7	208	466
6:30 PM	37	204	241	8	10	18	168	9	177	436
6:45 PM	45	197	242	8	13	21	122	6	128	391
Total	136	822	958	33	78	111	702	30	732	1801
Grand Total	1269	8786	10055	392	1036	1428	9259	387	9646	21129
Approach %	12.6	87.4		27.5	72.5		96.0	4.0		
Total %	6.0	41.6	47.6	1.9	4.9	6.8	43.8	1.8	45.7	

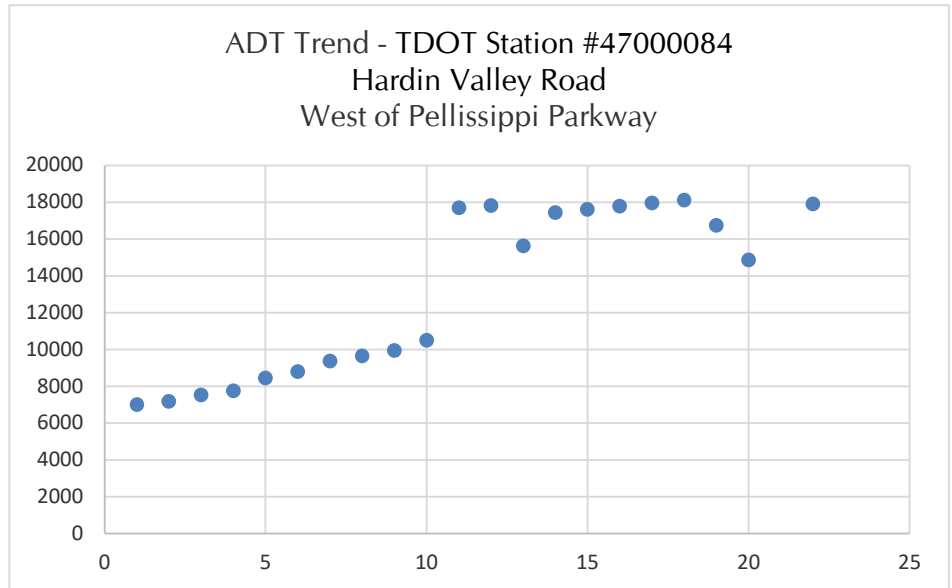
**Project: Silver Creek at Hardin Valley Apartments**  
**Intersection: Hardin Valley Road at Valley Vista Road**  
**Date Conducted: Tuesday, April 19, 2022**

AM Peak Hour	7:30 AM - 8:30 AM	0.96
PM Peak Hour	4:45 PM - 5:45 PM	0.95

Start	Hardin Valley Road Westbound			Valley Vista Road Northbound			Hardin Valley Road Eastbound			Int. Total
	Left	Thru	Total	Left	Right	Total	Thru	Right	Total	
Peak Hour Analysis from 7:00 AM to 9:00 AM										
AM Peak Hour begins at 7:30 AM										
7:30 AM	26	244	270	5	41	46	269	11	280	596
7:45 AM	22	301	323	5	21	26	266	13	279	628
8:00 AM	17	311	328	24	29	53	239	5	244	625
8:15 AM	26	224	250	16	38	54	244	9	253	557
Total Volume	91	1080	1171	50	129	179	1018	38	1056	2406
Future (2% over 5 yrs)	100	1192		55	142		1124	42		2656
PHF	0.88	0.87		0.52	0.79		0.95	0.73		0.96
Peak Hour Analysis from 2:00 PM to 6:00 PM										
PM Peak Hour begins at 4:45 PM										
4:45 PM	34	278	312	13	34	47	211	6	217	576
5:00 PM	19	239	258	9	33	42	263	10	273	573
5:15 PM	37	227	264	11	36	47	250	7	257	568
5:30 PM	42	266	308	9	25	34	263	9	272	614
Total Volume	132	1010	1142	42	128	170	987	32	1019	2331
Future (2% over 5 yrs)	146	1115		46	141		1090	35		2574
PHF	0.79	0.91		0.81	0.89		0.94	0.80		0.95

# Attachment 3 ADT Trends

Year	Adjusted Average Daily Traffic
2001	7019
2002	7179
2003	7533
2004	7761
2005	8457
2006	8804
2007	9379
2008	9660
2009	9950
2010	10492
2011	17696
2012	17809
2013	15642
2014	17441
2015	17615
2016	17791
2017	17969
2018	18120
2019	16739
2020	14864
2021	
2022	17908



Most Recent Trend Line Growth

Year	ADT
2012	17809
2022	17908

**Annual Percent Growth 0.06%**

# Attachment 4

## Trip Generation

Project: Silver Creek at Hardin Valley Apartments

Date Conducted: June 22, 2023

### Local Apartment Trip Generation Study 274 units

#### Average Daily Traffic

$$T = 15.193(X)^{0.899}$$

$$T = 15.193(274)^{0.899}$$

$$T = 2361$$

#### Peak Hour of Adjacent Street Traffic

##### One Hour Between 7 and 9 a.m.

$$T = 0.758(X)^{0.924}$$

$$T = 0.758(274)^{0.924}$$

$$T = 136$$

#### Peak Hour of Adjacent Street Traffic

##### One Hour Between 4 and 6 p.m.

$$T = 0.669(X) + 10.069$$

$$T = 0.669(274) + 10.069$$

$$T = 191$$

Time Period	Total Trips	Percent		Number	
		Enter	Exit	Enter	Exit
Weekday (24 hours)	2361	50%	50%	1181	1181
AM Peak Hour	136	22%	78%	30	106
PM Peak Hour	193	55%	45%	106	87



## MEMORANDUM

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

**From:** Mike Conger *ADC*

**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.

## TRAFFIC IMPACT STUDY REVIEWER & PREPARER GROUP

<b>Name</b>	<b>Organization</b>	<b>Phone Number</b>
Daniel Armstrong	Wilbur Smith	584-8584
Rusty Baksa	Land Dev. Solutions	671-2281
Kim Henry Begg	SITE, inc.	693-5010
Mark Best	TDOT	594-9170
Alan Childers	Cannon & Cannon	988-4818
Steve Drummer	Barge Waggoner	637-2810
Mark Geldmeier	City of Knoxville	215-6100
John Gould	Wilbur Smith	584-8584
Barbara Hatcher	SITE, inc.	693-5010
John Heid	AR/TEC	681-8848
Bill Kervin	Allen Hoshall	694-1834
Hollis Loveday	Wilbur Smith	584-8584
David McGinley	City of Knoxville	215-2148
David Moore	TDOT	594-9170
Linda Mosch	Consultant	777-2025
Amanda Rule	TDOT	594-9170
Cindy Pionke	Knox County	215-5800
Pam Porter	TDOT	594-9170
John Sexton	Allen Hoshall	694-1834
Jim Snowden	Knox County	215-5800
Darcy Sullivan	SITE, inc.	693-5010
Jeff Welch	MPC	215-2500



**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

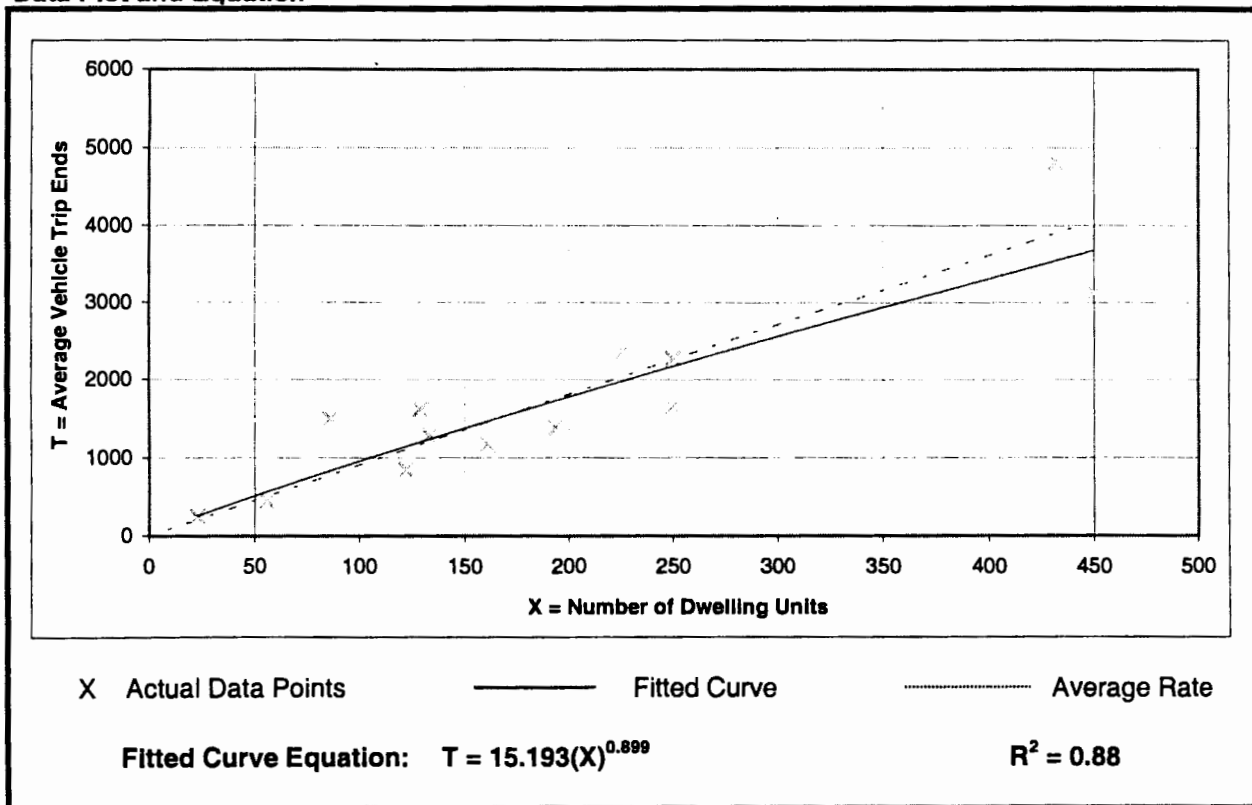
Average Vehicle Trip Ends vs: Dwelling Units  
On a: Weekday

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



# Local Apartment Trip Generation Study

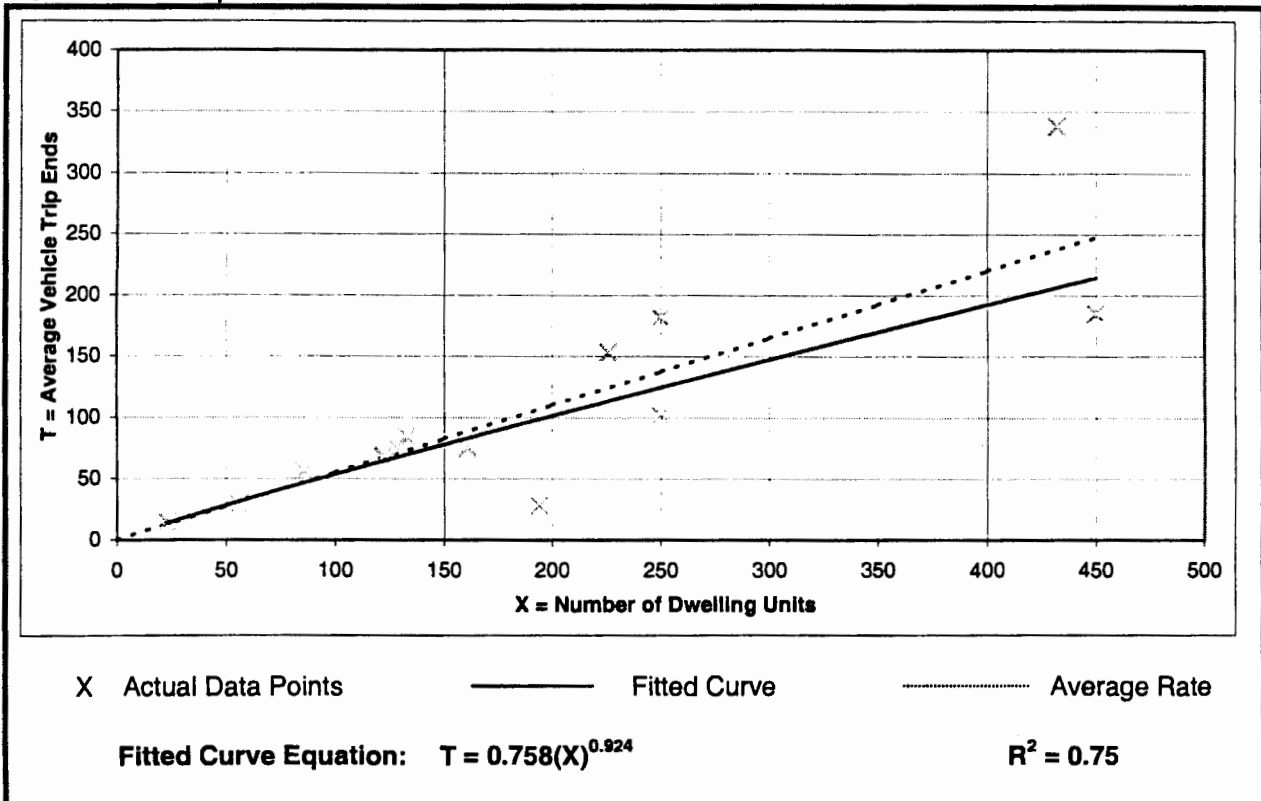
Average Vehicle Trip Ends vs: Dwelling Units  
 On a: Weekday,  
 Peak Hour of Adjacent Street Traffic,  
 One Hour Between 7 and 9 a.m.

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



# Local Apartment Trip Generation Study

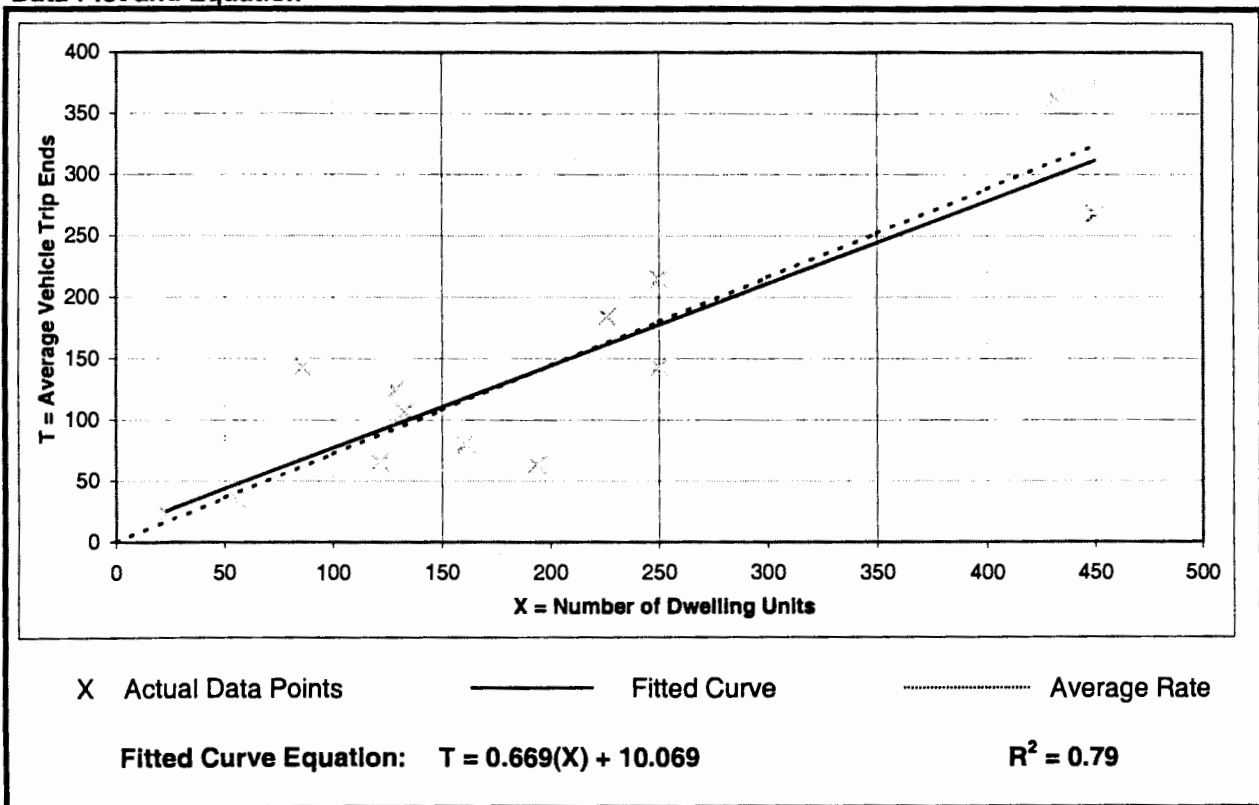
Average Vehicle Trip Ends vs: Dwelling Units  
 On a: Weekday,  
 Peak Hour of Adjacent Street Traffic,  
 One Hour Between 4 and 6 p.m.

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

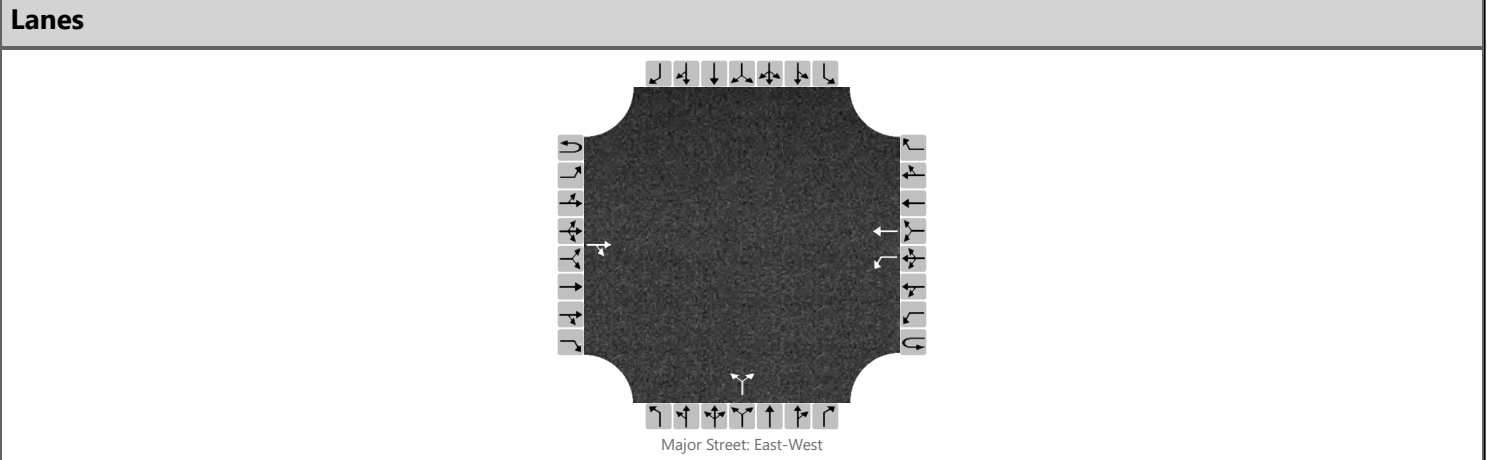


**Attachment 5**  
**Intersection Worksheets – Existing AM/PM Peaks**

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# HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Hardin Valley at Gliding
Agency/Co.	Ardurra Group	Jurisdiction	Knox County
Date Performed	5/4/2022	East/West Street	Hardin Valley Road
Analysis Year	2022	North/South Street	Gliding Hawk Lane
Time Analyzed	Existing AM Peak	Peak Hour Factor	0.94
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	717.001 - The Edge at Hardin Valley Apartments		



**Vehicle Volumes and Adjustments**

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		0	1	0		0	0	0
Configuration				TR		L	T				LR					
Volume, V (veh/h)			1062	0		1	1107			0		1				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Left Only								1							

**Critical and Follow-up Headways**

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

**Delay, Queue Length, and Level of Service**

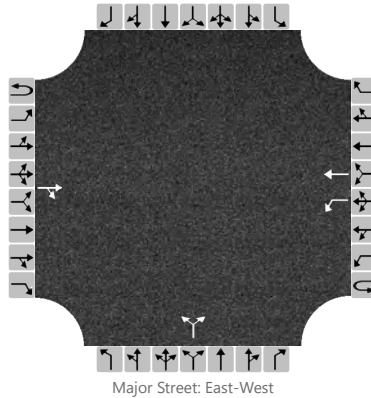
Flow Rate, v (veh/h)						1					1					
Capacity, c (veh/h)						618					248					
v/c Ratio						0.00					0.00					
95% Queue Length, Q <sub>95</sub> (veh)						0.0					0.0					
Control Delay (s/veh)						10.8					19.6					
Level of Service, LOS						B					C					
Approach Delay (s/veh)					0.0				19.6							
Approach LOS									C							



# HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Hardin Valley at Gliding
Agency/Co.	Ardurra Group	Jurisdiction	Knox County
Date Performed	5/4/2022	East/West Street	Hardin Valley Road
Analysis Year	2022	North/South Street	Gliding Hawk Lane
Time Analyzed	Existing PM Peak	Peak Hour Factor	0.95
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	717.001 - The Edge at Hardin Valley Apartments		

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		0	1	0		0	0	0
Configuration				TR		L	T				LR					
Volume, V (veh/h)			953	2		0	1032			0		4				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Left Only								1							

## Critical and Follow-up Headways

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

## Delay, Queue Length, and Level of Service

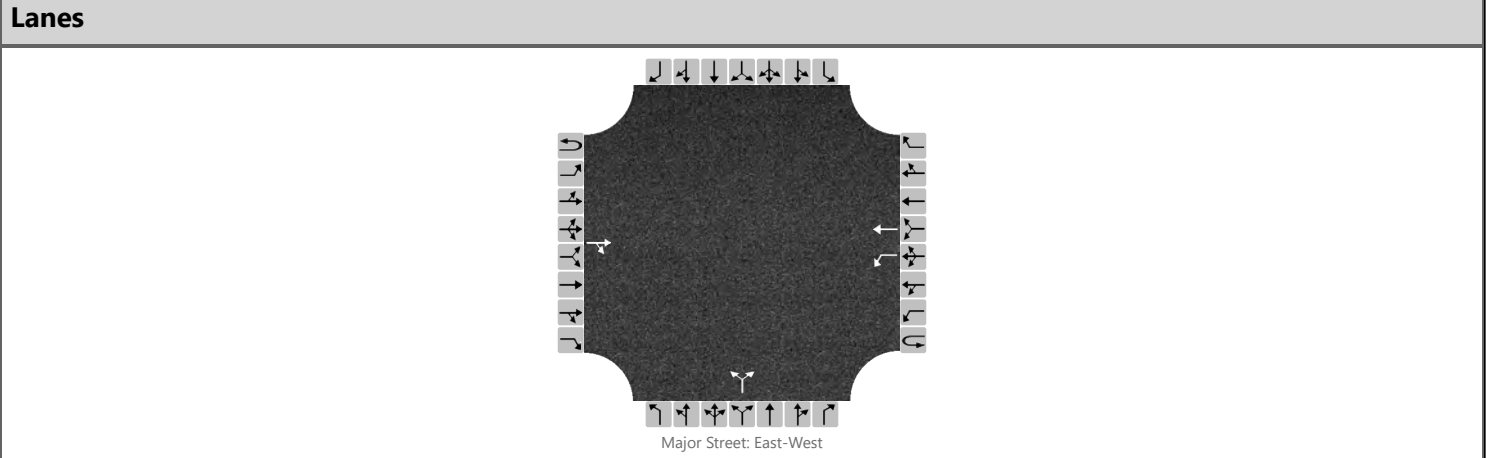
Flow Rate, v (veh/h)					0					4						
Capacity, c (veh/h)					689					293						
v/c Ratio					0.00					0.01						
95% Queue Length, Q <sub>95</sub> (veh)					0.0					0.0						
Control Delay (s/veh)					10.2					17.4						
Level of Service, LOS					B					C						
Approach Delay (s/veh)					0.0				17.4							
Approach LOS									C							

**Attachment 6**  
**Intersection Worksheets – Background AM/PM Peaks**

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# HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Hardin Valley at Gliding
Agency/Co.	Ardurra Group	Jurisdiction	Knox County
Date Performed	5/4/2022	East/West Street	Hardin Valley Road
Analysis Year	2027	North/South Street	Gliding Hawk Lane
Time Analyzed	Background AM Peak	Peak Hour Factor	0.94
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	717.001 - The Edge at Hardin Valley Apartments		



**Vehicle Volumes and Adjustments**

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		0	1	0		0	0	0
Configuration				TR		L	T				LR					
Volume, V (veh/h)			1173	0		1	1222			0		1				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Left Only								1							

**Critical and Follow-up Headways**

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

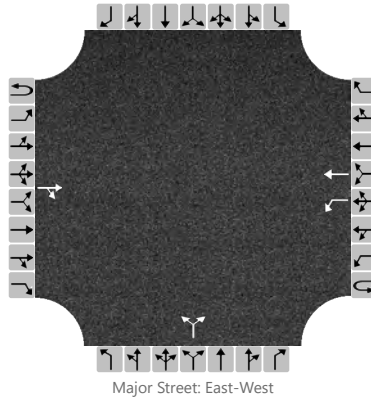
**Delay, Queue Length, and Level of Service**

Flow Rate, v (veh/h)						1					1					
Capacity, c (veh/h)						557					211					
v/c Ratio						0.00					0.00					
95% Queue Length, Q <sub>95</sub> (veh)						0.0					0.0					
Control Delay (s/veh)						11.5					22.1					
Level of Service, LOS						B					C					
Approach Delay (s/veh)					0.0				22.1							
Approach LOS									C							

# HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Hardin Valley at Gliding
Agency/Co.	Ardurra Group	Jurisdiction	Knox County
Date Performed	5/4/2022	East/West Street	Hardin Valley Road
Analysis Year	2027	North/South Street	Gliding Hawk Lane
Time Analyzed	Background PM Peak	Peak Hour Factor	0.95
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	717.001 - The Edge at Hardin Valley Apartments		

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		0	1	0		0	0	0
Configuration				TR		L	T				LR					
Volume, V (veh/h)			1052	2		0	1139			0		4				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized			No			No				No				No		
Median Type/Storage				Left Only								1				

## Critical and Follow-up Headways

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

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)					0					4						
Capacity, c (veh/h)					629					255						
v/c Ratio					0.00					0.02						
95% Queue Length, Q <sub>95</sub> (veh)					0.0					0.0						
Control Delay (s/veh)					10.7					19.3						
Level of Service, LOS					B					C						
Approach Delay (s/veh)					0.0				19.3							
Approach LOS									C							

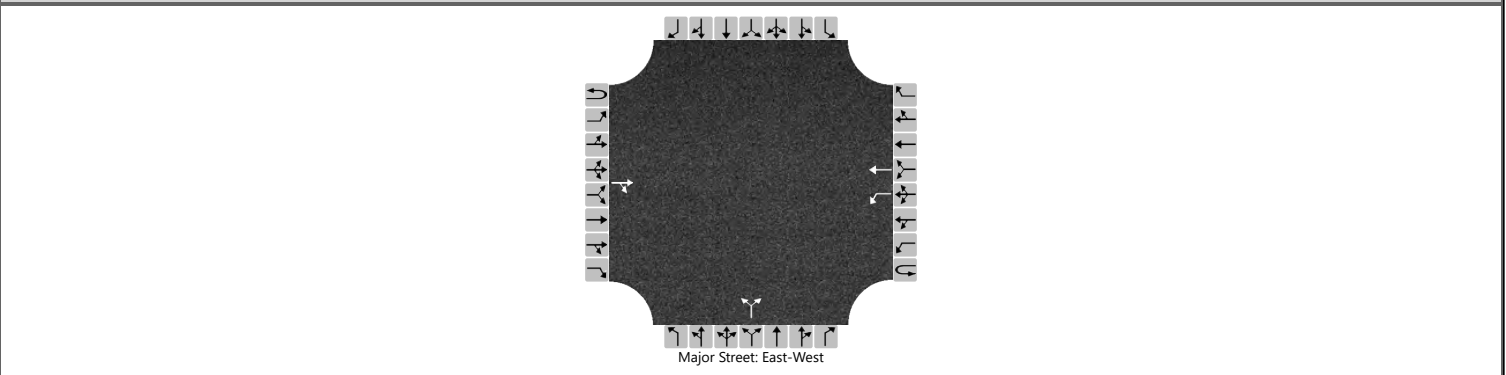
**Attachment 7**  
**Intersection Worksheets – Full Buildout AM/PM Peaks**

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# HCS Two-Way Stop-Control Report

General Information				Site Information			
Analyst	Addie Kirkham	Intersection	Hardin Valley at Gliding				
Agency/Co.	Ardurra Group	Jurisdiction	Knox County				
Date Performed	6/28/2023	East/West Street	Hardin Valley Road				
Analysis Year	2027	North/South Street	Gliding Hawk Lane				
Time Analyzed	Full Buildout AM Peak	Peak Hour Factor	0.94				
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25				
Project Description	717.001 - The Edge at Hardin Valley Apartments						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6	7	8	9	10	11	12		
Priority																
Number of Lanes	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	
Configuration				TR		L	T				LR					
Volume (veh/h)			1175	5		14	1229			19		46				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized																
Median Type   Storage					Left Only								1			

## Critical and Follow-up Headways

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

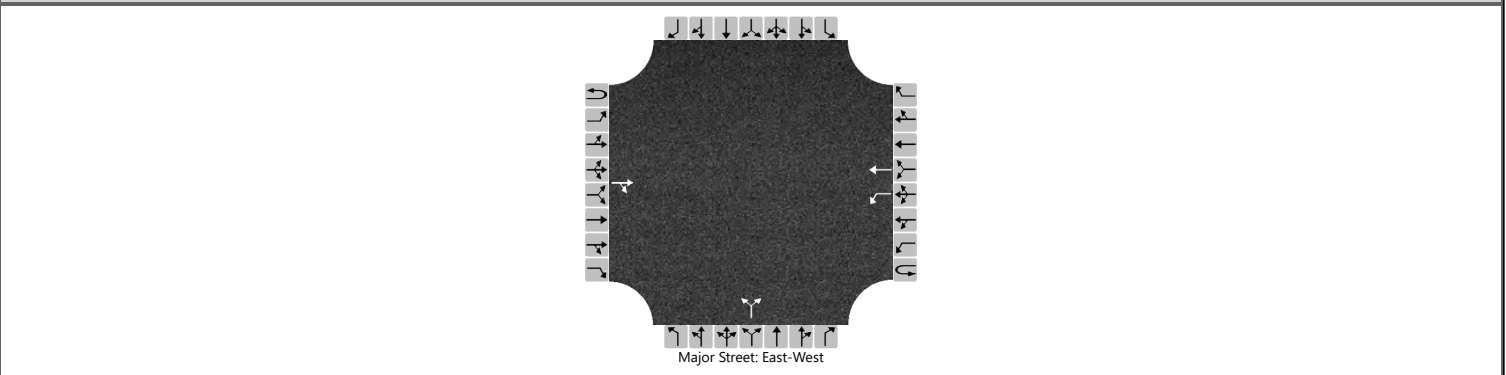
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						15					69				
Capacity, c (veh/h)						554					177				
v/c Ratio						0.03					0.39				
95% Queue Length, Q <sub>95</sub> (veh)						0.1					1.7				
Control Delay (s/veh)						11.7					37.9				
Level of Service (LOS)						B					E				
Approach Delay (s/veh)						0.1					37.9				
Approach LOS						A					E				

# HCS Two-Way Stop-Control Report

General Information				Site Information			
Analyst	Addie Kirkham			Intersection	Hardin Valley at Gliding		
Agency/Co.	Ardurra Group			Jurisdiction	Knox County		
Date Performed	6/28/2023			East/West Street	Hardin Valley Road		
Analysis Year	2027			North/South Street	Gliding Hawk Lane		
Time Analyzed	Full Buildout PM Peak			Peak Hour Factor	0.95		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	717.001 - The Edge at Hardin Valley Apartments						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		0	1	0		0	0	0
Configuration				TR		L	T				LR					
Volume (veh/h)			1057	18		48	1144			12		44				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized																
Median Type   Storage					Left Only								1			

## Critical and Follow-up Headways

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

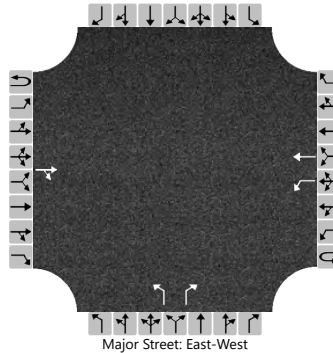
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						51					59					
Capacity, c (veh/h)						617					212					
v/c Ratio						0.08					0.28					
95% Queue Length, Q <sub>95</sub> (veh)						0.3					1.1					
Control Delay (s/veh)						11.4					28.4					
Level of Service (LOS)						B					D					
Approach Delay (s/veh)						0.5					28.4					
Approach LOS						A					D					

# HCS Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Addie Kirkham	Intersection	Hardin Valley at Gliding
Agency/Co.	Ardurra Group	Jurisdiction	Knox County
Date Performed	6/28/2023	East/West Street	Hardin Valley Road
Analysis Year	2027	North/South Street	Gliding Hawk Lane
Time Analyzed	Full Buildout AM Peak	Peak Hour Factor	0.94
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	717.001 - The Edge at Hardin Valley Apartments		

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		1	0	1		0	0	0
Configuration				TR		L	T			L		R				
Volume (veh/h)			1175	5		14	1229			19		46				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized										No						
Median Type   Storage					Left Only								1			

## Critical and Follow-up Headways

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

## Delay, Queue Length, and Level of Service

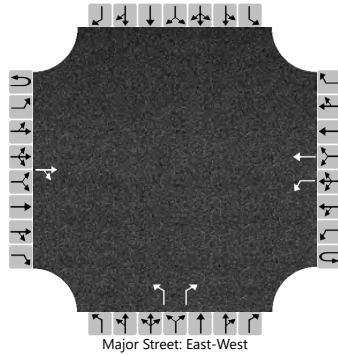
Flow Rate, v (veh/h)						15				20		49				
Capacity, c (veh/h)						554				128		210				
v/c Ratio						0.03				0.16		0.23				
95% Queue Length, Q <sub>95</sub> (veh)						0.1				0.5		0.9				
Control Delay (s/veh)						11.7				38.4		27.3				
Level of Service (LOS)						B				E		D				
Approach Delay (s/veh)						0.1				30.5						
Approach LOS						A				D						



# HCS Two-Way Stop-Control Report

General Information				Site Information			
Analyst	Addie Kirkham	Intersection	Hardin Valley at Gliding				
Agency/Co.	Ardurra Group	Jurisdiction	Knox County				
Date Performed	6/28/2023	East/West Street	Hardin Valley Road				
Analysis Year	2027	North/South Street	Gliding Hawk Lane				
Time Analyzed	Full Buildout PM Peak	Peak Hour Factor	0.95				
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25				
Project Description	717.001 - The Edge at Hardin Valley Apartments						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	1	0	0	1	1	0		1	0	1		0	0	0
Configuration				TR		L	T			L		R				
Volume (veh/h)			1057	18		48	1144			12		44				
Percent Heavy Vehicles (%)						2				2		2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized										No						
Median Type   Storage					Left Only								1			

## Critical and Follow-up Headways

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

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						51				13		46				
Capacity, c (veh/h)						617				136		250				
v/c Ratio						0.08				0.09		0.18				
95% Queue Length, Q <sub>95</sub> (veh)						0.3				0.3		0.7				
Control Delay (s/veh)						11.4				34.2		22.6				
Level of Service (LOS)						B				D		C				
Approach Delay (s/veh)						0.5					25.1					
Approach LOS						A					D					

**Attachment 8**  
**Turn Lane Warrant Analysis**

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**Project: Silver Creek at Hardin Valley Apartments**

**Hardin Valley Road at Gliding Hawk Lane**

		VOLUMES				
Hardin Valley Road Gliding Hawk Lane		Opposing	Thru	LT	LT MAX	Warrant Met
LEFT TURN						
AM		1180	1229	14	15	NO
PM		1075	1144	48	15	YES

**Hardin Valley Road**

		VOLUMES				
Hardin Valley Road Gilding Hawk Lane			Thru	RT	RT MAX	Warrant Met
RIGHT TURN						
AM			1175	5	25	NO
PM			1057	18	25	NO

**Valley Vista Road**

		VOLUMES				
Valley Vista Road Site Access			Thru	RT	RT MAX	Warrant Met
RIGHT TURN						
AM			142	10	499	NO
PM			181	37	499	NO

TABLE 5A

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

(If the left-turn volume exceeds the table value a left -turn lane is needed)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160	115	85	75	65	55
250 - 299	130	100	75	65	60	50
300 - 349	110	90	70	60	55	45
350 - 399	100	80	65	55	50	40
400 - 449	90	70	60	50	45	35
450 - 499	80	65	55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599	65	55	40	35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	25	25
350 - 399	40	35	30	25	25	20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	AM Peak 14 LT		15
750 or More	20	20	20	PM Peak 48 LT		15

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

TABLE 5B

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

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

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99					AM Peak 5 RT PM Peak 18 RT	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.

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	AM Peak 10 RT <span style="border: 2px solid magenta; border-radius: 50%; padding: 2px;">10</span> PM Peak 37 RT					
100 - 149 150 - 199						
200 - 249 250 - 299						Yes
300 - 349 350 - 399				Yes	Yes Yes	Yes Yes
400 - 449 450 - 499			Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599		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
200 - 249 250 - 299	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

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

**Attachment 9**  
**Signal Warrant Analysis**

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**Project: The Edge at Hardin Valley Apartments**  
**Intersection: Hardin Valley Road at Valley Vista Road**  
**Date Conducted: 5/4/2022**

	Existing Conditions		Warrant 1			Warrant 2	Warrant 3
	Major Street	Minor Street	Condition A	Condition B	Condition A/B		
Start	veh/hr	veh/hr					
7:00 a.m.	1915	132	NO	YES	NO	YES	NO
8:00 a.m.	1685	160	NO	YES	YES	YES	NO
11:00 a.m.	1205	104	NO	YES	NO	NO	NO
12:00 p.m.	1448	113	NO	YES	NO	NO	NO
2:00 p.m.	1302	99	NO	YES	NO	NO	NO
3:00 p.m.	1683	107	NO	YES	NO	NO	NO
4:00 p.m.	1876	147	NO	YES	NO	YES	NO
5:00 p.m.	1969	164	NO	YES	YES	YES	YES

	Background Conditions		Warrant 1			Warrant 2	Warrant 3
	Major Street	Minor Street	Condition A	Condition B	Condition A/B		
Start	veh/hr	veh/hr					
7:00 a.m.	2114	146	NO	YES	NO	YES	NO
8:00 a.m.	1860	177	NO	YES	YES	YES	YES
11:00 a.m.	1330	115	NO	YES	NO	YES	NO
12:00 p.m.	1599	125	NO	YES	NO	YES	NO
2:00 p.m.	1438	109	NO	YES	NO	NO	NO
3:00 p.m.	1858	118	NO	YES	NO	YES	NO
4:00 p.m.	2071	162	NO	YES	YES	YES	YES
5:00 p.m.	2174	181	NO	YES	YES	YES	YES

	Full Buildout		Warrant 1			Warrant 2	Warrant 3
	Major Street	Minor Street	Condition A	Condition B	Condition A/B		
Start	veh/hr	veh/hr					
7:00 a.m.	2114	172	NO	YES	YES	YES	YES
8:00 a.m.	1860	203	NO	YES	YES	YES	YES
11:00 a.m.	1330	141	NO	YES	NO	YES	NO
12:00 p.m.	1599	151	NO	YES	NO	YES	NO
2:00 p.m.	1438	126	NO	YES	NO	YES	NO
3:00 p.m.	1858	135	NO	YES	NO	YES	NO
4:00 p.m.	2071	179	NO	YES	YES	YES	YES
5:00 p.m.	2174	198	NO	YES	YES	YES	YES



**Attachment 10**  
**Sight Distance**

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Valley Vista Road at Driveway Connection – Looking South



Valley Vista Road at Driveway Connection – Looking North



June 28, 2023

John Sexton  
Knox County Engineering  
205 W Baxter Ave  
Knoxville, TN 37917

Re: Silver Creek at Hardin Valley Apartments TIA Comments

Dear Mr. Sexton:

The following comment response letter is submitted to address comments dated June 1, 2023:

- 1. Reviewer Comment:** Update the site name from “The Edge” to “Silver Creek.”

Response: Updated the report from “The Edge at Hardin Valley Apartments” to “Silver Creek at Hardin Valley Apartments” throughout the report, figures and attachments.

- 2. Reviewer Comment:** Correct the number of proposed units from 270 to 274.

Response: Updated the trip generation, figures and highway capacity analysis to reflect the proposed 274 apartment units.

- 3. Reviewer Comment:** Update the site plan in the TIS.

Response: Updated “Figure 2: Site Plan” in the TIA report.

- 4. Reviewer Comment:** Add the right-turn lane warrants at the site access on Valley Vista Road.

Response: Updated the turn lane warrant analysis in the report and in the attachments to include the intersection of Valley Vista Road at the site access. A right turn lane is not warranted at this intersection per the Knox County “Access Control and Driveway Design Policy.”

I hope that this is helpful. Please contact me if you have any questions.

Thank you,

Addie Kirkham, P.E.

