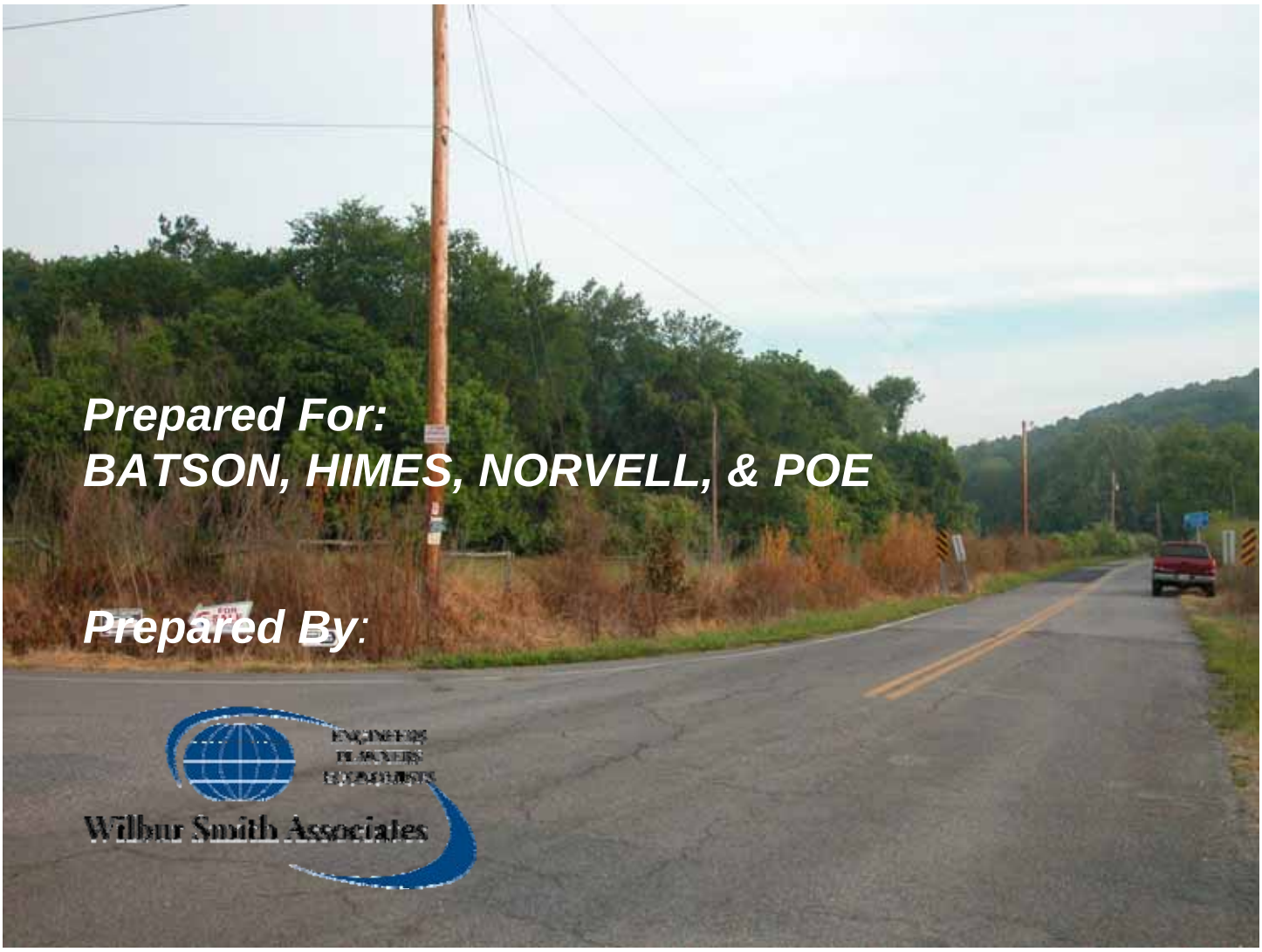
COVERED BRIDGE OF HARDIN VALLEY
Knox County

TRAFFIC IMPACT STUDY



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July 2006

COVERED BRIDGE OF HARDIN VALLEY SUBDIVISION

KNOX COUNTY, TENNESSEE

TRAFFIC IMPACT STUDY

Prepared for

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PROJECT NO. 100432

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INTRODUCTION

Wilbur Smith Associates (WSA) is pleased to submit this report to address the impact and access of a proposed residential development located on E. Gallaher Ferry Road in northwest Knox County. The basis for this 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 potential site. Analyses of the resulting traffic projections were conducted to determine the capacity and levels of service for the site accesses and adjacent intersections. This study will develop measures necessary to mitigate traffic impacts including improved roadway geometrics and traffic control devices within the environs of the proposed residential development.

According to the Knoxville-Knox County Metropolitan Planning Commission's Administrative Rules and Procedures, the proposed residential development site is identified for a Level 2 Traffic Impact Study. WSA discussed with Knox County Department of Engineering and Public Works and MPC to define the study area and address specific concerns relative to the proposed residential development. Therefore, this study will address the anticipated traffic impacts of the proposed residential development site accesses on E. Gallaher Ferry Road, Hickory Creek Road and Hardin Valley Road.

Project Description

The proposed development is for approximately 393 single family units on approximately 160 acres thereby at a density of 2 units per acre. The proposed development has two proposed residential streets to E. Gallaher Ferry Road and one residential street to Hickory Creek Road and Hardin Valley Road, respectively. The proposed residential street to E. Gallaher Ferry Road will serve 108 and 244 single-family units. The proposed development will have 244 single family units accessing E. Gallaher Ferry Road and Hickory Creek Road from proposed residential streets. A proposed street will intersect Hardin Valley Road and provide access to 41 single-family units. Figure 1 shows the proposed site plan.

Site Location

The location of the proposed residential development is north of the E. Gallaher Ferry Road and Hickory Creek Road/Hardin Valley Road intersection in northwest Knox County, Tennessee, and northwest of the Knoxville central business district (CBD). Figure 2 illustrates the site location relative to local and regional access.

SITE PLAN
Covered Bridge of Hardin Valley

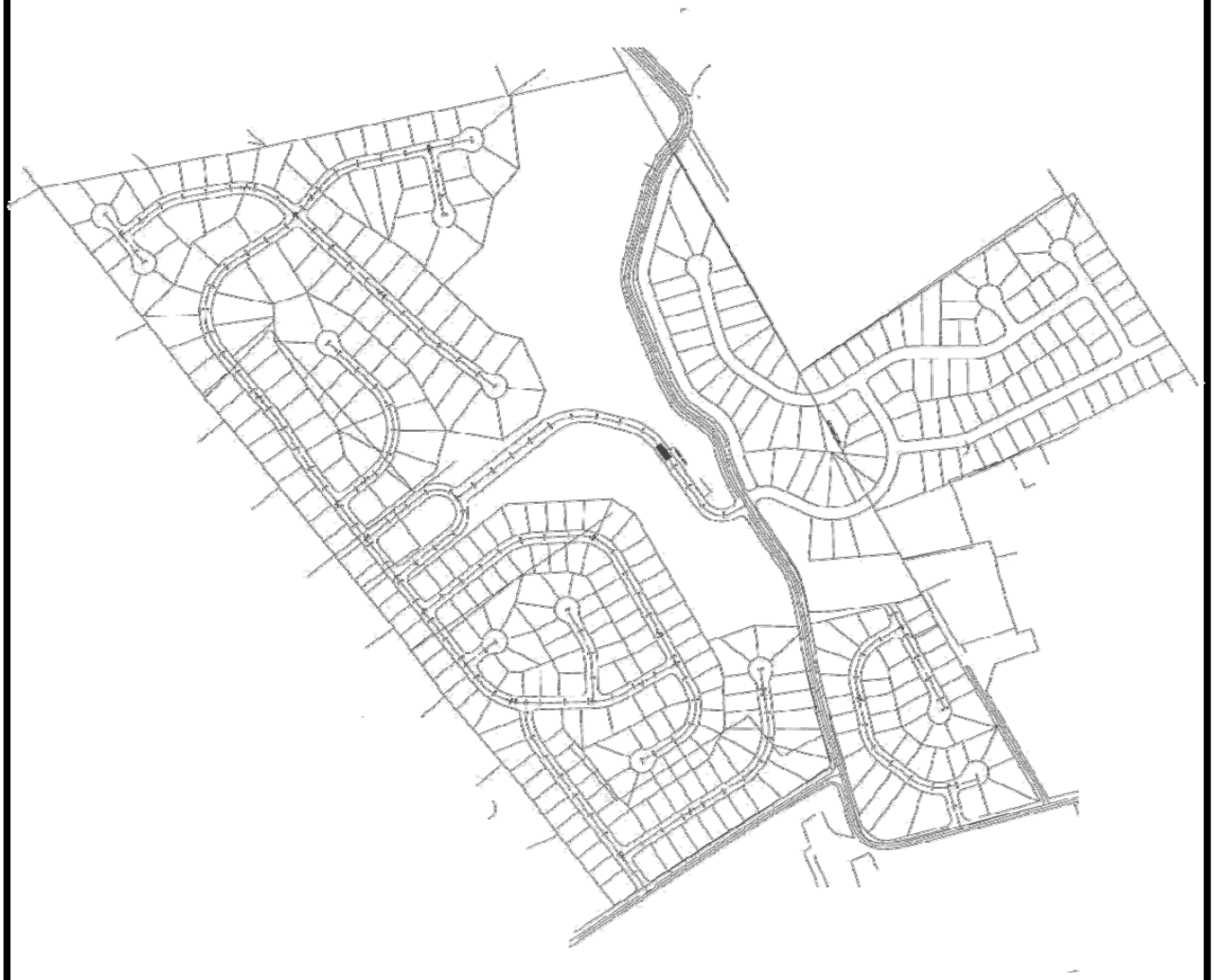


Figure 1

VICINITY MAP
Covered Bridge of Hardin Valley

Figure 2

LOCAL AND REGIONAL ACCESS

Local Access

The proposed zone change and development of 330 single family units is located adjacent to Hardin Valley Road and Hickory Creek Road to the south and E. Gallaher Ferry Road. Hardin Valley Road and Hickory Creek Road are classified minor arterials. Average daily traffic (ADT) volume on Hardin Valley Road in 2003 is approximately 3,020, and Hickory Creek Road had an approximate ADT of 1,480 for 2004. Hardin Valley Road and Hickory Creek Road are 2-lane roadways with an approximate width of 22-feet and 1-foot shoulders. Hardin Valley Road, east of Campbell Station and the site, has recently been improved to a 3-lane curb and gutter section.

East Gallaher Ferry Road is a local road with an approximate width of 19-feet and has posted signs for blind spots. A 2003 ADT for E. Gallaher Ferry Road is 500. East Gallaher Ferry Road intersects Hickory Creek Road and Hardin Valley Road to the south.

Regional Access

Regional access to this site is Hardin Valley Road to the east where it intersects Pellissippi Parkway (S.R. 162) which extends northwest to Oak Ridge and southeast to Interstate 40 and 140. Hickory Creek Road provides access to I-40, west of Knoxville, at Watts Road.

Pellissippi Parkway extends northeast to Oak Ridge Highway with a 2003 ADT of 49,740. Pellissippi Parkway extends south intersecting Interstate 40 and terminating at Alcoa Highway (U.S. 129) near the Knoxville Airport. Pellissippi Parkway has a 2003 ADT of 41,870 north of Hardin Valley Road and 48,960 south of Dutchtown Road. To the east, Hardin Valley becomes S.R. 169 (Middlebrook Pike) and intersects S.R. 131 (Lovell Road). Interstate access is also provided from both Campbell Station Road and Lovell Road southeast of the proposed site.

Interstate 40 provides significant east and west regional access through Tennessee. To the east, Interstate 40 connects to Interstate 81, which extends into the Tri-Cities area of Tennessee and Virginia. Westbound Interstate 40 connects to Interstate 75, providing north- and southbound connections into neighboring states such as Kentucky and Georgia, respectively. Interstate 40 provides significant east and west regional access through Tennessee. South of the site, I-40/75 has a 2003 ADT of 106,960 and 96,830 east and west of Lovell Road

Existing Traffic Control

Hardin Valley Road, south of the site and the intersection with Hickory Creek Road, has a substandard 90-degee horizontal curve with an advisory speed of 20mph posted. The posted speed limit on Hardin Valley Road and Hickory Creek Road is 40mph. The 20mph curve and the Hickory Creek Road STOP controlled approach to the Hardin Valley Road and E. Gallaher Ferry Road intersection represents a discontinuous arterial alignment on the southern boundary of the site.

Existing Traffic Volumes

WSA conducted an eight-hour turning movement count for the intersection of Hardin Valley Road and Hickory Creek Road in May of 2005. The hours counted were from 7:00a.m. to 9:00a.m., 11:00a.m. to 1:00p.m.and 2:00p.m. to 6:00p.m. Figure 3 presents the existing AM and PM peak-hour traffic volumes for the intersection and daily traffic volumes for the adjacent roadways.

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 **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. A LOS A is the best, and LOS F is failing. For unsignalized intersections, a LOS 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 Tables 1.

EXISTING TRAFFIC
Covered Bridge of Hardin Valley

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**

Analyses were conducted using the Synchro Software, developed by Trafficware. Table 2 presents the analyses of the study intersections. The analyses indicate that existing traffic conditions for the unsignalized intersection are very good and acceptable.

TABLE 2. 2005 TRAFFIC CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	DELAY	LOS
E. Gallaher Ferry Road & Hardin Valley/Hickory Creek Road	STOP NB-L (EB- LR)	AM	0.01 (0.11)	6.7 (8.9)	A (A)
		PM	0.07 (0.10)	6.0 (9.1)	A (A)

Note : Average vehicle delay estimated in seconds

BACKGROUND TRAFFIC CONDITIONS

Background traffic is traffic that can be anticipated regardless of the proposed development. Traffic within the study area should continue to grow due to other developments as well as the continued growth within the surrounding area. This background traffic must be analyzed and evaluated for the purpose of establishing a baseline. In addition, the background traffic reflects the historical traffic volumes in the area of the proposed development.

Background Traffic Volumes

In reviewing the history of the average daily traffic volume in the site's vicinity, traffic growth appears to be minimal. Therefore, for the purpose of this study, an annual compounded growth rate of 1.5-percent and a horizon year of 2010 are assumed. Therefore, using a 1.5 percent compounded growth rate until 2010, background traffic was determined and is illustrated in Figure 4, reflecting a 7.7-percent growth for Hickory Creek Road and Hardin Valley Road intersection.

Background Capacity and Level of Service

Analysis was performed with the grown traffic volumes and is displayed in Table 34. The levels of service are measured to be acceptable for the unsignalized study intersection with background conditions.

TABLE 3. 2010 BACKGROUND TRAFFIC CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	DELAY	LOS
E. Gallaher Ferry Road & Hardin Valley/Hickory Creek Road	STOP NB-L (EB- LR)	AM	0.02 (0.12)	6.7 (8.9)	A (A)
		PM	0.07 (0.11)	6.0 (9.2)	A (A)

Note : Average vehicle delay estimated in seconds

2010 BACKGROUND TRAFFIC
Covered Bridge of Hardin Valley

LEGEND
XXX AM PEAK
(XXX) PM PEAK

N

Figure 4

PROJECT IMPACTS

Project conditions are developed by generating traffic based on the proposed land uses, distributing the trips to the transportation network, and again conducting analyses for capacity and level of service.

Trip Generation

Project traffic was determined using the publication, **Trip Generation, 7th 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. **Trip Generation** is an essential tool in calculating the traffic, which may be generated by a proposed development. The study will generate traffic for 330 single-family units. From the trip generation calculations, the proposed site may generate approximately 3,340 daily trips. Table 4 presents the trip generation of this proposed site.

TABLE 4. TRIP GENERATION

LAND USE	L.U.C	SIZE	DAILY TRAFFIC	AM PEAK ENTER	AM PEAK EXIT	PM PEAK ENTER	PM PEAK EXIT
SINGLE FAMILY	210	41	458	10	29	31	17
		244	2,362	45	135	153	86
		108	1,116	21	64	74	41
Total		**393**	**3,936**	**76**	**228**	**257**	**145**

Trip Distribution and Assignment

Using the turning-movement counts for the study intersections, trips are distributed to the adjacent streets with 70- and 30-percent of the generated trips distributed east and west of the site, respectively. Figures 5a-c illustrates this distribution and assignment.

Project Traffic Volumes

By multiplying the trips generated by the distribution percentages, the project traffic volumes were determined. Figure 6 illustrates the resulting project traffic volumes associated with the proposed project.

DISTRIBUTION AND ASSIGNMENT
Covered Bridge of Hardin Valley

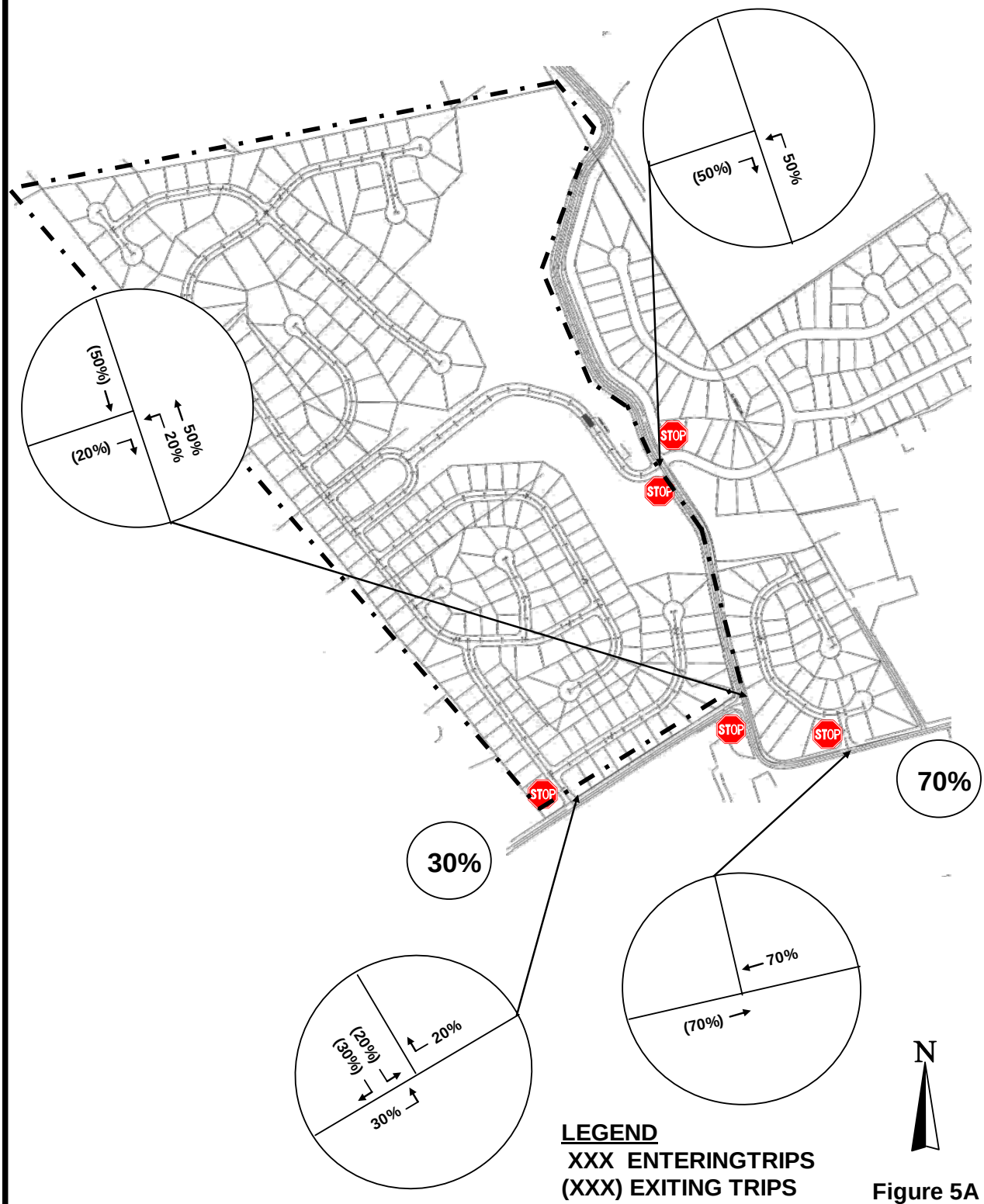
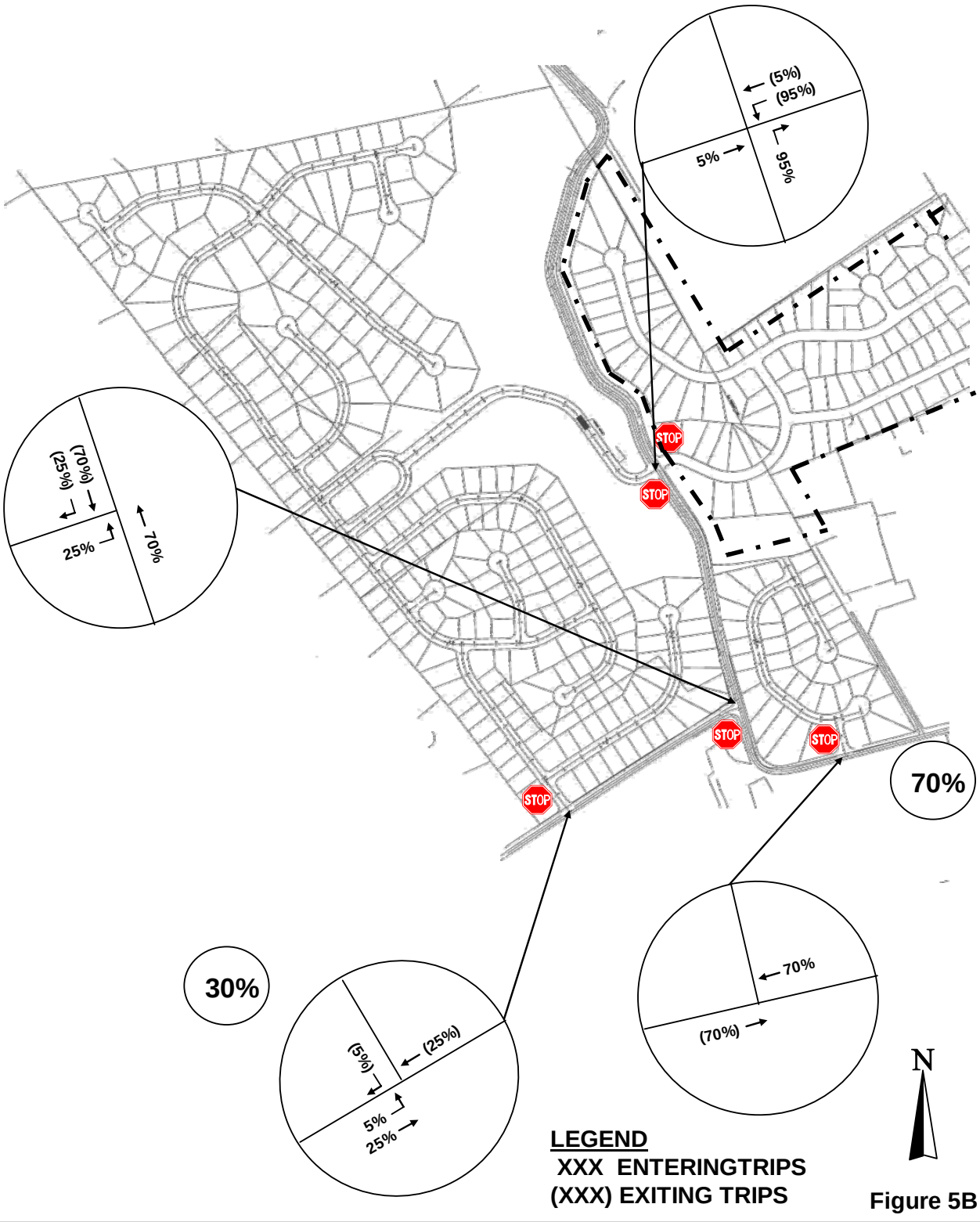


Figure 5A

DISTRIBUTION AND ASSIGNMENT
Covered Bridge of Hardin Valley



LEGEND
XXX ENTERINGTRIPS
(XXX) EXITING TRIPS

Figure 5B

DISTRIBUTION AND ASSIGNMENT
Covered Bridge of Hardin Valley

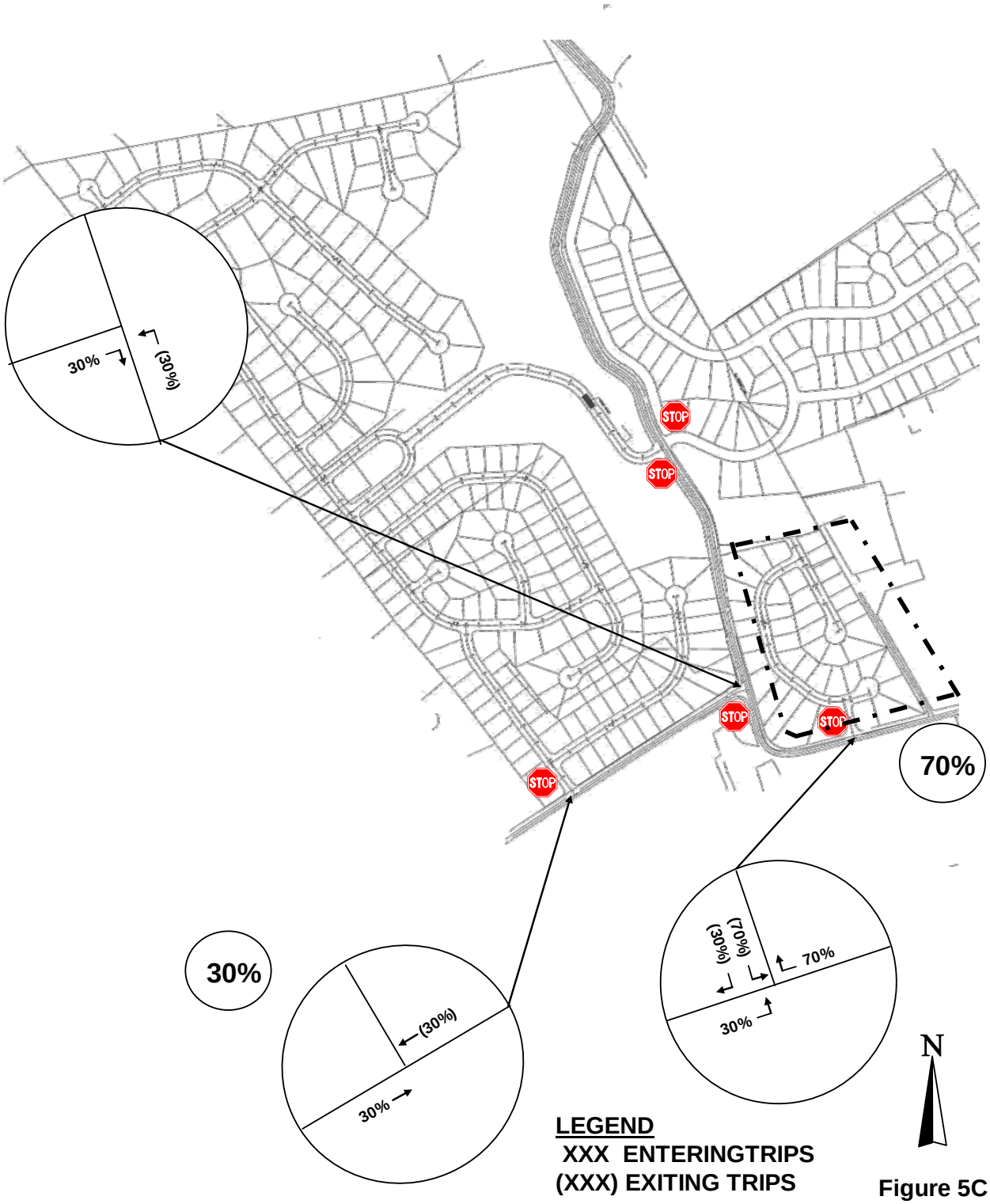


Figure 5C

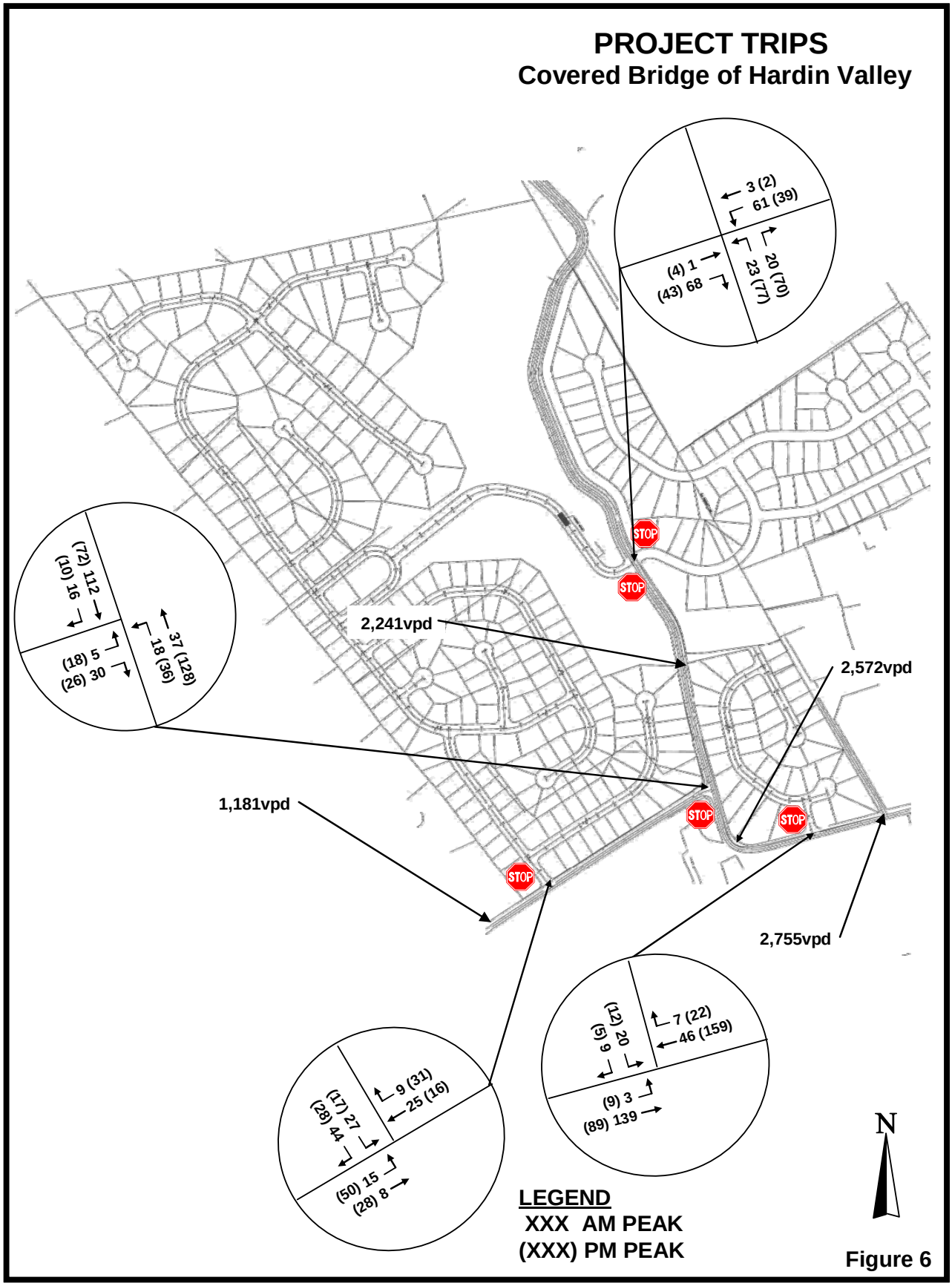

PROJECT TRIPS
Covered Bridge of Hardin Valley
3 (2)
61 (39)
(4) 1
(43) 68
20 (70)
23 (77)
(72) 112
(10) 16
37 (128)
18 (36)
(18) 5
(26) 30
2,241vpd
2,572vpd
1,181vpd
2,755vpd
STOP
(17) 27
(28) 44
9 (31)
25 (16)
(50) 15
(28) 8
(12) 20
(5) 9
7 (22)
46 (159)
(9) 3
(89) 139
N
LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 6

Total Projected Traffic Volumes

Background and project traffic volumes were added together to develop post-development traffic volumes for the year 2010. Figure 7 illustrates this 2010 projection. For 2010 conditions, site traffic represents a 69-, 61-, and 250-percent traffic increase on Hardin Valley Road, Hickory Creek Road, and E. Gallaher Ferry Road, respectively. Traffic projected for Hardin Valley Road reflect typical volumes for a minor arterial, and Hickory Creek Road projected traffic reflect volumes typical for a major collector or minor arterial. The proposed development may impact E. Gallaher Ferry Road with approximately 40-percent of the generated trips. The projected traffic volumes for E. Gallaher Ferry Road reflect typical volumes for a collector roadway. Adjacent roadway capacities are limited by the widths, lack of shoulders, and substandard horizontal and vertical geometry; however, these projected volumes can be found on many collector facilities in Knox County. The minor arterial classifications of Hardin Valley Road and Hickory Creek Road are appropriate for the proposed development. Improvements to Hardin Valley Road and its alignment and intersection with Hickory Creek Road and E. Gallaher Ferry Road should be considered to insure safety and access for the site.

Projected Capacity and Level of Service

The development of the site has an insignificant impact on the study intersections. The projected LOS analyses are shown in Table 5 and summarized in Table 6. Results conclude that the study intersections would operate at acceptable level of service for projected traffic volumes and patterns.

TABLE 5. 2010 PROJECTED TRAFFIC CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	DELAY	LOS
E. Gallaher Ferry Road & Hardin Valley/Hickory Creek Road	STOP NB-L (EB- LR)	AM	0.04 (0.19)	4.4 (10.1)	A (B)
		PM	0.10 (0.21)	4.1 (11.3)	A (B)
E. Gallaher Ferry Road & Site Access	STOP EB LTR (WB-LTR)	AM	0.07 (0.10)	8.7 (10.4)	A (B)
		PM	0.05 (0.08)	9.0 (11.8)	A (B)
Hickory Creek Road & Site Access	STOP EB-L (SB- LR)	AM	0.01 (0.07)	0.9 (9.6)	A (A)
		PM	0.04 (0.07)	2.5 (10.2)	A (B)
Hardin Valley Road & Site Access	STOP EB-L (SB- LR)	AM	0.00 (0.05)	0.1 (10.5)	A (B)
		PM	0.01 (0.03)	0.4 (11.8)	A (B)

Note : Average vehicle delay estimated in seconds

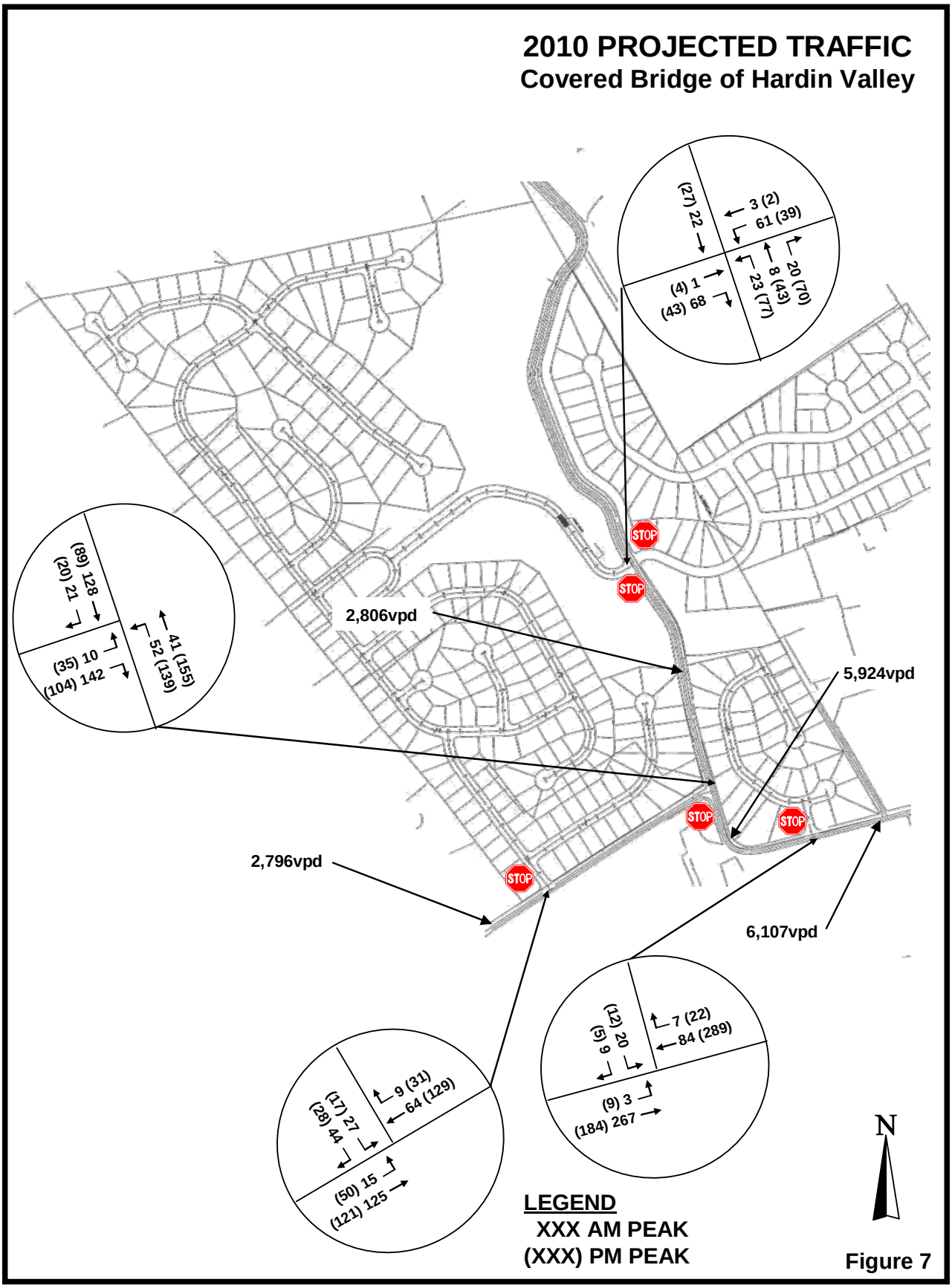

2010 PROJECTED TRAFFIC
Covered Bridge of Hardin Valley
(27) 22
3 (2)
61 (39)
(4) 1
(43) 68
8 (43)
23 (77)
20 (70)
(89) 128
(20) 21
(35) 10
(104) 142
41 (155)
52 (139)
2,806vpd
5,924vpd
2,796vpd
6,107vpd
STOP
(17) 27
(28) 44
9 (31)
64 (129)
(50) 15
(121) 125
(12) 20
(5) 9
7 (22)
84 (289)
(9) 3
(184) 267
N
LEGEND
XXX AM PEAK
(XXX) PM PEAK

Figure 7

TABLE 6
Table 6- CAPACITY & LEVEL OF SERVICE SUMMARY

INTERSECTION		TRAFFIC CONTROL	PEAK PERIOD	2005 TRAFFIC			2010 BACKGROUND			2010 PROJECTED		
				V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS
E. Gallaher Ferry Road & Hardin Valley/Hickory Creek Road		STOP NB-L (EB- LR)	AM	0.01 (0.11)	6.7 (8.9)	A (A)	0.02 (0.12)	6.7 (8.9)	A (A)	0.04 (0.19)	4.4 (10.1)	A (B)
			PM	0.07 (0.10)	6.0 (9.1)	A (A)	0.07 (0.11)	6.0 (9.2)	A (A)	0.10 (0.21)	4.1 (11.3)	A (B)
E. Gallaher Ferry Road & Access	Site	STOP EB LTR (WB-LTR)	AM	-	-	-	-	-	-	0.07 (0.10)	8.7 (10.4)	A (B)
			PM	-	-	-	-	-	-	0.05 (0.08)	9.0 (11.8)	A (B)
Hickory Creek Road & Access	Site	STOP EB-L (SB- LR)	AM	-	-	-	-	-	-	0.01 (0.07)	0.9 (9.6)	A (A)
			PM	-	-	-	-	-	-	0.04 (0.07)	2.5 (10.2)	A (B)
Hardin Valley Road & Access	Site	STOP EB-L (SB- LR)	AM	-	-	-	-	-	-	0.00 (0.05)	0.1 (10.5)	A (B)
			PM	-	-	-	-	-	-	0.01 (0.03)	0.4 (11.8)	A (B)

Note : Average vehicle delay estimated in seconds

Because of the discontinuous arterial and substandard horizontal curve, Hardin Valley Road and Hickory Creek Road should be realigned to provide a continuous arterial and should provide for a more acceptable horizontal curve standard. This realignment results in a lower LOS for the intersection with E. Gallaher Road due to reassignment of right-of-way; however, the LOS remains acceptable and the improved horizontal alignment would provide a safer road adjacent to the site.

Turn Lane Evaluation

Using Knox County's Access Control and Driveway Design Policy, the review and evaluation of the projected traffic volumes did not determine any requirement of left- or right-turn lanes. Projected traffic was found to be well below the traffic volume thresholds.

Sight Distance

The project is proposed to have four residential with two accesses to E. Gallaher Ferry Road, one access to Hardin Valley Road and one access to Hickory Creek Road. E. Gallaher Ferry Road is approximately 19 feet wide with several areas having blind spot signs posted due to the curvature of the roadway. The proposed access road on E. Gallaher Ferry Road has a measured sight distance of 250 feet and 330 feet looking left and right, respectively. The vegetation and the curvature of the roadway reduced the sight distance to the north of this access. Sight distance to the north may be improved with grading and clearing of vegetation during the construction of the subdivision. Street accesses to E. Gallaher Ferry Road meet the required minimum sight distance of 200 feet based on the American Association of State Highway and Transportation Officials (AASHTO) standards and nearly meet the 300 feet Knox County Minimum Corner Sight-distance standard. For Hardin Valley Road and Hickory Creek Road with a 40mph posted speed limit, Knox County requires 400 feet of corner sight-distance and the AASHTO minimum stopping sight distance is 305 feet. The measured sight distances for the two proposed accesses along Hickory Creek Road and Hardin Valley Road are greater than 400 feet, thereby exceeding both standards. The existing Hickory Creek/Hardin Valley/E. Gallaher Ferry Roads intersection meets the AASHTO standards and nearly meets the Knox County standards. Realignment of Hardin Valley and Hickory Creek Roads should provide sight distances to meet both AASHTO and Knox County standards at its intersection with E. Gallaher Ferry Road.

SIGHT DISTANCES
Covered Bridge of Hardin Valley

N

Figure 8

RECOMMENDATIONS

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

- Use a minimum intersection radius of 30-foot for the efficient and safe ingress and egress of the site.

- Post the proposed residential accesses with STOP signs (R1-1) at E. Gallaher Ferry Road, Hickory Creek Road and Hardin Valley Road.

- Realignment of Hardin Valley Road and Hickory Creek Road should be considered to provide for a continuous arterial and address the 20mph substandard horizontal curve which currently exists.

- Intersection design should conform to the recommended standards and practices of the American Association of State Highway and Transportation Officials, the Institute of Transportation Engineers, and the Knox County Public Works Department.

CONCLUSION

The study of this proposed residential development evaluated the projected traffic conditions. Background traffic was determined using a 1.5-percent annual compounded growth rate until the year 2010. Traffic associated with the proposed project was then generated and distributed to the proposed site access. Using the identified turning movements for the projected traffic conditions, unsignalized capacity and level of service analyses were conducted using the **2000 Highway Capacity Manual**. Unsignalized levels of service were found to be acceptable for the existing traffic conditions, and continued to be acceptable for background with and without the proposed development for the study intersections. A LOS C was identified for the eastbound left and right turns from E. Gallaher Ferry Road and Hickory Creek Road/Hardin Valley Road intersection. A minimum LOS B was identified for the left-turn ingress at the site egress at Hickory Creek Road during the peak hours. With the recommendations of this report, the efficient and safe flow of traffic should be acceptable.

APPENDIX

Trip Generation

HCS Unsignalized Analyses

Traffic Counts


ENGINEERS
PLANNERS
ECONOMISTS
Wilbur Smith Associates