

**GREENWELL ROAD
RESIDENTIAL DEVELOPMENT
KNOX COUNTY, TENNESSEE**

TRAFFIC IMPACT STUDY

Prepared for

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September 2002

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TABLE OF CONTENTS

Introduction.....	1
Project Description.....	1
Site Location.....	1
Local and Regional Access.....	1
Local Access.....	1
Region Access.....	4
Existing Traffic Conditions.....	4
Existing Traffic Control.....	4
Existing Traffic Volumes.....	4
Signal Warrant Analysis.....	6
Existing Capacity and LOS.....	6
Background Traffic Conditions.....	8
Background Traffic Volumes.....	8
Background Signal Warrant Evaluation.....	10
Background Capacity and LOS.....	10
Development Impacts.....	11
Trip Generation.....	11
Trip Distribution and Assignment.....	11
Project Traffic Volumes.....	13
Total Projected Traffic Volumes.....	13
Projected Signal Warrant Evaluation.....	13
Projected Capacity and Level of Service.....	13
Sight Distance.....	13
Recommendations.....	16
Conclusion.....	18
APPENDIX	
Trip Generation	
Capacity & LOS Analyses	
Signal Warrant Analyses	
Traffic Counts	

LIST OF FIGURES

Figure 1-Development Site Plan.....	2
Figure 2-Vicinity Map.....	3
Figure 3-2002 Existing Traffic	5
Figure 4-2005 Background Traffic	9
Figure 5-Trip Distribution and Assignment.....	12
Figure 6-Project Trips.....	14
Figure 7-2005 Projected Traffic.....	15

LIST OF TABLES

Table 1- Unsignalized LOS Description.....	7
Table 2- Signalized LOS Description.....	7
Table 3- 2002 Existing LOS.....	8
Table 4- 2005 Background LOS.....	10
Table 5-Trip Generation.....	11
Table 6-2005 Projected LOS and Capacity.....	16
Table 7-Capacity and LOS Summary.....	17

INTRODUCTION

This traffic impact study was commissioned to address the impact of a proposed residential development within Knox County. The study of this development required the collection of traffic data, generation of anticipated traffic volumes from the proposed site, development of future traffic volumes from both normal growth and the site, analysis of the resulting traffic conditions, and the development of measures necessary to mitigate traffic impacts of normal traffic growth and the proposed development. Methods and procedures utilized in the study are those required for a Level 1 traffic impact study as adopted by the Knoxville/Knox County Metropolitan Planning Commission.

Project Description

The proposed project is a residential development adjacent to Greenwell Road. The site is approximately 25 acres with a residential zoning. The proposed development will subdivide the property for 101 single-family units. Figure 1 is the proposed site plan.

Site Location

The location of the site is east of Greenwell Road and north of E. Emory Road (S.R. 131). The site is in Knox County, northeast of the Knoxville central business district (CBD). The adjacent land use is residential in character. Figure 2 illustrates this location relative to local and regional access.

LOCAL AND REGIONAL ACCESS

Local Access

Local access to this site is primarily Greenwell Road. Adjacent to the proposed site, Greenwell Road is a 2-lane road classified as a major collector. Site access is a proposed residential street. Greenwell Road is a north and south facility extending north from E. Emory Road (S.R. 131). The 2000 average daily traffic (ADT) for Greenwell Road is approximately 1,250. Greenwell Road is a single lane approach at E. Emory Road.

SITE PLAN

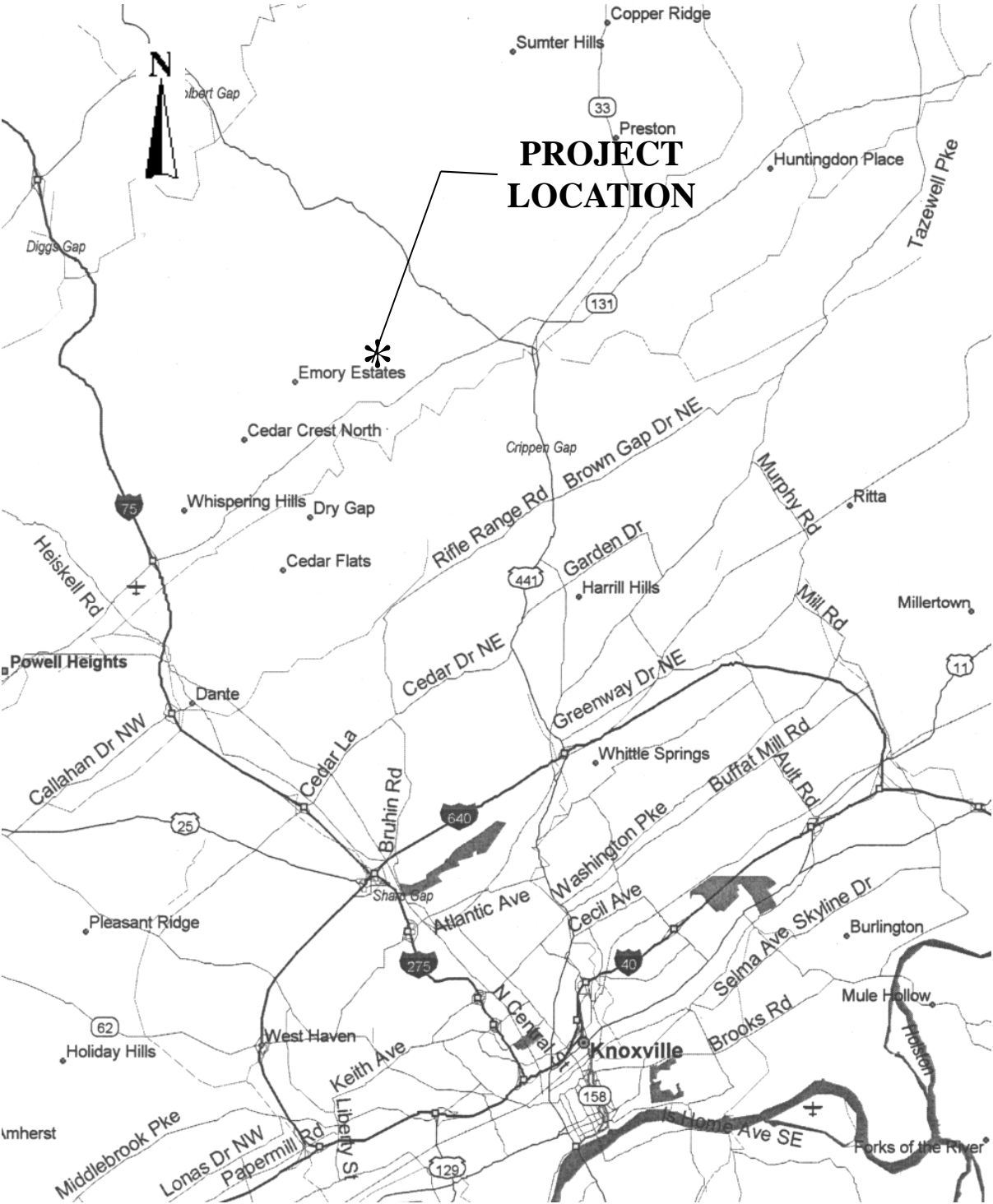
GREENWELL TIS



Figure 1

VICINITY MAP

GREENWELL TIS



**PROJECT
LOCATION**



Wilbur Smith Associates

Figure 2

Regional Access

Regional access is from E. Emory Road classified a minor arterial. E. Emory Road is an east-west facility extending from Norris Freeway (S.R. 71) to the east and becoming Lovell Road and extending west to Kingston Pike. State Route 131 provides access to both Interstates 75 and 40 west of the proposed site. The nearest interchange is with I-75, which will be the primary interstate access. E. Emory Road has an ADT of 11,220 and is being improved to a 5-lane urban facility from of I-75 and to Dry Gap Pike. This improvement will extend east to Norris Freeway. Near the site, E. Emory Road is a 2-lane facility. The extension of the 5-lane improvements is currently planned by TDOT.

Interstate 75 extends north and south near the proposed project site. The average daily traffic count on Interstate 75, south of Emory Road, is approximately 48,630. This facility is designated as part of the federal interstate system intersecting Interstate 40 to the south, which is an east and west facility running through Knoxville.

To the south, I-75 intersects I-640, which connects to I-40 east and west of the Knoxville CBD. Interstate 75 becomes I-275 south of I-640 and extends into the Knoxville CBD. Interstate 75 extends north to Lexington, Kentucky, and to the west, I-75 turns south to Chattanooga, Tennessee. Interstate 40 is an east and west facility extending between Nashville, Tennessee and Asheville, North Carolina. The approximate 2000 ADT for I-40/75 west of I-640 is 140,170. To the east of I-640, I-40 has an ADT of 106,380.

EXISTING TRAFFIC CONDITIONS

Existing Traffic Control

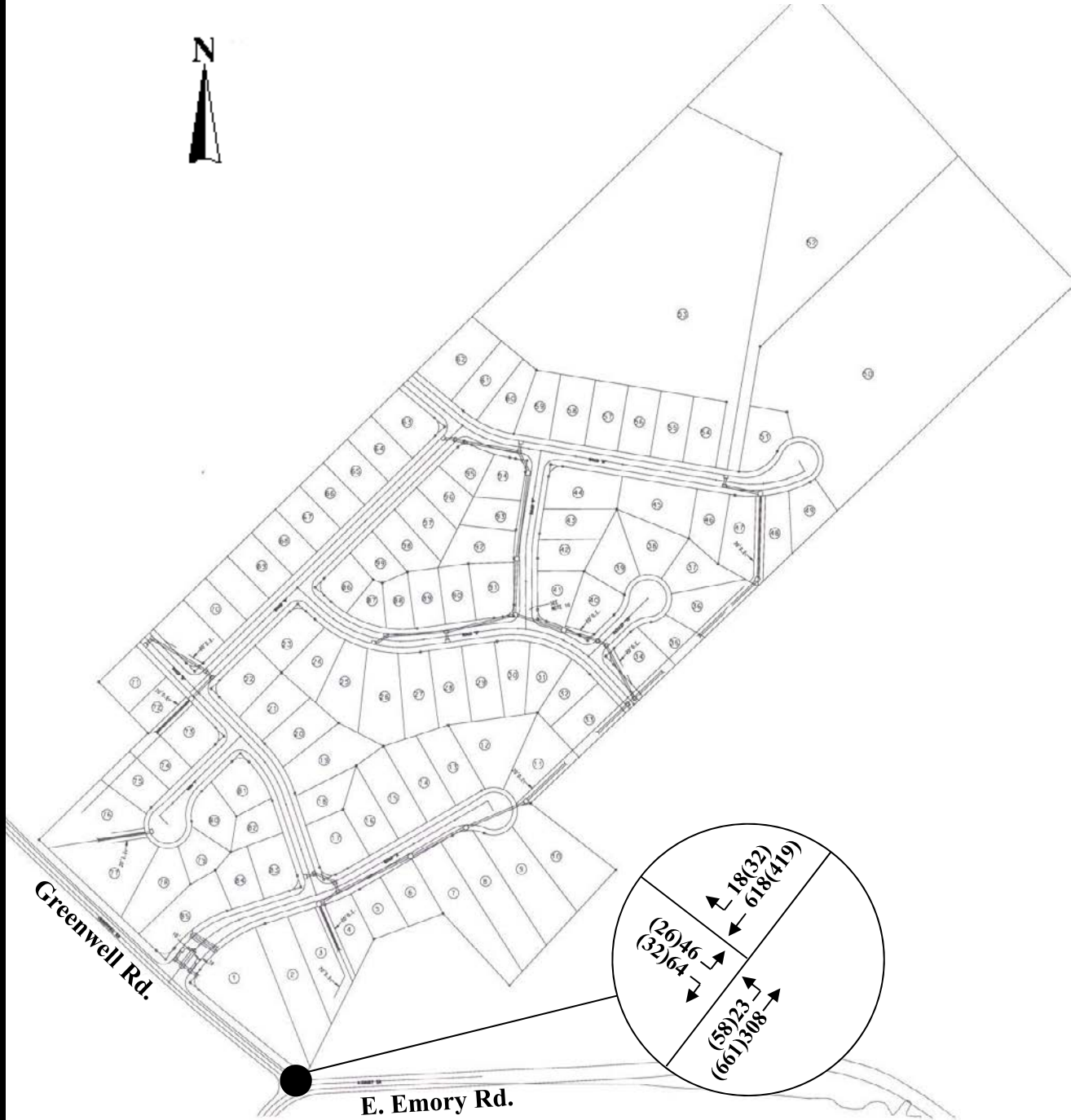
Currently traffic control within the study vicinity is stop controlled at the intersection of Greenwell Road and E. Emory Road. Adjacent intersections with Greenwell Road are stop controlled. Greenwell Road has a posted speed limit of 30 mph. The posted speed limit on E. Emory Road is 40mph.

Existing Traffic Volumes

This traffic impact study addresses the intersection of E. Emory Road and Greenwell Road. Peak-hour counts were conducted for 7:00-9:00AM and 4:00-6:00PM. Figure 3 illustrates the adjacent street traffic volumes.

2002 EXISTING TRAFFIC

GREENWELL TIS



LEGEND
XXX AM PEAK
(XXX) PM PEAK



Figure 3

Signal Warrant Analysis

Traffic signal warrants were evaluated for the intersection of E. Emory Road and Greenwell Road. There are eight warrants published in the **Manual on Uniform Traffic Control Devices, 2000 Edition**. For prevailing speeds greater than 40mph, signal warrants were evaluated. Three traffic volume warrants were examined with the first having three separate criteria. Warrants include 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). Each of these warrants examines the varying traffic volume for major and minor approaches. 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).

Existing traffic volumes indicate that a signal is currently warranted for the intersection. Warrants met are the Interruption, Four-Hour, and Peak-Hour warrants. Warrant 1A, Minimum Volume is satisfied for 1 hour and nearly 2 hours.

Existing Capacity and Level of Service

In order to evaluate the 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. 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 of 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 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 intersection 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**

LOS	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: 2000 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: 2000 Highway Capacity Manual, TRB Special Report 209

Unsignalized levels of service for the existing traffic conditions were found to be acceptable with a LOS of D. Signalized analysis determined that the intersection of E. Emory Road and Greenwell Road would operate at a LOS A with the installation of a traffic signal. These analyses uses the current intersection geometry. Table-3 presents the analyses conducted.

TABLE-3
2002 EXISTING
LEVELS OF SERVICE

INTERSECTION	CONTROL	V/C	AM PEAK		PM PEAK		
			DELAY	LOS	V/C	DELAY	LOS
E. Emory Road & Greenwell Road	STOP		26.3	D		27.4	D
	Signal	0.52	5.6	A	0.60	4.6	A

Note: Average vehicle control delay estimated in seconds.

BACKGROUND TRAFFIC CONDITIONS

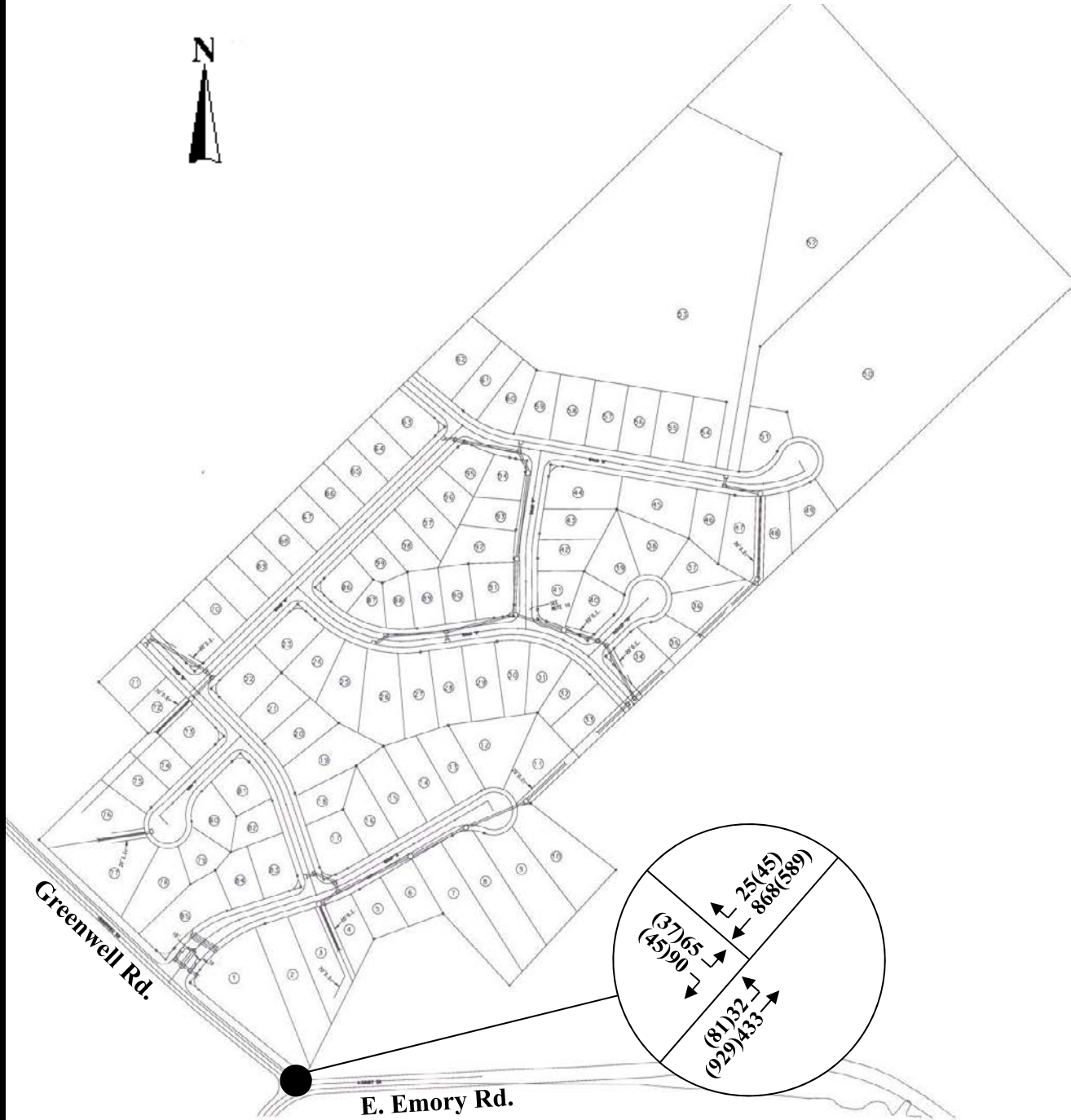
Background traffic is traffic that can be anticipated regardless of the proposed development. Traffic within the study area should continue to grow due to other developments and continued growth of Knoxville and Knox County. This traffic must be developed and analyzed for the purpose of establishing a baseline.

Background Traffic Volumes

In the vicinity of the proposed site, significant development is occurring. Previous studies conducted by WSA in the vicinity of this site determined an approximate 4.16-percent growth rate. Traffic counts conducted in 1999 for the Pelleau Road Residential Development traffic analysis and counts conducted for 2002 suggests a growth rate of approximately 12-percent. This rate of growth should continue over the next few years until build-out of much of this development is achieved. Therefore, for the purpose of this study, background traffic was projected for the year 2005 using a 12-percent annual compounded growth rate. Completion of this development will depend largely upon market considerations; however, a three-year build-out seems reasonable for this density of development. Figure 4 illustrates the resulting 2005 background traffic. This traffic is obtained growing existing traffic by a total of 40.5-percent.

2005 BACKGROUND TRAFFIC

GREENWELL TIS



LEGEND
XXX AM PEAK
(XXX) PM PEAK



Figure 4

Background Signal Warrant Evaluation

Evaluation of traffic signal warrants for the intersection of E. Emory Road with Greenwell Road and the projected 2005 background traffic determined that the increase in traffic over the next few years would further warrant a traffic signal. This analysis assumes the improvements for E. Emory Road. The hours met for the Interruption Warrant increases from 12 hours to 15 hours. Minimum Volume Warrant (Warrant 1A) is satisfied for 4 hours and nearly 5 hours.

Background Capacity and Level of Service

The study intersection of E. Emory Road and Greenwell Road was analyzed with the projected traffic. Unsignalized analyses indicate that the intersection of E. Emory Road and Greenwell Road will operate at lower levels of service. Without the improvements to E. Emory Road, the unsignalized intersection will fail. With the improvements of a 5-lane facility, the intersection LOS is lowered to an E. Signalization of the intersection would result in very good LOS. Table 4 presents the LOS analyses for the study intersection.

**TABLE-4
2005 BACKGROUND
LEVELS OF SERVICE**

INTERSECTION	CONTROL	V/C	AM PEAK		PM PEAK		
			DELAY	LOS	DELAY	LOS	
E. Emory Road & Greenwell Road	STOP	-	82.9	F	-	70.8	F
		-	40.7	E	-	46.1	E
	Signal	0.73	9.7	A	0.89	14.7	B
		0.44	5.8	A	0.43	4.1	A

Note: Average vehicle control delay estimated in seconds.
Planned E. Emory Road improvements.

DEVELOPMENT IMPACTS

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

Trip Generation

Project traffic for the single-family units was determined using the publication, **Trip Generation, 6th Edition**. The **Trip Generation** 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. From the trip generation calculations, the proposed site may generate approximately 1,046 daily trips. Table 5 presents the trip generation of this proposed site.

TABLE-5

TRIP GENERATION

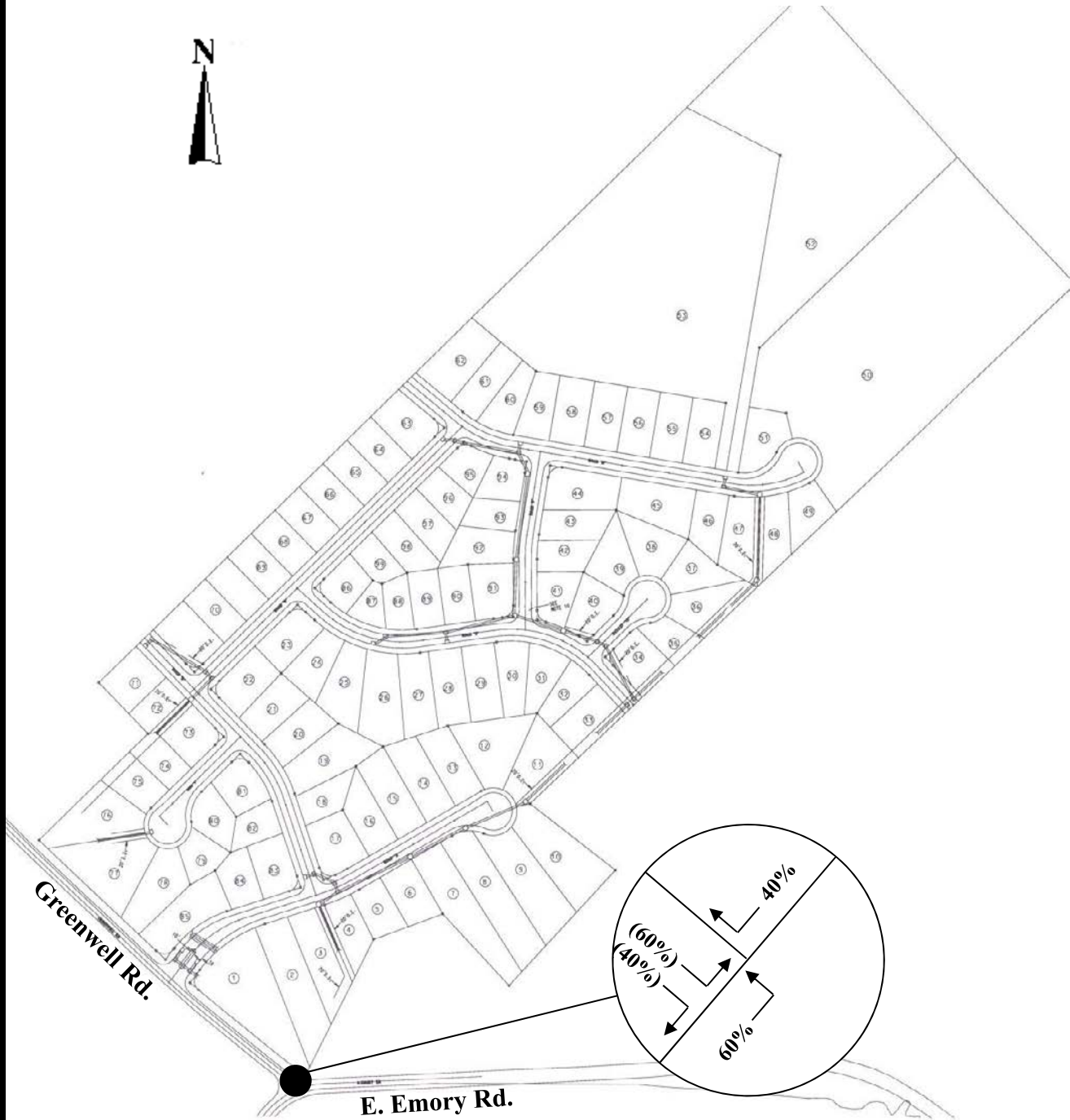
LAND USE	L.U.C.	Units	DAILY TRIPS	AM PEAK ENTER	AM PEAK EXIT	PM PEAK ENTER	PM PEAK EXIT
Single Family	210	101	1046	20	60	69	39

Trip Distribution and Assignment

Using the turning-movement counts conducted for E. Emory Road and Greenwell Road, the trip distribution assumes approximately 60-percent of the residential trips will turn to the west towards Interstate 75, and 40-percent to the east towards Norris Freeway. Figures 5 illustrate this distribution and assignment.

TRIP DISTRIBUTION

GREENWELL TIS



LEGEND

XXX ENTERING
(XXX) EXITING



Figure 5

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 2005. Figure 7 illustrates this 2005 projection. Using this projection, mitigation measures including traffic control devices and roadway and intersection geometry can be evaluated.

The projected traffic indicates the requirement for left- and right-turn lanes for E. Emory Road at Greenwell Road. A continuous left-turn lane will be provided with the TDOT planned improvements.

Projected Signal Warrant Evaluation

With the development of this subdivision, the Minimum Volume Warrant is essentially satisfied. The Minimum Volume Warrant is satisfied for 6 hours with another 6 hours nearly met.

Projected Capacity and Level of Service

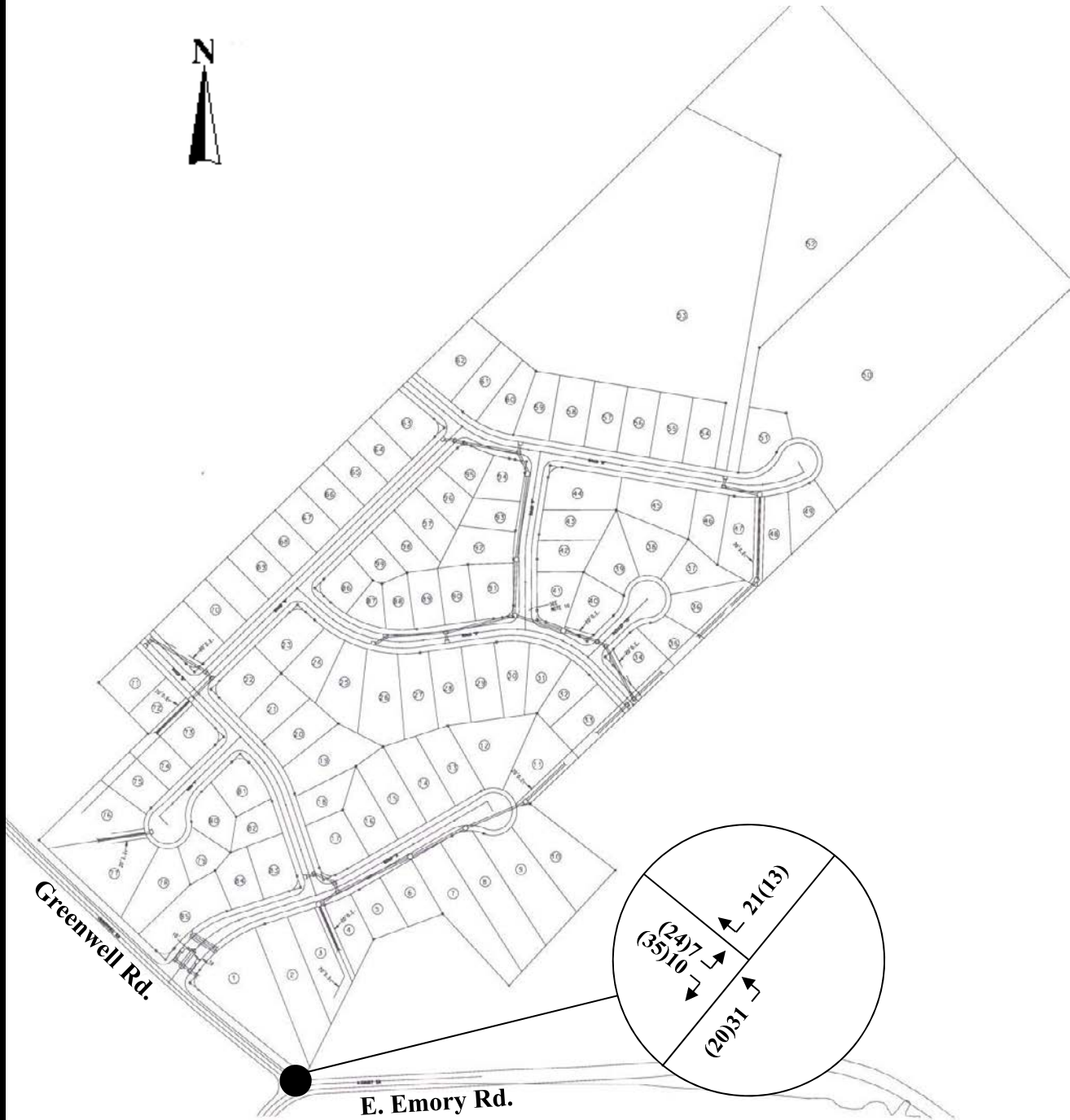
The analyses conducted determined that the study intersection would operate at unacceptable levels of service. The unsignalized intersection of E. Emory Road and Greenwell Road would fail. Signalization of the study intersection would improve the intersection LOS to a minimum LOS of C. Table 6 presents the projected capacity and LOS, and the capacity and LOS is summarized in Table 7. Unsignalized analyses suggest increases in the delay for the Greenwell Road approach with or without the planned E. Emory Road improvements. Increased delays and V/C ratios were determined insignificant with signalization of the intersection and very good levels of service were maintained with the development.

Sight Distance

The project access is proposed to Greenwell Road. The road's speed limit is currently posted for 30mph. Measured sight distance for the access street is approximately 285 feet to the north and 350 feet to the south. The required distance is 200 feet to meet the minimum

PROJECT TRIPS

GREENWELL TIS



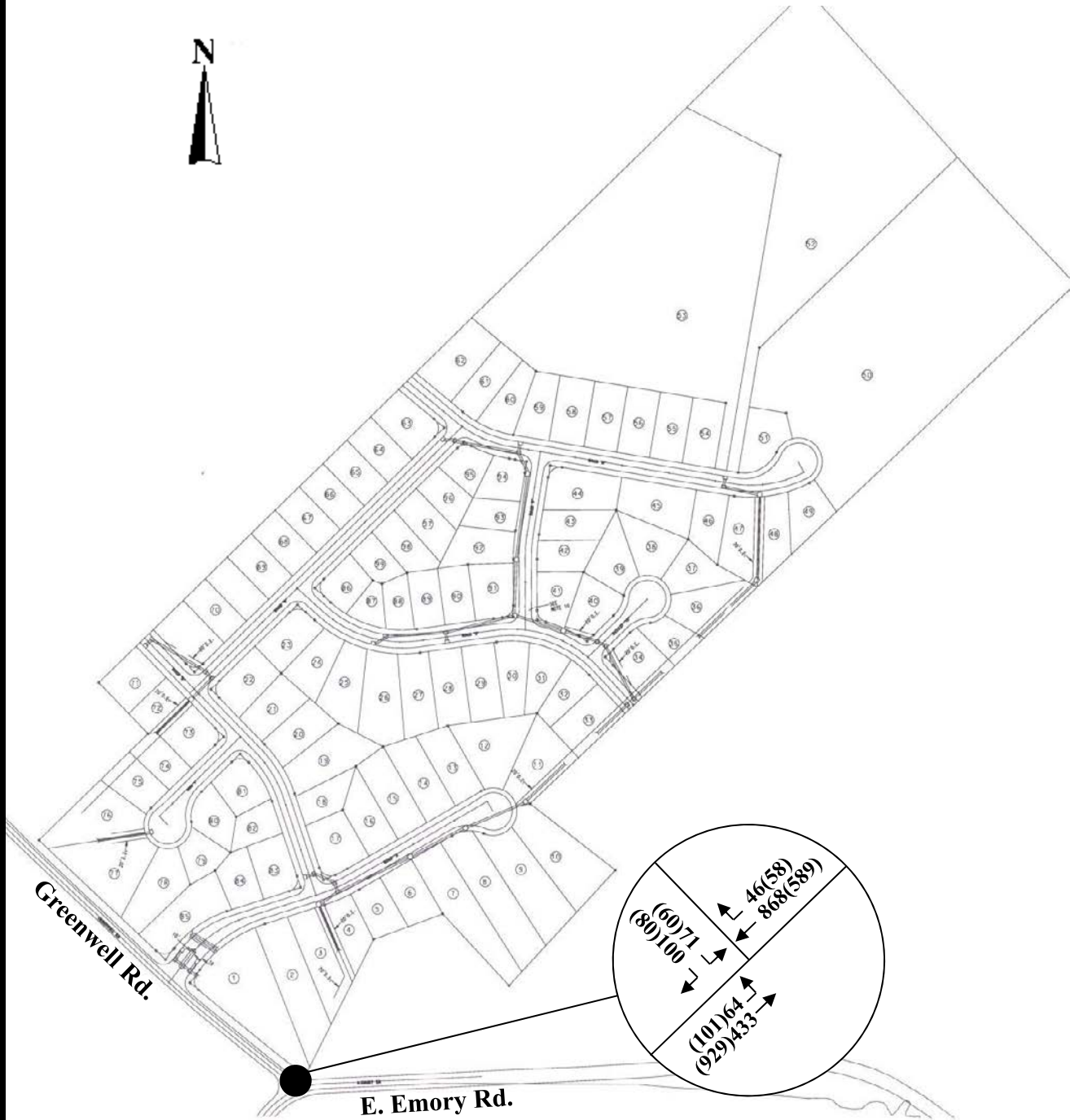
LEGEND
XXX AM PEAK
(XXX) PM PEAK



Figure 6

2005 PROJECTED TRAFFIC

GREENWELL TIS



LEGEND
 XXX AM PEAK
 (XXX) PM PEAK



Figure 7

**TABLE-6
2005 PROJECTED
LEVELS OF SERVICE**

INTERSECTION	CONTROL	V/C	AM PEAK		PM PEAK		LOS
			DELAY	LOS	V/C	DELAY	
E. Emory Road & Greenwell Road	STOP	-	196.2	F	-	193.6	F
		-	83.4	F	-	54.8	F
	Signal	0.82 0.52	16.0 6.5	B A	0.94 0.43	22.8 4.5	C A

Note: Average vehicle control delay estimated in seconds.
Planned E. Emory Road improvements.

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 the minimum stopping sight-distance and essentially the County’s corner sight-distance criteria. To the north, the sight-distance restriction is a vertical curve.

RECOMMENDATIONS

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

- Minimize landscaping, using low growing vegetation, and signing at the street access 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 street with a STOP sign (R1-1) at Greenwell 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.
- Signalization of E. Emory Road and Greenwell Road should be provided within the next five years.

- Provide a 125-foot left-turn and a minimum 50-foot right-turn lane on E. Emory Road at Greenwell Road.

CONCLUSION

The study of this proposed residential development evaluated the projected traffic conditions for the intersection of E. Emory Road and Greenwell Road. Background traffic was determined using a 12.0-percent annual compounded growth rate until the year 2005, reflecting traffic growth estimated from the 1999 turning movement count for the Pelleaux Road Residential Development traffic study prepared by WSA and the more recent 2002 count. 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 intersection of E. Emory Road and Greenwell Road for the future year studied. A LOS F may be experienced for the Greenwell approach to E. Emory Road during the peak hours for background and projected traffic conditions. For background traffic conditions with planned 5-lane section improvements for E. Emory Road, the LOS for the study intersections resulted in a LOS of E. Improvements for E. Emory Road did not result in a LOS better than F with the proposed development. The installation of traffic signal would be required to provide an acceptable LOS. Capacities and delays with installation of a traffic signal were found to be very good, resulting in acceptable levels of service. The proposed development was found to have an insignificant impact on the signalized intersection of E. Emory Road and Greenwell Road. Signal warrants are currently met. Hours satisfied for the volume warrants increase with background increases in traffic and with the development trips. Site access is found to be acceptable with adequate sight-distances.

The proposed development does not have an unacceptable impact on the adjacent street and intersections. With the recommendations of this report, the efficient and safe flow of traffic should be maintained.

APPENDIX

**TRIP GENERATION
CAPACITY AND LOS ANALYSES
SIGNAL WARRANT ANALYSES
TRAFFIC COUNTS**