

***PRESTIGE SUBDIVISION
Knox County***

TRAFFIC IMPACT STUDY



Prepared For:
BATSON, HIMES, NORVELL, & POE

Prepared By:



ENGINEERS
PLANNERS
ECONOMISTS

Wilbur Smith Associates

April 2004

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SUBDIVISION
KNOX COUNTY, TENNESSEE
TRAFFIC IMPACT STUDY**

Prepared for

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April 2004

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TABLE OF CONTENTS

INTRODUCTION	1
Project Description.....	1
Site Location.....	1
LOCAL AND REGIONAL ACCESS	4
Local Access.....	4
Regional Access.....	4
EXISTING TRAFFIC CONDITIONS	5
Existing Traffic Control.....	5
Existing Traffic Volumes.....	5
Signal Warrant Analyses.....	5
Existing Capacity and Level of Service.....	7
BACKGROUND TRAFFIC CONDITIONS	9
Background Traffic Volumes.....	9
Background Signal Warrant Analyses.....	9
Background Capacity and Level of Service.....	9
PROJECT IMPACTS	11
Trip Generation.....	11
Trip Distribution and Assignment.....	11
Project Traffic Volumes.....	12
Total Projected Traffic Volumes.....	12
Sight Distance.....	12
Projected Signal Warrant Analyses.....	16
Projected Capacity and Level of Service.....	16
RECOMMENDATIONS	18
CONCLUSION	18
APPENDIX	19

LIST OF FIGURES

Figure 1: Proposed Site Plan.....	2
Figure 2: Vicinity Map.....	3
Figure 3: 2003/2004 Existing Traffic	6
Figure 4: 2010 Background Traffic.....	10
Figure 5: Distribution and Assignment.....	13
Figure 6: Project Trips.....	14
Figure 7: 2010 Projected Traffic.....	15

LIST OF TABLES

Table 1- Unsignalized LOS Description.....	7
Table 2- Signalized LOS Description.....	8
Table 3- 2004 Existing Capacity and Level of Service.....	8
Table 4- 2010 Background Capacity and Level of Service.....	11
Table 5- Trip Generation.....	12
Table 6- 2010 Projected Capacity and Level of Service.....	16
Table 7- Summary of Capacity and Level of Service.....	17

INTRODUCTION

Wilbur Smith Associates (WSA) is pleased to submit this report to address the impact and access of a proposed residential development located on Carter Mill Road in East 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 site accesses. 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 met 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 Carter Mill Road.

Project Description

The proposed project is a residential development. The proposed site is approximately 187.46 acres zoned Planned Residential (PR). This tract is bounded by Carter Mill Road to the north and Paschat Carter Memorial Park to the east. Three site access streets are proposed to Carter Mill Road. One proposed street would access 76 single-family units and the other two would access the remaining 229 single family units. Figure 1 shows the proposed site plan.

Site Location

The location of the proposed residential development is on Carter Mill Road in East Knox County, Tennessee, and east of the Knoxville central business district (CBD). The proposed development will be located south of Carter Mill Road and southwest of Asheville Highway. Figure 2 illustrates the site location relative to local and regional access.

SITE PLAN

Prestige Subdivision



Figure 1

VICINITY MAP

Carter Mill Road Subdivision

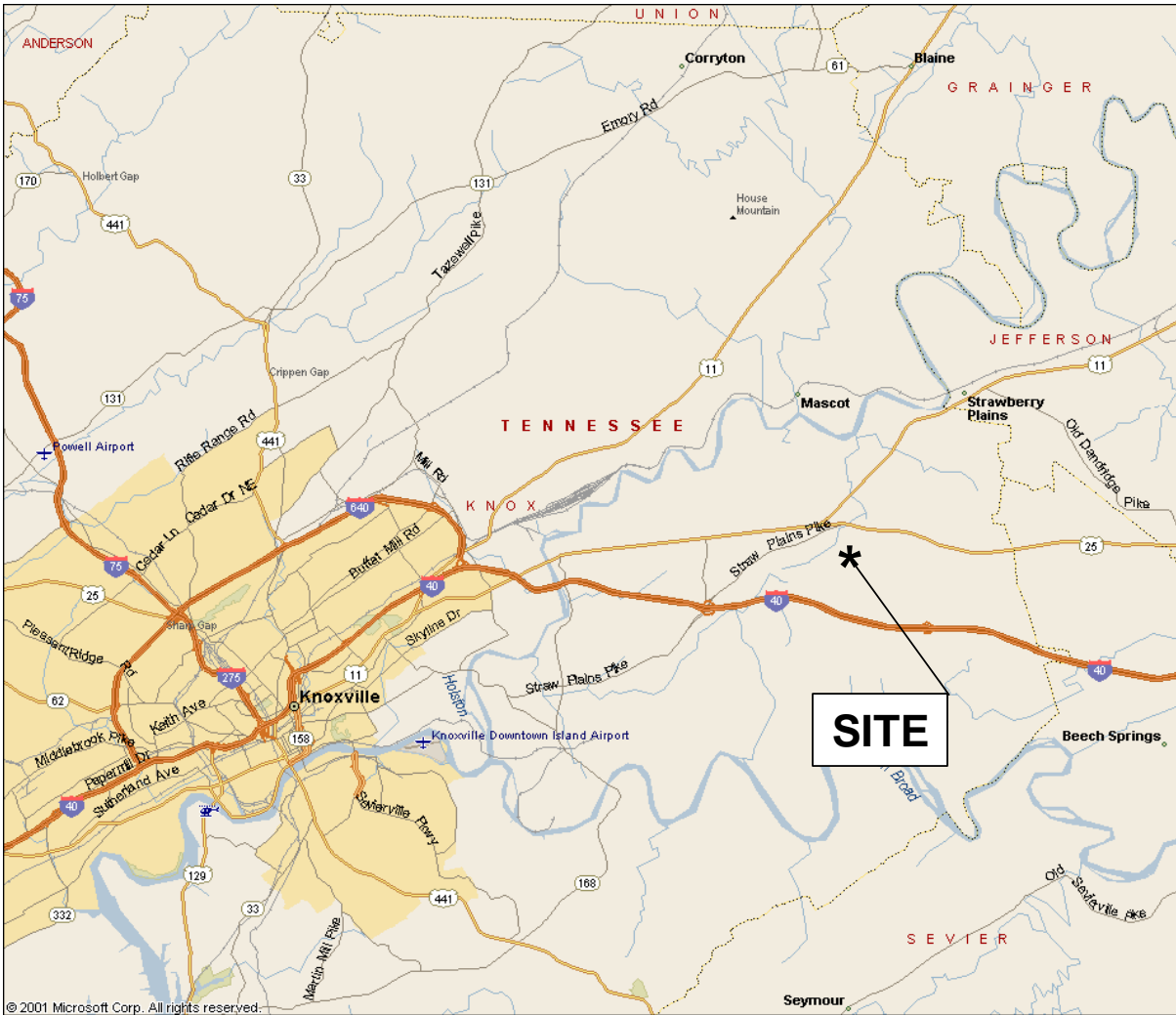


Figure 2

LOCAL AND REGIONAL ACCESS

Local Access

Carter Mill Road provides local access to the site. Carter Mill Road is a northeast and southwest local facility between Carter School Road and McCubbins Road. Carter Mill Road is a 15-foot roadway becoming a 20-foot facility as it approaches Carter School Road where it transverses an adverse reverse horizontal curve. This wider section of pavement is provided adjacent to the Paschat Carter Memorial Park. Carter School Road extends southeast and north to Asheville Highway (US 70/25W, SR 9). McCubbins Road extends north to Strawberry Plains Pike.

Regional Access

Strawberry Plains Pike is classified as a minor arterial roadway. It is an east-west four-lane divided facility at Interstate 40 having two lanes in both directions that average 24' feet in width with a 36' grass median. It becomes a 2-lane facility northeast and southwest of the interstate. It provides access to Interstate 40 to the west and intersects Asheville Highway northwest of the proposed site.

A major arterial highway, Asheville Highway extends east and west north of the site intersecting Strawberry Plains Pike and Andrew Johnson Highway (US 11E, SR 34) to the west. Asheville Highway extends west into the Knoxville CBD. North of the site, Asheville Highway is a 2-lane highway with an ADT of 5,700.

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.

EXISTING TRAFFIC CONDITIONS

Existing Traffic Control

The Carter Mill Road approach to Carter School Road is STOP controlled, and Carter School Road approaches to Asheville Road are STOP controlled. The posted speed limit for Asheville Highway and Carter School Road is 45mph and 40mph, respectively. Carter Mill Road does not have a posted speed limit based on a current field visit. For analysis purpose, an assumed speed limit of 30mph was used.

Existing Traffic Volumes

Eight-hour turning movement counts (TMC) were conducted by WSA in April of 2003 for the intersection of Carter School Road and Carter Mill Road and January of 2004. Figure 3 illustrates the resulting intersection turning movements for the AM and PM peaks. The peak hours were found between 7:30-8:30 AM and 3:15-4:15 PM.

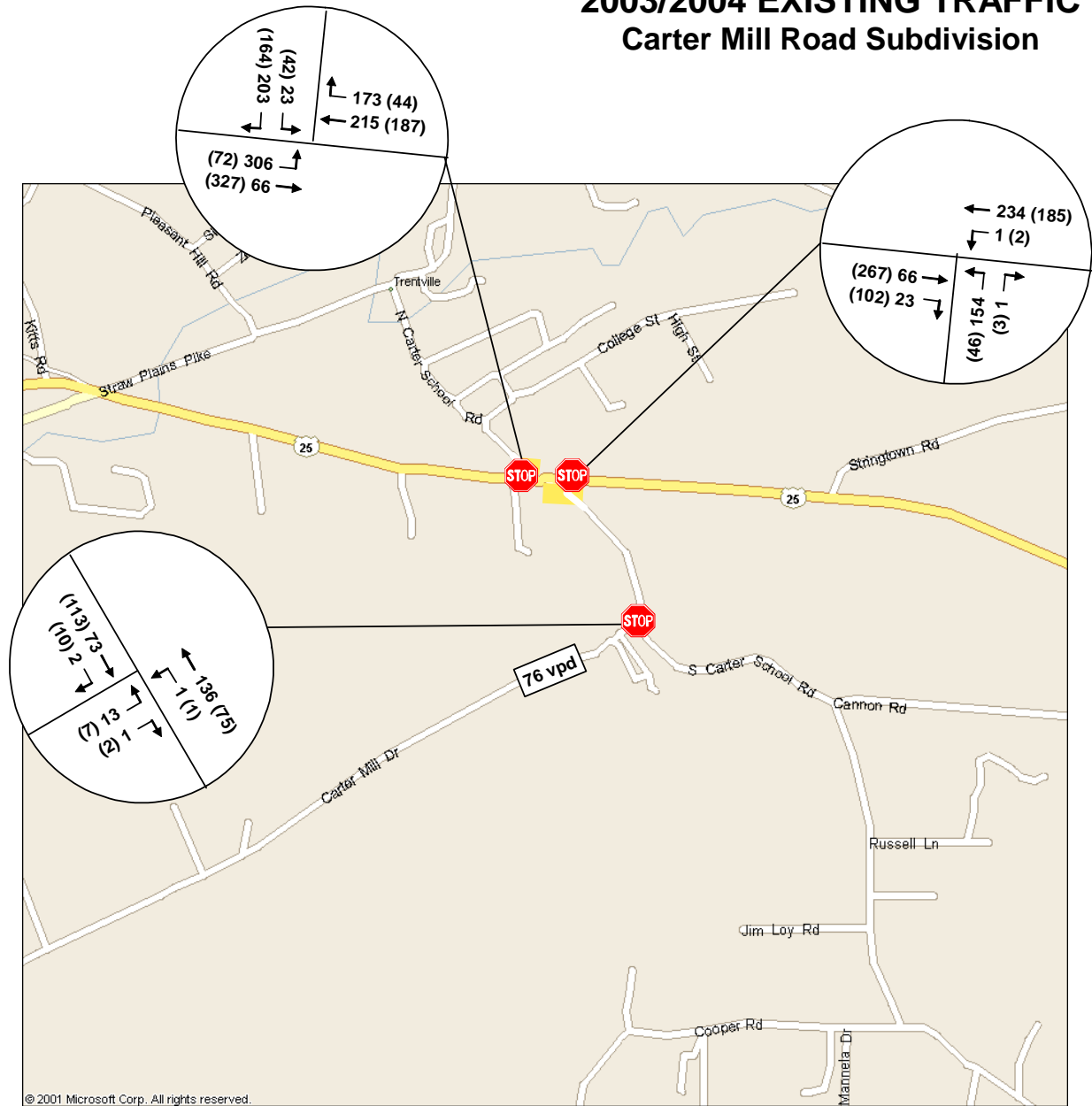
Signal Warrant Analyses

For the study intersection of Asheville Highway and Carter School Road, east and west, 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 Asheville 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, volume warrants are not met for either the southbound or northbound approaches of Carter School Road which are separated by 500 feet. The analyses are summarized as follows:

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

2003/2004 EXISTING TRAFFIC Carter Mill Road Subdivision



LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



Figure 3

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 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

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

SOURCE: Highway Capacity Manual, TRB Special Report 209

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

LOS	Average Control Delay per Vehicle (seconds)	Description
A	≤ 10.0	Very low delay with extremely favorable progression. Most vehicles don't stop.
B	> 10.0 and ≤ 20.0	Generally good progression. Increase number of stops from that described for LOS "A" resulting in higher delays
C	> 20.0 and ≤ 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 ≤ 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 ≤ 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 3 presents the unsignalized analyses of the study intersections

TABLE 3
2004 TRAFFIC
CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2004 TRAFFIC		
			V/C	DELAY	LOS
Asheville Hwy & N. Carter School Rd	STOP SB-L,R	AM	-	29.1 , 12.3	D , B
		PM	-	16.4 , 10.7	C , B
Asheville Hwy & S. Carter School Rd	STOP NB	AM	-	12.20	B
		PM	-	12.4	B
S. Carter School Rd & Carter Mill Rd	STOP NB	AM	-	9.80	A
		PM	-	9.5	A

Note: Average vehicle delay estimated in seconds. STOP control analyses presented by 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 Carter School Road, east of the site. The increased ADT between 1995 and 2000 indicated that an average of 2.5 percent could be expected for the area. The expected completion of the proposed residential development is assumed as Year 2010. Therefore, using a compounded growth rate, the intersections of Carter School Road with Asheville Highway and Carter School Road with Carter Mill Road, background traffic reflects a 16- and 18.9-percent growth, respectively. Figure 4 illustrates the traffic volumes with the appropriately applied growth factors.

Background Signal Warrant Analyses

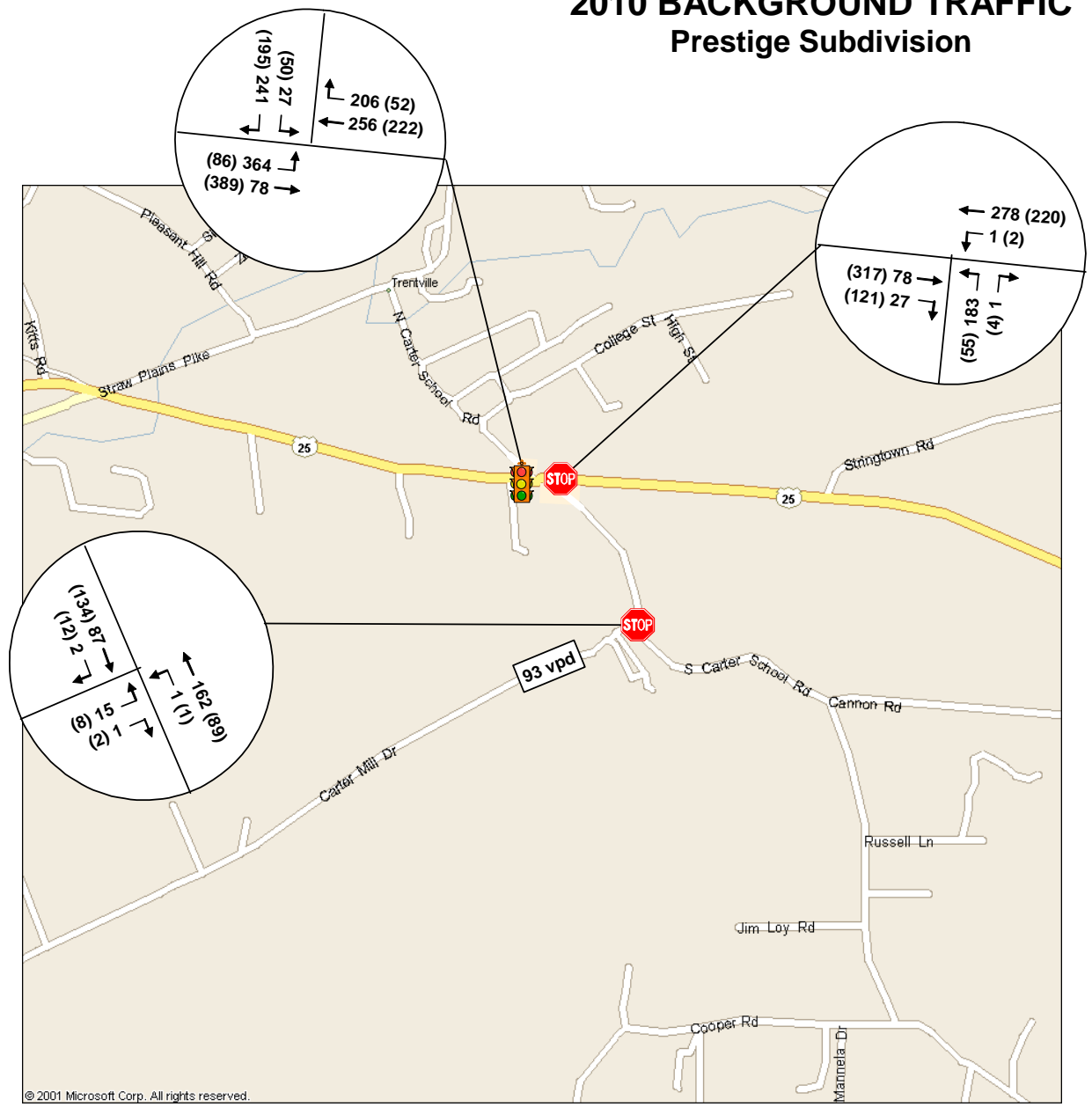
For the background traffic conditions, Warrants 2 and 3B are satisfied met for the southbound approach of Carter School Road at Asheville Highway, but traffic volumes for the northbound approach of Carter School Road remain insufficient to satisfy any traffic signal warrants. The southbound approach satisfies the Peak Hour warrant and nearly the Interruption warrant. Warrants for the southbound approach, however, are satisfied primarily due to the southbound right-turn volume, which is associated with the left-turn volume from eastbound Asheville Highway. The analyses are summarized as follows:

		<u>Northbound</u>	<u>Southbound</u>
Warrant 1A	Minimum Volume	1 hours	2 hours
Warrant 1B	Interruption to Continuous Traffic Flow	2 hours	7 hours
Warrant 1C	Combination of Parts A & B	0 hours	5 hours
Warrant 2	Four Hour	2 hours	4 hours
Warrant 3B	Peak-hour Volume	0 hours	2 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 acceptable for the unsignalized study intersection with background conditions.

2010 BACKGROUND TRAFFIC Prestige Subdivision



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LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



Figure 4

TABLE 4

2010 BACKGROUND TRAFFIC

CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2010 BACKGROUND		
			V/C	DELAY	LOS
Asheville Hwy & N. Carter School Rd	STOP SB-L,R	AM	-	45.8 , 14.0	E , B
		PM	-	20.0 , 11.5	C , B
	<i>New Signal</i>	AM	<i>0.81</i>	9.8	A
		PM	<i>0.52</i>	6.1	A
Asheville Hwy & S. Carter School Rd	STOP NB	AM	-	13.6	B
		PM	-	13.6	B
S. Carter School Rd & Carter Mill Rd	STOP NB	AM	-	10.1	B
		PM	-	9.8	A

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

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 187.46 acres of zoned Planned Residential. This development is a total of 305 single-family units divided with 76 units accessing one proposed street and 229 units accessing two proposed streets. From the trip generation calculations, the proposed site may generate approximately 3,040 daily trips. Table 5 presents the trip generation of this proposed site.

Trip Distribution and Assignment

Using the turning-movement counts for the study intersections, trips are distributed to the adjacent streets with 85-percent of the generated trips distributed north and east of the site and 15-percent assigned south on Carter Mill Road. The 85-percent was divided into four directions. Asheville Highway was assigned

50-percent to the west and 5-percent to the east. Carter School Road was assigned 25-percent from the north and 5-percent from the south. Figure 5 illustrates this distribution and assignment.

TABLE 5
TRIP GENERATION

LAND USE	L.U.C.	Units	DAILY	AM PEAK		PM PEAK	
			TRIPS	ENTER	EXIT	ENTER	EXIT
Single Family	210	76	808	16	47	54	30
Single Family	210	229	2,228	42	127	145	81
Total		305	3,036	58	174	199	111

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.

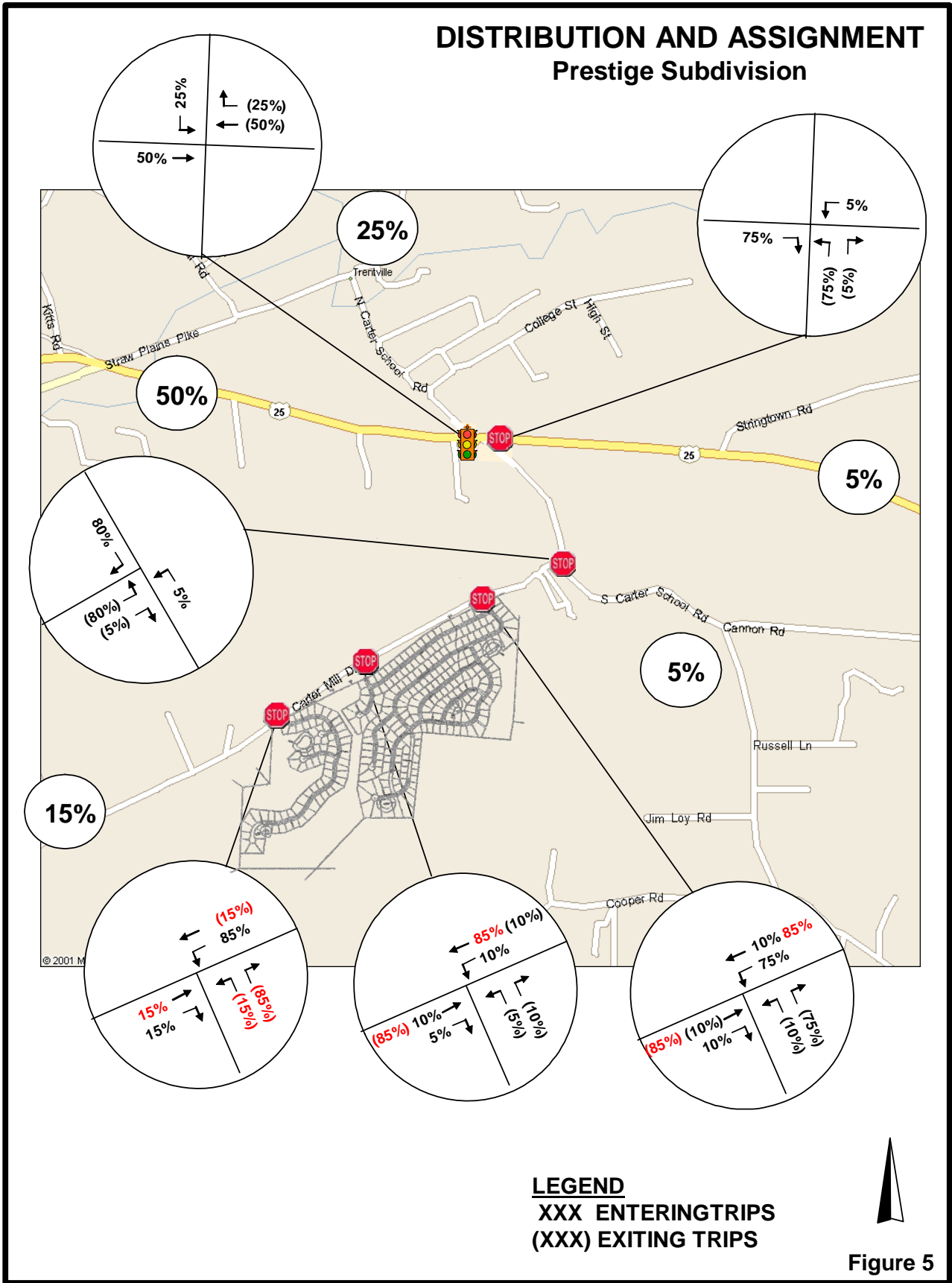
Total Projected Traffic Volumes

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 Carter Mill Road is approximately 548 and 2,674 west and east of the proposed site, respectively.

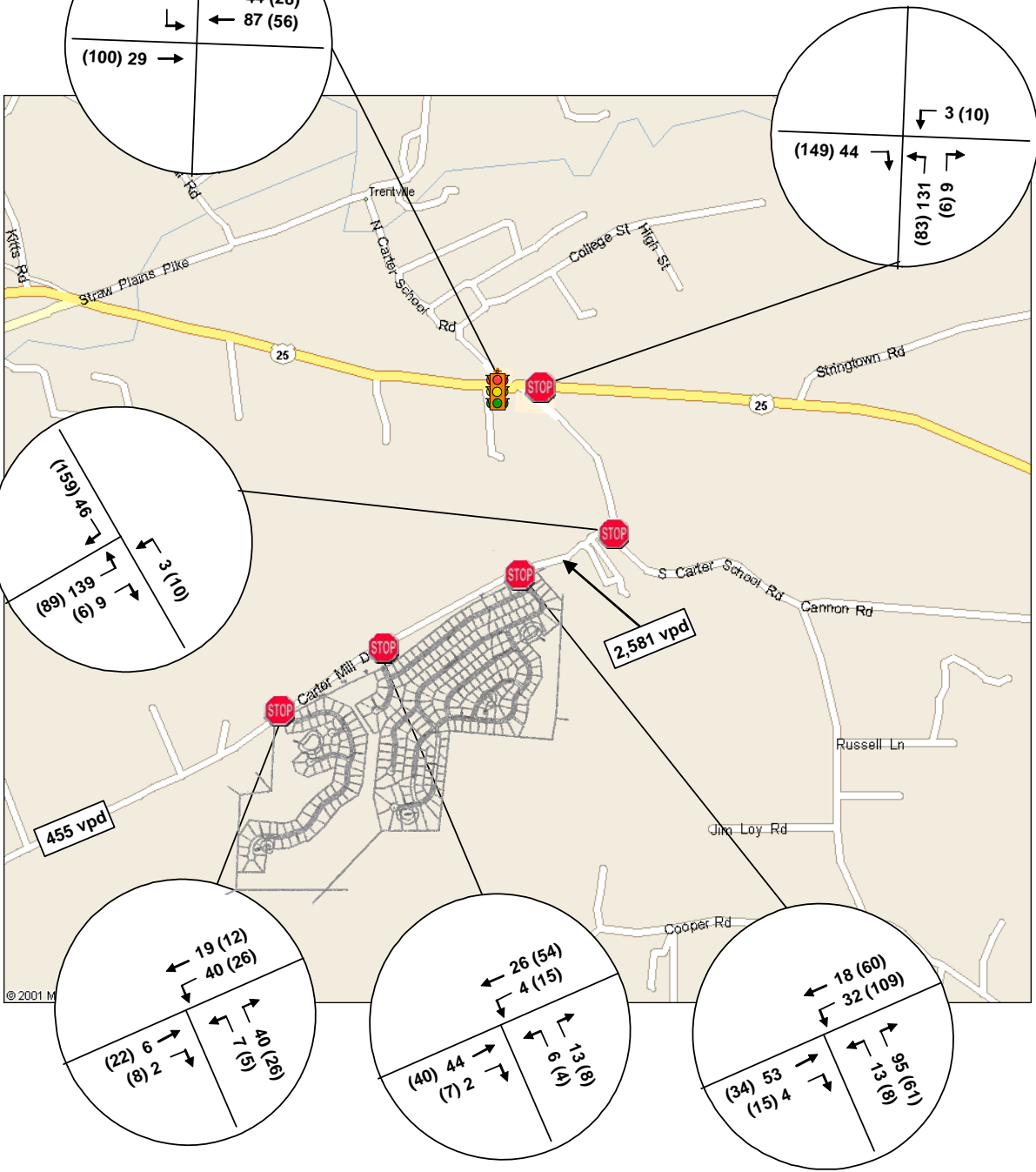
Sight Distance

The project is proposed to access Carter Mill Road at three locations. The road’s speed limit is currently not posted. For analysis purposes, an assumed 30-mph speed limit was used. Measured sight distance at the westerly access is approximately 525 feet and 750 feet looking left and right, respectively. The middle access roadway has a measured sight distance of 900 feet and 645 feet looking left and right, respectively. A sight distance of 250 feet and 510 feet looking left and right, respectively, were measured at the location of the easterly access roadway. The restricted sight distance of 250 feet is due to a vertical curve along Carter Mill Road in the vicinity of the residential driveway on the northside of Carter Mill Road and north of the proposed site. The required distance is 200 feet to meet the minimum stopping sight-distance for American Association of State Highway and Transportation Officials (AASHTO) and

DISTRIBUTION AND ASSIGNMENT Prestige Subdivision



PROJECT TRIPS Prestige Subdivision

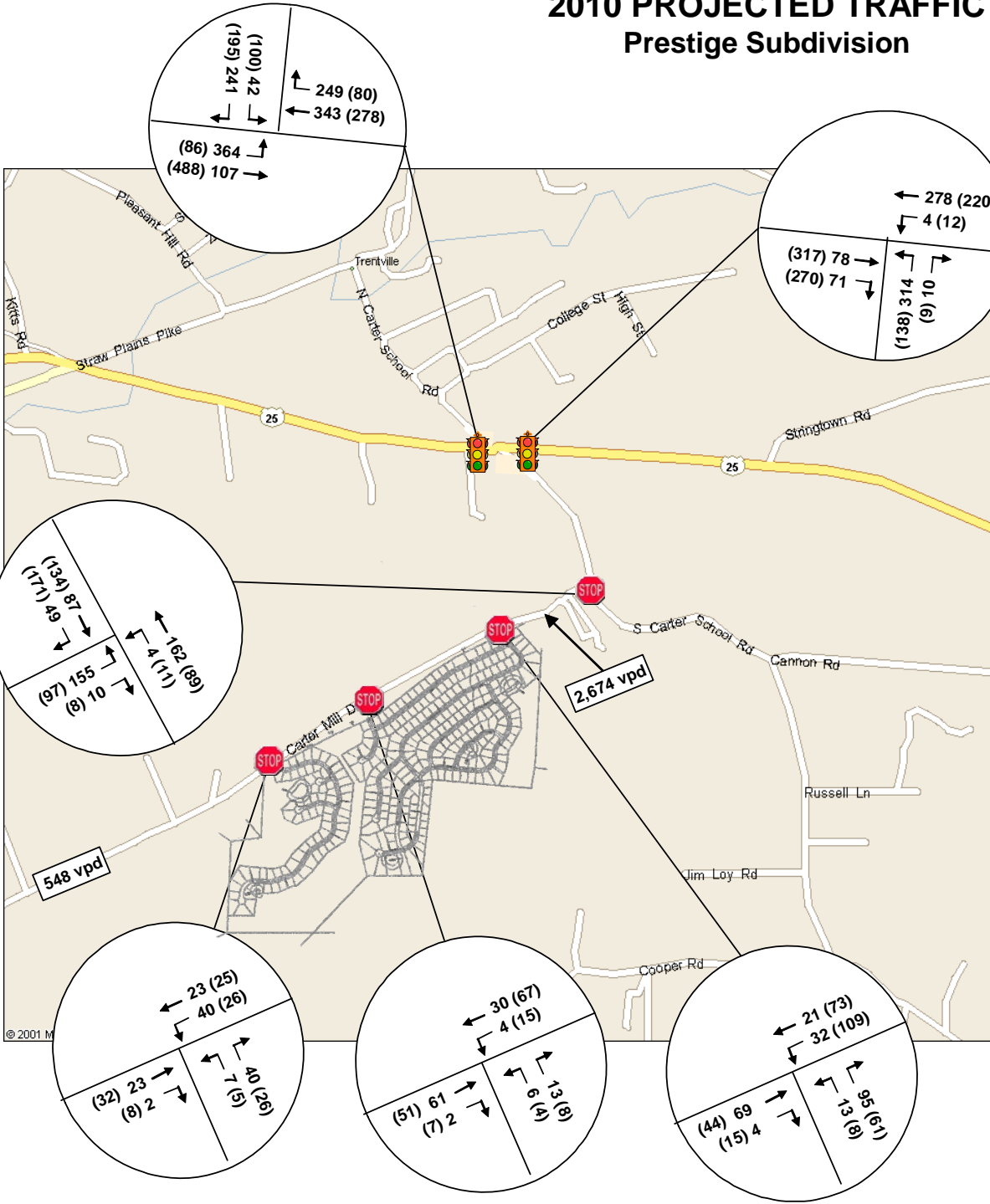


LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



Figure 6

2010 PROJECTED TRAFFIC Prestige Subdivision



LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



Figure 7

300 feet to meet the Knox County Minimum Corner Sight-distance Standard. The proposed site accesses, therefore, almost meet both criteria to be acceptable for safe operations.

Projected Signal Warrant Analyses

For the background traffic conditions, Warrants 2 and 3B are satisfied for both the southbound and northbound approaches of Carter School Road at Asheville Highway and nearly met for the Minimum Volume (Warrant 1A). The southbound approach also nearly satisfies the Interruption Warrant (Warrant 1B). The analyses are summarized as follows:

		<u>Northbound</u>	<u>Southbound</u>
Warrant 1A	Minimum Volume	7 hours	6 hours
Warrant 1B	Interruption to Continuous Traffic Flow	4 hours	7 hours
Warrant 1C	Combination of Parts A & B	6 hours	6 hours
Warrant 2	Four Hour	7 hours	6 hours
Warrant 3B	Peak-hour Volume	3 hours	4 hour

Projected Capacity and Level of Service

The development of the site may further impact the unsignalized intersection. The summarized analysis is shown in Table 6. To recap the analysis performed for this study Table 7 summarizes the volume to capacity ratio, delay and LOS measured and projected for this development.

TABLE 6

2010 PROJECTED TRAFFIC

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2010 PROJECTED		
			V/C	DELAY	LOS
Asheville Hwy & N. Carter School Rd	STOP	AM	-	83.9 , 16.8	F , C
	SB-L,R	PM	-	34.5 , 12.4	D , B
	<i>New Signal</i>	AM	<i>0.78</i>	<i>11.4</i>	<i>B</i>
		PM	<i>0.48</i>	<i>8.2</i>	<i>A</i>
Asheville Hwy & S. Carter School Rd	STOP	AM	-	18.4	C
	NB	PM	-	16.6	C
	<i>New Signal</i>	AM	<i>0.40</i>	<i>23.6</i>	<i>C</i>
		PM	<i>0.32</i>	<i>6.4</i>	<i>A</i>
S. Carter School Rd & Carter Mill Rd	STOP	AM	-	12.0	B
	NB	PM	-	11.8	B
Carter Mill Rd & East Driveway Access	STOP	AM	-	9.3	A
	NB	PM	-	9.2	A
Carter Mill Rd & West/East Driveway Access	STOP	AM	-	8.9	A
	NB	PM	-	8.9	A
Carter Mill Rd & West Driveway Access	STOP	AM	-	8.8	A
	NB	PM	-	8.7	A

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

TABLE 7

SUMMARY

CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2004 TRAFFIC			2010 BACKGROUND			2010 PROJECTED		
			V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS
Asheville Hwy & N. Carter School Rd	STOP SB-L,R	AM	-	29.1 , 12.3	D , B	-	45.8 , 14.0	E , B	-	83.9 , 16.8	F , C
		PM	-	16.4 , 10.7	C , B	-	20.0 , 11.5	C , B	-	34.5 , 12.4	D , B
	<i>New Signal</i>	AM	-	-	-	0.81	9.8	A	0.78	11.4	B
		PM	-	-	-	0.52	6.1	A	0.48	8.2	A
Asheville Hwy & S. Carter School Rd	STOP NB	AM	-	12.2	B	-	13.6	B	-	18.4	C
		PM	-	12.4	B	-	13.6	B	-	16.6	C
	<i>New Signal</i>	AM	-	-	-	-	-	-	0.40	23.6	C
		PM	-	-	-	-	-	-	0.32	6.4	A
S. Carter School Rd & Carter Mill Rd	STOP NB	AM PM	- -	9.8 9.5	A A	- -	10.1 9.8	B A	- -	12.0 11.8	B B
	Carter Mill Rd & East Driveway Access	STOP NB	AM PM	- -	- -	- -	- -	- -	- -	- -	9.3 9.2
Carter Mill Rd & West/East Driveway Access		STOP NB	AM PM	- -	- -	- -	- -	- -	- -	- -	8.9 8.9
	Carter Mill Rd & West Driveway Access	STOP NB	AM PM	- -	- -	- -	- -	- -	- -	- -	8.8 8.7

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

RECOMMENDATIONS

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

- Improve Carter Mill Road to a 2-lane collector roadway from the southwesterly access to Carter School Road.
- 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 Carter Mill 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 Public Works Department.
- Signalize the intersection of Asheville Highway and Carter School Road.

CONCLUSION

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 acceptable for the existing traffic conditions, but deteriorate for background with and without the proposed development for the intersection of Asheville Highway and Carter School Road. The deficient sight distance for the easterly driveway may be corrected with the completion of the improvements to Carter Mill Road to the standards of a collector facility. With the recommendations of this report, the efficient and safe flow of traffic should be maintained.

APPENDIX

Trip Generation

Trip Assignment

HCS Unsignalized Analyses

HCS Signalized Analyses

Traffic Counts

