

TIPTON STATION SUBDIVISION
Knox County

TRAFFIC IMPACT STUDY



May 2004

**TIPTON STATION
SUBDIVISION
KNOX COUNTY, TENNESSEE
TRAFFIC IMPACT STUDY**

Prepared for

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May 2004

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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 Tipton Station 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 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 1 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 Tipton Station Road and the adjacent intersections with Chapman Highway and West Hendron Chapel Road.

Project Description

The proposed project is a residential development. The proposed site is approximately 35.59 acres zoned Agriculture and will be rezoned Planned Residential (PR). This tract is bounded by Tipton Station Road to the east. A site access street is proposed to Tipton Station Road. The proposed street would access 92 single-family units. Figure 1 shows the proposed site plan.

Site Location

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

SITE PLAN

Tipton Station Subdivision

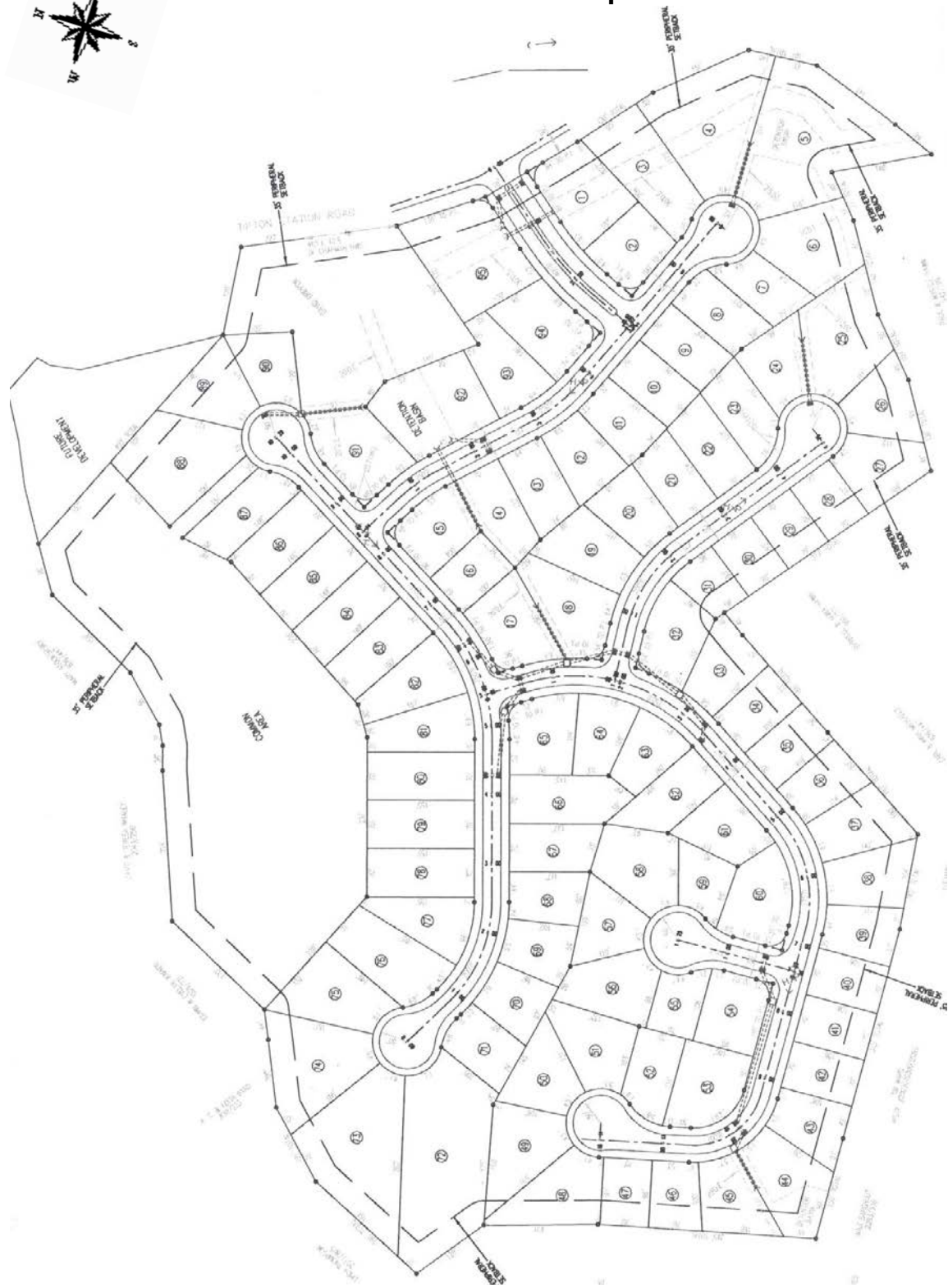


Figure 1

VICINITY MAP

Tipton Station Subdivision



Figure 2

LOCAL AND REGIONAL ACCESS

Local Access

Tipton Station Road provides local access for the site and connects to the regional arterial of Chapman Highway (U.S. 441, S.R. 71) to the north. Tipton Station Road is a 20-foot wide, 2-lane roadway which is classified as a minor collector. Access to Chapman Highway is also provided by Hendron Chapel Road intersecting Tipton Station Road south of the site.

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 4-lane section with shoulders intersecting Tipton Station 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.

EXISTING TRAFFIC CONDITIONS

Existing Traffic Control

The Tipton Station Road approach to Chapman Highway is STOP controlled, and STOP control is provided for the Hendron Chapel Road approach to Tipton Station Road. Hendron Chapel Road is signalized at its intersection with Chapman Highway.

Existing Traffic Volumes

Peak-hour turning movement counts (TMC) were conducted by WSA in May of 2004 for the intersection of Tipton Station Road and Hendron Chapel Road. The TMC for Chapman Highway and Tipton Station Road came from “Intersection Evaluation Part 1”, which is a Knox County study performed by WSA, and was collected in July 2002. The 2002 data was factored by a 1.05 factor to represent 2004 traffic conditions. Figure 3 illustrates the resulting intersection turning movements for the AM and PM peaks. The peak hours were found between 7:00-8:30 AM and 4:45-6:00 PM.

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). 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.

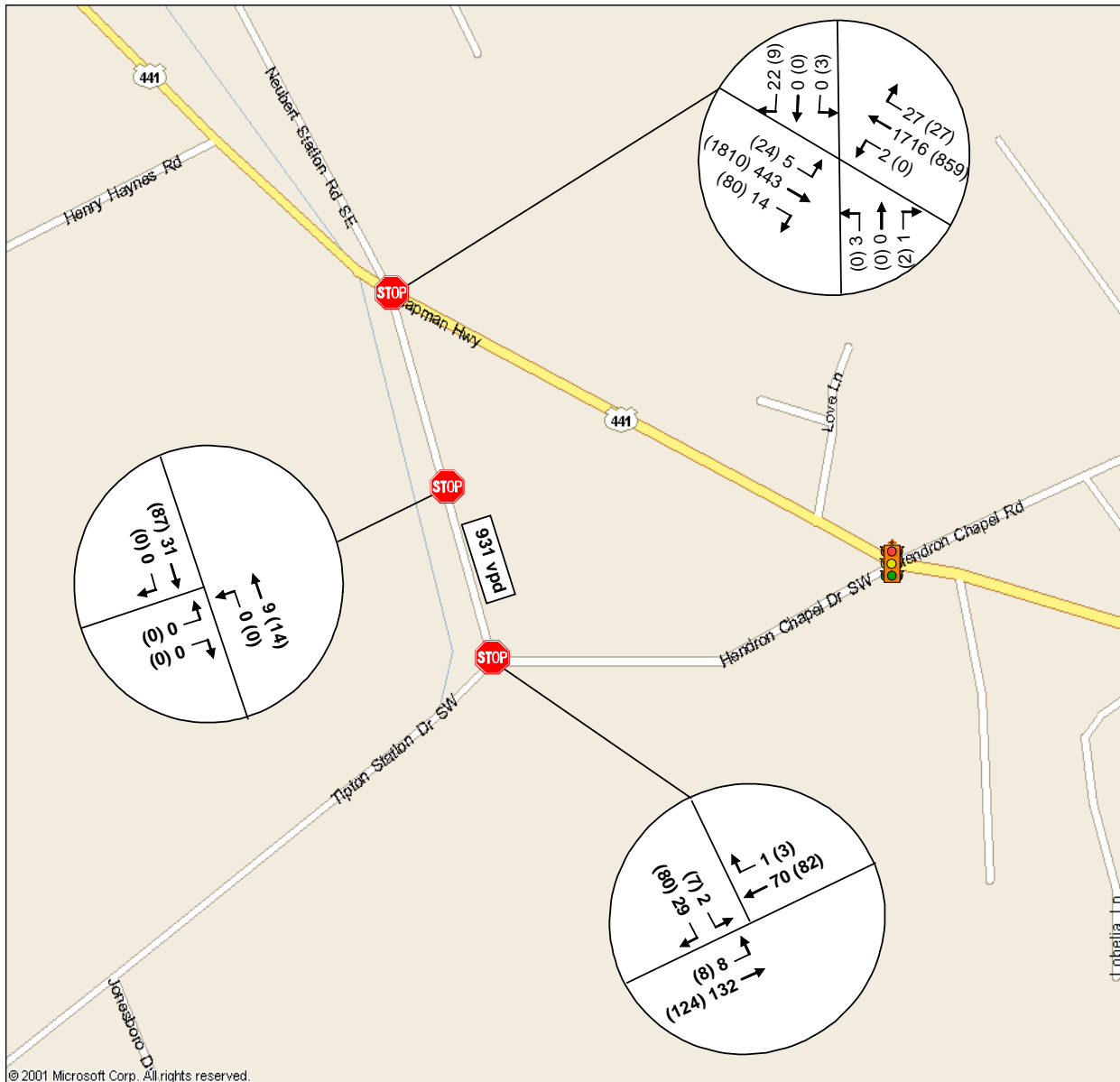
Unsignalized intersections levels of service have lower thresholds of delays. A LOS of F exceeds estimated delays of 50 seconds. For urban arterials, minor approaches may frequently experience levels of service E. A full level of service description for unsignalized intersections is presented in Table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

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

2004 EXISTING TRAFFIC Tipton Station Subdivision



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LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



Figure 3

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 AM northbound and PM southbound have less than acceptable LOS's. This section of Chapman Highway has been identified, by "Intersection Evaluation Part 1" performed for Knox County, to be improved by construction of left- and right-turn lanes for the eastbound approach. In 2004, construction of a two-way left-turn lane has begun south of the site on Chapman Highway through the Maryville Highway (US 411) intersection where it will taper back to a four-lane undivided roadway. 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 Tipton Station Road. The LOS would be better due to the available two-stage movement when making a left turn. If construction of the entire length from Governor John Sevier Highway to Maryville Highway is not feasible, then widening Chapman Highway at the intersection of Tipton Station Road to construct the recommended turn lanes would provide an opening for a driver to make a two-stage left-turn. The majority of the left-turning vehicles from Tipton Station Road headed toward Knoxville are using the Hendron Chapel Road and Chapman Highway signalized intersection. The road network is triangular in shape with segment lengths of 1200 to 1800 feet. Drivers from Tipton Station bound toward Knoxville would make a right onto Hendron Chapel Road, which has a large turn radius, and then turn left at the signal onto Chapman Highway. The PM peak shows that approximately the same amount of drivers turn and follow Tipton Station Road as use Hendron Chapel Road. Drivers do not utilize Tipton Station Road as much in the AM as in the PM possibly due to easy access to a signalized intersection.

TABLE 2

2004 TRAFFIC

CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2004 TRAFFIC		
			DELAY	LOS	
Chapman Hwy & Kimberlin Heights/Tipton St. Rd.	STOP NB/SB	AM	58.5/22.4	F/C	
		PM	20.2/47.1	C/E	
	<i>Chapman Hwy Improved</i>		AM	25.0/22.4	D/C
			PM	20.2/18.5	C/C
Hendron Chapel Rd. & Tipton Station Rd.	STOP WB	AM	9.60	A	
		PM	10.7	B	

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

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. The expected completion of the proposed residential development is assumed as Year 2008. Therefore, using a 2.5 percent compounded growth rate, the study intersections reflect a 10.4-percent growth. Figure 4 illustrates the traffic volumes with the appropriately applied growth factor.

Background Capacity and Level of Service

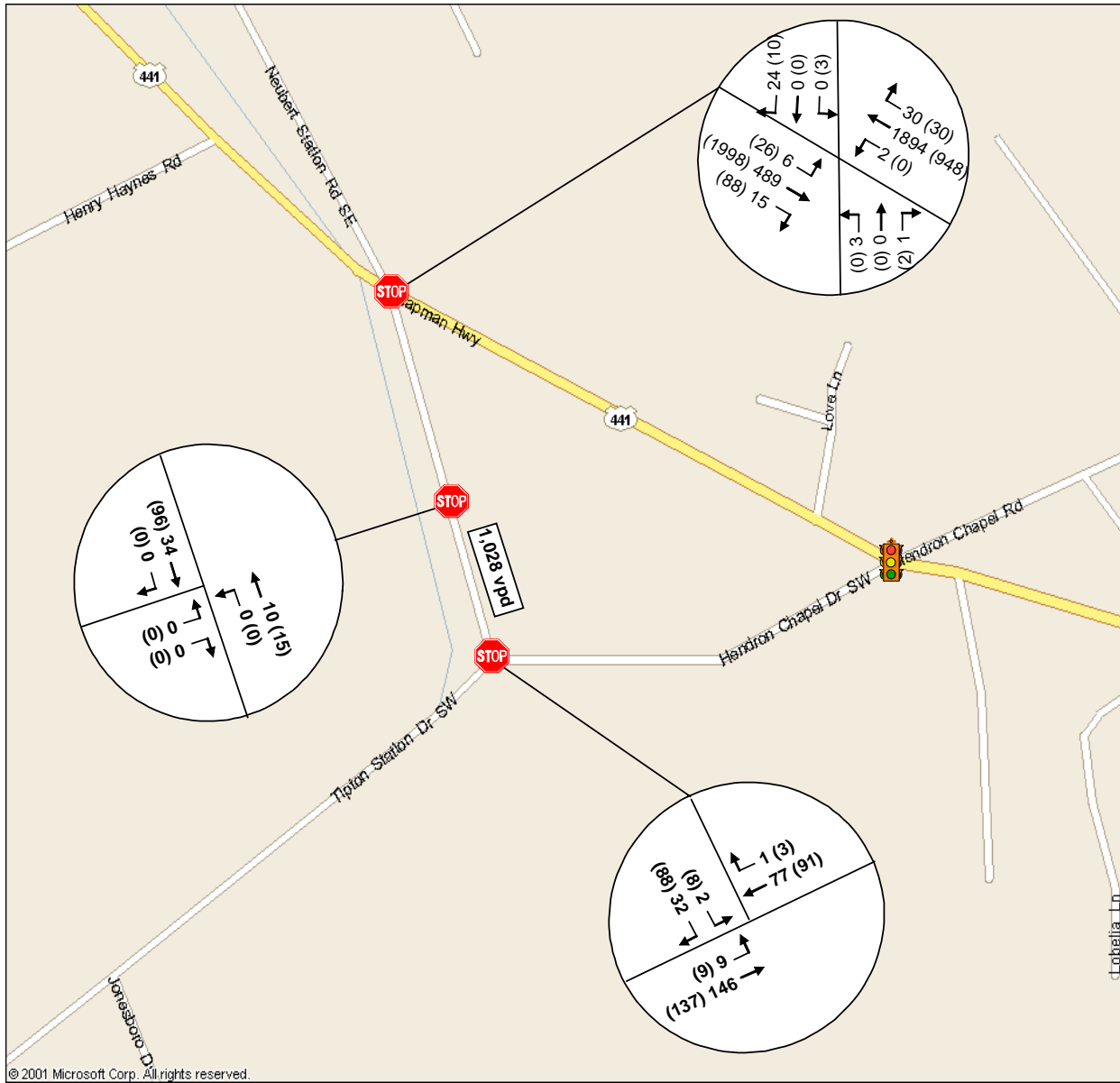
Analysis was performed with the grown traffic volumes and is displayed in Table 3. The levels of service are measured to be unacceptable for the unsignalized study intersection (Chapman Highway and Tipton Station Road) with background conditions and no improvements to Chapman Highway. However, the LOS is improved to a C with turn lanes identified in the WSA study for Knox County.

TABLE 3
2010 BACKGROUND TRAFFIC
CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2008 BACKGROUND DELAY	LOS	
Chapman Hwy & Kimberlin Heights/Tipton St. Rd.	STOP	AM	53.9/23.1	F/C	
	NB/SB	PM	23.5/52.4	C/F	
	<i>Chapman Hwy Improved</i>		AM	24.4/23.1	C/C
			PM	23.5/18.8	C/C
Hendron Chapel Rd. & Tipton Station Rd.	STOP	AM	9.6	A	
	WB	PM	10.2	B	

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

2008 BACKGROUND TRAFFIC Tipton Station Subdivision



LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



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 35.59 acres for Planned Residential. This development is a total of 92 single-family units. From the trip generation calculations, the proposed site may generate approximately 960 daily trips. Table 4 presents the trip generation of this proposed site.

TABLE 4
TRIP GENERATION

LAND USE	L.U.C.	Units	DAILY	AM PEAK		PM PEAK	
			TRIPS	ENTER	EXIT	ENTER	EXIT
Single Family	210	92	963	18	55	64	36

Trip Distribution and Assignment

Using the turning-movement counts for the study intersections, trips are distributed to the adjacent streets with 65-percent of the generated trips distributed northwest and 30-percent assigned southeast on Chapman Highway. Tipton Station Road, southwest of the site, was assigned 5-percent of the generated trips. Figure 5 illustrates the traffic distribution and assignment. The assignment of the generated trips reflects the influence of the traffic signal provided for the intersection of Chapman Highway and Hendron Chapel Road.

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 Tipton Station Subdivision

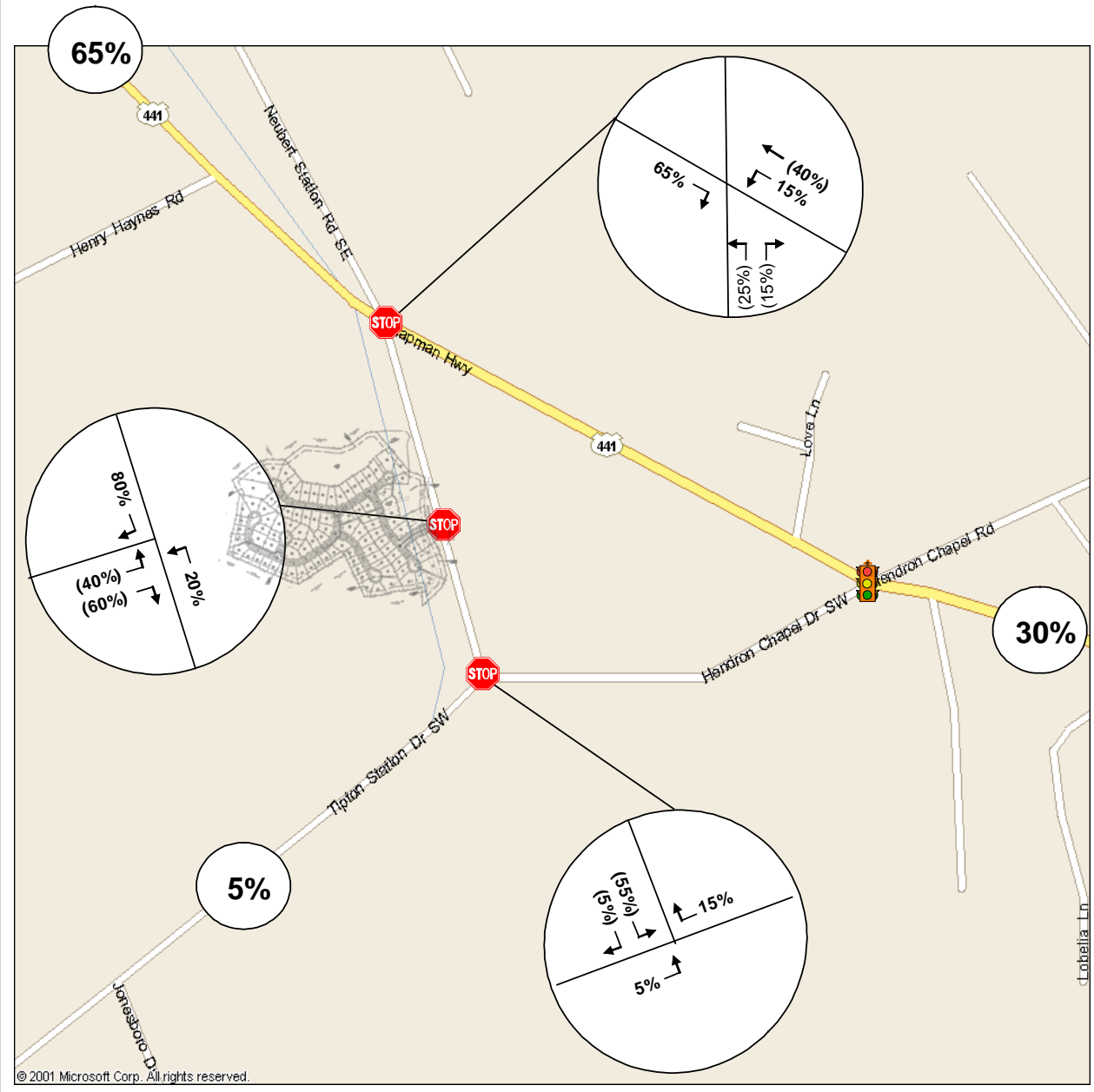
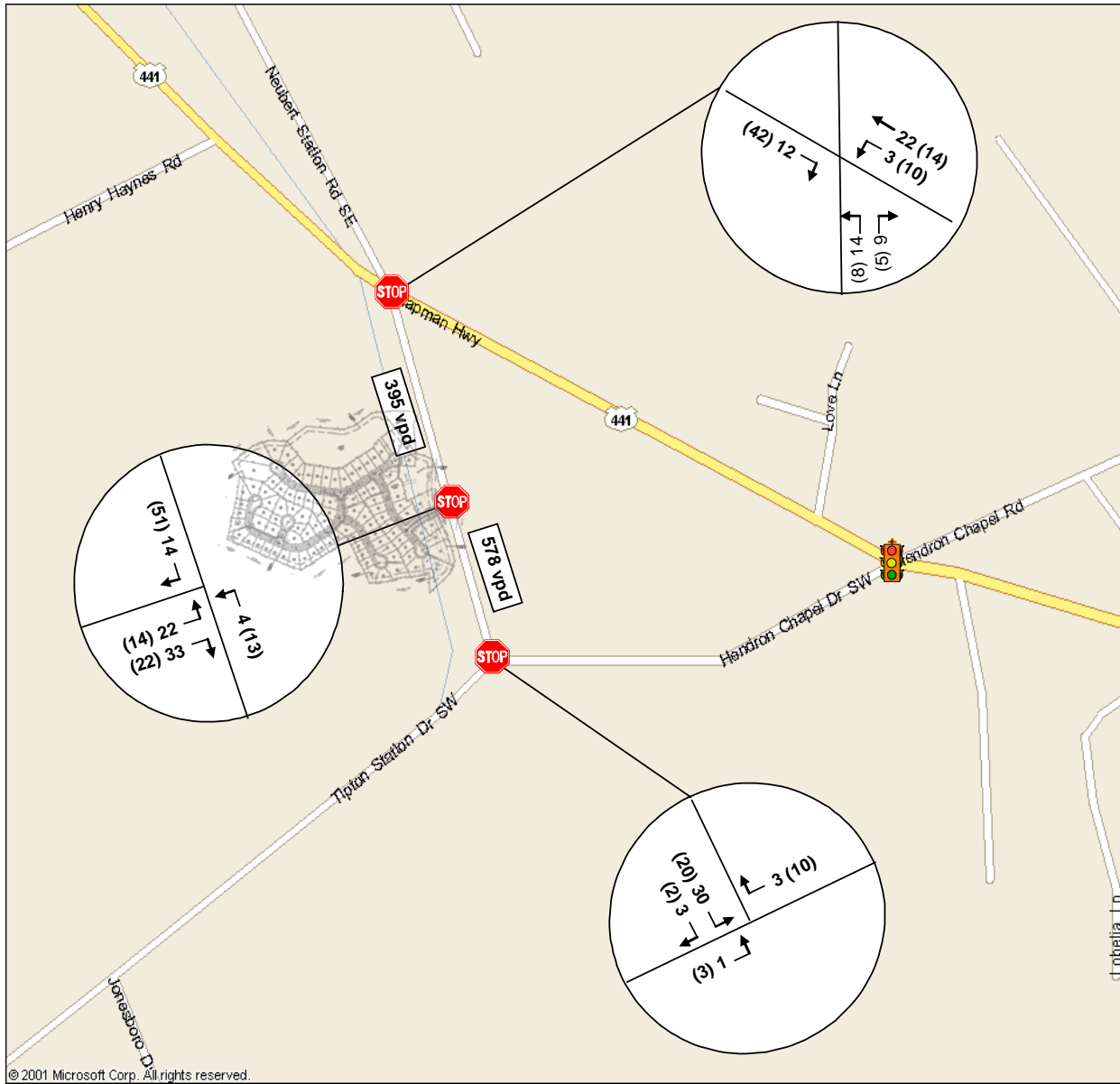


Figure 5

PROJECT TRIPS Tipton Station Subdivision



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 2008. Figure 7 illustrates this 2008 projection. Using this projection, mitigation measures including traffic control devices and roadway and intersection geometry can be evaluated. The projected ADT for Tipton Station Road is approximately 1,423 and 1,606 north and south of the proposed site access, respectively.

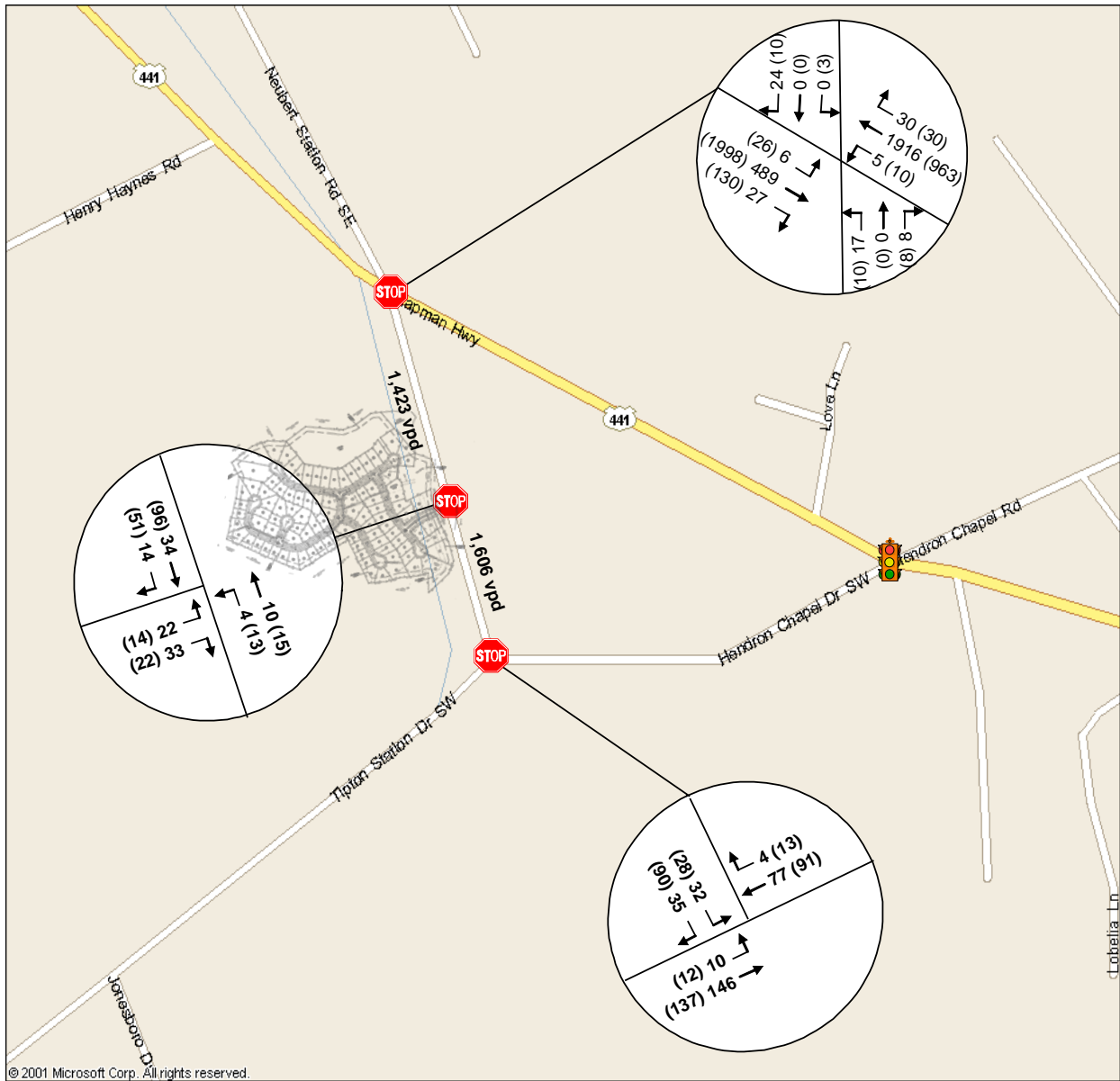
Sight Distance

The project is proposed to access Tipton Station Road. The road's speed limit is currently not posted between Chapman Highway and Hendron Chapel Road. Tipton Station Road is posted 40-mph for the section south of the Hendron Chapel Road intersection. For analysis purposes, an assumed 40-mph speed limit was used. Measured sight distance access is approximately 410 feet and 400 feet looking left and right, respectively. These measurements were taken against the currently overgrown wire mesh fence. The sight distance is expected to be slightly greater than measured with the removal of the fence and vegetation along Tipton Station Road. The intersection of Hendron Chapel Road and Tipton Station Road is approximately 400 feet from the site access. The required distance is 305 feet to meet the minimum stopping sight-distance for American Association of State Highway and Transportation Officials (AASHTO) and 400 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.

Projected Capacity and Level of Service

The development traffic from the site was analyzed to project the impact the unsignalized intersections. The summarized analysis is shown in Table 5. The LOS still fails without the improvements to Chapman Highway. The LOS, based on the two-stage analysis, worsens by one level of service in the AM and three levels of service in the PM. However, the PM development traffic projected to turn left from the unsignalized intersection rather than the signalized intersection is only 8 vehicles. To recap the analysis performed for this study, Table 6 summarizes the volume to capacity ratio, delay and LOS measured and projected for this development.

2008 PROJECTED TRAFFIC Tipton Station Subdivision



LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



Figure 7

TABLE 5
2010 PROJECTED TRAFFIC
CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2008 PROJECTED DELAY	LOS	
Chapman Hwy & Kimberlin Heights/Tipton St. Rd.	STOP	AM	70.3/2.5	F/C	
	NB/SB	PM	914.9/60.7	F/F	
	<i>Chapman Hwy Improved</i>		AM	26.0/23.5	D/C
			PM	112.8/19.8	F/C
Hendron Chapel Rd. & Tipton Station Rd.	STOP	AM	10.2	B	
	WB	PM	10.7	B	
Tipton Station Rd. & Site Access Rd.	STOP	AM	8.9	A	
	WB	PM	9.3	A	

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

TABLE 6
SUMMARY
CAPACITY AND LEVEL OF SERVICE

INTERSECTION	TRAFFIC CONTROL	PEAK PERIOD	2004 TRAFFIC DELAY	2004 TRAFFIC LOS	2008 BACKGROUND DELAY	2008 BACKGROUND LOS	2008 PROJECTED DELAY	2008 PROJECTED LOS	
Chapman Hwy & Kimberlin Heights/Tipton St. Rd.	STOP	AM	58.5/22.4	F/C	53.9/23.1	F/C	70.3/2.5	F/C	
	NB/SB	PM	20.2/47.1	C/E	23.5/52.4	C/F	914.9/60.7	F/F	
	<i>Chapman Hwy Improved</i>		AM	25.0/22.4	D/C	24.4/23.1	C/C	26.0/23.5	D/C
			PM	20.2/18.5	C/C	23.5/18.8	C/C	112.8/19.8	F/C
Hendron Chapel Rd. & Tipton Station Rd.	STOP	AM	9.6	A	9.6	A	10.2	B	
	WB	PM	10.7	B	10.2	B	10.7	B	
Tipton Station Rd. & Site Access Rd.	STOP	AM	-	-	-	-	8.9	A	
	WB	PM	-	-	-	-	9.3	A	

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

RECOMMENDATIONS

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

- Chapman Highway should be improved to provide left- and right-turn lanes on the eastbound approach per the recommendations in Knox County's Intersection Evaluation Part 1 study. The westbound left-turn lane should be constructed to provide symmetry.
- 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 25-foot for the efficient and safe ingress and egress of the site.
- Post the proposed streets with a STOP sign (R1-1) at Tipton Station 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.

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 2008. 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 and Tipton Station Road. This LOS may be acceptable with Chapman Highway improvements per Knox County's Intersection Evaluation Part 1. However, this LOS may fail with development trips, but these trips are minimal and have an alternative access via Hendron Chapel Road. Left-turn egress to Chapman Highway will be available from the signalized intersection of Chapman Highway and Hendron Chapel Road, which also provides gaps for left-turn egress from Tipton Station Road. The sight distance for the driveway, which is in an S-curve section of Tipton Station Road, will be adequate based on field measurements for a posted speed limit of 40-mph. With the recommendations of this report, the efficient and safe flow of traffic should be maintained.

APPENDIX

Trip Generation

HCS Unsignalized Analyses

Traffic Counts

