

# **HIGHLAND VIEW SUBDIVISION** **Knox County**

## **TRAFFIC IMPACT STUDY**

**Prepared For:**  
**BATSON, HIMES, NORVELL, & POE**

**Prepared By:**



**Wilbur Smith Associates**

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**HIGHLAND VIEW  
SUBDIVISION  
KNOX COUNTY, TENNESSEE  
TRAFFIC IMPACT STUDY**

**Prepared for**

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**Project No. 528230**

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## **INTRODUCTION**

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Wilbur Smith Associates (WSA) is pleased to submit this report to address the impact and access of a proposed residential development located on Highland View Road in Southeast 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. Analysis of the resulting traffic projections was conducted to determine the capacity and levels of service for the study intersections and site access. This study will develop measures necessary to mitigate traffic impacts including improved roadway geometrics and traffic control devices within the environs of the proposed residential development.

According to the Knoxville-Knox County Metropolitan Planning Commission's (MPC) Administrative Rules and Procedures, the proposed residential development site is identified for a Level 1 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 access on Highland View Road and the intersections of Highland View Road and Simpson Road with Chapman Highway.

### **Project Description**

The proposed project is a residential development. The proposed site is approximately 119.80 acres zoned Agriculture and will be rezoned Planned Residential (PR). This tract is bounded by Highland View Road to the south. A proposed street for the development will intersect Highland View Road to the south. The proposed street would access 131 single-family units. Figure 1 shows the proposed site plan.

### **Site Location**

The location of the proposed residential development is on Highland View Road in southeast Knox County. The site is near the Sevier and Blount Counties. The proposed development is located west of the Highland View Road and Chapman Highway intersection. Figure 2 illustrates the site location relative to local and regional access.



# SITE PLAN

## Highland View Subdivision



Figure 1

# VICINITY MAP

## Highland View Subdivision



Figure 2

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## LOCAL AND REGIONAL ACCESS

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### **Local Access**

Highland View Road provides local access for the site and connects to the regional arterial of Chapman Highway (U.S. 441, S.R. 71) to the east. Highland View Road is a 2-lane classified minor collector with an approximate 19-foot width and no shoulders. Access to Chapman Highway is also provided by Simpson Road intersecting Highland View Road between the site and Chapman Highway.

### **Regional Access**

Chapman Highway, U.S. 441, is classified major arterial extending northwest into the Knoxville CBD and southeast towards the Sevier County line and Sevierville. Chapman Highway is a 5-lane section with shoulders at Highland View Road and a 4-lane section at Simpson Road. Chapman Highway intersects Interstate 40 in the Knoxville CBD. Chapman Highway also intersects Governor John Sevier Highway (S.R. 168) to the northwest and has a junction with the Maryville Highway (U.S. 411) to the southeast. Governor John Sevier Highway extends between Interstate 40 east of the Knoxville CBD and Alcoa Highway (U.S. 129) south of Knoxville.

Interstate 40 provides significant east and west regional access throughout 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 throughout Tennessee.



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## EXISTING TRAFFIC CONDITIONS

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### Existing Traffic Control

The Highland View Road and Simpson Road approaches to Chapman Highway are STOP controlled. Highland View Road has a posted speed limit of 30mph. Simpson Road has STOP controlled approaches to Highland View Road.

### Existing Traffic Volumes

Peak-hour turning movement counts (TMC) were conducted by WSA in March of 2005 for the intersections of Chapman Highway at Simpson Road and Highland View Road. A previous TMC for Chapman Highway and Highland View Road came from "Intersection Evaluation Part 1", a Knox County study performed by WSA, and was collected in July 2002. The 2002 traffic data met traffic signal warrants. Figure 3 illustrates the resulting intersection turning movements for the 2005 AM and PM peaks. The peak hours were found between 7:00-8:30 AM and 4:45-6:00 PM.

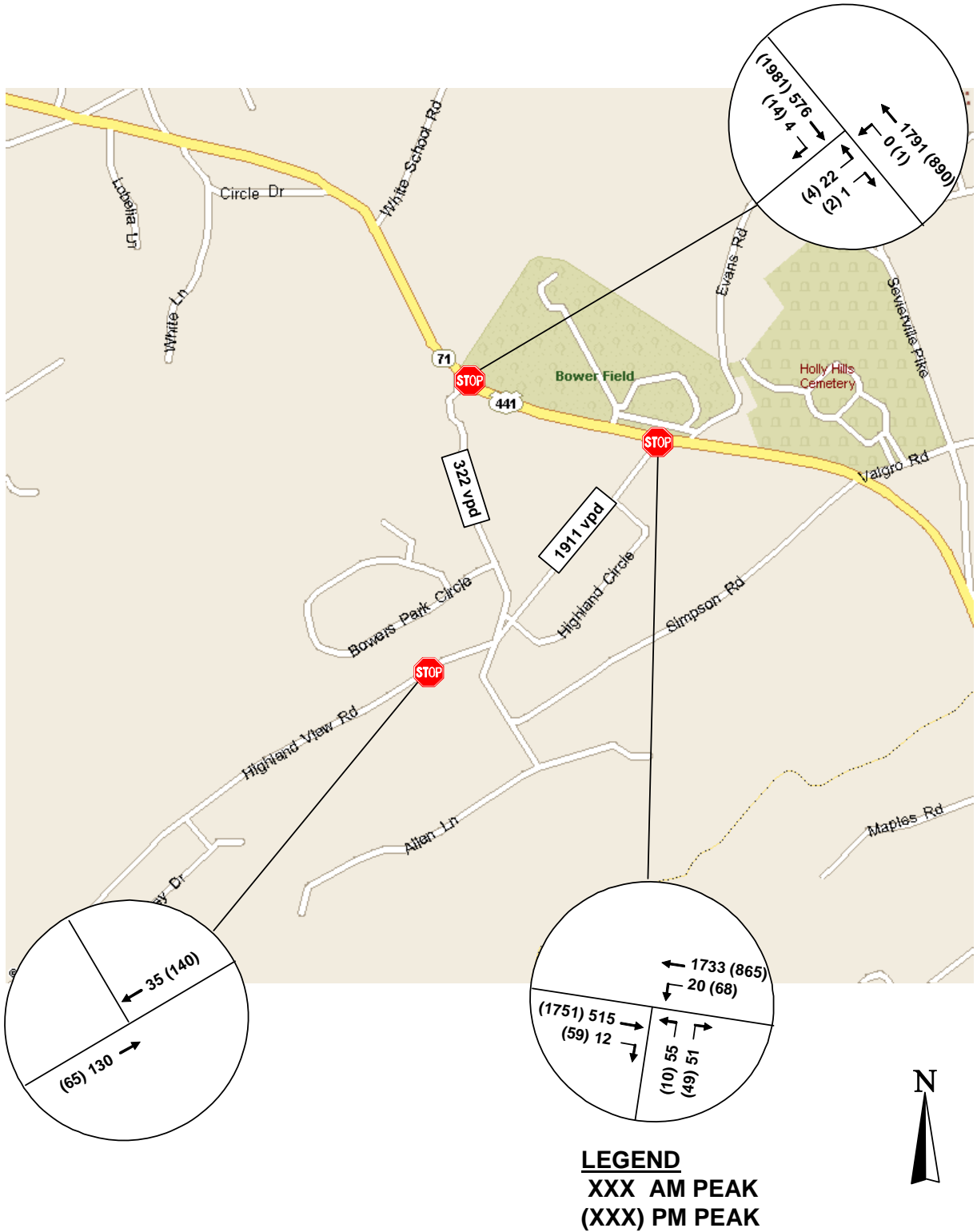
### Signal Warrant Analyses

For the study intersection of Chapman Highway and Highland View Road, an evaluation for a traffic control signal was conducted. There are eight warrants published in the **Manual on Uniform Traffic Control Devices, 2000 Edition**. For prevailing speeds in excess of 40mph on Chapman Highway, signal warrant volumes for each of the warrants can be reduced. Three traffic volume warrants were examined of which were the Eight-Hour Traffic Volume Warrant consisting of the Minimum Volume (Warrant 1A), Interruption to Continuous Traffic Flow (Warrant 1B), Combination (Warrant 1A & B); Four-Hour (Warrant 2); and Peak-Hour Volume (Warrant 3B). Any part of Warrant 1 must be met for a minimum of eight hours. Warrant 2 must be met for four hours, and one hour must be met for the Peak-Hour Warrant (Warrant 3B).

For the existing traffic conditions, peak-hour volume warrant (Warrant 3B) is met for the northbound approach of Highland View Road. The analyses are summarized as follows:

		Hours	Hours
		<u>100% Satisfied</u>	<u>90% Satisfied</u>
Warrant 1A	Minimum Volume	0 hours	
Warrant 1B	Interruption to Continuous Traffic Flow	1 hour	1 hour
Warrant 1C	Combination of Parts A & B	0 hours	
Warrant 2	Four Hour	0 hours	
Warrant 3B	Peak-hour Volume	1 hour	

# 2005 EXISTING TRAFFIC Highland View Subdivision



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### **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. LOS A is the best, and LOS F is failing. For signalized intersections, a LOS of A has an average estimated intersection delay of less than 10 seconds, and LOS F has an estimated delay of greater than 80 seconds. A LOS of C and D are typical design values. Within urban areas, a LOS D, delay between 35 and 55 seconds, is considered acceptable by the Institute of Transportation Engineers (ITE) for signalized intersections.

Unsignalized intersections levels of service have lower thresholds of delays. A LOS of F exceeds estimated delays of 50 seconds. For urban arterials, minor approaches may frequently experience levels of service E. A full level of service description for unsignalized and signalized intersections is presented in Tables 1 and 2, respectively.

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

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

**SOURCE:** Highway Capacity Manual, TRB Special Report 209

**Table 2**  
**LEVEL-OF-SERVICE (LOS) DESCRIPTION**  
**FOR SIGNALIZED INTERSECTIONS**

LOS	Average Control Delay per Vehicle (seconds)	Description
A	$\leq 10.0$	Very low delay with extremely favorable progression. Most vehicles don't stop.
B	$> 10.0$ and $\leq 20.0$	Generally good progression. Increase number of stops from that described for LOS "A" resulting in higher delays
C	$> 20.0$ and $\leq 35.0$	Fair progression with increased delay. Number of stopping vehicles become significant; however, many still pass through the intersection without stopping. Stable flow.
D	$> 35.0$ and $\leq 55.0$	The influence of congestion becomes more noticeable. Longer delays resulting from unfavorable progression, longer cycles, or high V/C ratios. Approaching unstable flow.
E	$> 55.0$ and $\leq 80.0$	Limit of acceptable delay. Long delays associated with poor progression, long cycles, or high V/C ratios.
F	$> 80.0$	Unacceptable operation resulting from oversaturation (flow rates exceed capacity). Poor progression, long cycles, and high V/C ratios.

**SOURCE:** Highway Capacity Manual, TRB Special Report 209

Analyses were conducted using the Synchro Software, developed by Trafficware. Table 2 presents the unsignalized analyses of the study intersections. Current conditions show that the Simpson Road and Highland View Road at Chapman Highway have less than acceptable LOS's. Both AM and PM fail for the Simpson Road approach, and is a LOS E for the Highland View Road approach to Chapman Highway during the PM peak hour. Ideally, connecting the end of new 5-lane section in Seymour, TN, to the section of just south of Governor John Sevier Highway would provide a two-way left-turn lane through the intersection with Highland View Road and Simpson Road. The LOS would be better due to the available two-stage movement when making a left-turn from Simpson Road. Signalization of Chapman Highway at Highland View Road was identified in the **Knox County's Intersection Evaluation, Part 1**, study prepared by Wilbur Smith Associate in 2002 and results in a very good LOS. Signalization of Chapman Highway and Highland View Road should also create some gaps in the traffic flow at Simpson Road.



**TABLE 3  
2005 TRAFFIC  
CAPACITY AND LEVEL OF SERVICE**

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	2005 TRAFFIC DELAY	LOS
Chapman Hwy & Simpson Rd	STOP	AM	0.25	52.40	F
	NB	PM	0.24	178.1	F
Chapman Hwy & Highland View Rd	STOP	AM	0.35	21.4	C
	NB	PM	0.36	35.9	E
	<i>SIGNAL</i>	<i>AM</i>	<i>0.69</i>	<i>6.80</i>	<i>A</i>
	<i>Mitigation</i>	<i>PM</i>	<i>0.71</i>	<i>6.5</i>	<i>A</i>

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

### **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**

An average growth rate was determined using historical ADT traffic data from the Tennessee Department of Transportation (TDOT) count station on Chapman Highway. The increased ADT between 1995 and 2000 indicated that a yearly average of 2.0 percent could be expected for the area. For study purposes, target year 2010 was analyzed. Therefore, using a 2.5 percent compounded growth rate, the study intersections reflect a 13.1-percent growth. Figure 4 illustrates the traffic volumes with the appropriately applied growth factor.

# 2010 BACKGROUND TRAFFIC Highland View Subdivision

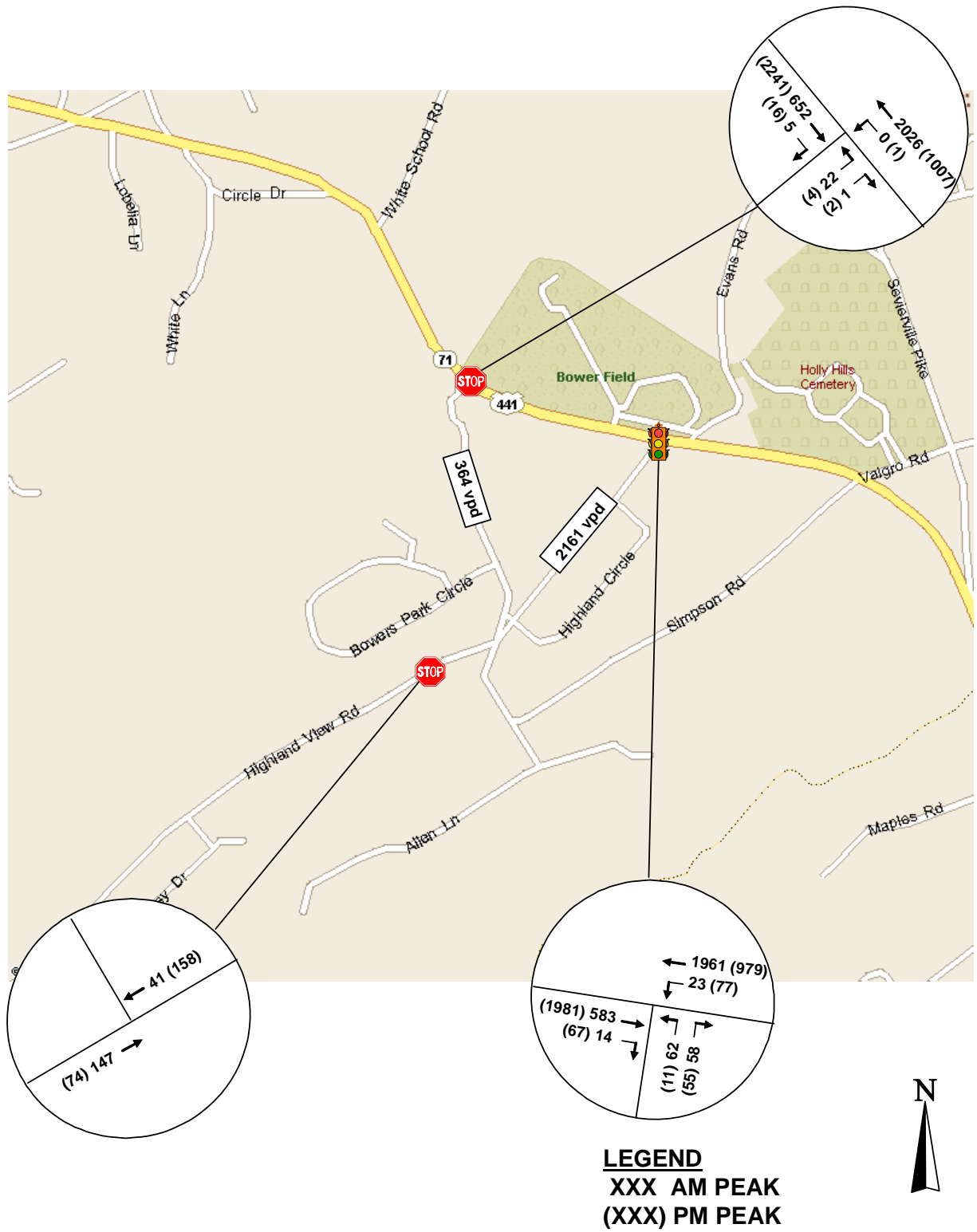


Figure 4

**Background Signal Warrant Analyses**

For the background traffic conditions, Warrant 3B continues to be satisfied for the northbound approach of Highland View Road at Chapman Highway and the Interruption Warrant (1B) is approached with nearly 6 hours satisfied. The analyses are summarized as follows:

		Hours <u>100% Satisfied</u>	Hours <u>90% Satisfied</u>
Warrant 1A	Minimum Volume	0 hours	
Warrant 1B	Interruption to Continuous Traffic Flow	4 hours	2 hours
Warrant 1C	Combination of Parts A & B	1 hour	
Warrant 2	Four Hour	1 hour	
Warrant 3B	Peak-hour Volume	1 hour	

**Background Capacity and Level of Service**

Analysis was performed with the grown traffic volumes and is displayed in Table 4. The levels of service are measured to be unacceptable with a LOS F for the unsignalized intersections of Chapman Highway at Highland View Road and Simpson Road with background conditions and no improvements to Chapman Highway. Signalization is required to mitigate the unacceptable LOS.

**TABLE 4  
2010 BACKGROUND TRAFFIC  
CAPACITY AND LEVEL OF SERVICE**

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2010 BACKGROUND		
			V/C	DELAY	LOS
Chapman Hwy & Simpson Rd	STOP	AM	0.34	78.7	F
	NB	PM	0.42	354.4	F
Chapman Hwy & Highland View Rd	STOP	AM	0.45	27.4	D
	NB	PM	0.51	55.4	F
	<i>SIGNAL</i>	<i>AM</i>	<i>0.75</i>	<i>7.8</i>	<i>A</i>
	<i>Mitigation</i>	<i>PM</i>	<i>0.79</i>	<i>10.1</i>	<i>B</i>

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

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## PROJECT IMPACTS

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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 119.80 acres for Planned Residential. This development is a total of 131 single-family units. From the trip generation calculations, the proposed site may generate approximately 1,330 daily trips. Table 5 presents the trip generation of this proposed site.

**TABLE 5  
TRIP GENERATION**

LAND USE	L.U.C.	Units	DAILY TRIPS	AM PEAK		PM PEAK	
				ENTER	EXIT	ENTER	EXIT
Single Family	210	131	1,333	25	76	87	49

### Trip Distribution and Assignment

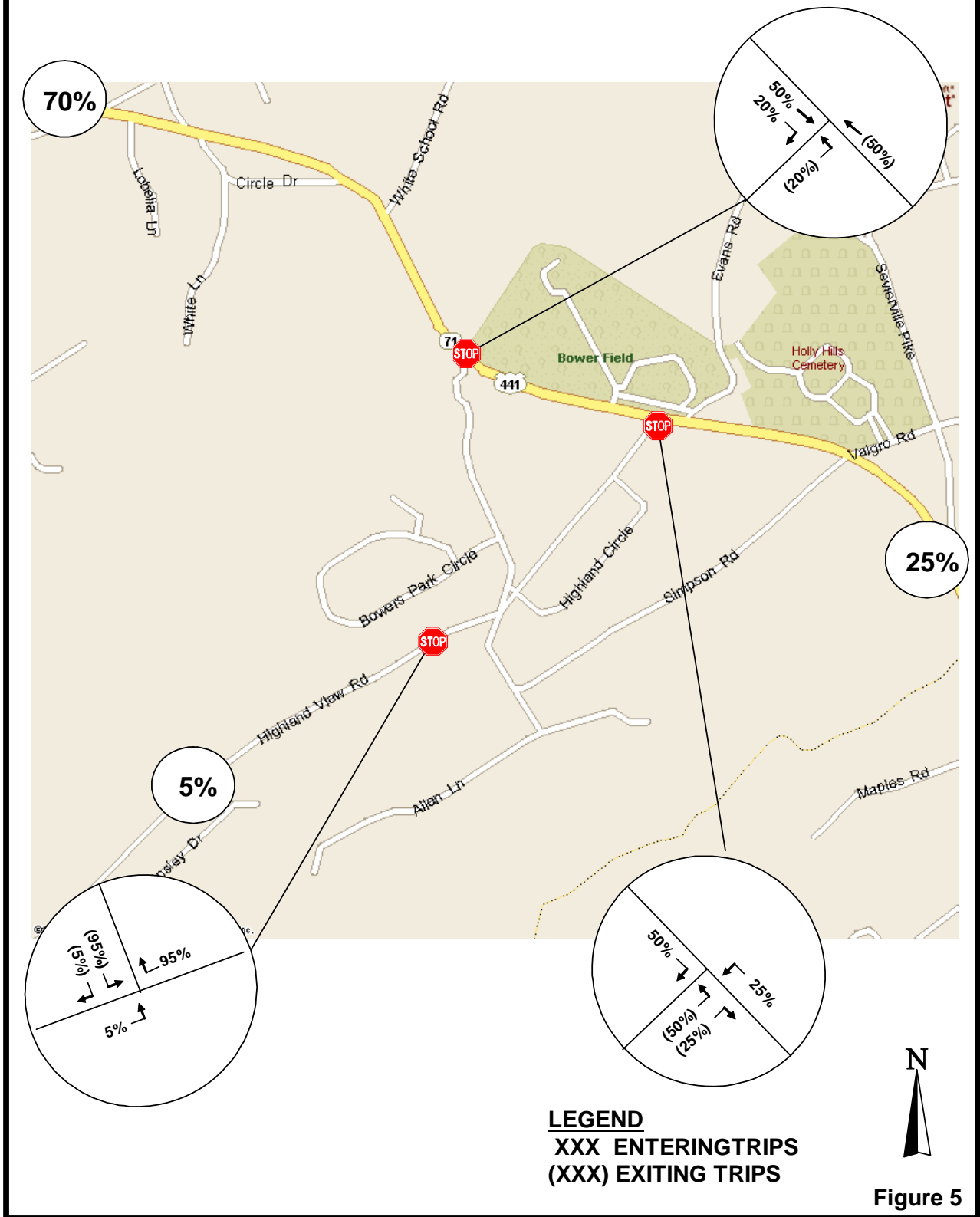
Using the turning-movement counts for the study intersections, trips are distributed to the adjacent streets with 70-percent of the generated trips distributed northwest and 25-percent assigned southeast on Chapman Highway. Highland View Road, southwest of the site, was assigned 5-percent of the generated trips. Figure 5 illustrates the traffic distribution and assignment.

### Project Traffic Volumes

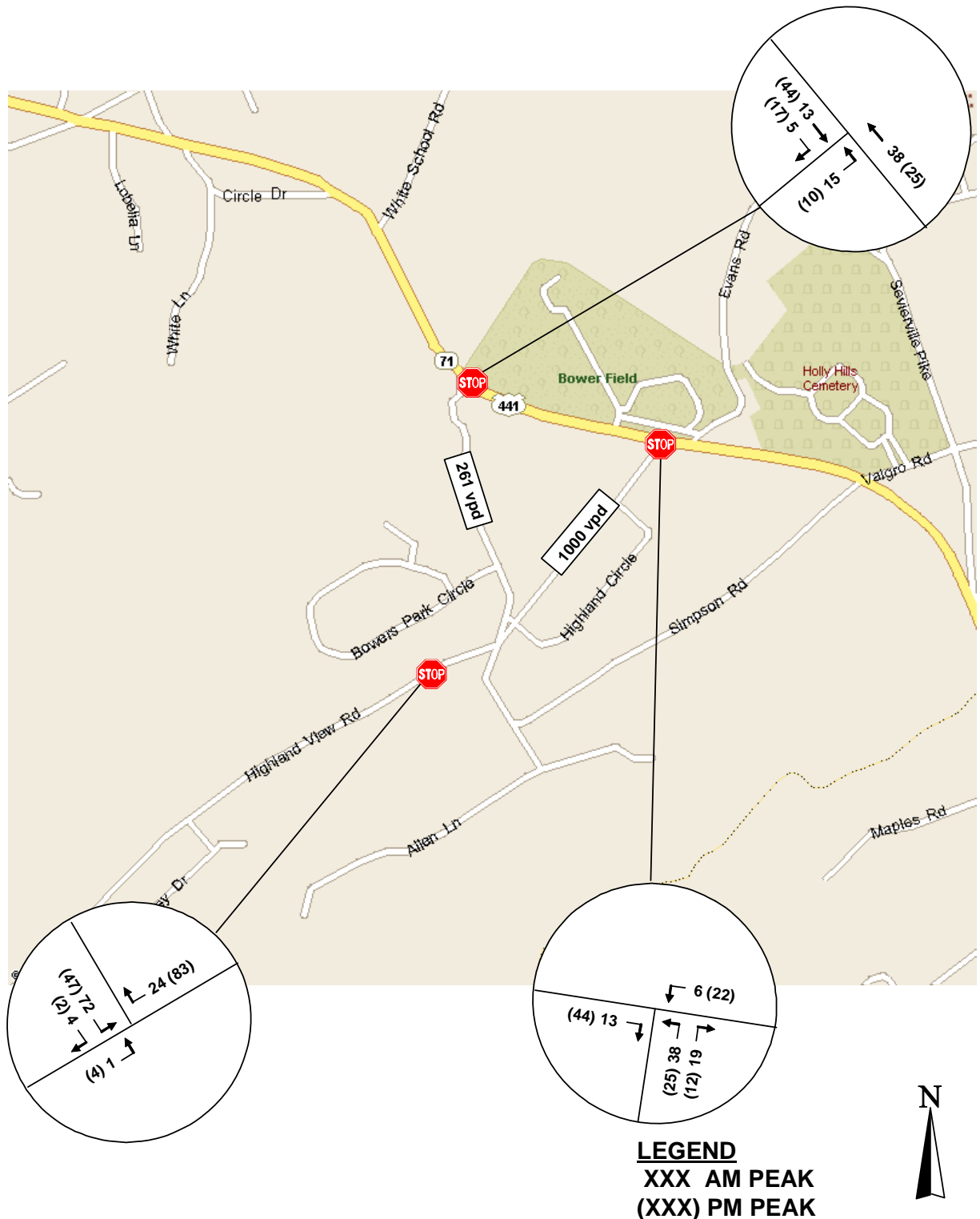
By multiplying the trips generated by the distribution percentages, the project traffic volumes were determined. Figure 6 illustrates the resulting project traffic volumes associated with the proposed project.



# DISTRIBUTION AND ASSIGNMENT Highland View Subdivision



# PROJECT TRIPS Highland View Subdivision



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### **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. Using this projection, mitigation measures including traffic control devices and roadway and intersection geometry can be evaluated. The projected ADT for Highland View Road and Simpson Road are approximately 3,161 and 631, respectively.

### **Projected Signal Warrant Analyses**

For the projected traffic conditions, Warrants 1B, 2 and 3B are satisfied for northbound approach of Highland View Road at Chapman Highway. The analyses are summarized as follows:

		Hours <u>100% Satisfied</u>	Hours <u>90% Satisfied</u>
Warrant 1A	Minimum Volume	1 hour	
Warrant 1B	Interruption to Continuous Traffic Flow	12 hours	3 hours
Warrant 1C	Combination of Parts A & B	1 hour	
Warrant 2	Four Hour	8 hours	4 hours
Warrant 3B	Peak-hour Volume	4 hours	1 hour

### **Projected Capacity and Level of Service**

The development traffic from the site was analyzed to project the impact the unsignalized intersections. The projected levels of service are shown in Table 6. The unsignalized LOS continue to fail without the improvements to Chapman Highway. An acceptable LOS may be achieved for Chapman Highway and Highland View Road intersection with signalization, and signalization of Chapman Highway at Highland View Road should also create some gaps in traffic flow improving the ability of drivers to turn left from Simpson Road. The traffic volumes generated by the proposed development during the AM and PM peak hours are minimal for the Simpson Road approach to Chapman Highway and can be accommodated on Highland View Road if insufficient gaps are available for traffic approaching on Simpson Road. To recap the analysis performed for this study, Table 7 summaries the volume to capacity ratio, delay and LOS measured and projected for this development.

### **Sight Distance**

The project is proposed to access Highland View Road. The road's speed limit is currently posted for 30mph adjacent to the site. Stopping 10-foot from the edge of pavement, measured sight distance for the proposed subdivision street access is approximately 570 feet looking left and right. Sight-distance is limited by a tree to the east and a utility box to the west when sight-distance is measured 15-feet back of the edge of pavement. The required distance is 200 feet to meet the minimum stopping sight-distance for American Association of State Highway and Transportation Officials (AASHTO) and 300 feet to meet the Knox County minimum corner sight-distance standard. The proposed site access, therefore, meets both criteria to be acceptable for safe operations.

# 2010 PROJECTED TRAFFIC Highland View Subdivision

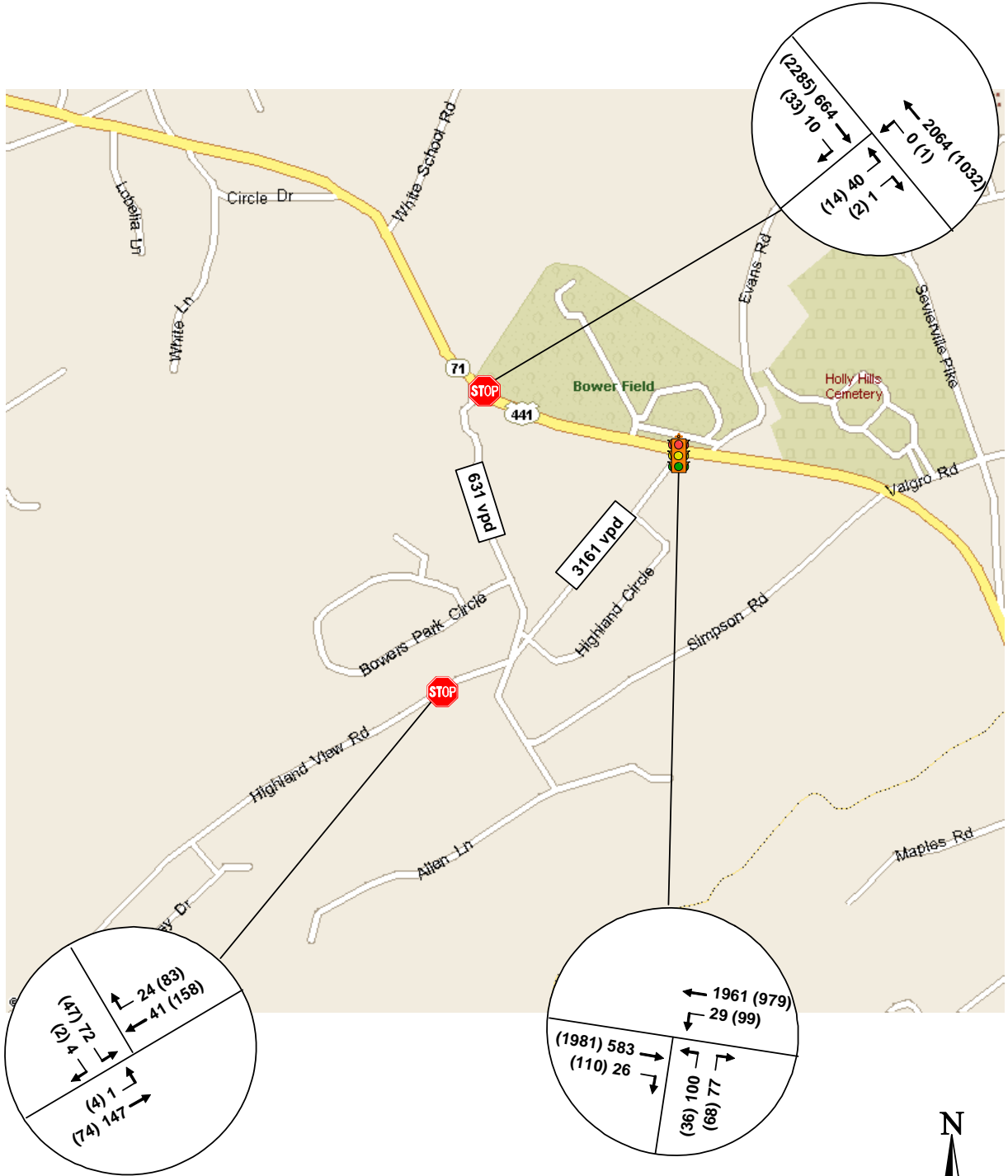


Figure 7



**TABLE 6  
2010 PROJECTED TRAFFIC  
CAPACITY AND LEVEL OF SERVICE**

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	2010 PROJECTED	
				DELAY	LOS
Chapman Hwy & Simpson Rd	STOP	AM	0.66	129.5	F
	NB	PM	1.62	991.6	F
Chapman Hwy & Highland View Rd	STOP	AM	0.72	46.4	E
	NB	PM	1.16	222.6	F
	<i>SIGNAL</i>	<i>AM</i>	<i>0.79</i>	<i>9.9</i>	<i>A</i>
	<i>Mitigation</i>	<i>PM</i>	<i>0.76</i>	<i>11.3</i>	<i>B</i>
Highland View Rd & Site Access	STOP	AM	0.11	10.2	B
	SB	PM	0.08	10.7	B

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

**TABLE 7  
SUMMARY  
CAPACITY AND LEVEL OF SERVICE**

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	V/C	2005 TRAFFIC		2010 BACKGROUND			2010 PROJECTED		
				DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS
Chapman Hwy & Simpson Rd	STOP	AM	0.25	52.4	F	0.34	78.7	F	0.66	129.5	F
	NB	PM	0.24	178.1	F	0.42	354.4	F	1.62	991.6	F
Chapman Hwy & Highland View Rd	STOP	AM	0.35	21.4	C	0.45	27.4	D	0.72	46.4	E
	NB	PM	0.36	35.9	E	0.51	55.4	F	1.16	222.6	F
	<i>SIGNAL</i>	<i>AM</i>	<i>0.69</i>	<i>6.8</i>	<i>A</i>	<i>0.75</i>	<i>7.8</i>	<i>A</i>	<i>0.79</i>	<i>9.9</i>	<i>A</i>
	<i>Mitigation</i>	<i>PM</i>	<i>0.71</i>	<i>6.5</i>	<i>A</i>	<i>0.79</i>	<i>10.1</i>	<i>B</i>	<i>0.82</i>	<i>11.9</i>	<i>B</i>
Highland View Rd & Site Access	STOP	AM	-	-	-	-	-	-	0.11	10.2	B
	SB	PM	-	-	-	-	-	-	0.08	10.7	B

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

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## RECOMMENDATIONS

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The analyses conducted and the review of the traffic volumes identified the following recommendations:

- Chapman Highway at Highland View should be improved with signalization as identified in the recommendations of **Knox County's Intersection Evaluation Part 1** study.
- 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 streets with a STOP sign (R1-1) at Highland View Road.
- 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 Department of Engineering and Public Works.

## CONCLUSION

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The study of this proposed residential development evaluated the projected traffic conditions. Background traffic was determined using a 2.5-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 and signalized capacity and level of service analyses were conducted using the **2000 Highway Capacity Manual**. Unsignalized levels of service were found to be unacceptable for the existing traffic conditions and would further deteriorate for background with and without the proposed development for the intersection of Chapman Highway at Simpson Road and Highland View Road. This LOS may be acceptable with Chapman Highway signalization per **Knox County's Intersection Evaluation, Part 1**. The sight distance for the driveway will be adequate based on field measurements for a posted speed limit of 30-mph. With the recommendations of this report, the efficient and safe flow of traffic should be maintained.

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## APPENDIX

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Trip Generation

Signal Warrants

HCS Unsignalized Analyses

HCS Signalized Analyses

Traffic Counts

