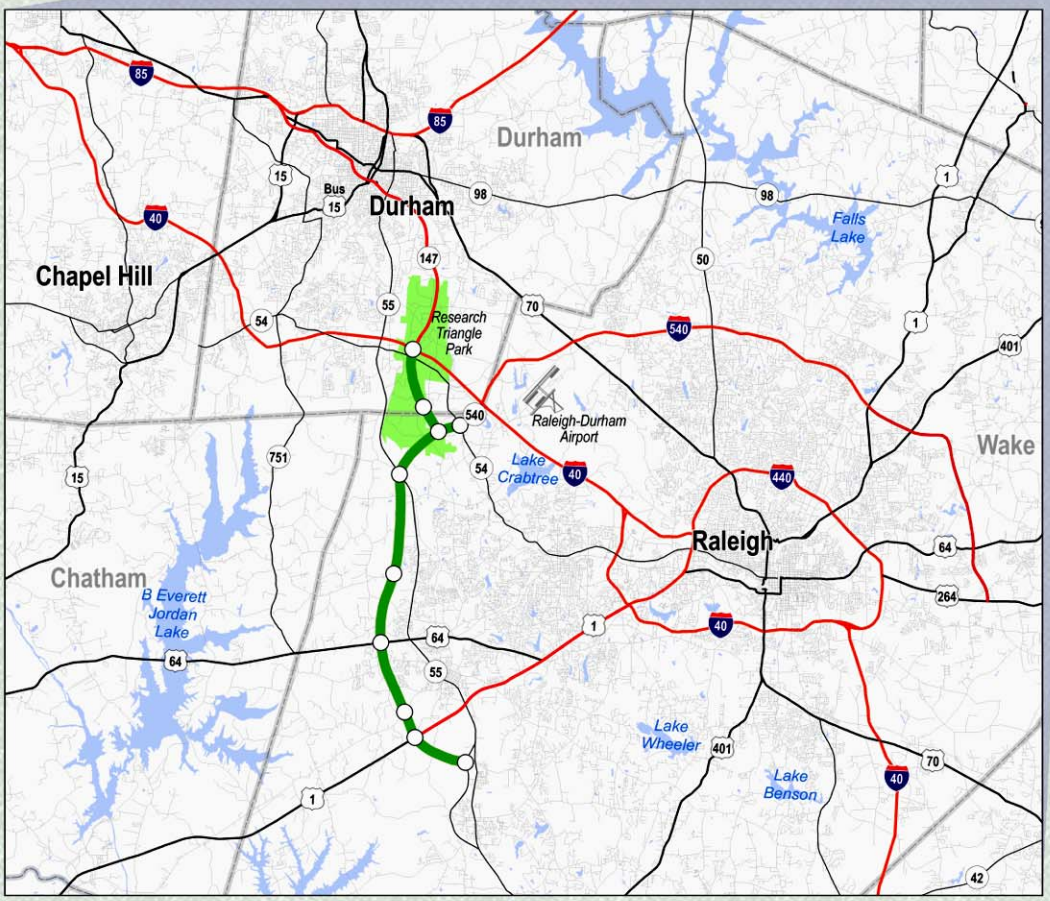
Triangle Expressway

Comprehensive Traffic and Revenue Study

Final Report



NORTH CAROLINA
Turnpike Authority

April 2009

Triangle Expressway

Comprehensive Traffic and Revenue Study

Final Report

Prepared For

NORTH CAROLINA Turnpike Authority

Prepared By

ENGINEERS PLANNERS ECONOMISTS

WilburSmith ASSOCIATES

April 2009

April 6, 2009

Mr. David Joyner
Executive Director
North Carolina Turnpike Authority
5400 Glenwood Avenue
Suite 400
Raleigh, NC 27612

Re: **Comprehensive Traffic and Revenue Study – Proposed Triangle Expressway**

Dear Mr. Joyner:

Wilbur Smith Associates (WSA) is most pleased to submit this report summarizing the results of our comprehensive traffic and revenue study for the proposed Triangle Expressway in Wake and Durham Counties, North Carolina. This study was conducted at a level of detail that is considered sufficient for use in support of project financing.

The proposed Triangle Expressway (TriEx) is comprised of the Triangle Parkway that would extend from NC 147 to NC 540 through the Research Triangle Park and the Western Wake Freeway that would extend from NC 55 near Morrisville to NC 55 Bypass near Holly Springs. The connecting section between the Triangle Parkway and the Western Wake Freeway, a portion of NC 540 between NC 54 and NC 55, is currently in operation as a free facility and will become part of the Triangle Expressway when the Triangle Parkway is opened by 2012. The Western Wake Freeway is expected to open in 2013.

Toll operations and collection were important considerations during this study. Detailed analyses led the North Carolina Turnpike Authority (NCTA) board to decide to operate this toll facility as a free-flow, cashless system with electronic toll collection and video toll collection for customers without an electronic transponder.

We conducted additional economic and behavioral analyses for this study. An independent economist, the Kenan Institute of Private Enterprise of the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill, reviewed and updated the latest regional socioeconomic forecasts that were used in the approved regional travel demand model. Travel characteristics and traveler behavior were also identified through origin-destination travel surveys and stated preference surveys. Finally, traffic and revenue estimates in this report were updated in March 2009 to reflect the impact of the current economic downturn. Methods used to complete this update are discussed in the report.

Our project manager, David Danforth, and other key members of the project team including Selvaraj Rayan, Will Letchworth, Bob Josef, and Cissy Szeto, as well as our subconsultant team, gratefully acknowledge the assistance provided by NCTA staff, CAMPO, DCHC, and others during the course of the study. We have appreciated this opportunity to be of service to the Authority.

Very truly yours,
WILBUR SMITH ASSOCIATES

Edward J. Regan, III
Executive Vice President

900 Chapel Street, Suite 1400 New Haven, Connecticut 06510
203.865.2191 *f* 203.624.0484 www.WilburSmith.com

TABLE OF CONTENTS

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TABLE OF CONTENTS (CONT'D)

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TABLE OF CONTENTS (CONT'D)

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TABLE OF CONTENTS (CONT'D)

ILLUSTRATIONS

(continued)

ILLUSTRATIONS (CONT'D)

TABULATIONS

(continued)

TABULATIONS (CONT'D)

CHAPTER 1

INTRODUCTION

The proposed Triangle Expressway (TriEx) in the Raleigh-Durham area is one of several candidate toll facility projects under consideration by the North Carolina Turnpike Authority (NCTA). Preliminary or "Level 2" traffic and revenue studies were conducted in 2006 for the TriEx and the NCTA decided to proceed with this "Level 3" study to support project financing on this approximate 18-mile facility that includes the Western Wake Freeway and Triangle Parkway. (1)

This report summarizes the results of a comprehensive traffic and revenue study which began in 2007. The study was initially completed, in draft form, in spring 2008. It was updated in mid-2008 to reflect rapidly increasing gasoline prices in effect at that time, culminating in the delivery of a draft report in September 2008. The findings were further updated in February and March 2009 to reflect the recent economic downturn as well as the return of motor fuel prices to normal levels. The traffic and revenue forecasts included in this document reflect the most recent updates, as well as the benefit of the various detailed analyses conducted in the study between mid-2007 and winter 2009.

PROJECT DESCRIPTION

Figures 1-1 and 1-2 depict the project location and its relationship to the surrounding transportation system. The proposed Triangle Expressway is defined for this study as follows: (2)

(1) Proposed Triangle Parkway Preliminary Traffic and Revenue Study, Wilbur Smith Associates for the North Carolina Turnpike Authority, March 30, 2006.
Proposed Western and Southern Wake Parkways Preliminary Traffic and Revenue Study, Wilbur Smith Associates for the North Carolina Turnpike Authority, June 16, 2006.

(2) The three designations discussed herein are based on the earlier studies and are included for continuity and clarity. The working name for the entire project is "Triangle Expressway."

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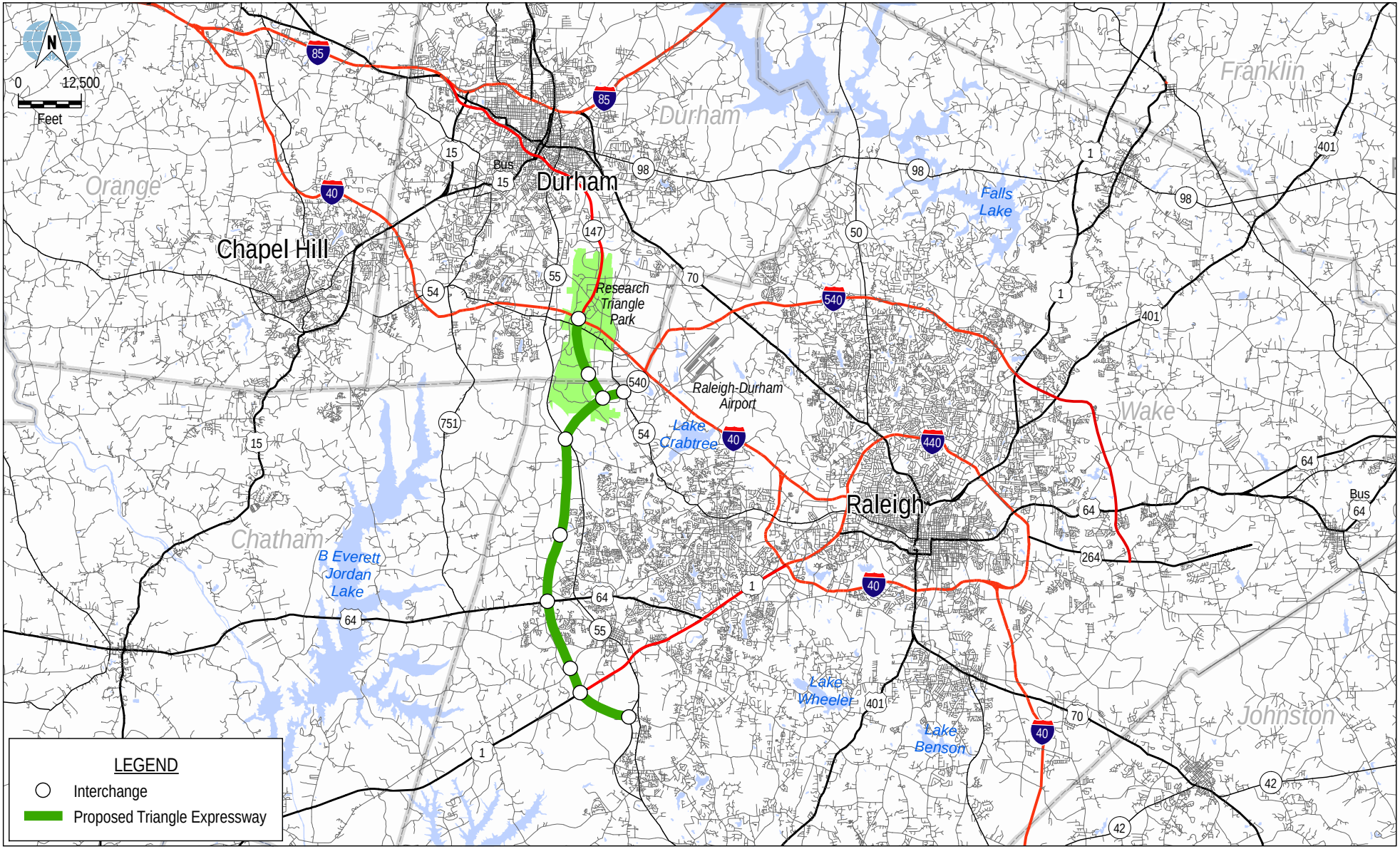

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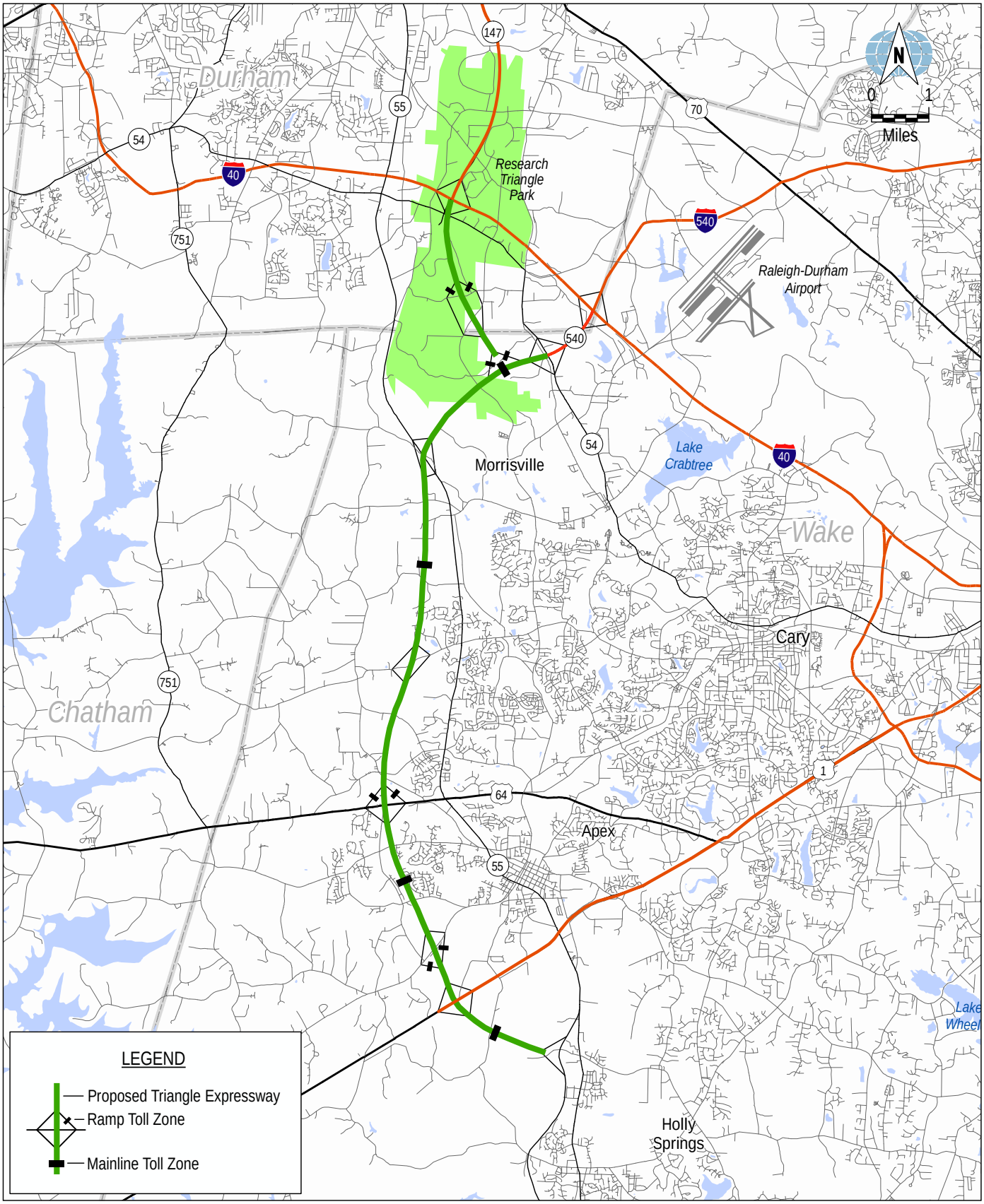
REGIONAL LOCATION MAP

FIGURE 1-1



NORTH CAROLINA Turnpike Authority

PROJECT LOCATION AND TOLL SYSTEM CONFIGURATION

FIGURE 1-2

- Triangle Parkway – NC 147/I-40 Interchange in Research Triangle Park to an interchange with NC 540 (3.4 miles);
- NC 540 - NC 54/NC 540 Interchange to NC 55 near Morrisville (2.8 miles); and
- Western Wake Freeway - NC 55 near Morrisville to NC 55 Bypass at Holly Springs (12.6 miles).

The proposed Triangle Expressway would extend for approximately 18 miles from the interchange of NC 540 and NC 54 south of Research Triangle Park at the northern end of the project to NC 55 Bypass near Holly Springs at the southern end of the project, and would include an approximate 3-mile connecting segment from NC 540 to NC 147 through the Research Triangle Park. The section of NC 540 between NC 54 and NC 55 is in operation now as a free facility, but will be re-designated as part of the Triangle Expressway when the Triangle Parkway is opened to traffic in 2012.

The Triangle Expressway would extend the planned and partially complete Wake Outer Loop around the greater Raleigh area. I-540, the northern portion of the Outer Loop terminates at I-40 and continues as state-designated NC 540 to NC 55 near Morrisville. NC 540 between NC 54 and NC 55 will become part of the Triangle Expressway in 2012. With the Triangle Expressway in place, drivers would have a high-grade facility from I-40 to NC 55 Bypass near Holly Springs, which would reduce congestion on the heavily-utilized parallel NC 55. It would also improve access into the Research Triangle Park and other area employment centers.

The Triangle Expressway would follow a generally north-south orientation parallel to NC 55. It would have 10 interchanges. This would provide significantly improved access to a rapidly developing area within the Triangle region, which, as noted below, is projected to have substantial increases in both population and employment over the next 25 years. NC 55 is currently being widened to a minimum of four lanes, with left-turn lane provisions. This will be the primary competing route to the Triangle Expressway. The improvement to NC 55 and other facilities was taken into consideration in this study. Other competing routes include Davis Drive, a major arterial facility located east of NC 55, and NC 751 to the west.

PROJECT CONFIGURATION AND TOLL COLLECTION CONCEPT

The project configuration is shown in Figure 1-2. Intermediate interchanges would be constructed at Davis Drive/Hopson Road, the junction of Triangle Parkway with NC 540 between NC 54 and NC 55, NC 55, Green Level Road, US 64, Old US 1 and US 1. The southern terminus of

this project would be at the NC 55 Bypass at Holly Springs. The northern termini would be at NC 147/I-40 and NC 54/NC 540.

An all-electronic, open road tolling (ORT) system is planned for the Triangle Expressway based upon analysis conducted for this study. The system will be structured as a barrier system with no free movements. Cash payments of tolls will not be available. Motorists not equipped for electronic toll collection (ETC) will be permitted to use the road under a video tolling system. ETC rates will be discounted from the base video rates.

Since all toll collection will be by either ETC or video at highway speeds, the Triangle Expressway will not have conventional toll plazas. Instead it will have locations, called "tolling zones," with appropriate equipment to read transponders or to capture license plate information by digital video.

Figure 1-2 shows the nominal location of four mainline tolling zones:

- Between US 1 and NC 55 Bypass;
- Between US 64 and Old US 1;
- Between NC 55 and Green Level Road; and
- Within the interchange of the Triangle Parkway and NC 540.

Tolling zones would also be established on certain interchange ramps to ensure no toll-free travel for users of the Triangle Expressway. Under this tolling concept, motorists using the TriEx from "end to end" would pass through four tolling zones without having to stop to pay tolls.

PROJECT PHASING

The proposed Triangle Expressway is expected to open for service in two phases:

- January 1, 2012: NC 147 to NC 55 Near Morrisville and NC 540 between NC 54 and NC 55 (Triangle Parkway and NC 540); and
- January 1, 2013: NC 55 near Morrisville to NC 55 Bypass at Holly Springs (Western Wake Freeway).

SCOPE OF WORK

This study was a follow-on to the preliminary studies described earlier. Previously collected data was reviewed and updated as necessary. Inventories of the corridor operating conditions including traffic counts and speed-delay studies on competing and complementary routes within the traffic impact study area plus other relevant routes outside the study area

were conducted. Information on the planned transportation improvement program was reviewed to determine its prospective impact on the traffic and revenue potential of the Triangle Expressway.

Previous reports and study materials related to the proposed Triangle Expressway were also reviewed. This information included previous traffic analysis and transportation modeling analysis prepared by the two Metropolitan Planning Organizations (MPOs) in the area, the Capital Area MPO (CAMPO) and the Durham-Chapel Hill-Carrboro MPO (DCHC).

Supplemental traffic counts were conducted in the project corridor. This information facilitated both the calibration of the travel demand model used in the analysis and provided a "base case" count condition for use in the traffic impact analysis as described below.

Origin-Destination Survey

An origin-destination (OD) survey was conducted in the project area to identify current travel patterns and trip characteristics. A mail-back survey procedure was followed in which motorists were given survey cards while stopped at traffic signals and encouraged to return them by pre-paid mail. The information obtained in this survey was used to supplement the Triangle Regional Model.

Stated Preference Survey

Surveys were also conducted to provide value-of-time data for use in the toll diversion models. Interactive, notepad-based interviews were held at various employment centers, shopping areas, and government offices. Interactive, internet-based surveys were also conducted with OD survey participants who responded to the internet link provided on the OD survey card.

Traffic Model Refinement

The Triangle Regional Model (TRM) used in the preliminary studies was also used for this Level 3 study. This traffic model covers all of Wake, Durham, and Orange Counties as well as adjacent portions of Chatham, Johnston, Harnett, Granville, and Franklin Counties.

A new model platform and revised socioeconomic data was under development during this study but was not adopted by the MPOs prior to the publication of this report. Consequently the older model was used with new socioeconomic forecasts as described below.

The socioeconomic data used in the original TRM trip generation process was replaced by more recent forecasts prepared by the MPO and adjusted by an independent economist. Accordingly, new trip tables were developed by applying the new socioeconomic data to the trip generation, trip distribution, and mode choice modules of the TRM.

The revised base-year model was calibrated in the immediate project area to achieve the best traffic volume assignments compared to observed traffic counts and observed speeds during speed-delay studies. The model also was updated to reflect committed highway improvements.

The toll collection concept used in the preliminary studies was revised to reflect the NCTA's decision to use ORT without toll plazas. As was the case for the earlier studies, considerable zone disaggregation was required along the TriEx. The trip tables were disaggregated on a proportionate basis using the updated trip generation and distribution process. Future-year trip tables were also disaggregated to reflect the new disaggregated zone system.

Information was also obtained regarding regional and corridor income characteristics to aid in the development of estimated values-of-time for potential users of the candidate toll facility. Additional information from the stated preference survey was used to establish values-of-time by trip purpose and income level. This is a critical model parameter used to assess motorists' willingness to pay tolls and to estimate motorists' sensitivity to toll rates for the facility. Vehicle operating cost parameters were also established specific to the study corridor.

Independent Corridor Growth Analysis

Economic growth is particularly important for a start-up toll facility such as the proposed Triangle Expressway. Given the strong employment-related growth in the Research Triangle region and population and employment growth in the project study area, analysis and validation of the projected economic activity is particularly important.

Since the completion of the preliminary studies, the MPOs began a reassessment of the Triangle Region's socioeconomic forecasts for use in the new transportation model that was under development during the Level 3 study. The new MPO forecasts as of June 2007, while not adopted by the MPOs during this study, were used by the independent economist in its review of study area growth.[3] The independent economist adjusted the

[3] Kenan Institute for Private Enterprise of the University of North Carolina at Chapel Hill.

MPO's new forecasts as described in its report. These forecasts by the independent economist were then used in the transportation model to create new trip tables for the toll diversion analysis.

Traffic and Revenue Analysis

The refined models were used to run a series of traffic assignments, both with and without the proposed Triangle Expressway. In each case, traffic assignments were run at AM peak, PM peak and off-peak conditions. A review was made of the reasonableness of the travel demand estimates, particularly under a toll condition, using various evaluation techniques such as select link, corridor share, and capture rate.

Toll sensitivity curves were developed for 2012 traffic volumes and 2030 volumes to determine optimum toll rates. These optimum rates were then used to conduct traffic assignments for other years.

Based on the results of the traffic modeling analysis, annual estimates of traffic and revenue from the proposed Triangle Expressway were developed for the base-case condition from opening year 2012 through 2030. The forecasts beyond 2030 were based on a computational extrapolation of modeling results from 2030.

Revenue estimates in the early years of the projection period were adjusted to reflect ramp-up, a pattern of gradual build-up in demand for new toll facilities. This reflects the fact that the full demand along a facility is not typically realized when it opens but gradually phases in over a period of two to four years.

Finally, estimates of revenue leakage were prepared to reflect potential losses of revenue due to system operational factors, unreadable license plates, unidentified vehicle owners, and account collection factors.

Effects of Recession

Most of the analysis for this report was completed by August 2008 before the effects of the current recession were apparent. However, the traffic and revenue forecasts were adjusted during February and March 2009 to reflect the recession. The procedures used for this adjustment are described in Chapter 6. Revenue forecasts in this report reflect an estimate of the impact of the current economic downturn.

Sensitivity Tests

A series of sensitivity tests were also performed to provide additional information on the sensitivity of the forecasts to changes in key parameters

such as higher and lower economic growth, different percentages of ETC usage, different values of time, different vehicle operating costs, longer ramp-up periods, the inclusion of additional toll facilities on the Southern Wake Freeway, increased use of transit in the study area, and the introduction of a hypothetical commuter rail service in the study area.

REPORT STRUCTURE

The remainder of this report consists of six chapters.

- Chapter 2 presents the traffic conditions in the project study area.
- Chapter 3 contains a summary of the stated preference surveys.
- Chapter 4 describes the socioeconomic characteristics of the study area using the independent economist's socioeconomic forecast.
- Chapter 5 describes the analysis that led to the decision to adopt all electronic, open road tolling concept as the preferred toll collection method.
- Chapter 6 describes the development of the traffic forecast model, assumed roadway and transit improvements, toll configuration, toll sensitivity, recommended toll rates, traffic and gross revenue forecasts, and revenue leakage.
- Chapter 7 contains the results of a series of sensitivity tests on key model parameters.

CHAPTER 2

EXISTING TRAFFIC CONDITIONS

A major part of the effort involved in this phase of the study included the collection of existing data in order to:

- Understand existing travel behavior as a context for the evolution of future travel behavior after the proposed toll road and other area facilities planned for construction over the forecast period are built; and

- Calibrate the base year of the forecasting models to current/baseline observed traffic conditions to assure that the forecasting tools are adequately replicating current conditions in the study area prior to forecasting future traffic volumes.

To achieve these objectives, the latest travel data on traffic speeds, traffic volumes, and vehicle type in the study area were compiled. In addition, extensive route reconnaissance and a review of available traffic statistics on highways within the study area was conducted.

This current empirical documentation of the traffic network in the study area was augmented by available traffic trend data from North Carolina Department of Transportation (NCDOT). Available information on programmed highway improvements scheduled in the study area was incorporated into the analysis also.

This chapter describes the collection of data used to characterize the operational performance of existing facilities in the Triangle Expressway study area.

EXISTING HIGHWAY SYSTEM

The proposed Triangle Expressway would facilitate traffic movement in a north-south direction between I-40 and I-540 and NC 55 southwest of Raleigh. It would pass through or near major employment centers, including

the Research Triangle Park, the dominant location for employment in the area. Table 2-1 summarizes the major features of the study area for the Triangle Expressway, which are described below.

- I-40 is the major east-west route in the Raleigh-Durham area. It extends from Wilmington on the coast across the State of North Carolina to the Tennessee state line and provides access to major cites along its length, including Asheville, Hickory, Winston Salem, Greensboro, Raleigh and Wilmington. In the area of the proposed project, I-40 is a limited access six to eight lane freeway with interchanges at I-540, Page Road, Miami Boulevard, Davis Drive, Durham Freeway (NC 147), and NC 55. The speed limit on I-40 is 65 mph.

- I-540 is part of a facility that eventually will provide an outer loop around Raleigh. Currently, I-540 extends from US 64 east of Raleigh to I-40 west of Raleigh. The eastern and southern sections of the I-540 Outer Loop, which will extend from US 64 Bypass east of Raleigh to NC 55 at Holly Springs, currently are not funded for right of way or construction. The speed limit on I-540 is 55 mph.

- NC 540 is a short section of the planned outer loop around Raleigh. NC 540 extends from I-40 between Raleigh and RTP to NC 55 near Morrisville. It is a six-lane median divided freeway with full control of access and interchanges at NC 54 and NC 55. The proposed Triangle Expressway will have its northern terminus at NC 54. The speed limit on NC 540 is 55 mph.

- US 1 is a major highway that runs north to south through Wake County. It is primarily a four-lane, median-divided expressway facility with 65 mph speed limits and multiple interchanges. US 1 is being widened at the time of this study.

- Old US 1 runs parallel to US 1. It is a two-lane roadway with numerous unsignalized intersections.

- US 64 is primarily an east-west route with interchanges at US 1 and NC 55. US 64 is a four-lane, median-divided highway that connects Raleigh, Apex and Cary to points west. Speed limits on US 64 are 45 and 55 mph.

- NC 54 extends east-west from NC 55, parallel to I-40, before turning south to become Miami Boulevard and Chapel Hill Road. It has between two and five lanes and a posted speed limit of 45 mph.

Table 2-1
Key Attributes of Major Routes Within the Study Area

Route	Location in Study Area	Direction in Study Area	Lanes Per Direction	Controlled Access	Traffic Signals	Posted Speed Limit
Davis Drive	North of I-40 to US 64	North - South	1-3	No	Yes	45-55
Green Level Road	NC 55 to NC 751	East - West	1	No	No	45
I-40	Raleigh to Chapel Hill/Durham	East - West	3-4	Yes	No	65
I-540	Proposed Outer Ring Road around Raleigh	East - West	3-4	Yes	No	65
Miami Boulevard	Durham to Research Triangle Park	North - South	2-3	No	Yes	45
Morrisville Carpenter Road	Chapel Hill Road to NC 55	East - West	1	No	No	45
NC 54	Miami Boulevard/Chapel Hill Road to Chapel Hill	East-West	1-3	No	Yes	45
NC 147 (Durham Freeway)	Durham to Research Triangle Park	North - South	2	Yes	No	55-65
NC 55	Durham to US 1/Holly Springs	North - South	2-3	No	Yes	45
Old US 1	Parallel to US 1	North - South	1	No	No	45-55
Page Road/Hopson Road	US 70 to Research Triangle Park	East-West	1-3	No	Yes	45
US 1	Raleigh to Apex/Sanford	North - South	2	Yes	No	65
US 64	Apex/Pittsboro to Raleigh	East - West	2	Yes	No	45-55
NC 540	I-40 to NC 55	East-West	2*	Yes	No	55

* Constructed to 3 lanes per direction but only 2 lanes per direction are currently opearational.

- NC 55 extends north-south along the western side of the study area with an interchange at I-40. NC 55, which would parallel the proposed Triangle Expressway, has between two and five lanes with signalized and unsignalized intersections throughout its length. The majority of NC 55 has a 45 mph speed limit.

- NC 147 (Durham Freeway) provides north-south access from Durham to the Research Triangle Park (RTP). This four-lane facility presently terminates at I-40. The proposed Triangle Expressway would extend south from the NC 147/I-40 Interchange. Speed limits vary from 55 to 65 mph.

- Davis Drive serves the Research Triangle Park from north of I-40 to US 64 south of the Park. It has between two and five lanes with speed limits from 45 to 55 mph.

- Green Level Road is an east-west local road with multiple unsignalized intersections. It is a two-lane roadway with a 45 mph speed limit.

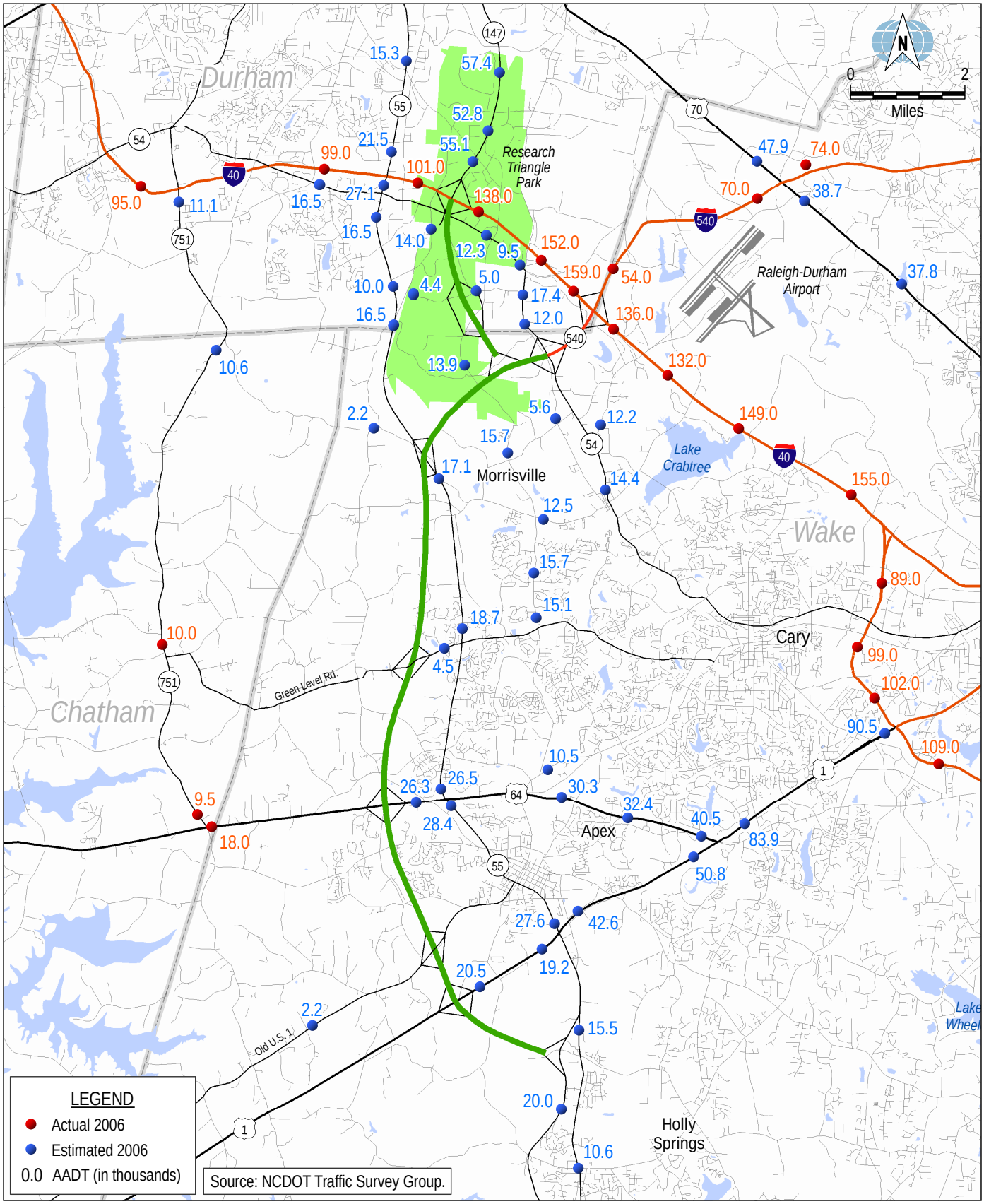
- Hopson Road and Page Road provide east-west access through the study area from an interchange with I-40 east of RTP to Alston Avenue west of RTP. Hopson Road is two lanes, while Page Road has between three and five lanes. The posted speed limit is 45 mph on both roadways.

- Miami Boulevard provides north-south access in the study area with an interchange at I-40. It is five lanes with multiple signalized intersections. The posted speed limit is 45 mph.

- Morrisville Carpenter Road is an east-west local road. It is two to four lanes with a 45 mph speed limit.

Traffic Trends and Variations

The NCDOT Traffic Survey Group conducts traffic counts for selected roadways statewide. Mainline and ramp traffic volumes are collected annually for interstate and limited access highways and used to develop estimates of Average Annual Daily Traffic (AADT). Traffic counts on arterial roadways are usually collected biennially. Existing traffic data from NCDOT were reviewed to aid in the traffic model calibration process. For locations where 2006 data was not available, historical data was used to estimate 2006 traffic volumes. Figure 2-1 provides a summary of available 2006 traffic counts conducted by NCDOT, as well as selected estimates of 2006 traffic volumes. All volumes are shown in thousands of vehicles.



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AVERAGE ANNUAL DAILY TRAFFIC AT SELECTED LOCATIONS, 2006

FIGURE 2-1

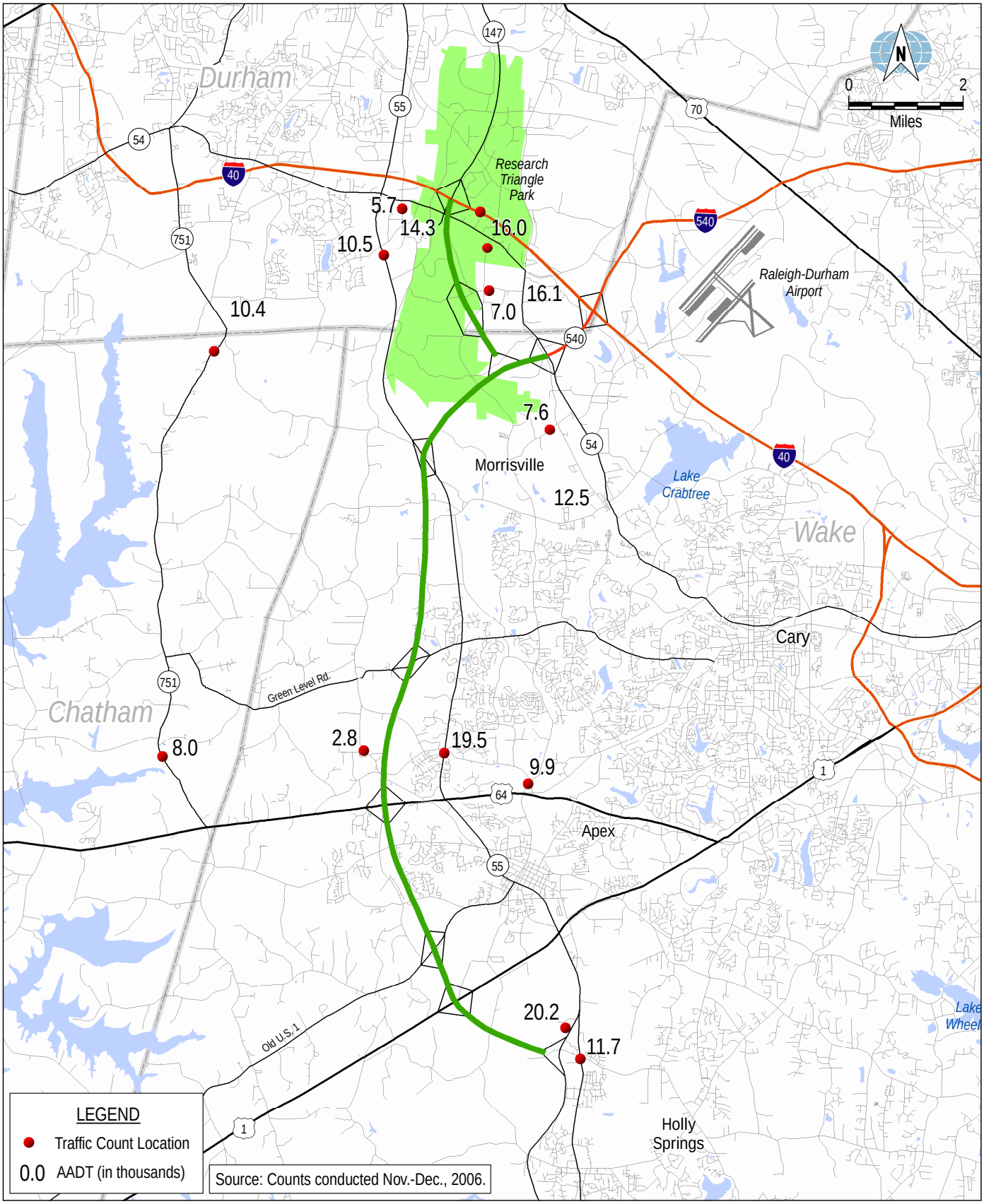
The dominant road within the study area is I-40 with daily volumes up to 159,000 vehicles per day. Other major east-west routes that would connect to the Triangle Expressway include NC 540, US 1, US 64, NC 54, and Green Level Road. The major north-south route parallel to the proposed Triangle Expressway is NC 55 with volumes between 10,600 and 28,400 vehicles per day. Other major north-south routes that could compete with the proposed Triangle Expressway include Davis Drive and NC 751.

Traffic information supplied by NCDOT was supplemented by new traffic counts within the Triangle Expressway study area and other key locations during November and December 2006. The major purpose of this supplemental work was to obtain current traffic volumes as an aid in re-calibrating the regional transportation demand model in the area of the proposed Triangle Expressway. Seven-day counts by day, hour, and vehicle class at 15 locations were obtained as shown in Figure 2-2. The average annual daily traffic volumes resulting from this data collection effort, which were calculated using North Carolina's published axle and seasonal correction factors, are summarized in Table 2-2.

Table 2-2
Average Annual Daily Traffic Volumes
at Supplemental Traffic Count Locations

Location	Average Annual Daily Traffic (AADT)		
	Northbound / Eastbound	Southbound / Westbound	Total
NC 55 Business south of Sunset Lake Road	5,957	5,779	11,736
NC 55 Bypass south of NC 55 Business	9,623	10,615	20,238
NC 55 West Williams Street south of Old Jenks Road	9,826	9,646	19,472
NC 55 south of Sedwick Drive	5,112	5,404	10,516
NC 147 west of TW Alexander Drive [(1)]	7,738	6,516	14,254
NC 751 south of Fayetteville Road	5,023	5,337	10,360
NC 751 south of Luther Road	4,030	3,989	8,019
Davis Drive south of NC 54 [(1)]	8,356	7,620	15,976
Davis Drive south of Old Jenks Road	3,951	5,943	9,894
Green Level Church Road north of Secluded Acres Road	1,465	1,366	2,831
Hopson Road east of Davis Drive	3,351	3,610	6,961
McCrimmon Parkway west of Church Street	3,732	3,916	7,648
Morrisville-Carpenter Road west of Church Street	5,719	6,762	12,481
South Alston Avenue south of NC 54	2,665	2,986	5,651
South Miami Boulevard south of NC 54 [(1)]	8,287	7,856	16,143

[(1)] Based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.



NORTH CAROLINA Turnpike Authority

AVERAGE ANNUAL DAILY TRAFFIC AT SUPPLEMENTAL TRAFFIC COUNT LOCATIONS, 2006

FIGURE 2-2

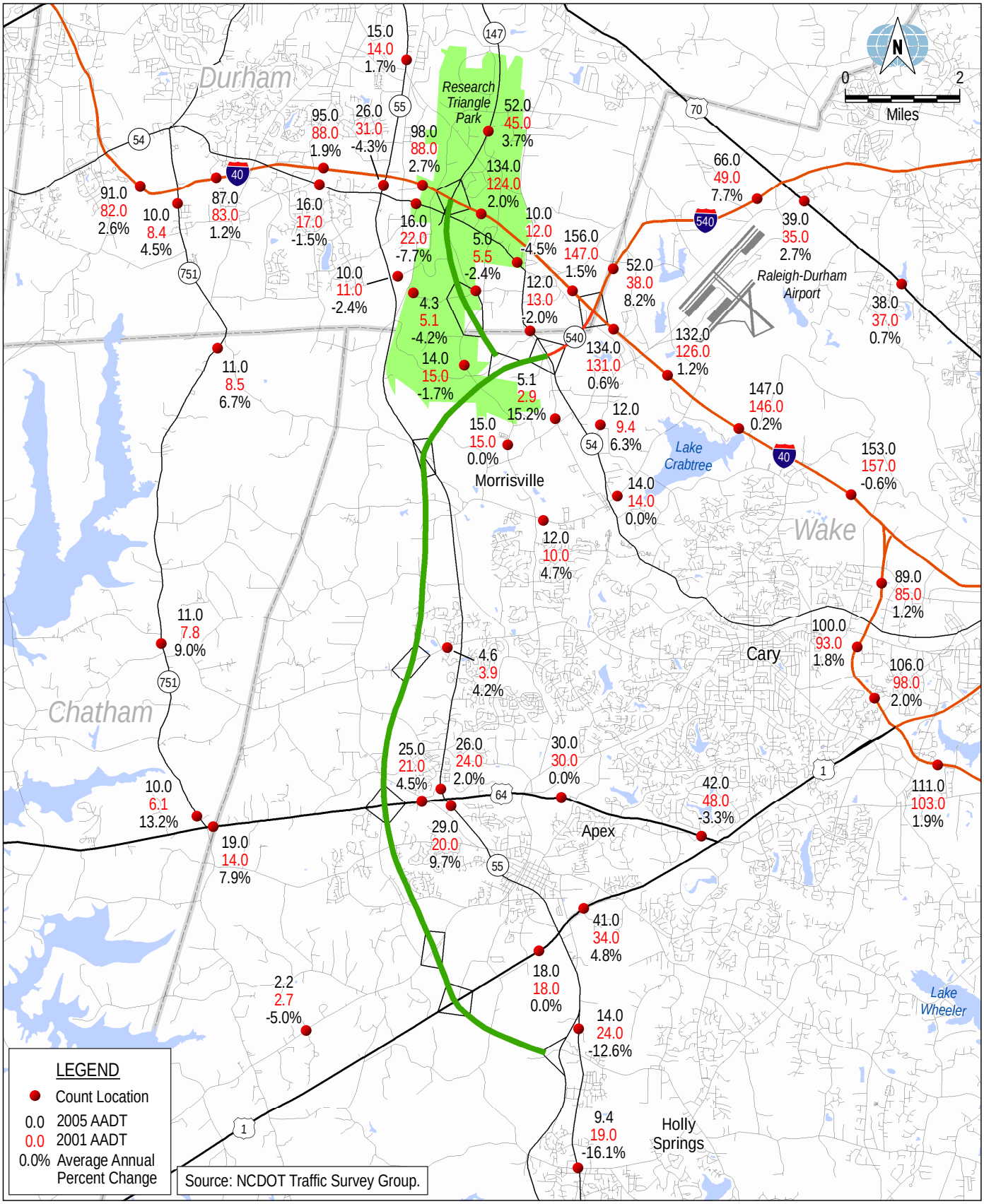
ANNUAL TRAFFIC TRENDS AND VARIATIONS

Based on available NCDOT traffic information for the years 2001 and 2005, total traffic within the study area increased a total of 6 percent between 2001 and 2005, with an average annual change of 1.5 percent. Figure 2-3 shows the location of traffic counts conducted on selected roadways, which are further summarized in Table 2-3. The highest percentages of growth occurred on I-540 and on various arterial roadways in Morrisville. This may be due to the opening of I-540 to the east between I-40 and US 1 in 1997. Additional increases in traffic can be seen on roadways near Apex and on NC 751, which would be parallel to the proposed Triangle Expressway. The largest decreases in traffic occurred on NC 55 in Holly Springs, due to the construction of the NC 55 Bypass, which would serve as the southern terminus of the proposed Triangle Expressway. Smaller decreases in traffic also occurred within the Research Triangle Park, which may be due to the diversion of traffic from local roadways to I-540.

Since traffic data for interstates and limited access highways are provided annually, further analysis was conducted regarding these roadways. Figure 2-4 summarizes the interstate traffic counts collected on I-40 in the study area between 2000 and 2006. I-40 is a major east-west roadway that would interchange with the proposed Triangle Expressway. Traffic on I-40 between NC 751 and the I-440/ Wade Avenue increased an average of 2.2 percent per year between 2000 and 2006. Traffic and traffic growth on I-40 were greatest overall between NC 147 and I-540. Traffic information is provided in Table 2-4 for all interstates in the study area between 2000 and 2006. Overall, traffic on interstates within the study area increased by 3 percent between 2000 and 2005, with an additional increase of 1.6 percent between 2005 and 2006.

MONTHLY TRAFFIC VARIATIONS

Seasonal adjustment factors obtained from the NCDOT Traffic Survey Group are shown in Table 2-5. These seasonal adjustment factors reflect the monthly traffic variations that occur on roadways in the study area. As shown in the table, the average May, June, July and August traffic volumes on secondary roads, such as NC 55, NC 54, and Davis Drive are 8 percent above the monthly average traffic volume. By contrast, average January traffic volume is 8 percent below the monthly average. Urban interstates generally have volumes above the monthly average, with the peak month being September with 10 percent above the monthly average. The seasonality on rural interstates is more pronounced, ranging from 12 percent below the monthly average in February to 9 percent above the monthly average in August.



NORTH CAROLINA Turnpike Authority

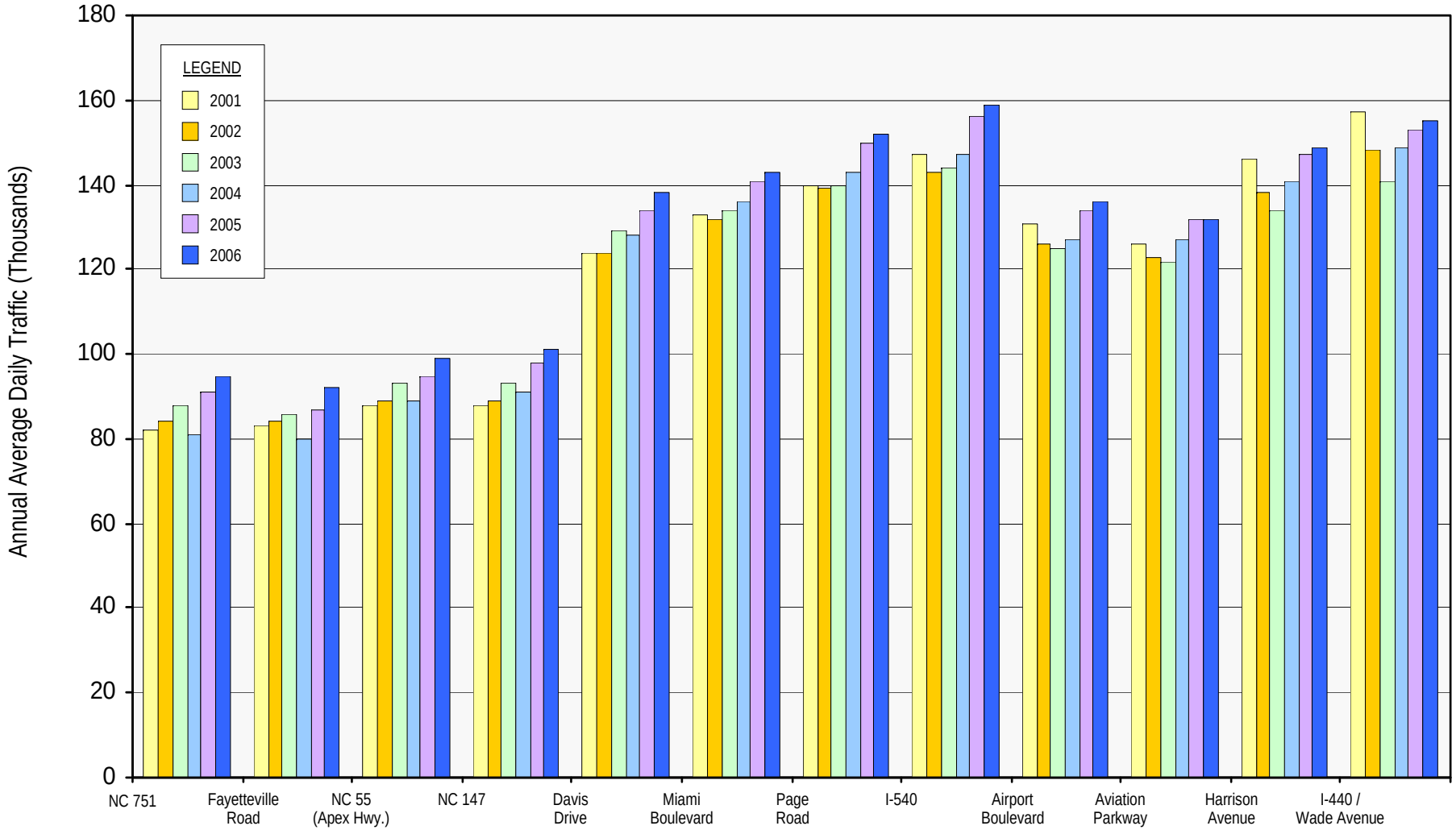
AVERAGE ANNUAL DAILY TRAFFIC, 2001 - 2005

FIGURE 2-3

Table 2-3
Historic Arterial Roadway Traffic Counts
2001 - 2005

Route Name	Traffic Count Location	Average Annual Daily Traffic (000s) 2001	2003	2005	Average Annual Growth 2001 - 2005
Airport Boulevard	East of NC 54	9.4	11.0	12.0	6.3%
Church Street	North of McCrimmon Parkway	2.9	3.7	5.1	15.2%
Davis Drive	North of Kitt Creek Road	15.0	15.0	14.0	-1.7%
Davis Drive	North of McCrimmon Parkway	15.0	17.0	15.0	0.0%
Hopson Road	West of Davis Drive	5.5	4.9	5.0	-2.4%
Hopson Road	East of South Alston Avenue	5.1	3.9	4.3	-4.2%
Morrisville Carpenter Road	East of Davis Drive	10.0	11.0	12.0	4.7%
NC 147	Between T W Alexander Drive and East Cornwallis Road	45.0	53.0	52.0	3.7%
NC 54	North of Aviation Parkway	14.0	15.0	14.0	0.0%
NC 54 (South Miami Boulevard)	South of Church Street	13.0	11.0	12.0	-2.0%
NC 54	West of NC 54 / South Miami / Creekstone	12.0	11.0	10.0	-4.5%
NC 54	East of South Alston Avenue	22.0	19.0	16.0	-7.7%
NC 54	East of Barbee Road	17.0	17.0	16.0	-1.5%
NC 55	South of Holly Springs Road	19.0	7.0	9.4	-16.1%
NC 55 (East Williams Street)	Between NC 55 Bypass and Sunset Lake Road	24.0	11.0	14.0	-12.6%
NC 55	South of US 64	20.0	24.0	29.0	9.7%
NC 55	North of US 64	24.0	25.0	26.0	2.0%
NC 55 (Apex Highway)	North of NC 54	31.0	31.0	26.0	-4.3%
NC 55	North of Cornwallis Road	14.0	15.0	15.0	1.7%
NC 751	North of US 64	6.1	8.9	10.0	13.2%
NC 751	North of Lewter Shop / Hollands Chapel	7.8	9.7	11.0	9.0%
NC 751	South of Okelly Chapel Road	8.5	8.8	11.0	6.7%
NC 751	South of I-40	8.4	10.0	10.0	4.5%
Old US 1	East of Bosco Road	2.7	2.1	2.2	-5.0%
T W Alexander Drive	East of NC 55 (Apex Highway)	11.0	10.0	10.0	-2.4%
US 1	West of NC 55 (East Williams Street)	18.0	16.0	18.0	0.0%
US 1	Between Ten Ten Road and NC 55 (East Williams Street)	34.0	35.0	41.0	4.8%
US 64	West of US 1	48.0	45.0	42.0	-3.3%
US 64	Between Laura Duncan Road and Salem Street	30.0	31.0	30.0	0.0%
US 64	Between NC 55 and Kelly Road	21.0	24.0	25.0	4.5%
US 64	East of NC 751	14.0	17.0	19.0	7.9%
US 70 (Glenwood Avenue)	Between Ebenezer Church Road and Pinecrest Road	37.0	36.0	38.0	0.7%
US 70 (Glenwood Avenue)	South of I-540	35.0	33.0	39.0	2.7%

Source: NCDOT, Information, Mapping, and Graphics Unit.



NORTH CAROLINA Turnpike Authority

HISTORICAL TRAFFIC VOLUMES ON I-40

FIGURE 2-4

Table 2-4
Historic Interstate Highway Traffic Counts
2000 - 2006

Route Name	Traffic Count Location	Average Annual Daily Traffic (000s) 2000	2001	2002	2003	2004	2005	2006	Average Annual Growth 2000 - 2006
I-40 / I-440	Between Gorman Street and US 1	94	103	101	103	109	111	109	2.5%
I-40	Between US 1 and Cary Towne Boulevard	85	98	96	96	105	106	102	3.1%
I-40	Between Cary Towne Boulevard and NC 54	80	93	91	92	98	100	99	3.6%
I-40	Between NC 54 and Wade Avenue/I-40	72	85	82	83	87	89	89	3.6%
I-40	Between I-40/Wade Avenue and Harrison Avenue	144	157	148	141	149	153	155	1.2%
I-40	Between Harrison Avenue and Aviation Parkway	135	146	138	134	141	147	149	1.7%
I-40	Between Aviation Parkway and Airport Boulevard	118	126	123	122	127	132	132	1.9%
I-40	Between Airport Boulevard and I-540	124	131	126	125	127	134	136	1.6%
I-40	Between I-540 and Page Road	140	147	143	144	147	156	159	2.1%
I-40	Between Page Road and South Miami Boulevard	133	140	139	140	143	150	152	2.3%
I-40	Between South Miami Boulevard and Davis Drive	126	133	132	134	136	141	143	2.1%
I-40	Between Davis Drive and NC 147	118	124	124	129	128	134	138	2.6%
I-40	Between NC 147 and NC 55 (Apex Highway)	83	88	89	93	91	98	101	3.3%
I-40	Between NC 55 (Apex Highway) and Fayetteville Road	83	88	89	93	89	95	99	3.0%
I-40	Between Fayetteville Road and NC 751	81	83	84	86	80	87	92	2.1%
I-40	Between NC 751 and NC 54	79	82	84	88	81	91	95	3.1%
I-540	Between I-40 and Aviation Parkway	28	38	35	47	45	52	54	11.6%
I-540	Between Lumley Road and US 70 (Glenwood Avenue)	36	49	48	58	57	66	70	11.7%

Source: NCDOT, Information, Mapping, and Graphics Unit.

Table 2-5
Seasonal Adjustment for Selected
Automatic Traffic Recorder Groups[1]

Month	Monthly Index [2] Urban Interstate	Rural Interstate	Secondary Roads
January	97	85	92
February	103	88	97
March	105	97	99
April	109	102	104
May	108	104	108
June	106	108	108
July	105	108	108
August	110	109	108
September	103	106	105
October	106	109	106
November	104	105	105
December	99	103	106

[1] An Automatic Traffic Recorder (ATR) Group is a set of roadways that have similar physical characterics and surrounding development patterns.
[2] The ratio of Monthly Traffic Volumes to the Average Monthly Traffic Volumes.
Source: NCDOT Traffic Survey Group - ATR Based Seasonal Factors

DAILY TRAFFIC VARIATIONS

In the absence of any continuous counting stations within the study area, the data collected during the seven-day supplemental counts conducted in November-December 2006 was used to analyze daily traffic variations. Table 2-6 summarizes the daily variations in traffic volumes at the 12 count locations where a full week of data was available. The average weekday traffic volume for all locations is 9 percent above the average daily traffic volume, while the average weekend traffic volume is 23 percent below the average. This suggests the heavy commuter pattern present within the study area. Additionally, the three routes with variations between weekdays and weekends of 50 percent or more are located along local roadways that provide access to the Triangle Research Park, Hopson

Table 2-6
Daily Traffic Variations at Supplemental Traffic Count Locations

Location	Daily Index[1]							Average	Average	Average
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Weekday	Weekend	Day
NC 55 Business south of Sunset Lake Road	76	108	101	104	102	111	97	105	87	100
NC 55 Bypass south of NC 55 Business	69	108	105	107	107	114	91	108	80	100
NC 55 West Williams Street south of Old Jenks Road	80	105	102	104	104	109	97	105	89	100
NC 55 south of Sedwick Drive	61	107	111	111	114	114	83	111	72	100
NC 751 south of Fayetteville Road	63	106	111	109	117	111	83	111	73	100
NC 751 south of Luther Road	62	113	107	109	112	115	82	111	72	100
Davis Drive south of Old Jenks Road	75	107	110	99	112	111	86	108	81	100
Green Level Church Road north of Secluded Acres Road	67	118	111	109	107	109	79	111	73	100
Hopson Road east of Davis Drive	19	127	128	136	135	128	27	131	23	100
McCrimmon Parkway west of Church Street	56	108	108	113	121	122	71	114	64	100
Morrisville-Carpenter Road west of Church Street	87	101	94	104	104	109	102	102	95	100
South Alston Avenue south of NC 54	41	115	116	116	118	118	76	117	59	100
Average	**68**	**108**	**107**	**108**	**111**	**113**	**86**	**109**	**77**	**100**

[1] Ratio of individual day's traffic to average daily traffic for the week.
Source: 7-Day Supplemental Counts in November-December 2006.

Road, McCrimmon Parkway and Alston Avenue. For most locations, the peak day is either Thursday or Friday. The average variation in daily traffic volumes is further illustrated in Figure 2-5.

Hourly Traffic Variations

Table 2-7 summarizes hourly traffic volumes at all 15 supplemental count locations. The average hourly traffic volumes at three locations on NC 55 are summarized in Figure 2-6. Distinct AM and PM peaks are present, as well as a smaller midday peak at the northern end of NC 55 near Research Triangle Park, which suggests the heavy influence of commuters. This midday peak is reduced at the southern end near Holly Springs. The locations that exhibit higher traffic volumes during the AM period are Davis Drive south of NC 54 and Hopson Road east of Davis Drive. These two roadways provide access to the Research Triangle Park.

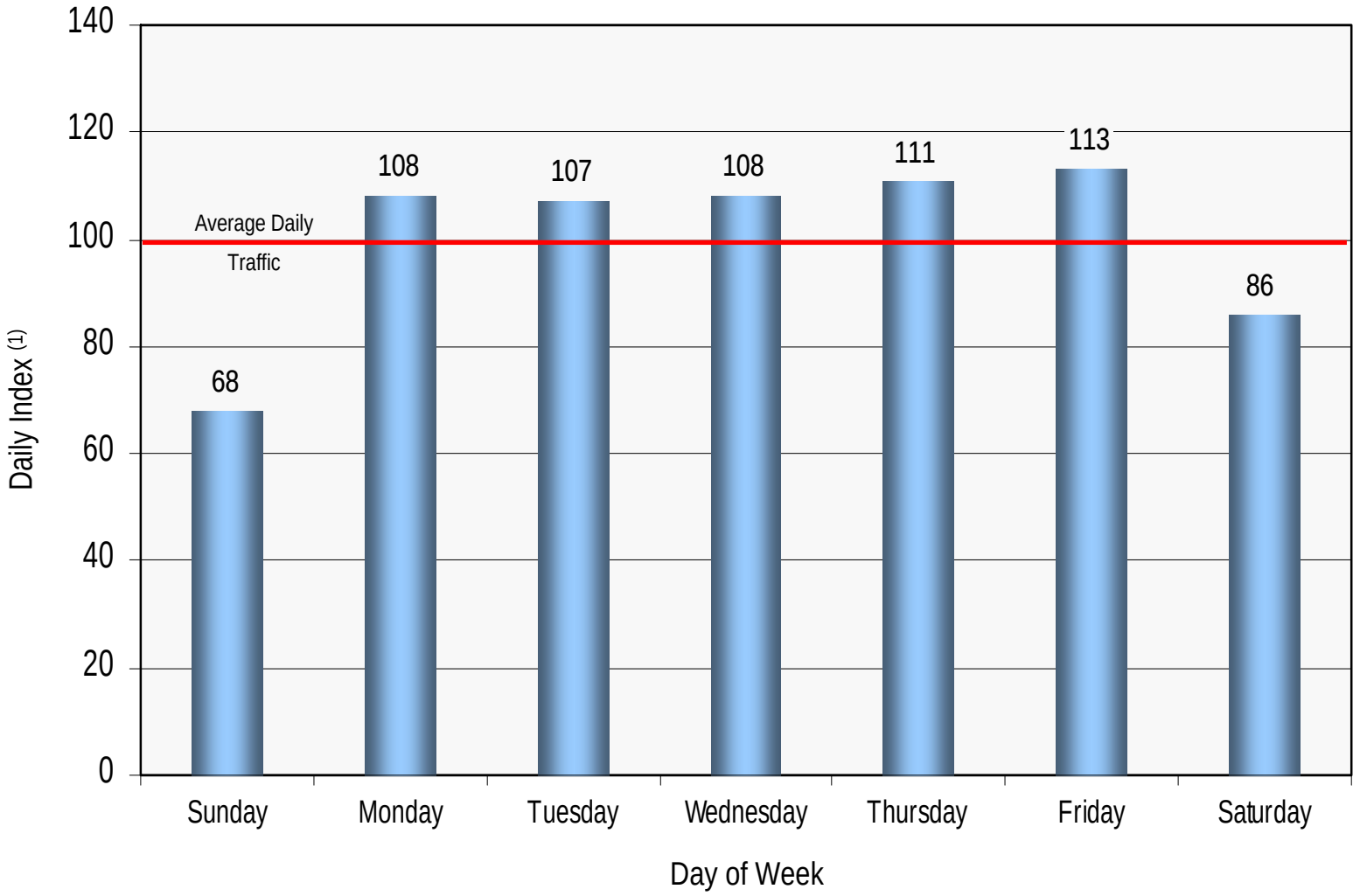
Table 2-8 examines the peak period share of average daily traffic at the 15 supplemental count locations. The AM peak period is defined as 6:00-10:00 a.m., and the PM peak period is defined as 3:00-7:00 p.m. There is also a Midday peak period from 10:00 a.m. to 3:00 p.m. and an Off-peak period from 7:00 p.m. to 6:00 a.m. From the table it is clear that the PM peak represents a significant share of daily traffic. For the supplemental count locations, an average of 30.1 percent of daily traffic occurs during the PM peak period. The AM peak period represents an average of 21.7 percent of daily traffic. This means that the majority of daily traffic occurs during the peak periods further suggesting the influence of commuters within the study area.

Vehicle Classification

Vehicle classification affects many modeling variables, such as value of time and vehicle operating costs. Additionally, it has an influence on revenue generation. Table 2-9 presents the vehicle classification data gathered from the 15 supplemental traffic count locations. Passenger vehicles predominate in this heavy commuter area, with an average of 90.9 percent for all locations. Heavy trucks, which are considered to be tractor trailers, constitute an average of 3.3 percent of all vehicles, while light and medium trucks make up 5.8 percent. The highest percentages of truck traffic were observed on NC 55, Miami Boulevard and Davis Drive, which all provide north-south access through the Research Triangle Park.

Travel Speeds and Delays

Weekday travel speeds within the project study area were measured on July 25 and 26, 2007. Data collection was performed during the AM peak period and PM peak period on multiple roads in each direction, including the following.



(1) Daily Index = Ratio of individual day's traffic to average daily traffic for week.

NORTH CAROLINA Turnpike Authority

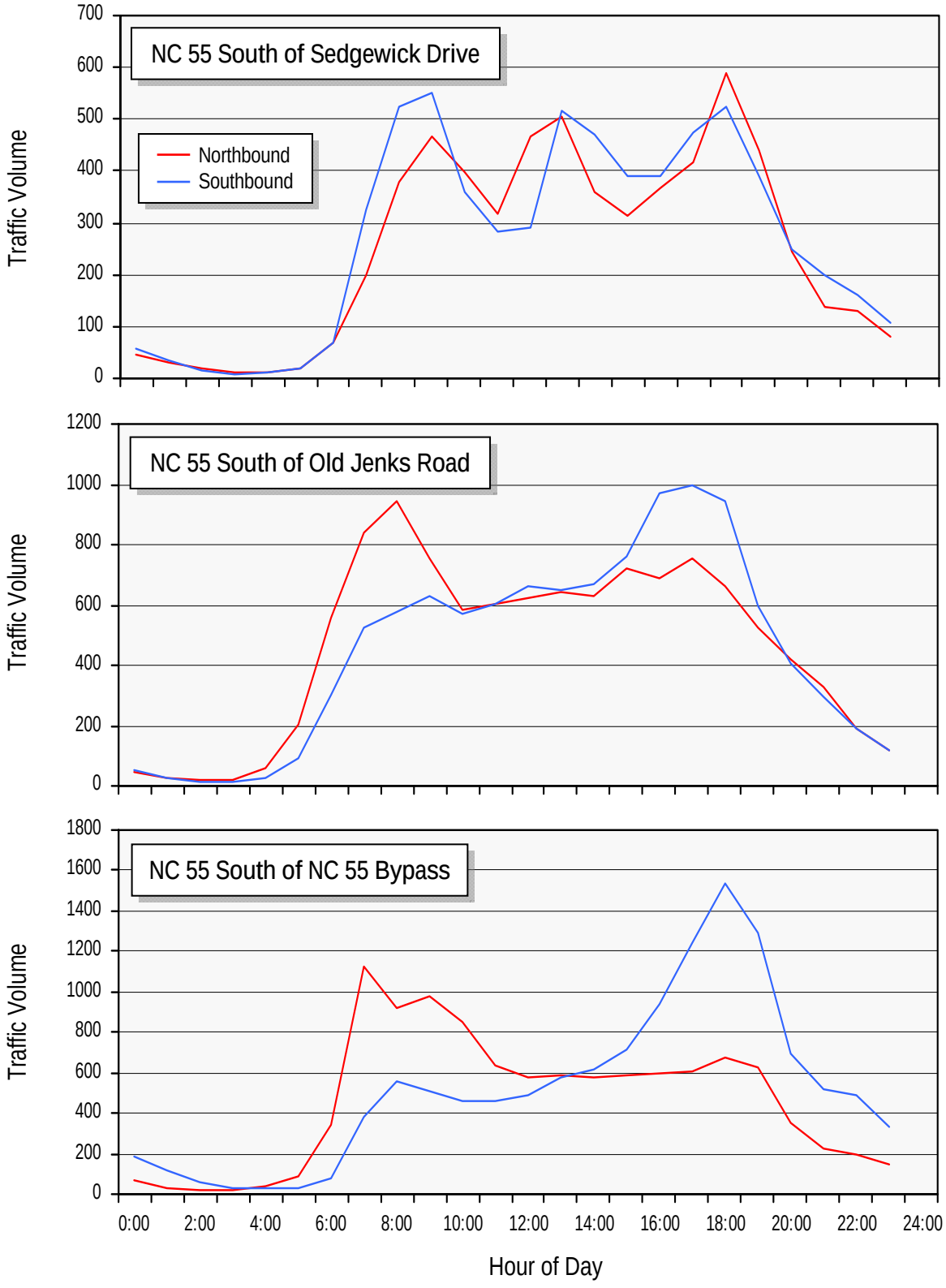
AVERAGE DAILY VARIATIONS
SUPPLEMENTAL TRAFFIC COUNT LOCATIONS

FIGURE 2-5

Table 2-7
Hourly Traffic Variations at Supplemental Traffic Count Locations

Beginning Hour	Percent of Total Day (7-day Counts)															
	NC 55 Business south of Sunset Lake	NC 55 Bypass south of NC 55 Business	NC 55 West Williams Street south of Old Jenks Road	NC 55 south of Sedwick Drive	NC 147 west of TW Alexander Drive [1]	NC 751 south of Fayetteville Road	NC 751 south of Luther Road	Davis Drive south of NC 54 [1]	Davis Drive south of Old Jenks Road	Green Level Church Road south of Secluded Acres Road	Hopson Road east of Davis Drive	McCrimmon Parkway west of Church Street	Morrisville-Carpenter Road west of Church Street	South Alston Avenue south of NC 54	South Miami Boulevard south of NC 54 [1]	Average
0:00	1.4%	1.5%	0.7%	1.2%	0.8%	0.7%	0.7%	0.7%	0.4%	0.5%	0.7%	0.7%	1.7%	1.2%	0.7%	0.9%
1:00	0.7%	0.9%	0.4%	0.7%	0.5%	0.4%	0.4%	0.4%	0.3%	0.2%	0.4%	0.3%	0.9%	0.6%	0.4%	0.5%
2:00	0.5%	0.5%	0.2%	0.4%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.3%	0.2%	0.4%	0.3%	0.2%	0.3%
3:00	0.4%	0.3%	0.2%	0.3%	0.2%	0.1%	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%	0.2%	0.3%	0.2%	0.2%
4:00	0.5%	0.3%	0.4%	0.2%	0.1%	0.1%	0.1%	0.1%	0.5%	0.1%	0.2%	0.4%	0.2%	0.2%	0.3%	0.3%
5:00	0.5%	0.5%	1.2%	0.3%	0.2%	0.3%	0.3%	0.2%	2.0%	0.0%	0.2%	1.0%	0.5%	0.2%	1.2%	0.6%
6:00	1.2%	1.6%	3.2%	1.0%	1.3%	1.0%	1.1%	0.9%	4.3%	0.2%	1.3%	3.4%	1.2%	0.8%	4.3%	2.0%
7:00	4.1%	5.4%	5.3%	3.8%	4.4%	4.7%	5.0%	4.1%	6.5%	2.6%	3.8%	6.3%	3.3%	2.2%	7.6%	4.9%
8:00	6.3%	5.5%	6.2%	6.2%	9.7%	8.7%	11.0%	9.7%	6.5%	8.4%	8.7%	6.5%	4.8%	7.0%	8.8%	7.4%
9:00	5.9%	5.8%	6.1%	7.4%	10.6%	7.9%	7.9%	11.7%	6.3%	9.6%	10.2%	5.7%	5.0%	7.7%	6.2%	7.4%
10:00	5.5%	5.6%	5.6%	6.0%	6.4%	5.3%	5.0%	7.7%	5.5%	5.7%	7.6%	4.9%	5.6%	4.9%	4.4%	5.7%
11:00	4.9%	5.1%	6.0%	5.2%	3.6%	4.7%	4.6%	4.3%	5.6%	4.4%	4.3%	5.6%	6.1%	4.0%	7.0%	5.2%
12:00	5.0%	5.0%	6.4%	6.2%	4.1%	4.9%	4.5%	4.9%	5.8%	5.1%	6.8%	7.4%	6.3%	5.3%	8.5%	5.8%
13:00	5.9%	5.6%	6.5%	8.1%	4.4%	5.3%	5.0%	6.1%	5.8%	6.0%	9.2%	6.7%	6.5%	7.5%	7.3%	6.3%
14:00	5.6%	5.7%	6.5%	6.9%	4.3%	5.3%	5.2%	5.4%	6.7%	5.7%	8.9%	6.1%	6.5%	7.2%	5.2%	5.9%
15:00	6.0%	6.0%	7.2%	6.0%	4.5%	5.9%	5.5%	4.8%	7.4%	5.6%	5.4%	6.8%	6.9%	5.8%	5.6%	6.0%
16:00	6.9%	6.8%	7.8%	6.4%	6.3%	7.1%	6.8%	5.8%	7.7%	6.9%	5.8%	8.4%	6.8%	7.9%	7.2%	6.9%
17:00	7.6%	7.8%	8.0%	7.2%	10.6%	10.0%	9.6%	8.7%	7.4%	8.2%	7.7%	8.9%	7.3%	7.8%	9.2%	8.4%
18:00	8.5%	9.0%	7.3%	8.7%	13.2%	12.0%	11.7%	9.0%	6.9%	12.7%	6.2%	6.7%	6.8%	10.5%	6.0%	8.7%
19:00	7.7%	7.8%	5.2%	6.6%	6.9%	6.3%	6.4%	6.9%	5.2%	8.2%	5.7%	4.8%	6.4%	6.7%	3.3%	6.2%
20:00	5.3%	4.6%	3.8%	4.1%	3.2%	3.4%	3.2%	3.5%	3.5%	4.0%	2.9%	3.4%	5.8%	4.4%	2.2%	3.8%
21:00	3.9%	3.4%	3.0%	3.0%	2.0%	2.4%	2.4%	2.2%	2.6%	2.5%	1.7%	2.6%	4.4%	3.3%	1.8%	2.8%
22:00	3.3%	3.1%	1.9%	2.5%	1.7%	1.9%	1.9%	1.3%	1.8%	2.1%	1.1%	1.7%	3.7%	2.5%	1.3%	2.2%
23:00	2.3%	2.2%	1.2%	1.8%	1.0%	1.3%	1.3%	0.9%	1.0%	1.0%	0.9%	1.3%	2.6%	1.7%	1.0%	1.5%
Total Day	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

[1] Figures based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.



Source: 7-Day Supplemental Traffic Counts in November-December, 2006

NORTH CAROLINA Turnpike Authority

AVERAGE HOURLY TRAFFIC ON NC 55

FIGURE 2-6

Table 2-8
Traffic Variations by Time Period at Selected Locations

Location	Percent of Average Daily Traffic				
	AM Peak 6 - 10 AM	Midday 10 AM- 3 PM	PM Peak 3 - 7 PM	Off-Peak 7 PM - 6 AM	Total Day
NC 55 Business south of Sunset Lake Road	17.5%	26.9%	29.0%	26.5%	100%
NC 55 Bypass south of NC 55 Business	18.3%	27.0%	29.6%	25.1%	100%
NC 55 West Williams Street south of Old Jenks Road	20.8%	31.0%	30.3%	18.2%	100%
NC 55 south of Sedwick Drive	18.4%	32.4%	28.3%	21.1%	100%
NC 147 west of TW Alexander Drive [(1)]	26.0%	22.8%	34.6%	16.8%	100%
NC 751 south of Fayetteville Road	22.3%	25.5%	35.0%	17.1%	100%
NC 751 south of Luther Road	25.0%	24.3%	33.6%	17.0%	100%
Davis Drive south of NC 54 [(1)]	26.4%	28.4%	28.3%	16.6%	100%
Davis Drive south of Old Jenks Road	23.6%	29.4%	29.4%	17.7%	100%
Green Level Church Road north of Secluded Acres Road	20.8%	26.9%	33.4%	18.8%	100%
Hopson Road east of Davis Drive	24.0%	36.8%	25.1%	14.3%	100%
McCrimmon Parkway west of Church Street	21.9%	30.7%	30.8%	16.6%	100%
Morrisville-Carpenter Road west of Church Street	14.3%	31.0%	27.8%	26.8%	100%
South Alston Avenue south of NC 54	17.7%	28.9%	32.0%	21.4%	100%
South Miami Boulevard south of NC 54 [(1)]	26.9%	32.4%	28.0%	12.6%	100%
Average	**21.7%**	**28.9%**	**30.1%**	**19.3%**	**100%**

[(1)] Figures based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.

Table 2-9
Vehicle Classifications at Supplemental Traffic Count Locations

Location	Passenger Vehicles	Light & Medium Trucks	Heavy Trucks	Total Trucks
NC 55 Business south of Sunset Lake Road	95.7%	3.6%	0.7%	4.3%
NC 55 Bypass south of NC 55 Business	90.8%	6.2%	3.1%	9.3%
NC 55 West Williams Street south of Old Jenks Road	88.7%	4.4%	6.9%	11.3%
NC 55 south of Sedwick Drive	90.2%	8.3%	1.5%	9.8%
NC 147 west of TW Alexander Drive [(1)]	95.4%	3.4%	1.2%	4.6%
NC 751 south of Fayetteville Road	90.9%	7.3%	1.8%	9.1%
NC 751 south of Luther Road	92.3%	5.5%	2.2%	7.7%
Davis Drive south of NC 54 [(1)]	87.8%	10.0%	2.1%	12.1%
Davis Drive south of Old Jenks Road	87.4%	5.7%	6.9%	12.6%
Green Level Church Road north of Secluded Acres Road	90.6%	8.4%	1.0%	9.4%
Hopson Road east of Davis Drive	95.7%	3.5%	0.9%	4.4%
McCrimmon Parkway west of Church Street	92.8%	3.5%	3.7%	7.2%
Morrisville-Carpenter Road west of Church Street	91.2%	7.4%	1.4%	8.8%
South Alston Avenue south of NC 54	94.8%	4.6%	0.6%	5.2%
South Miami Boulevard south of NC 54 [(1)]	87.1%	4.7%	8.2%	12.9%
Average	**90.9%**	**5.8%**	**3.3%**	**9.1%**

[(1)] Figures based on less than seven days of data
Source: 7-Day Supplemental Counts in November-December 2006.

The results of this data collection are summarized in Table 2-10.

Northbound – Southbound Routes:
- NC 55
- NC 147
- NC 751
- Davis Drive

Eastbound – Westbound Routes:
- I-40
- I-440/US 64/US 1/I-40
- NC 54 / Chapel Hill Road

Observed travel speeds collected during typical AM peak period speed and delay studies in the northbound and westbound direction are shown in Figure 2-7. Southbound and eastbound data are shown in Figure 2-8. The figures show reduced speeds on Davis Drive within the Research Triangle Park, and on NC 54 eastbound and westbound approaching the Research Triangle Park. Additionally, there appears to be reduced speeds on NC 55 northbound, south of US 64. Figures 2-7 and 2-8 also show that I-40, NC 147 and NC 751 appear to be generally at free-flow speeds. These observations are borne out by the average observed travel speeds presented in Table 2-10. However, AM peak travel westbound from the Raleigh area to Research Triangle Park is frequently subjected to significant delays that were not observed during these speed and delay studies.

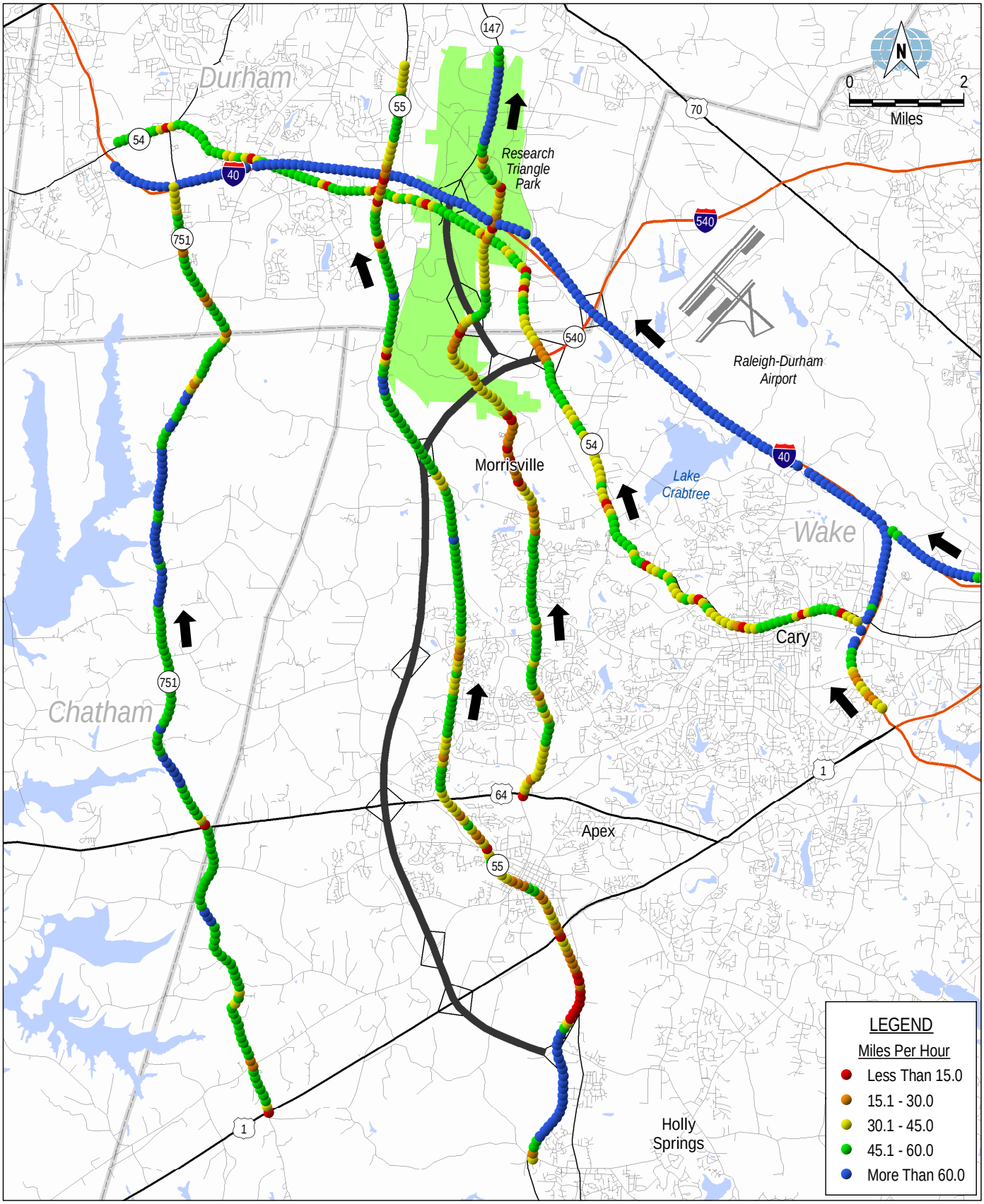
Travel speed data was collected on the same roadways during the PM peak period. Figure 2-9 presents the observed travel speeds collected during the PM peak period in the southbound and eastbound direction; Figure 2-10 presents the northbound and westbound data. Congestion is clearly visible on I-40 eastbound in the PM peak period from Aviation Parkway to just south of NC 54, while I-40 westbound appears to be at free-flow speeds. Additionally, there is some congestion in both directions on NC 54 from McCrimmon Parkway into the Town of Cary. NC 55 also shows some reduced speeds in the southbound direction from just north of Okelley Chapel Road to High House Road. The speeds observed on these roadways would suggest that the source of congestion within the study corridor is due to commuters travelling to and from the Research Triangle Park. Figures 2-9 and 2-10 also show that NC 147, NC 751, and NC 55 northbound appear to be generally at free-flow speeds. These observations are borne out by the average travel speeds presented in Table 2-10.

Table 2-10
Speed and Delay Studies on Selected Roads

Segment Start	Segment End	Distance (miles)	Observed Travel Speeds (MPH) Northbound AM	Northbound PM	Southbound AM	Southbound PM
NC 55						
East Cornwallis Road	I-40	1.9	42.7	49.2	35.0	27.8
I-40	T W Alexander Drive	1.9	32.2	34.3	30.8	37.8
T W Alexander Drive	Morrisville Carpenter Road	4.5	46.7	47.0	55.8	32.1
Morrisville Carpenter Road	High House Road	2.3	42.1	43.4	42.6	37.1
High House Road	US 64	2.8	40.9	40.7	39.3	38.0
US 64	US 1	3.1	25.4	25.0	30.8	16.2
US 1	New Hill Road	4.3	34.8	45.1	56.8	51.9
	Total Distance/ Average Speed	**20.7**	**36.5**	**39.1**	**41.7**	**31.0**
NC 147						
Ellis Road	I-40	2.9	41.8	47.1	65.3	55.9
NC 751						
I-40	Fayetteville Road	2.2	36.7	36.1	47.2	38.6
Fayetteville Road	US 64	10.0	51.4	52.0	51.2	46.8
US 64	US 1	5.4	40.8	47.3	45.3	43.3
	Total Distance/ Average Speed	**17.6**	**45.5**	**47.9**	**48.8**	**44.6**
Davis Drive						
East Cornwallis Road	NC 54	0.9	18.6	25.4	20.2	26.5
NC 54	Morrisville Carpenter Road	5.8	27.9	42.9	47.1	32.9
Morrisville Carpenter Road	High House Road	2.0	44.4	37.5	35.9	45.6
High House Road	US 64	3.0	38.2	41.1	39.5	31.8
	Total Distance/ Average Speed	**11.7**	**30.8**	**39.3**	**39.0**	**33.6**

Segment Start	Segment End	Distance (miles)	Observed Travel Speeds (MPH) Eastbound AM	Eastbound PM	Westbound AM	Westbound PM
I-40						
NC 54	NC 147	6.2	67.4	67.2	68.3	68.2
NC 147	I-540	2.7	69.3	53.0	69.5	70.3
I-540	Aviation Parkway	1.0	71.7	45.1	70.2	69.9
Aviation Parkway	I-440/US 64/US 1/I-40	6.7	68.6	27.8	69.6	71.3
I-440/US 64/US 1/I-40	US 1	2.7	68.2	44.5	42.6	67.0
	Total Distance/ Average Speed	**19.3**	**68.4**	**41.3**	**63.7**	**69.5**
I-440/US 64/US 1/I-40						
Exit 289	US1	3.0	56.9	59.2	62.5	66.0
NC 54 / Chapel Hill Road						
I-40 (Exit 273)	NC 55	5.2	34.8	27.9	31.7	33.0
NC 55	Hopson Road	3.3	27.1	37.6	19.2	22.3
Hopson Road	Aviation Parkway	4.1	40.2	23.8	33.7	34.7
Aviation Parkway	I-40	5.6	31.0	21.0	29.3	28.1
	Total Distance/ Average Speed	**18.2**	**32.8**	**25.5**	**28.0**	**29.2**

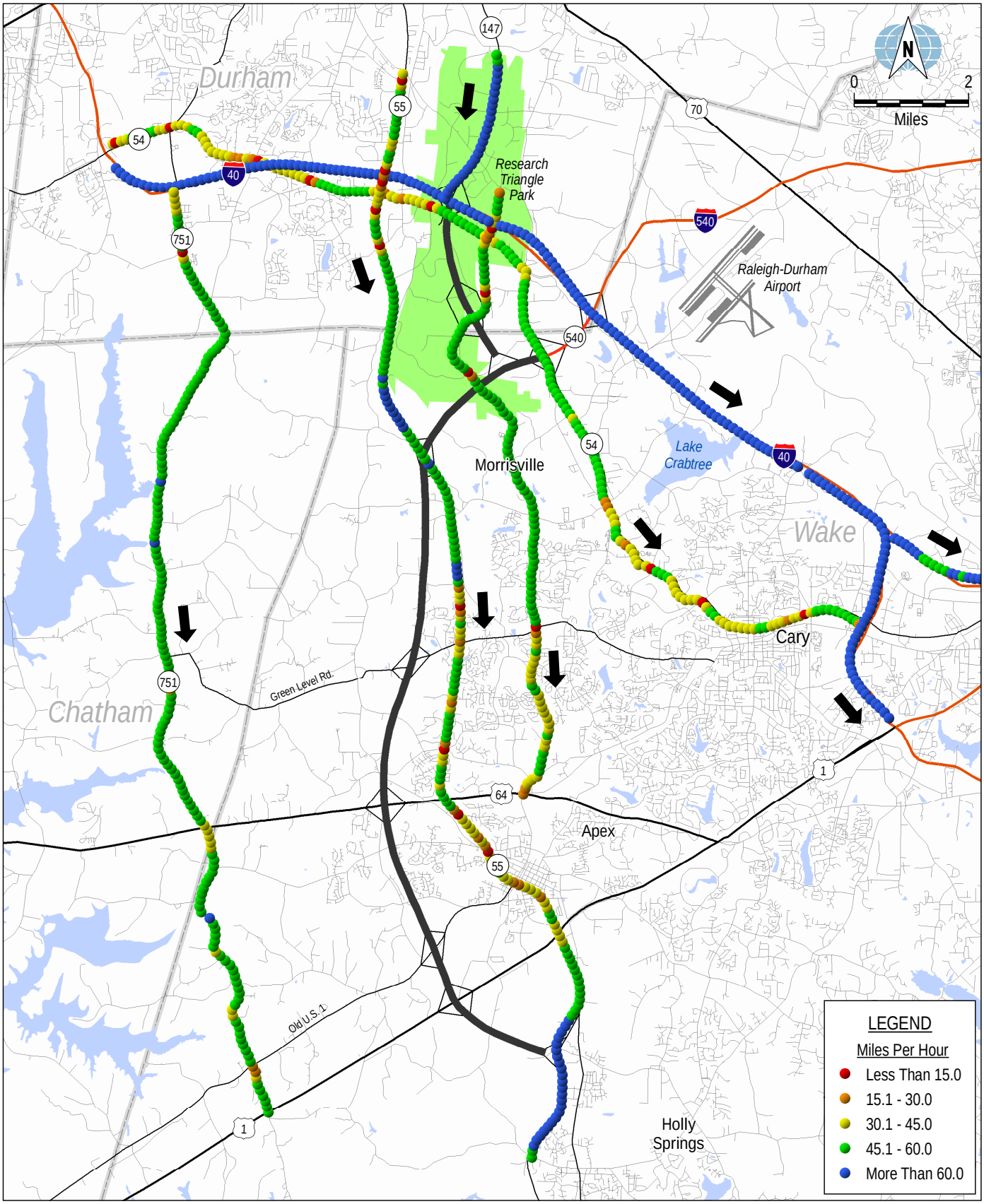
Source: Speed and Delay Studies, July 25 - 26, 2007



NORTH CAROLINA Turnpike Authority

OBSERVED AM PEAK PERIOD TRAVEL SPEEDS, NORTHBOUND AND WESTBOUND (NOV.-DEC., 2006)

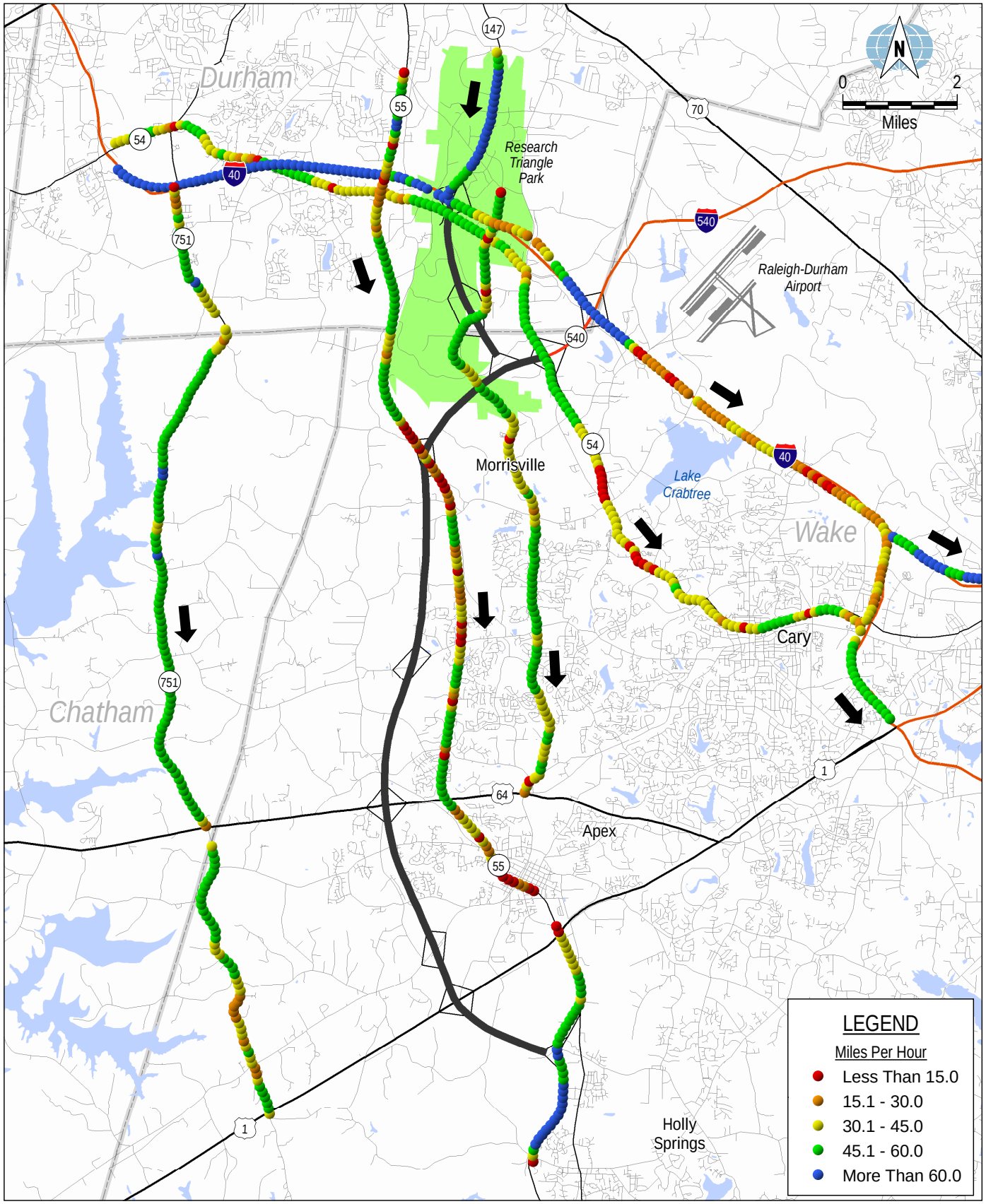
FIGURE 2-7



NORTH CAROLINA Turnpike Authority

OBSERVED AM PEAK PERIOD TRAVEL SPEEDS, SOUTHBOUND AND EASTBOUND (NOV.-DEC., 2006)

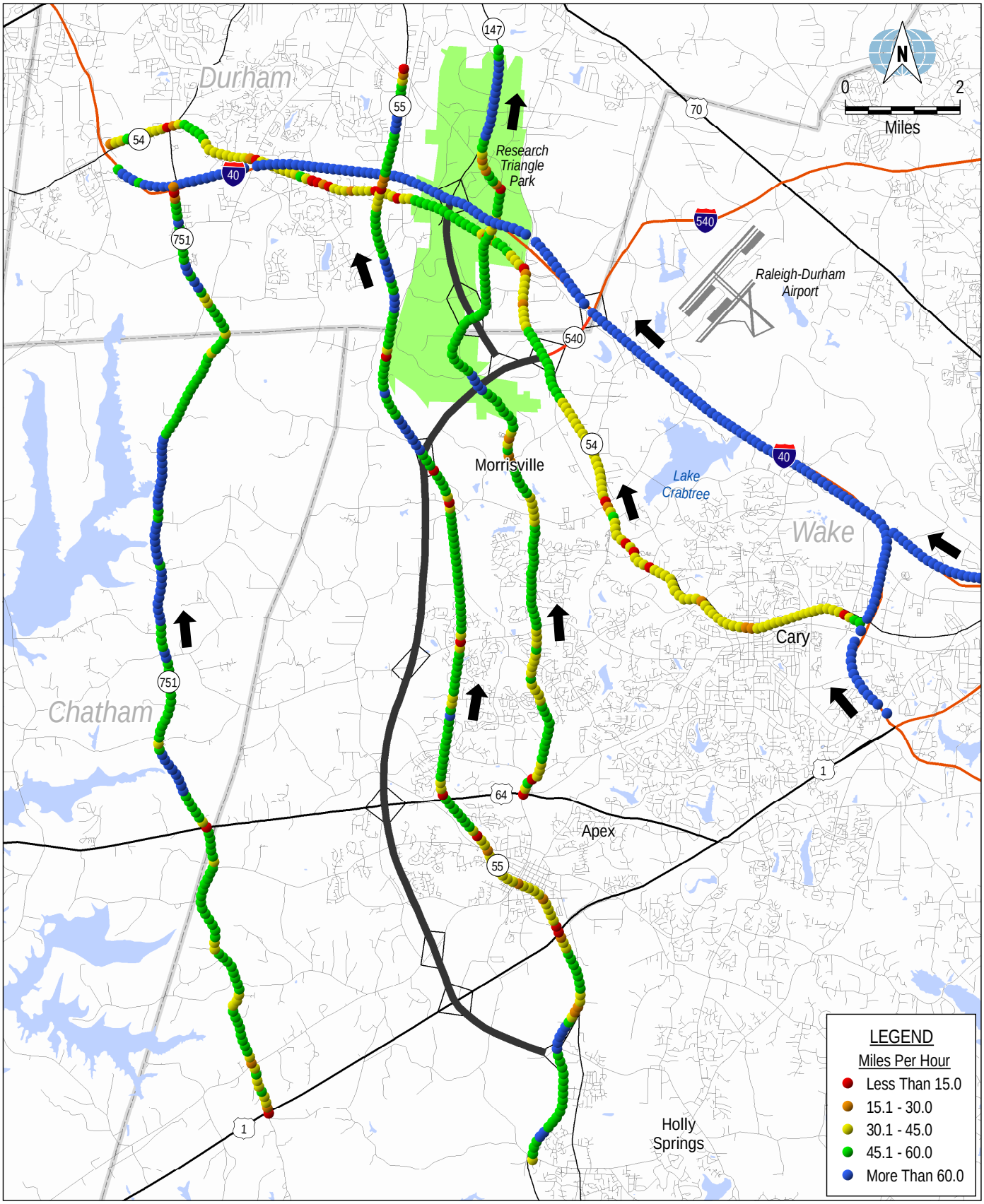
FIGURE 2-8



NORTH CAROLINA Turnpike Authority

OBSERVED PM PEAK PERIOD TRAVEL SPEEDS, SOUTHBOUND AND EASTBOUND (NOV.-DEC., 2006)

FIGURE 2-9



NORTH CAROLINA Turnpike Authority

OBSERVED PM PEAK PERIOD TRAVEL SPEEDS, NORTHBOUND AND WESTBOUND (NOV.-DEC., 2006)

FIGURE 2-10

EXISTING TRANSIT SERVICES IN THE STUDY AREA

TRANSIT AGENCIES

Several major transit agencies operate within the Triangle region. Many of these agencies are operated by local governments. Capital Area Transit (CAT) is operated by the City of Raleigh. Chapel Hill Transit (CHT) is operated by the City of Chapel Hill. The City of Cary offers fixed route service through Cary Transit (C-Tran). The Durham Area Transit Authority (DATA) is operated by the City of Durham.

More rural areas are served by county-wide agencies that provide demand-response services. Orange County Public Transportation (OPT) operates within Orange County. It recently began operating one fixed-route bus service in cooperation with the Triangle Transit Authority. The Chatham Transportation Network (CTN) operates within Chatham County.

The Wolfline is a bus service operated by North Carolina State University (NCSU) for the NC State Community. Wolfline buses are open to the public and operate every day that classes are in session serving all three campuses, two park and ride lots, and official NCSU housing. No university ID, pass or fare is required to ride.

The Triangle Transit Authority (TTA) is the only regional transit agency within the study area. It operates bus lines, vanpooling, and other ride-sharing services within Wake, Durham and Orange Counties.

Table 2-11 contains data on the transit agencies within the study area, as provided by the National Transit Database. Of the six agencies included in the database, TTA is the largest with a service area of 1,525 square miles and a fleet of 146 vehicles. Despite this, CHT and NCSU carry more bus passengers per hour than the other agencies. This may be due to the fact that CHT and NCSU are free services. TTA provides the longest average bus trips, at 8.58 miles, presumably due to its large service area and express bus service. TTA is also the only agency to provide vanpooling statistics.

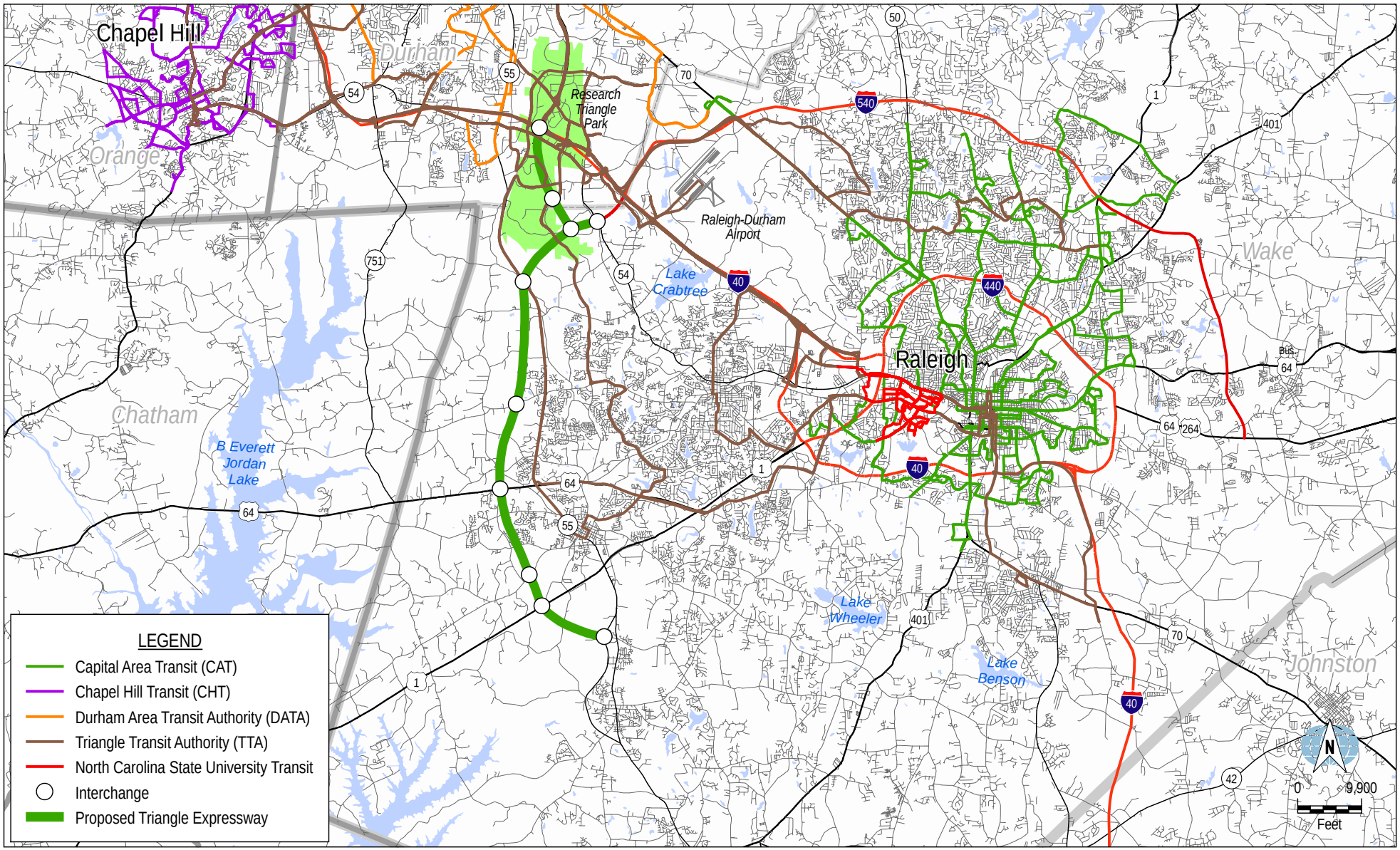
TRANSIT SERVICES

Figure 2-11 displays the routes of study area transit providers in 2005. TTA provides express and local bus service, and ridesharing programs throughout the Triangle Region. The Town of Cary is served by TTA and C-Tran. In the City of Chapel Hill, the University of North Carolina and downtown business district form a major regional employment center, which is served by CHT and TTA. Likewise, downtown Durham and

Table 2-11
Statistics for Transit Agencies in the Triangle Region
2005

Statistics	CAT	C-Tran	CHT	DATA	NCSU	TTA
Service Area (sq. mi.)	125	50	25	93	9	1525
Service Area Population [1]	311,053	107,973	52,440	179,000	40,000	1,002,876
Overall Service						
Fleet Size	86	18	97	91	25	146
Annual Passenger Miles	14,139,346	367,245	14,979,244	18,572,131	2,323,170	17,730,060
Annual Unlinked Trips	3,702,432	52,682	5,783,800	4,519,449	1,767,209	1,052,052
Passenger Miles Per Unlinked Trip	3.82	6.97	2.59	4.11	1.31	16.85
Bus						
Fleet Size	68		83	49	25	67
Annual Passenger Miles	13,387,657		14,620,347	18,043,241	2,323,170	6,204,180
Annual Unlinked Trips	3,546,761		5,711,073	4,443,568	1,767,209	723,184
Passenger Miles Per Unlinked Trip	3.77		2.56	4.06	1.31	8.58
Demand Response						
Fleet Size	18	18	14	42		5
Annual Passenger Miles	751,689	367,245	358,897	528,890		127,164
Annual Unlinked Trips	155,671	52,682	72,727	75,881		8,072
Passenger Miles Per Unlinked Trip	4.83	6.97	4.93	6.97		15.75
Vanpool						
Fleet Size						74
Annual Passenger Miles						11,398,716
Annual Unlinked Trips						320,796
Passenger Miles Per Unlinked Trip						35.53

[1] Urbanized Area (UZA) Statistics - 2000 Census
Source: 2005 National Transit Database (NTD)



NORTH CAROLINA Turnpike Authority

TRANSIT ROUTES 2005

FIGURE 2-11

Duke University, including the academic centers and the hospital, which are located within the City, are major centers for employment. DATA, TTA and Duke University all provide transit services to this area. In the City of Raleigh, CAT and TTA serve the downtown area. North Carolina State University's Wolfline serves the three NCSU campuses, two park and ride lots, and official housing.

Several routes are of particular significance in that they operate within the Triangle Expressway study area. These transit routes only operate Monday through Friday. Moreover, some of them only operate during the AM and PM peak periods. TTA Routes 105, 107, 201 and 205 are express routes; the others are local.

Table 2-12 provides a list of selected transit routes with comparable roadway traffic. The transit ridership in the Triangle Expressway corridor is extremely small in comparison to the vehicular traffic. For example, TTA Route 311, which operates on NC 55 parallel to the proposed Triangle Expressway, carried 100 passengers per day in 2005. Vehicular traffic on NC 55 was between 19,000 and 38,000 vehicles per day.

In the study area, standard fares vary from free to $2.50 per ride. Triangle Transit is the most expensive service, with differing fares for local and express service. Several agencies also offer monthly passes, which are generally less expensive per ride and encourage commuting. Regional passes are also available, which provide unlimited rides on and transfers between all DATA routes, CAT routes, and TTA local routes. A regional pass costs $4.00 for 1 day and $64.00 for 30 days. Table 2-13 provides the 2007 fixed-route fare structure for the transit agencies in the study area.

VANPOOL SERVICES

The Triangle Transit Authority (TTA) offers vanpool service in Wake, Durham, and Orange Counties. A vanpool is made up of 10 commuters or more who live and work near each other and who share approximately the same work hours. TTA pays for gas and insurance, and arranges, oversees, and pays for all van maintenance. In addition, TTA provides potential users with a list of current vanpool routes and schedules; workers can join a current route by finding one that operates near home and work, or start a new one. Table 2-14 lists some of the current TTA vanpool routes in the Triangle Expressway study area. Riders pay a monthly fare based on average daily round-trip mileage and the number of riders. Table 2-15 provides an overview of the TTA vanpooling fare structure.

Table 2-12
Ridership on Selected Transit Routes and Comparable Roadway Traffic Volumes
2005

Service Provider	Route Number	Origin	Destination	Major Roadways	Daily Ridership (Person Trips)	Lowest AADT in Corrdior (Vehicles)	Highest AADT in Corrdior (Vehicles)
DATA	12	Durham	RTP	NC54 / NC55	21	13,000	26,000
TTA	105	Raleigh	RTP	I-40	226	132,000	153,000
TTA	107	Raleigh	RTP	I-40	190	132,000	156,000
TTA	201	New Hope	RTP	I-540 / US70	75	38,000	74,000
TTA	202	Brookhaven	RTP	I-540	19	52,000	74,000
TTA	301	Raleigh	RTP	I-40 / NC54	255	10,000	153,000
TTA	302	Raleigh	RTP	Davis Drive	139	13,000	15,000
TTA	311	Apex	RTP	US64 / NC55	100	19,000	38,000
TTA	402	Durham	RTP	NC147	342	52,000	54,000
TTA	403	Durham	RTP	NC147	353	52,000	54,000
TTA	412	Chapel Hill	RTP	NC54 / NC147	359	13,000	55,000
TTA	413	Durham	RTP	NC147	362	52,000	54,000

Source: Triangle Transit Authority, Durham Area Transit Authority

Table 2-13
Fixed Route Fare Structure
2007

Agency	One-Way Adult Cash Fare[(1)]	Senior/Disabled Persons Cash Fare[(1)]	Monthly Pass[(2)]
Capital Area Transit	$1.00	$0.50	$36.00
Cary Transit	$1.00	$0.50	$30.00
Chapel Hill Transit	FREE	FREE	N/A
Duke Transit	FREE	FREE	N/A
Durham Area Trans. Authoriy	$1.00	FREE	$36.00
NCSU Transit	FREE	FREE	N/A
Triangle Transit Authority Local Route	$2.00	$1.00	$80.00
Triangle Transit Authority Express Route	$2.50	$1.25	$80.00

[(1)] Transfer between an agency's routes is free

[(2)] The Triangle Transit Authority Monthly Pass is accepted on express and local routes

Note: Orange County Public Transportation has the same fare structure as the Triangle Transit Authority

Source: Fare Information is published online by the various transit agencies.

Table 2-14
Triangle Transit Authority Vanpool Routes and Schedules in Study Area

ID#	Origin	Destination	Work Hours
1863	Chapel Hill	SAS (Cary)	8:45am - 5:00pm
1867	Garner	Research Tri. Park	7:30am - 4:30pm
1868	Apex	Wyeth Vaccines (Stanford)	8:00am - 4:30pm
1871	Apex	UNC-Chapel Hill	
1883	Cary	UNC-Chapel Hill	8:00am - 4:30pm
1900	Chapel Hill/Carrboro	Research Triandgle (EPA)	8:00am - 5:00pm
1901	Chapel Hill	Research Triandgle (EPA)	8:00am - 5:00pm
1915	Garner	Wyeth Vaccines (Stanford)	7:30am - 4:30pm
1927	Cary	Wyeth Vaccines (Stanford)	8:00am - 4:30pm
1935	Stanford	Research Tri. Park/Durham	7:00am - 4:00pm
1936	North Raleigh	Durham VA Medical Center	8:00am - 4:30pm

Source: Triangle Transit Authority

Table 2-15
Triangle Transit Authority Vanpool Fares
2006

Daily Round Trips (Miles)	Monthly Lease	Rider Fare 14 Riders	Rider Fare 12 Riders	Rider Fare 10 Riders
20	$554.20	$39.59	$46.18	$55.42
25	602.50	43.04	50.21	60.25
30	650.80	46.49	54.23	65.08
35	699.10	49.94	58.26	69.91
40	747.40	53.39	62.28	74.74
45	795.70	56.84	66.31	79.57
50	844.00	60.29	70.33	84.00
65	988.90	70.64	82.41	98.89
70	1037.20	74.09	86.43	103.72
75	1085.50	77.54	90.46	108.55
80	1133.80	80.99	94.84	113.38
85	1182.10	84.44	98.51	118.21
90	1230.40	87.89	102.53	123.04
95	1278.70	91.34	106.56	127.87
100	1237.00	94.79	110.58	132.70
110	1423.60	101.69	118.63	142.36
120	1520.20	108.59	126.68	152.02
130	1616.80	115.49	134.73	161.68
140	1713.40	122.39	142.78	171.34
150	1810.00	129.29	150.83	181.00

Source: Triangle Transit Authority

JOURNEY TO WORK

The study area for the Triangle Expressway incorporates portions of Chatham, Durham, Orange and Wake Counties. The majority of commuters living in those counties chose to drive alone to work. Orange County, where Chapel Hill Transit (CHT) is a free service, has the largest percentage of workers using public transportation to commute to work (4.2 percent), as well as the largest percentages of people bicycling (1.8 percent) and walking (7.0 percent) to work. Durham County has the largest percentage of people choosing to carpool to work (15.9 percent). Wake County, as the most populous of the four counties, has the most commuters using public transportation (4,153) and carpooling (37,823). The means of travel to work in Chatham, Durham, Orange and Wake Counties, as reported by the 2000 Census, is provided Table 2-16. For the four-

Table 2-16
Transportation to Work Mode
2000

Mode	Chatham County		Durham County		Orange County		Wake County		Four County Area	
	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers	Workers Age 16+	% of Total Workers
Drove Alone	18,966	76.9%	84,063	74.8%	42,668	70.1%	274,674	81.1%	420,371	78.3%
Carpooled	3,902	15.8%	17,927	15.9%	7,149	11.7%	37,823	11.2%	66,801	12.5%
Public Transportation	54	0.2%	3,384	3.0%	2,566	4.2%	4,153	1.2%	10,157	1.9%
Motorcycle	16	0.1%	115	0.1%	108	0.2%	306	0.1%	545	0.1%
Bicycle	47	0.2%	396	0.4%	1,124	1.8%	643	0.2%	2,210	0.4%
Walked	357	1.4%	2,959	2.6%	4,263	7.0%	5,847	1.7%	13,426	2.5%
Other Means	207	0.8%	539	0.5%	295	0.5%	2,419	0.7%	3,460	0.6%
Worked at Home	1,108	4.5%	3,050	2.7%	2,687	4.4%	12,737	3.8%	19,582	3.6%
Total	24,657	100%	112,433	100%	60,860	100%	338,602	100%	536,552	100%

Source: 2000 Census Data

county area, approximately 91 percent of workers either drove alone or carpooled to work. Less than 2 percent used public transportation.

Commuter travel time is influenced by several factors, such as the location of major employment centers, county size, and population. Table 2-17 provides 2000 travel time data for Chatham, Durham, Orange and Wake counties. Durham County has the lowest average travel time (23 minutes), while Chatham County has the highest average travel time (29 minutes). Of the four counties, Orange County has the highest percentage of commuters traveling less than 15 minutes to work (30.9 percent).

Table 2-18 shows vehicle occupancy data for Chatham, Durham, Orange and Wake Counties collected during the 2000 Census. Chatham and Durham Counties had the highest average vehicle occupancy (1.27 and 1.28 persons, respectively). Conversely, Wake County had the largest percentage of motorists choosing to drive alone to work (321,497).

TRAVEL PATTERN SURVEYS

As part of this study effort, travel pattern surveys were conducted between November and early December 2006 at 13 locations in the vicinity of the proposed Triangle Expressway. The travel patterns observed from the survey served as integral inputs into the travel demand model for the Triangle Expressway traffic and toll revenue forecast. The key findings of the travel pattern surveys are summarized below.

METHODOLOGY AND PROCEDURES

Thirteen survey locations were selected for the travel pattern survey in order to provide an adequate representation of study area traffic. The survey team coordinated with county and local jurisdictions to ensure that safety concerns were taken into consideration. Figure 2-12 depicts the locations of the 13 survey stations. As shown in the figure, all surveys were conducted in a single direction of travel at signalized intersections in accordance with an operation and safety plan developed for each location.[(1)] The survey was conducted in such a manner as to minimize impact on traffic flow and maximize safety to motorists and survey personnel.

The survey questionnaire was distributed in the form of a postage-paid business-reply card. Figure 2-13 shows the mail-back, handout survey questionnaire**.** The survey contained nine questions that queried motorists about their trip origin and destination; residence status; trip purpose; trip

(1) During later survey processing, observed one-way trips were "reversed" in order to provide estimates of daily travel patterns in each direction.

Table 2-17
Travel Time to Work
2000

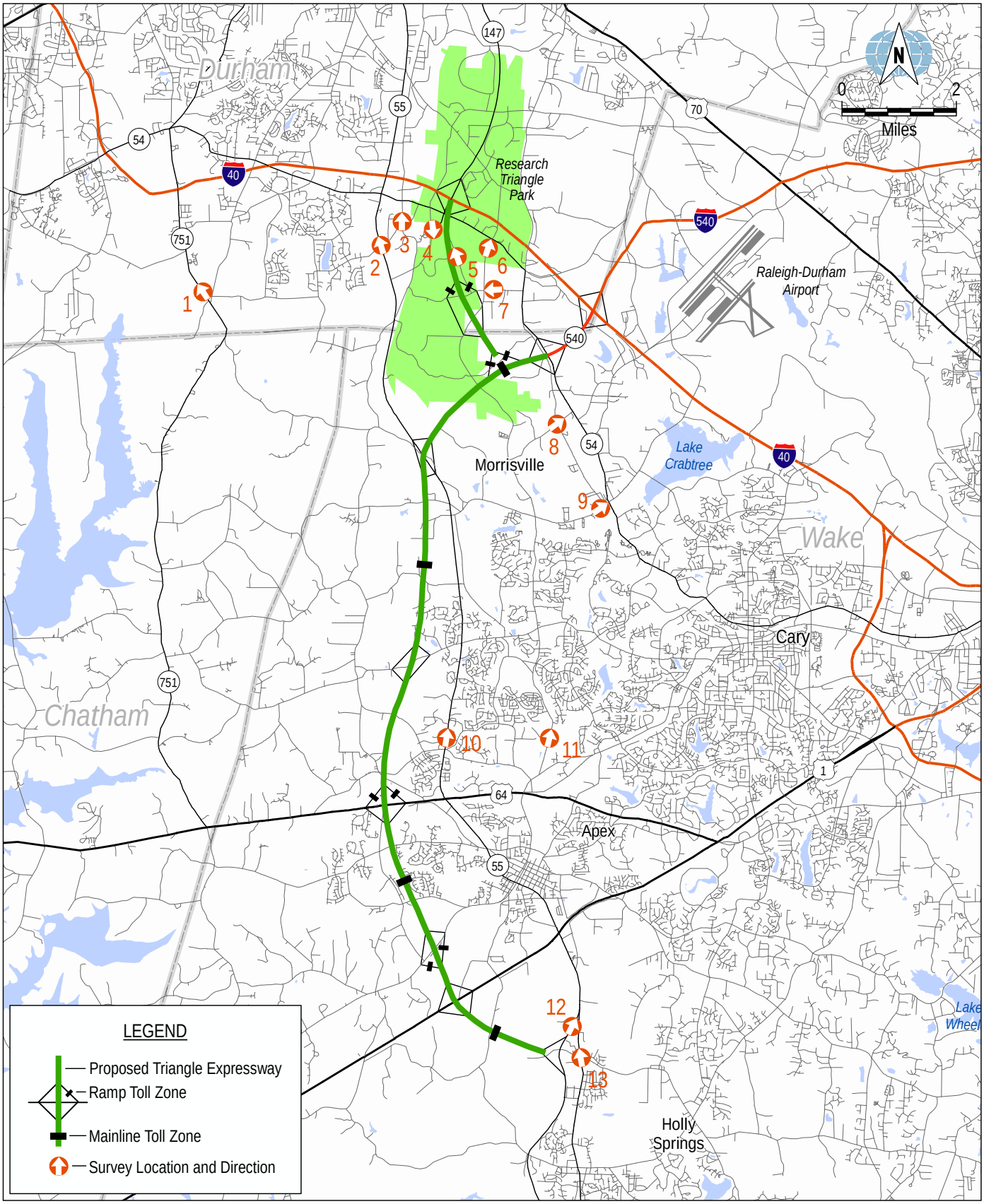
	Chatham County		Durham County		Orange County		Wake County		Four County Areaa	
Trip Length	Commuters	% of Total Commuters	Commuters	% of Total Commuters	Commuters	% of Total Commuters	Commuters	% of Total Commuters	Commuters	% of Total Commuters
Less than 5 minutes	713	3.0%	2,301	2.1%	1,484	2.6%	7,151	2.2%	11,649	3.6%
5 to 9 minutes	2,283	9.7%	10,330	9.4%	6,283	10.8%	27,154	8.3%	46,050	14.1%
10 to 14 minutes	2,613	11.1%	18,979	17.4%	10,212	17.6%	42,047	12.9%	73,851	22.7%
15 to 19 minutes	3,048	12.9%	25,376	23.2%	9,991	17.2%	52,957	16.3%	91,372	28.0%
20 to 24 minutes	3,283	13.9%	19,238	17.6%	9,724	16.7%	57,773	17.7%	90,018	27.6%
25 to 29 minutes	1,449	6.2%	6,435	5.9%	4,102	7.1%	24,749	7.6%	36,735	11.3%
30 to 34 minutes	3,654	15.5%	14,373	13.1%	8,163	14.0%	54,366	16.7%	80,556	24.7%
35 to 39 minutes	1,055	4.5%	2,069	1.9%	1,651	2.8%	10,921	3.4%	15,696	4.8%
40 to 44 minutes	1,133	4.8%	2,136	2.0%	1,690	2.9%	11,403	3.5%	16,362	5.0%
45 to 59 minutes	2,687	11.4%	4,739	4.3%	3,027	5.2%	21,899	6.7%	32,352	9.9%
60 to 89 minutes	1,169	5.0%	2,145	2.0%	1,190	2.0%	9,990	3.1%	14,494	4.4%
90 or more minutes	462	2.0%	1,262	1.2%	656	1.1%	5,455	1.7%	7,835	2.4%
Total	23,549	100%	109,383	100%	58,173	100%	325,865	100%	516,970	159%
Average Travel Time	29		23		24		26		25	

Source: 2000 Census Data

Table 2-18
Commuter Vehicle Occupancy
2000

	Chatham County		Durham County		Orange County		Wake County		Four County Area	
Trip Length	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**	**Motorists**	**% of Total Motorists**
Drove alone	18,966	82.9%	84,063	82.4%	42,668	85.6%	274,674	87.9%	420,371	86.3%
2-person carpool	2,641	11.5%	12,117	11.9%	5,267	10.6%	27,874	8.9%	47,899	9.8%
3-person carpool	784	3.4%	3,218	3.2%	1,100	2.2%	5,863	1.9%	10,965	2.3%
4-person carpool	269	1.2%	1,525	1.5%	459	0.9%	2,204	0.7%	4,457	0.9%
5- or 6-person carpool	131	0.6%	749	0.7%	224	0.4%	1,483	0.5%	2,587	0.5%
7-or-more-person carpool	77	0.3%	318	0.3%	99	0.2%	399	0.1%	893	0.2%
Total	22,868	100%	101,990	100%	49,817	100%	312,497	100%	487,172	100%
Average Vehicle Occupancy	1.27		1.28		1.21		1.18		1.21	

Source: 2000 Census Data



NORTH CAROLINA Turnpike Authority

TRAVEL PATTERN SURVEY LOCATIONS

FIGURE 2-12

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Dear Motorist:
The North Carolina Turnpike Authority (NCTA) is undertaking an important transportation initiative to improve mobility in the Triangle Region. NCTA is requesting your assistance and is asking for information about the one-way trip that you made today when you received this questionnaire. Please complete the questionnaire and drop it into the mail at your earliest convenience. Postage is pre-paid. All information is confidential and will not be used for any purpose other than for this study. Thank you for your participation. This information is critical as NCTA plans future highway improvements in the area.

A. Where did you start your trip today? (In this direction) Please be as specific as possible. If you do not know the street address, please identify the nearest intersection, shopping area, subdivision, etc.

_____
Street Address, nearest intersection or location

_____
City or town State Zip Code (if known)

B. Where did you end this trip today? (In this direction) Please be as specific as possible. If you do not know the street address, please identify the nearest intersection, shopping area, subdivision, etc.
The answer should not be the same as your answer for Question A. Please do not describe a round trip such as home to work and then home. Please describe the trip only in the direction you were going when you received this card.

_____
Street Address, nearest intersection or location

_____
City or town State Zip Code (if known)

C. Did you or will you use any of the following roads during this specific one-way trip? (Circle all that apply)

1. I-40 2. I-540 3. NC 55 4. NC 54 5. NC 751 6. Did not use any of these roads

D. Please indicate the main purpose of your one-way trip. (Circle one)

1. To or from work
2. Company business
3. School
4. Shopping
5. Recreation
6. Social event and/or visit
7. Other personal business

E. How many times per week do you make this one-way trip? (Circle one)

Less than 1 1 2 3 4 5 6 or more

F. How many people, including yourself and any children, were in your vehicle? (Circle one)

1 2 3 4 5 6 or more

G. Please identify the type of vehicle you were driving. (Circle one)

1. Two-axle, Four-tire Passenger Car, SUV or Pickup Truck
2. 2-axle, 6 tire Truck
3. 3-axle Truck
4. Four-axle Truck
5. Truck with Five or More Axles
6. Motorcycle

H. What is the zip code of your primary residence? _____

I. OPTIONAL - If you would like to participate in an internet-based survey of transportation options, please provide your e-mail address. (This information will be used only for the internet survey and will not be used for any other purpose.)

E-mail address _____

	DAY	DIR	HR		C						D	E	F	G	H	I

NORTH CAROLINA Turnpike Authority

SAMPLE SURVEY CARD

FIGURE 2-13

frequency; and vehicle occupancy. An optional question was included asking if motorists wished to participate in an internet-based survey of transportation options.

Of the 21,276 surveys distributed, a total of 2,501 valid surveys were returned or 11.8 percent of the total. Table 2-19 indicates the dates on which the surveys were conducted, the number of surveys distributed and the return rate for each location. Upon receipt, the completed questionnaires were filtered for validity and entered into a Geographic Information Systems (GIS) database. This database was a valuable tool in constructing the Triangle Expressway travel demand model, ensuring that appropriate trip tables reflected current usage patterns of the highway system in the study area.

Survey Trip Characteristics

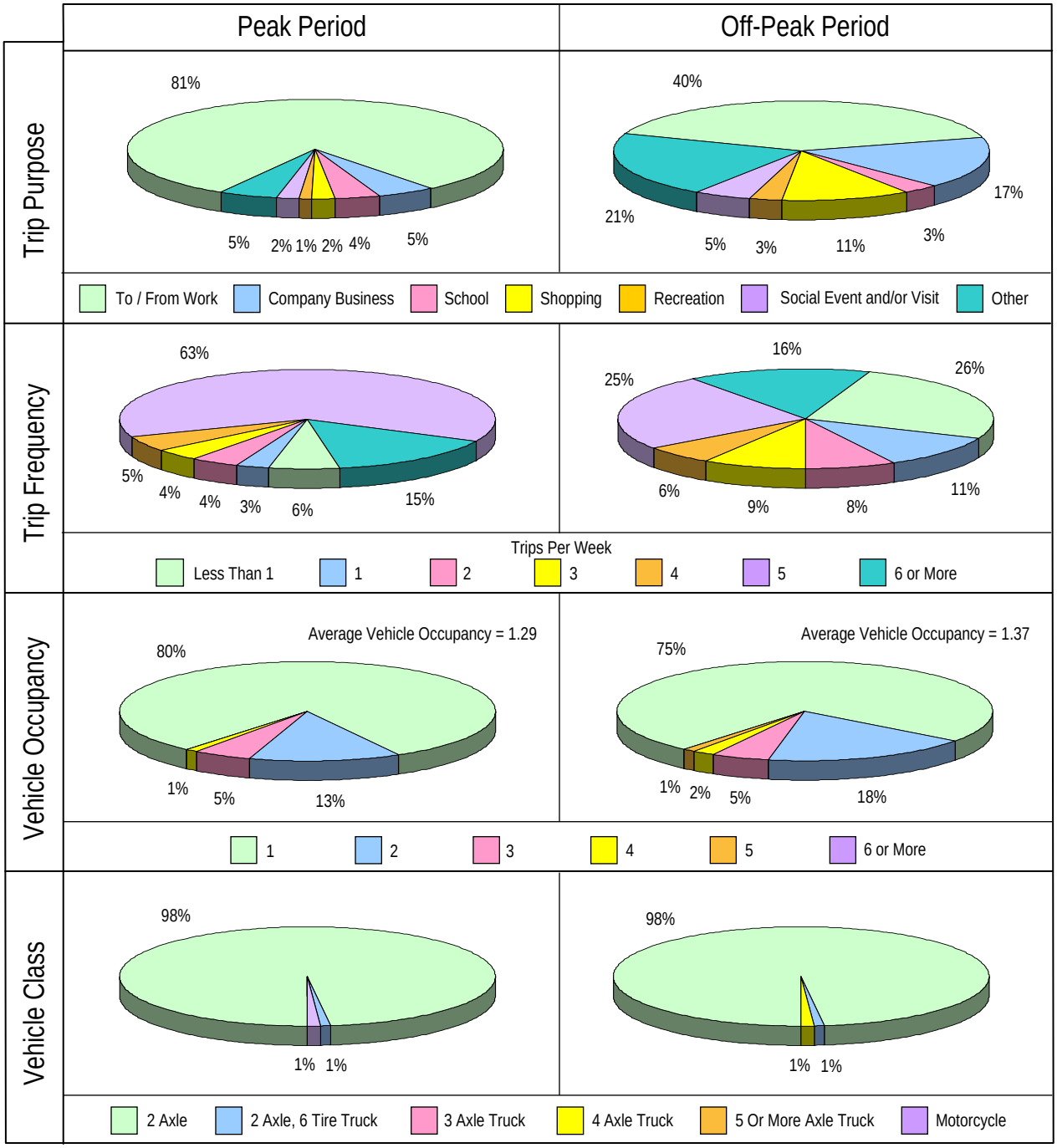
The travel pattern survey results illustrated several trends in trip characteristics in the Raleigh-Durham area. Motorists were asked to identify the roads they used on their one-way trip. Of the surveys returned, 2,501 respondents provided usable information regarding road choice. Road choice usage was broken down by peak and off-peak periods. Although travel was greatly reduced in the off-peak hours, the percentage of road usage remained almost identical. For example, 28 percent of motorists used NC 55 during peak hours as compared to 27 percent using the same road during off-peak hours. Other major roads listed on the survey include I-40, I-540, NC 54 and NC 751. This analysis helped identify competing routes to the proposed toll road, from which traffic could be diverted to the proposed Triangle Expressway (especially during peak periods when these roads could be less attractive because of congestion).

Questions regarding trip purpose were also included in the travel pattern survey. As shown in Figure 2-14, the overwhelming majority of surveyed motorists (81 percent) traveling in the study area during peak periods were commuters traveling "to and from work." When combined with the "company business" category, work related trips accounted for 86 percent of total trips. During off-peak periods as indicated in Figure 2-14, work related trips were reduced to 57 percent, with shopping and other trip purposes comprising the bulk of off-peak travel.

Figure 2-14 also provides information collected from the survey regarding trip frequency. During the peak period, 78 percent of survey respondents indicated that they make similar trips a minimum of 5 times per week. This roughly corresponds to the percentage of "To and From Work" trips described by the Trip Purpose pie chart, suggesting that a large percentage

Table 2-19
Motorist Survey Sample Size

Survey Station	Date	Location	Direction	Number of Surveys Distributed	Number of Valid Surveys Returned	Passing Traffic	Percent of Passing Traffic Surveyed	Percent of Valid Surveys Returned
1	11/29/2006	NC 751 Hope Valley Road South of Fayetteville	Northbound	665	126	4,847	13.7	18.9
2	11/29/2006	NC 55 South of Sedwick Drive	Northbound	1,370	97	4,189	32.7	7.1
3	11/29/2006	South Alston Avenue South of NC 54	Northbound	1,040	100	2,231	46.6	9.6
4	11/29/2006	NC 147 West of TW Alexander Drive	Southbound	1,799	372	6,072	29.6	20.7
5	11/30/2006	Davis Drive South of NC 54	Northbound	2,029	225	6,482	31.3	11.1
6	11/30/2006	South Miami Boulevard South of NC 54	Northbound	2,827	237	7,428	38.1	8.4
7	11/30/2006	Hopson Road South of NC 54	Westbound	1,072	155	4,750	22.6	14.5
8	12/5/2006	McCrimmon Parkway West of Church Street	Eastbound	1,561	176	3,269	47.8	11.3
9	12/5/2006	Morrisville Carpenter Road West of Railroad Lin	Eastbound	3,340	435	4,029	82.9	13.0
10	12/6/2006	NC 55 West Williams Street South of Old Jenks	Northbound	1,508	94	8,498	17.7	6.2
11	12/6/2006	Davis Road South of Old Jenks Road	Northbound	360	65	3,055	11.8	18.1
12	12/7/2006	Bypass NC 55 South of NC 55 Junction	Northbound	3,379	376	8,212	41.1	11.1
13	12/7/2006	NC 55 Main Street South of Sunset Lake Road	Northbound	326	43	4,952	6.6	13.2
			Total	**21,276**	**2,501**	**68,014**	**31.3**	**11.8**



Note: Charts represent sum of all survey locations.

of trips are made by weekly commuters. During off-peak periods, trip frequencies of 4 or less times per week were predominant, accounting for 60 percent of the trips made within the study area.

Vehicle occupancy rates for the various types of users in the project study area are also displayed in Figure 2-14. As shown, 80 percent of peak hour surveyed respondents and 75 percent of off-peak hour respondents indicated that trips were made by single occupancy vehicles (SOV). Only 13 to 18 percent of respondents traveled with one passenger. Overall, the survey indicates average vehicle occupancy of between 1.3 to 1.4 persons per vehicle.

The overwhelming majority of survey respondents, (98 percent) stated that they were traveling in passenger cars.

Trip Origins and Destinations

A majority of survey respondents, over 90 percent, indicated that they began their trip in Apex, Cary, Holly Springs, Morrisville, Durham, Fuquay-Varina and Raleigh. The most prevalent destination cities included Durham, Cary, Chapel Hill, Research Triangle Park (RTP) and Apex. The relatively low percent of destination trips attributable to the Research Triangle Park (RTP) is because several destinations in the RTP have Durham addresses as defined by the United States Postal Service. Table 2-20 shows the percent distribution of trips by origin city and by destination city. The origin towns and cities help to identify the market area of the proposed Triangle Expressway.

Detailed origin-destination analysis for some frequent origins and destinations was conducted using “factored” trips data. The survey database containing valid trips was “factored up” to traffic counts conducted at the same time as the surveys. This “factoring” process is a method by which each survey record is associated with a multiplying factor representing the number of trips for that particular origin-destination movement at average weekday levels.

Table 2-21 shows the number of “factored” trips in the peak and off-peak periods for some of the common traffic movements identified from the surveys. Only origin-destination pairs that had over 1,000 trips per day are depicted in the table. The most popular trips surveyed were from Apex, Holly Springs, Cary, Morrisville and Durham, to destinations such as Durham, RTP and Cary. The two most prevalent origin-destination pairs, Apex-Durham and Holly Springs-Durham, accounted for more than 25 percent of all the trips shown in the table.

Table 2-20
Trips by Origin and Destination City

Origin City	Total Trips	Percent
Apex	15,053	18.9%
Holly Springs	12,750	16.0%
Cary	12,672	15.9%
Morrisville	11,349	14.2%
Durham	10,724	13.4%
Fuquay-Varina	5,999	7.5%
Raleigh	4,489	5.6%
Research Triangle Park	4,881	6.1%
Sanford	671	0.8%
Chapel Hill	638	0.8%
Pittsboro	536	0.7%
TOTAL	79,762	100.0%

Destination City	Total Trips	Percent
Durham	39,497	48.2%
Cary	8,448	10.3%
Chapel Hill	7,720	9.4%
Research Triangle Park	6,760	8.2%
Apex	5,356	6.5%
Hillsborough	3,304	4.0%
Mebane	3,124	3.8%
Raleigh	2,184	2.7%
Morrisville	2,380	2.9%
Roxboro	1,325	1.6%
Burlington	831	1.0%
Cedar Grove	556	0.7%
Butner	527	0.6%
TOTAL	82,013	100.0%

Source: Factored trips from travel pattern survey in November and December 2006.

Table 2-21
Trips for Common Origin-Destination Pairs

Origin City or Town	Destination City or Town	Trips			Percent Share of Trips		
		Peak	Off-Peak	Total	Peak	Off-Peak	Total
Apex	Cary	491	699	1,190	7.4	12.5	9.7
	Chapel Hill	922	705	1,628	13.9	12.6	13.3
	Durham	4,793	3,392	8,185	72.1	60.5	66.8
	RTP	441	807	1,248	6.6	14.4	10.2
	Total	6,647	5,604	12,251	100.0	100.0	100.0
Cary	Cary	551	755	1,306	11.1	16.1	13.5
	Chapel Hill	753	1,176	1,928	15.2	25.0	20.0
	Durham	3,095	1,959	5,054	62.4	41.7	52.3
	RTP	560	811	1,371	11.3	17.2	14.2
	Total		4,700	9,659	100.0	100.0	100.0
Durham	Cary	604	553	1,157	15.9	14.9	15.4
	Durham	2,539	2,364	4,903	66.6	63.6	65.2
	RTP	668	797	1,465	17.5	21.5	19.5
	Total	3,811	3,714	7,525	100.0	100.0	100.0
Fuquay-Varina	Durham	1,219	1,371	2,590	100.0	100.0	100.0
Holly Springs	Cary	689	324	1,013	12.1	8.5	10.7
	Chapel Hill	763	264	1,027	13.4	7.0	10.8
	Durham	3,679	2,724	6,403	64.5	71.9	67.4
	RTP	571	480	1,051	10.0	12.7	11.1
	Total	5,702	3,792	9,494	100.0	100.0	100.0
Morrisville	Cary	622	700	1,322	14.4	16.6	15.4
	Chapel Hill	582	588	1,171	13.4	13.9	13.7
	Durham	3,128	2,935	6,064	72.2	69.5	70.9
	Total	4,332	4,224	8,556	100.0	100.0	100.0
Raleigh	Durham	1,129	1,133	2,262	100.0	100.0	100.0
RTP	Durham	1,079	1,043	2,122	100.0	100.0	100.0

Table 2-21 also shows that peak traffic was higher than off-peak traffic even though the peak periods account for only eight hours of the day. All trips heading to Durham clearly show a higher percentage of trips in the peak periods than in the off-peak. Peak and off-peak travel patterns differ for trips originating from Apex, Cary and Holly Springs and having destinations in Cary, Durham and Chapel Hill. The higher share of off-peak traffic for trips heading to the RTP from Apex, Cary, Durham and Holly Springs may be due to the fact that many locations in the RTP have mailing addresses in Durham and Morrisville. All of this data suggests a strong commuting pattern within the study area.

ROAD CHOICE

Figure 2-15 graphically shows the popular route choices for common origin-destination pairs. NC 55 emerges as a major roadway within the study area, favored by 55 percent of motorists making trips from Apex to Durham. NC 55 is also used by motorists traveling to Durham from Cary and Holly Springs. Another significant route in the study area is NC 54, which is used by motorists traveling from Cary to Durham and the majority of motorists traveling from Morrisville to Durham. Additionally, a majority of surveyed motorists, 43 percent, traveling from Raleigh to Durham indicated that they use a combination of I-40 and I-540. As Figure 2-15 indicates, other origin-destination pairs favor NC 54 and NC 55 for east-west movements and NC 55, I-40 or a combination of I-40 and NC 55 for north-south movements.

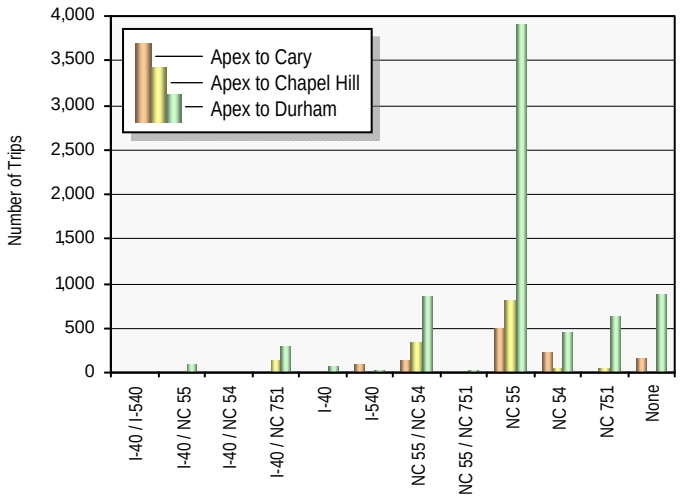
TRIP PURPOSE

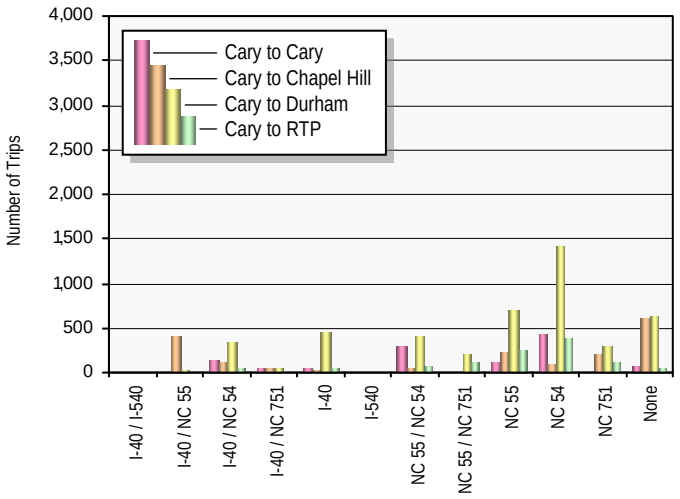
Figure 2-16 depicts the distribution of trips by trip purpose for common origin-destination pairs. The most common trip purpose for the frequent origin-destination pairs was to and from work. Combined with company business trips, work trips accounted for nearly two-thirds of all origin-destination trips.

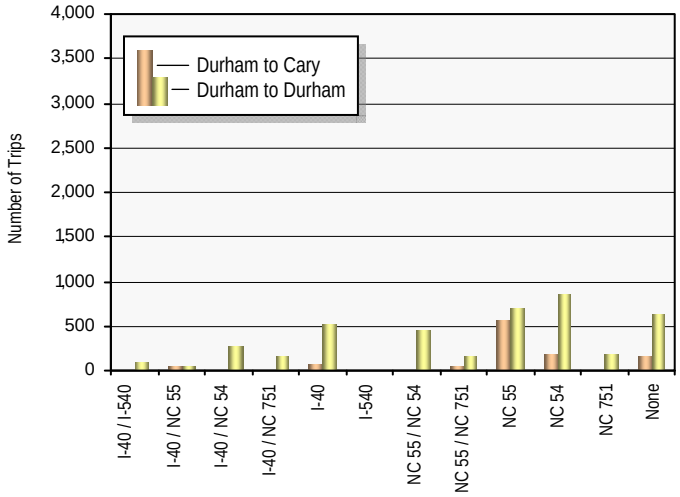
Figure 2-16 also identifies a few other trip patterns. Twenty-eight (28) percent of trips between Apex and Chapel Hill are shopping trips. A significant number of trips, about 20 percent, are school trips (likely trips made by students to the University of North Carolina.) Similarly, the Cary-Chapel Hill and Holly Springs-Chapel Hill origin-destination pairs show a significant number of school trips, 17 and 12 percent, respectively, of all trips between the origin-destination pairs.

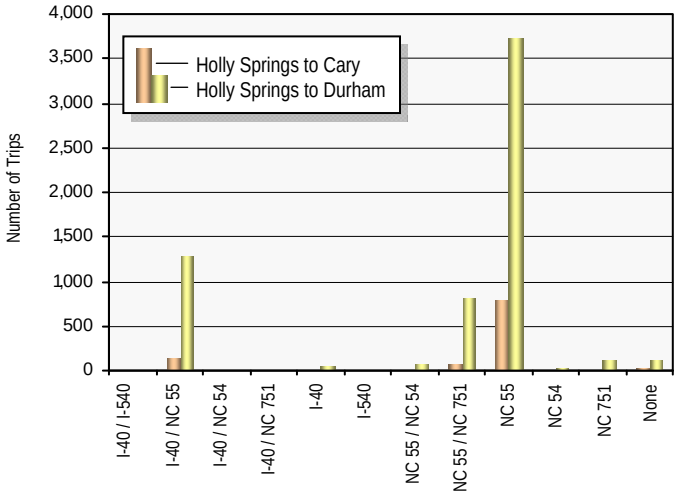
TRIP FREQUENCY

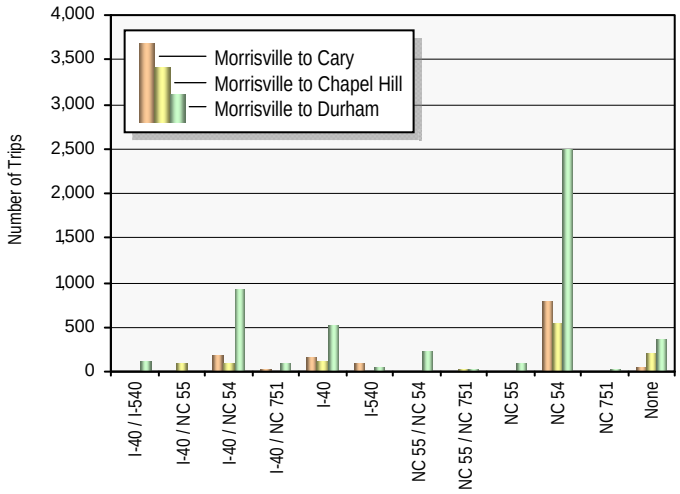
Figure 2-17 indicates the frequency between common origin and destination pairs. Of the 63,000 origin-destination trips between the most frequent origin and destination cities, 58 percent of trips were made five times or

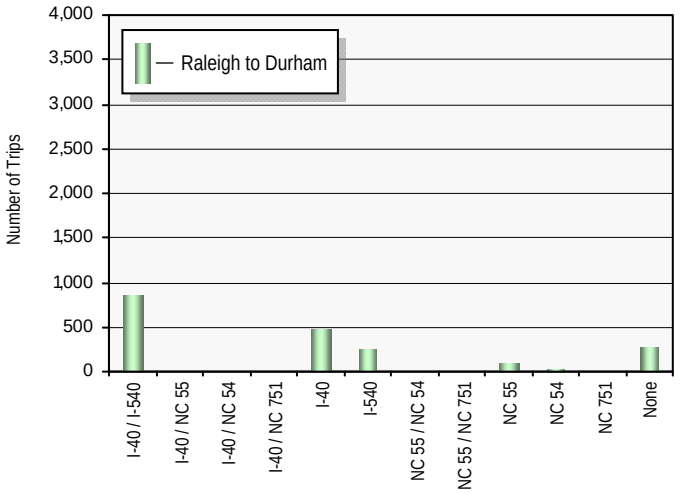












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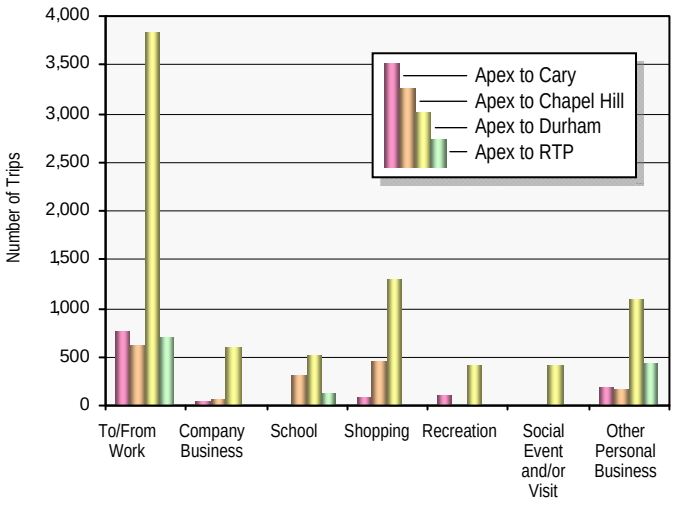
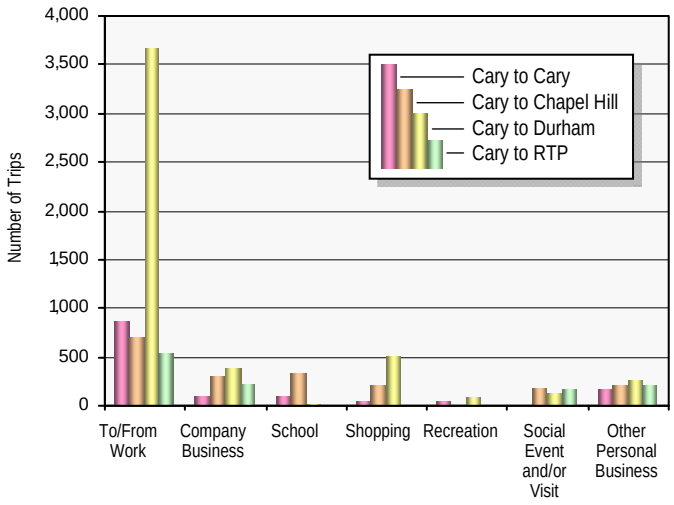
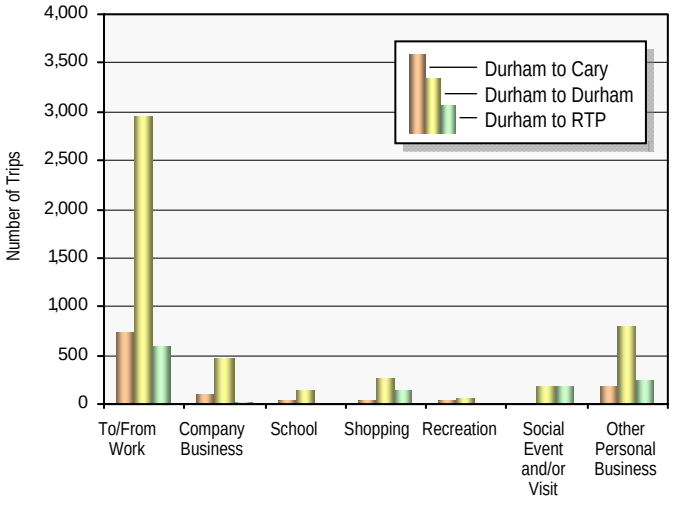
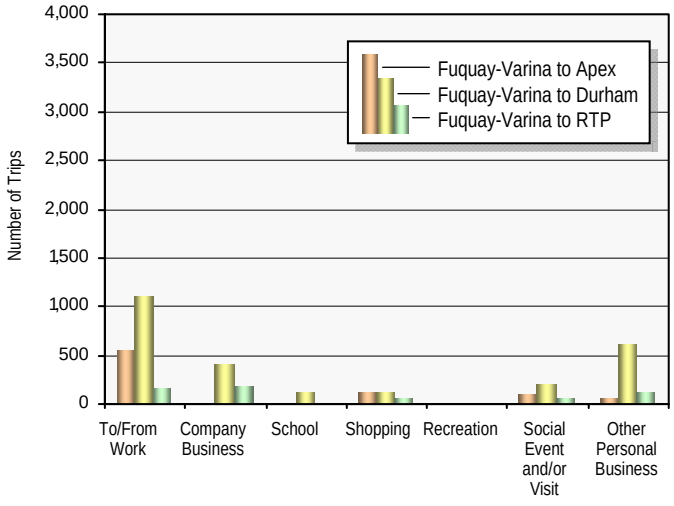
ROAD CHOICE FOR COMMON ORIGIN-DESTINATION PAIRS

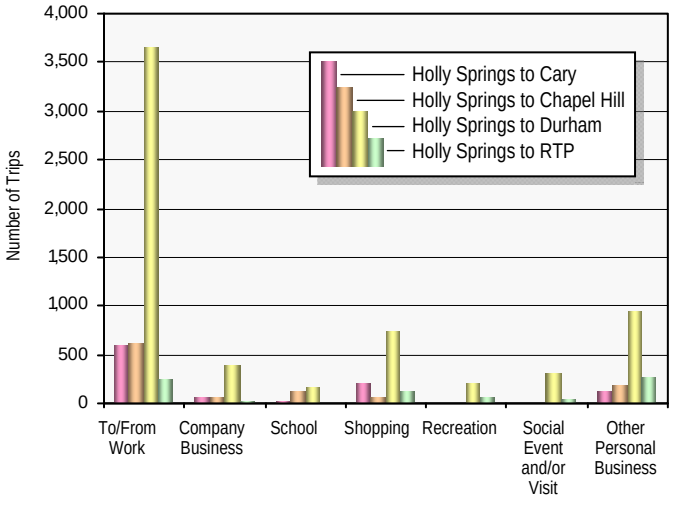
FIGURE 2-15

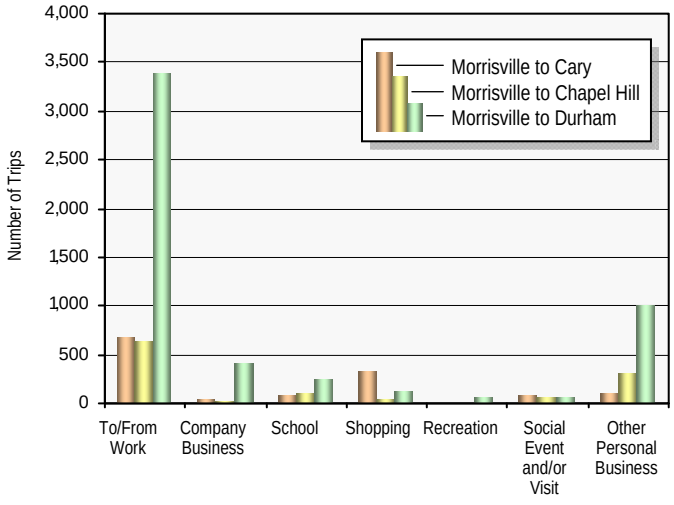








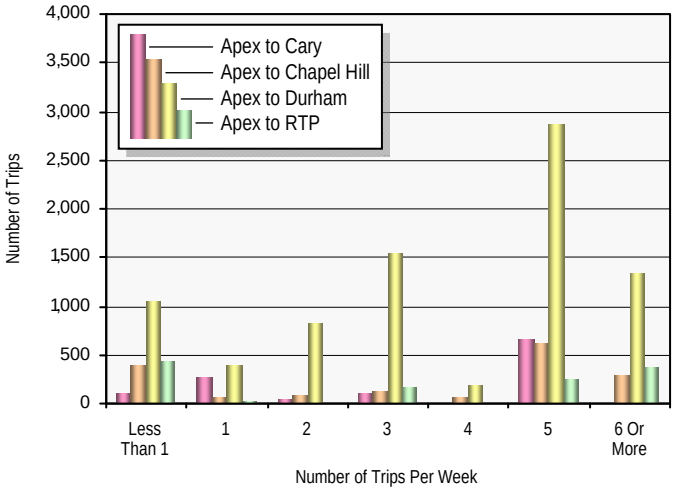


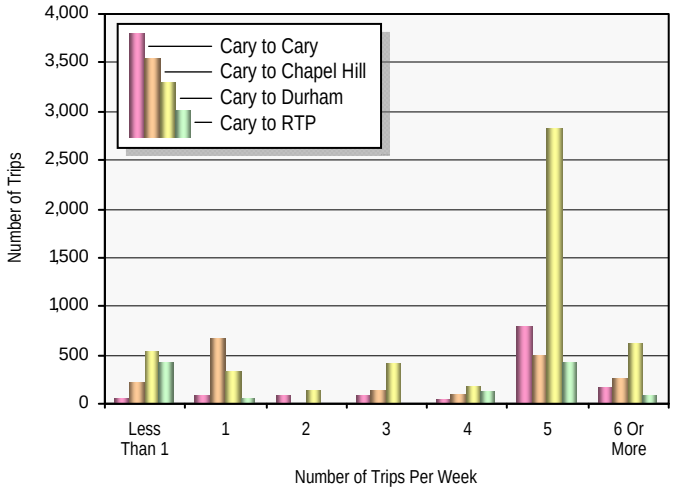


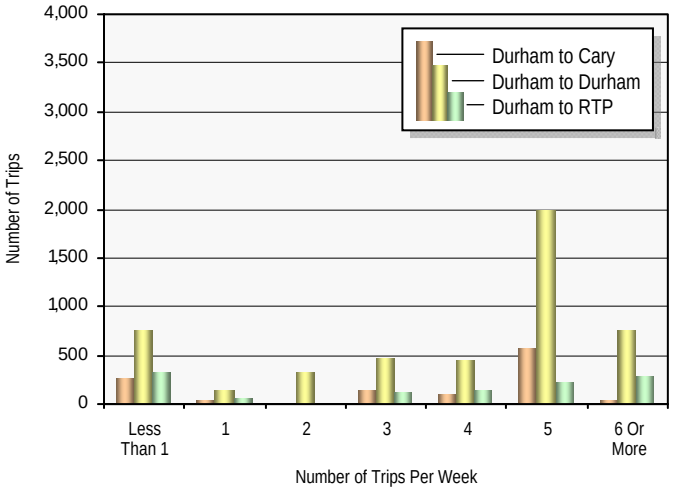
NORTH CAROLINA Turnpike Authority

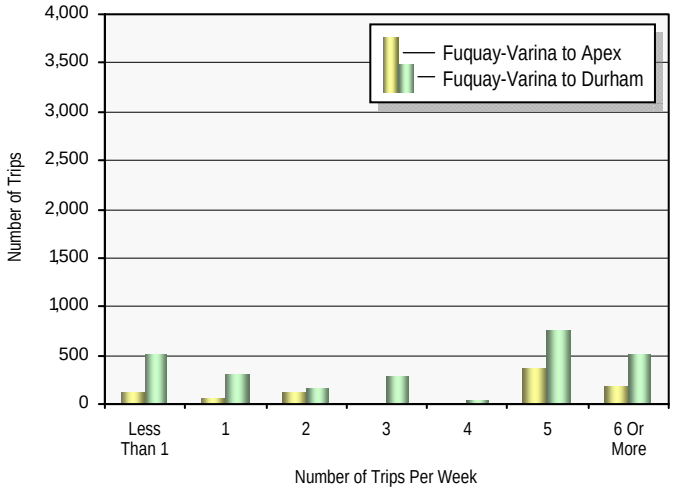
TRIP PURPOSE FOR COMMON ORIGIN-DESTINATION PAIRS

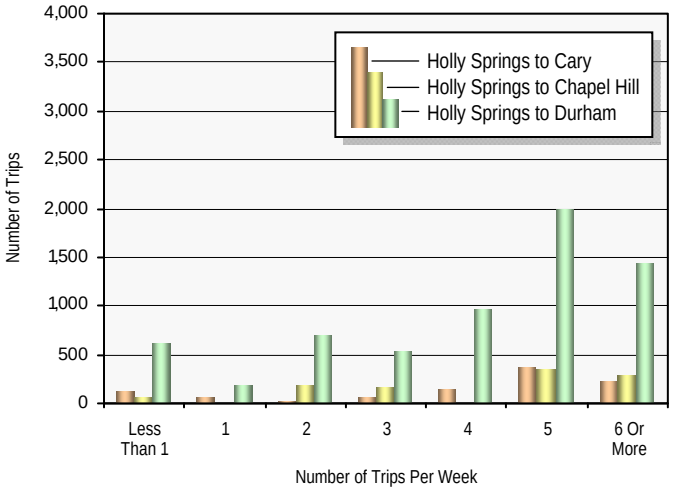
FIGURE 2-16

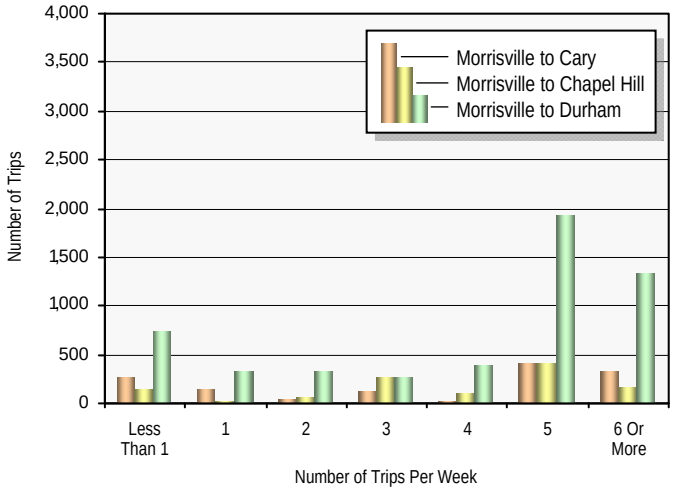












NORTH CAROLINA Turnpike Authority

TRIP FREQUENCY FOR COMMON ORIGIN-DESTINATION PAIRS

FIGURE 2-17

more every week. Of these, 17 percent of surveyed motorists make the trip six or more times a week. This corresponds to the percentage of motorists who indicated that they were making the trip to or from work.

A more detailed analysis of the trip characteristics of common origin and destination pairs is provided in a technical memorandum that details the travel patterns for some common origin-destination pairs in the Raleigh-Durham area.

CHAPTER 3

STATED PREFERENCE SURVEYS

The Triangle Expressway Stated Preference Survey was conducted by Resource Systems Group (RSG) for Wilbur Smith Associates and the North Carolina Turnpike Authority (NCTA). The objective of the stated preference survey was to estimate reliable values of the toll sensitivity, or "values of time," of travelers in the proposed Triangle Expressway study area. The survey was designed to provide sufficient detail to allow analyses of traveler responses to different toll structures and toll collection options; and to allow analysis of toll sensitivities by trip type sufficient to support route diversion modeling. The inputs and results of the stated preference survey are documented in a technical memorandum.

APPROACH

The stated preference survey instrument was programmed using customized software developed by RSG for field intercept administration using laptop computers and for online administration through RSG's SurveyCafe.com website. Respondents for this survey were recruited from several sources, including email invitation to those travel pattern survey respondents expressing interest in participating in follow-up surveys, workers with jobs in the study area, local shopping centers and motor vehicle departments.

The customized computer-based survey software adapts to the trip characteristics of each respondent, making the survey realistic for them. By performing calculations behind the scenes, it allowed for the presentation of complex ideas in a simple manner. Electronic validation of each question eliminated item non-response and prevented the entry of invalid inputs. Responses were stored directly into a database after every question, reducing data entry costs and eliminating transcription error.

SURVEY QUESTIONNAIRE

The survey questionnaire briefly introduced the purpose of the survey and then asked questions grouped into four sections: trip description, stated preference section with questions about travel time and toll cost, stated preference follow-up questions, and demographic questions.

TRIP DESCRIPTION

Respondents were screened to ensure that they had made trips recently within the Triangle Expressway study area. Each was asked to provide details of their trip, including day of the week, the purpose of their trip, the time period in which their trip began, the roads they used during their trip, and where their trip began and ended. These data were used to validate the Triangle Expressway as a possible alternative for the respondent's reported trip and as inputs to build the alternatives described in the stated preference scenarios.

After entering origin and destination information, respondents were asked for additional details about their trips, including, trip duration, amount of travel delay experienced, vehicle occupancy and how many times a week they make the particular trip (trip frequency).

STATED PREFERENCE SECTION

Before beginning the stated preference exercises, respondents were presented with more specific information about the proposed Triangle Expressway. Respondents were also given a description of the toll collection methods that likely would be used on the new facility.

Definition of Alternatives - The stated preference section consisted of eight hypothetical scenarios, with each scenario presenting two alternatives for traveling between the respondent's trip origin and destination. The first alternative presented the respondent's reported travel time using a toll-free rate. The second alternative presented the estimated travel time and toll cost based on the calculated use of Triangle Expressway for the identical trip. Figure 3-1 shows an example stated preference experiment.

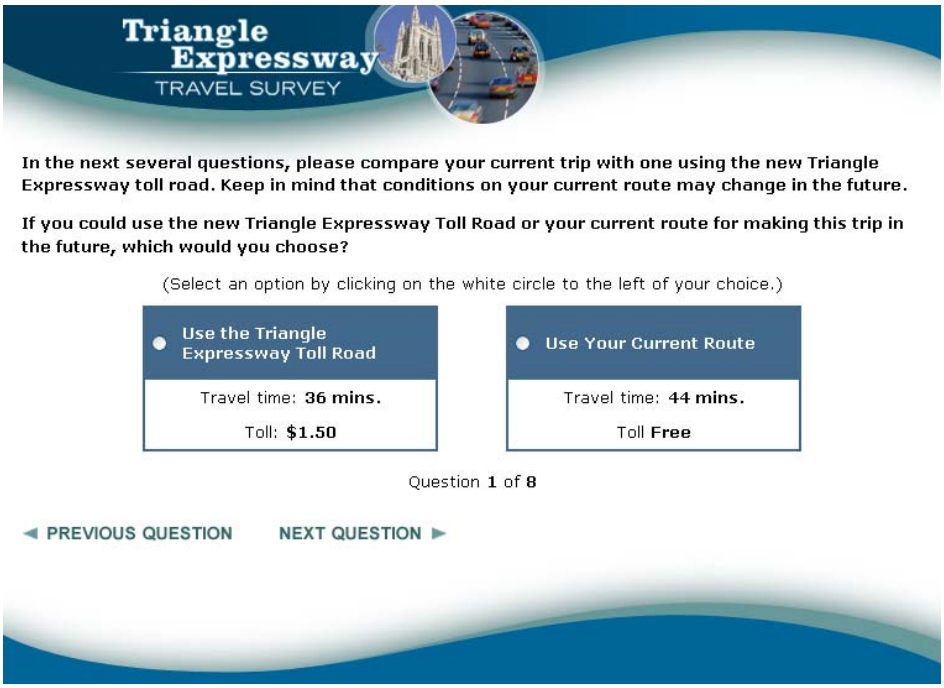


Figure 3-1

Definition of Attributes and Levels **-** Travel times for the respondent's current route, as well as travel times and toll costs for the Triangle Expressway alternative, were presented at different values or "levels" in eight scenarios for each respondent. The combination of times and costs presented in each scenario were selected using a fractional factorial orthogonal experimental design, a commonly used experimental design method. The experimental design consisted of 32 scenarios, and each respondent saw 8 of the 32 scenarios in a randomized order.

To ensure that the Triangle Expressway scenarios were believable to the respondent, the values for travel times and toll costs were based on characteristics of the respondent's own trip: the respondent's likely route for their trip using the Triangle Expressway was estimated based on the stated origin and destination for their trip. Calculations of the most likely entrance and exit ramps determined the respondent's hypothetical access times to, egress times from, and total distance along the Expressway. Times spent on the Expressway and toll costs were varied by travel speed and toll cost per mile, respectively, to provide values meeting the experimental design criteria. By varying the travel times and tolls shown in each scenario, the respondent was presented with different time costs and saving amounts for each scenario, allowing the demonstration of travel preferences across a range of values of time.

STATED PREFERENCE FOLLOW-UP

Directly following the stated preference section, respondents who did not select the Triangle Expressway alternative in any of the eight stated preference scenarios were asked to indicate their primary reason for not choosing the toll road. Respondents who chose the Triangle Expressway option at least once were asked their likelihood of acquiring an electronic toll collection (ETC) device as well as their familiarity with these devices. Those respondents who were not "very likely" to acquire an ETC device were asked if a reduced toll would increase their likelihood of ETC use. Respondents who still were not interested in ETC devices were asked why they were unlikely to open an ETC account.

The final follow-up section of the survey asked about their opinions of the project and their primary reason for support or opposition. Finally, respondents were asked a few attitudinal questions regarding tolling in general.

DEMOGRAPHICS

The final section of the survey contained a series of questions to collect data such as county of residence, household size, number of children, number of household vehicles, gender, age, employment status, and income. This information was used to determine differences in responses among traveler market segments, such as trips to and from Research Triangle Park, non-work trips, and airport trips.

SURVEY RESULTS

SAMPLE OVERVIEW

Stated preference data from 4,597 respondents were used to estimate the choice models presented in the following section of this report. Approximately 13 percent of these responses were recruited at intercept sites; 10 percent were recruited from the origin-destination survey email list; and 77 percent were recruited via business recruiting efforts. The intercept surveys were conducted at North Carolina Department of Motor Vehicles offices, area shopping centers, and other public locations:

- North Carolina Department of Motor Vehicles – west Raleigh, east Durham;
- Cary Towne Center Mall - Cary;
- Streets at Southpoint Mall – Durham;
- Raleigh-Durham Airport – Morrisville; and
- Cary West Regional Library – Cary.

While the majority of the sample came from one sample source, there are sufficient data from each sample source to provide unbiased results for a range of traveler market segments.

Respondent Characteristics

The sample was comprised of 34 percent women and 66 percent men. The median age was between 35 and 44 years of age. Most respondents (80 percent) were residents of Wake County, with 11 percent from Durham County and the remainder from other counties such as Orange and Chatham. The median household size was three people, and median vehicle ownership was two vehicles per household.

Ninety (90) percent of respondents were employed full time, and five (5) percent were employed part-time or were self-employed. Of those three groups, 82 percent were employed in the RTP. The majority of those working in the RTP (80 percent) were employed in professional or technical positions. The job types of non-RTP employees were more diverse, with 47 percent in professional or technical jobs, 16 percent in executive or managerial jobs, 11 percent in manufacturing jobs, and the remaining 26 percent doing other types of work.

The sample's median annual household income was in the $100,000–$149,999 per year bracket. It was clear that the median income of those employed within the RTP was higher than those employed elsewhere. The income of the respondents who were employed outside the RTP more closely resembled the median income reported in the census. To address this, variations in income by zone were applied within the tolling analysis.

Trip Characteristics

The multi-method sampling approach used for the survey allowed respondents who made a diverse range of trips to be recruited. Of those respondents who were recruited at intercept sites, 27 percent described work commute trips and the remainder described social or recreational trips, shopping trips and other personal business trips. Surveys completed by employees of businesses in the study area and travel pattern survey respondents largely described work related travel; in both these groups, less than a quarter of respondents described a non-work trip.

Over three quarters (86 percent) of respondents indicated that their trip began at home. Most respondents described trips that used I-40 (60 percent of respondents), Davis Drive (40 percent of respondents), and/or NC-55 (40 percent of respondents).

The median travel time in the sample was between 30 and 39 minutes. Over 90 percent of trips were less than an hour in duration (see Figure 3-2).

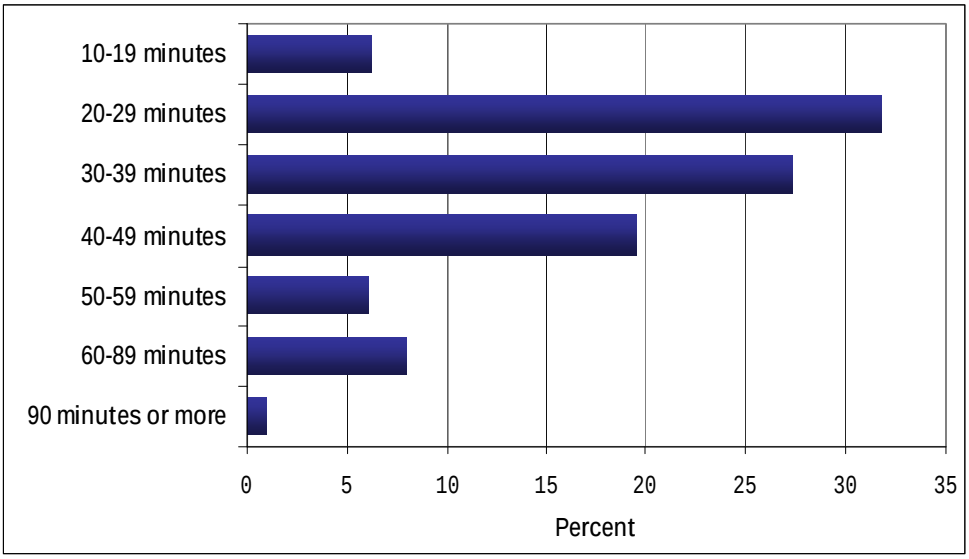


Figure 3-2 - Current Total Travel Time

Around two-thirds of the trips took place during the peak periods. About two-thirds of peak period travelers and one-third of off-peak travelers experienced some delay. A slightly higher proportion of PM peak travelers than AM peak travelers experienced delays of 10 minutes or more.

ETC FAMILIARITY

Although there are no toll roads in North Carolina, 82 percent of respondents said that they were familiar with electronic toll collection (ETC). A significant number of respondents (16 percent) currently own or have owned an ETC device in another state; for most respondents that device was an E-ZPass transponder.

MODEL ESTIMATION

Data from the stated preference alternatives were expanded into a dataset that contained eight observations for each of the 4,597 usable surveys, yielding a total of 36,776 observations that were used to complete model estimation. The statistical estimation and specification testing was completed using a conventional maximum likelihood procedure that estimated

a single set of coefficients for a multinomial logit model. These coefficients were used to estimate the value of travel time savings for travelers in the proposed Triangle Expressway study area. The value-of-time estimates were input into the travel demand model to estimate traffic and revenue for the proposed Triangle Expressway.

Model Coefficients By Market Segment

Model coefficients were estimated for the nine different market segments listed below:

- Peak Work Trips to/from RTP;
- Peak Work Trips Outside RTP;
- Peak Non-work Trips;
- Off-peak Work Trips;
- Off-peak Non-work Trips;
- Business-related Trips;
- Airport Pick-up/Drop-off Trips;
- Airport Business-related Trips; and
- Airport Non-Business related Trips.

The final model structures are provided in the full report from RSG included in a technical memorandum. For most of the market segments, value-of-time was determined to be sensitive to income and total trip distance. That is, people with higher incomes tended to have higher values of time and those with longer travel distances also tended to value their time more.

The value-of-time for the different market segments based on a household income of $70,000 (the median for the region) and a trip length of 20 miles is shown in Table 3-1. It should be noted that these values were chosen to be representative but the actual values used were localized for each traffic analysis zone in the model.

Table 3-1
Estimated Value of Time

Market Segment	Value-of-time ($ per hour) [1]
Peak Work to/from RTP	$16.51
Peak Work Outside RTP	13.24
Peak Non-Work	14.51
Off-peak Work	13.03
Off-peak Non-work	9.85
Business-related	12.97
Airport Pick-up/Drop-off	11.99
Airport Business	20.97
Airport Non-Business	16.20

[1] Estimated at $70,000 per year household income and 20 miles total trip length.

APPLICATION TO MODEL FOR TRAFFIC AND REVENUE FORECAST

A weighted average value-of-time was calculated for each traffic analysis zone within the travel demand model used for the traffic and revenue analysis for this project. The estimated value-of-time for each zone was weighted based on the trip purpose distribution for trips originating within the zone, the household income for the zone, and the average length of trips from the zone that would potentially use the Triangle Expressway. This matrix was used as input to the traffic assignments for the project under a variety of tolling conditions.

CHAPTER 4

STUDY AREA GROWTH REVIEW

Economic growth is an important factor in evaluating the viability of any start-up toll facility such as the proposed Triangle Expressway. Given the strong nature of past and current employment-related growth in the Triangle Region, anticipated economic activity is particularly important.

This study will be used in support of project financing; therefore, it was important to conduct an independent analysis of the expected economic growth of the region. This "Study Area Growth Review" provides independently-developed socioeconomic forecasts of all parameters that were used in the regional travel demand model to predict future travel in the region rather than relying on the parameters developed by the two metropolitan planning organizations (MPOs) as was the case for the preliminary level traffic and revenue studies.

The independent economist for this study was the Kenan Institute of Private Enterprise of the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill. The Kenan team of economists had no affiliation with the forecasts developed by the MPOs or any affiliation with local governments or developers in the area. Thus Kenan could provide an unbiased review of regional economic growth and the independently-derived data sets that were needed for the travel demand models to forecast future traffic at the Transportation Analysis Zone (TAZ) level.

METHODOLOGY

The details of the Kenan study are contained in a technical memorandum.

This chapter contains a brief overview of the Kenan approach.[1]

Kenan reviewed the original (2002) socioeconomic forecasts that were used in the preliminary traffic and revenue studies for the Triangle Expressway and a newer (2007) set of draft forecasts developed by the MPOs as part of the new regional travel demand model (TDM). This new TDM was in development during this study, therefore the newer draft socioeconomic forecasts were not officially adopted by the MPOs before the beginning of the transportation modeling and toll diversion analysis. Through discussions with the MPOs, it was determined that the draft socioeconomic forecasts of June 2007 were expected to be close to the final forecasts, which would be officially adopted later in the year. Slightly modified forecasts and projections were adopted by the Capitol Area MPO (CAMPO) in August 2007 and by the Durham-Chapel Hill-Carrboro MPO (DCHC) in September 2007. The differences between the draft forecasts and the official forecasts are small.

Kenan employed two methods in preparing the regional socioeconomic forecast that were used for this traffic and revenue study. The results of these two methods were then reconciled to create the individual forecasts at the TAZ level for use in the transportation demand model.

The first method was a top-down approach that began with overall forecast for the region using economic model-driven parameters to allocate population and employment throughout the region. Trend analysis was performed to determine the reasonableness of economic growth rates in relation to the new MPO draft forecasts, other forecasting organizations, and individual experts.

The second method was a bottom-up approach that reviewed the new draft forecasts coordinated by the two MPOs on behalf of the member jurisdictions. The MPO process involves local envisioning and inter-municipality discussions subject to broad constraints. The MPOs' forecasts are based on current planning assumptions in each member's jurisdiction. Kenan evaluated the basic assumptions upon which the MPOs jurisdictions forecast socioeconomic parameters and conducted interviews with local planners, developers, and others to assess the contingencies that affect the projections.

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[1] The independent economic analysis was conducted by Kenan during 2007 at a time before the current recession and surge in fuel prices had started. As discussed elsewhere in this report, the current recession is expected to affect future traffic and revenue on the Triangle Expressway. This chapter contains both the original Kenan analysis and a review of more recent economic trends which have led to a revision of the traffic and revenue forecasts as described in detail in Chapter 6.

Finally, Kenan reconciled the top-down and bottom-up methods by relying on the top-down method for regional and county-wide control totals and the bottom-up method, informed by historical precedent, for distribution to the TAZ level in the model.

COMPARISON WITH PREVIOUS FORECASTS

The Kenan socioeconomic forecasts form the basis for the toll traffic and revenue forecasts presented in this report. The preliminary traffic and revenue studies used the MPOs' 2002 socioeconomic forecasts. As discussed previously, the MPOs prepared new socioeconomic forecasts in 2007 as part of the development of a new regional travel demand model. These three forecasts differ; and it was important to compare them, to identify major changes, and to point to the potential effect on the toll traffic and revenue forecasts.

Direct comparison at the regional level was difficult because the MPOs' 2007 draft forecasts cover a larger geographic area than the 2002 forecasts. The older travel demand model, which was used for both the preliminary and comprehensive traffic and revenue studies, covers the smaller geographic area. However, comparisons can be made for the Triangle Expressway study area by converting the data that uses the new TAZ system boundaries to the older TAZ boundaries and then concentrating only on the study area as illustrated in a later figure in this chapter.

Tables 4-1 and 4-2 contain comparisons of the population and employment forecasts, respectively, in the Triangle Expressway study area. All three forecasts are shown for the study area: the 2002 forecasts used in the preliminary studies, the 2007 draft forecasts prepared by the MPOs, and the forecasts prepared by Kenan, the independent economist. Figures 4-1 and 4-2 depict the three forecasts graphically.

POPULATION IN THE TRIANGLE EXPRESSWAY STUDY AREA

The three population forecasts for the study area vary considerably, particularly in the later years of the forecast. In each case the independent economist population forecasts are lower than the MPOs' forecasts. The MPOs' 2007 draft population forecasts for the study area in 2010 are 3.5 percent higher than the MPOs' 2002 forecasts; whereas, the Kenan forecasts are slightly lower. By 2020, the MPOs' 2007 draft population forecasts are lower that the 2002 forecasts by 2.4 percent; and the Kenan forecasts are 11 percent lower, which represents a lower growth expectation by Kenan than by the MPOs. The Kenan population forecasts for 2030 are

Table 4-1
Comparison of Population Projections
Triangle Expressway Study Area

Year	2002 MPO Population[1]	2007 MPO [2] Population	2007 MPO [2] Change from Preliminary Study	Independent Economist [3] Population	Independent Economist [3] Change from Preliminary Study
2010	213,862	221,443	3.5%	213,510	-0.2%
2020	327,723	319,826	-2.4%	291,656	-11.0%
2030	435,140	386,276	-11.2%	364,849	-16.2%

(1) Proposed Western and Southern Wake Freeways Preliminary Traffic and Revenue Study, June 16, 2006 using MPO socioeconomic forecasts contained in the Regional Transportaton Demand Model adopted at the time of the study.

(2) Draft forecasts prepared by Capital Area MPO and Durham-Chapel Hill-Carrboro MPO through June 2007 for new Regional Transportation Demand Model.

(3) Forecasts prepared by Kenan Insitute of Private Enterprise based on review of 2007 MPO forecasts.

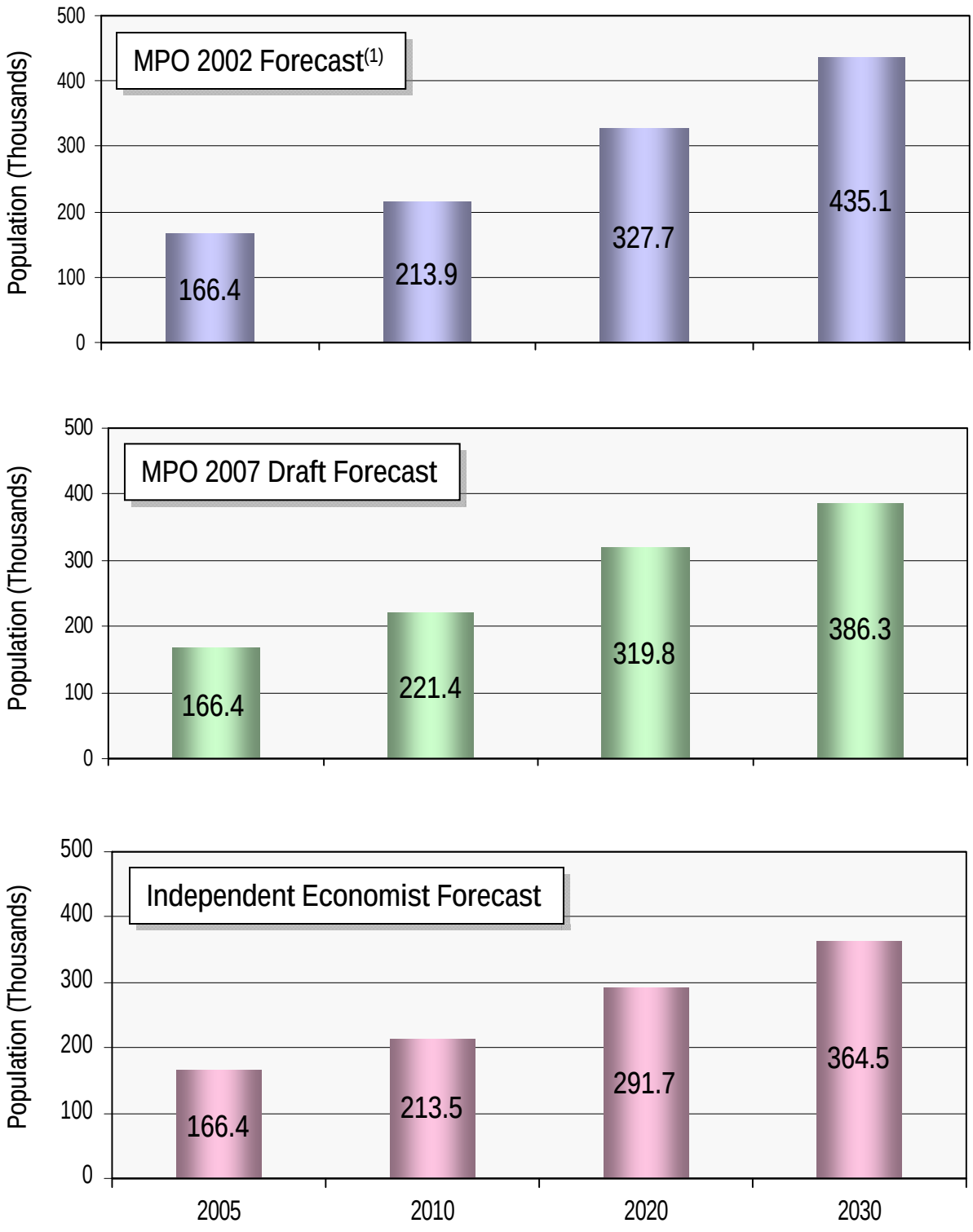
Table 4-2
Comparison of Employment Projections
Triangle Expressway Study Area

Year	2002 MPO Employment[1]	2007 MPO [2] Employment	2007 MPO [2] Change from Preliminary Study	Independent Economist [3] Employment	Independent Economist [3] Change from Preliminary Study
2010	153,685	141,248	-8.1%	140,589	-8.5%
2020	246,350	195,195	-20.8%	184,596	-25.1%
2030	341,549	242,231	-29.1%	222,669	-34.8%

(1) Proposed Western and Southern Wake Freeways Preliminary Traffic and Revenue Study, June 16, 2006 using MPO socioeconomic forecasts contained in the Regional Transportaton Demand Model adopted at the time of the study.

(2) Draft forecasts prepared by Capital Area MPO and Durham-Chapel Hill-Carrboro MPO through June 2007 for new Regional Transportation Demand Model.

(3) Forecasts prepared by Kenan Insitute of Private Enterprise based on review of 2007 MPO forecasts.



(1) Used in Preliminary Study

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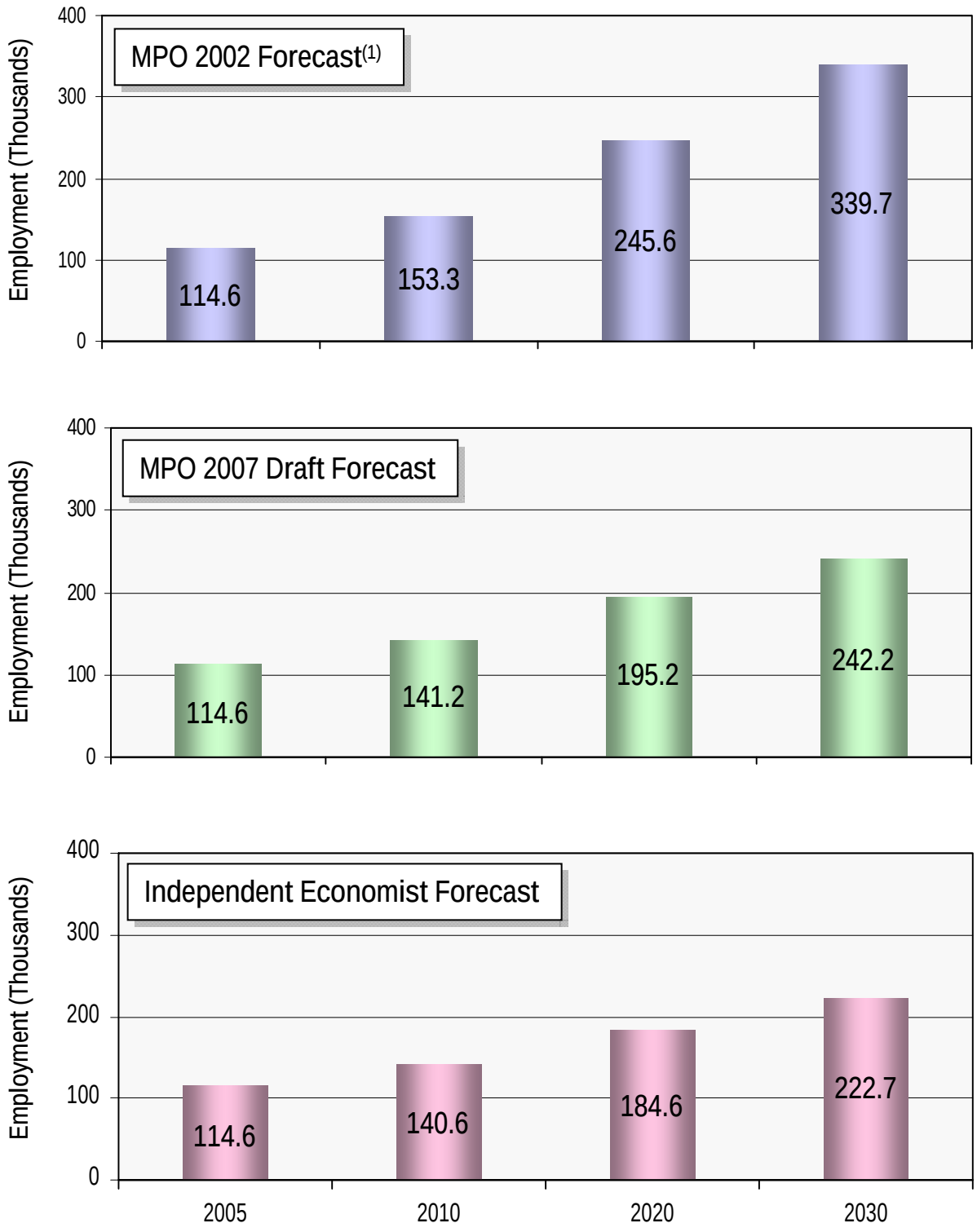
COMPARISON OF POPULATION PROJECTIONS
IN TRIANGLE EXPRESSWAY STUDY AREA

FIGURE 4-1



(1) Used in Preliminary Study

NORTH CAROLINA Turnpike Authority

COMPARISON OF EMPLOYMENT PROJECTIONS
IN TRIANGLE EXPRESSWAY CORRIDOR

FIGURE 4-2

also significantly lower than the MPOs' 2002 and 2007 draft forecasts. The 2007 MPO draft population forecast for 2030 is nearly 49,000 residents less (-11 percent) than the MPOs' 2002 forecasts, and the Kenan forecast is 70,000 residents less (-16 percent).

However, while the population growth estimates for the study area were reduced, the changes in traffic zones proximate to the proposed Expressway were positive in some cases. Hence, the net impact of the changes in population forecasts on the traffic estimates for the Expressway was not as significant.

EMPLOYMENT IN THE TRIANGLE EXPRESSWAY STUDY AREA

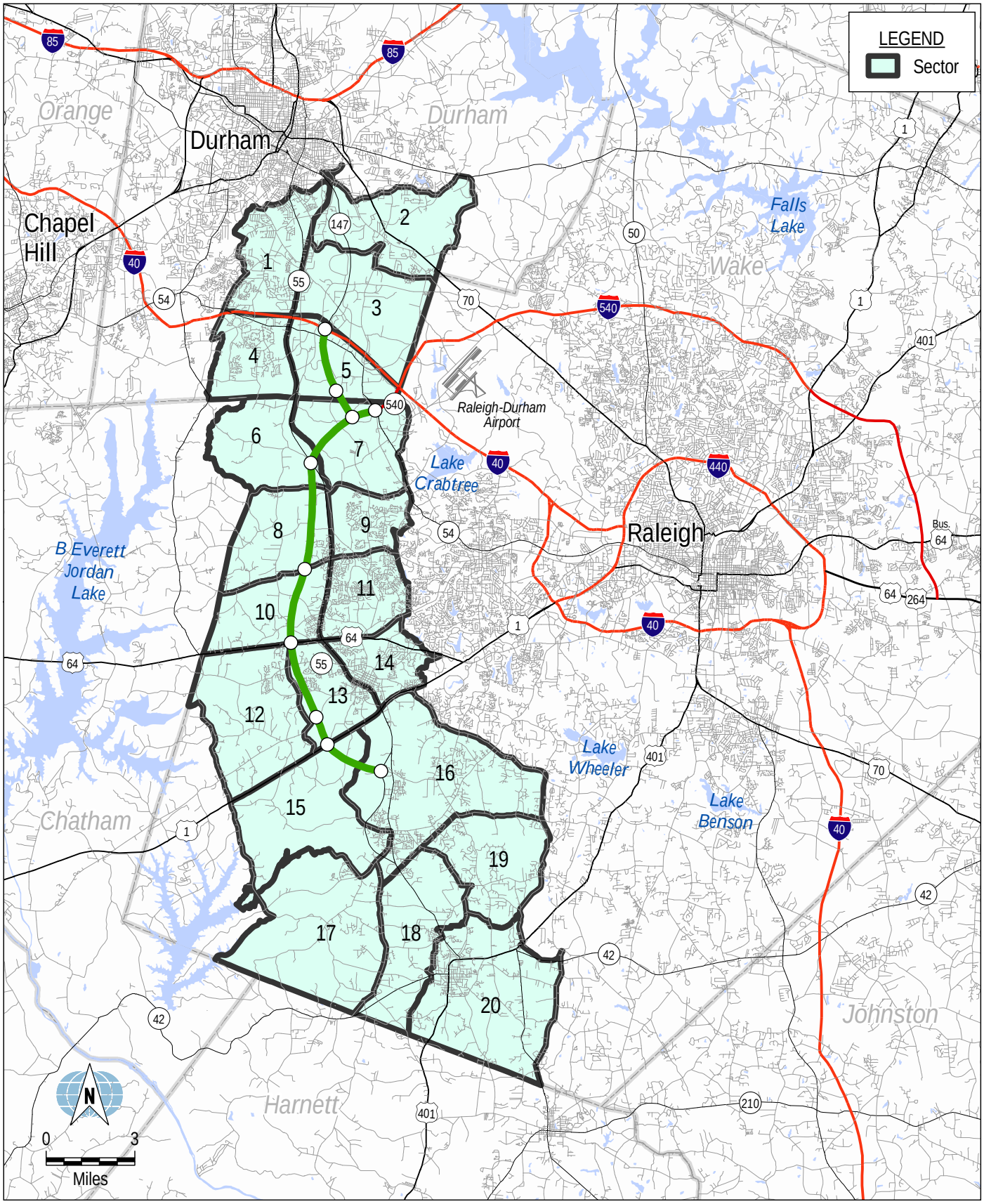
Table 4-2 shows the comparisons for employment in the study area. The MPOs' 2007 draft forecasts and Kenan forecasts are much lower than the forecast prepared by the MPOs' in 2002. By 2030, the MPOs' 2007 draft employment forecast is 29 percent lower, and the Kenan forecast is 35 percent lower than the 2002 forecasts. The difference between the Kenan forecast and the 2002 forecast, which was used in the preliminary traffic and revenue study, is nearly 119,000 jobs. These differences are due to lower expectations of growth in the study area; as employment is now expected to grow more rapidly in other areas of the Triangle Region.

Like population, adjustments in employment estimates in the immediate vicinity of the proposed Expressway were less negative than for the study area, and in some cases were positive. Most negative adjustments were made in the outlying sections of the study area.

GROWTH PROJECTIONS

These updated forecasts in the Triangle Expressway study area were analyzed further in order to identify specifically where the changes in growth are expected. Figure 4-3 depicts the 20 geographic sectors within the Triangle Expressway study area. The Triangle Expressway is also shown to orient the sectors to the proposed toll road.

The population and employment within the vicinities of the Western and Southern Wake Freeways are expected to grow extensively over the next three decades based on the forecasts made by the MPOs and the independent economist.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POPULATION FORECASTS

Table 4-3 summarizes population growth within the Triangle Expressway study area using the Kenan forecasts and the TAZ structure in the older travel demand model and compares the study area growth to growth for the rest of the Triangle Region.

In 2005, the Triangle Region had approximately 1.2 million residents with nearly 166,000 people (13.5 percent) residing within the Triangle Expressway study area. By 2030, the regional population is forecast to grow to about 2.1 million people, and the study area's population will grow to more than 365,000 people. By that time the study area's share of the population is expected to be 17.8 percent of the regional population, which means that the study area population is growing faster than the regional population. In fact, the average annual growth rate for the study area is expected to be 3.2 percent annually over the 2005-2030 period, whereas the entire region is expected to grow at only 2 percent annually.

The table also shows the study area sectors where the greatest population growth is expected to occur. Three sectors are expected to have population growth rates exceeding 6 percent per year. Figure 4-4 highlights the growth by percentage in the study area. At the southern end of the study area, nearly all of the sectors are expected to grow at rates exceeding 3 percent with some sectors exceeding 5 percent. The western side of the study area exhibits the highest growth rates with all geographic sectors exceeding 4 percent. These rates, although somewhat lower than the MPOs' 2002 forecasts, nevertheless represent significant growth of population within the study area.

EMPLOYMENT FORECASTS

As shown in Table 4-4 and Figure 4-5, employment in the Triangle Expressway study area represented 19 percent of regional employment in 2005 and is expected to increase to 22 percent by 2030. This growth from 115,000 employees in 2005 to nearly 223,000 employees in 2030 represents a 2.7 percent average annual growth rate. The regional growth rate of 2.1 percent per annum is forecast to increase employment from 603,000 persons in 2005 to more than 1 million in 2030.

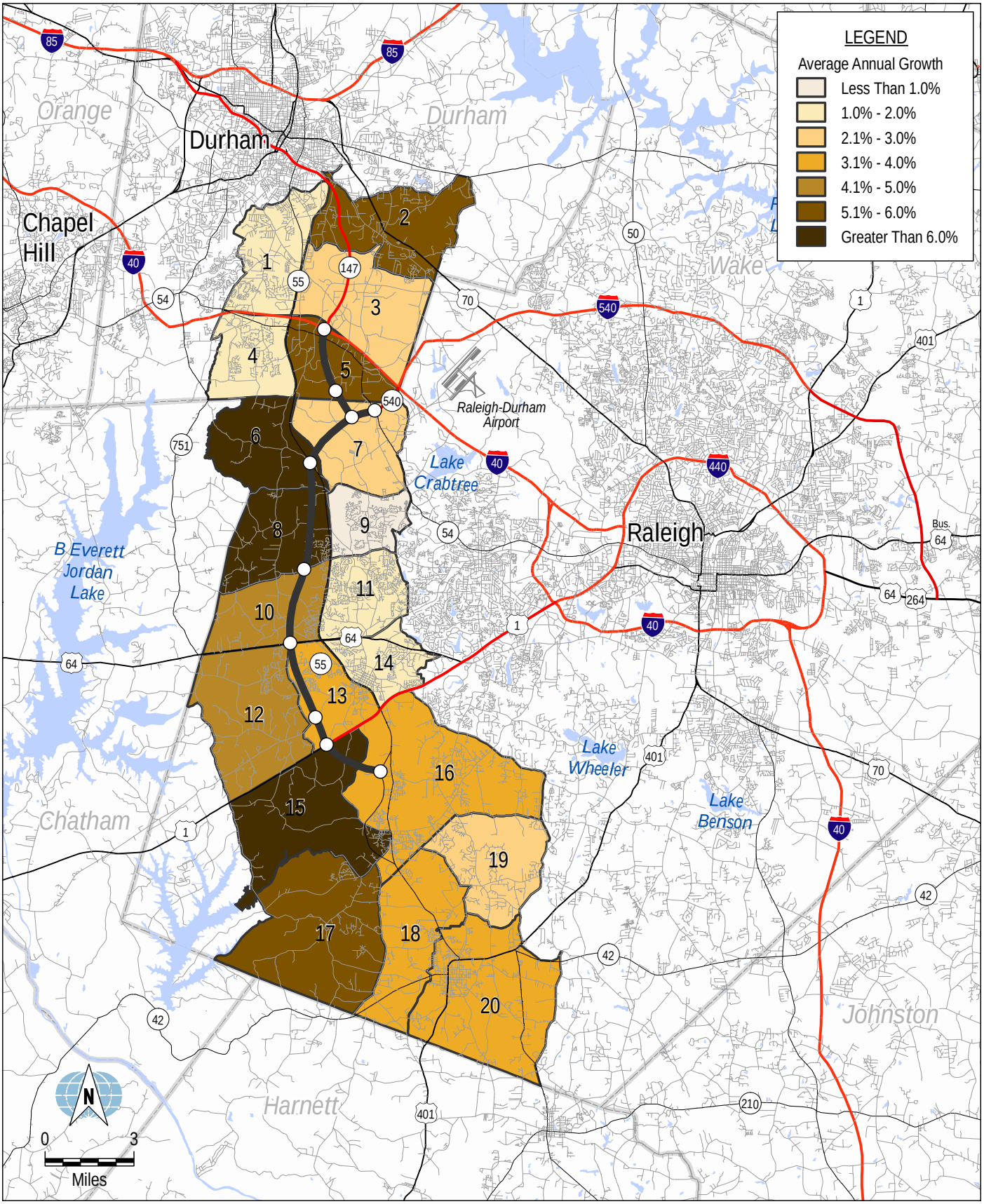
Figure 4-5 illustrates the projected employment growth between 2005 and 2030 for each sector of the study area. While significant employment growth is exhibited throughout the study area, the western and southern

Table 4-3
Study Area Population Projections
Proposed Triangle Expressway

Study Area Sector	2005	Average Annual Growth	2010	Average Annual Growth	2020	Average Annual Growth	2030	Average Annual Growth 2005-2030	Total Growth 2005-2030
1	19,745	1.4%	21,161	1.3%	24,050	1.0%	26,611	1.2%	34.8%
2	6,210	10.0%	9,984	5.1%	16,372	2.7%	21,370	5.1%	244.2%
3	4,678	6.0%	6,252	3.4%	8,772	1.9%	10,610	3.3%	126.8%
4	9,896	1.7%	10,750	1.3%	12,282	0.8%	13,244	1.2%	33.8%
5	1,485	2.3%	1,667	9.1%	3,977	4.4%	6,130	5.8%	312.8%
6	504	68.1%	6,753	9.5%	16,726	3.8%	24,390	16.8%	4742.1%
7	7,003	10.5%	11,538	1.1%	12,840	0.7%	13,726	2.7%	96.0%
8	4,078	23.9%	11,927	2.7%	15,494	1.9%	18,760	6.3%	360.1%
9	11,950	0.5%	12,270	-0.8%	11,368	0.3%	11,684	-0.1%	-2.2%
10	3,085	10.1%	5,000	2.9%	6,668	2.4%	8,447	4.1%	173.8%
11	21,246	1.6%	23,012	0.2%	23,500	1.0%	26,080	0.8%	22.8%
12	5,390	3.8%	6,494	5.7%	11,276	4.5%	17,573	4.8%	226.0%
13	9,267	0.4%	9,434	5.1%	15,572	2.8%	20,534	3.2%	121.6%
14	10,820	1.3%	11,515	1.0%	12,693	1.7%	15,024	1.3%	38.9%
15	1,869	11.4%	3,205	11.5%	9,562	3.9%	14,023	8.4%	650.1%
16	19,509	5.2%	25,104	3.3%	34,752	2.4%	43,983	3.3%	125.4%
17	3,777	9.3%	5,884	5.5%	10,049	3.1%	13,582	5.3%	259.6%
18	5,827	3.7%	6,992	4.8%	11,144	3.0%	14,942	3.8%	156.4%
19	7,934	3.7%	9,514	1.7%	11,240	1.8%	13,411	2.1%	69.0%
20	12,142	4.4%	15,053	4.5%	23,318	2.8%	30,724	3.8%	153.0%
Total Study Area Population	166,416	5.1%	213,510	3.2%	291,656	2.3%	364,849	3.2%	119.2%
Percent of Triangle Region	13.5%		15.2%		16.9%		17.8%		
Triangle Region Population	1,235,663	2.6%	1,403,428	2.1%	1,722,332	1.8%	2,050,416	2.0%	65.9%

Study Area Sector	Population Change 2005-2010	2010-2020	2020-2030	2010-2030
1	1,416	2,888	2,561	6,866
2	3,774	6,388	4,998	15,161
3	1,574	2,520	1,837	5,932
4	854	1,531	962	3,347
5	182	2,310	2,153	4,645
6	6,249	9,973	7,664	23,887
7	4,535	1,302	887	6,723
8	7,849	3,567	3,266	14,683
9	320	-902	315	-266
10	1,915	1,668	1,779	5,362
11	1,766	488	2,580	4,834
12	1,103	4,783	6,297	12,183
13	166	6,138	4,962	11,267
14	696	1,178	2,331	4,205
15	1,336	6,356	4,462	12,154
16	5,595	9,647	9,232	24,474
17	2,107	4,165	3,533	9,805
18	1,165	4,153	3,797	9,115
19	1,580	1,727	2,171	5,477
20	2,911	8,265	7,406	18,581
Total Study Area Population Change	47,095	78,146	73,193	198,433
Triangle Region Population Change	167,765	318,903	328,084	814,753

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone



STUDY AREA POPULATION GROWTH 2005-2030

NORTH CAROLINA Turnpike Authority

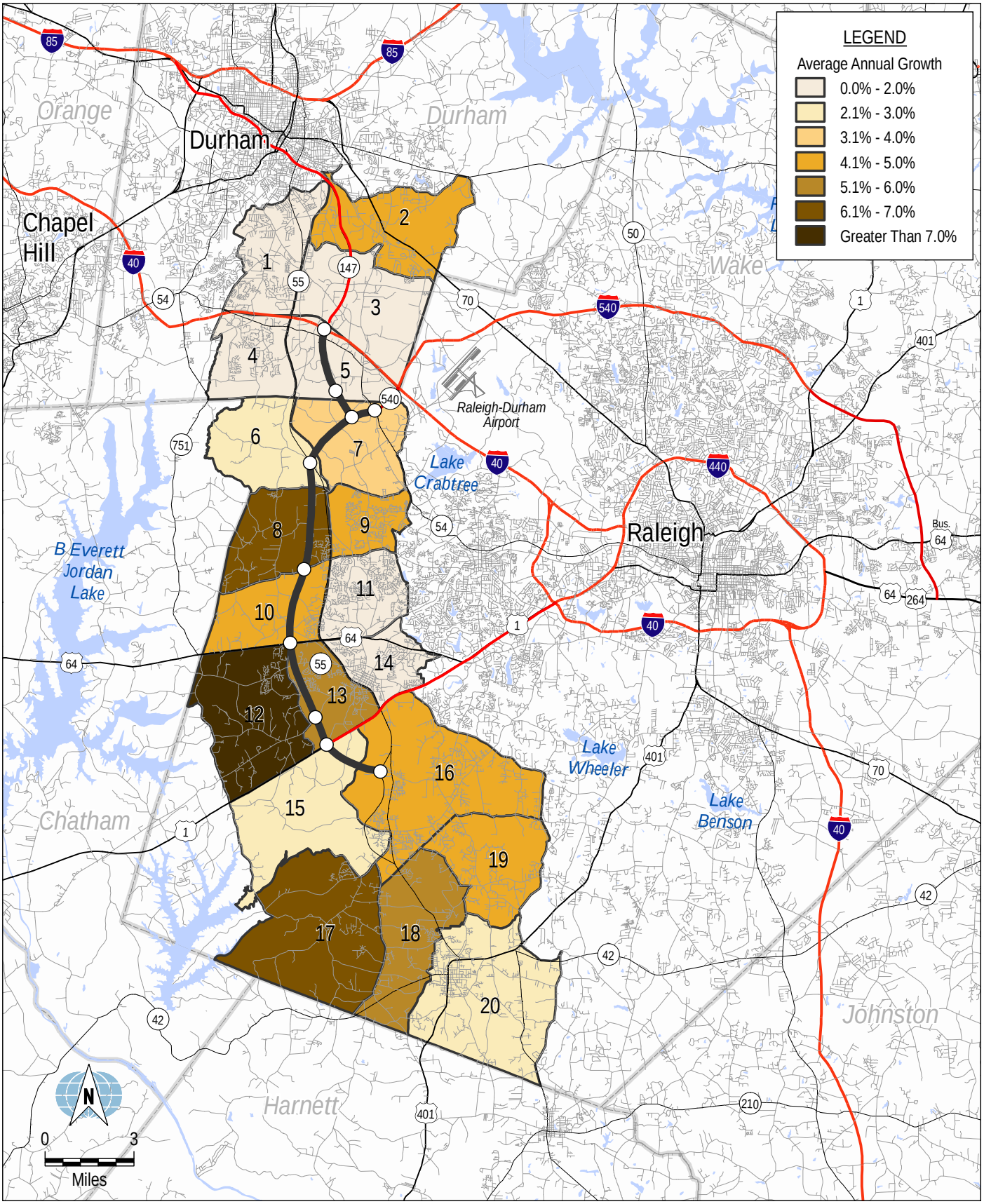
FIGURE 4-4

Table 4-4
Study Area Employment Projections
Proposed Triangle Expressway

Study Area Sector	2005	Average Annual Growth	2010	Average Annual Growth	2020	Average Annual Growth	2030	Average Annual Growth 2005-2030	Total Growth 2005-2030
1	5,886	2.6%	6,699	2.1%	8,254	1.4%	9,485	1.9%	61.1%
2	3,044	2.6%	3,464	2.1%	4,269	7.0%	8,397	4.1%	175.9%
3	29,466	2.3%	33,006	1.9%	39,749	0.3%	41,072	1.3%	39.4%
4	2,876	1.5%	3,094	1.3%	3,506	2.2%	4,373	1.7%	52.1%
5	20,436	3.0%	23,661	2.3%	29,840	0.4%	30,965	1.7%	51.5%
6	6,890	3.5%	8,178	1.9%	9,852	1.9%	11,906	2.2%	72.8%
7	11,997	5.7%	15,845	3.3%	21,876	2.6%	28,197	3.5%	135.0%
8	583	13.1%	1,077	6.2%	1,974	3.6%	2,818	6.5%	383.4%
9	1,699	9.0%	2,608	4.8%	4,181	3.2%	5,712	5.0%	236.3%
10	939	7.3%	1,338	4.1%	2,001	2.9%	2,667	4.3%	183.8%
11	2,284	2.9%	2,637	1.5%	3,046	1.7%	3,589	1.8%	57.1%
12	485	20.6%	1,235	7.9%	2,647	4.1%	3,946	8.7%	713.7%
13	2,363	9.6%	3,743	5.1%	6,149	3.3%	8,476	5.2%	258.8%
14	6,508	2.9%	7,509	1.4%	8,656	1.6%	10,184	1.8%	56.5%
15	5,392	4.7%	6,771	2.7%	8,796	2.3%	11,023	2.9%	104.4%
16	5,978	9.0%	9,188	4.8%	14,727	3.2%	20,129	5.0%	236.7%
17	691	12.8%	1,261	6.2%	2,291	3.6%	3,265	6.4%	372.5%
18	1,446	9.4%	2,271	5.0%	3,705	3.2%	5,094	5.2%	252.2%
19	1,204	7.2%	1,708	4.1%	2,545	2.9%	3,388	4.2%	181.5%
20	4,387	3.8%	5,296	2.1%	6,531	2.0%	7,981	2.4%	81.9%
Total Study Area Employment	114,553	4.2%	140,589	2.8%	184,596	1.9%	222,669	2.7%	94.4%
Percent of Triangle Region	19.0%		20.1%		22.1%		22.2%		
Triangle Region Employment	602,563	3.0%	699,675	1.8%	836,563	1.8%	1,001,494	2.1%	66.2%

Study Area Sector	Employment Change 2005-2010	2010-2020	2020-2030	2010-2030
1	813	1,556	1,231	3,599
2	420	805	4,128	5,353
3	3,540	6,743	1,323	11,606
4	218	413	867	1,497
5	3,225	6,179	1,125	10,529
6	1,288	1,674	2,054	5,016
7	3,848	6,031	6,321	16,199
8	494	897	844	2,235
9	909	1,573	1,532	4,014
10	399	663	666	1,727
11	354	409	543	1,305
12	750	1,412	1,299	3,461
13	1,381	2,406	2,327	6,114
14	1,001	1,146	1,529	3,676
15	1,380	2,025	2,227	5,632
16	3,209	5,539	5,403	14,151
17	570	1,030	974	2,574
18	825	1,435	1,389	3,648
19	504	838	843	2,185
20	910	1,235	1,450	3,595
Total Study Area Employment Change	26,035	44,007	38,072	108,115
Triangle Region Employment Change	97,112	136,888	164,932	398,931

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone



STUDY AREA EMPLOYMENT GROWTH
2005-2030

FIGURE 4-5

sectors are expected to have the highest growth. These areas generally have growth rates that exceed 4 percent per year. The more mature sectors in the northern part of the study area such as the sectors around the highly developed northern portion of RTP have lower expected growth rates. The less developed southern sectors and areas southwest of RTP are expected to grow significantly.

NUMBER OF HOUSEHOLDS

The growth in the number of households in the study area is relative to the expected population growth. Table 4-5 summarizes the households as contained in the Kenan forecasts. In 2005, the number of households in the study area was estimated at over 62,000, which is a 13 percent share of the regional number of households. By 2030 the study area is forecast to increase in households to over 144,000, which would be 17 percent of the region's households. This growth rate of 3.4 percent annually between 2005 and 2030 is significantly higher than the 2.2 percent annual growth rate anticipated for the region. The highest growth rate in the number of households is expected to occur in the southern and western sectors of the study area.

HOUSEHOLD INCOME

Median household incomes by location are summarized in Table 4-6. All values shown are in 2002 dollars. In 2005, the median household income in the region was estimated at $57,667. The Triangle Expressway study area had a 17 percent higher median household income ($67,586) than the region. By 2030, the forecast median household income in the study area is estimated to be 6.5 percent higher than the regional median.

The relatively high household income correlates with the study area's high incidence of residents with college degrees. According to 2000 census data, 44 percent of the study area's population age 25 and older has achieved an education level of Bachelor's Degree or higher compared to the national average of around 24 percent. This important statistic is likely related to the higher skill and knowledge level required by much of the employment in the region, especially that which is affiliated with Research Triangle Park.

Table 4-5
Study Area Households Projections
Proposed Triangle Expressway

Study Area Sector	2005	Average Annual Growth	2010	Average Annual Growth	2020	Average Annual Growth	2030	Average Annual Growth 2005-2030	Total Growth 2005-2030
1	7,982	1.7%	8,693	1.4%	10,026	1.1%	11,160	1.3%	39.8%
2	2,384	10.2%	3,874	5.2%	6,446	2.8%	8,475	5.2%	255.5%
3	1,855	6.1%	2,495	3.5%	3,532	2.0%	4,293	3.4%	131.4%
4	3,964	2.0%	4,374	1.5%	5,074	0.8%	5,516	1.3%	39.2%
5	566	2.7%	647	9.2%	1,561	4.5%	2,422	6.0%	328.2%
6	202	66.6%	2,588	9.8%	6,581	4.0%	9,722	16.8%	4714.0%
7	2,702	11.0%	4,543	1.3%	5,184	0.8%	5,616	3.0%	107.9%
8	1,542	24.5%	4,610	2.9%	6,150	2.1%	7,550	6.6%	389.8%
9	4,642	0.9%	4,867	-0.5%	4,625	0.4%	4,817	0.1%	3.8%
10	1,167	10.6%	1,931	3.2%	2,643	2.5%	3,395	4.4%	191.0%
11	7,158	2.0%	7,905	0.5%	8,314	1.2%	9,383	1.1%	31.1%
12	2,036	4.2%	2,504	5.9%	4,456	4.7%	7,035	5.1%	245.5%
13	3,465	0.8%	3,603	5.3%	6,022	2.9%	8,027	3.4%	131.6%
14	3,954	1.6%	4,291	1.2%	4,840	1.8%	5,798	1.5%	46.6%
15	681	11.7%	1,184	11.8%	3,610	4.0%	5,363	8.6%	687.7%
16	7,063	5.6%	9,292	3.6%	13,183	2.5%	16,906	3.6%	139.4%
17	1,376	9.8%	2,192	5.8%	3,842	3.2%	5,264	5.5%	282.5%
18	2,171	4.1%	2,659	5.0%	4,351	3.1%	5,920	4.1%	172.7%
19	2,934	4.1%	3,585	2.0%	4,352	1.9%	5,270	2.4%	79.6%
20	4,671	4.8%	5,903	4.7%	9,369	2.9%	12,512	4.0%	167.9%
Total Study Area Number of Households	62,513	5.5%	81,740	3.4%	114,161	2.4%	144,444	3.4%	131.1%
Percent of Triangle Region	12.8%		14.5%		16.2%		17.1%		
Triangle Region Number of Households	488,982	2.9%	564,177	2.2%	702,823	1.8%	843,133	2.2%	72.4%

Study Area Sector	Number of Households Change 2005-2010	2010-2020	2020-2030	2010-2030
1	711	1,333	1,134	3,178
2	1,490	2,573	2,028	6,091
3	640	1,037	761	2,438
4	411	700	442	1,552
5	81	913	862	1,857
6	2,386	3,992	3,142	9,520
7	1,841	641	432	2,914
8	3,069	1,539	1,400	6,008
9	225	-242	192	175
10	764	712	752	2,228
11	747	410	1,068	2,225
12	468	1,952	2,580	4,999
13	138	2,419	2,005	4,562
14	337	550	958	1,844
15	503	2,426	1,754	4,682
16	2,229	3,891	3,723	9,843
17	815	1,650	1,423	3,888
18	488	1,692	1,569	3,749
19	652	767	917	2,336
20	1,232	3,466	3,143	7,841
Total Study Area Number of Households Change	19,227	32,421	30,284	81,931
Triangle Region Number of Households Change	75,194	138,646	140,311	354,151

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone

Table 4-6
Study Area Median Household Income
Proposed Triangle Expressway
2002 Dollars

Study Area Sector	2005	2010	2020	2030
1	$49,609	$49,626	$49,511	$49,287
2	51,855	51,068	50,944	51,280
3	60,349	60,654	59,827	58,288
4	70,543	71,354	72,305	72,431
5	56,502	64,746	56,614	52,078
6	64,761	55,984	53,263	53,134
7	54,425	49,204	49,704	51,474
8	69,549	63,933	59,698	56,818
9	89,962	88,288	87,726	87,394
10	85,456	86,404	83,632	80,135
11	87,073	86,850	85,210	83,640
12	63,701	64,197	60,113	56,811
13	66,530	67,043	61,423	60,924
14	78,485	76,093	73,618	71,519
15	65,334	59,584	56,775	54,833
16	64,762	61,816	59,302	57,676
17	61,565	54,617	53,514	52,889
18	58,137	57,152	55,055	54,818
19	89,120	80,093	77,016	75,343
20	49,015	48,518	49,802	50,597
Total Study Area Median Income	$67,583	$64,837	$61,576	$60,082
Percent of Triangle Region	117.2%	113.0%	108.7%	106.5%
Triangle Region Median Income	$57,667	$57,372	$56,640	$56,402

Source: Kenan Institute of Private Enterprise, Summarized by Traffic Analysis Zone

RESEARCH TRIANGLE PARK

The Research Triangle Park (RTP) is a major economic driver in the region. The RTP reports that its corporate occupants employ approximately 44,000 staff and contractors. This employment is expected to grow to 85,000 as the Park builds out its remaining space over the next 20 years. Employees of Park companies are expected to be potential customers of the proposed toll road.

The RTP occupies approximately 7,000 acres with around two thirds of the Park lying south of I-40. The southern portion of RTP is less developed than the northern portion and will accommodate the extensive growth that is anticipated as the Park develops its remaining 1,100 acres. The proposed Triangle Expressway would provide a limited access roadway into the southern portion of the RTP.

ADJUSTMENTS TO TRIANGLE REGIONAL MODEL (TRM)

As discussed earlier, socioeconomic forecasts prepared by the Kenan Institute independent economist were used in the trip generation process for this study. That is, the transportation network representation, trip distribution procedure, and mode choice procedure used in the MPOs' older regional travel demand model (TDM) were used to develop toll traffic forecast for this study; but the socioeconomic data used in the generation, distribution, and mode choice procedures to estimate future traffic are from the forecasts prepared by the independent economist.

Finally, the review of the structure and size of the traffic analysis zones (TAZs) contained in the MPOs' older regional TDM revealed that certain zones along the Expressway study area were not adequate to provide reliable estimates of traffic through proposed tolling locations. In effect, certain TAZs were deemed too large geographically to reflect traffic at the level of detail necessary for the traffic and revenue analysis.

Accordingly, certain TAZs in the northern sectors of the study area near RTP were disaggregated into multiple zones, as were select TAZs in the northern sectors of the Western Wake Freeway. These new zones were coded into the network.

RECENT IMPACTS OF THE RECESSION

Since the completion of the original economic analysis in late 2007, the country has experienced a significant economic downturn that has now been designated as a recession. While it is impossible to predict the depth or length of this recession, it is nevertheless important to review more recent impacts of the recession in the Triangle Region and the potential effect on traffic and revenue.

Several key economic indicators are reviewed in this section in order to provide guidance as to whether or not the local recession impact is significantly different than statewide or national trends. Later in Chapter 6 is a description of the adjustments made to the base forecasts to account for the recession on the Triangle Expressway traffic and revenue forecasts.

HOUSING AND HOUSE PRICES

The change in the number of houses sold in the region and the state began shifting during 2007. Before 2007, the year on year trend was upwards; since that time the trend is negative. Table 4-7 provides details of sales of existing homes for the state and the Triangle MLS Region [(2)] according to Multiple Listing Service information. A key indicator is the percent change in sales for each month in comparison to the same month the previous year. For example the December 2008 sales in the Triangle MLS Region were 47 percent lower than the December 2007 sales. Statewide the percent reduction was nearly 38 percent in December 2008. Overall sales in 2008 were nearly 33 percent lower than 2007 for the region in comparison to a 26 percent reduction statewide. Figure 4-6 illustrates this trend since 2006. Since mid-2007, the regional year on year sales have been negative.

Housing price changes have lagged by a few months compared to the housing sales as summarized in Table 4-7 and illustrated in Figure 4-7. Prices in the Raleigh MLS Region have fluctuated from positive to negative during the third quarter of 2007. In some months of 2008, regional housing prices have been higher than comparable months in 2007. However, average prices from November 2008 have been less than the previous year's prices. On a statewide basis, average housing prices have been less than the comparable month since December 2006. Overall housing prices, while down in recent months in the region, have not be as bad as

(2) The Triangle Multiple Listing Service Region includes all or portions of several counties including Wake, Durham, Orange, Alamance, Caswell, Chatham, Franklin, Granville, Halifax, Harnett, Johnston, Lee, Nash, Person, Vance and Warren.

Table 4-7
Multiple Listing Service Existing Home Sales
North Carolina and Triangle Region

Home Sales

	Triangle Multiple Listing Service Region									All North Carolina Multiple Listing Service Regions								
Month	2005	Percent Change	2006	Percent Change	2007	Percent Change	2008	Percent Change	2009	2005	Percent Change	2006	Percent Change	2007	Percent Change	2008	Percent Change	2009
January	2,000	3.2%	2,063	5.8%	2,183	-28.9%	1,553	-43.4%	879	8,500	0.8%	8,565	-2.1%	8,385	-23.6%	6,408	-36.9%	4,044
February	1,836	34.4%	2,467	-9.7%	2,227	-16.0%	1,871			7,981	19.6%	9,543	-5.6%	9,004	-17.6%	7,421		
March	2,515	19.7%	3,011	1.6%	3,059	-27.5%	2,217			9,984	23.4%	12,317	-6.8%	11,475	-25.5%	8,549		
April	2,714	3.8%	2,818	5.8%	2,982	-24.2%	2,260			11,327	2.5%	11,606	-3.7%	11,179	-24.0%	8,501		
May	3,127	8.3%	3,388	7.9%	3,655	-31.1%	2,517			12,778	4.9%	13,404	-6.5%	12,536	-22.3%	9,735		
June	3,686	6.8%	3,935	1.7%	4,002	-36.8%	2,531			14,044	7.9%	15,157	-11.8%	13,368	-26.4%	9,836		
July	3,883	0.3%	3,895	-10.9%	3,471	-30.2%	2,422			13,977	-1.3%	13,795	-9.4%	12,494	-23.5%	9,552		
August	3,640	1.3%	3,688	-8.3%	3,382	-39.3%	2,053			13,538	2.4%	13,861	-10.2%	12,441	-31.5%	8,527		
September	2,966	4.5%	3,098	-24.2%	2,347	-26.0%	1,736			12,194	-2.2%	11,920	-22.8%	9,203	-19.4%	7,417		
October	3,025	-2.4%	2,953	-14.4%	2,528	-44.7%	1,397			11,499	-1.1%	11,368	-20.5%	9,037	-29.3%	6,389		
November	2,590	-1.3%	2,556	-16.4%	2,138	-44.5%	1,186			10,543	-3.6%	10,160	-18.4%	8,288	-40.2%	4,959		
December	2,923	-13.2%	2,537	-19.0%	2,055	-47.0%	1,089			10,631	-5.6%	10,039	-18.6%	8,176	-37.6%	5,100		
Total	34,905	4.3%	36,409	-6.5%	34,029	-32.9%	22,832		879	136,996	3.5%	141,735	-11.4%	125,586	-26.4%	92,394		4,044

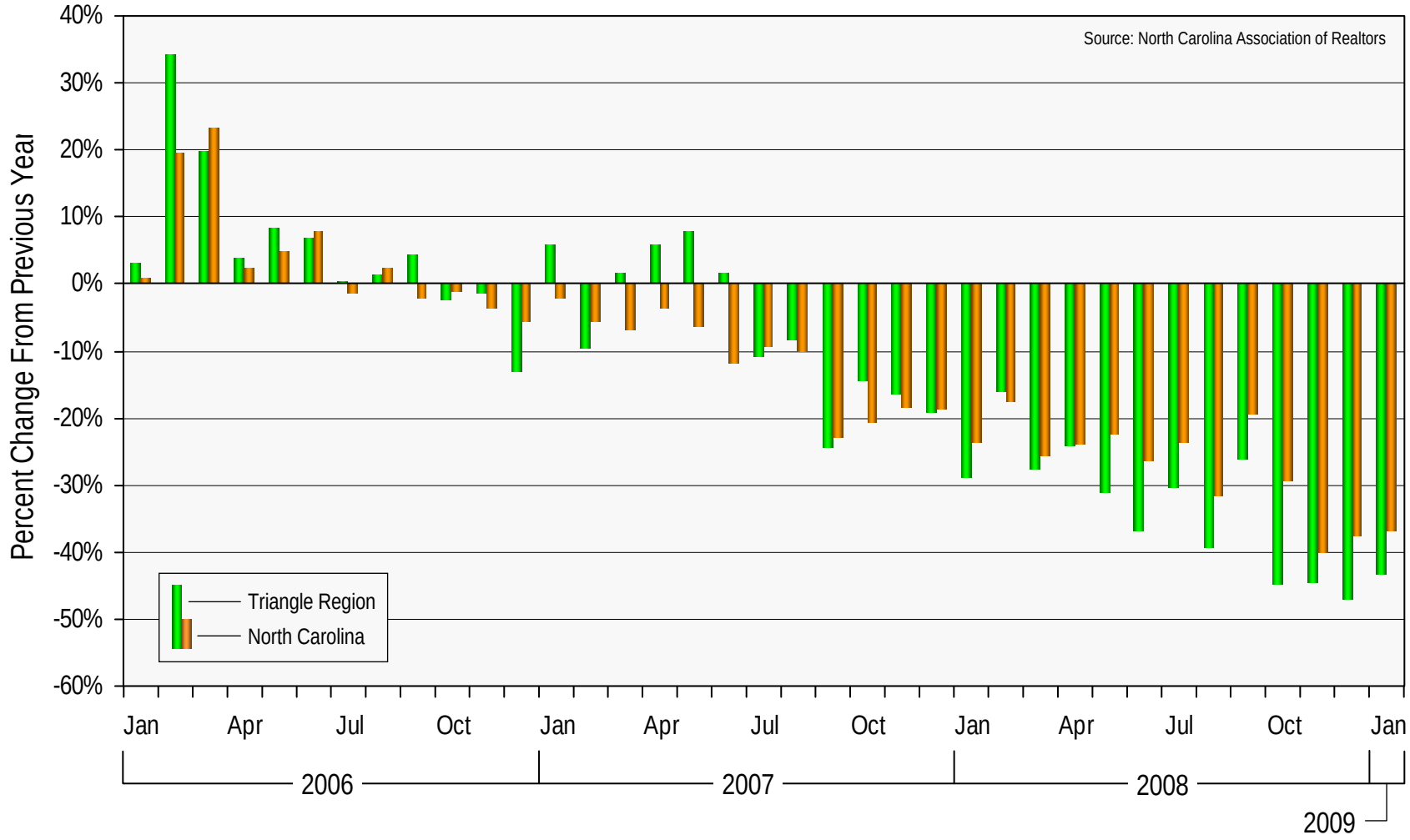
Average Sales Price

	Triangle Multiple Listing Service Region									All North Carolina Multiple Listing Service Regions								
Month	2005	Percent Change	2006	Percent Change	2007	Percent Change	2008	Percent Change	2009	2005	Percent Change	2006	Percent Change	2007	Percent Change	2008	Percent Change	2009
January	$200,000	7.9%	$215,713	4.3%	$225,056	3.6%	$233,236	-3.6%	$224,831	$200,000	3.5%	$206,905	3.1%	$213,258	-0.3%	$212,543	-9.4%	$192,587
February	198,240	-1.3%	195,579	21.1%	236,910	3.1%	244,363			192,963	0.1%	193,064	10.8%	213,879	-3.2%	206,964		
March	209,647	5.1%	220,258	6.1%	233,763	0.6%	235,175			209,421	-1.5%	206,177	6.0%	218,449	-3.3%	211,186		
April	208,877	8.3%	226,248	2.3%	231,549	-1.5%	228,183			202,459	4.5%	211,668	3.9%	219,850	-3.4%	212,396		
May	213,600	6.2%	226,786	5.7%	239,635	2.6%	245,788			209,962	3.0%	216,273	4.8%	226,697	-3.6%	218,647		
June	223,519	8.1%	241,727	0.4%	242,594	5.3%	255,382			217,454	4.5%	227,171	2.4%	232,565	-2.8%	226,032		
July	210,267	10.5%	232,367	6.6%	247,760	-2.6%	241,437			213,136	3.7%	221,059	4.3%	230,604	-4.4%	220,535		
August	218,322	5.8%	230,959	7.2%	247,582	0.2%	248,079			217,552	0.8%	219,224	4.7%	229,432	-3.4%	221,571		
September	222,075	3.4%	229,687	5.7%	242,885	0.0%	242,854			209,751	1.0%	211,877	7.8%	228,483	-7.1%	212,276		
October	219,690	3.4%	227,185	5.6%	239,820	3.7%	248,693			215,769	-1.2%	213,179	2.4%	218,362	-2.2%	213,621		
November	224,045	1.9%	228,241	6.2%	242,316	-6.5%	226,528			214,718	0.4%	215,539	3.3%	222,681	-10.7%	198,908		
December	223,212	6.0%	236,499	0.5%	237,628	-0.3%	236,888			212,282	3.2%	218,999	-0.6%	217,727	-7.6%	201,255		
Annual Average	$215,358	5.5%	$227,155	5.5%	$239,537	0.8%	$241,382		$224,831	$210,550	1.8%	$214,332	4.3%	$223,484	-4.1%	$214,393		$192,587

Note: Data not available for January, 2005. Estimated values shown.

Triangle Multiple Listing Service Region includes all or portions of the following counties: Wake, Durham, Orange, Alamance, Caswell, Chatham, Franklin, Granville, Halifax, Harnett, Johnston, Lee, Nash, Person, Vance, and Warren.

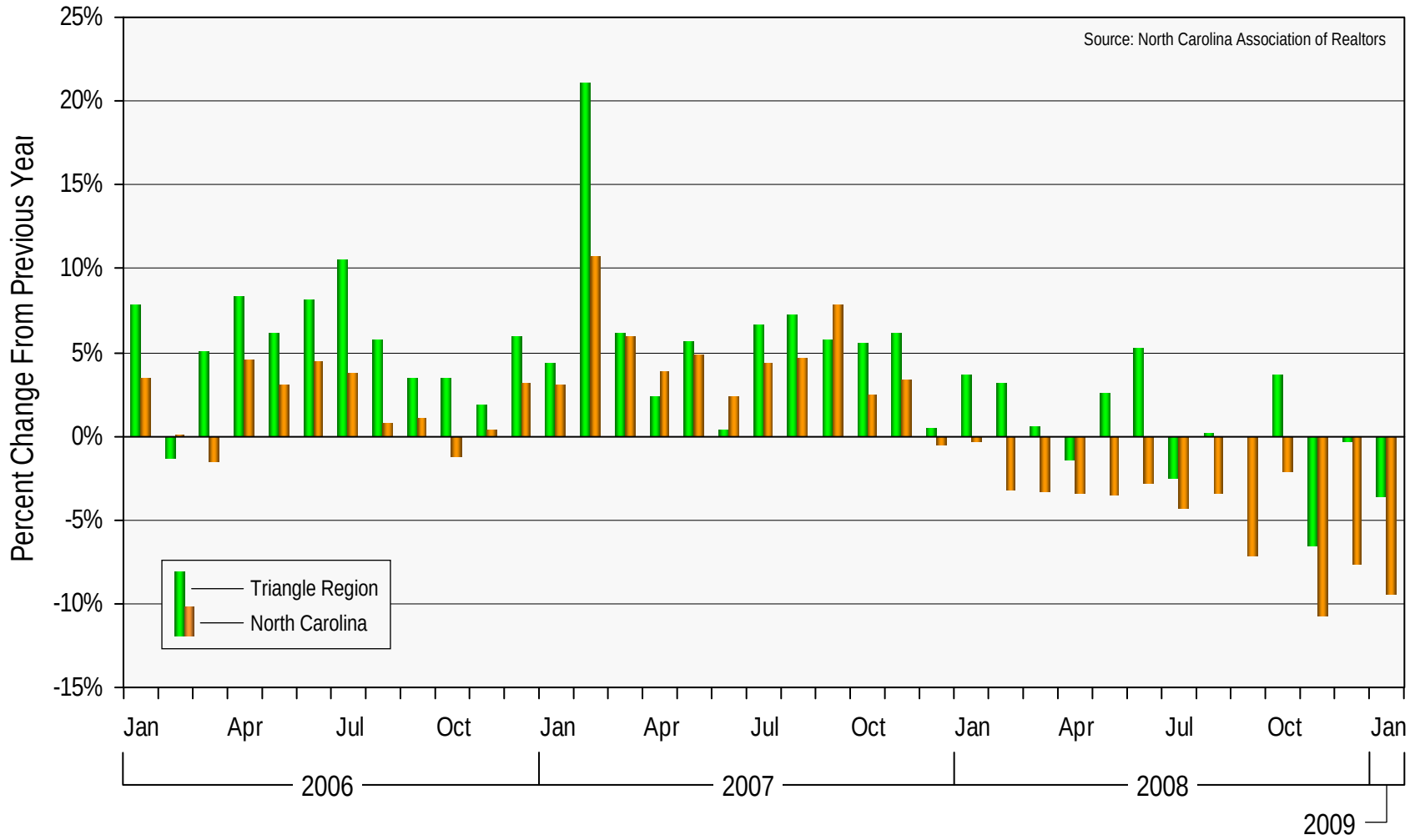
Source: NC Association of Realtors



NORTH CAROLINA Turnpike Authority

HOUSING SALES YEAR OVER YEAR PERCENT CHANGE

FIGURE 4-6



NORTH CAROLINA Turnpike Authority

HOUSING PRICES YEAR OVER YEAR PERCENT CHANGE

FIGURE 4-7

for the state as a whole, and much less of a drop than many other parts of the U.S., which suggests some of the economic strength of the region.

Recent Employment Trends

Table 4-8 summarizes local and state employment information since 2005. Unemployment, a key indicator of the economy's strength, was generally below 4 percent in the Raleigh/Durham/Cary areas between late 2005 and January 2008. This unemployment rate was significantly lower than both the statewide rates and the national rates during the same period. However, beginning in January 2008, unemployment rates have been climbing. In this region, the December 2008 unemployment rate reached 6.3 percent which is over two percentage points lower than the statewide rate of 8.5 percent.

Nationally the unemployment rates in recent months have been lower than North Carolina's as illustrated in Figure 4-8. While all of the recent employment data indicates one measure of this recessionary economy, the Raleigh/Durham/Cary region is at least somewhat better than the state and nation. Figure 4-9 provides comparisons of the December 2008 unemployment on a county basis. Both Wake and Durham Counties are near the regional average in unemployment rates, but Harnett and Johnston Counties are significantly worse. Orange County has a significantly better unemployment rate than the rest of the region and is near the statewide rate.

The Raleigh-Durham area was one of the few regions in the country which actually experienced a slight increase in total employment during 2008. Positive growth in jobs were shown in each month through July 2008, with negative trends beginning well into the second half of the year. In total, about 1,200 jobs were added in the Raleigh-Durham area, during a year which saw a reduction of about three million jobs nationwide.

Employment in the total state, on the other hand, was negative during 2008, with a loss of about 0.9 percent statewide. Much of the job loss occurred in rural areas and in the greater Charlotte region, hit particularly hard due to the concentration of banking interests in that region. The relatively strong employment growth pattern exhibited in the Raleigh-Durham area, as compared with the rest of the state and the nation, underscores the continued benefit of a well educated, high tech employment base.

Airport Activity

Activity at the Raleigh-Durham International Airport is summarized in Table 4-9 and Figure 4-10. Total passengers have declined by 3.1 percent in 2008, and air cargo has declined by 7.7 percent. Passenger activity has

Table 4-8
Regional Employment Trends
Raleigh-Cary and Durham MSAs and North Carolina

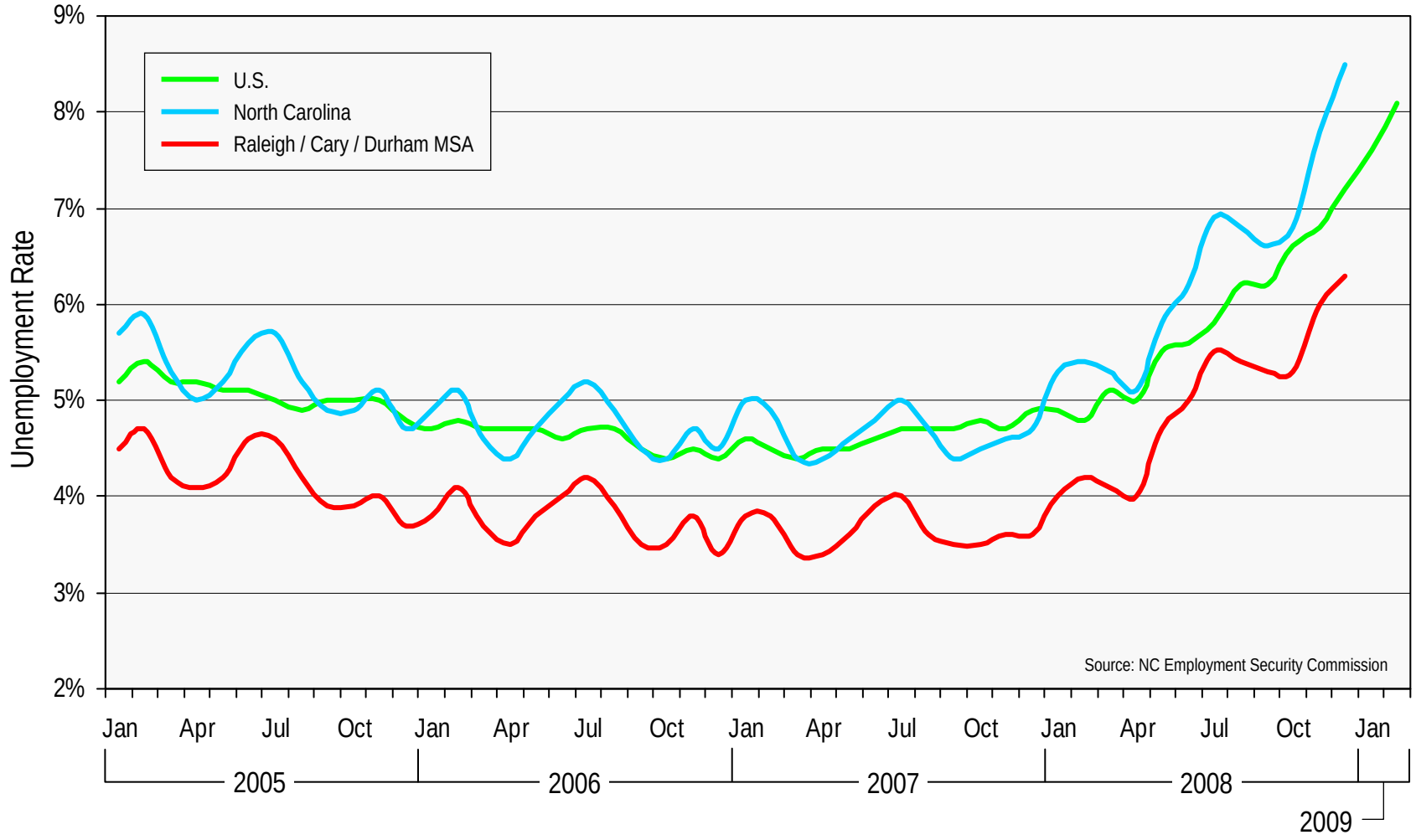
Employment

	Raleigh-Cary MSA and Durham MSA							North Carolina						
Month	2005	Percent Change	2006	Percent Change	2007	Percent Change	2008	2005	Percent Change	2006	Percent Change	2007	Percent Change	2008
January	696,238	4.9%	730,054	2.7%	750,053	1.8%	763,822	4,025,048	2.9%	4,139,840	2.8%	4,257,028	0.4%	4,272,980
February	697,487	5.0%	732,360	3.0%	754,684	1.3%	764,812	4,033,119	2.8%	4,147,639	2.9%	4,268,075	-0.3%	4,255,847
March	703,683	4.8%	737,454	3.1%	760,003	0.8%	766,463	4,066,814	2.8%	4,180,561	2.9%	4,302,311	-0.5%	4,280,356
April	706,729	5.3%	743,980	1.8%	757,123	1.7%	770,268	4,096,268	3.1%	4,222,665	1.6%	4,291,769	0.2%	4,302,076
May	711,682	5.2%	748,487	1.6%	760,616	0.9%	767,208	4,108,371	3.2%	4,238,768	1.7%	4,312,805	-0.4%	4,297,274
June	715,651	5.5%	754,956	1.8%	768,656	0.2%	770,461	4,113,481	3.5%	4,258,467	1.8%	4,336,243	-0.5%	4,316,413
July	729,790	4.8%	765,058	1.5%	776,266	0.9%	783,128	4,144,723	3.4%	4,283,903	1.2%	4,333,862	0.3%	4,344,800
August	727,040	5.1%	763,782	1.0%	771,281	-0.6%	766,874	4,148,343	3.2%	4,281,196	0.8%	4,314,578	-0.8%	4,280,113
September	729,089	4.6%	762,336	1.4%	772,877	-1.1%	764,280	4,154,692	3.0%	4,279,476	1.2%	4,330,984	-1.4%	4,271,774
October	729,445	5.4%	768,720	0.4%	771,490	0.0%	771,399	4,174,674	3.4%	4,316,625	0.3%	4,329,258	-1.0%	4,285,788
November	731,485	5.5%	771,775	0.0%	771,846	-1.7%	759,086	4,160,163	3.8%	4,319,220	0.3%	4,330,248	-2.9%	4,205,375
December	732,854	5.3%	771,955	-0.5%	768,449	-2.5%	749,394	4,153,023	3.9%	4,313,522	-0.4%	4,296,326	-3.4%	4,148,975
Average	717,598	5.1%	754,243	1.5%	765,279	0.2%	766,433	4,114,893	3.2%	4,248,490	1.4%	4,308,624	-0.9%	4,271,814

Unemployment Rate

	Raleigh-Cary MSA and Durham MSA				North Carolina			
Month	2005	2006	2007	2008	2005	2006	2007	2008
January	4.5%	3.8%	3.8%	4.0%	5.7%	4.9%	5.0%	5.3%
February	4.7%	4.1%	3.8%	4.2%	5.9%	5.1%	4.9%	5.4%
March	4.2%	3.7%	3.4%	4.1%	5.3%	4.6%	4.4%	5.3%
April	4.1%	3.5%	3.4%	4.0%	5.0%	4.4%	4.4%	5.1%
May	4.2%	3.8%	3.6%	4.7%	5.2%	4.7%	4.6%	5.8%
June	4.6%	4.0%	3.9%	5.0%	5.6%	5.0%	4.8%	6.2%
July	4.6%	4.2%	4.0%	5.5%	5.7%	5.2%	5.0%	6.9%
August	4.2%	3.9%	3.6%	5.4%	5.2%	4.9%	4.7%	6.8%
September	3.9%	3.5%	3.5%	5.3%	4.9%	4.5%	4.4%	6.6%
October	3.9%	3.5%	3.5%	5.3%	4.9%	4.4%	4.5%	6.8%
November	4.0%	3.8%	3.6%	6.0%	5.1%	4.7%	4.6%	7.8%
December	3.7%	3.4%	3.6%	6.3%	4.7%	4.5%	4.7%	8.5%
Annual Average	4.2%	3.8%	3.7%	5.0%	5.3%	4.7%	4.7%	6.4%

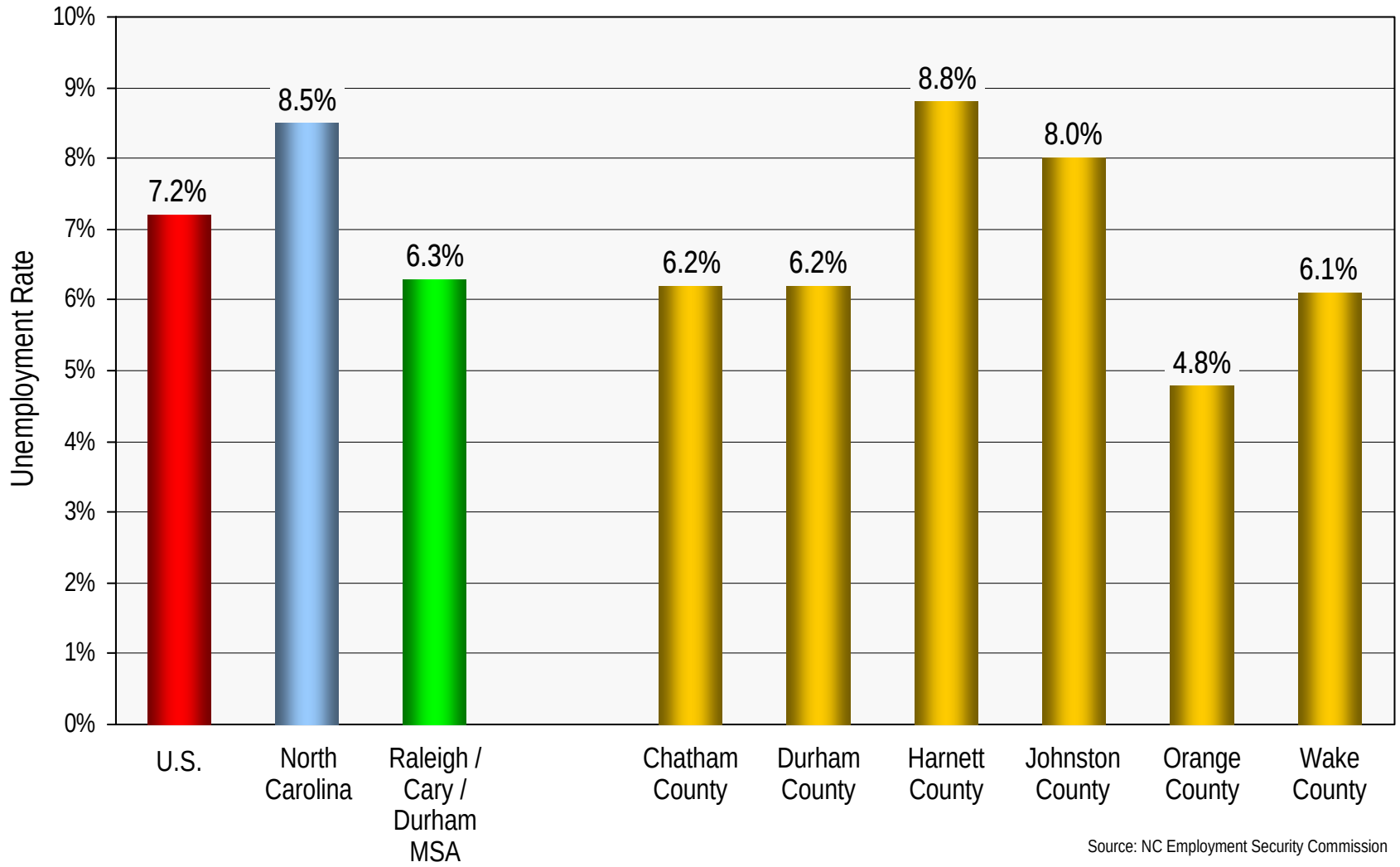
Source: NC Employment Security Commission



NORTH CAROLINA Turnpike Authority

UNEMPLOYMENT RATES

FIGURE 4-8



Source: NC Employment Security Commission

NORTH CAROLINA Turnpike Authority

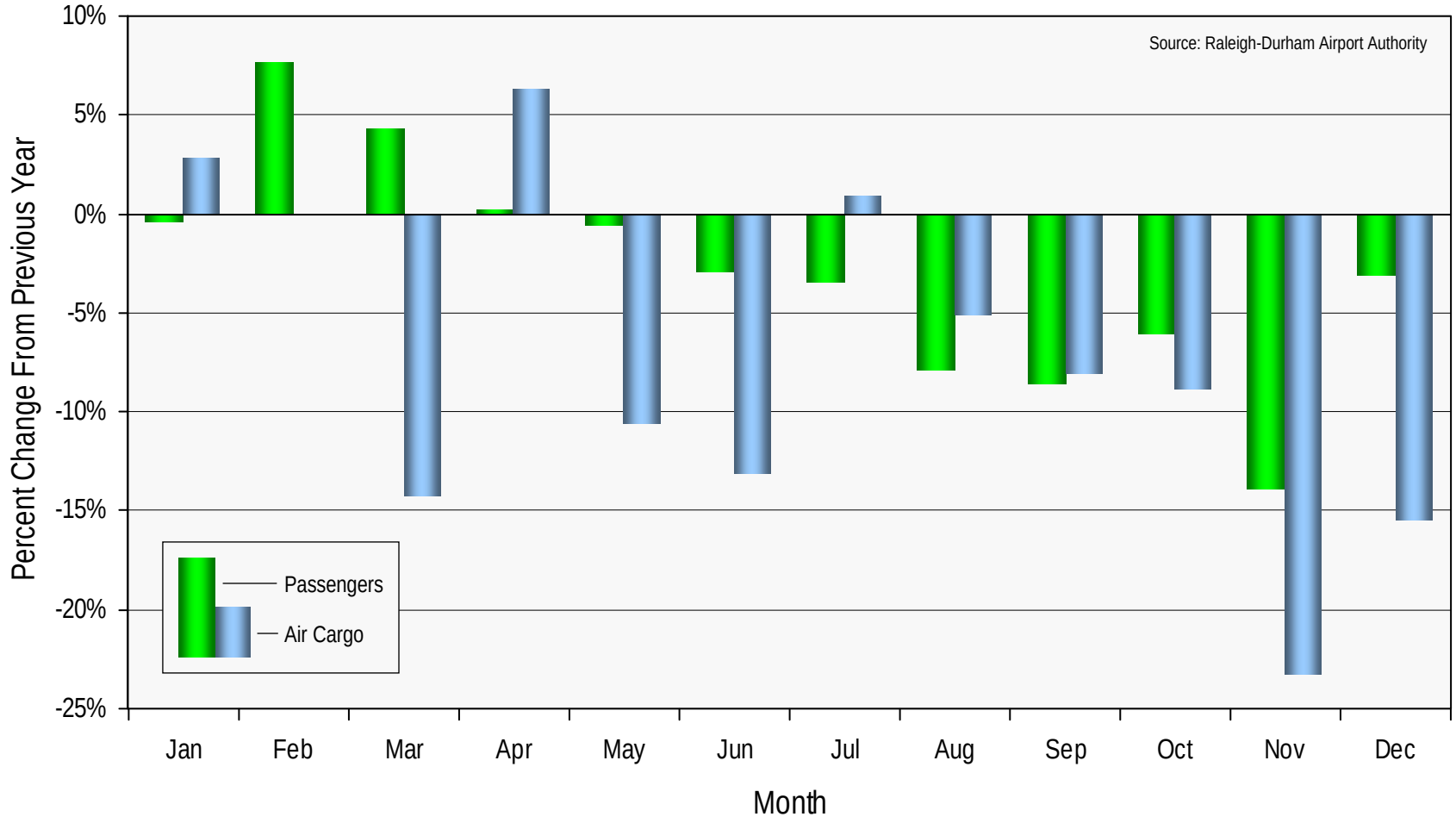
UNEMPLOYMENT BY LOCATION, DECEMBER 2008

FIGURE 4-9

Table 4-9
Passenger and Air Cargo Activity at Raleigh-Durham International Airport

	Passengers			Air Cargo (tons)		
Month	2007	Percent Change	2008	2007	Percent Change	2008
January	705,541	-0.4%	702,546	9,642	2.8%	9,912
February	656,933	7.7%	707,349	9,235	-0.1%	9,228
March	822,932	4.4%	858,732	10,735	-14.3%	9,204
April	842,051	0.3%	844,278	9,025	6.3%	9,598
May	891,087	-0.6%	886,089	10,866	-10.6%	9,711
June	939,086	-2.9%	911,857	10,266	-13.1%	8,920
July	944,075	-3.4%	911,534	9,277	0.9%	9,365
August	938,428	-7.9%	864,717	10,127	-5.1%	9,611
September	773,304	-8.6%	707,142	9,618	-8.0%	8,845
October	874,384	-6.1%	821,358	10,420	-8.9%	9,496
November	845,647	-13.9%	727,930	10,189	-23.3%	7,819
December	797,207	-3.1%	772,394	9,702	-15.5%	8,200
Total	10,030,675	-3.1%	9,715,926	119,101	-7.7%	109,908

Source: Raleigh-Durham Airport Authority



NORTH CAROLINA Turnpike Authority

PASSENGER AND AIR CARGO ACTIVITY AT RALEIGH DURHAM INTERNATIONAL AIRPORT YEAR OVER YEAR PERCENT CHANGE

FIGURE 4-10

been flat or negative in comparison to the same month in the previous year since April 2008. In November 2008 passengers were nearly 14 percent lower than November 2007. December 2008 saw improvement to 3.1 percent lower than then previous December. Air cargo has also decreased significantly in 2008 with November and December being 23 and 15 percent lower than the comparable months the year before.

VEHICLE-MILES OF TRAVEL

Table 4-10 and Figure 4-11 summarize the impact of the recession and higher fuel prices on local, statewide and national travel. In 2006, all North Carolina roads combined exhibited very high growth rates in comparison to the same months in the 2005. Generally the growth rates compared to the 2005 months were over 5 percent. Urban arterial roads in the state had lower growth rates of less than 2 percent over 2005 or even negative in some months. However in late 2006 through late 2007, the annual growth rates began to decline or even turn flat or negative. Late in 2007, vehicle miles of travel in the state and nation turned dramatically downward with peak declines in the spring and summer of 2008 when fuel prices were at their highest. Now, fuel prices have declined significantly since the peak in the summer of 2008, but vehicle mile of travel are still negative on a year on year basis. That is, the negative effects on travel caused in large part by high fuel prices appear to be replaced now by negative effects of the recession. In December 2008, travel increased compared to early months but was still less than the December 2007 travel.

RECESSIONARY IMPACTS

At the time of this report, March 2009, the length, depth, and long term impacts of the recession are unknown. However, economic indicators provide some information that can be used to adjust the traffic and revenue forecasts to address the current economic reality.

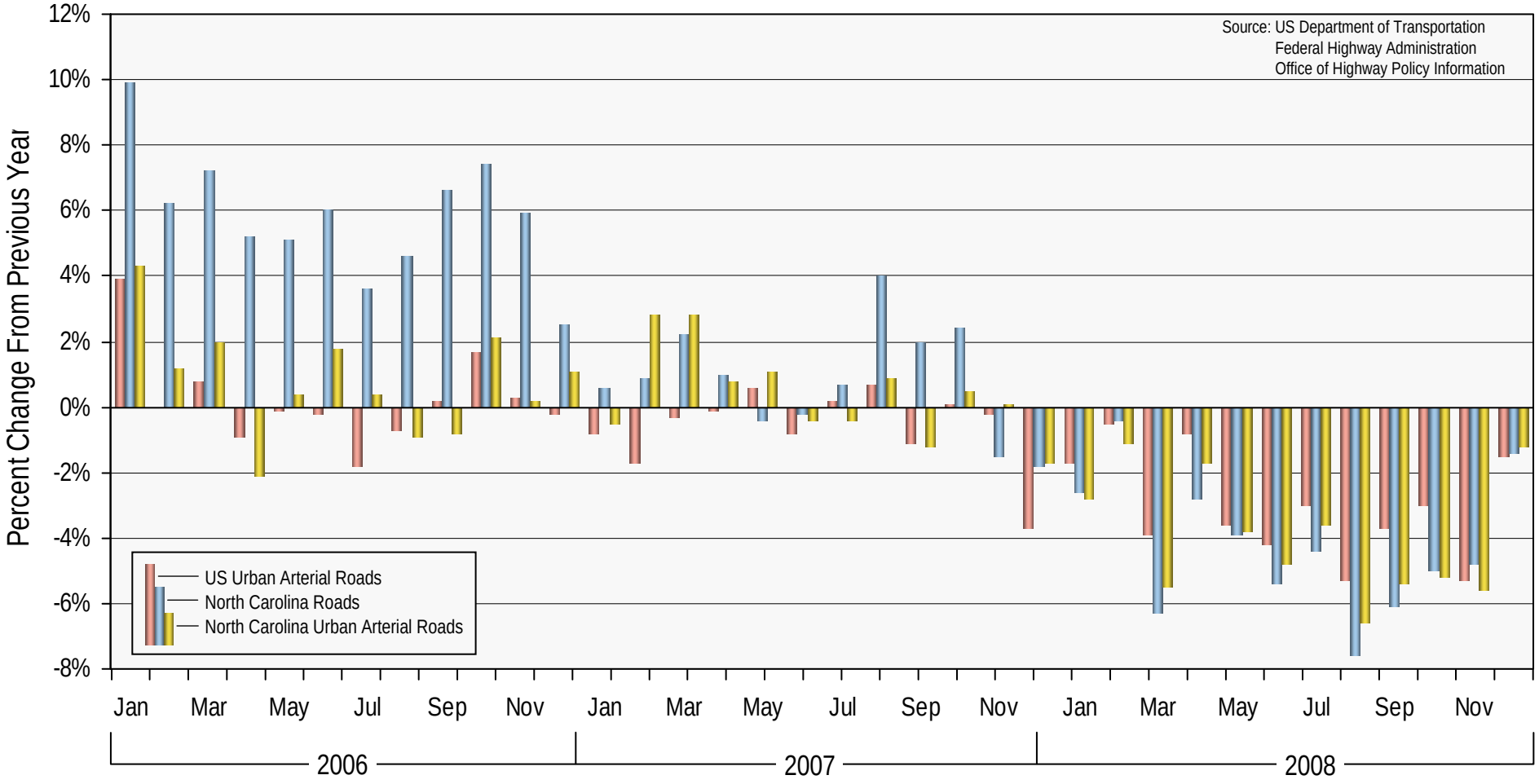
As will be discussed subsequently in Chapter 6, for purposes of developing an updated revenue outlook for the proposed Triangle Expressway, it was assumed that the current economic downturn would bottom out at some point during the second half of 2009. It is further anticipated that economic recovery will begin by the first quarter of 2010. The net effect of the economic downturn is assumed to be represented by a three-year lag in housing and employment growth for the corridor and the overall region. That is, updated estimates of travel demand for the year 2012 were assumed to be represented by previously developed regional travel demand estimates for the year 2009.

A gradual recovery was assumed to take place over several years, reaching prior socioeconomic growth forecast levels by 2030.

Table 4-10
Vehicle Miles of Travel Trends
Percent Change From Previous Year

Month	2006			2007			2008		
	US Urban Arterial Roads	North Carolina All Roads	North Carolina Urban Arterial Roads	US Urban Arterial Roads	North Carolina All Roads	North Carolina Urban Arterial Roads	US Urban Arterial Roads	North Carolina All Roads	North Carolina Urban Arterial Roads
January	3.9%	9.9%	4.3%	-0.8%	0.6%	-0.5%	-1.7%	-2.6%	-2.8%
February	0.0%	6.2%	1.2%	-1.7%	0.9%	2.8%	-0.5%	-0.4%	-1.1%
March	0.8%	7.2%	2.0%	-0.3%	2.2%	2.8%	-3.9%	-6.3%	-5.5%
April	-0.9%	5.2%	-2.1%	-0.1%	1.0%	0.8%	-0.8%	-2.8%	-1.7%
May	-0.1%	5.1%	0.4%	0.6%	-0.4%	1.1%	-3.6%	-3.9%	-3.8%
June	-0.2%	6.0%	1.8%	-0.8%	-0.2%	-0.4%	-4.2%	-5.4%	-4.8%
July	-1.8%	3.6%	0.4%	0.2%	0.7%	-0.4%	-3.0%	-4.4%	-3.6%
August	-0.7%	4.6%	-0.9%	0.7%	4.0%	0.9%	-5.3%	-7.6%	-6.6%
September	0.2%	6.6%	-0.8%	-1.1%	2.0%	-1.2%	-3.7%	-6.1%	-5.4%
October	1.7%	7.4%	2.1%	0.1%	2.4%	0.5%	-3.0%	-5.0%	-5.2%
November	0.3%	5.9%	0.2%	-0.2%	-1.5%	0.1%	-5.3%	-4.8%	-5.6%
December	-0.2%	2.5%	1.1%	-3.7%	-1.8%	-1.7%	-1.5%	-1.4%	-1.2%

Source: Traffic Volume Trends, US Department of Transporation, Federal Highway Administration, Office of Highway Policy Information, Updated Monthly.



NORTH CAROLINA Turnpike Authority

VEHICLE MILES OF TRAVEL
PERCENT CHANGE FROM PREVIOUS YEAR

FIGURE 4-11

CHAPTER 5

TOLL COLLECTION AND VEHICLE CLASSIFICATION

The preliminary studies considered a tolling system that would provide both ETC and cash toll collection on the assumption that providing both options would attract more customers. Estimates of net operating revenue were made on the assumption that 75 percent of the transactions would be by ETC and that 25 percent would be by cash. No discounts were assumed for either ETC or cash toll collection.

However, the toll industry is moving rapidly toward cashless open road tolling (ORT) systems, particularly for newer facilities. In the current study, the concept of a cashless system was examined in detail using a series of assumptions based on the preliminary work. The North Carolina Turnpike Authority subsequently decided to implement an all-electronic, open road tolling system instead of the ETC/cash system assumed for the preliminary studies.

OPEN ROAD TOLLING ANALYSIS

An open road tolling analysis was conducted to provide guidance on continuing with a cash option or converting to a cashless system in which all toll collection would be by ETC or by video identification. Since the assumptions in the earlier study were developed for an ETC/cash system, a new set of assumptions was developed to estimate the proportion of traffic that would use the system if cash payment was no longer an option.

The customer base was divided into several components for this analysis:

- **Open Road Tolling Customers** – These are ETC or video tolling customers.

- **Cash Customers** – These customers would pay cash if that option is available. However, if the cash option is not available, this group would be divided into:
  - Those who would switch to ETC or video tolling, and
  - Those who would choose not to use the toll road.

Assumptions were made regarding the percentage of ETC and video customers, the percentage of cash customers who would divert to the ETC or video if cash payment is not available, and the percentage of cash customers who would not be willing to purchase an ETC device or pay the higher tolls associated with video.

The analysis yielded estimates of annual transactions and toll revenue for a cashless system, which were compared to the estimates of annual transactions and toll revenue from the preliminary studies. Total transactions for the ORT system would be reduced by approximately 15 percent in the early years to approximately 5 percent in the later years in comparison to the ETC/cash system. However, the reduction in transactions would be offset by the higher charges for video tolling, which would result in slightly higher revenues for the ORT system than for the ETC/cash system.

Based on this analysis, the NCTA decided to implement the Triangle Expressway as an all-electronic, open road tolling facility with no cash collection.

VEHICLE CLASSIFICATION SYSTEM AND TOLL RATES

The NCTA decided to use a simplified vehicle classification system as follows:

- **Class 1, Light Vehicles** – Included in this class are automobiles, pickup trucks, passenger and service vans, sports utility vehicles, and motor cycles.
- **Class 2, Medium Vehicles** – Included in this class are single unit trucks larger than pickup trucks including 2-axle, 6-tire vehicles; passenger buses; recreational vehicles and any Class 1 vehicle that is towing a trailer.
- **Class 3, Heavy Trucks** – Included in this class are all multi-unit vehicles with four or more axles and all oversize vehicles.

The toll rate for Class 1 vehicles is the rate on which the rates for other vehicle classes are based. The recommended premiums for Class 2 and Class 3 vehicles are based on a review of the premiums that are charged by other toll agencies for such vehicles. Table 5-1 contains a summary of the rates charged for passenger cars; for 3, 4, 5-axle single unit trucks; and for 6-axle multi unit trucks for 22 urban toll roads. The average rate is between two and three times the passenger vehicle rates. The rates for 5-axle trucks are 3.75 times the passenger car rate on average, and the average rate for 6-axle trucks are 4.50 times the average passenger care rate. Accordingly the following premiums were selected for the Class 2 and Class 3 vehicles:

- **Class 2, Medium (Single-unit) Vehicles** – Two times the Class 1 rate.
- **Class 3, Heavy (Multi-unit) Trucks** – Four times the Class 1 rate.

It is expected that the majority of the Triangle Expressway users would be electronic toll collection (ETC) customers. ETC customers would be identified via radio-frequency transponders attached to the windshield of their vehicles. ETC customers would be charged a lower toll rate that video customers because it is less expensive to match ETC accounts to the NCTA database.

Video toll customers would be identified using digital video capture of their vehicle license plates. Video toll customers would include users with registered video accounts and non-registered users of the toll road. Users that do not register for ETC or video toll accounts would be considered potential customers and provided an opportunity to pay before their transactions are classified as violations. Based on discussions with the NCTA and others, the following rate differentials are recommended for video toll collection and ETC:

- **Video Toll Collection Rates** – The toll rates established for Class 1, Class 2 and Class 3 video toll customers; and

- **Electronic Toll Collection Rates** – The toll rates for Class 1, Class 2 and Class 3 toll customers discounted by no more than 35 percent from the corresponding video rates.

The ETC and video toll rates for each vehicle class were determined through toll rate sensitivity tests as described in Chapter 6.

Table 5-1
Electronic Toll Collection Rates by Toll Agency and Number of Axles

Agency and Facility Name	Length (Miles)	Vehicle Type: Passenger Car		3-Axle Truck/Bus			4-Axle Truck			5-Axle Truck			6-Axle Truck		
		Toll	Cost/ Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile	Toll	Cost/ Mile	Percent of Passenger Toll/Mile
Florida Turnpike Enterprise - Beachline (SR 528) (Orlando)	8.2	$0.50	$0.061	$1.00	$0.122	200%	$1.50	$0.183	300%	$2.00	$0.244	400%	$2.50	$0.305	500%
Florida Turnpike Enterprise - Sawgrass Expressway (Broward County)	20.8	$1.50	$0.072	$3.00	$0.144	200%	$4.50	$0.216	300%	$6.00	$0.288	400%	$7.50	$0.361	500%
Florida Turnpike Enterprise - Seminole Expressway (Orlando)	17.0	$1.50	$0.088	$3.00	$0.177	200%	$4.50	$0.265	300%	$6.00	$0.354	400%	$7.50	$0.442	500%
Florida Turnpike Enterprise - Veterans Expressway (Tampa)	16.0	$1.25	$0.078	$2.50	$0.156	200%	$3.75	$0.234	300%	$5.00	$0.313	400%	$6.25	$0.391	500%
Harris County Toll Road Authority - Hardy Toll Road	21.7	$2.50	$0.115	$6.00	$0.276	240%	$8.00	$0.369	320%	$12.00	$0.553	480%	$15.00	$0.691	600%
Harris County Toll Road Authority - Sam Houston Toll Road	67.0	$9.75	$0.146	$22.75	$0.340	233%	$31.25	$0.466	321%	$39.00	$0.582	400%	$57.50	$0.858	590%
Harris County Toll Road Authority - Westpark Tollway	11.0	$2.50	$0.227	$6.00	$0.545	240%	$8.00	$0.727	320%	$10.00	$0.909	400%	$13.00	$1.182	520%
Miami-Dade Expressway Authority - Don Shula (South Dade) Expressway - SR 874	7.3	$1.00	$0.137	$2.00	$0.274	200%	$3.00	$0.411	300%	$4.00	$0.548	400%	$5.00	$0.685	500%
Miami-Dade Expressway Authority - East-West (Dolphin) Expressway - SR 836	11.0	$1.00	$0.091	$2.00	$0.182	200%	$3.00	$0.273	300%	$4.00	$0.364	400%	$5.00	$0.455	500%
Miami-Dade Expressway Authority - Gratigny Parkway - SR 924	5.4	$1.00	$0.185	$2.00	$0.370	200%	$3.00	$0.556	300%	$4.00	$0.741	400%	$5.00	$0.926	500%
Miami-Dade Expressway Authority - Miami Airport Expressway - SR 112	4.2	$1.00	$0.238	$2.00	$0.476	200%	$3.00	$0.714	300%	$4.00	$0.952	400%	$6.00	$1.429	600%
North Texas Tollway Authority - Dallas North Tollway (DNT)	21.0	$1.80	$0.086	$2.85	$0.136	158%	$3.60	$0.171	200%	$4.35	$0.207	242%	$5.10	$0.243	283%
North Texas Tollway Authority - President George Bush Turnpike (PGBT)	26.0	$3.00	$0.115	$6.00	$0.231	200%	$9.00	$0.346	300%	$12.00	$0.462	400%	$15.00	$0.577	500%
Orlando-Orange County Expressway Authority - Beachline Expressway (SR 528)	24.0	$2.00	$0.083	$3.75	$0.156	188%	$4.75	$0.198	238%	$6.00	$0.250	300%	$6.00	$0.250	300%
Orlando-Orange County Expressway Authority - Central Florida Greeneway	38.0	$3.25	$0.086	$6.00	$0.158	185%	$7.95	$0.209	245%	$9.75	$0.257	300%	$7.50	$0.197	231%
Orlando-Orange County Expressway Authority - East-West Expressway	22.0	$2.50	$0.114	$4.50	$0.205	180%	$5.25	$0.239	210%	$6.75	$0.307	270%	$6.75	$0.307	270%
Osceola County, FL - Osceola Parkway	13.0	$1.00	$0.077	$1.50	$0.115	150%	$2.00	$0.154	200%	$2.50	$0.192	250%	$2.50	$0.192	250%
Tampa-Hillsborough Expressway - Lee Roy Selmon Crosstown Expressway	14.0	$2.50	$0.179	$5.00	$0.357	200%	$7.50	$0.536	300%	$10.00	$0.714	400%	$12.50	$0.893	500%
Transportation Corridor Agencies - Route 133	4.6	$1.25	$0.272	$2.50	$0.543	200%	$2.50	$0.543	200%	$5.00	$1.087	400%	$5.00	$1.087	400%
Transportation Corridor Agencies - Route 241 (1)	24.0	$4.25	$0.177	$8.50	$0.354	200%	$8.50	$0.354	200%	$17.00	$0.708	400%	$17.00	$0.708	400%
Transportation Corridor Agencies - Route 261 (1)	6.6	$1.25	$0.189	$2.50	$0.379	200%	$2.50	$0.379	200%	$5.00	$0.758	400%	$5.00	$0.758	400%
Transportation Corridor Agencies - San Joaquin, Route 73 (1)	15.0	$4.25	$0.283	$8.50	$0.567	200%	$8.50	$0.567	200%	$17.00	$1.133	400%	$17.00	$1.133	400%
Average			$0.141		$0.285	200%		$0.369	250%		$0.542	375%		$0.640	450%

(1) Tolls for peak conditions shown.
Source: Toll Agency Web Sites

TOLL PAYMENT PROCESS AND ENFORCEMENT

Tolls will be set at the video rate, but the NCTA may discount that rate up to 35 percent for vehicles equipped with electronic transponders. Tolls are payable via ETC or video accounts, or at designated payment locations accepting cash and other acceptable forms of payment. The Triangle Expressway will have signage to notify users of the toll payment requirements, payment options (including directions to nearby payment locations accepting cash) and procedures to follow if users do not establish an account or make payment at designated payment locations within 15 days after using the roadway. In summary, unpaid tolls will be enforced generally as follows:

- **Bill for Unpaid Tolls** – If a toll is not paid within 15 days of use of the road, the NCTA will send a bill within 90 days of the first occurrence of an unpaid toll. The bill will contain an image of the vehicle license plate and will list all unpaid tolls from the time of the first unpaid toll. It will explain how to make payment without the imposition of additional processing fees and penalties;
- **Payment Procedures and Processing Fees** – The recipient of a bill for unpaid tolls can pay the bill within 30 days with no additional fees and penalties. If the recipient does not pay within 30 days, the NCTA may re-bill the amount and may add up to a $6 processing fee with a maximum of $48 in processing fees allowed within a calendar year. The processing fee will be based on the additional cost of identifying the user who has not paid a toll. The NCTA will retain processing fee receipts;
- **Civil Penalties** – A recipient of one or more bills during the first or second six-month period in a calendar year and who has not paid the amounts due is subject to a civil penalty of $25. Only one civil penalty will be imposed in the first or second six-month period. This penalty must be collected by the NCTA. Provided, the NCTA can retain only the actual costs of collecting the penalty not to exceed 20 percent of the amount collected. The remaining portion of the penalty, by law, will be deposited to the State's Civil Penalty and Forfeiture Fund;
- **Registration Block** – The NCTA will notify the Commissioner of Motor Vehicles of registered vehicle owners who have not paid tolls, processing fees, or civil penalties. The Commissioner of Motor Vehicles will withhold the vehicle registration renewal of the vehicle until the overdue amounts are paid; and
- **Review and Disputes** – The NCTA will institute appropriate dispute resolution processes including administrative hearings and judicial review.

CHAPTER 6

TRAFFIC AND REVENUE ANALYSIS

Chapter 6 presents a summary of the traffic and revenue analysis conducted for the proposed Triangle Expressway. In addition to an overview of the travel demand modeling process, this chapter also presents information on the regional highway improvement program, basic assumptions upon which the traffic and revenue forecasts are based, a toll rate sensitivity analysis, and the traffic and revenue forecasts for the proposed toll road.

Traffic and revenue forecasts included in this Chapter reflect recent updates intended to recognize the impact of the current local and national economic downturn. Forecasts were originally developed during 2008, using the full methodology described below. Updated estimates, prepared in March 2009 involve the development of new traffic assignments, generally following the methodology described below, but assuming a "three-year lag" in economic development in the early years of the project life, in an attempt to reflect the impact of the current recession.

In addition to assuming a significant lag in development, the new forecasts also recognize a delay in the opening of each phase of the project, by approximately one year. As described in more detail below, the forecast now assumes the first partial phase of the project will be open in 2012 and the first year of the full project operation will be 2013. It is assumed that significant economic recovery will have occurred by the time the project opens and previously anticipated rates of economic growth will resume. However, for purposes of the most recent update, it is assumed that there would be a net three-year lag in economic growth activity in the project corridor, and throughout the Raleigh-Durham area.

The section below provides a description of the full methodology used in the traffic modeling and assignment process. This full process was undertaken in the development of original traffic and revenue findings. In the most recent update, new traffic assignments were performed for each of the modeling years, simply using earlier year regional travel demand estimates to replicate later years, to introduce the net effect of the assumed

three-year lag. For example, updated traffic assignments for the year 2012 were made using trip matrices based on socioeconomic data representative of the year 2009.

In future years, the assumed "lag" was reduced progressively, such that by 2030 economic development in the corridor was assumed to have reached previously anticipated levels.

ANALYTICAL METHODOLOGY

This section describes the general procedures followed to prepare the forecasts of annual toll traffic and gross toll revenue. Figure 6-1 depicts the process schematically.

TRIANGLE REGIONAL TRANSPORTATION DEMAND MODEL

The two Metropolitan Planning Organizations (MPOs) in the region maintain a regional travel demand model, referred to as the Triangle Regional Model (TRM) that was used for this traffic and revenue analysis.

The currently available TRM, which was last updated in November 2006, was used to forecast traffic for this comprehensive traffic and revenue analysis. The two MPOs have subsequently adopted a new TRM using different software and have updated the land use and socioeconomic data used in the trip generation process. However, the new model platform was not ready in time to use in this analysis.

The following steps were used in the modeling process:

MODEL SOFTWARE AND NETWORK

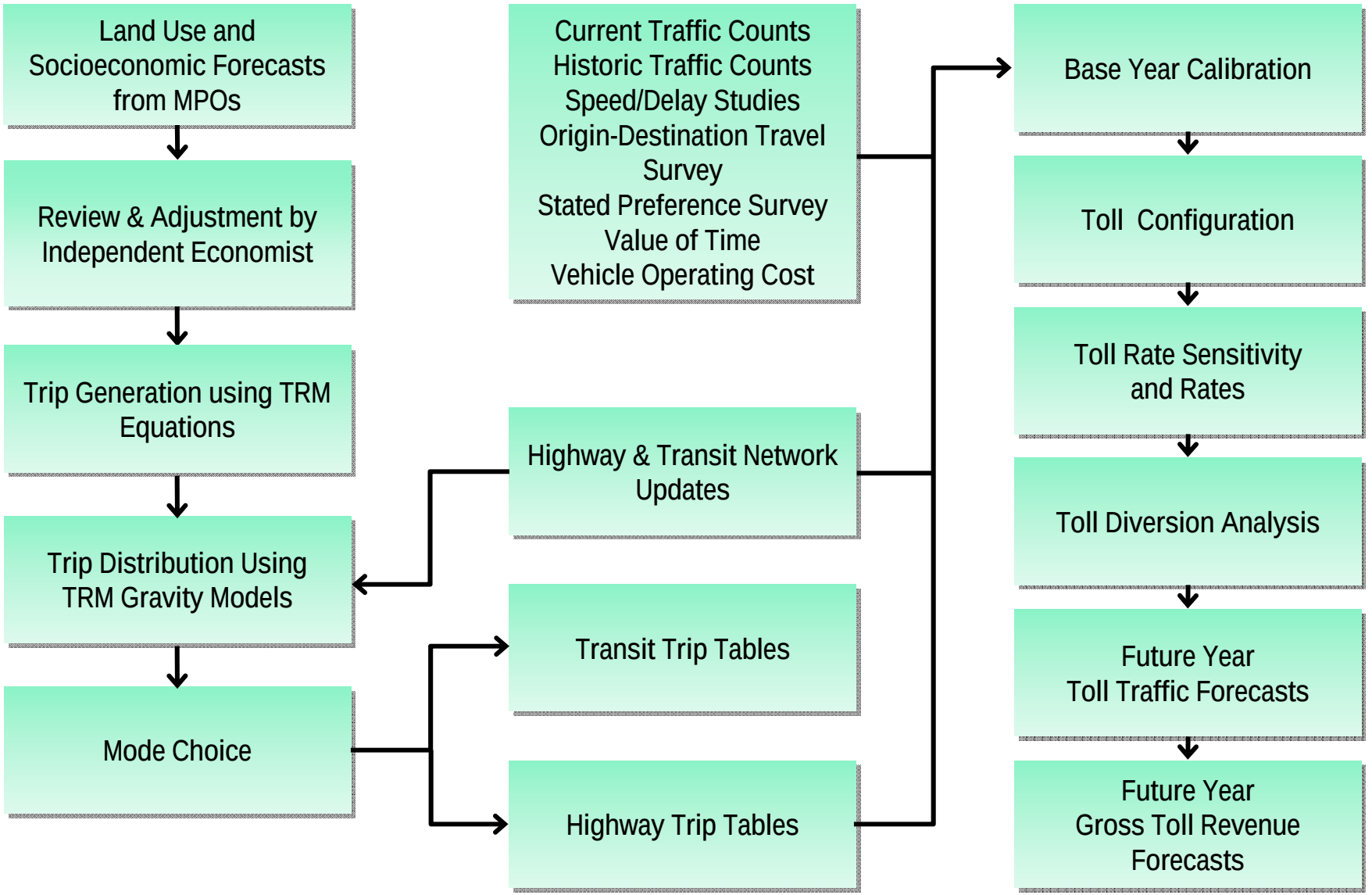
The same model framework and software that was used for the preliminary study was used for this study. Changes to the highway and transit networks to reflect plans adopted after completion of the preliminary study were incorporated.

LAND USE AND SOCIOECONOMIC DATA USED FOR THE TRIP GENERATION PROCESS

Land use and socioeconomic data prepared by the MPOs in 2007 was reviewed by the independent economist. Adjustments to the socioeconomic data in the TRM were made by the economist for use in the trip generation process for this comprehensive study.

TRANSPORTATION ANALYSIS ZONES

The new TRM will use different traffic analysis zones (TAZs) than the current TRM, which was used for this study. Consequently, extensive checking was performed to ensure that the updated socioeconomic data



NORTH CAROLINA Turnpike Authority

TOLL TRAVEL DEMAND MODELING PROCESS

FIGURE 6-1

prepared by the independent economist under the new TAZ structure was allocated properly to the TAZ structure used in current TRM. In addition some of the TAZs were disaggregated into smaller TAZs to allow for a better representation of the roadway system within the study area. Trip tables were disaggregated accordingly to fit this revised TAZ structure.

Future Roadway and Transit Network Review

Highways and transit routes proposed for future improvement in the model were compared with proposed roadway and transit improvements in the Transportation Improvement Plans and Long Range Plans adopted by the two MPOs. In addition the commuter rail service planned for travel between Raleigh and Durham was removed from the network since funding for this project was withdrawn. Special attention was paid to proposed roadway and transit improvements in the Triangle Expressway study area. Detailed coding was added to represent the locations of proposed interchanges and tolling zones.

Trip Generation, Distribution, and Mode Choice

Three standard steps – trip generation, distribution and mode choice – were followed in the modeling process because the socioeconomic data and some highway and transit facilities and services had changed since the preliminary study. In the earlier study, the highway vehicle trip tables prepared by the MPOs formed the basis for the forecasts. In the current study, new vehicle trip tables were prepared based on the updated networks and socioeconomic data.

Model Calibration

The model was calibrated in the vicinity of the proposed Triangle Expressway by comparing model results with traffic volumes and travel speeds observed in the study area. Screenline analyses in the study area resulted in adjustments to travel speeds and trip tables for some movements in order to calibrate the model in the TriEx corridor.

Vehicle Operating Cost

Updates were made to the assumed operating costs of passenger vehicles and trucks using available data from AAA and other sources. Vehicle operating costs reflected an average gasoline price of $3.00 per gallon inflated by 2.5 percent annually for future-year costs. Finally the vehicle operating cost per mile on the toll road was reduced by 15 percent in comparison to the cost on competing roads. This reduction reflects the relative fuel efficiency of a steady speed facility in comparison to the stop and go traffic on congested arterial facilities.

VALUE OF TIME

Estimates of the value of time were calculated using updated median income information at the TAZ level and results of the stated preference survey described earlier. Values of time differed by trip purpose and TAZ. The overall average value of time from passenger cars was $0.225 per minute in peak periods and $0.174 per minute in off-peaks.

TRAFFIC DIVERSION ANALYSIS

Following calibration of the model, a series of traffic assignments were generated for the future years of 2012, 2015, 2020, and 2030 under no build, toll free, and tolled conditions. Several toll rates were tested for the years 2012/2013 and 2030 in order to estimate the optimum toll rates. A toll diversion analysis was conducted using trips tables divided by time period, trip purpose, vehicle type, and toll payment class.

Toll traffic assignments were generated using a diversion assignment technique. This process involved comparing travel time and distance for trips on the Triangle Expressway with trips on the best toll-free alternative routes. The estimated traffic that would be expected to use the Expressway is a function of travel time and distance savings, the assumed monetary value of these savings, and the toll rate being tested in any given assignment. In general, as the total costs to use the proposed toll road increased, the traffic decreased.

The model also recognizes capacity constraints on roadways. Speeds for future-year forecasts were lowered to reflect increasing congestion on both the proposed toll facility and existing toll free roads.

FISCAL YEAR CONVERSION

The forecasts for this study were initially on a calendar-year basis because the TRM parameters were also on a calendar-year basis. These forecasts were later converted to a fiscal-year basis to conform to the NCTA's fiscal year which begins on July 1. The details of the conversion process are presented later in this chapter.

BASIC ASSUMPTIONS

The traffic and revenue estimates for the Triangle Expressway are predicated on the following basic assumptions, which are considered reasonable for purposes of the base case forecast:

1. The Triangle Parkway (NC 147 to NC 540) will open to traffic and NC 540 (NC 54 to NC 55) will convert to a toll section by January 1,

2012. The Western Wake Freeway (NC 55 near Morrisville to NC 55 Bypass near Holly Springs) will open to traffic by January 1, 2013;

2. The existing southern terminus of NC-147 at T.W. Alexander Drive will close upon the completion of the first section of the Triangle Expressway in January 2012;

3. Improvements in the current Transportation Improvement Program, including the widening of some existing toll free routes and construction of HOV lanes on I-40, will be implemented by 2030;

4. Tolls would be charged for three vehicle classes and two payment types and will be increased annually. The toll rates and tolling zone locations will be as shown later in this chapter;

5. No new toll-free facilities or additional capacity will be constructed during the projection period, other than those in the current Transportation Improvement Plan;

6. The system will operate in a cashless environment. Both electronic toll collection and video tolling will be used. However, provisions will be made for drivers to register their license plate by paying in cash at off-site locations;

7. The percentage of ETC and video customers will be as described later in this chapter;

8. Revenue leakage due to unreadable or uncollectible ETC or video transactions, or any transactions that cannot be processed and payment collected will occur. The leakage estimates contained in this report are dependent upon the selection of appropriate toll collection technology and the adoption of business rules and enforcement procedures designed to minimize the loss of revenue;

9. Economic growth in the project study area and associated travel demand would occur as forecast by the independent economist. The current economic recession is assumed to "bottom out" by the end of 2009, with recovery beginning by the first quarter of 2010. For purposes of this analysis, a three-year lag in previously developed socioeconomic forecasts is assumed to represent the net impact of the recession;

10. The traffic and revenue forecasts were then adjusted to estimate the impacts of the current recession;

11. Inflation will average 2.5 percent per year;

12. The Triangle Expressway will be well maintained, efficiently operated, effectively signed, and promoted to encourage maximum usage and to reach the assumed percentage goals for ETC and video usage;

13. Motor fuel will remain in adequate supply throughout the forecast period. Fuel prices are assumed to gradually increase back to levels approaching $3.00 per gallon by 2011, and remain at that level, in real terms after adjustment for inflation, throughout the forecast period; and

14. No national or regional emergency will arise that would abnormally restrict the use of motor vehicles.

Any significant departure from these basic assumptions could materially affect traffic and revenue potential on the proposed Triangle Expressway.

FUTURE ROADWAY IMPROVEMENTS

People's travel behavior and the number of vehicles that would use the proposed Triangle Expressway would be heavily influenced by the operating conditions on other area roadways in the study area. The process of transportation project development and funding makes it impossible to know with certainty which proposed transportation improvements will be implemented and when. However, it is important that reasonable assumptions are made regarding future improvements, since such improvements could have a considerable effect on the number of vehicles that would use the Expressway.

The TRM contains all future highway improvements listed in the two MPOs' fiscally constrained 2030 transportation improvement programs in effect at the time of the analysis. A list of the planned road improvements that could affect traffic volumes on the Triangle Expressway is provided in Table 6-1. The improvements that would have the most significant impact on the operation of the Expressway and the year that they are programmed in the TRM include:

- **Model Year 2012**
  - Widening of T.W. Alexander Drive, Davis Drive, and NC 55;

Table 6-1
Major Highway Improvements Contained in the Triangle Regional Model
Proposed Triangle Expressway

Name and Location	Project Description	Model Year
Garner Road	Walnut Creek Bridge to Martin Luther King Jr., 2-Lanes to 3-Lanes	2012
Edwards Mill Road Extension-Part II	Trinity Road to Chapel Hill Road, New 4-Lane	2012
Davis Drive	Morrisville - Carpenter Road to Farm Pond Road, 2-Lane to 4-Lane	2012
Davis Drive	Morrisville - Carpenter Road to Durham County line, 2-Lane to 4-Lane	2012
South Loop Road	Louis Stephan Drive to Davis Drive, New 4-Lane	2012
NC 54	Trinity Road to Maynard Road, 2-Lane to 4-Lane	2012
High House Road	Davis Drive to NC 55, 2 Lane to 4 Lane	2012
US 70 (Clayton) Bypass	I-40 (South) to US 70 Business, 4 New Lanes	2012
US 1-64	US 64 to Walnut Street, 4-Lanes to 6-Lanes	2012
Louis Stephens Drive Extension	Morrisville Parkway to High House Road, new 2-Lane	2012
Tryon Road	Keisler to Cary Parkway, 2-Lane to 4-Lane	2012
Tryon Road	Cary Parkway to Jones Franklin Road, 2-Lane to 4-Lane	2012
Tryon Road	Jones Frankin Road to Dillard Drive, 2-Lane to 4-Lane	2012
Tryon Road	Gorman Street to Lake Wheeler Road, 2-Lane to 4-Lane	2012
Tryon Road	Norfolk Southern Rail to Existing Tryon Road, 2-Lane to 4-Lane	2012
Tryon Road	New Tryon Road Alignment to South Wilmington Street	2012
County Line Road	North of O'Kelly Chapel to Yates Store Road	2012
NC 55	Carpenter Fire Station Road to Durham County line, 2-Lane to 4-Lane	2012
NC 55	Carpenter Fire Station Road to High House Road, 2-Lane to 4-Lane	2012
NC 55	High House Road to US 64, 2-Lane to 4-Lane	2012
NC 55	Holly Springs Bypass to Wake Chapel Road, 2-Lane to 4-Lane	2012
Airport Boulevard Extension	NC 54 to Davis Drive, New 4-Lane	2020
Timber Drive East	White Oak Road to New Rand Road, New 4-Lane	2020
Hillsborough Street Safety	Gorman Street to Woodburn Road, 4 Lane to 2-Lane	2020
Sunset Lake Road Connector	NC 55 to Optimist Farm Road, 2-Lane to 4-Lane	2020
Davis Drive	Farm Pond Road to US 64, 2-Lane to 4-Lane	2020
Trinity Road	Edwards Mill Road Extension to Trenton Road, 2-Lane to 4-Lane	2020
S.W. Maynard Road	W. Gatham Street to Kildare Farm Pond, 2-Lane to 4-Lane	2020
Old Apex Road	High House Road to Cary Parkway, 2-Lane to 4-Lane	2020
Morrisville Parkway	Davis Drive to NC 55, 2-Lane to 4-Lane	2020
Ten-Ten Road	Holly Springs Road to US 1, 2-Lane to 4-Lane	2020
Blue Ridge Road	Duraleigh Road to Glen Eden Drive, 2-Lane to 4-Lane	2020

(continued)

Table 6-1 (cont'd.)
Major Highway Improvements Contained in the Triangle Regional Model
Proposed Triangle Expressway

Name and Location	Project Description	Model Year
Holly Springs Road	Sunset Lake Road to Old Holly Springs Apex., 2-Lane to 4-Lane	2020
Center Street/1010	US 1 to Apex Peakway, 2-Lane to 4-Lane	2020
Lake Wheeler Road	I-40/I-440 to Tryon Road, 2-Lane to 4-Lane	2020
Tryon Road	Lake Wheeler Road to Norfolk Southern Rail, 2-Lane to 4-Lane	2020
Tryon Road Extension	Garner Road to Rock Quarry Road, New 4-Lane	2020
McCrimmon Parkway	Airport Boulevard to Aviation Parkway, New 4-Lane	2020
NC 55	Olive Chapel Road to US 64, 2-Lane to 4 Lane	2020
NC 55	Apex Peakway (South) to Olive Chapel Road, 2-Lane to 4-Lane	2020
Evans Road	NW Maynard Road to Dynasty Drive, 2-Lane to 4-Lane	2020
I-40 (South)	US 70 to East Parkway, 4-Lane to 6-Lane	2020
I-40 (South)	US 1/64 to Wade Avenue, 4-Lane to 6-Lane	2020
I-40 (South)	I-440 to US 70, 4-Lane to 8-Lane	2020
I-40(South)	US 70 to NC 42, 4-Lane to 8-Lane	2020
Smithfield Road	Carrington Drive to Forestville Road, 2-Lane to 4-Lane	2020
Cary Parkway Extension	Harrison Avenue to Trinity Road, New 2-Lane	2020
Jones Franklin Road	I-440 to Western Boulevard, 2-Lane to 4-Lane	2020
Johnson Pond Road	US 401 to North to Bells Lake Road, 2-Lane to 3-Lane	2030
Ten-Ten Road	Holly Springs Road to Bells Lake Road, 2-Lane to 4-Lane	2030
Kit Creek Road	NC 55 to Green Level to Durham, New 4-Lane	2030
Kit Creek Road	Davis Drive to NC 54, 2-Lane to 3-Lane	2030
Green Level Road to Durham	Green Level West to Jenks Road, 2-Lane to 4-Lane	2030
Green Level Road to Durham	Green Level West to Durham County Line, 2-Lane to 4-Lane	2030
Kelly Road	Jenks Road to Old US 1, 2-Lane to 4-Lane	2030
Olive Chapel Road	Kelly Road to NC 55, 2-Lane to 4-Lane	2030
Apex Peakway	NC 55 to NC 55, 4 New Lanes	2030
Reedy Creek Road	NE Maynard Road to Harrison Avenue, 2-Lane to 3-Lane	2030
New Hope Road	Old Pool Road to Rock Quarry Road, 2-Lane to 4-Lane	2030
NC 55	NC 42 to Harnett County, 2-Lanes to 4-Lanes	2030
Bells Lake Road	Ten-Ten Road to Johnson Pond Road, 2-Lane to 4-Lane	2030
Sunset Lake Road	Davis Drive to NC 55, 2-Lane to 4-Lane	2030
Sunset Lake Road	Hilltop-Needmore Road to Optimist Farm Road, 2-Lane to 4-Lane	2030
Creech/Jones Sausage Connector	Creech Road to Jones Sausage Road, 4 New Lanes	2030

(continued)

Table 6-1 (cont'd.)
Major Highway Improvements Contained in the Triangle Regional Model
Proposed Triangle Expressway

Name and Location	Project Description	Model Year
Rock Quarry Road	New Hope Road to Battle Bridge Road, 2-Lane to 4-Lane	2030
NC 54	NE Maynard Road to NW Maynard Road	2030
East Garner Road	Rock Quarry Road to Shotwell Road, 2-Lane to 4-Lane	2030
Bethlehem Road	Smithfield Road to Grasshopper Road, 2-Lane to 4-Lane	2030
Old Holly Springs Apex Road	Holly Springs Road to Jessi Drive, 2-Lane to 4-Lane	2030
Jessi Drive Part (NL)	Ten-Ten Road to Holly Springs Road, 2-Lane to 4-Lane	2030
Western Boulevard	Gorman Street to Avent Ferry Road, 4-Lane to 6-Lane	2030
Louis Stephens Drive Extension (Part NL)	Durham County Line to O'Kelly Chapel Road, 2-Lane to 4-Lane	2030
Dillard Drive	Jones Franklin Road to Walnut Street, 2-Lane to 4-Lane	2030
Dillard Drive	Tryon Road to Jones Franklin Road, 2-Lane to 4-Lane	2030
Eastern Parkway	US 401 to US 401, New 4-Lane	2030
Hilltop-Needmore Extension (Part NL)	NC 55 (Broad Street) to US 401 New 3-Lane	2030
Western Parkway (Fuquay Varina)	NC 55 to US 401, New 4-Lane	2030
Rock Quarry Road	Old Birch Road to New Hope Road, 2-Lane to 4-Lane	2030
Kildaire Farm Road	Ten-Ten Road to Kildaire Farm Connector, 2-Lane to 4-Lane	2030
Lake Pond Drive/Old Raleigh Road	Cary Parkway to Apex Peakway, 2-Lane to 4-Lane	2030
Penny Road	Ten-Ten Road to Holly Springs Road, 2-Lane to 4-Lane	2030
NC 55 (Main Street)	Holly Springs Road to Bobbitt Road, 2-Lane to 4-Lane	2030
Trinity Road Extension	NC 54 to Cary Town Boulevard, New 4-Lane	2030
New Rand Road	NC 50 to Old Garner Road, 2-Lanre to 4-Lane	2030
I-40 HOV/HOT Project	Durham County Line to I-440/US 1-64	2030
I-40 HOV/HOT Project	I-440/US 1/64 to Johnson County	2030
Morrisville Carpenter Road	NC 54 to Davis Drive, 2-Lane to 4-Lane	2030
Morrisville Carpenter Road	Davis Drive to NC 55, 2-Lane to 4-Lane	2030
Holly Springs Road	Cary Parkway to Penny Road, 2-Lane to 6-Lane	2030
Holly Springs Road	Penny Road to Ten-Ten Road, 2-Lane to 6-Lane	2030
Holly Springs Road	Ten-Ten Road to Kildaire Farm Connector, 2-Lane to 6-Lane	2030
McCrimmon Parkway Extension	Townhall Drive to Louis Stevens Road, 2-Lane to 4-Lane	2030
McCrimmon Parkway Extension	Louis Stevens Rd. to NC 55, New 4-Lane	2030
McCrimmon Parkway Extension	NC 55 to Triangle Expressway, 2-Lane to 4-Lane	2030
McCrimmon Parkway Extension	Davis Drive to NC 55, 2-Lane to 4-Lane	2030
McCrimmon Parkway Extension	Green Level to Durham to Durham County line, New 2-Lane	2030
NC 54	Cary Parkway to McCrimmon Parkway, 2-Lane to 4-Lane	2030

Source: Capital Area Metropolitan Planning Organization, 2030 Long Range Transportation Plan, September, 15, 2004
Durham-Chapel Hill-Carrboro Metropolitan Planning Organization, FY 2006-2012 Metropolitan Transportation Improvement Program

- **Model Year 2020**
  - New roads – Airport Boulevard Extension, McCrimmon Parkway from Airport Boulevard to Aviation Parkway and from Davis Drive to NC 55, Extension of T.W. Alexander from US 70 to Leesville Road;
  - Widening of T.W. Alexander Drive, Davis Drive, McCrimmon Parkway, Morrisville Parkway, NC 54, US 401, I-40 (South), and Ten-Ten Road;

- **Model Year 2030**
  - I-40 – Widening and HOV/HOT Lanes;
  - Other new roads – Extensions of Kit Creek Road and McCrimmon Parkway; and Western Parkway (NC 55 to US 401); and
  - Widening of Morrisville Carpenter Road, NC 147, NC 54, and Ten-Ten Road.

Several of these highway improvements would compete directly with the proposed Triangle Expressway. For example, the widening of NC 55 parallel to the Expressway would affect toll road traffic by increasing free road capacity within the study area. Other new roads would complement the proposed toll road by providing better access to the toll road interchanges. Examples of complementary roads include the extension or widening of Kit Creek Road and Green Level Road.

FUTURE TRANSIT IMPROVEMENTS

Transit service providers, headways, fares and service type data were reviewed for 2010, 2015, 2020, 2025, 2030, and 2035 according to the regional long range transportation plans and transportation improvement programs. Changes to the TRM transit network models were made as necessary to reflect new information.

A regional commuter rail system, proposed by the Triangle Transit Authority, (TTA) was removed from the TRM for this study. It was part of the transit network for the preliminary study. The 28-mile system was planned to connect Chapel Hill and Durham to the Research Triangle Park. However, in August 2006, the TTA decided not to proceed with federal funding for the project. CAMPO and DCHC appointed a Joint MPO Special Transit Advisory Commission (STAC) to draft a Regional Transit Vision Plan to examine goals and objectives for investments in regional transit and make recommendations for future transit projects. With funding for the regional commuter rail project uncertain and regional tran-

sit priorities being studied by the STAC, the rail project was not included in any of the transit networks for the current study.

- **Model Year 2010** - The 2010 network was reviewed using information provided by CAMPO and information contained in the DCHC LRTP and TIP. Overall, 21 new routes were added to the regional transit network, primarily to DATA and CHT. None are in the immediate area of the Triangle Expressway.

- **Model Year 2015** - The 2015 network was updated in a similar way to the 2010 network. The 2010 network was used as a base, assuming that no routes established in 2010 would be eliminated. Thirty-two new routes were added by 2015, with the majority being operated by DATA and therefore not expected to affect Triangle Expressway traffic forecasts.

- **Model Year 2020** - The 2020 transit network included both service changes and changes to existing routes. Fifteen routes were added to the 2020 transit network, with the majority of them being operated by CHT. Two new peak period routes extending from Lillington in Harnett County to the Research Triangle Park were added by TTA. Additionally, the headways of seven routes was reduced by 50 percent.

- **Model Years 2030 and 2035** - The 2030 and 2035 transit networks include 72 additional transit routes throughout the region plus changes to headways.

TOLL STRUCTURE

As discussed in more detail in Chapter 5, the recommended toll structure was established for three vehicle classes. This study evaluates six combinations of vehicle class and toll rate in order to estimate the anticipated traffic and revenue for the Triangle Expressway.

VEHICLE CLASSES

Three vehicle classes are recommended in order to simplify the toll structure for the public. The three vehicle classes are as follows;

- **Class 1, Light Vehicles** – Included in this class are automobiles, pick-up trucks, passenger and service vans, sports utility vehicles, and motorcycles.

- **Class 2, Medium Vehicles** – Included in this class are single unit trucks larger than pickup trucks including 2-axle, 6-tire vehicles, passenger buses, recreational vehicles and any Class 1 vehicle that is towing a trailer. Class 2 toll rates are two times the Class 1 rates.

- **Class 3, Heavy Trucks** – Included in this class are all multi-unit vehicles with four or more axles and all oversize vehicles. Class 3 toll rates are four times the Class 1 rates.

COLLECTION METHODS

Toll rates for the Triangle Expressway would be established for two collection methods – electronic toll collection (ETC) and video toll collection.

Electronic Toll Collection (ETC) – This toll rate is based on the use of an electronic transponder or tag, which identifies the vehicle as it passes through each tolling zone and debits the user's account accordingly. ETC is the preferred methodology for toll collection on the Expressway. ETC is considered highly reliable and is the most convenient and economical method for collecting tolls. It is expected that ETC will be strongly promoted by the North Carolina Turnpike Authority. ETC will be offered at a discount of 35 percent below the video toll rate.

Video Toll Collection (VTC) – This toll rate is based on the use of digital video technology to capture an image of the license plate as the vehicle passes through each tolling zone. The license plate image is compared to the NCTA video account database and the user's account is debited accordingly. The collection and payment process for video toll customers is described in more detail in Chapter 5. The video toll rate for Class 1 vehicles will be the base toll rate for the Triangle Expressway.

Toll road users that do not register for an ETC or VTC account will be identified through license plate video imaging and vehicle registration information provided by the Department of Motor Vehicles or similar agencies in other states. Non-registered users will be considered potential customers and provided an opportunity to pay before their transactions are classified as violations. The Authority will not collect cash payments for tolls on the Triangle Expressway. However, cash payments will be accepted at a designated location in the vicinity of the toll facility where drivers may also open an ETC or VTC account prior to using the facility.

There will be no difference in the video toll rate for registered and non-registered vehicles.

TOLL COLLECTION PERCENTAGES BY COLLECTION METHOD

Table 6-2 shows the model input assumptions of ETC users and video toll users for each modeling year. These "input percentages" are shown separately for Class 1 vehicles and Class 2 and 3 vehicles. The "input percentages" were used as a starting point in apportioning the total number of trips into theoretical market shares.

The lower section of Table 6-2 for each class of vehicle shows the "output percentages" of video users following a toll diversion analysis. Since video users would be subjected to higher toll rates than ETC users, the "output percentages" for video users decreased; hence, the output proportion of video users is lower than the input assumptions. Conversely, the proportion of actual users on the Triangle Expressway with ETC is expected to be higher than the nominal input assumptions.

TOLL RATE SENSITIVITY

Figure 6-2 shows the 2012 Class 1 toll sensitivity curve for ETC and video toll collection assuming the entire toll road was in operation. This year was used to determine the optimum base case toll rate, which is the video toll rate for Class 1 vehicles. In practice, the southern half of the Expressway will now not be opened until 2013, but the rate optimization analysis was performed at 2012 levels for the full project for continuity purposes.

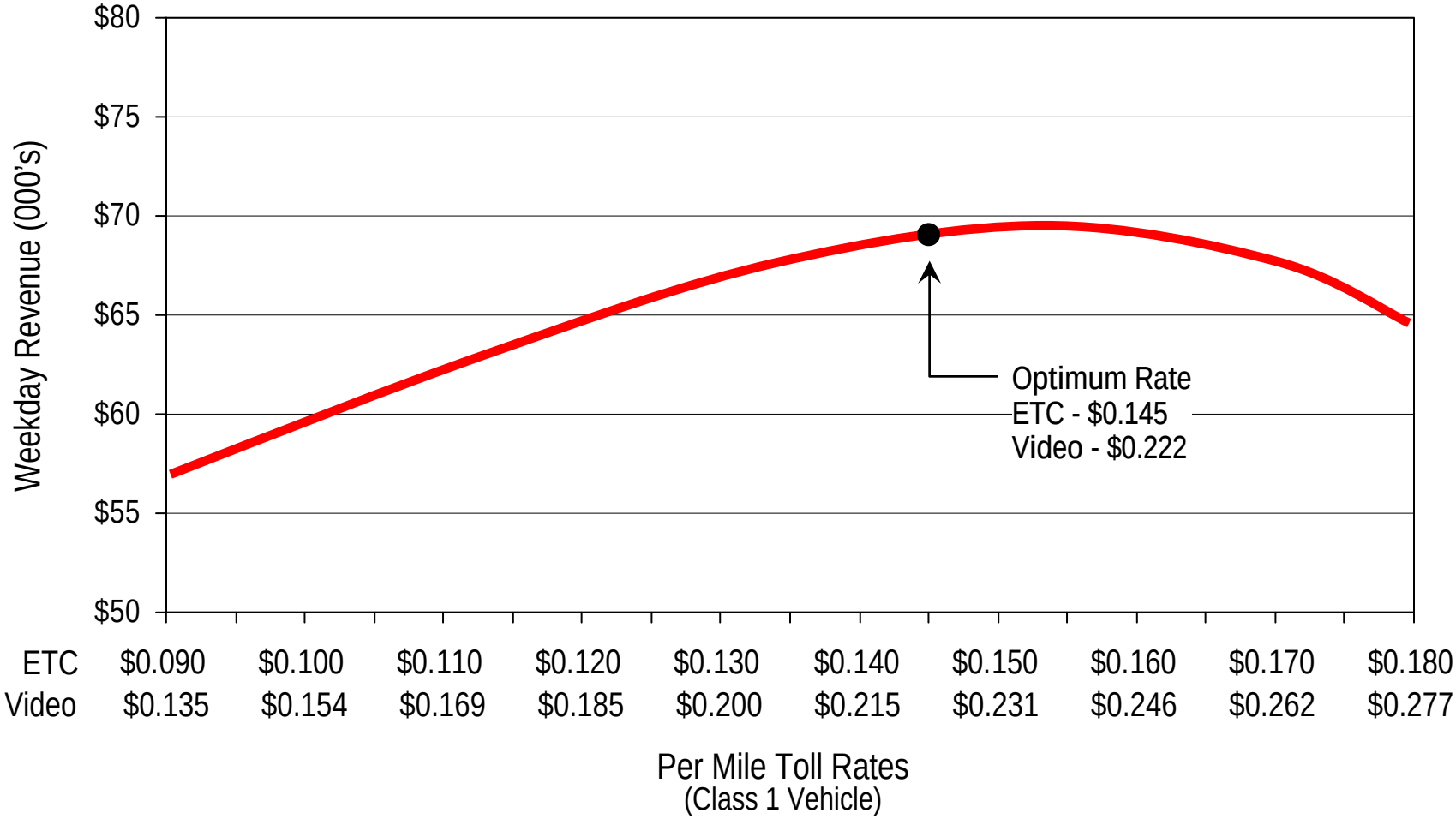
As shown in the figure, the base-case video toll rate for a Class 1 vehicle traveling from NC 55 Bypass near Holly Springs to NC 147 at RTP would be approximately $0.222 per mile. The ETC rate for the same trip for a Class 1 vehicle would be $0.145 per mile. Tolls for registered vehicles would be deducted from the owner's account as the vehicle passes through each toll collection zone. Tolls collected in each zone would be based on the maximum length of travel.

The base toll rate is set slightly below the rate which would maximize toll revenue in order to provide a limited "margin of safety" for setting future rates. Rates were assumed to increase annually as discussed later in this chapter. Table 6-3 compares the ETC toll rate for the Triangle Expressway in 2013 with toll rates for ETC at other comparable toll road facilities. At $0.153 per mile, the Triangle Expressway ETC rate for Class 1 vehicles would be approximately in the mid-range of ETC rates for comparable urban toll roads. The current average is $0.141 per mile.

Table 6-2
Toll Collection Percentages of Total Transactions
Triangle Expressway

	Model Input Assumptions Class 1			Model Input Assumptions Class 2 and 3		
Year	ETC	Video	Total	ETC	Video	Total
2012	65.0%	35.0%	100.0%	80.0%	20.0%	100.0%
2015	70.0%	30.0%	100.0%	85.0%	15.0%	100.0%
2020	77.0%	23.0%	100.0%	89.0%	11.0%	100.0%
2025	81.0%	19.0%	100.0%	89.0%	11.0%	100.0%
2030	84.0%	16.0%	100.0%	89.0%	11.0%	100.0%
2035	84.0%	16.0%	100.0%	89.0%	11.0%	100.0%

	Diversion Model Results Class 1			Diversion Model Results Class 2 and 3		
Year	ETC	Video	Total	ETC	Video	Total
2012	73.0%	27.0%	100.0%	90.9%	9.1%	100.0%
2015	77.1%	22.9%	100.0%	91.0%	9.0%	100.0%
2020	83.2%	16.8%	100.0%	94.2%	5.8%	100.0%
2025	88.3%	11.7%	100.0%	94.5%	5.5%	100.0%
2030	89.5%	10.5%	100.0%	94.5%	5.5%	100.0%
2035	90.3%	9.7%	100.0%	94.8%	5.2%	100.0%



NORTH CAROLINA Turnpike Authority

ESTIMATED 2012 LEVEL SYSTEM TOLL SENSITIVITY CURVE

FIGURE 6-2

Table 6-3

Comparison of Per-mile Electronic Toll Collection Rates
for Selected Urban Toll Roads In Other States
Class 1

Agency and Facility Name	Length (Miles)		ETC Toll	Cost/ Mile
Transportation Corridor Agencies - San Joaquin Hills Tollway	15.0	(1)	$4.25	$0.283
Transportation Corridor Agencies - Foothill/Eastern Tollway	4.6		$1.25	$0.272
E-470 Tollway (Denver, CO)	46.1		$11.00	$0.239
Harris County Toll Road Authority - Westpark Tollway	11.0		$2.50	$0.227
Transportation Corridor Agencies - Route 261	6.6	(1)	$1.25	$0.189
Miami-Dade Expressway Authority - Gratigny Parkway - SR 924	5.4		$1.00	$0.185
Tampa-Hillsborough Expressway Authority - Lee Roy Selmon Crosstown Expressway	14.0		$2.50	$0.179
Transportation Corridor Agencies - Route 241	24.0	(1)	$4.25	$0.177
North Carolina Turnpike Authority - Triangle Expressway (2)	**17.8**	(2)	**$2.72**	**$0.153**
Harris County Toll Road Authority - Sam Houston Tollway	67.0		$9.75	$0.146
Miami-Dade Expressway Authority - Don Shula (South Dade) Expressway - SR 874	7.3		$1.00	$0.137
North Texas Tollway Authority - President George Bush Turnpike (PGBT)	26.0		$3.00	$0.115
Harris County Toll Road Authority - Hardy Toll Road	21.7		$2.50	$0.115
Orlando-Orange County Expressway Authority - East-West Expressway	22.0		$2.50	$0.114
North Texas Tollway Authority - Dallas North Tollway (DNT)	30.1		$3.15	$0.105
Miami-Dade Expressway Authority - East-West (Dolphin) Expressway - SR 836	11.0		$1.00	$0.091
Florida Turnpike Enterprise - Seminole Expressway (Orlando)	17.0		$1.50	$0.088
Orlando-Orange County Expressway Authority - Central Florida Greeneway	38.0		$3.25	$0.086
Orlando-Orange County Expressway Authority - Beachline Expressway (SR 528)	24.0		$2.00	$0.083
Florida Turnpike Enterprise - Veterans Expressway (Tampa)	16.0		$1.25	$0.078
Osceola County, FL - Osceola Parkway	13.0		$1.00	$0.077
Florida Turnpike Enterprise - Sawgrass Expressway (Broward County)	20.8		$1.50	$0.072
Florida Turnpike Enterprise - Beachline (SR 528) (Orlando)	8.2		$0.50	$0.061
Average of other agencies				$0.141

(1) Tolls for peak conditions.

(2) 2013 rates
Maximum distance from NC 147 at I-40 to NC 55 Bypass at Holly Springs.
Rate is for ETC, which is a 35 percent discount from the base video rate of $4.15.

Source: Toll Agency Web Sites

RECOMMENDED TOLL RATES BY LOCATION

Table 6-4 shows annual video toll and electronic toll rates for Class 1 vehicles for each tolling zone in the opening year and extending through 2035. Since the Triangle Expressway will operate as a cashless toll collection system, tolls can be increased relatively easily. In the preliminary study, tolls were assumed to increase every five years beginning in 2015. However, in the current study, small annual increases in toll rates are assumed, rather than large increases every five years.

A Class 2 vehicle would be charged a rate double the Class 1 vehicle rate; and a Class 3 vehicle would be charged four times the Class 1 vehicle rate. The ETC rates would be 35 percent less than the video rates.

Figure 6-3 graphically displays the base video toll rates in 2013, the first year of full operation, and 2030 at each tolling zone location for Class 1, Class 2 and Class 3 vehicles. The opening-year video toll for a full-length trip through four tolling zones on the Triangle Expressway would be $4.15 for Class 1 vehicles, rising to $7.31 by 2030.

Similarly, Figure 6-4 illustrates the ETC toll rates for Class 1 vehicles by location for 2013 and 2030. These rates reflect a 35 percent discount from the video toll rates. The 2013 ETC rate for a full-length trip would be $2.72, rising to $4.78 by 2030.

All rates are in future-year dollars; that is, there would be no further increase for inflation beyond the rates shown. The increase in tolls between the opening year and the later years of operation is slightly greater than the direct effect of inflation, reflecting the need for some level of "real increase" in rates based on the significant increase in traffic demand. The assumed average annual rate increases over time are:

- 2012 – 2015: 5.0 percent;
- 2015 – 2020: 3.5 percent;
- 2020 – 2030: 3.0 percent; and
- After 2030: 3.0 percent or less.

The four proposed mainline tolling zones are indicated in Figure 6-3:

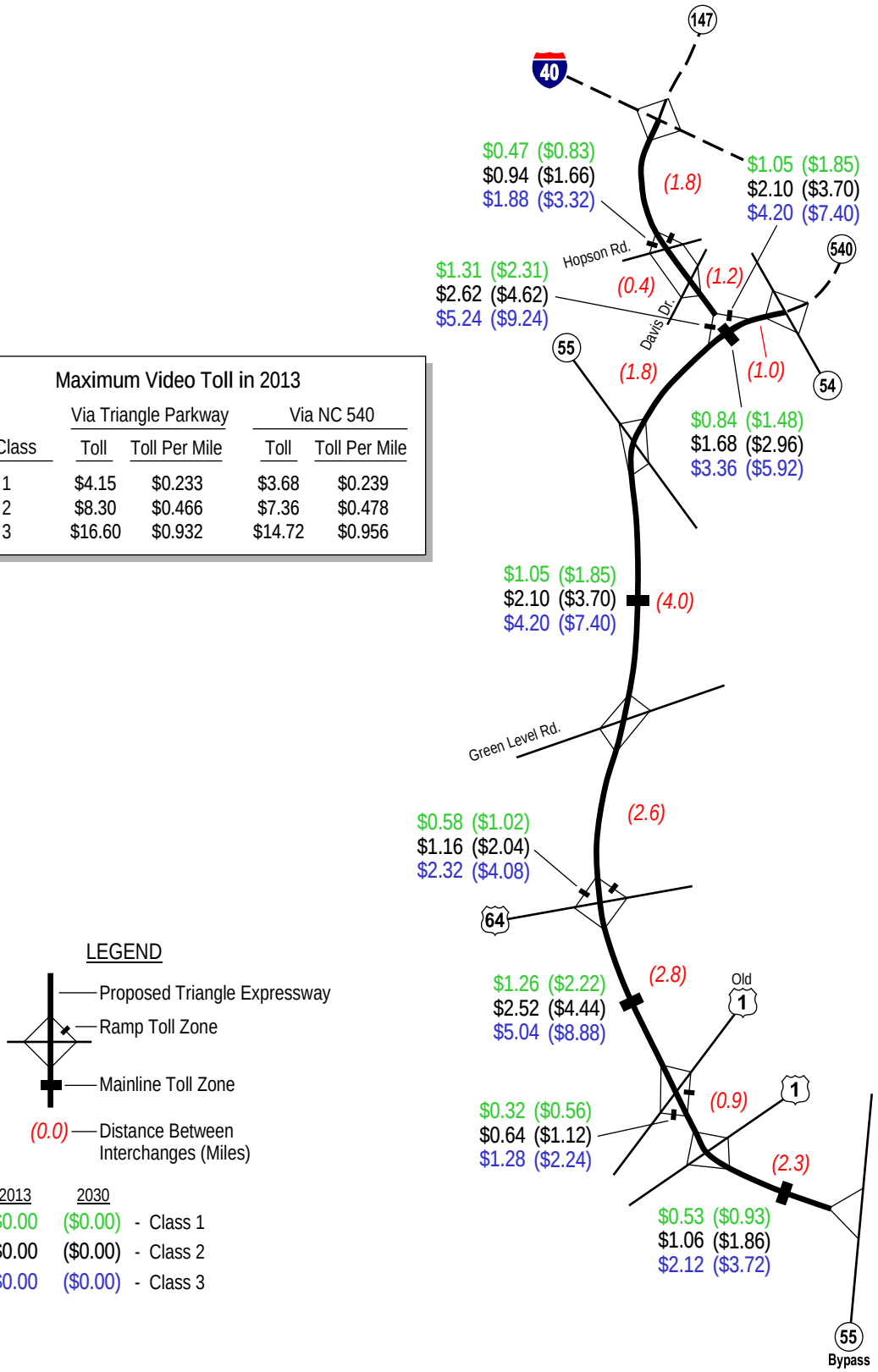
- Between US 1 and NC 55 Bypass;
- Between US 64 and Old US 1;
- Between NC 55 and Green Level Road; and
- Within the interchange of the Triangle Parkway and NC 540.

Table 6-4
Recommended Annual Toll Rates by Tolling Zone
Class 1 - ETC and Video

Year	Hopson Road/ Davis Drive Ramps		Triangle Parkway Ramp to NC 540/NC 54		Triangle Parkway Ramp to NC 540/NC 55		Mainline Zone 1: NC 540 Between Triangle Parkway Ramps		Mainline Zone 2: Between NC 55 & Green Level Road		US 64 Ramps		Mainline Zone 3: Between US 64 & Old US 1		Old US 1 Ramps		Mainline Zone 4: Between US 1 & NC 55 Bypass	
	ETC	Video	ETC	Video	ETC	Video	ETC	Video	ETC	Video	ETC	Video	ETC	Video	ETC	Video	ETC	Video
2012	$0.30	$0.45	$0.65	$1.00	$0.82	$1.25	$0.52	$0.80										
2013	0.31	0.47	0.69	1.05	0.86	1.31	0.55	0.84	0.69	1.05	0.38	0.58	0.82	1.26	0.21	0.32	0.35	0.53
2014	0.33	0.50	0.72	1.10	0.90	1.38	0.58	0.88	0.72	1.10	0.40	0.61	0.86	1.32	0.22	0.33	0.36	0.55
2015	0.34	0.52	0.76	1.16	0.95	1.45	0.61	0.93	0.76	1.16	0.42	0.64	0.91	1.39	0.23	0.35	0.34	0.58
2016	0.36	0.54	0.78	1.20	0.98	1.50	0.63	0.96	0.78	1.20	0.43	0.66	0.94	1.44	0.24	0.36	0.35	0.60
2017	0.37	0.56	0.81	1.24	1.01	1.55	0.65	1.00	0.81	1.24	0.45	0.69	0.97	1.49	0.25	0.37	0.36	0.62
2018	0.38	0.58	0.84	1.29	1.05	1.61	0.67	1.03	0.84	1.29	0.47	0.71	1.01	1.54	0.26	0.39	0.38	0.64
2019	0.39	0.60	0.87	1.33	1.08	1.66	0.70	1.07	0.87	1.33	0.48	0.73	1.04	1.60	0.26	0.40	0.39	0.67
2020	0.41	0.62	0.90	1.38	1.12	1.72	0.72	1.10	0.90	1.38	0.50	0.76	1.08	1.65	0.28	0.42	0.45	0.69
2021	0.42	0.64	0.93	1.42	1.16	1.77	0.74	1.13	0.93	1.42	0.51	0.78	1.11	1.70	0.28	0.43	0.47	0.71
2022	0.43	0.66	0.95	1.46	1.19	1.82	0.77	1.17	0.95	1.46	0.53	0.81	1.14	1.75	0.30	0.45	0.48	0.73
2023	0.45	0.68	0.99	1.51	1.23	1.88	0.78	1.20	0.99	1.51	0.54	0.83	1.17	1.80	0.30	0.46	0.49	0.75
2024	0.46	0.70	1.01	1.55	1.27	1.94	0.81	1.24	1.01	1.55	0.56	0.86	1.21	1.86	0.31	0.47	0.51	0.78
2025	0.47	0.72	1.04	1.60	1.30	1.99	0.84	1.28	1.04	1.60	0.58	0.88	1.25	1.91	0.32	0.49	0.52	0.80
2026	0.49	0.74	1.08	1.65	1.34	2.05	0.86	1.31	1.08	1.65	0.60	0.91	1.29	1.97	0.33	0.50	0.54	0.82
2027	0.50	0.76	1.11	1.70	1.38	2.12	0.88	1.35	1.11	1.70	0.61	0.93	1.32	2.03	0.34	0.52	0.56	0.85
2028	0.52	0.79	1.14	1.75	1.42	2.18	0.91	1.39	1.14	1.75	0.63	0.96	1.36	2.09	0.35	0.53	0.57	0.87
2029	0.53	0.81	1.17	1.80	1.46	2.24	0.94	1.44	1.17	1.80	0.65	0.99	1.40	2.15	0.36	0.55	0.59	0.90
2030	0.54	0.83	1.21	1.85	1.51	2.31	0.97	1.48	1.21	1.85	0.67	1.02	1.45	2.22	0.37	0.56	0.61	0.93
2031	0.56	0.85	1.25	1.91	1.55	2.38	0.99	1.52	1.25	1.91	0.69	1.05	1.49	2.29	0.38	0.58	0.63	0.96
2032	0.58	0.88	1.28	1.96	1.60	2.45	1.03	1.57	1.28	1.96	0.71	1.08	1.54	2.36	0.39	0.59	0.65	0.99
2033	0.60	0.91	1.32	2.02	1.64	2.52	1.06	1.62	1.32	2.02	0.73	1.11	1.58	2.43	0.40	0.61	0.67	1.02
2034	0.61	0.93	1.36	2.08	1.69	2.60	1.09	1.67	1.36	2.08	0.75	1.15	1.63	2.50	0.41	0.63	0.69	1.05
2035	0.63	0.96	1.40	2.14	1.75	2.68	1.12	1.72	1.40	2.14	0.77	1.18	1.68	2.57	0.43	0.65	0.71	1.08

Note:
Class 2 tolls are two times the Class 1 video tolls.
Class 3 tolls are four times the Class 1 video tolls.
Electronic rates are 65 per cent of video rates.

Schematic
Not To Scale



Maximum Video Toll in 2013

Vehicle Class	Via Triangle Parkway Toll	Via Triangle Parkway Toll Per Mile	Via NC 540 Toll	Via NC 540 Toll Per Mile
Class 1	$4.15	$0.233	$3.68	$0.239
Class 2	$8.30	$0.466	$7.36	$0.478
Class 3	$16.60	$0.932	$14.72	$0.956

LEGEND

- Proposed Triangle Expressway
- Ramp Toll Zone
- Mainline Toll Zone
- (0.0) Distance Between Interchanges (Miles)

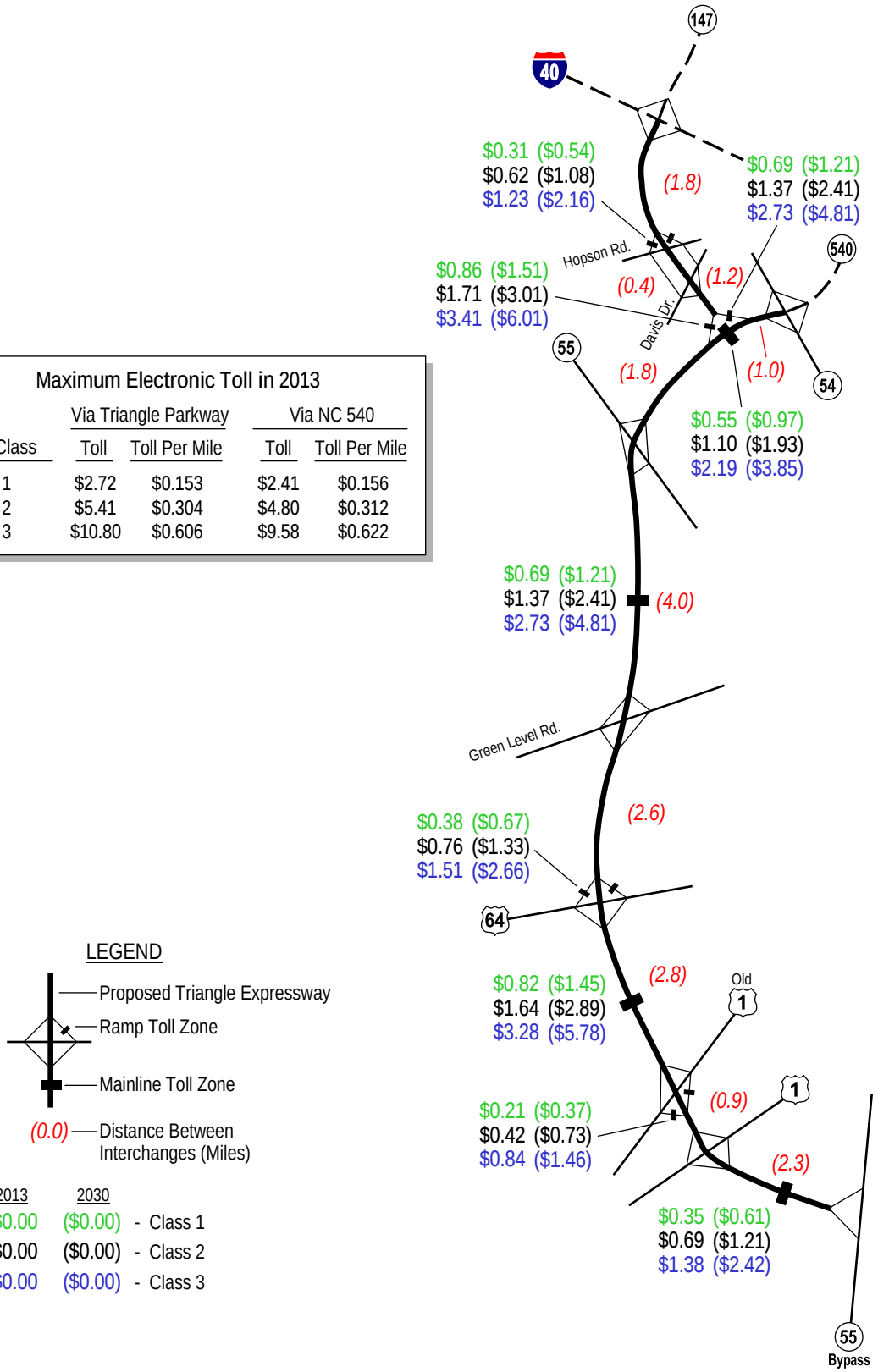
2013	2030	
$0.00	($0.00)	- Class 1
$0.00	($0.00)	- Class 2
$0.00	($0.00)	- Class 3

NORTH CAROLINA Turnpike Authority

COMPARISON OF VIDEO TOLL RATE ASSUMPTIONS

FIGURE 6-3

Schematic
Not To Scale



Maximum Electronic Toll in 2013

Vehicle Class	Via Triangle Parkway Toll	Via Triangle Parkway Toll Per Mile	Via NC 540 Toll	Via NC 540 Toll Per Mile
Class 1	$2.72	$0.153	$2.41	$0.156
Class 2	$5.41	$0.304	$4.80	$0.312
Class 3	$10.80	$0.606	$9.58	$0.622

LEGEND

- Proposed Triangle Expressway
- Ramp Toll Zone
- Mainline Toll Zone
- (0.0) Distance Between Interchanges (Miles)

2013	2030	
$0.00	($0.00)	- Class 1
$0.00	($0.00)	- Class 2
$0.00	($0.00)	- Class 3

NORTH CAROLINA Turnpike Authority

COMPARISON OF ETC TOLL RATE ASSUMPTIONS

FIGURE 6-4

Tolling zones would be established on ramps to and from the south at the Old US 1 interchange; and to and from the north at the Hopson Road/Davis Drive interchange and US 64. Tolling zones would be established on the ramps to and from the Triangle Parkway also. The interchanges at NC 55 Bypass near Holly Springs, NC 54 and I-40/NC 147 would not have tolling zones.

RECESSION IMPACT UPDATE

The current recession will likely induce a "lag" in economic development in the project corridor and throughout the region. Accordingly adjustments were made to the base forecasting models to reflect an assumed three-year lag in economic development as a result of the recession over the first few years of operation with a full economic recovery assumed to occur by sometime between 2020 and 2030. The following adjustments to the base model were made:

- Model runs at 2012 levels were made using trip tables reflecting 2009 levels of economic development (nominal three-year lag);
- Model runs at 2015 levels were made using trip tables reflective of base 2013 economic forecast (nominal lag of two years);
- Model runs at 2020 levels were made using trip tables representative of base 2019 economic conditions (nominal one-year lag); and
- Model runs at 2030 levels were made using the base 2030 trip tables (assumed full recovery from recession).

Opening year traffic assignments were all conducted at 2012 levels, for purposes of continuity with the previous analysis. However, model runs at 2012 were made under two configurations; the partial project which is assumed to be open by January 1, 2012 and the full project which is actually assumed to be open by January 1, 2013. Opening year traffic and revenue forecasts for 2012 reflect only the partial project configuration. 2013 traffic estimates were developed by interpolating full project assignment results made at 2012 with those made at 2015, thereby reflecting one year of additional growth at 2013 levels.

In addition to the specific recession impact approach described above, the updated traffic and revenue model runs also assumed reduced motor fuel costs as compared with forecasts developed in the summer of 2008. Previously, fuel prices were assumed to be in the range of $3.75 - $4.00 per gallon; the new analysis reflected opening year fuel price levels closer to $2.50, assumed to increase nominally to $3.00 and remain generally constant, in real terms, thereafter.

In summary, the update completed in March 2009 reflected both the negative impact of an assumed three-year lag in economic development, offset in part by assumed reduced motor fuel costs. In addition to modifying vehicle cost estimates, the lower fuel cost also enabled WSA to restore the 3 percent reductions in the regionwide trip tables which had been introduced in mid-2008 to reflect the effect of higher gas prices.

ESTIMATED WEEKDAY TRAFFIC VOLUMES

Estimates of weekday traffic volumes in 2013 are shown in Figure 6-5. The highest volume would occur between NC 55 and the junction of the Triangle Parkway and NC 540 where traffic is estimated at 22,800 vehicles per day in 2013. The lowest volume would occur between US 1 and NC 55 Bypass where 11,200 vehicles per day are expected. Traffic along the Triangle Parkway between NC 540 and NC 147 is estimated to range from 17,700 to 19,800 vehicles per day. The traffic volumes shown do not yet reflect downward "ramp-up" adjustments, which are incorporated later in the annual forecasts.

Figures 6-6 and 6-7 show estimated weekday traffic volumes in Year 2020 in Year 2030, respectively. Year 2030 is the most distant year actually modeled for purposes of the analysis. Traffic volumes in 2030 are estimated to reach 61,600 vehicles per day between Green Level Road and US 64. This is well within the available capacity of the planned six-lane toll road.

ESTIMATED ANNUAL TRAFFIC AND REVENUE

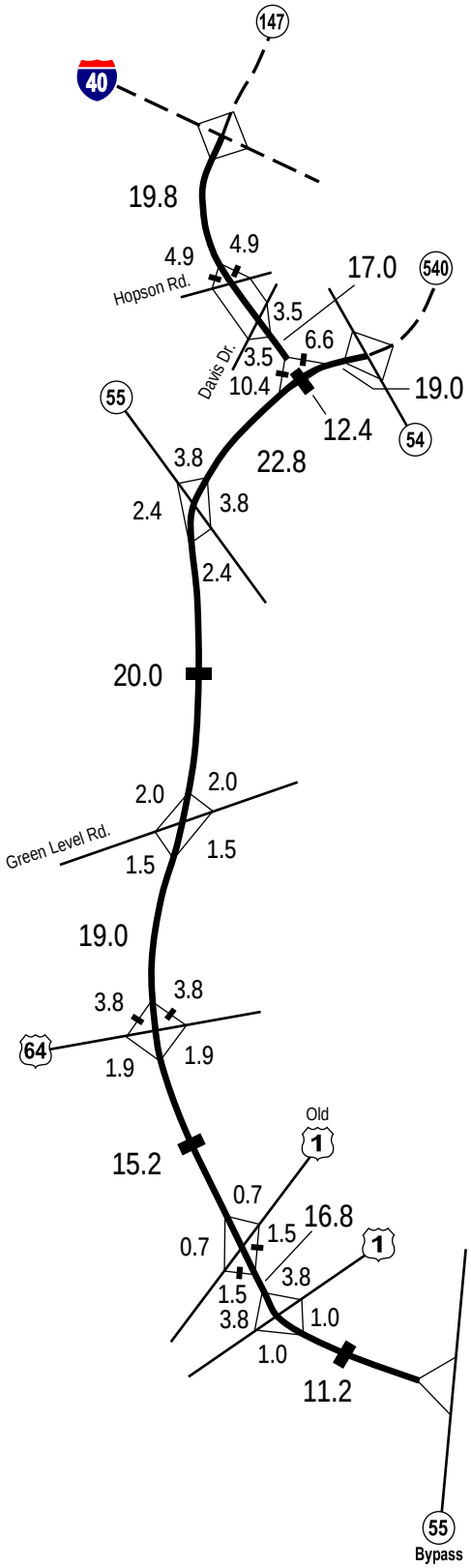
FY 2013 Weekday Transactions and Revenue

Weekday traffic by vehicle class was calculated for each tolling zone and multiplied by the recommended ETC or video toll rate to develop estimates of weekday revenue. The weekday revenue estimates were then annualized and converted to fiscal years. Table 6-5 shows the toll transactions and gross revenue projections by vehicle class and toll rate for 2012 and 2013 and the conversion process to yield FY 2013 forecasts of transactions and gross toll revenue.

Fiscal Year Conversion

Transaction and revenue forecasts on a calendar-year basis were divided in half and allocated to the appropriate fiscal year, which is assumed to run from July 1 of one calendar year to June 30 of the following calendar year. Since the two sections of the Triangle Expressway will open in different calendar years, the transaction and revenue forecasts were estimated and

Schematic
Not To Scale



LEGEND

Proposed Triangle Expressway

Ramp Toll Zone

Mainline Toll Zone

00.0 — Mainline Traffic

00.0 — Ramp Traffic

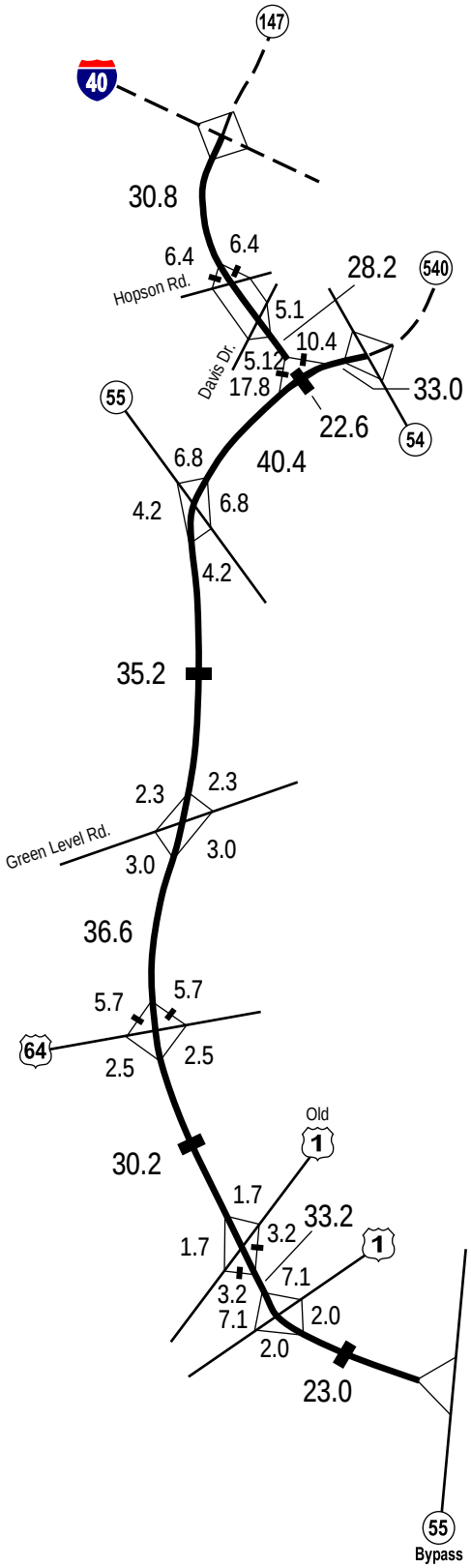
Note: Volumes are in thousands.

NORTH CAROLINA Turnpike Authority

ESTIMATED WEEKDAY TRAFFIC - 2013
CALENDAR YEAR BASIS

FIGURE 6-5

Schematic
Not To Scale



LEGEND

Proposed Triangle Expressway
Ramp Toll Zone
Mainline Toll Zone

00.0 — Mainline Traffic
00.0 — Ramp Traffic

Note: Volumes are in thousands.

NORTH CAROLINA Turnpike Authority

ESTIMATED WEEKDAY TRAFFIC - 2020
CALENDAR YEAR BASIS

FIGURE 6-6

Schematic
Not To Scale

LEGEND

Proposed Triangle Expressway
Ramp Toll Zone
Mainline Toll Zone

00.0 — Mainline Traffic
00.0 — Ramp Traffic

Note: Volumes are in thousands.

NORTH CAROLINA Turnpike Authority

ESTIMATED WEEKDAY TRAFFIC - 2030
CALENDAR YEAR BASIS

FIGURE 6-7

Table 6-5
Toll Transactions and Gross Toll Revenue Estimates, Fiscal Year 2013
Triangle Expressway

Toll Zone	Class 1 ETC	Class 1 Video	Class 2 ETC	Class 2 Video	Class 3 ETC	Class 3 Video	Total
Weekday Transactions - Calendar Year 2012							
Hopson Road/Davis Drive Ramps	6,807	2,634	104	11	58	6	9,600
Triangle Parkway Ramp to NC 540/NC 54	4,536	1,348	69	5	39	3	6,000
Triangle Parkway Ramp to NC 540/NC 55	3,676	1,298	128	17	72	9	5,200
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	4,138	1,817	138	20	77	11	6,201
Mainline Zone 2: Between NC 55 & Green Level Road US 64 Ramps							
Mainline Zone 3: Between US 64 & Old US 1							
Old US 1 Ramps							
Mainline Zone 4: Between US 1 & NC 55 Bypass							
Weekday Total Transactions - Triangle Parkway and Northern Wake	19,157	7,077	439	53	246	29	27,001
Weekday Total Transactions - Western Wake							
Weekday Total Transactions	19,157	7,077	439	53	246	29	27,001
Toll							
Hopson Road/Davis Drive Ramps	$0.30	$0.45	$0.59	$0.90	$1.17	$1.80	
Triangle Parkway Ramp to NC 540/NC 54	$0.65	$1.00	$1.30	$2.00	$2.60	$4.00	
Triangle Parkway Ramp to NC 540/NC 55	$0.82	$1.25	$1.63	$2.50	$3.25	$5.00	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	$0.52	$0.80	$1.04	$1.60	$2.08	$3.20	
Mainline Zone 2: Between NC 55 & Green Level Road US 64 Ramps	$0.65	$1.00	$1.30	$2.00	$2.60	$4.00	
Mainline Zone 3: Between US 64 & Old US 1	$0.36	$0.55	$0.72	$1.10	$1.43	$2.20	
Old US 1 Ramps	$0.78	$1.20	$1.55	$2.40	$3.12	$4.80	
Mainline Zone 4: Between US 1 & NC 55 Bypass	$0.20	$0.30	$0.39	$0.60	$0.78	$1.20	
	$0.33	$0.50	$0.65	$1.00	$1.30	$2.00	
Weekday Gross Toll Revenue - Calendar Year 2012							
Hopson Road/Davis Drive Ramps	$2,042	$1,176	$61	$10	$68	$11	$3,368
Triangle Parkway Ramp to NC 540/NC 54	2,948	1,348	90	10	101	12	4,509
Triangle Parkway Ramp to NC 540/NC 55	3,014	1,623	209	43	234	45	5,168
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	2,152	1,454	144	32	160	35	3,977
Mainline Zone 2: Between NC 55 & Green Level Road US 64 Ramps							
Mainline Zone 3: Between US 64 & Old US 1							
Old US 1 Ramps							
Mainline Zone 4: Between US 1 & NC 55 Bypass							
Weekday Total Revenue - Triangle Parkway and Northern Wake	10,156	5,601	504	95	563	103	17,022
Weekday Total Revenue - Western Wake							
Weekday Total Transactions	$10,156	$5,601	$504	$95	$563	$103	$17,022

Toll Zone	Class 1 ETC	Class 1 Video	Class 2 ETC	Class 2 Video	Class 3 ETC	Class 3 Video	Total
Weekday Transactions - Calendar Year 2013							
Hopson Road/Davis Drive Ramps	7,074	2,594	109	14	61	8	9,860
Triangle Parkway Ramp to NC 540/NC 54	5,007	1,448	78	7	44	4	6,588
Triangle Parkway Ramp to NC 540/NC 55	7,633	2,213	307	26	171	15	10,365
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	8,602	3,083	352	46	196	25	12,304
Mainline Zone 2: Between NC 55 & Green Level Road US 64 Ramps	14,149	4,604	644	71	359	40	19,867
Mainline Zone 3: Between US 64 & Old US 1	5,459	1,718	196	23	109	13	7,518
Old US 1 Ramps	10,628	3,737	545	62	304	35	15,311
Mainline Zone 4: Between US 1 & NC 55 Bypass	2,142	825	31	6	17	3	3,024
Weekday Total Transactions - Triangle Parkway and Northern Wake	28,316	9,938	646	93	472	52	39,517
Weekday Total Transactions - Western Wake	40,329	13,714	1,707	191	951	110	57,006
Weekday Total Transactions	68,645	23,052	2,353	284	1,423	162	96,123
Toll							
Hopson Road/Davis Drive Ramps	$0.31	$0.47	$0.62	$0.94	$1.23	$1.88	
Triangle Parkway Ramp to NC 540/NC 54	$0.69	$1.05	$1.37	$2.10	$2.73	$4.20	
Triangle Parkway Ramp to NC 540/NC 55	$0.86	$1.31	$1.71	$2.62	$3.41	$5.24	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	$0.55	$0.84	$1.10	$1.68	$2.19	$3.36	
Mainline Zone 2: Between NC 55 & Green Level Road US 64 Ramps	$0.69	$1.05	$1.37	$2.10	$2.73	$4.20	
Mainline Zone 3: Between US 64 & Old US 1	$0.38	$0.58	$0.76	$1.16	$1.51	$2.32	
Old US 1 Ramps	$0.82	$1.25	$1.64	$2.50	$3.28	$5.04	
Mainline Zone 4: Between US 1 & NC 55 Bypass	$0.21	$0.32	$0.42	$0.64	$0.84	$1.28	
	$0.35	$0.53	$0.69	$1.06	$1.38	$2.12	
Weekday Gross Toll Revenue - Calendar Year 2013							
Hopson Road/Davis Drive Ramps	$2,193	$1,219	$68	$13	$75	$15	$3,583
Triangle Parkway Ramp to NC 540/NC 54	3,455	1,520	107	15	120	17	5,234
Triangle Parkway Ramp to NC 540/NC 55	6,564	2,899	525	68	583	79	10,718
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	4,731	2,590	387	77	429	84	8,298
Mainline Zone 2: Between NC 55 & Green Level Road US 64 Ramps	9,763	4,834	882	149	980	168	16,776
Mainline Zone 3: Between US 64 & Old US 1	2,074	996	149	27	165	30	3,441
Old US 1 Ramps	8,715	4,709	894	156	967	176	15,617
Mainline Zone 4: Between US 1 & NC 55 Bypass	450	264	13	4	14	4	749
Weekday Total Revenue - Triangle Parkway and Northern Wake	2,783	1,500	201	35	224	40	4,783
Weekday Total Revenue - Western Wake	16,943	8,228	1,087	173	1,207	195	27,833
Weekday Total Transactions	23,785	12,303	2,139	371	2,380	418	41,396
	$40,728	$20,531	$3,226	$544	$3,587	$613	$69,229

Annualization Procedure
(Rounded to Thousands)
Annualization Factor: 319 days per year

Annual Transactions

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)	Total Transactions
Calendar 2012	8,613,000		8,613,000
Calendar 2013	12,478,000	9,092,000	21,570,000

Conversion to Fiscal Year
(Rounded to Thousands)

Annual Transactions

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)	Total Transactions
Half of Calendar 2012	4,307,000		4,307,000
Half of Calendar 2013	6,239,000	4,546,000	10,785,000
Total	10,546,000	4,546,000	15,092,000

Ramp-up Factors

Transactions

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)
July-December 2013	0.6700	
January-June 2014	0.7725	0.5500

Fiscal Year 2013 Transactions and Gross Toll Revenue After Ramp-up
(Rounded to Thousands)

Annual Transactions

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)	Total Transactions
July-December 2012	2,886,000		2,886,000
January-June 2013	4,820,000	2,499,000	7,319,000
Total Fiscal Year 2013	7,706,000	2,499,000	**10,205,000**

Annual Gross Revenue [1]

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)	Total Gross Revenue
Calendar 2012	$5,430,000		$5,430,000
Calendar 2013	$8,879,000	$6,603,000	$15,482,000

Annual Gross Revenue [1]

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)	Total Gross Revenue
Half of Calendar 2012	$2,715,000		$2,715,000
Half of Calendar 2013	$4,440,000	$3,302,000	$7,742,000
Total	$7,155,000	$3,302,000	$10,457,000

Gross Revenue

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)
July-December 2013	0.6700	
January-June 2014	0.7725	0.5500

Annual Gross Revenue [1]

Period	Triangle Parkway and Northern Wake (half year)	Western Wake (half year)	Total Gross Revenue
July-December 2012	$1,819,000		$1,819,000
January-June 2013	3,429,000	1,816,000	$5,245,000
Total Fiscal Year 2013	$5,248,000	$1,816,000	**$7,064,000**

[1] Excludes any allowance for uncollectible revenue

allocated to fiscal years separately. This process, shown in detail in Table 6-5 for FY 2013, yields annual transaction forecasts of 15.1 million and $10.5 million in gross toll revenue assuming no adjustments for ramp-up. This annualization is based on 319 equivalent weekdays per year and assumes lower weekend and holiday traffic. For annualization purposes, it was assumed that average weekend-day traffic would be 60 percent of average weekday traffic.

ADJUSTMENTS FOR RAMP-UP

The annualized transactions and revenues in 2012 were further adjusted to reflect "ramp-up." Ramp-up is the phenomenon experienced on most new start-up toll facilities in which high levels of growth may be experienced over the first three years or so of operation as the motoring public gradually becomes aware of and begins using the new facility.

There are a number of reasons for the "ramp-up" phenomenon. For example, not all motorists who will use the facility are from the local area, therefore it may take several months before certain travelers are aware that the roadway is there, or where it goes. It will also take several months for the project to begin appearing on new maps and for motorists to become accustomed to using the facility. The duration and level of ramp-up adjustments can be directly affected by a well-conceived promotion and signing program.

For purposes of this study, a 36-month ramp-up period was assumed. The nominal traffic and revenue estimates prepared for the opening three years are adjusted downward on a six-month basis to reflect the time it will take to gradually build up demand. Since the Triangle Expressway is expected to open in two phases, the ramp-up factors were applied separately to each section every six months for the first three years of operation. Table 6-6 shows the ramp-up factors and the periods and locations to which they apply.

After applying these ramp-up factors, the Triangle Expressway is estimated to produce 10.2 million transactions and $7.1 million in gross toll revenue in FY 2013 as shown in Table 6-5.

Table 6-6
Ramp-up Factors

Section Opening January 1, 2012

Fiscal Year	Factor [1] July - December	Factor [1] January - June	Tolling Zones
2012		0.550	Hopson Road/Davis Drive Ramps
2013	0.670	0.773	Triangle Parkway Ramp to NC 540/NC 54
2014	0.854	0.915	Triangle Parkway Ramp to NC 540/NC 55
2015+	0.975	1.000	Mainline 1: NC 540 Between Triangle Parkway Ramps

Section Opening January 1, 2013

Fiscal Year	Factor [1] July - December	Factor [1] January - June	Tolling Zones
2013		0.550	Mainline 2: Between NC 55 & Green Level Road
2014	0.670	0.773	US 64 Ramps
2015	0.854	0.915	Mainline 3: Between US 64 & Old US 1
2016+	0.975	1.000	Old US 1 Ramps
			Mainline 4: Between US 1 & NC 55 Bypass

[1] Average 6-month factor applied to forecast of total traffic before ramp-up.

FY 2020 AND FY 2030 TRANSACTIONS AND REVENUE

Tables 6-7 and 6-8 show the anticipated transactions and gross toll revenue for FY 2020 and FY 2030, respectively, based on the weekly traffic estimates contained in Figures 6-5 and 6-6. In both of these cases, no ramp-up adjustments were made. The annualization factor of 319 days was also used in these future-year forecasts, based on the assumption that weekend day traffic is 60 percent of weekday traffic.

ESTIMATED ANNUAL TOLL TRANSACTIONS AND REVENUE

Estimated annual toll transactions by vehicle class and year are shown in Table 6-9 and in Figure 6-8. Annual transactions are expected to increase from about 25.5 million in FY 2014, the first full year of operation of the entire Expressway, to 84.3 million by FY 2030. Traffic estimates for FY 2012 through FY 2015 were adjusted downward to reflect the impact of successive three year ramp-up periods as discussed above and shown in Table 6-6.

Table 6-7
Toll Transactions and Gross Toll Revenue Estimates, Fiscal Year 2020
Triangle Expressway

Toll Zone	Class 1 ETC	Class 1 Video	Class 2 ETC	Class 2 Video	Class 3 ETC	Class 3 Video	Total
Weekday Transactions - Calendar Year 2019							
Hopson Road/Davis Drive Ramps	9,617	2,249	235	16	131	9	12,257
Triangle Parkway Ramp to NC 540/NC 54	7,884	1,546	164	9	91	5	9,699
Triangle Parkway Ramp to NC 540/NC 55	13,367	2,403	493	27	275	15	16,580
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	16,172	3,608	567	42	316	23	20,728
Mainline Zone 2: Between NC 55 & Green Level Road	25,752	5,138	1,002	60	559	33	32,544
US 64 Ramps	8,579	1,681	272	14	152	8	10,706
Mainline Zone 3: Between US 64 & Old US 1	21,730	4,669	878	63	489	35	27,864
Old US 1 Ramps	4,632	1,122	69	6	39	3	5,871
Mainline Zone 4: Between US 1 & NC 55 Bypass	16,760	3,722	490	32	273	18	21,295
Weekday Total Transactions	124,493	26,138	4,170	269	2,325	149	157,544
Toll							
Hopson Road/Davis Drive Ramps	$0.39	$0.60	$0.78	$1.20	$1.56	$2.40	
Triangle Parkway Ramp to NC 540/NC 54	$0.87	$1.33	$1.73	$2.66	$3.46	$5.32	
Triangle Parkway Ramp to NC 540/NC 55	$1.08	$1.66	$2.16	$3.32	$4.32	$6.64	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	$0.70	$1.07	$1.40	$2.14	$2.79	$4.28	
Mainline Zone 2: Between NC 55 & Green Level Road	$0.87	$1.33	$1.73	$2.66	$3.46	$5.32	
US 64 Ramps	$0.48	$0.73	$0.95	$1.46	$1.90	$2.92	
Mainline Zone 3: Between US 64 & Old US 1	$1.04	$1.60	$2.08	$3.20	$4.16	$6.40	
Old US 1 Ramps	$0.26	$0.40	$0.52	$0.80	$1.04	$1.60	
Mainline Zone 4: Between US 1 & NC 55 Bypass	$0.39	$0.67	$0.88	$1.34	$1.75	$2.68	
Weekday Gross Toll Revenue - Calendar Year 2019							
Hopson Road/Davis Drive Ramps	$3,751	$1,349	$183	$19	$204	$22	$5,528
Triangle Parkway Ramp to NC 540/NC 54	6,859	2,056	284	24	315	27	9,565
Triangle Parkway Ramp to NC 540/NC 55	14,436	3,989	1,065	90	1,188	100	20,868
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	11,320	3,861	794	90	882	98	17,045
Mainline Zone 2: Between NC 55 & Green Level Road	22,404	6,834	1,733	160	1,934	176	33,241
US 64 Ramps	4,118	1,227	258	20	289	23	5,935
Mainline Zone 3: Between US 64 & Old US 1	22,599	7,470	1,826	202	2,034	224	34,355
Old US 1 Ramps	1,204	449	36	5	41	5	1,740
Mainline Zone 4: Between US 1 & NC 55 Bypass	6,536	2,494	431	43	478	48	10,030
Weekday Total Gross Toll Revenue	$93,227	$29,729	$6,610	$653	$7,365	$723	$138,307

Toll Zone	Class 1 ETC	Class 1 Video	Class 2 ETC	Class 2 Video	Class 3 ETC	Class 3 Video	Total
Weekday Transactions - Calendar Year 2020							
Hopson Road/Davis Drive Ramps	10,159	2,208	262	16	146	9	12,800
Triangle Parkway Ramp to NC 540/NC 54	8,543	1,554	185	10	103	5	10,400
Triangle Parkway Ramp to NC 540/NC 55	14,554	2,409	511	26	285	15	17,800
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	17,874	3,699	620	40	346	22	22,601
Mainline Zone 2: Between NC 55 & Green Level Road	28,250	5,213	1,059	56	590	31	35,199
US 64 Ramps	9,253	1,676	290	13	161	7	11,400
Mainline Zone 3: Between US 64 & Old US 1	23,928	4,748	918	60	512	34	30,200
Old US 1 Ramps	5,119	1,151	78	6	43	3	6,400
Mainline Zone 4: Between US 1 & NC 55 Bypass	18,375	3,775	516	29	288	16	22,999
Weekday Total Transactions	136,055	26,433	4,439	256	2,474	142	169,799
Toll							
Hopson Road/Davis Drive Ramps	$0.41	$0.62	$0.81	$1.24	$1.62	$2.48	
Triangle Parkway Ramp to NC 540/NC 54	$0.90	$1.38	$1.80	$2.76	$3.59	$5.52	
Triangle Parkway Ramp to NC 540/NC 55	$1.12	$1.72	$2.24	$3.44	$4.48	$6.88	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	$0.72	$1.10	$1.43	$2.20	$2.86	$4.40	
Mainline Zone 2: Between NC 55 & Green Level Road	$0.90	$1.38	$1.80	$2.76	$3.59	$5.52	
US 64 Ramps	$0.50	$0.76	$0.99	$1.52	$1.98	$3.04	
Mainline Zone 3: Between US 64 & Old US 1	$1.08	$1.65	$2.15	$3.30	$4.29	$6.60	
Old US 1 Ramps	$0.28	$0.42	$0.55	$0.84	$1.10	$1.68	
Mainline Zone 4: Between US 1 & NC 55 Bypass	$0.45	$0.69	$0.90	$1.38	$1.80	$2.76	
Weekday Gross Toll Revenue - Calendar Year 2020							
Hopson Road/Davis Drive Ramps	$4,165	$1,369	$212	$20	$237	$22	$6,025
Triangle Parkway Ramp to NC 540/NC 54	7,689	2,145	333	28	370	28	10,593
Triangle Parkway Ramp to NC 540/NC 55	16,300	4,143	1,145	89	1,277	103	23,057
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	12,869	4,069	887	88	990	97	19,000
Mainline Zone 2: Between NC 55 & Green Level Road	25,425	7,194	1,906	155	2,118	171	36,969
US 64 Ramps	4,627	1,274	287	20	319	21	6,548
Mainline Zone 3: Between US 64 & Old US 1	25,842	7,834	1,974	198	2,196	224	38,268
Old US 1 Ramps	1,433	483	43	5	47	5	2,016
Mainline Zone 4: Between US 1 & NC 55 Bypass	8,269	2,605	464	40	518	44	11,940
Weekday Total Gross Toll Revenue	$106,619	$31,116	$7,251	$643	$8,072	$715	$154,416

Annualization Procedure
(Rounded to Thousands)
Annualization Factor: 319 days per year

Period	Total Annual Transactions	Total Annual Gross Revenue
Calendar 2019	50,257,000	$44,120,000
Calendar 2020	54,166,000	$49,259,000

Conversion to Fiscal Year
(Rounded to Thousands)

Period	Transactions	Total Gross Revenue
Half of Calendar 2019	25,129,000	$22,060,000
Half of Calendar 2020	27,083,000	$24,630,000
Total Fiscal Year 2020	**$52,212,000**	**$46,690,000**

(1) Excludes any allowance for uncollectible revenue

Table 6-8
Toll Transactions and Gross Toll Revenue Estimates, Fiscal Year 2030
Triangle Expressway

Toll Zone	Class 1 ETC	Class 1 Video	Class 2 ETC	Class 2 Video	Class 3 ETC	Class 3 Video	Total
Weekday Transactions - Calendar Year 2029							
Hopson Road/Davis Drive Ramps	13,220	1,928	389	29	217	16	15,799
Triangle Parkway Ramp to NC 540/NC 54	12,671	1,496	247	13	138	7	14,572
Triangle Parkway Ramp to NC 540/NC 55	24,202	2,428	627	31	350	17	27,655
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	27,547	3,481	729	47	406	26	32,236
Mainline Zone 2: Between NC 55 & Green Level Road	48,287	5,318	1,304	71	727	40	55,747
US 64 Ramps	15,342	1,712	334	18	186	10	17,602
Mainline Zone 3: Between US 64 & Old US 1	43,066	5,114	1,186	72	661	40	50,139
Old US 1 Ramps	9,080	1,202	131	7	73	4	10,497
Mainline Zone 4: Between US 1 & NC 55 Bypass	31,844	3,985	597	37	333	21	36,817
Weekday Total Transactions	225,259	26,664	5,544	325	3,091	181	261,064
Toll							
Hopson Road/Davis Drive Ramps	$0.53	$0.81	$1.06	$1.62	$2.11	$3.24	
Triangle Parkway Ramp to NC 540/NC 54	$1.17	$1.80	$2.34	$3.60	$4.68	$7.20	
Triangle Parkway Ramp to NC 540/NC 55	$1.46	$2.24	$2.92	$4.48	$5.83	$8.96	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	$0.94	$1.44	$1.88	$2.88	$3.75	$5.76	
Mainline Zone 2: Between NC 55 & Green Level Road	$1.17	$1.80	$2.34	$3.60	$4.68	$7.20	
US 64 Ramps	$0.65	$0.99	$1.29	$1.98	$2.58	$3.96	
Mainline Zone 3: Between US 64 & Old US 1	$1.40	$2.15	$2.80	$4.30	$5.59	$8.60	
Old US 1 Ramps	$0.36	$0.55	$0.72	$1.10	$1.43	$2.20	
Mainline Zone 4: Between US 1 & NC 55 Bypass	$0.59	$0.90	$1.17	$1.80	$2.34	$3.60	
Weekday Gross Toll Revenue - Calendar Year 2029							
Hopson Road/Davis Drive Ramps	$7,007	$1,562	$412	$47	$458	$52	$9,538
Triangle Parkway Ramp to NC 540/NC 54	14,825	2,693	578	47	646	50	18,839
Triangle Parkway Ramp to NC 540/NC 55	35,335	5,439	1,831	139	2,041	152	44,937
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	25,894	5,013	1,371	135	1,523	150	34,086
Mainline Zone 2: Between NC 55 & Green Level Road	56,496	9,572	3,051	256	3,402	288	73,065
US 64 Ramps	9,972	1,695	431	36	480	40	12,654
Mainline Zone 3: Between US 64 & Old US 1	60,292	10,995	3,321	310	3,695	344	78,957
Old US 1 Ramps	3,269	661	94	8	104	9	4,145
Mainline Zone 4: Between US 1 & NC 55 Bypass	18,788	3,587	698	67	779	76	23,995
Weekday Total Gross Toll Revenue	$231,878	$41,217	$11,787	$1,045	$13,128	$1,161	$300,216

Toll Zone	Class 1 ETC	Class 1 Video	Class 2 ETC	Class 2 Video	Class 3 ETC	Class 3 Video	Total
Weekday Transactions - Calendar Year 2030							
Hopson Road/Davis Drive Ramps	13,412	1,925	396	29	221	16	15,999
Triangle Parkway Ramp to NC 540/NC 54	12,023	1,393	234	12	130	7	13,799
Triangle Parkway Ramp to NC 540/NC 55	24,724	2,438	634	32	354	18	28,200
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	28,256	3,514	742	48	414	27	33,001
Mainline Zone 2: Between NC 55 & Green Level Road	50,167	5,430	1,341	73	748	41	57,800
US 64 Ramps	15,720	1,726	338	18	189	10	18,001
Mainline Zone 3: Between US 64 & Old US 1	44,929	5,247	1,225	74	683	41	52,199
Old US 1 Ramps	8,666	1,128	125	7	70	4	10,000
Mainline Zone 4: Between US 1 & NC 55 Bypass	33,283	4,097	616	38	344	21	38,399
Weekday Total Transactions	231,180	26,898	5,651	331	3,153	185	267,398
Toll							
Hopson Road/Davis Drive Ramps	$0.54	$0.83	$1.08	$1.66	$2.16	$3.32	
Triangle Parkway Ramp to NC 540/NC 54	$1.21	$1.85	$2.41	$3.70	$4.81	$7.40	
Triangle Parkway Ramp to NC 540/NC 55	$1.51	$2.31	$3.01	$4.62	$6.01	$9.24	
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	$0.97	$1.48	$1.93	$2.96	$3.85	$5.92	
Mainline Zone 2: Between NC 55 & Green Level Road	$1.21	$1.85	$2.41	$3.70	$4.81	$7.40	
US 64 Ramps	$0.67	$1.02	$1.33	$2.04	$2.66	$4.08	
Mainline Zone 3: Between US 64 & Old US 1	$1.45	$2.22	$2.89	$4.44	$5.78	$8.88	
Old US 1 Ramps	$0.37	$0.56	$0.73	$1.12	$1.46	$2.24	
Mainline Zone 4: Between US 1 & NC 55 Bypass	$0.61	$0.93	$1.21	$1.86	$2.42	$3.72	
Weekday Gross Toll Revenue - Calendar Year 2030							
Hopson Road/Davis Drive Ramps	$7,242	$1,598	$428	$48	$477	$53	$9,846
Triangle Parkway Ramp to NC 540/NC 54	14,548	2,577	564	44	625	52	18,410
Triangle Parkway Ramp to NC 540/NC 55	37,333	5,632	1,908	148	2,128	166	47,315
Mainline Zone 1: NC 540 Between Triangle Parkway Ramps	27,408	5,201	1,432	142	1,594	160	35,937
Mainline Zone 2: Between NC 55 & Green Level Road	60,702	10,046	3,232	270	3,598	303	78,151
US 64 Ramps	10,532	1,761	450	37	503	41	13,324
Mainline Zone 3: Between US 64 & Old US 1	65,147	11,648	3,540	329	3,948	364	84,976
Old US 1 Ramps	3,206	632	91	8	102	9	4,048
Mainline Zone 4: Between US 1 & NC 55 Bypass	20,303	3,810	745	71	832	78	25,839
Weekday Total Gross Toll Revenue	$246,421	$42,905	$12,390	$1,097	$13,807	$1,226	$317,846

Annualization Procedure
(Rounded to Thousands)
Annualization Factor: 319 days per year

Period	Total Annual
Calendar 2029	$95,769,000
Calendar 2030	$101,393,000

Conversion to Fiscal Year
(Rounded to Thousands)

Period	Transactions	Gross Revenue
Half of Calendar 2029	41,640,000	$47,885,000
Half of Calendar 2030	42,650,000	$50,696,000
Total Fiscal Year 2030	**84,290,000**	**$98,581,000**

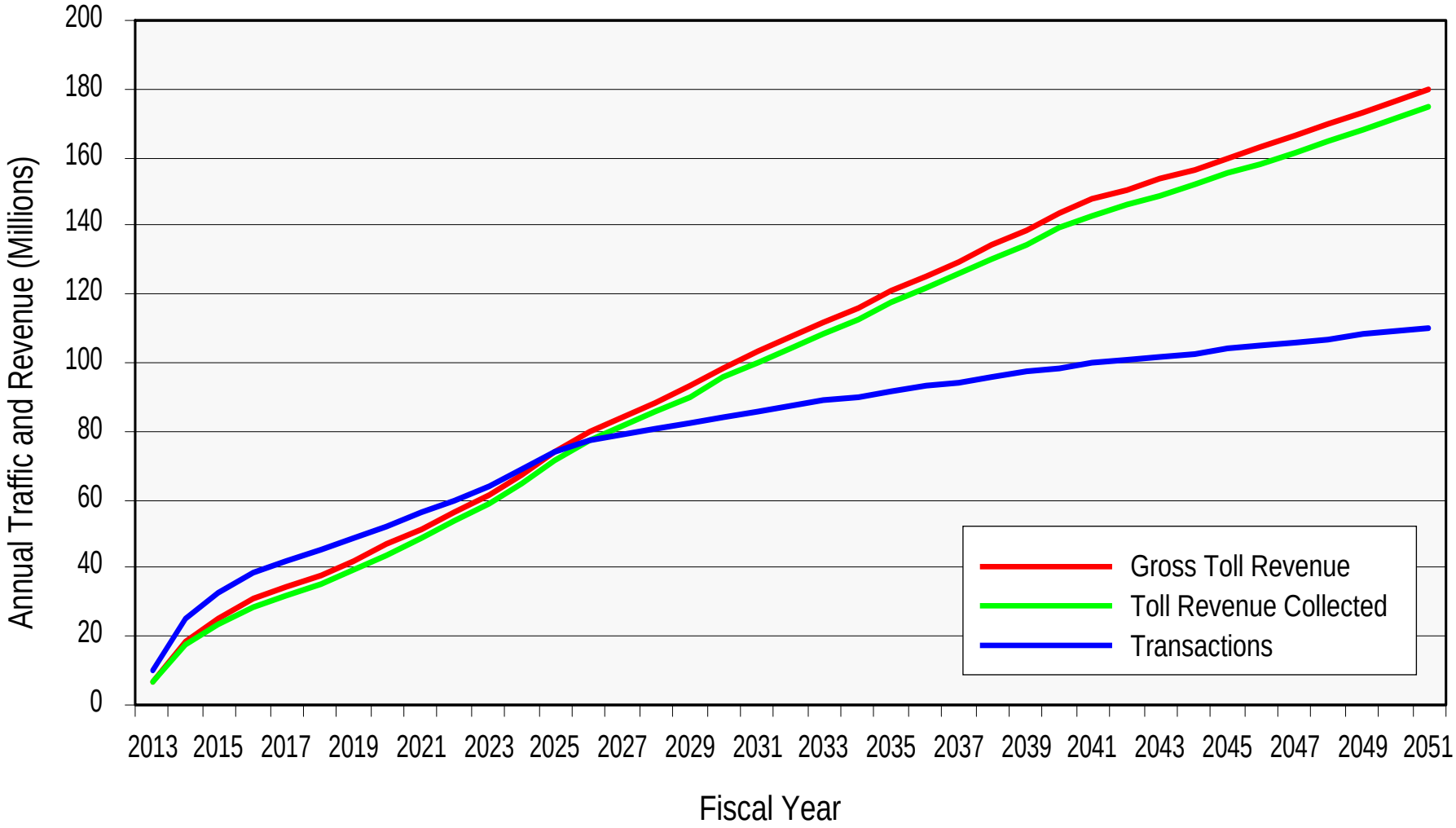
(1) Excludes any allowance for uncollectible revenue

Table 6-9
Annual Toll Transactions (Fiscal Year)
Triangle Expressway
(Thousands)

Fiscal Year		Class 1			Class 2			Class 3			Total Transactions	Percent ETC
		ETC	Video	Total Class 1	ETC	Video	Total Class 2	ETC	Video	Total Class 3		
2012	(1)	840	310	1,150	19	2	21	11	1	12	1,183	73.5%
2013	(2)	7,305	2,508	9,813	226	26	252	126	14	140	10,205	75.0%
2014		18,405	5,909	24,314	675	73	748	376	41	417	25,479	76.4%
2015		24,352	7,232	31,584	903	90	993	504	50	554	33,131	77.7%
2016		28,953	7,962	36,915	1,066	98	1,164	594	55	649	38,728	79.0%
2017		31,859	8,110	39,969	1,142	95	1,237	637	53	690	41,896	80.3%
2018		34,805	8,200	43,005	1,213	91	1,304	677	51	728	45,037	81.5%
2019		38,029	8,291	46,320	1,290	87	1,377	720	49	769	48,466	82.6%
2020		41,557	8,385	49,942	1,373	84	1,457	766	47	813	52,212	83.7%
2021		45,223	8,413	53,636	1,436	83	1,519	801	46	847	56,002	84.7%
2022		49,031	8,375	57,406	1,479	86	1,565	825	48	873	59,844	85.8%
2023		53,186	8,342	61,528	1,523	88	1,611	849	49	898	64,037	86.8%
2024		57,720	8,313	66,033	1,570	91	1,661	876	51	927	68,621	87.7%
2025		62,672	8,288	70,960	1,620	94	1,714	903	53	956	73,630	88.5%
2026		66,013	8,300	74,313	1,660	97	1,757	926	54	980	77,050	89.0%
2027		67,570	8,350	75,920	1,690	99	1,789	942	55	997	78,706	89.2%
2028		69,219	8,407	77,626	1,720	101	1,821	959	56	1,015	80,462	89.4%
2029		70,963	8,472	79,435	1,752	103	1,855	977	57	1,034	82,324	89.5%
2030		72,802	8,543	81,345	1,786	105	1,891	996	58	1,054	84,290	89.7%
2031		74,410	8,581	82,991	1,818	106	1,924	1,014	59	1,073	85,988	89.8%
2032		75,750	8,581	84,331	1,849	106	1,955	1,031	59	1,090	87,376	90.0%
2033		77,113	8,581	85,694	1,881	106	1,987	1,049	59	1,108	88,789	90.1%
2034		78,501	8,581	87,082	1,913	106	2,019	1,067	59	1,126	90,227	90.3%
2035		79,914	8,581	88,495	1,945	106	2,051	1,085	59	1,144	91,690	90.5%
2036		81,232	8,624	89,856	1,976	106	2,082	1,102	59	1,161	93,099	90.6%
2037		82,450	8,710	91,160	2,006	107	2,113	1,119	60	1,179	94,452	90.6%
2038		83,687	8,797	92,484	2,036	108	2,144	1,135	60	1,195	95,823	90.6%
2039		84,942	8,885	93,827	2,067	109	2,176	1,152	61	1,213	97,216	90.7%
2040		86,216	8,974	95,190	2,098	111	2,209	1,170	62	1,232	98,631	90.7%
2041		87,292	9,064	96,356	2,124	112	2,236	1,184	62	1,246	99,838	90.7%
2042		88,165	9,154	97,319	2,145	113	2,258	1,196	63	1,259	100,836	90.7%
2043		89,047	9,246	98,293	2,167	114	2,281	1,208	64	1,272	101,846	90.7%
2044		89,938	9,338	99,276	2,188	115	2,303	1,220	64	1,284	102,863	90.7%
2045		90,837	9,432	100,269	2,210	116	2,326	1,232	65	1,297	103,892	90.7%
2046		91,745	9,526	101,271	2,232	117	2,349	1,245	65	1,310	104,930	90.7%
2047		92,663	9,621	102,284	2,254	119	2,373	1,257	66	1,323	105,980	90.7%
2048		93,589	9,717	103,306	2,277	120	2,397	1,270	67	1,337	107,040	90.7%
2049		94,525	9,815	104,340	2,300	121	2,421	1,282	67	1,349	108,110	90.7%
2050		95,471	9,913	105,384	2,323	122	2,445	1,295	68	1,363	109,192	90.7%
2051		96,425	10,012	106,437	2,346	123	2,469	1,308	69	1,377	110,283	90.7%

(1) Triangle Parkway and NC 540 from NC 55 at Morrisville to NC 54 open January 1, 2012.
(2) Full project open January 1, 2013.

Note: Forecasts for FY 2012 - FY 2014 reflect an assumed ramp-up to full traffic volumes beginning in FY 2015 for Triangle Parkway and NC 540 at NC 55 to Morrisville to NC 54.
Forecasts for FY 2013 - FY 2015 reflect an assumed ramp-up to full traffic volumes beginning in FY 2016 for Western Wake Freeway.



NORTH CAROLINA Turnpike Authority

ANNUAL TOLL TRANSACTIONS AND REVENUE

FIGURE 6-8

Electronic toll transactions are expected to be the largest proportion of users and are estimated to increase from about 73 percent in the opening year to nearly 90 percent by about FY 2030. Note that transaction estimates through FY 2030 are based on a detailed modeling analysis. Transactions between FY 2030 and FY 2051 were assumed to grow at the rates shown in Table 6-10.

Table 6-10
Annual Transaction Growth Rate Assumptions, 2020 - 2051
Triangle Expressway
(Thousands)

	Class 1 Vehicles		Class 2 and 3 Vehicles	
Period	ETC	Video	ETC	Video
2030 - 2035	1.8%	0.0%	1.7%	0.0%
2035 - 2040	1.5%	1.0%	1.5%	1.0%
2040 - 2051	1.0%	1.0%	1.0%	1.0%

In developing the assumed extrapolated growth rates beyond FY 2030, the patterns of growth determined by the travel demand modeling over years prior to FY 2030 were considered. In general, overall transaction growth rates were assumed to moderate, dropping to an overall average growth rate of 1 percent per year subsequent to FY 2040. Prior to FY 2030, model results showed an annual decline in the number of video transactions, largely due to assumed continued increases in the penetration of electronic toll collection.

However, experience on other facilities suggests that ETC penetration typically reaches a maximum level in the range of 90 percent. Accordingly, WSA assumed declines in video transactions would "bottom out" between FY 2030 and FY 2035, with zero growth assumed in that category during that period. Subsequent to FY 2035, video transactions were assumed to grow at a nominal one percent per year through FY 2051, equivalent to the assumed growth rate of ETC vehicles after FY 2041. This resulted in the stabilization of the ETC share at approximately 90.7 percent of total transactions over the last 10 years of the forecast period.

Annual revenue estimates are provided in Table 6-11 and illustrated in Figure 6-8. Revenue estimates are presented for each vehicles class by toll rate. The total annual gross revenue is expected to increase from about $18.8 million in FY 2014 to $98.6 million by FY 2030. This reflects the impact of both traffic growth and periodic toll adjustments. Again, revenue estimates during the first four years of operation were adjusted to reflect a progressive ramp-up pattern. Assumed annual growth rates for gross toll revenue are shown in Table 6-12. ETC revenue growth rates were assumed to be 4.3 percent annually for Class 1 vehicles and 3.7 percent annually for Class 2 and 3 vehicles between FY 2030 and FY 2035. Video revenue was assumed to grow at the annual inflation rate of 2.5 percent during this same period.

Electronic tolls are expected to account for between 72 and 82 percent of total revenue after the ramp-up period. This is a lower percentage than the proportion of transactions, but reflects the fact that video users are assessed a significant premium toll charge.

Revenue Collection and Leakage

Revenue leakage can be a significant issue if the toll system design and agency's operational policies and procedures are not adequate to minimize the potential for leakage. During the initial years (early 1990s) of ETC in the industry, the issue of revenue leakage was greater than today due to the implementation of the then cutting edge technology that did not provide high performance accuracies. In recent years, ETC subsystems have become much more robust and video technology is now a proven technology.

The system being developed for the Triangle Expressway is an adaptation of two toll collection systems: ORT using ETC supplemented by automated video imaging that will serve both as the primary collection system and as the violation enforcement system.

The lane-level hardware required for implementing ORT and video enforcement/toll collection includes vehicle mounted transponders, overhead antennas, and roadside equipment such as readers, controllers, electrical circuit protection and distribution equipment, vehicle detection trigger devices, cameras, and supplemental lighting, as well as image processors and transmission equipment housed in an environmentally controlled roadside cabinet. Taken together with the necessary software and operational procedures, an ORT collection system can be quite complex resulting in lost revenue unless appropriate technology is used and procedures followed.

Table 6-11
Annual Gross Toll Revenue (Fiscal Year)
Triangle Expressway
(Thousands)

Fiscal Year	Class 1 ETC	Class 1 Video	Class 1 Total Class 1	Class 2 ETC	Class 2 Video	Class 2 Total Class 2	Class 3 ETC	Class 3 Video	Class 3 Total Class 3	Total Gross Revenue [3]	Percent ETC
2012 [1]	$445	$246	$691	$22	$4	$26	$25	$5	$30	$747	65.9%
2013 [2]	4,216	2,152	6,368	282	48	330	313	53	366	7,064	68.1%
2014	11,226	5,402	16,628	878	141	1,019	977	157	1,134	18,781	69.7%
2015	15,547	6,958	22,505	1,237	185	1,422	1,377	206	1,583	25,510	71.2%
2016	19,179	7,994	27,173	1,518	209	1,727	1,692	233	1,925	30,825	72.6%
2017	21,823	8,435	30,258	1,677	209	1,886	1,868	234	2,102	34,246	74.1%
2018	24,751	8,841	33,592	1,840	208	2,048	2,049	232	2,281	37,921	75.5%
2019	28,037	9,266	37,303	2,017	207	2,224	2,247	231	2,478	42,005	76.9%
2020	31,876	9,704	41,580	2,211	206	2,417	2,463	230	2,693	46,690	78.3%
2021	36,027	10,045	46,072	2,380	212	2,592	2,651	236	2,887	51,551	79.6%
2022	40,223	10,295	50,518	2,520	224	2,744	2,807	249	3,056	56,318	80.9%
2023	44,912	10,561	55,473	2,671	237	2,908	2,975	264	3,239	61,620	82.0%
2024	50,228	10,843	61,071	2,835	251	3,086	3,157	280	3,437	67,594	83.2%
2025	56,171	11,130	67,301	3,008	266	3,274	3,350	297	3,647	74,222	84.2%
2026	61,089	11,483	72,572	3,173	280	3,453	3,532	313	3,845	79,870	84.9%
2027	64,548	11,930	76,478	3,330	294	3,624	3,708	328	4,036	84,138	85.1%
2028	68,097	12,401	80,498	3,495	309	3,804	3,894	345	4,239	88,541	85.3%
2029	71,969	12,892	84,861	3,671	325	3,996	4,089	362	4,451	93,308	85.4%
2030	76,289	13,417	89,706	3,857	341	4,198	4,296	381	4,677	98,581	85.7%
2031	80,299	13,858	94,157	4,026	354	4,380	4,485	395	4,880	103,417	85.9%
2032	83,752	14,204	97,956	4,175	363	4,538	4,651	405	5,056	107,550	86.1%
2033	87,353	14,559	101,912	4,330	372	4,702	4,823	415	5,238	111,852	86.3%
2034	91,110	14,923	106,033	4,490	382	4,872	5,002	426	5,428	116,333	86.5%
2035	95,027	15,296	110,323	4,656	391	5,047	5,187	436	5,623	120,993	86.7%
2036	98,725	15,717	114,442	4,824	402	5,226	5,373	448	5,821	125,489	86.8%
2037	102,181	16,189	118,370	4,993	414	5,407	5,561	462	6,023	129,800	86.9%
2038	105,757	16,675	122,432	5,167	426	5,593	5,756	476	6,232	134,257	86.9%
2039	109,459	17,175	126,634	5,348	439	5,787	5,958	490	6,448	138,869	87.0%
2040	113,290	17,690	130,980	5,535	452	5,987	6,166	505	6,671	143,638	87.0%
2041	116,390	18,131	134,521	5,687	464	6,151	6,335	517	6,852	147,524	87.0%
2042	118,718	18,494	137,212	5,801	473	6,274	6,462	528	6,990	150,476	87.0%
2043	121,093	18,864	139,957	5,917	482	6,399	6,591	538	7,129	153,485	87.0%
2044	123,514	19,241	142,755	6,035	492	6,527	6,723	549	7,272	156,554	87.0%
2045	125,985	19,626	145,611	6,156	502	6,658	6,857	560	7,417	159,686	87.0%
2046	128,504	20,018	148,522	6,279	512	6,791	6,994	571	7,565	162,878	87.0%
2047	131,075	20,418	151,493	6,404	522	6,926	7,134	582	7,716	166,135	87.0%
2048	133,696	20,827	154,523	6,532	533	7,065	7,277	594	7,871	169,459	87.0%
2049	136,370	21,243	157,613	6,663	543	7,206	7,422	606	8,028	172,847	87.0%
2050	139,097	21,668	160,765	6,796	554	7,350	7,571	618	8,189	176,304	87.0%
2051	141,879	22,102	163,981	6,932	565	7,497	7,722	630	8,352	179,830	87.0%

[1] Triangle Parkway and NC 540 from NC 55 at Morrisville to NC 54 open January 1, 2012.
[2] Full project open January 1, 2013.
[3] **EXCLUDES ANY ALLOWANCE FOR UNCOLLECTIBLE REVENUE.**

Note: Forecasts for FY 2012 - FY 2015 reflect an assumed ramp-up to full traffic volumes beginning in the second half of FY 2015 for Triangle Parkway and NC 540 at NC 55 to Morrisville to NC 54.
Forecasts for FY 2013 - FY 2016 reflect an assumed ramp-up to full traffic volumes beginning in the second half of FY 2016 for Western Wake Freeway.

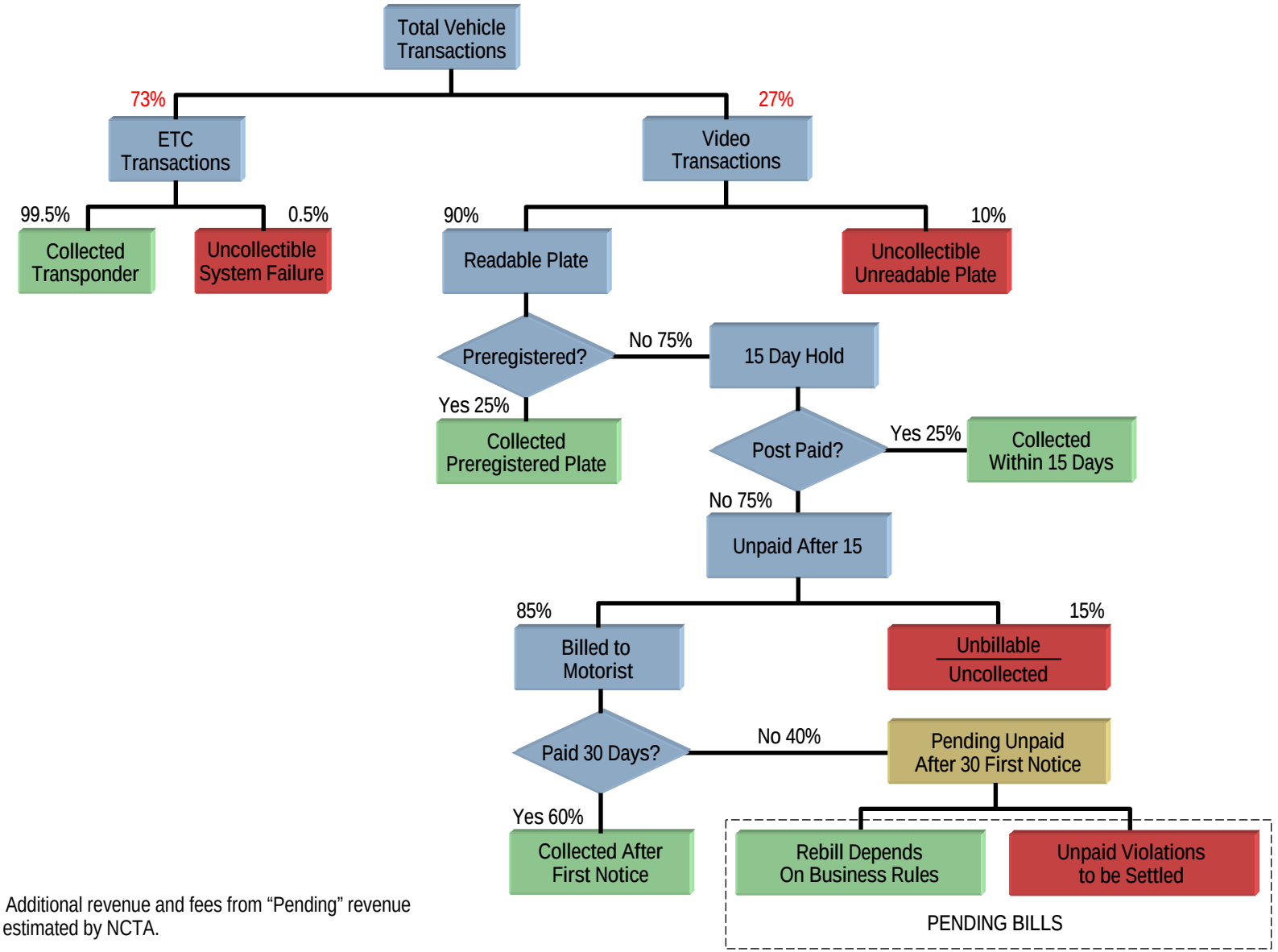
Table 6-12
Annual Revenue Growth Rate Assumptions, 2020 - 2051
Triangle Expressway
(Thousands)

	Class 1 Vehicles		Class 2 and 3 Vehicles	
Period	ETC	Video	ETC	Video
2030 - 2035	4.3%	2.5%	3.7%	2.5%
2035 - 2040	3.5%	3.0%	3.5%	3.0%
2040 - 2051	2.0%	2.0%	2.0%	2.0%

Figure 6-9 illustrates the toll collection process and revenue collection flow which will be used on the Triangle Expressway. As noted previously, no option will be provided for direct payment in cash at the time of passage through an electronic toll zone. However, opportunities for payment in cash will be provided in the vicinity of the toll road.

In addition to showing the flow of potential transactions, Figure 6-9 also shows assumed collection rates, and percentages of uncollectable revenue at each point in the process.

Each vehicle which passes through an electronic toll zone will fall into one of two categories, either equipped with an electronic toll transponder or not. The share of traffic distribution between ETC and video transactions, by vehicle class, was a direct output in each year of the modeling process, and the differential tolls in effect at each location. In the example shown in Figure 6-9, reflecting 2012 conditions, the model estimated approximately 73 percent of vehicles would be equipped with ETC transponders and 27 percent would not. Of the ETC transactions, 99.5 percent were expected to be valid transactions, resulting in collected revenue. This collection rate appears high when compared to typical ETC express lane operations on other toll facilities today. However, on those facilities, any vehicles in ETC express toll lanes not equipped with transponders are considered violators. In the NCTA system, vehicles without transponders would fall into the “video transaction” category and be processed as shown on the right side of the chart. Hence, the 0.5 percent uncollectable rate for ETC transactions would only relate to unusual system failure conditions.



Note: Additional revenue and fees from "Pending" revenue estimated by NCTA.

NORTH CAROLINA Turnpike Authority

TOLL PAYMENT AND COLLECTION STRUCTURE 2012 ASSUMPTIONS

FIGURE 6-9

Video transactions are estimated to represent approximately 27 percent of total transactions in 2012. Potential for uncollectable transactions are shown in the red boxes at several locations along the video transaction process.

Ten percent of video transactions are assumed to have unreadable license plates; such as plates which are obscured by trailer hitches or inclement weather conditions. Of the 90 percent of video transactions with readable plates, 25 percent are assumed to be pre-registered vehicles with video toll accounts. The remaining 75 percent of readable plates would be placed in a "hold" for 15 days, during which time motorists would have the opportunity to pay in person at a customer service center or via telephone, internet and other means prior to being sent a bill. The analysis assumes 25 percent of non-registered vehicles will choose this option. The remaining 75 percent are assumed to remain unpaid after 15 days.

All video transactions that remain unpaid 15 days after the transaction occurs would be invoiced. At this point, the leakage analysis assumes that 15 percent of these transactions would be "unbillable" due to inaccurate DMV information, out-of-state users with only a single transaction, or other similar circumstances. The remaining 85 percent are assumed billable. Invoices would be mailed to these vehicle owners. Based on North Carolina General Statute, those who pay the invoice within 30 days would pay only the video toll charge. The analysis assumes 60 percent of the invoices would be paid within the 30-day limit. The remaining 40 percent, representing about 5 percent of total toll revenue, would fall into a "pending" category. A portion of these would be unpaid violations based on NCTA business rules. Others will be "rebilled" one or more times. NCTA would add a $6.00 processing fee to each bill that is resent following the initial 30-day period.

It is emphasized that a portion of the "pending" revenue, plus additional revenue from processing fees, will ultimately be collected. Estimates of the pending revenue that would be collectible were provided to WSA by NCTA. Assumptions regarding rebilling and collections of pending revenue are provided in a brief technical memorandum by NCTA included as an appendix to this report.

Over time, collectability assumptions were modified slightly to reflect anticipated improvements in technology and billing practices. Table 6-13 shows revenue collection assumptions for each class of vehicle, for each of the various decision points shown in Figure 6-9. In addition, WSA performed a sensitivity test (see Chapter 7) to evaluate the impact on collected revenue of using more conservative assumptions regarding leakage.

Table 6-13
Revenue Collection Assumptions
Triangle Expressway

	Class 1 Vehicles				
	Percent by Year				
Assumption	**2012**	**2015**	**2020**	**2025**	**2030**
ETC Collectible	99.5%	99.5%	99.5%	99.5%	99.5%
ETC Uncollectible	0.5%	0.5%	0.5%	0.5%	0.5%
Total ETC Transactions	100.0%	100.0%	100.0%	100.0%	100.0%
Readable Plates	90%	92%	93%	94%	95%
Unreadable Plates	10%	8%	7%	6%	5%
Total Plates Imaged	100%	100%	100%	100%	100%
Preregistered Video	25%	27%	30%	35%	40%
Unregistered Video	75%	73%	70%	65%	60%
Total Readable Plates	100%	100%	100%	100%	100%
Postpaid Collectible Before 15 Days	25%	25%	25%	25%	25%
Postpaid Unpaid After 15 Days	75%	75%	75%	75%	75%
Total Unregistered Vehicle	100%	100%	100%	100%	100%
Billable After 15 Days	85%	85%	85%	85%	85%
Unbillable After 15 Days	15%	15%	15%	15%	15%
Total Unpaid After 15 Days	100%	100%	100%	100%	100%
Collectible After 30 Days	60%	60%	60%	60%	60%
Unpaid After 30 Days	40%	40%	40%	40%	40%
Total Billable After 30 Days	100%	100%	100%	100%	100%

	Class 2 and 3 Vehicles				
	Percent by Year				
Assumption	**2012**	**2015**	**2020**	**2025**	**2030**
ETC Collectible	99.5%	99.5%	99.5%	99.5%	99.5%
ETC Uncollectible	0.5%	0.5%	0.5%	0.5%	0.5%
Total ETC Transactions	100.0%	100.0%	100.0%	100.0%	100.0%
Readable Plates	90%	92%	93%	94%	95%
Unreadable Plates	10%	8%	7%	6%	5%
Total Plates Imaged	100%	100%	100%	100%	100%
Preregistered Video	25%	27%	30%	35%	40%
Unregistered Video	75%	73%	70%	65%	60%
Total Readable Plates	100%	100%	100%	100%	100%
Postpaid Collectible Before 15 Days	25%	25%	25%	25%	25%
Postpaid Unpaid After 15 Days	75%	75%	75%	75%	75%
Total Unregistered Vehicle	100%	100%	100%	100%	100%
Unbillable After 15 Days	15%	15%	15%	15%	15%
Total Unpaid After 15 Days	100%	100%	100%	100%	100%
Collectible After 30 Days	60%	60%	60%	60%	60%
Unpaid After 30 Days	40%	40%	40%	40%	40%
Total Billable After 30 Days	100%	100%	100%	100%	100%

It is important to recognize that while there will be a portion of the video transactions which ultimately may go uncollected, over time video transactions represent a smaller and smaller part of total transactions; hence, the overall leakage as a percent of total revenue will continue to decline.

ETC Collection –The accuracy of ETC and video equipment is key to the success of an open road toll collection system. The ETC equipment accuracy is quoted by vendors at between 99.95 and 99.99 percent. For this analysis, the ETC accuracy was assumed to be 99.5 percent. The largest number of toll customers is expected to use ETC technology. If the ETC system fails to capture an ETC transaction, the video system will be available for backup processing.

Video Collection - Video capture rates are quoted by vendors in the 96 to 98 percent range for non-obscured plates. These rates are not achieved in practice and are dependent for example, on proper lane and tolling zone configurations. Within the video system, both an automatic and a manual process can be implemented in order to accurately identify vehicles and process transactions. For this analysis, the video accuracy rates were assumed to be 90 percent in the early years after opening and improving to 95 percent by 2030.

Pending Video Collection – As noted above, the toll collection amount from road users that do not pay after the first invoice would be considered as "pending" (40 percent of those that receive a second invoice). These invoices would include administrative fees and civil penalties as described in Chapter 5. Collection from this group is dependent upon the business rules implemented by the NCTA. For example, the NCTA may determine the number of second and subsequent invoices that would be issued based upon the likelihood of payment and the cost of collection. Collection assumptions were made by the NCTA based on draft business rules. The collection amounts included both the toll and the administrative fees and civil penalties. The appendix contains the NCTA assumptions and estimates for the pending revenue category.

Estimated Collected Revenue –Table 6-14 summarizes the total revenue collected annually, the revenue collected under 30 days, the revenue collected over 30 days as estimated by the NCTA, and the administrative fee and civil penalty revenue as estimated by the NCTA. The percent of uncollected toll revenue ranges from 9.9 percent in the opening year to 2.9 percent in the later years. When the fee and penalty revenue is included, the total revenue collected is only slightly lower that the gross toll revenue. Figure 6-8 presented earlier also illustrates the toll revenue collected in comparison to the gross toll revenue.

Table 6-14
Annual Toll Transactions and Revenue Forecasts (Fiscal Year)
Triangle Expressway
(Thousands)

Fiscal Year		Total Gross Transactions	Gross Toll Revenue	Collected Toll Revenue Under 30 Days	Collected Toll Revenue Over 30 Days [3]	Total Collected Toll Revenue	Administrative Fees and Civil Penalty Revenue [3]	Total Net Revenue	Percent Uncollected Toll Revenue	Percent Uncollected Revenue of Total Revenue
2012	[1]	1,184	$747	$655	$18	$673	$7	$680	9.9%	9.0%
2013	[2]	10,205	7,063	6,256	265	6,521	95	6,616	7.7%	6.3%
2014		25,478	18,782	16,765	638	17,403	215	17,618	7.3%	6.2%
2015		33,131	25,509	22,979	548	23,527	177	23,704	7.8%	7.1%
2016		38,727	30,825	27,971	646	28,617	201	28,818	7.2%	6.5%
2017		41,895	34,246	31,263	671	31,934	204	32,138	6.8%	6.2%
2018		45,036	37,921	34,826	690	35,516	203	35,719	6.3%	5.8%
2019		48,465	42,006	38,792	710	39,502	203	39,705	6.0%	5.5%
2020		52,211	46,690	43,355	734	44,089	204	44,293	5.6%	5.1%
2021		56,002	51,551	48,127	765	48,892	183	49,075	5.2%	4.8%
2022		59,843	56,318	52,840	780	53,620	183	53,803	4.8%	4.5%
2023		64,038	61,620	58,082	795	58,877	182	59,059	4.5%	4.2%
2024		68,621	67,593	63,991	815	64,806	182	64,988	4.1%	3.9%
2025		73,631	74,221	70,553	834	71,387	183	71,570	3.8%	3.6%
2026		77,050	79,870	76,125	857	76,982	182	77,164	3.6%	3.4%
2027		78,705	84,139	80,304	885	81,189	183	81,372	3.5%	3.3%
2028		80,462	88,541	84,612	910	85,522	182	85,704	3.4%	3.2%
2029		82,324	93,308	89,285	939	90,224	183	90,407	3.3%	3.1%
2030		84,291	98,582	94,456	971	95,427	183	95,610	3.2%	3.0%
2031		85,988	103,418	99,184	997	100,181	173	100,354	3.1%	3.0%
2032		87,376	107,551	103,203	1,013	104,216	172	104,388	3.1%	2.9%
2033		88,788	111,853	107,389	1,053	108,442	175	108,617	3.0%	2.9%
2034		90,226	116,332	111,748	1,083	112,831	175	113,006	3.0%	2.9%
2035		91,690	120,994	116,286	1,112	117,398	176	117,574	3.0%	2.8%
2036		93,099	125,490	120,647	1,141	121,788	177	121,965	3.0%	2.8%
2037		94,452	129,799	124,809	1,177	125,986	179	126,165	2.9%	2.8%
2038		95,824	134,257	129,112	1,212	130,324	181	130,505	2.9%	2.8%
2039		97,217	138,868	133,566	1,249	134,815	183	134,998	2.9%	2.8%
2040		98,630	143,638	138,175	1,290	139,465	185	139,650	2.9%	2.8%
2041		99,838	147,524	141,921	1,322	143,243	187	143,430	2.9%	2.8%
2042		100,837	150,474	144,762	1,348	146,110	189	146,299	2.9%	2.8%
2043		101,845	153,484	147,656	1,376	149,032	191	149,223	2.9%	2.8%
2044		102,863	156,554	150,609	1,403	152,012	193	152,205	2.9%	2.8%
2045		103,892	159,685	153,623	1,431	155,054	195	155,249	2.9%	2.8%
2046		104,931	162,878	156,694	1,459	158,153	196	158,349	2.9%	2.8%
2047		105,980	166,136	159,827	1,489	161,316	198	161,514	2.9%	2.8%
2048		107,040	169,459	163,025	1,518	164,543	200	164,743	2.9%	2.8%
2049		108,110	172,848	166,285	1,549	167,834	202	168,036	2.9%	2.8%
2050		109,192	176,305	169,611	1,581	171,192	205	171,397	2.9%	2.8%
2051		110,283	179,831	173,004	1,611	174,615	206	174,821	2.9%	2.8%

[1] Triangle Parkway and NC 540 from NC 55 at Morrisville to NC 54 open January 1, 2012.

[2] Full project open January 1, 2013.

[3] Applies to transactions for which a second bill is sent. Estimated by NCTA based on business rules.

Note: Forecasts for FY 2012 - FY 2015 reflect an assumed ramp-up to full traffic volumes beginning in the second half of FY 2015 for Triangle Parkway and NC 540 at NC 55 to Morrisville to NC 54.
Forecasts for FY 2013 - FY 2016 reflect an assumed ramp-up to full traffic volumes beginning in the second half of FY 2016 for Western Wake Freeway.

DISCLAIMER

Current accepted professional practices and procedures were used in the development of these traffic and revenue forecasts. However, as with any forecast of the future, it should be understood that there may be differences between forecasted and actual results caused by events and circumstances beyond the control of the forecasters. In formulating its forecasts, WSA has reasonably relied upon the accuracy and completeness of information provided (both written and oral) by North Carolina Turnpike Authority and other local and state agencies. WSA also has relied upon the reasonable assurances of some independent parties and are not aware of any facts that would make such information misleading.

WSA has made qualitative judgments related to several key variables in the development and analysis of the traffic and revenue forecasts that must be considered as a whole; therefore selecting portions of any individual result without consideration of the intent of the whole may create a misleading or incomplete view of the results and the underling methodologies used to obtain the results. WSA gives no opinion as to the value or merit to partial information extracted from this report.

All estimates and projections reported herein are based on WSA' experience and judgment and on a review of information obtained from multiple state and local agencies, including North Carolina Turnpike Authority, by an independent third party. These estimates and projections may not be indicative of actual or future values, and are therefore subject to substantial uncertainty. Future developments cannot be predicted with certainty, and may affect the estimates or projections expressed in this report, such that WSA does not specifically guarantee or warrant any estimate or projections contained within this report.

While WSA believes that some of the projections or other forward-looking statements contained within the report are based on reasonable assumptions as of the date in the report, such forward looking statements involve risks and uncertainties that may cause actual results to differ materially from the results predicted. Therefore, following the date of this report, WSA will take no responsibility or assume any obligation to advise of changes that may affect its assumptions contained within the report, as they pertain to socioeconomic and demographic forecasts, proposed residential or commercial land use development projects and/or potential improvements to the regional transportation network.

CHAPTER 7

SENSITIVITY TESTS

A series of tests were conducted to provide a measure of the sensitivity of annual transactions and revenue to changes in key study assumptions. (1) The sensitivity tests were conducted for FY 2014, FY 2020, and FY 2030 with the exception of a commuter rail test and a toll road extension test, which were conducted for FY 2020 and FY 2030 only. The results of the sensitivity tests are presented in Table 7-1 and illustrated in Figure 7-1. The sensitivity tests included the following assumptions:

- **MPO Socioeconomic Forecasts** – The updated socioeconomic forecasts from CAMPO and DCHC form the basis for future travel demand instead of the forecasts from the independent economist;
- **Revised Long Term Economic Growth** – The base trip table rate of growth increases and decreases plus or minus 30 percent from the baseline growth rate;
- **Value of Time (VOT)** – 20 percent increases and decreases in base VOT's;
- **Electronic Toll Collection (ETC) Participation** – Higher and lower participation rates of ETC have a correspondingly lower and higher rate of video tolling;
- **Higher Motor Fuel Prices** – 5 percent reduction in regional travel demand;
- **Longer Ramp-up Period** – Traffic levels will gradually build up to full demand over a five-year "ramp up" period instead of the three-year period used for the base case;
- **Express Bus Service on Triangle Expressway** – Express buses on the parallel NC 55 are routed via the Triangle Expressway non-stop between NC 55 Bypass at Holly Springs and NC 55 near Morrisville;

(1) The sensitivity tests were performed during the course of this comprehensive study to estimate the percent difference from the base case. For this final report, which incorporates the effects of the current recession, the original percent differences were applied to the final base case forecasts to estimate the net differences from the base case forecasts.

Table 7-1
Annual Toll Transactions and Gross Revenue Forecasts
Sensitivity Tests
Triangle Expressway
(Thousands)

Test	FY 2014 [1] Transactions	FY 2014 [1] Revenue [2]	Difference from Base Case: Transactions	Difference from Base Case: Revenue [2]	Percent Difference from Base Case: Transactions	Percent Difference from Base Case: Revenue [2]
Base Case	**25,479**	**$18,781**				
Sensitivity Test						
MPO Economic Forecast	25,928	19,251	449	$470	1.8%	2.5%
30 Percent Higher Traffic Growth	31,679	23,278	6,200	4,497	24.3%	23.9%
30 Percent Lower Traffic Growth	22,733	16,712	-2,746	-2,069	-10.8%	-11.0%
20 Percent Higher Value of Time	27,027	20,573	1,548	1,792	6.1%	9.5%
20 Percent Lower Value of Time	23,057	16,488	-2,422	-2,293	-9.5%	-12.2%
20 Percent Higher ETC Share	27,045	18,404	1,566	-377	6.1%	-2.0%
20 Percent Lower ETC Share	23,894	19,385	-1,585	604	-6.2%	3.2%
Higher Fuel Costs, 5 Percent Traffic Reduction	23,245	17,249	-2,234	-1,532	-8.8%	-8.2%
Express Buses on Triangle Expressway	25,479	18,781	---------- Negligible ----------			
Increased Leakage [4]	25,479	17,876	0	-905	0.0%	-4.8%

Test	FY 2020 Transactions	FY 2020 Revenue [2]	Difference from Base Case: Transactions	Difference from Base Case: Revenue [2]	Percent Difference from Base Case: Transactions	Percent Difference from Base Case: Revenue [2]
Base Case	**52,212**	**$46,690**				
Sensitivity Test						
MPO Economic Forecast	57,106	50,734	4,894	$4,044	9.4%	8.7%
30 Percent Higher Traffic Growth	68,060	61,624	15,848	14,934	30.4%	32.0%
30 Percent Lower Traffic Growth	41,956	37,329	-10,256	-9,361	-19.6%	-20.0%
20 Percent Higher Value of Time	55,709	51,060	3,497	4,370	6.7%	9.4%
20 Percent Lower Value of Time	47,395	41,079	-4,817	-5,611	-9.2%	-12.0%
20 Percent Higher ETC Share	55,203	46,721	2,991	31	5.7%	0.1%
20 Percent Lower ETC Share	50,618	47,683	-1,594	993	-3.1%	2.1%
Higher Fuel Costs, 5 Percent Traffic Reduction	48,014	42,943	-4,198	-3,747	-8.0%	-8.0%
Express Buses on Triangle Expressway	52,212	46,690	---------- Negligible ----------			
Commuter Rail In Triangle Expressway Study Area	51,746	46,381	-466	-309	-0.9%	-0.7%
Southern Wake Freeway as Toll Road [3]	58,504	53,612	6,292	6,922	12.1%	14.8%
Increased Leakage [4]	52,212	45,191	0	-1,499	0.0%	-3.2%

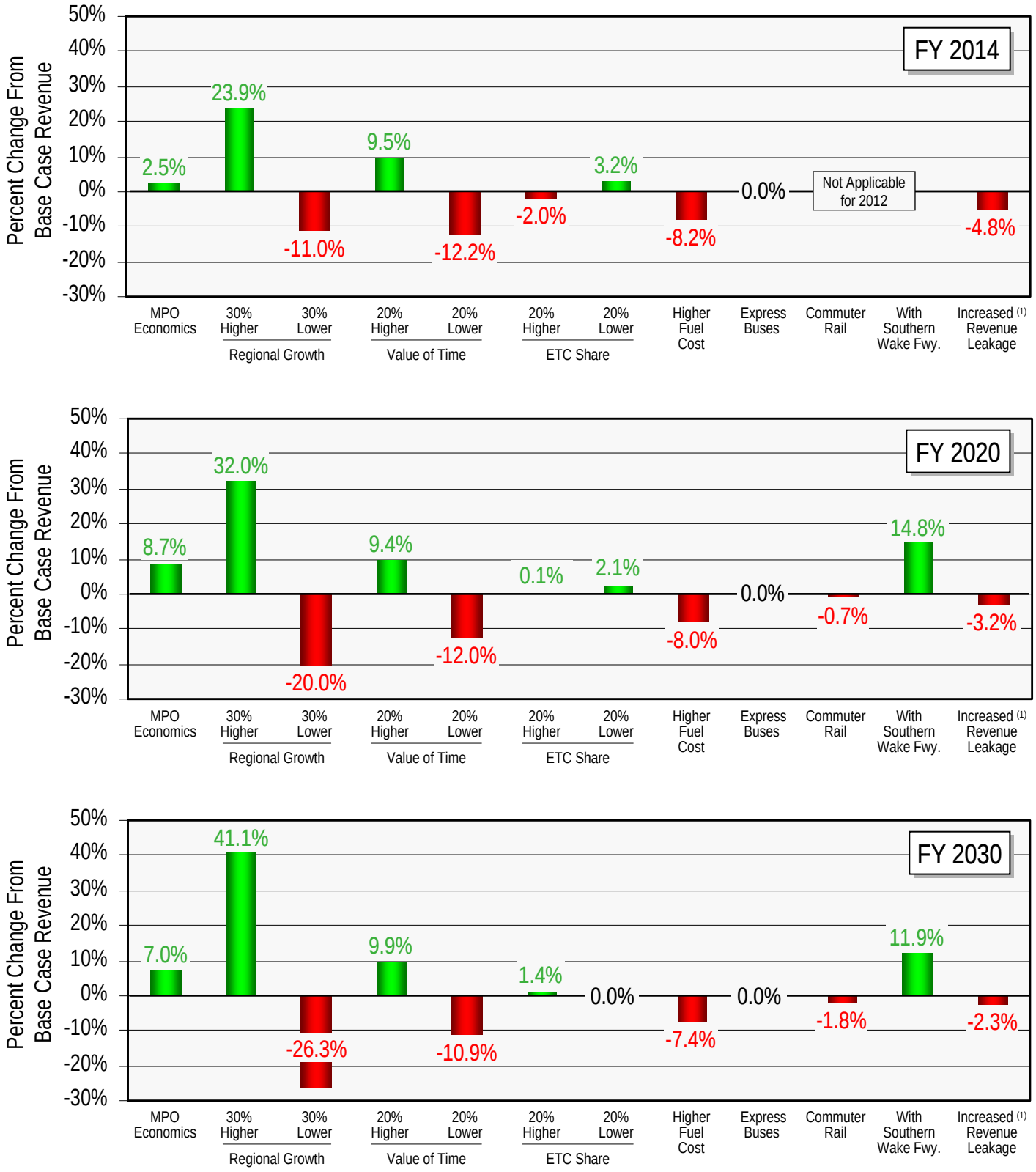
Test	FY 2030 Transactions	FY 2030 Revenue [2]	Difference from Base Case: Transactions	Difference from Base Case: Revenue [2]	Percent Difference from Base Case: Transactions	Percent Difference from Base Case: Revenue [2]
Base Case	**84,290**	**$98,581**				
Sensitivity Test						
MPO Economic Forecast	90,018	105,448	5,728	$6,867	6.8%	7.0%
30 Percent Higher Traffic Growth	115,763	139,069	31,473	40,488	37.3%	41.1%
30 Percent Lower Traffic Growth	63,039	72,630	-21,251	-25,951	-25.2%	-26.3%
20 Percent Higher Value of Time	90,635	108,299	6,345	9,718	7.5%	9.9%
20 Percent Lower Value of Time	75,826	87,806	-8,464	-10,775	-10.0%	-10.9%
20 Percent Higher ETC Share	88,078	99,936	3,788	1,355	4.5%	1.4%
20 Percent Lower ETC Share	81,156	98,595	-3,134	14	-3.7%	0.0%
Higher Fuel Costs, 5 Percent Traffic Reduction	78,204	91,258	-6,086	-7,323	-7.2%	-7.4%
Express Buses on Triangle Expressway	84,290	98,581	---------- Negligible ----------			
Commuter Rail In Triangle Expressway Study Area	82,702	96,832	-1,588	-1,749	-1.9%	-1.8%
Southern Wake Freeway as Toll Road [3]	91,606	110,282	7,316	$11,701	8.7%	11.9%
Increased Leakage [4]	84,290	96,291	0	-2,290	0.0%	-2.3%

[1] Forecasts for FY 2014 reflect an assumed ramp-up to full trafic volumes beginning in the second half of FY 2015 for Triangle Parkway and NC 540 between NC 54 and NC 55 at Morrisville and to full ltraffic volumes beginning in the second half of FY 2016 for Western Wake Freeway.

[2] **EXCLUDES ANY ALLOWANCE FOR UNCOLLECTIBLE REVENUE.**

[3] Transactions and Revenue For Triangle Expressway only. Excludes revenue from Southern Wake Freeway.

[4] Excludes administrative fees and civil penalties.



(1) Based on Collected Toll Revenue Excluding Fees and Penalties

NORTH CAROLINA Turnpike Authority

REVENUE SENSITIVITY TESTS
FY 2014, 2020, 2030

FIGURE 7-1

- **Commuter Rail in Triangle Expressway Corridor** – Commuter rail service is available within the Triangle Expressway study area between NC 55 Bypass and the transit center east of the Davis Drive and Hopson Road Interchange;
- **Southern Wake Freeway** – The Triangle Expressway is extended from the proposed southern terminus at NC 55 Bypass near Holly Springs to I-40 south of Raleigh; and
- **Increased Revenue Leakage** – Higher revenue leakage rates for both ETC and video traffic.

MPO SOCIOECONOMIC FORECASTS

The base case traffic and revenue forecasts for this study were calculated using the socioeconomic forecasts that were prepared by the independent economist rather than those prepared by the two MPOs in the region, CAMPO and DCHC. The MPOs' socioeconomic forecasts for the Triangle region were somewhat higher than those developed by the independent economist as discussed in more detail in Chapter 4. For this sensitivity test, the travel demand model was recoded using the MPO socioeconomic forecast in the trip generation step of the model. This resulted in gross toll revenues that were 2.5 percent higher for FY 2014, 8.7 percent higher for FY 2020, and 7.0 percent higher in FY 2030 than the revenue for the base case. In the early years, the two sets of socioeconomic forecasts are similar. However, the forecasts diverge in the later years, and the differences are correspondingly larger between the base case and the MPO forecast sensitivity test.

LOWER OR HIGHER LONG TERM TRAFFIC GROWTH

Increases and decreases in the long term regional traffic growth rates were tested to examine the effects of such delays or accelerations on annual transactions and revenues. This was emulated by adjusting the rate of trip growth in the trip tables by plus or minus 30 percent from the base case forecast.

INCREASED GROWTH

This test assumed that the total traffic growth rate in the base-year trip tables would increase by 30 percent. For example, a 4.0 percent annual growth rate for a specific movement in the base case was increased to 5.2 percent annual growth in the sensitivity test. Under this higher growth rate test, the gross toll revenue increased by approximately 24 percent in FY 2014 and over 41 percent by FY 2030.

DECREASED GROWTH

Conversely, the lower traffic growth sensitivity test assumed a 30 percent decrease for each movement in the trip tables. As indicated in Table 7-1, the reduction in gross toll revenue is 11 percent in FY 2014 and about 26 percent in FY 2030.

Based on this analysis of higher and lower traffic growth rates, it appears that the gross revenue is more sensitive to higher traffic growth than lower traffic growth.

VALUE-OF-TIME

Individual value-of-time (VOT) is a critical parameter in the toll diversion model because a driver's decision to use a toll road is heavily influenced by the travel time saved by using a toll road relative to the toll charged. Values-of-time for individual movements are based on the stated preference (SP) survey results, the estimates of median household income and the annual hours worked by traffic analysis zone (TAZ). In these two sensitivity tests, the base case value-of-time for each movement was increased and decreased by 20 percent.

HIGHER VALUE OF TIME

Higher values-of-time would favor the Triangle Expressway because more drivers would be willing to pay a toll to save travel time in comparison to the base case. This test increased the median VOT for all trip purposes in the traffic assignment process by 20 percent. Under this scenario, as presented in Table 7-1, the total annual gross revenue increased by 9.4 to 9.9 percent for the test years: FY 2014, FY 2020, and FY 2030.

LOWER VALUE-OF-TIME

Lowering the base case value-of-time by 20 percent had the opposite effect on the Triangle Expressway because fewer people would be willing to pay a toll to save travel time. The reduction in gross toll transactions in comparison to the base case is estimated at between 11 and 12 percent for each of the test years.

Thus the forecast model is slightly more sensitive to lower values-of-time than to higher values-of-time.

ELECTRONIC TOLL COLLECTION PARTICIPATION

The base-case assumptions for ETC participation are that participation rates would increase as drivers become more familiar with the lower costs

and convenience of ETC. Conversely the use of video tolling would decrease over the years as ETC increases.

Two sensitivity tests were conducted. The first test assumed higher levels of initial ETC participation and the second test assumed lower levels of ETC participation. Table 7-2 shows the percentages of ETC and video participation for the base case and for the two sensitivity tests.

HIGHER ETC PARTICIPATION

This test assumes that FY 2014 base case ETC participation would increase from 65 to 78 percent for Class 1 vehicles and from 80 to 96 percent for Class 2 and 3 vehicles. The toll diversion model indicates that this increase would have minimal impact on gross toll revenues. The FY 2014 revenue is estimated to be 2 percent less than the base-case revenue. By FY 2020, the impact is negligible, and by FY 2030 the revenue would increase slightly over the base case. These results are not surprising because of the toll price differentials between ETC and video tolling. With higher ETC participation, the percentage of video tolling customers would decrease. Since these video tolling customers would pay substantially more than ETC customers, the revenue effects of higher ETC participation would tend to be offset.

REDUCED ETC PARTICIPATION

Similarly, an assumed reduction in ETC participation also has little effect on gross toll revenues because of the price differential of the payment types.

Although these two sensitivity tests indicate that changes in the share of ETC participation have little impact on gross toll revenue, this analysis did not include any allowances for revenue losses due to uncollectible video tolling charges. Under the lower ETC share sensitivity test, more video tolling would occur, which means that more revenue would be lost due to leakage than with the base case.

INCREASED FUEL COST

This sensitivity test was based on the assumption that significantly higher fuel prices would result in fewer vehicles using the Triangle Expressway. Therefore, in order to reflect gas price increases in the range of 65 percent, the FY 2014, FY 2020, and FY 2030 base trip tables were reduced by 5 percent. Under this hypothetical scenario, total annual revenues were reduced by approximately 7 to 8 percent for each of the test years.

Table 7-2
Toll Collection Percentages of Total Transactions - Sensitivity Tests
Triangle Expressway

Base Case

Fiscal Year	Model Input Assumptions - Class 1		Model Input Assumptions - Class 2/3	
	ETC	Video	ETC	Video
2014	65%	35%	80%	20%
2020	77%	23%	89%	11%
2030	84%	16%	89%	11%

Higher ETC Participation

Fiscal Year	Model Input Assumptions - Class 1		Model Input Assumptions - Class 2/3	
	ETC	Video	ETC	Video
2014	78%	22%	96%	4%
2020	92%	8%	99%	1%
2030	99%	1%	99%	1%

Lower ETC Participation

Fiscal Year	Model Input Assumptions - Class 1		Model Input Assumptions - Class 2/3	
	ETC	Video	ETC	Video
2014	52%	48%	64%	36%
2020	62%	38%	71%	29%
2030	67%	33%	71%	29%

LONGER RAMP-UP PERIOD

In the base case, it was assumed that full traffic potential would be realized after a three-year period in which the traffic would build up from a 50 percent level the first month of operation to a 100 percent level in month 36. The sensitivity test assumed a five-year ramp-up period, which would result in lower annual traffic and revenue forecasts in comparison to the base case.

The annual ramp-up factors for the three-year and the five-year ramp-ups are listed in Table 7-3. For example, in the first six months of operation, the traffic and revenue forecasts are 55 percent of the full annual forecasts in the three-year ramp-up and 53.8 percent of the full annual forecasts in the five-year ramp-up.

Table 7-3

Annual Ramp-up Factors - Sensitivity Test

Year	Months	3-year Factor (1)	5-year Factor (1)
1	1-6	0.550	0.538
	7-12	0.670	0.628
2	1-6	0.773	0.700
	7-12	0.854	0.760
3	1-6	0.915	0.813
	7-12	0.975	0.860
4	1-6	1.000	0.903
	7-12	1.000	0.941
5	1-6	1.000	0.973
	7-12	1.000	0.995
6+	1-12	1.000	1.000

(1) Average yearly factor applied to forecast of total traffic before ramp-up.

The total transactions and gross revenues for the three-year and five-year ramp-up periods are compared in Table 7-4 for FY 2012 through FY 2014. The revenues for the five-year ramp-up period are between 4.5 and 11 percent lower than the revenues for the base case depending upon the year of operation. The Triangle Parkway and NC 540 sections of the toll road were assumed to open in FY 2012, and the ramp-up was assumed to cover FY 2012 – FY 2015 for this test. The Western Wake Freeway segment was assumed to open in FY 2013, and its ramp-up was assumed to cover FY 2013 – FY 2016 for this sensitivity test. After FY 2018, the traffic volumes would be the same in both the three-year and the five-year ramp-up cases.

EXPRESS BUS SERVICE ON TRIANGLE EXPRESSWAY

The regional transportation model includes bus services in accordance with the MPOs' long range transportation plans. The services in the area of the proposed Triangle Expressway include bus routes along NC 55 from Apex to a location on Page Road near the Research Triangle Park. In later years, bus service would be extended south to include Fuquay-Varina in Wake County and Lillington in Harnett County.

In this transit sensitivity test, the segment of the bus routes between Old US 1 and NC 55 near Morrisville were re-routed to the Triangle Expressway. The routes would still originate and terminate in the same locations as in the base case, but there would not be bus service on NC 55 between Old US 1 and NC 55 near Morrisville. Figure 7-2 depicts the bus service in this sensitivity test. The headways for these express buses would be:

- 2014: 30 minutes peak (1 route), no off-peak service;
- 2020: 30 minutes peak (2 routes), 60 minutes off-peak (1 route); and
- 2030: 30 minutes peak (2 routes), 60 minutes off-peak.

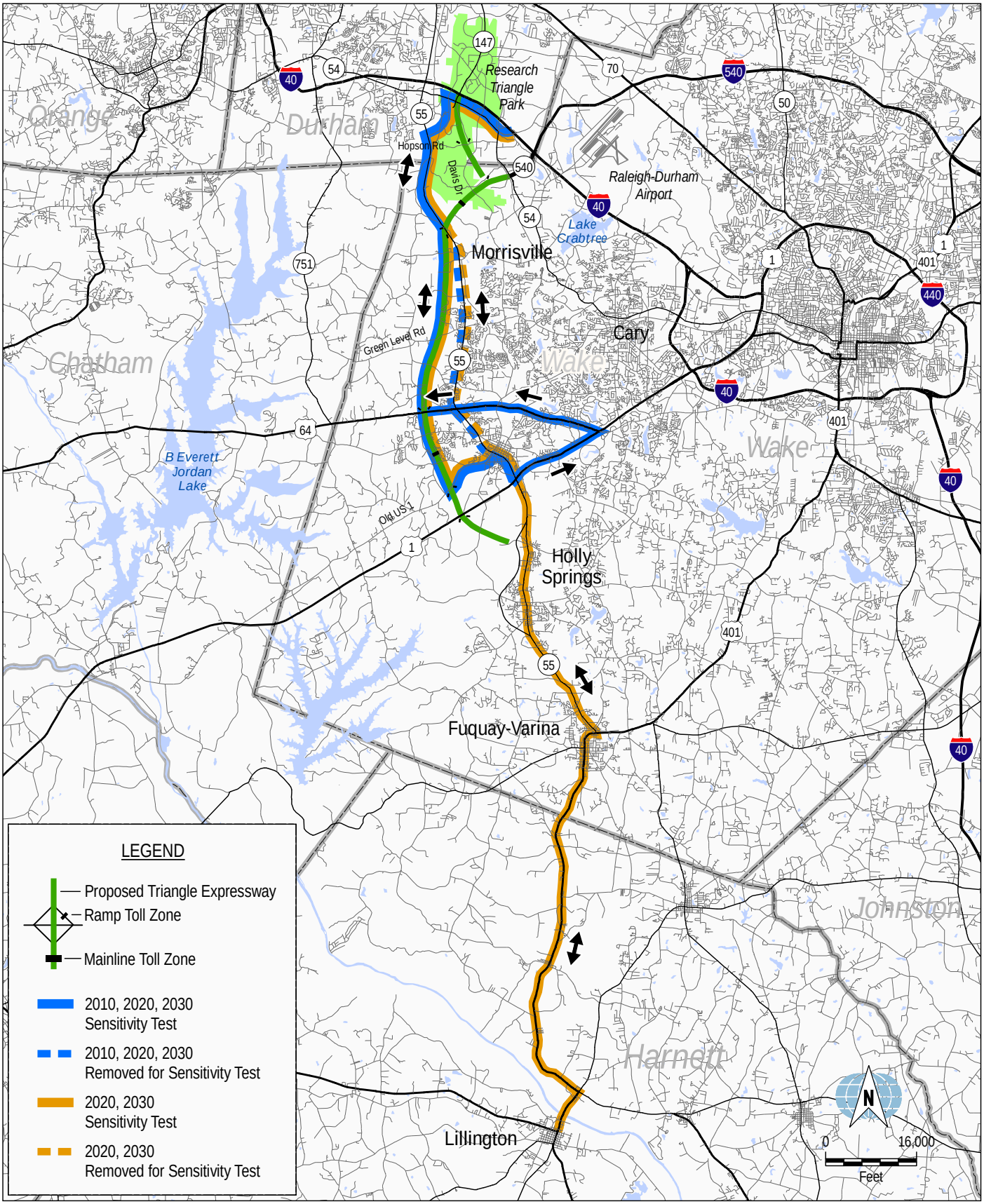
Since the express buses operating along the Triangle Expressway would offer more rapid service to and from the Research Triangle Park area than buses operating along NC 55, it might be expected that some diversion from automobiles to public transit would occur. Consequently the reduction of automobiles on the Triangle Expressway might lead to a reduction in gross toll revenue. However, this is not the case. The re-routing of buses to the Triangle Expressway would have little effect on gross toll revenue because the Triangle Regional Model (TRM) forecasts little ridership on buses along NC 55 in the study area. In fact, according to 2005

Table 7-4
Annual Toll Transactions and Gross Revenue Forecasts
Five-year Ramp-up Sensitivity Test
Triangle Expressway
(Thousands)

Fiscal Year	Base Case (3-year Ramp-up) [1]		Sensitivity Test (5-year Ramp-up) [2]		Difference from Base Case		Percent Difference from Base Case	
	Transactions	Revenue	Transactions	Revenue	Transactions	Revenue	Transactions	Revenue
2012	1,183	$747	1,130	$713	-53	-$34	-4.5%	-4.5%
2013	10,205	7,064	9,456	6,543	-749	-521	-7.3%	-7.4%
2014	25,479	18,781	22,725	16,750	-2,754	-2,031	-10.8%	-10.8%
2015	33,131	25,510	29,858	22,998	-3,273	-2,512	-9.9%	-9.8%
2016	38,728	30,825	36,703	29,238	-2,025	-1,587	-5.2%	-5.1%
2017	41,896	34,246	41,494	33,925	-402	-321	-1.0%	-0.9%
2018 - 2051			No Change					

[1] Forecasts for FY 2012-FY 2015 reflect an assumed ramp-up to full trafic volumes beginning in the second half of FY 2015 for Triangle Parkway and NC 540 between NC 54 and NC 55 at Morrisville.
Forecasts for FY 2013 - FY 2016 reflect an assumed ramp-up to full trafic volumes beginning in second half of FY 2016 for Western Wake Freeway.

[2] Forecasts for FY 2012 -FY 2017 reflect an assumed ramp-up to full trafic volumes beginning in the second half of FY 2017 for Triangle Parkway and NC 540 between NC 54 and NC 55 at Morrisville.
Forecasts for FY 2013 - FY 2018 reflect an assumed ramp-up to full trafic volumes beginning in the second half of FY 2018 for Western Wake Freeway



NORTH CAROLINA Turnpike Authority

BUS SENSITIVITY TEST ROUTES

FIGURE 7-2

ridership data from the Triangle Transit Authority, the average daily transit ridership on the only bus route on NC 55 in the study area was 100. [2]

Average annual daily vehicle traffic along NC 55 ranged from 19,000 vpd to 38,000 vpd in 2005. The TRM was run to determine any mode diversions associated with the re-routing of bus services using the headways listed above. The model indicated low future transit ridership with or without the Triangle Expressway.

Because of the low current and forecast transit ridership in the corridor, any diversion of automobile users to transit using the Triangle Expressway would have minimal traffic or gross revenue impact.

However, it should be noted that this sensitivity test is reflective of the current transportation mode choice model, the currently-modeled levels of transit service in the study area, and the expected modal splits between cars and buses. If the bus levels of service and routings were increased substantially and road traffic conditions and costs deteriorated significantly, then some diversion from automobile to bus transit in the study area could be expected, which could lead to reduction of toll revenue to some degree.

COMMUTER RAIL IN TRIANGLE EXPRESSWAY CORRIDOR

In this sensitivity test, a commuter rail line would closely parallel the Triangle Expressway. It would have stops at each interchange and feeder bus lines to connect the rail line to NC 55, the closest major north-south toll-free road. As shown in Figure 7-3, the commuter line would extend from NC 55 Bypass at Holly Springs to the bus transit center on Page Road.

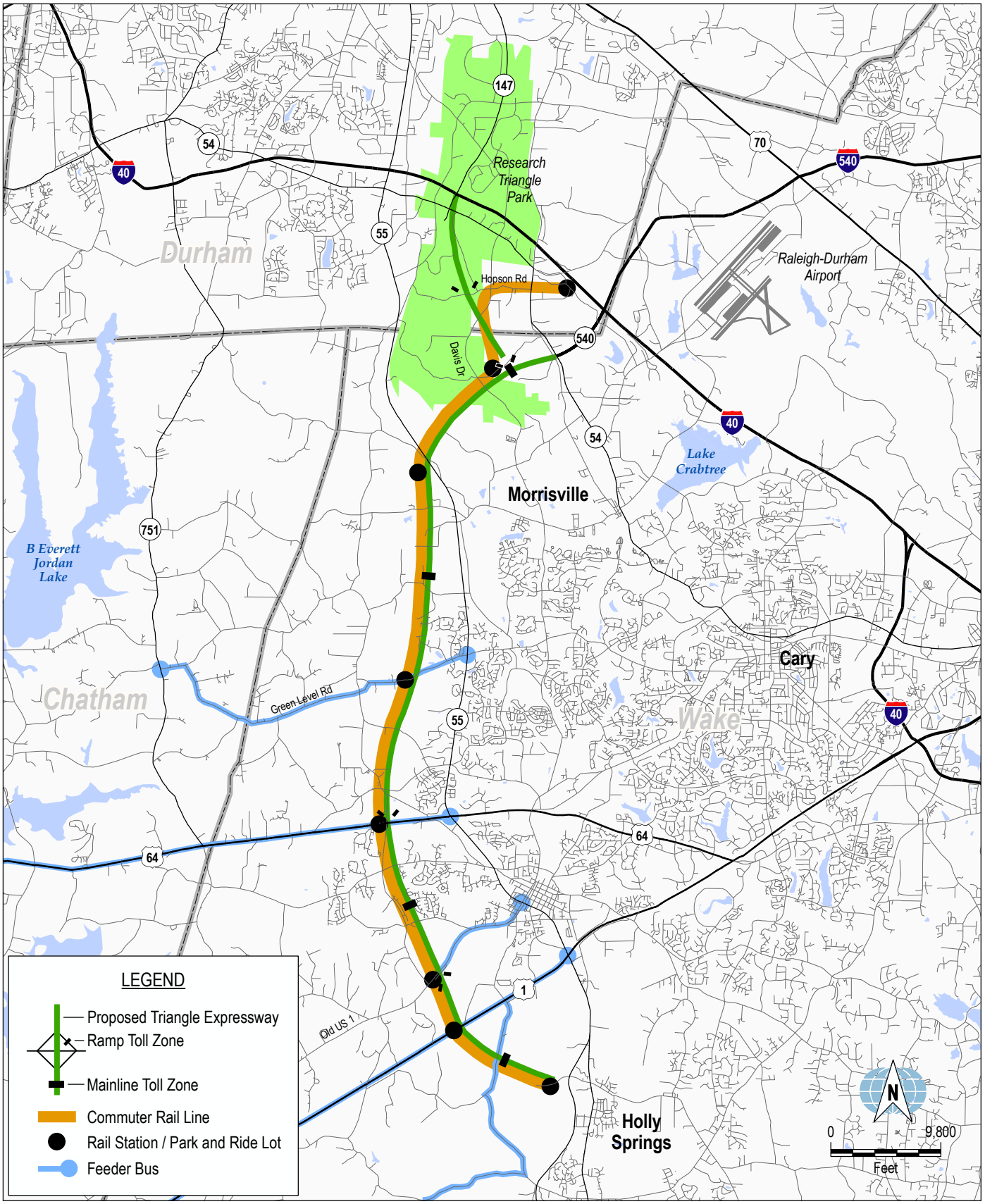
This theoretical rail line would have service characteristics similar to the commuter line that was not approved by the US DOT in 2006: [3]

- Rail Headways - 10 minutes peak and 20 minutes off-peak;
- Feeder Bus Headways - 20 minutes peak and 40 minutes off-peak;
- Average Speeds - up to 45 miles per hour depending on distances between stations (average 36 miles per hour);

---

(2) See Table 2-12.

(3) This sensitivity test is theoretical in the sense that neither an engineering nor a financial feasibility analysis was conducted to confirm that the rail line could be placed near the Triangle Expressway. The purpose of the sensitivity test was to estimate the effects on the Triangle Expressway gross toll revenue if such a rail line were implemented.



NORTH CAROLINA Turnpike Authority

COMMUTER RAIL SENSITIVITY TEST

FIGURE 7-3

- Rail Fares - $2.00 flat fare in opening year, same as the fare in the earlier rail project for the same distance;
- Feeder Bus Fares - $0.75 in opening year; and
- Park and Ride Lots - at each station.

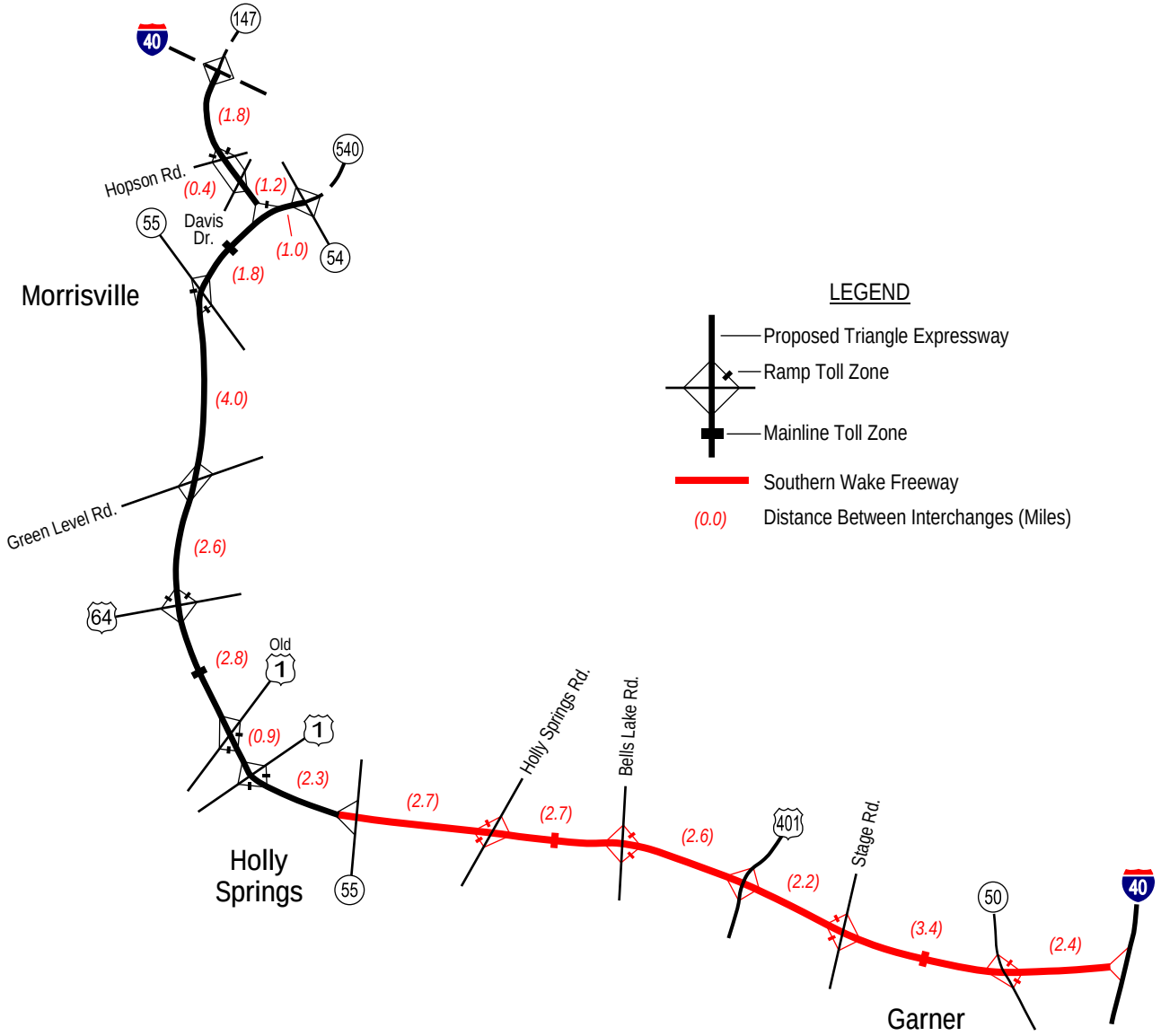
Some potential toll road commuters could be attracted to this line for all or portions of certain trips, but the slower speed of the rail line and transfer times between feeder buses and rail would tend to favor the toll road. The average speed of the toll road would be approximately 65 mph, and the average speed over the commuter rail line would be 36 mph. As indicated in Table 7-1, the expected gross toll revenue would be 0.7 percent lower than the base case in FY 2020 and 1.8 percent lower in FY 2030. Clearly other factors such as significantly higher fuel costs, congestion on the area road network, and reduction of available parking in the RTP area would contribute to higher rail usage.

SOUTHERN WAKE FREEWAY

The preliminary traffic and revenue study included an analysis of both the Western Wake and the Southern Wake Freeways.[(4)] However, this comprehensive study does not include the Southern Wake Freeway. A sensitivity test was conducted to estimate the potential impact on Triangle Expressway traffic and toll revenue if the Southern Wake Freeway were available. The Western and Southern Wake Freeways would provide enhanced connectivity for travelers in western and southern Wake County. Figure 7-4 depicts a toll road that includes the Southern Wake Freeway.

The incremental revenue on the Triangle Expressway due to the additional Southern Wake traffic is forecast to be approximately 15 percent higher than the base case in FY 2020 and 12 percent in FY 2030. This revenue is incremental and does not include the revenue for traffic passing through tolling zones on the Southern Wake Freeway itself. It includes only revenue impacts on the Triangle Expressway tolling zones and is used as a basis of comparison to illustrate the effects of the enhanced connectivity offered by the Southern Wake Freeway.

(4) Proposed Western and Southern Wake Parkways Preliminary Traffic and Revenue Study, Wilbur Smith Associates for the North Carolina Turnpike Authority, June 16, 2006.



Schematic
Not To Scale

NORTH CAROLINA Turnpike Authority

SENSITIVITY TEST TOLL CONFIGURATION
TRIANGLE EXPRESSWAY WITH SOUTHERN WAKE FREEWAY

FIGURE 7-4

INCREASED LEAKAGE

Table 7-1 presented earlier summarized the effect of leakage assumptions for 2012, 2020, and 2030. In this sensitivity test, higher rates of revenue leakage for ETC and video collection were assumed as shown in Table 7-5. For ETC transactions, it was assumed that 1 percent of the transactions would be uncollected in contrast to 0.5 percent for the base case. For video toll transaction, the assumption for readable plates was reduced from 90 to 85 percent in the opening year and from 95 to 90 percent by FY 2030. The assumption for percentage of registered video accounts, the percentage of toll transactions collected less 30 days after usage, the percentage of toll transactions collected more over 30 days after usage, and the percentage of pending toll transactions were also revised. Table 7-6 presents the results of the sensitivity test for increased leakage. In FY 2014, the higher leakage rates would yield a reduction in collected toll revenue of 5.2 percent. By FY 2030, the reduction would be 2.4 percent, which indicates that the collected revenue is relatively insensitive to the leakage rates tested.

Table 7-5
Comparison of Alternative Leakage Assumptions
for Sensitivity Tests

	Class 1 Vehicles					
	Percent by Year					
	FY 2014		FY 2020		FY 2030	
Assumption	Base Case	Sensitivity Test	Base Case	Sensitivity Test	Base Case	Sensitivity Test
ETC Collectible	99.5%	99%	99.5%	99%	99.5%	99%
ETC Uncollectible	0.5%	1%	0.5%	1%	0.5%	1%
Total ETC Transactions	100.0%	100%	100%	100%	100%	100%
Readable Plates	90%	85%	93%	87%	99%	90%
Unreadable Plates	10%	15%	7%	13%	5%	10%
Total Plates Imaged	100%	100%	100%	100%	100%	100%
Preregistered Video	25%	15%	30%	22%	40%	25%
Unregistered Video	75%	85%	70%	78%	60%	75%
Total Readable Plates	100%	100%	100%	100%	100%	100%
Postpaid Collectible Before 15 Days	25%	15%	25%	15%	25%	15%
Postpaid Unpaid After 15 Days	75%	85%	75%	85%	75%	85%
Total Unregistered Vehicle	100%	100%	100%	100%	100%	100%
Billable After 15 Days	85%	80%	85%	80%	85%	80%
Unbillable After 15 Days	15%	20%	15%	20%	15%	20%
Total Unpaid After 15 Days	100%	100%	100%	100%	100%	100%
Collectible After 30 Days	60%	50%	60%	56%	60%	60%
Unpaid After 30 Days	40%	50%	40%	44%	40%	40%
Total Billable After 30 Days	100%	100%	100%	100%	100%	100%

	Class 2 and 3 Vehicles					
	Percent by Year					
	FY 2014		FY 2020		FY 2030	
Assumption	Base Case	Sensitivity Test	Base Case	Sensitivity Test	Base Case	Sensitivity Test
ETC Collectible	99.5%	99%	99.5%	99%	99.5%	99%
ETC Uncollectible	0.5%	1%	0.5%	1%	0.5%	1%
Total ETC Transactions	100.0%	100%	100%	100%	100%	100%
Readable Plates	90%	85%	93%	87%	99%	90%
Unreadable Plates	10%	15%	7%	13%	5%	10%
Total Plates Imaged	100%	100%	100%	100%	100%	100%
Preregistered Video	25%	15%	30%	22%	40%	25%
Unregistered Video	75%	85%	70%	78%	60%	75%
Total Readable Plates	100%	100%	100%	100%	100%	100%
Postpaid Collectible Before 15 Days	25%	15%	25%	15%	25%	15%
Postpaid Unpaid After 15 Days	75%	85%	75%	85%	75%	85%
Total Unregistered Vehicle	100%	100%	100%	100%	100%	100%
Billable After 15 Days	85%	80%	85%	80%	85%	80%
Unbillable After 15 Days	15%	20%	15%	20%	15%	20%
Total Unpaid After 15 Days	100%	100%	100%	100%	100%	100%
Collectible After 30 Days	60%	50%	60%	56%	60%	60%
Unpaid After 30 Days	40%	50%	40%	44%	40%	40%
Total Billable After 30 Days	100%	100%	100%	100%	100%	100%

Table 7-6
Increased Leakage Sensitivity Test
Triangle Expressway
(Thousands)

Fiscal Year	Collected Toll Revenue [2]		Difference from Base Case	Percent Difference from Base Case [2]
	Base Case	Increased Leakage Sensitivity Test		
2014	$17,403	$16,498	-$905	-5.2%
2020	44,089	42,590	-1,499	-3.4%
2030	95,427	93,137	-2,290	-2.4%

(1) Forecasts for FY 2014 reflect an assumed ramp-up to full trafic volumes beginning in the second half of FY 2015 for Triangle Parkway and NC 540 between NC 54 and NC 55 at Morrisville and to full ltraffic volumes beginning in the second half of FY 2016 for Western Wake Freeway.

2) Excludes administrative fees and civil penalties.

APPENDIX

Pending Revenue and Unpaid Violations to be Settled Estimates

HNTB Corporation
Engineers Architects Planners

2 Thomas Drive
Westbrook, Maine 04092

Telephone (207) 774-5155
Facsimile (207) 772-7410
www.hntb.com

Date
March 19, 2008

To
James Eden, NCTA
Grady Rankin, NCTA

From
Walter Fagerlund, P.E.

Memorandum

Subject
"Pending" revenue and "Unpaid Violations to be Settled" estimates

The following provides documentation of a collaborative effort by the NCTA in conjunction with its consultants, Wilbur Smith Associates (WSA), PBS&J and HNTB to develop estimates of revenue realized and unpaid violations to be settled associated with the proposed video tolling process for the agency.

As part of their most recent updates to the traffic and revenue forecasts (dated March 4, 2009), WSA provided estimates of the number of transactions that would be included as part of the video toll noticing process. WSA assumed a first set of notices collected on in their revenue estimates and from this set, the notices not paid were labeled "pending". This was where the calculation of revenue by WSA was concluded. WSA recommended that the NCTA use the "pending" transaction volumes along with NCTA's operations plan and the applicable enforcement legislation to estimate what amount of the "pending" transactions would be projected to be realized as revenue and what amount would be considered "unpaid violations to be settled".

The following inputs and factors were assumed in calculating the "pending revenue" and "unpaid violations to be settled" amounts:

- Average toll rates for "pending" transactions (WSA T&R)
- Anticipated "pending" notice and transaction volumes (HNTB O&M model)
- Fees and penalty amounts anticipated for paid "pending" transactions (NCTA and PBS&J)
- Adjustments to fees based on limitations of maximum amounts (NCTA and PBS&J)
- Per legislation, fees and penalty amounts were not escalated over time

The following table provides the summary of projected values. Note the "unpaid violations to be settled" amounts are only for toll revenue (does not include potential fees) associated with "pending" transactions to be settled beyond the pending revenue recovery stated. These "unpaid violations to be settled" amounts do not include other types uncollected transactions, such as unreadable license plate images or undeliverable mail, which might also be considered as part of the overall "uncollected revenue". Furthermore, these estimates only represent planning level documentation by the overall team (NCTA, WSA, PBS&J and HNTB) and therefore should not be considered a formal portion by HNTB of the overall revenue projection. We recommend that the NCTA take these estimates into consideration with their own internal estimates of revenue and uncollected revenue as part of the development of any financing plans.

"Pending" Revenue and "Unpaid Violations to be Settled" Estimates
(Values in Future $1000s)

Year	"Pending" Revenue Received (Toll and Fee)	"Unpaid Violations to be Settled" (Toll only)
2012	25	18
2013	360	266
2014	853	639
2015	725	549
2016	847	646
2017	875	672
2018	893	691
2019	913	711
2020	938	735
2021	948	765
2022	963	781
2023	978	796
2024	997	816
2025	1,017	835
2026	1,040	858
2027	1,067	886
2028	1,092	910
2029	1,121	940
2030	1,154	972
2031	1,170	998
2032	1,184	1,014
2033	1,227	1,054
2034	1,258	1,084
2035	1,288	1,113
2036	1,317	1,142
2037	1,356	1,178
2038	1,393	1,213
2039	1,432	1,251
2040	1,475	1,292
2041	1,509	1,324
2042	1,536	1,349
2043	1,566	1,377
2044	1,596	1,405
2045	1,626	1,433
2046	1,655	1,460
2047	1,687	1,490
2048	1,719	1,520
2049	1,751	1,550
2050	1,785	1,582
2051	1,818	1,613