

Transportation Impact Analysis

Fall 2009 Update for the Carolina North Development

Executive Summary

SUBMITTED TO

TOWN OF CHAPEL HILL, NORTH CAROLINA

SUBMITTED BY

Vanasse Hangen Brustlin, Inc.

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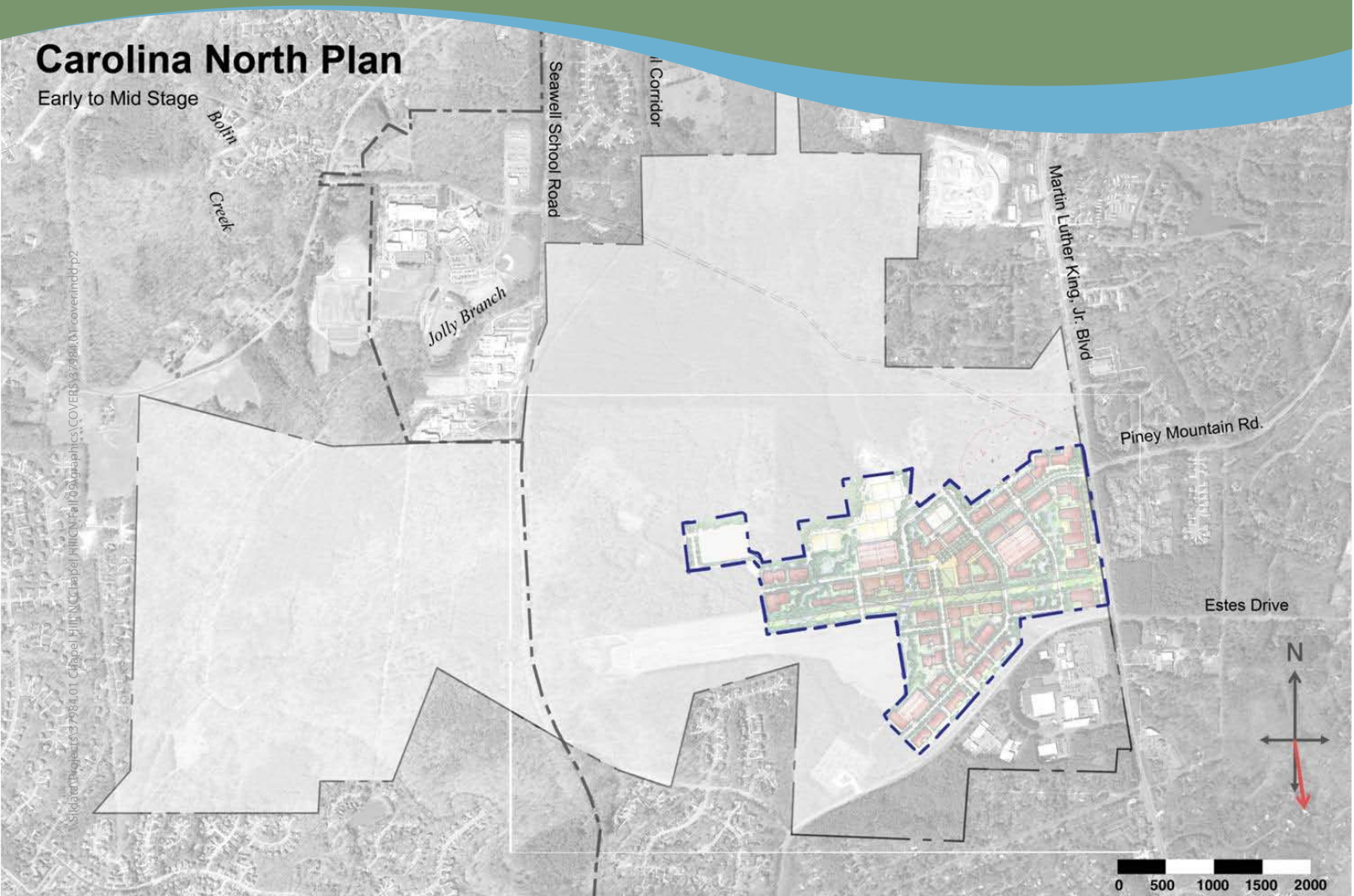

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1 Introduction

The University of North Carolina at Chapel Hill (the "University") has proposed redevelopment of the Horace Williams tract as a new campus, referred to as the Carolina North Development. Over the long term, 8 to 10 million square feet of additional campus development is proposed for the site. In the more immediate term, the University has outlined an 800,000 square foot development scenario which has been used as the basis for a 2015 (TIA Phase 1) impact analysis and a 3,000,000 square foot development scenario that has been used as the basis for a 2030 (TIA Phase 2)[1] impact analysis.

VHB originally completed a Transportation Impact Analysis (TIA) for the Carolina North Development dated June 3, 2009, which was prepared with the active participation of Town and University staff. This fall 2009 TIA serves as an update of the original TIA and is based on new traffic, transit, pedestrian and bicycle data collected in September and October of 2009. This study update also has a modified horizon year for the analysis of the second phase of development from the year 2025 to 2030. It also includes additional focus on the multi-modal impacts of the development in the immediate vicinity of the project. It is important to note that this update is not an expansion of the scope or study area for the TIA, but is limited to a validation and update of the analysis based on the new existing transportation data collected. No change to the program for the Carolina North development was assumed as part of this update.

The University has outlined two interim stages of development for the site. The early phase scenario totals 800,000 square feet and a longer term scenario totals 3,000,000 square feet. For the purposes of evaluating the transportation impacts of the project, the TIA includes the 800,000 square foot development program in a 2015 (TIA Phase 1) scenario and the 3,000,000 square foot development program in a 2030 (TIA Phase 2) scenario[2].

For both horizon years, the TIA update provides an analysis of traffic, transit, pedestrian, and bicycle impacts to the Chapel Hill-Carrboro area. Additional analyses, based on more or less constrained parking options, show the potential impacts if the development program under varying conditions. The key defining characteristics of this methodology include:

- Development Scenarios and Horizon Years
- Other Development and Regional Growth
- Parking and Travel Choices

[1] These dates and square footage estimates were established for analytical purposes and do not represent a prediction of the Carolina North development program.
[2] These dates and square footage estimates were established for analytical purposes and do not represent a prediction of the Carolina North development program.

- Site Generated Trips
- Distribution of Trips
- Traffic Impacts
- Transit Impacts
- Pedestrian and Bicycle Access
- Mesoscale Air Quality and Greenhouse Gas impacts

This TIA update re-analyzes the transportation-related aspects of the Carolina North project. It provides a comprehensive analysis of traffic, transit, pedestrian, and bicycle impacts to the Chapel Hill-Carrboro area. It is important to note that this TIA is unusual and follows the prescribed requirements in the July 1, 2000 Development Agreement by and between the University of North Carolina at Chapel Hill and the Town of Chapel Hill. The development program and timeline for Carolina North are not well defined given the need to respond to changing needs and conditions and the long-term planning horizon. As such, this TIA is the first in a series of periodic TIA updates required for the project.

Typically, a TIA identifies specific transportation system improvements that are then implemented along with the development, or at specified dates. This TIA does not identify improvements that will be implemented on a specific schedule. Instead, this TIA identifies the potential impacts and potential improvements that mitigate the impacts. Much like the conduct of this TIA update, the specific mitigation requirements are determined by the provisions specified in the Development Agreement. Given the timeframe of this development, these potential improvements will require more study and evaluation to determine the most appropriate measures at the time in question. In some cases, identified improvements may not be needed. In other cases, modified solutions that address then-current issues will be proposed. In still other cases, entirely different solutions may be identified and implemented. Analysis of then-current conditions as documented in future TIA updates will be needed to determine the specific mitigation characteristics and implementation times.

In essence, this TIA updates the overall assessment of the potential impacts of the project, identifies solutions that address these impacts, and informs the details and timing of specific mitigation commitments as defined in the development agreement for Carolina North. TIAs will continue to be updated at regular intervals of development at Carolina North to reflect changes in the development program, the transportation system, and to refine the mitigation requirements at each interval.

Carolina North is located on the Horace Williams tract, on the west side of Martin Luther King, Jr. Boulevard, and contains around 950 acres in both Chapel Hill and Carrboro. The development proposal is contained in approximately 250 acres on the southeast corner of the property. Carolina North is located two miles north of the Main Campus and less than three miles south of Interstate 40. The proposal for Carolina North represents substantial change from the existing uses on the site. The long-term proposal will have a profound impact on how people move to and from the site; therefore, the study area extends well beyond the immediate vicinity of the property.

A preliminary study area was identified by the Town as a starting point for the traffic component of this study. It contains 52 intersections throughout Chapel Hill and Carrboro. However, the results of the analysis for the year 2015 (TIA Phase 1) and 2030 (TIA Phase 2) scenarios revealed that only a select number of intersections meet the Town's criteria for inclusion into the study area, as detailed below:

- 15 signalized and 3 unsignalized intersections are included in the 2015 (TIA Phase 1) study area
- 42 signalized and 4 unsignalized intersections are included in the 2030 (TIA Phase 2) study area

The 2009 (Existing), 2015 (TIA Phase 1), and 2030 (TIA Phase 2) study areas are illustrated in Figure 1, which is attached at the end of this document. It should be noted that this is the same study area (for each phase) as analyzed in the spring 2009 TIA.

Separate from traffic component, the study areas for the pedestrian, bicycle and transit analyses were defined through discussions with the Town and the University. For the pedestrian and bicycle analysis, it was determined that the roadways immediately surrounding all sides of the site would be analyzed, as well as Martin Luther King, Jr. Boulevard extending south to the main UNC Campus. For the transit analysis, the six (6) routes that operate in closest proximity to the Carolina North campus were included as part of this study. These include the A, G, HS, NS, NU, and T routes. The study areas for this effort are the same as those studied in the spring 2009 TIA.

2 Spring 2009 TIA and Fall 2009 TIA Update Comparison

The goal of this chapter of the Executive Summary document is to give a brief overview and comparison of the data utilized and resulting potential mitigation measures between the Spring 2009 TIA and the Fall 2009 TIA Update.

2.1 Data Comparison

The traffic data utilized for the original TIA document was gathered from a variety of sources and included counts from 2008 and 2009. For this TIA update, all traffic count data that was not collected in the spring of 2009 was updated based on a data collection effort performed in September and October of 2009. For the effort in September and October of 2009, SEPI Engineering Group performed new turning movement counts at forty-five intersections from 7:00 a.m. – 9:00 a.m., 11:30 a.m. – 1:30 p.m., and 4:00 p.m. – 6:00 p.m. between September 15th and October 15th, 2009. *A general comparison of the turning movement count data between the fall 2009 counts and those counts used in the spring 2009 TIA revealed that the fall 2009 counts are in the range of approximately 5 – 10 percent lower at almost every intersection.*

In addition, average daily traffic (ADT) volume counts were also conducted at twenty-one locations between September 15th and October 15th, 2009 using tube counters. Tube counts included the collection of speed data as well as traffic volumes. The following table compares the ADT volumes taken in the fall of 2009, versus the ADTs used in the spring 2009 TIA. *It can be seen in Table 1 that the ADTs decrease by just over 8 percent in total between the spring 2009 TIA and the fall 2009 counts.*

Table 1: ADT Comparison between Spring and Fall 2009 TIAs

ID	Roadway Section	Spring 2009 ADT	Fall 2009 ADT	% Change
1	Martin Luther King, Jr. Blvd (NC 86) between Clyde Rd and Hilltop MHP	7606	7070	-7.05%
2	Eubanks Rd between Northwood Dr and Martin Luther King, Jr. Blvd (NC 86)	7960	7495	-5.84%
3	Martin Luther King, Jr. Blvd (NC 86) between Perkins Dr and Northwood Dr	30280	23361	-22.85%
4	Weaver Dairy Rd Ext between Lonebrook and Martin Luther King, Jr. Blvd (NC 86)	5290	4836	-8.58%
5	Weaver Dairy Rd between Timberlyne Rd and Weatherstone Dr	11291	10178	-9.86%
6	Seawell School Rd between Homestead Rd and Savannah Terrace	4581	4121	-10.04%
7	Homestead Rd between Brookstone Dr and Martin Luther King, Jr. Blvd (NC 86)	8944	9669	8.11%
8	Martin Luther King, Jr. Blvd (NC 86) between Dixie Ln and Homestead Rd	26564	24689	-7.06%
9	Seawell School Rd between Hanover Place and Railroad Xing 0.1 mi to the West	4974	3527	-29.09%
10	Estes Dr Ext between Seawell School Rd and Umstead Rd	13662	12609	-7.71%
11	N. Estes Dr between Martin Luther King, Jr. Blvd (NC 86) and UNC Facilities Dept. Driveway to the west	17171	11806	-31.24%
12	Martin Luther King, Jr. Blvd (NC 86) between N. Estes Dr and YMCA Driveway to the south	21843	21699	-0.66%
13	N. Estes Dr between Halifax Rd and Granville Rd	15567	14148	-9.12%
14	Martin Luther King, Jr. Blvd (NC 86) between Bolin Heights and E. Longview St	17916	19222	7.29%
15	Hillsborough St between North St and Rosemary St	7987	7750	-2.97%
16	Hillsborough St between Bolinwood Dr and Martin Luther King, Jr. Blvd (NC 86)	6949	6589	-5.18%
17	Martin Luther King, Jr. Blvd (NC 86) between Piney Mountain Rd and N. Estes Dr	28090	28391	1.07%
18	Piney Mountain Rd between Timber Hollow Ct and Woodshire Ln	2954	2743	-7.14%
19	Piney Mountain Rd between Lake Ellen Dr and Oosting Dr	2395	2442	1.96%
20	Kingston Dr between Balsam Ct and Kingston Ct	1037	1038	0.10%
21	Homestead Rd between Seawell School Rd and Hearthstone Ln	9472	9030	-4.67%
	AVERAGE % CHANGE			**-8.66%**

Recent transit ridership data were also collected for the fall 2009 TIA update, based on data collected in September of 2009, provided by the Town of Chapel Hill. The following Figure 2 and Figure 2A depict a comparison between the Fall 2008 data used for the Spring 2009 TIA and the September 2009 data. Figure 2 shows data for all Chapel Hill Transit routes, and Figure 2A compares only those routes that would serve or operate nearby the Carolina North site. In general, the data comparison revealed that ridership had increased overall by 4 percent, mainly due to significant increases in the J, NS, and RU routes. In particular, it should be noted that service on the NS route has been significantly increased by 1-year CMAQ funding which contributes to the significant ridership increase between 2008 and 2009.

Figure 2: All Transit Ridership Data Comparison between Spring and Fall 2009 TIAs

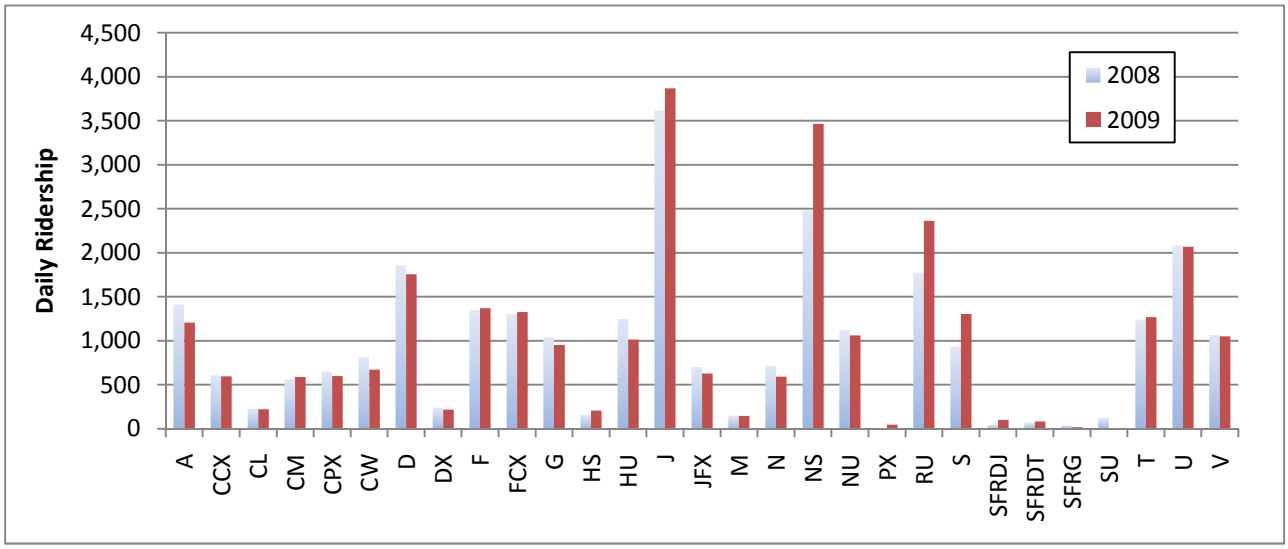
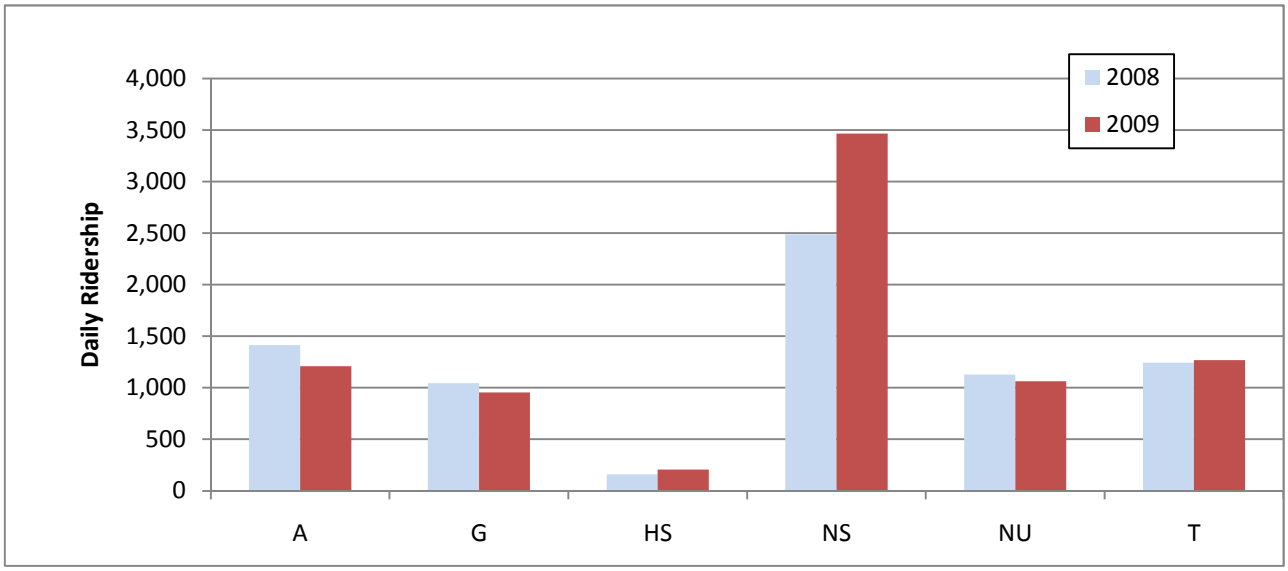


Figure 2A: Transit Ridership Data near Carolina North Comparison between Spring and Fall 2009 TIAs



Related to the transit element, Table 2 shows park-and-ride occupancy data from fall 2007, April 2009, and November 2009. There are some minor differences between the data sets, but the overall utilization is consistent. Only one of the University's and three of the Town's park-and-ride lots have any significant parking availability based on the November 2009 counts. There are over 700 spaces available among the Eubanks, Jones Ferry, Carrboro Plaza, and Chatham County lots. Eubanks is the park-and-ride most accessible to Carolina North and has approximately 130 available parking spaces.

Table 2: Park-and-Ride Occupancy Comparison between Spring and Fall 2009 TIAs

Lot Name	Owner	Bus Routes Serving Lot	No. of Parking Spaces	Parking Occupancy Fall 2007	Parking Occupancy April 2009	Parking Occupancy Nov 2009	Available Parking Spaces
Eubanks	Chapel Hill	NS	400	234	201	268	132
Carrboro Plaza	Chapel Hill	CPX, CW	145	136	132	111	34
Jones Ferry	Chapel Hill	JFX, CW, CM	443	252	240	230	213
Southern Village	Chapel Hill	NS, V	400	388	332	385	15
NC-54 East	Chapel Hill	HU, S	512	508	505	512	0
Friday Center	University	HU, V, FCX	871	882	867	871	0
Chatham County	University	CCX	550	150	215	214	336
Franklin Street	University	CL, D, F, M	67	67	67	67	0
Martin Luther King, Jr. Blvd	University	G, HS, NS, NU, T	40	39	39	40	0
Total			**3,428**	**2,656**	**2,598**	**2,698**	**730**

Source: No. of parking spaces from the University of North Carolina at Chapel Hill.
Fall 2007 occupancy counts from *The University of North Carolina at Chapel Hill Development Plan Traffic Impact Analysis, December 2007 amended January 2008.*
April 2009 space-available counts conducted by VHB on Wednesday, April 8th.
Nov 2009 space utilization counts conducted on November 17, 2009 by Martin/Alexiou/Bryson (MAB).
Note: CCX, CPX, FCX, and JFX are express routes.

2.2 Potential Traffic Mitigation Measures Comparison

Table 3 provides a brief comparison of the potential traffic mitigation measures in the fall 2009 TIA Update and the spring 2009 TIA. In general, most improvements at the critical intersections are the same, although restriping or geometric improvements are no longer needed at some major intersections along the US 15/501 corridor, as identified in the spring 2009 study. This is due to the decrease in traffic volumes observed with the fall 2009 traffic counts, versus the data used in the spring 2009 TIA.

Table 3: Potential Traffic Mitigation Measures Comparison

Location	Spring 2009 TIA Potential Mitigation Measure	Fall 2009 TIA Update Potential Mitigation Measure
Martin Luther King, Jr. Boulevard (NC 86) & Eubanks Road	Restripe eastbound approach as a dual left-turn and a shared left/right	Construct an additional eastbound left-turn lane to provide triple lefts
Martin Luther King, Jr. Boulevard (NC 86) & Weaver Dairy Road	Construct an exclusive westbound right-turn lane Construct an exclusive southbound right-turn lane Construct an exclusive northbound right-turn lane	Construct an exclusive westbound right-turn lane Construct an exclusive southbound right-turn lane
Martin Luther King, Jr. Boulevard (NC 86) & Piney Mountain Road/Municipal Drive	Construct an exclusive southbound right-turn lane Widen eastbound approach to accommodate site traffic Construct a northbound shared through/right-turn lane	Construct an exclusive southbound right-turn lane Widen eastbound approach to accommodate site traffic Construct an exclusive northbound right-turn lane
Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive	Construct an exclusive northbound right-turn lane Construct an additional eastbound and westbound through lane Construct an additional southbound left-turn lane to provide dual lefts Construct an exclusive southbound right-turn lane	Construct an exclusive northbound right-turn lane* Construct an additional eastbound and westbound through lane Construct an additional southbound left-turn lane to provide dual lefts
Martin Luther King, Jr. Boulevard (NC 86) & Homestead Road	Adjust signal timings and offsets	Construct an additional eastbound right-turn lane to provide dual rights Remove north side crosswalk across Martin Luther King, Jr. Boulevard (NC 86)
Martin Luther King, Jr. Boulevard (NC 86) & Airport Drive	Signalize intersection	Signalize intersection
Estes Drive & Caswell Road/Curtis Road	Restripe the southbound approach to a shared left-turn/through lane and an exclusive right-turn lane	Restripe the southbound approach to a shared left-turn/through lane and an exclusive right-turn lane

Estes Drive Extension & Airport Drive	Signalize intersection	Signalize intersection
	Modify westbound approach to include a shared left-turn/through lane, one through lane, and an exclusive right-turn lane	Modify westbound approach to include a shared left-turn/through lane, one through lane, and an exclusive right-turn lane
	Modify eastbound approach to include an exclusive left-turn, one through lane, and a shared through/right-turn lane	Modify eastbound approach to include an exclusive left-turn, one through lane, and a shared through/right-turn lane
	Construct southbound approach (site driveway) to provide an exclusive left-turn lane, one through lane, and an exclusive right-turn lane	Construct southbound approach (site driveway) to provide dual left-turn lanes, one through lane, and an exclusive right-turn lane
		Construct an exclusive northbound left-turn lane
Estes Drive & Franklin Street	Construct an exclusive southbound right-turn lane	Construct an exclusive southbound right-turn lane
Fordham Boulevard (US 15-501) & Eastowne Drive/BSBC Drive	Restripe the northbound approach to a shared left-turn/through lane and an exclusive right-turn lane	Adjust signal timings and offsets
Fordham Boulevard (US 15-501) & Eastowne Drive/Lakeview Drive	Restripe the northbound approach to a shared left-turn/through lane and an exclusive right-turn lane	Adjust signal timings and offsets
Fordham Boulevard (US 15-501) & I-40 Eastbound Ramps	Restripe the southbound approach to an exclusive right-turn lane, a shared right/through/left-turn lane and an exclusive left-turn lane	Adjust signal timings and offsets

Note: Red text indicates potential mitigation measures suggested for Phase 1 development
*Unless implemented by others

2.3 Potential Traffic Calming Measures

Table 4 provides a brief comparison of the potential traffic calming measures in the fall 2009 TIA Update and the spring 2009 TIA. Since the ADT volume information for the roadways selected to be studied for traffic calming did not alter significantly enough, the potential mitigation measures between the fall and spring studies are identical.

Table 4: Potential Traffic Calming Measures Comparison

Road Segment	Spring 2009 TIA	Fall 2009 TIA Update
Piney Mountain Road	roundabouts, speed humps, speed tables, lane narrowing	same
Hillsborough Street	roundabouts, speed humps, speed tables, lane narrowing	same
Seawell School Road	roundabouts, speed humps, speed tables, lane narrowing	same
North Elliott Road/Curtis Road/Caswell Road	roundabouts, speed humps, speed tables, lane narrowing	same
North Lakeshore Drive	roundabouts, speed humps, speed tables, lane narrowing	same
Barclay Road	roundabouts, speed humps, speed tables, lane narrowing	same
Northwood Road	roundabouts, speed humps, speed tables, lane narrowing	same

2.4 Potential Transit Mitigation Measures

Table 5 provides a brief comparison of the potential transit mitigation measures in the fall 2009 TIA Update and the spring 2009 TIA. Due to some capacity improvements made in the Summer 2009 to the NS Route and changes in ridership data used for the fall 2009 TIA Update, some minor changes in the potential mitigation measures occurred between the spring and fall studies, as noted in the table. It should be noted that the potential transit mitigation measures identified in this document will be reviewed as part of the development of the Chapel Hill Transit Short Range Transit Plan and incorporated into the analysis of future service needs. Continuation of the service improvements on the NS route are also needed to support the potential mitigation levels identified below.

Table 5: Potential Transit Mitigation Measures Comparison

	Spring 2009 TIA	Fall 2009 TIA Update
2015 Vehicle Requirements	1 new vehicle needed to serve Carolina North	No new vehicles needed to serve Carolina North
2030 Vehicle Requirements	10 new vehicles needed to serve Carolina North	13 new vehicles needed to serve Carolina North
2015 Capacity Needs	Additional capacity needed on NS Route	No additional capacity needed after 2009 changes to service
2030 Capacity Needs	Additional capacity needed on all routes except NU and HS	Same

Note: Red text indicates potential mitigation measures suggested for Phase 1 development

2.5 Potential Pedestrian Facility Mitigation Measures

Table 6 provides a brief comparison of the potential pedestrian mitigation measures in the fall 2009 TIA Update and the spring 2009 TIA. It should be noted that for the fall 2009 TIA Update, a higher level of detail was used for the analysis of pedestrian facilities

surrounding the site. For the fall 2009 Update, the Pedestrian Level of Service (LOS) was calculated for select roadway segments in the study area accordance with TRB's Multimodal Level of Service Analysis for Urban Streets (NCHRP Report 616). Pedestrian LOS reflects the perspective of pedestrians sharing the roadside environment with motor vehicles. This assessment is based primarily on the existence of a sidewalk, lateral separation between pedestrians and motorized vehicles, motorized vehicle volumes, and motorized vehicle speeds. Similar to analyzing vehicular traffic, each level is assigned a letter from A to F, with LOS A representing the best pedestrian accommodations and LOS F representing the worst.

It should be noted that this is a recently developed methodology that has not been adopted by the Town of Chapel, but is a methodology that is being applied in other localities. It is used in this study solely to identify locations that may require improvements to provide a high pedestrian level of service. These potential improvements are not specifically necessary to mitigate impacts generated by Carolina North, and the methodology is not intended to identify improvements that will be required as part of the development. Rather, the potential improvements represent a set of measures to address a lack of widely available and high quality pedestrian facilities near the project site and to inform the design of improvements included in the Development Agreement. Further definition of the specific characteristics and phased implementation for these facilities will be a component of the future design effort for these facilities. Below is a comparison the potential mitigation measures between the spring and fall 2009 TIAs.

Table 6: Potential Pedestrian Facility Mitigation Measures Comparison

Location	Spring 2009 TIA	Fall 2009 TIA Update
Martin Luther King, Jr. Boulevard (NC 86) from Homestead Road to Airport Drive	Provide continuous sidewalk along Martin Luther King, Jr. Boulevard (NC 86) from Homestead Road to Airport Drive (continuous sidewalk currently exists south of Airport Drive).	Provide continuous sidewalk with a planting strip and street trees along Martin Luther King, Jr. Boulevard (NC 86) from Homestead Road to Hillsborough Street/Umstead Drive on both sides of the roadway (Analysis indicates that it is desirable to match existing sidewalk widths where possible and provide a wide planting strip buffer between the street and sidewalk, depending on the traffic volume on the adjacent street).
	Construct sidewalk across driveways to complete sidewalk network. It is important that the sidewalk be consistent in its design so that there is a clear differentiation between the sidewalk and the driveway.	Construct sidewalk across driveways to complete sidewalk network. It is important that the sidewalk be consistent in its design so that there is a clear differentiation between the sidewalk and the driveway.
	Install continental-style crosswalks and pedestrian countdown signals at all legs of signalized intersections along Martin Luther King Jr. Blvd, including at Municipal Dr and Estes Dr.	Install continental-style crosswalks and pedestrian countdown signals at all legs of signalized intersections along Martin Luther King Jr. Boulevard (NC 86) including at Municipal Drive and Estes Drive.
	Narrow curb-radii at intersections to 25 feet maximum where feasible to slow turning cars and shorten-pedestrian crossing distances.	Narrow curb-radii at intersections to 25 feet maximum where feasible to slow turning cars and shorten-pedestrian crossing distances.

	Convert (TWLTL) to a planted raised median with median refuges at (warranted) mid-block crossing locations.	Convert (TWLTL) to a planted raised median with median refuges at (warranted) mid-block crossing locations.
	Conduct analysis to determine if and what type of mid-block crossings are warranted.	Conduct analysis to determine if and what type of mid-block crossings are warranted.
	Widen intersections to allow for turning bays and for 8-foot pedestrian refuge areas in the median. Pedestrian signals and push buttons should be installed in the median refuge.	Widen intersections to allow for turning bays and for minimum 8-foot pedestrian refuge areas in the median. Pedestrian signals and push buttons should be installed in the median refuge.
	Stripe 11-foot travel lanes to slow traffic.	Stripe 11-foot travel lanes to slow traffic.
	Add transit stops in the vicinity of the pedestrian access points.	Add transit stops in the vicinity of the pedestrian access points.
Estes Drive from Seawell School Road to Caswell Road	Provide continuous sidewalk along Estes Drive Extension from Seawell School Road to Martin Luther King, Jr. Boulevard (NC 86).	Provide continuous sidewalk along Estes Drive Extension from Seawell School Road to Martin Luther King, Jr. Boulevard (NC 86) on both sides of the roadway (Analysis indicates that it is desirable to provide a 5' minimum sidewalk width and a planting strip buffer).
	Improve pedestrian walkway along both sides of Estes Drive east of Martin Luther King, Jr. Boulevard.	
	Add transit stops in the vicinity of the pedestrian access points to Carolina North.	Add transit stops in the vicinity of the pedestrian access points to Carolina North.
Seawell School Road from Estes Drive to Homestead Road	Provide continuous sidewalk along Seawell School Road from Hanover Place to Estes Drive	Provide continuous sidewalk along Seawell School Road from Estes Drive to Homestead Road on both sides of the roadway (Analysis indicates that it is desirable to provide a 5' minimum sidewalk width and a planting strip buffer).
Homestead Road from Martin Luther King, Jr. Boulevard (NC 86) to Seawell School Road	None	Provide continuous sidewalk along Homestead Road from Martin Luther King, Jr. Boulevard (NC 86) to Seawell School Road on both sides of the roadway (Analysis indicates that it is desirable to provide a 5' minimum sidewalk width and a planting strip buffer).
Airport Drive from Martin Luther King, Jr. Boulevard (NC 86) to Estes Drive	None	Provide continuous sidewalk along Airport Drive from Martin Luther King, Jr. Boulevard (NC 86) to Estes Drive on both sides of the roadway (Analysis indicates that it is desirable to provide a 5' minimum sidewalk width and a planting strip buffer).

2.6 Potential Bicycle Facility Mitigation Measures

Table 7 provides a brief comparison of the potential bicycle facility mitigation measures in the fall 2009 TIA Update and the spring 2009 TIA. Similar to the pedestrian analysis, it should be noted that for the fall 2009 TIA Update, a higher level of detail was used for the analysis of bicycle facilities surrounding the site. Bicycle LOS was calculated for select roadway segments in the study area accordance with TRB's *Multimodal Level of Service Analysis for Urban Streets* (NCHRP Report 616), which is described in more detail in Section 6.5 of this document.

It should be noted that this is also a recently developed methodology that has not been adopted by the Town of Chapel, but is a methodology that is being applied in other localities. Additional detail related to the design of the new or modified bicycle facilities was included in the fall 2009 TIA Update, as shown in the table below and there are some additions to the potential mitigation measures for bicycle facilities on Homestead Road and Airport Drive. These potential improvements are not specifically necessary to mitigate impacts generated by Carolina North, and the methodology is not intended to identify improvements that will be required as part of the development. Rather, the potential improvements represent a set of measures to address a lack of widely available and high quality bicycle facilities near the project site and to inform the design of improvements included in the Development Agreement. Further definition of the specific characteristics and phased implementation for these facilities will be a component of the future design effort for these facilities.

Table 7: Potential Bicycle Facility Mitigation Measures Comparison

	Spring 2009 TIA	Fall 2009 TIA Update
Stripe 4-5 foot bike lanes on each side of the road on the following segments:	Martin Luther King, Jr. Boulevard (NC 86) from Homestead Road to Bolinwood Drive	Martin Luther King, Jr. Boulevard (NC 86) from Homestead Road to Franklin Street
	Estes Drive from Seawell School Road to Caswell Road	Estes Drive from Seawell School Road to Caswell Road
	Seawell School Road from Hanover Place to Estes Drive	Seawell School Road from Estes Drive to Homestead Road
	Piney Mountain Road from Martin Luther King Jr. Boulevard (NC 86) to Crow Hollow	Homestead Road from Martin Luther King, Jr. Boulevard (NC 86) to Seawell School Road
		Airport Drive from Martin Luther King, Jr. Boulevard (NC 86) to Estes Drive

3 Carolina North Development Program

Over the long term, the University envisions about eight to ten million square feet of additional development over a 50 year period on the site. To provide a framework for the TIA, the University identified two development programs including several different types of land uses such as academic, research, private sector, residential, and medical facilities.

The University identified the 2015 (TIA Phase 1) development program as 800,000 square feet and the 2030 (TIA Phase 2) development program as 3,000,000 square feet. These two scenarios are not specific development proposals anticipated for completion in the TIA timeframes, but are defined for testing the transportation impacts. The 2015 (TIA Phase 1) development program is shown in Table 8 and the 2030 (TIA Phase 2) development program is shown in Table 9. The approximate development area for the TIA Phase 2 scenario is shown Figure 3.

Table 8: 2015 (TIA Phase 1) Carolina North Development Program

	Development (Sq ft)		Parking Spaces*		Approx. Population
Land Use	Size	Percent	Number	Percent	Emp./Stud./Res.
Academic	410,000	51%	705	46%	820
Private	180,000	23%	450	30%	540
Civic /Retail	10,000	1%	15	1%	20
Recreation fields (3)	n/a	n/a	105	7%	n/a
Housing	200,000 (200 units)	25%	250	16%	400
Health Care	0	0%	0	0%	n/a
Total	**800,000**	**100%**	**1,525**	**100%**	**1,780**

Source: University of North Carolina at Chapel Hill, as compiled by VHB.
* Based on Main Campus ratios for similar uses.

Within the 2015 (TIA Phase 1) development program, a little over half of the planned 800,000 square foot development consists of academic facilities, with the rest of the development split between private development and 200 housing units, and a small amount of civic/campus-supporting retail space. To support this development, approximately 1,525 parking spaces would be provided using the ratios identified in this TIA.

Table 9: 2030 (TIA Phase 2) Carolina North Development Program

	Development (Sq ft)		Parking Spaces*		Approx. Population
Land Use	**Size**	**Percent**	**Number**	**Percent**	**Emp./Stud./Res.**
Academic	1,280,000	43%	2,035	35%	2,410
Private	700,000	23%	1,750	30%	2,100
Civic /Retail	70,000	2%	210	2%	140
Recreation fields (3)	n/a	n/a	105	2%	n/a
Housing	750,000 (750 units)	25%	940	16%	1,500
Health Care	200,000	7%	900	15%	950
Total	**3,000,000**	**100%**	**5,835**	**100%**	**7,100**

Source: University of North Carolina at Chapel Hill, as compiled by VHB.
* Based on Main Campus ratios for similar uses.

The 2030 (TIA Phase 2) development program includes an additional 2.2 million square feet of development on the Carolina North site. The 2030 (TIA Phase 2) development program adds nearly 900,000 square feet of academic space to the campus. However, academic uses will account for a smaller share of the total development (roughly one-third), compared with over 50 percent of the development in 2015 (TIA Phase 1). Private development and housing units will each add 520,000 and 550,000 (550 units) square feet of space, respectively, and will each continue to account for roughly one-quarter of the development. Health care uses are introduced into Carolina North and will account for approximately seven percent of the development. Civic and campus-supporting retail space will represent a larger share of the Carolina North development plan, though still a small portion of the total. Additional parking spaces will be added by the completion of Phase Two, bringing the total to approximately 5,835 parking spaces using the ratios developed for this TIA.

4 Existing Conditions

An evaluation of the transportation impacts associated with the proposed Carolina North project includes an understanding of the existing transportation system surrounding the site for four transportation modes: vehicular traffic, transit, pedestrian, and bicycle.

4.1 Existing Traffic Conditions

A traffic evaluation was conducted to determine the existing operational Level of Service (LOS) at the study area intersections. LOS is a qualitative measure that describes the operating conditions within an intersection and the perception of those conditions by the facility's users. There are six levels of service defined for each facility type. Each level is assigned a letter from A to F, with LOS A representing the best operating conditions and LOS F representing the worst. The intersection operations analysis revealed that a number of intersections operate at unacceptable LOS (E or F) during three weekday periods:

- AM Peak Hour: no signalized intersections
- Midday Peak Hour: no signalized intersections
- PM Peak Hour: 2 signalized intersections and 2 unsignalized intersections

As one would expect, the morning and evening peak hours were found to be more congested than the midday peak hour. The 2009 Existing Condition intersection LOS results for the study area intersections are illustrated in Figure 4.

In addition to intersection analysis, a capacity assessment of 21 roadway segments was also performed. The Town's *Guidelines for Traffic Impact Analysis* requires the roadway segments to be analyzed based on a volume-to-capacity (v/c) ratio, where the threshold capacities are established by roadway classification. When the v/c ratio exceeds 1 on a roadway segment, more frequent traffic congestion can be anticipated. The roadway segment analysis has revealed that the following roadway segments currently exceed the Town's established capacity thresholds during one or more of the peak hour periods studied:

- Eubanks Road between Martin Luther King, Jr. Boulevard and Northwood Drive
- Weaver Dairy Road between Timberlyne Road and Weatherstone Drive
- Estes Drive Extension between Seawell School Road and Umstead Road
- Estes Drive Extension between Martin Luther King, Jr. Boulevard and UNC Facilities Department Driveway
- Estes Drive between Halifax Road and Granville Road
- Hillsborough Street between North Street and Rosemary Street
- Homestead Road between Hearthstone Lane and Seawell School Road

4.2 Existing Transit Conditions

Chapel Hill is served by a robust local transit system that is supplemented by regional bus transit service and a substantial park-and-ride network. The Carolina North site is currently served by six weekday transit routes (A, G, HS, NS, NU, and T), including one route (the NS) that originates at the Eubanks park-and-ride lot. It should be noted that the NS route has significantly increased service when compared to 2008, due to CMAQ funding received by Chapel Hill Transit. However, long-term funding to sustain this service has not been secured at this time. These routes are illustrated in Figure 5.

The capacity of bus routes is determined by the frequency of bus service on the route (number of buses per hour) and the capacity of the vehicles (passengers per bus). The majority of the routes are served by typical (35 or 40 foot) transit buses. The NS has a combination of regular and articulated (60 foot) transit buses. Route capacities were provided by Chapel Hill Transit for the routes serving Carolina North based on the fleet mix and frequency of service.

Additionally, Chapel Hill Transit provided passenger count data for the routes. The count data was used to estimate the passenger load on the routes serving Carolina North. As shown in Table 10 and Table 11 below, the routes serving the Carolina North site have available capacity during peak periods.

Table 10: Existing Available Capacity <u>APPROACHING</u> Carolina North

Route	Direction	AM Peak Hour		Midday Peak Hour		PM Peak Hour	
		Vehicle Capacity	Available Capacity	Vehicle Capacity	Available Capacity	Vehicle Capacity	Available Capacity
Route A	NB	120	118	60	48	120	75
	SB	120	88	120	110	60	59
Route G	NB	120	117	120	110	60	35
	SB	120	98	120	116	60	58
Route HS	NB	120	106	60	53	120	106
	SB	120	100	60	51	120	110
Route NS	NB	462	442	75	35	438	198
	SB	462	268	150	114	438	408
Route NU	NB	180	171	120	87	120	85
	SB	n/a	n/a	n/a	n/a	n/a	n/a
Route T	NB	120	103	60	47	60	26
	SB	120	36	120	94	120	78
Total	NB	1,122	1,057	495	381	918	525
	SB	942	590	570	485	798	713
	Peak Direction	1,122	883	1,065	866	918	588
	Total	2,064	1,647	1,065	866	1,716	1,238

Note: Shaded area indicates peak direction APPROACHING Carolina North
Source: Chapel Hill Transit, as compiled by VHB.

Table 11: Existing Available Capacity DEPARTING Carolina North Site

Route	Direction	AM Peak Hour		Midday Peak Hour		PM Peak Hour	
		Vehicle Capacity	Available Capacity	Vehicle Capacity	Available Capacity	Vehicle Capacity	Available Capacity
Route A	NB	120	117	60	55	120	104
	SB	120	61	120	96	60	57
Route G	NB	120	117	120	116	60	35
	SB	120	97	120	108	60	57
Route HS	NB	120	105	60	53	120	107
	SB	120	106	60	50	120	109
Route NS	NB	462	446	75	46	438	282
	SB	462	191	150	101	438	398
Route NU	NB	n/a	n/a	n/a	n/a	n/a	n/a
	SB	180	145	60	55	180	169
Route T	NB	120	86	60	50	60	34
	SB	120	35	120	89	120	79
Total	NB	942	871	375	321	798	562
	SB	1,122	634	630	500	978	869
	Peak Direction	1,122	761	1,005	822	978	753
	Total	2,064	1,505	1,005	822	1,776	1,431

Note: Shaded area indicates peak direction DEPARTING Carolina North
Source: Chapel Hill Transit, as compiled by VHB.

- During the morning peak hour (7:30 am to 8:30 am) there is currently available capacity for 883 passengers to arrive at the Carolina North site, and available capacity for 761 passengers to depart from the Carolina North site, in the peak direction.
- During the midday peak hour (12:30 pm to 1:30 pm) there is currently available capacity for 866 passengers to arrive at the Carolina North site, and available capacity for 822 passengers to depart from the Carolina North site.
- During the evening peak hour (4:00 pm to 5:00 pm) there is currently available capacity for 588 passengers to arrive at the Carolina North site, and available capacity for 753 passengers to depart from the Carolina North site, in the peak direction.

Route capacity is one component of the transit system's ability to serve Carolina North. In addition to the capacity of the system, one must consider the suitability of the current route structure to serve Carolina North. The majority of the existing system is designed to connect areas to the downtown and University campus. As a result, transfers will be required for many local riders to access Carolina North. As Carolina North becomes a more prominent destination in the Town, changes to the route structure so that more direct service to Carolina North may be needed.

In addition to the passenger carrying capacity of the transit system, its reliability is affected by traffic congestion in the Town. It may also be necessary to implement traffic signal priority, queue jump lanes, and other bus rapid transit elements to provide a satisfactory service quality in the future. The current experience of maintain more frequent service on the NS route suggests that these improvements may be needed in the near-term.

The transit system also relies heavily on a set of park-and-ride lots located at major gateways to Chapel Hill. This analysis assumes that all park-and-ride passengers use the lots served by direct connections to the Carolina North site. This concentrates the park-and-ride demand at the Eubanks and Southern Village park-and-ride lots. If the service network were changed, some of the Carolina North demand could use park-and-ride lots at other gateways to town. Additionally, implementation of regional transit improvements by Triangle Transit or others could result in more transit-only connections to Carolina North and could reduce the need for park-and-ride system expansion within the Town. The existing available capacity at each park-and-ride lot was shown in Table 2.

4.3 Existing Pedestrian Facilities

The pedestrian evaluation included a review of the sidewalk network, pedestrian crossings, traffic control devices, and warning signs. Overall, there are few existing pedestrian facilities serving the Carolina North site. Most notably, the following conditions were found:

- There are no sidewalks along the Carolina North site, including the west side of Martin Luther King, Jr. Boulevard (NC 86) and the north side of Estes Drive Extension.
- The presence of crosswalks is limited. The only crossing on Martin Luther King, Jr. Boulevard (NC 86) within a ½ mile radius of Carolina North is located at Northfield Drive.

In addition, an evaluation of the pedestrian facilities in the vicinity of the project site was conducted to determine the existing Pedestrian LOS. This analysis was performed in accordance with TRB's *Multimodal Level of Service Analysis for Urban Streets* (NCHRP Report 616). Pedestrian LOS reflects the perspective of pedestrians sharing the roadside environment with motor vehicles. This assessment is based primarily on the following four variables:

- Presence of a sidewalk;
- Lateral separation between pedestrians and motorized vehicles;
- Motorized vehicle volumes, and
- Motorized vehicle speeds.

Similar to analyzing vehicular traffic, each level is assigned a letter from A to F, with LOS A representing the best pedestrian accommodations and LOS F representing the worst. The existing roadway and sidewalk characteristics, peak hour traffic volumes, and traffic speeds at select roadway segments in the project vicinity were input into the Pedestrian LOS equation outlined in NCHRP Report 616 to conduct the existing analysis. A more detailed description of this analysis is provided in the full version of the report. Results were obtained for each side of the roadway and have revealed that the following roadway segments currently operate at LOS E or LOS F during the peak period of vehicular traffic:

- East side of Martin Luther King, Jr. Boulevard from north of Piney Mountain Road to south of Homestead Road
- West side of Martin Luther King, Jr. Boulevard from north of Airport Drive to south of Northfield Road
- North side of Estes Drive Extension from east of Martin Luther King, Jr. Boulevard to west of Seawell School Road
- South side of Estes Drive Extension from west of Martin Luther King, Jr. Boulevard to west of Seawell School Road
- North side of Homestead Road from east of Weaver Dairy Road to west of Seawell School Road
- South side of Homestead Road from east of Weaver Dairy Road to west of Seawell School Road
- East side of Seawell School Road from north of Estes Drive to south of High School Road
- West side of Seawell School Road from north of Estes Drive to south of High School Road and from north of High School Road to south of Homestead Road

4.4 Existing Bicycle Facilities

Bicycle conditions were evaluated within a ½ mile radius of the proposed access points to Carolina North. Overall, there are few existing bicycle facilities serving the Carolina North site. Most notably, the following conditions were found:

- There are no bicycle lanes or paths within the study area.
- Unmarked paved shoulders along Martin Luther King, Jr. Boulevard (NC 86) from Homestead Road to Estes Drive are available for cyclists.

In addition, an evaluation of the bicycle facilities in the vicinity of the project site was also conducted to determine the existing Bicycle Level-of-Service (LOS). This analysis was performed in accordance with TRB's *Multimodal Level of Service Analysis for Urban Streets* (NCHRP Report 616). Bicycle LOS reflects the bicyclist's perspective of sharing the roadway environment with motor vehicle traffic. This assessment is based primarily on the following five variables:

- Average effective width of the outside through lane;
- Motorized vehicle volumes;
- Motorized vehicle speeds;
- Heavy vehicle (truck) volumes, and
- Pavement condition.

Just like Pedestrian LOS, each level is assigned a letter from A to F, with LOS A representing the best bicycle accommodations and LOS F representing the worst. The existing roadway characteristics, peak hour traffic volumes, and traffic speeds at select roadway segments in the project vicinity were input into the Bicycle LOS equation outlined in NCHRP Report 616 to conduct the existing analysis. Results were obtained for each side of the roadway and have revealed that the following roadway segments currently operate at LOS E or LOS F during the peak period of vehicular traffic:

- East side of Columbia Street south of Franklin Road
- West side of Martin Luther King, Jr. Boulevard north Piney Mountain Road, north of Estes Drive, north of Hillsborough Street
- West side of Columbia Street to the north and south of Rosemary Street
- South side of Hillsborough Street east of Martin Luther King, Jr. Boulevard
- East side of Seawell School Road from north of Estes Drive to south of High School Road

5 Impact Analysis

The project transportation impacts for the Carolina North development were determined based on analysis performed for two future year scenarios that correspond to two separate phases of development for Carolina North. The selected analysis years are 2015 (TIA Phase 1 – 800,000 sf) and 2030 (TIA Phase 2 – 3,000,000 sf). It should be noted that the horizon year for Phase 2 for this TIA update has been changed from 2025 to 2030 when compared to the spring TIA. This change in the future horizon year does not consider any changes to the program or volume of traffic generated by the Carolina North development, but does consider an additional five years of background traffic growth. The study identifies the impacts of vehicular traffic generated by the site, the estimated project impacts on the local transit system, and improvements to the surrounding pedestrian and bicycle networks. The analysis also assesses the anticipated traffic impacts to the streets within the surrounding residential neighborhoods and suggests possible traffic calming measures that may mitigate any future traffic impacts.

Also as part of this study, a parking supply sensitivity analysis was performed that identifies the relative impacts of adjustments made to the amount of parking supplied internal to the Carolina North campus. This analysis addresses scenarios where the parking supply on site would be more or less constrained for 2015 (TIA Phase 1) and two levels of more constrained for 2030 (TIA Phase 2).

5.1 Methodology

Travel forecasting is a process used to estimate the travel impacts of a new development. The first step in this process is to estimate future traffic conditions in the horizon years without the Carolina North development, in order to understand the baseline future conditions that are anticipated.

As a starting point, the existing daily traffic volumes on roads surrounding the site are:

- Martin Luther King, Jr. Boulevard (NC 86) – approximately 28,000 vehicles per day
- Estes Drive– approximately 13,500 vehicles per day
- Homestead Road – approximately 9,500 vehicles per day, and
- Seawell School Road – approximately 4,500 vehicles per day.

These initial daily volumes are increased to reflect the anticipated traffic generated by a number of planned developments throughout Chapel Hill-Carrboro, as well as traffic increases due to sustained regional traffic growth of 2.0 percent until 2015 and 1.25 percent until 2030. This provides the future baseline conditions that will be used to define the impacts of the Carolina North development.

The next step is to estimate the trip generation for Carolina North, which is added to the future baseline conditions in order to determine the impacts of the development. These trips were estimated for each transportation mode serving the project as summarized in Table 12 and Table 13.

Since the parking supply for the site is provided in similar measure to the Main Campus, the mode split for these trips is based on the existing travel choices at the Main Campus for University uses and on general travel behavior for the Town of Chapel Hill for other uses. Vehicle trips often carry more than one person; therefore the total person trip generation of the site is higher than the total in the tables.

Once the trip generation by mode of travel is understood, the next step is to determine the geographic distribution of these trips. In order to understand origin-destination patterns for Carolina North trips, *Triangle Regional Model* (TRM) and University of North Carolina location of residence data were reviewed. TRM distributions were adjusted to account for results of a travel time study on the major approach routes to Carolina North and University-supplied data were used for student location of residence to determine the geographic distribution of trips.

Table 12: Carolina North Trip Generation 2015 (TIA Phase One) – 800,000 sf

		AM Peak Hour			PM Peak Hour		
Trip Type	**Daily**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Vehicle	5,049	420	115	535	265	399	665
Park & Ride	1,248	120	22	141	65	109	174
Transit	1,941	126	84	210	124	135	259
Walk/Bike/Other	1,497	57	71	128	87	84	171
Total	**9,734**	**722**	**292**	**1,014**	**542**	**727**	**1,269**

Table 13: Carolina North Trip Generation 2030 (TIA Phase Two) – 3,000,000 sf

		AM Peak Hour			PM Peak Hour		
Trip Type	**Daily**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Vehicle	23,261	1,929	554	2,484	990	1,736	2,726
Park & Ride	4,089	398	73	471	197	355	551
Transit	6,438	416	310	726	347	417	764
Walk/Bike/Other	5,957	186	260	446	255	272	528
Total	**39,746**	**2,929**	**1,197**	**4,127**	**1,788**	**2,781**	**4,569**

The trip distribution matches each generated trip with an origin and destination and shows the general pattern of travel for potential employees, potential residents, and potential students at Carolina North. A variety of data sources were reviewed to determine the geographic distribution of trips to Carolina North. Generally, the following distribution applies:

- Approximately 40 percent of the trips are within Chapel Hill-Carrboro
- For the remaining 60 percent of trips, the following gateway distribution applies:
  - Around 20 percent Martin Luther King, Jr. Boulevard (NC 86)
  - Around 10 percent Fordham Boulevard (US 15-501)(N)
  - Around 15 percent Smith Level Road and U.S. 15/501(S)
  - Around 10 percent Greensboro Street
  - Around 5 percent NC 54

The projected trips to be generated by Carolina North were then assigned to the appropriate travel mode and approach/departure routes, and added to the future baseline conditions as estimated for the years 2015 and 2030. For comparative purposes, Figure 6 and Figure 7 graphically illustrate the accumulative increases in traffic on the road segments surrounding the intersection of Martin Luther King, Jr. Boulevard and Estes Drive during the PM peak hour.

Figure 6: 2015 (TIA Phase 1) Traffic Volume Comparison - PM Peak Hour

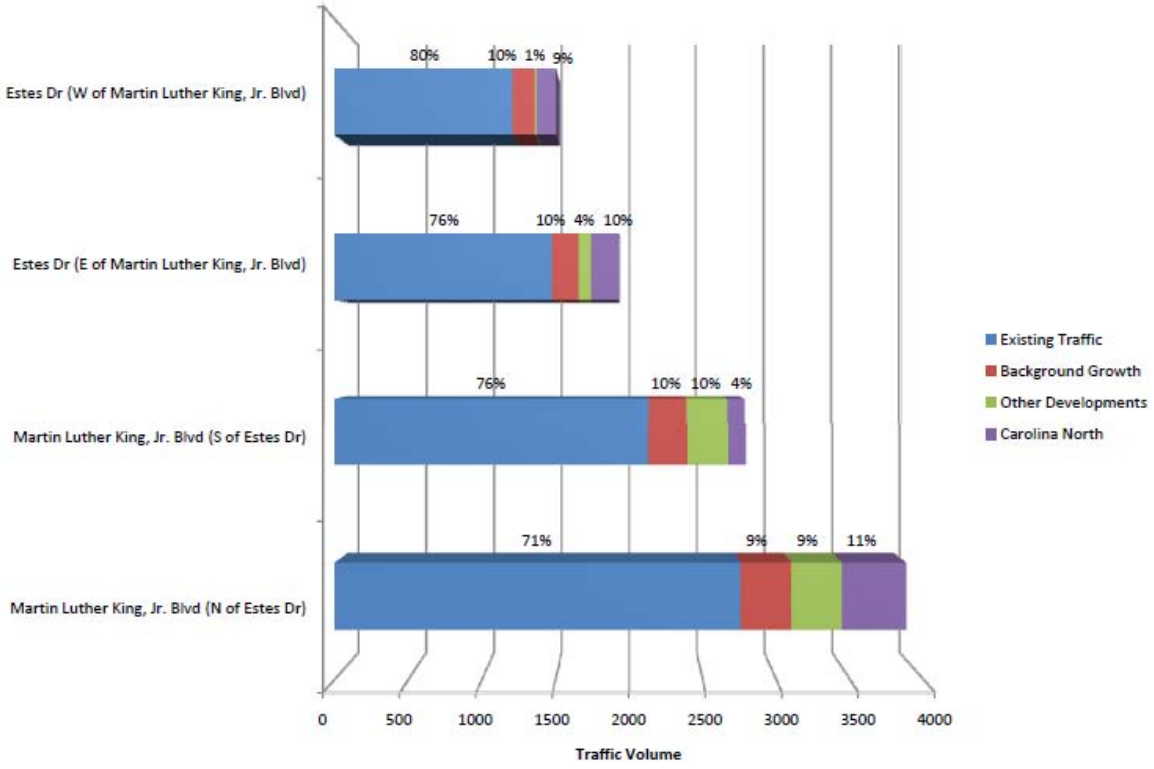
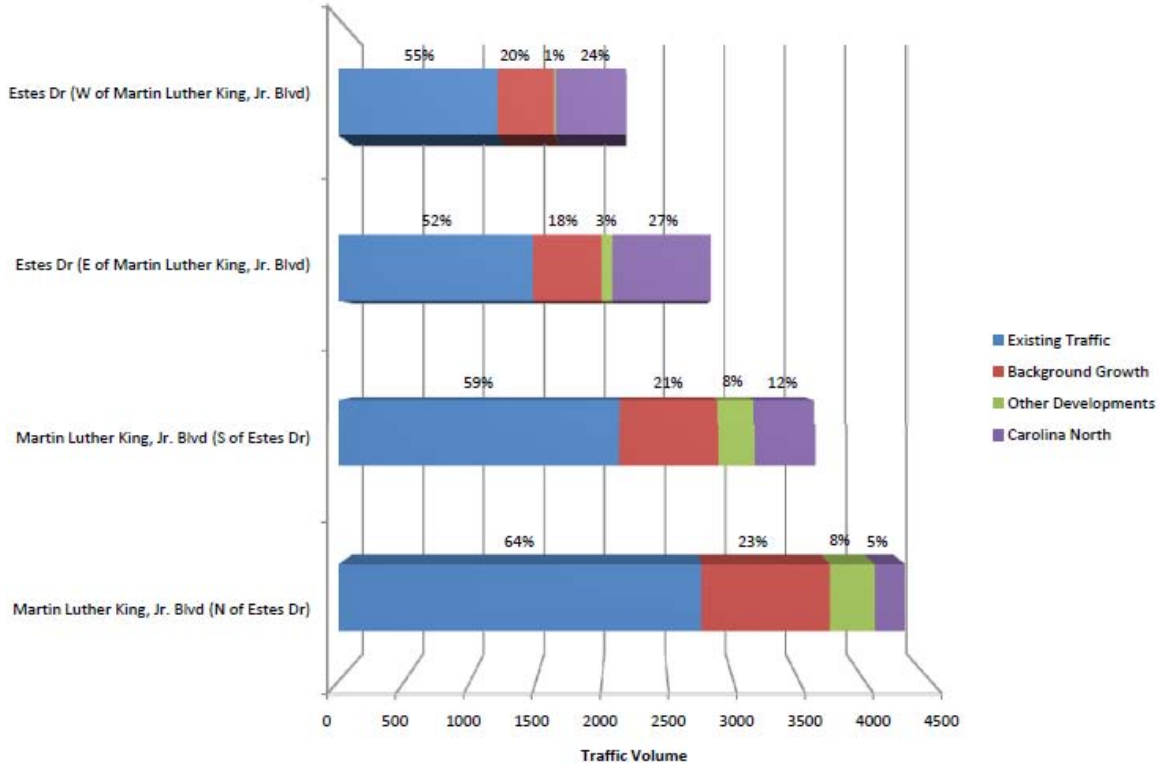


Figure 7: 2030 (TIA Phase 2) Traffic Volume Comparison - PM Peak Hour



The future conditions with the trips generated by the Carolina North development were then analyzed to determine the estimate impacts to the roadway and transit systems. The following sections review these analyses.

5.2 Traffic Impacts

The project traffic impacts for the Carolina North development were determined based on analysis performed for two future year scenarios that correspond to two separate phases of development for Carolina North: 2015 (TIA Phase 1) and 2030 (TIA Phase 2) .

5.2.1 2015 (TIA Phase 1) Traffic Impacts

No-Build and Build conditions were reviewed for the 2015 (TIA Phase 1) year. The following intersections were found to degrade in level-of-service and operate at an overall LOS E or F once the traffic volumes generated by the Carolina North development are added to the network:

- Martin Luther King, Jr. Boulevard (NC 86) & I-40 Eastbound Ramps
- Martin Luther King, Jr. Boulevard (NC 86) & Weaver Dairy Road

- Martin Luther King, Jr. Boulevard (NC 86) & Piney Mountain Road/Municipal Drive
- Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive
- Estes Drive & Caswell Road
- Estes Drive & Franklin Street

The following two-way STOP controlled intersection was also found to have decreased to a level-of -service below the acceptable threshold, but would require a signal warrant study to determine if signalization is required:

- Homestead Road & Rogers Road

All other intersections projected to operate at a LOS of E or F in the 2015 (TIA Phase 1) Build scenario were also projected to operate at the same level during the No-Build scenario. The 2015 No-Build Condition intersection LOS results for the study area intersections are illustrated in Figure 8 while the 2015 Build condition intersection LOS results are shown in Figure 9.

In addition, the following roadway segments are projected to exceed a V/C of 1.0 in the 2015 (TIA Phase 1) Build without Mitigation scenario once traffic generated by Carolina North is added to the network:

- Martin Luther King, Jr. Boulevard (NC 86) between Perkins Drive and Northwood Drive

All other roadway segments projected to operate at a V/C ratio of over 1.0 during the 2015 (TIA Phase 1) Build scenario were also projected to operate at this level during the 2015 No-Build scenario.

5.2.2 2030 (TIA Phase 2) Traffic Impacts

When comparing the results of the 2030 (TIA Phase 2) Build without Mitigation scenario to the 2030 (TIA Phase 2) No-Build scenario, the following intersections were found to degrade in level-of-service and operate at an overall LOS E or F once the volumes generated by the Carolina North development are added to the network. These intersections are in addition to the intersections affected in the 2015 (TIA Phase 1) Build scenario.

- Martin Luther King, Jr. Boulevard (NC 86) & Whitfield Road
- Martin Luther King, Jr. Boulevard (NC 86) & I-40 Eastbound Ramps
- Martin Luther King, Jr. Boulevard (NC 86) & Eubanks Road
- Martin Luther King, Jr. Boulevard (NC 86) & Homestead Road
- Martin Luther King, Jr. Boulevard (NC 86) & Piney Mountain Road/Municipal Drive
- Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive
- Martin Luther King, Jr. Boulevard (NC 86) & Airport Drive

- Columbia Street (NC 86) & Rosemary Street
- Pittsboro Street (NC 86) & McCauley Street
- US 15-501 & Mount Carmel Church Road/Culbreth Road
- Homestead Road/Dairyland Road & Old NC 86
- Estes Drive Extension & Airport Drive
- Estes Drive Extension & Seawell School Road
- Estes Drive Extension & Greensboro Street
- Greensboro Street & Weaver Street
- Greensboro Street & Main Street
- Estes Drive & Caswell Road
- Franklin Street & Estes Drive
- Franklin Street & Ephesus Church Road
- Franklin Street at Elliott Road
- Fordham Boulevard (US 15-501) & Sage Drive/Scarlet Drive
- Fordham Boulevard (US 15-501) & Eastowne Drive/BCBS Drive
- Fordham Boulevard (US 15-501) & Eastowne Drive/Lakeview Drive
- Fordham Boulevard (US 15-501) & I-40 Eastbound Ramps
- Fordham Boulevard (US 15-501) & I-40 Westbound Ramps

The following two-way STOP controlled intersection was also found to have decreased to a level-of-service below the acceptable threshold, but would require a signal warrant study to determine if signalization is required:

- Homestead Road and Weaver Dairy Road

All other intersections projected to operate at a LOS of E or F in the 2030 (TIA Phase 2) Build scenario were also projected to operate at the same level during the 2030 No-Build scenario. The 2030 No-Build Condition intersection LOS results for the study area intersections are illustrated in Figure 10 while the 2030 Build condition intersection LOS results are shown in Figure 11.

In addition to intersection analysis, analysis of 21 roadway segments identified by the Town was also performed to determine the projected V/C ratios for the 2030 (TIA Phase 2) Build scenario. When comparing the table to the 2030 (TIA Phase 2) No-Build scenario, no additional roadway segments are projected to exceed a V/C of over 1.0 in the year 2030 (TIA Phase 2) Build without Mitigation scenario once the traffic generated by Carolina North is added to the network. All roadway segments projected to operate at a V/C over 1.0 during the 2030 (TIA Phase 2) Build scenario were also projected to operate at this level during the No-Build scenario.

However, it should be noted that five roadway segments in particular are projected to operate at a V/C of over 2.0 during one of the peak hours analyzed:

- Eubanks Road between Martin Luther King, Jr. Boulevard and Northwood Drive
- Estes Drive Extension between Seawell School Road and Umstead Road
- Estes Drive Extension between Martin Luther King, Jr. Boulevard and UNC Facilities Department Driveway
- Estes Drive between Halifax Road and Granville Road
- Homestead Road between Hearthstone Lane and Seawell School Road

This result suggests that widening of these segments may be needed to accommodate the traffic projected for the 2030 (TIA Phase 2) Build condition.

5.3 Transit Impacts

Transit impacts were evaluated for both horizon years/development scenarios. The analysis considers whether capacity is available on existing services to provide adequate access to the Carolina North site. The analysis does not include service changes that are considered in the *Chapel Hill/Carrboro Long Range Transit Plan*, although the findings are consistent in many ways with the preliminary analysis presented in that document, nor does it consider service improvements that may be necessary to address route coverage or quality of service frequency increases. All transit analysis is based on ridership and housing choices as projected in the regional model and the potential transit mitigation measures may need to be adjusted if these choices change over time. Additionally, this analysis considers the long-term continuation of the current service levels provided on the NS route that is funded through a 1-year CMAQ grant, even though long-term funding for continuation of this service has not yet been secured.

It should be noted that the potential transit mitigation measures identified in this document will be reviewed as part of the development of the Chapel Hill Transit Short Range Transit Plan and incorporated into the analysis of future service needs.

The only modification to the existing Chapel Hill Transit bus routes that was considered was a diversion into Carolina North for the six routes that operate within the vicinity of the site (A, G, HS, NS, NU, and T). This route modification will add approximately five to ten minutes to the travel time of each route, and will require additional trips to maintain the existing headways. In addition, for the purposes of this analysis, passengers boarding from areas other than those served by the six Carolina North routes were assumed to make a transfer in downtown Chapel Hill. In reality, the local bus route structure may be adjusted to provide additional direct service to Carolina North. However, since each route has its own ridership patterns, ridership is not interchangeable between routes.

5.3.1 2015 (TIA Phase 1) Transit Impacts

Transit ridership, generated both by local riders and park-and-ride patrons, is projected to continue to grow quickly between 2009 and 2015 (TIA Phase 1) and between 2015

and 2030 (TIA Phase 2). This growth uses a significant portion of the available transit capacity available today. However, the 2015 (TIA Phase 1) No-Build condition for transit continues to show available capacity to and from the Carolina North site. Inbound available capacity is 1,044 passengers in the northbound direction and 508 passengers in the southbound direction during the morning peak hour. Outbound available capacity is 503 passengers in the northbound direction and 847 passengers in the southbound direction during the evening peak hour.

The 2015 (TIA Phase 1) Phase One development program will add 113 inbound transit trips in the northbound direction and 123 trips in the southbound direction during the morning peak hour. The program will add 114 trips in the northbound direction and 121 outbound trips in the southbound direction during the evening peak hour. Table 14 shows the available transit capacity on each of the routes serving Carolina North for the 2015 (TIA Phase 1) conditions with the TIA Phase One development program in place. After adding the transit trips associated with the project, there remains capacity among all the transit routes serving the Carolina North site.

The only notable outcome of this analysis in the year 2015 is that the additional park-and-ride activity associated with Carolina North nearly exceeds the carrying capacity of the existing Route NS bus schedule in the mid-day peak hour.

5.3.2 2030 (TIA Phase 2) Transit Impacts

The 2030 (TIA Phase 2) No-Build Condition for transit shows that overall there remains excess capacity to and from the Carolina North site. Inbound available capacity is 1,018 passengers in the northbound direction and 382 passengers in the southbound direction during the morning peak hour. Outbound available capacity is 424 passengers in the northbound direction and 804 passengers in the southbound direction during the evening peak hour.

The 2030 (TIA Phase 2) Carolina North development will add over 800 transit trips to the baseline condition during the morning peak hour, over 500 during the midday peak hour, and nearly 800 during the evening peak hour. Table 14 shows the available transit capacity on the routes serving Carolina North for the 2030 (TIA Phase 2) conditions with the full Carolina North development program in place.

Please note in Table 14, the peak direction for travel to Carolina North is opposite of the peak direction traveling to downtown Chapel Hill and the UNC Main Campus, except for the NS Route.

The most notable transit impact of the 2030 (TIA Phase 2) development program is on Route NS. The park-and-ride activity associated with Carolina North exceeds the carrying capacity of the existing Route NS. The carrying capacity of Route T is also exceeded. The following capacity deficits exist, according to the analysis performed for this study:

- The NS route is project to be overcapacity by 223 passengers during the morning peak hour approaching Carolina North in the southbound direction.
- The T route is projected to be overcapacity by 26 passengers during the morning peak hour approaching Carolina North in the southbound direction.
- The T route is projected to be overcapacity by 29 passengers during the morning peak hour leaving Carolina North in the southbound direction.
- The NS route is projected to be overcapacity by 25 passengers during the midday peak hour approaching Carolina North in the northbound direction.
- The NS route is projected to be overcapacity by 88 passengers during the midday peak hour departing Carolina North in the northbound direction.
- The NS route is projected to be overcapacity by 147 passengers during the evening peak hour departing Carolina North in the northbound direction.

The transit impacts of the 2030 (TIA Phase 2) Carolina North development include nearing or overcapacity on Route A, Route G, and Route T departing Carolina North during the evening peak hour. Route T is overcapacity in the southbound direction during the morning peak hour both approaching and departing Carolina North.

Table 14: Available Transit Capacity Analysis Results

Route	AM Peak Hour						Mid-day Peak Hour						PM Peak Hour					
	Route Capacity	Available Capacity					Route Capacity	Available Capacity					Route Capacity	Available Capacity				
		2009	2015		2030			2009	2015		2030			2009	2015		2030	
		Existing	No Build	Build	No-Build	Build		Existing	No Build	Build	No-Build	Build		Existing	No Build	Build	No-Build	Build
INBOUND																		
Northbound																		
A	120	118	118	106	116	79	60	48	46	39	41	19	120	75	68	n/a	47	n/a
G[1]	120	117	117	106	116	79	120	110	108	98	103	69	120	35	32	n/a	20	n/a
HS	120	106	104	93	97	61	60	53	52	52	49	49	120	106	104	n/a	97	n/a
NS	462	442	435	391	430	284	75	35	23	12	13	-25	438	198	125	n/a	61	n/a
NU	180	171	170	149	165	98	120	87	83	73	67	36	120	85	80	n/a	64	n/a
T	120	103	101	86	93	43	60	47	46	36	40	9	60	26	22	n/a	6	n/a
Total	*1122*	*1057*	*1044*	*931*	*1018*	*643*	*495*	*381*	*358*	*309*	*313*	*156*	*978*	*525*	*430*	n/a	*295*	n/a
Southbound																		
A	120	88	84	81	69	60	120	110	109	108	104	101	60	59	59	n/a	58	n/a
G	120	98	94	92	84	77	120	116	116	115	114	111	60	58	57	n/a	56	n/a
HS	120	100	97	96	87	86	60	51	49	49	45	45	120	110	108	n/a	103	n/a
NS	462	268	209	94	157	-223	150	114	103	79	94	14	438	408	399	n/a	390	n/a
NU	0	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
T	120	36	24	21	-15	-26	120	94	90	89	78	74	120	78	72	n/a	53	n/a
Total	*942*	*590*	*508*	*385*	*382*	-27	*570*	*485*	*467*	*440*	*435*	*345*	*798*	*713*	*695*	n/a	*661*	n/a
OUTBOUND																		
Northbound																		
A	120	117	116	n/a	115	n/a	60	55	55	54	53	49	120	104	102	99	94	85
G[1]	120	117	117	n/a	115	n/a	120	116	116	115	114	111	120	35	32	29	20	13
HS	120	105	102	n/a	95	n/a	60	53	52	52	49	49	120	107	105	104	99	97
NS	462	446	441	n/a	437	n/a	75	46	38	2	30	-88	438	282	234	130	192	-147
NU	0	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
T	120	86	81	n/a	65	n/a	60	50	49	47	44	40	60	34	31	27	19	7
Total	*942*	*871*	*858*	n/a	*827*	n/a	*375*	*321*	*309*	*271*	*290*	*161*	*858*	*562*	*503*	*389*	*424*	*55*
Southbound																		
A	120	61	52	n/a	24	n/a	120	96	92	82	81	48	60	57	57	40	55	4
G	120	97	93	n/a	82	n/a	120	108	107	97	101	68	60	57	57	45	56	20
HS	120	106	104	n/a	97	n/a	60	50	49	49	44	44	120	109	107	96	102	67
NS	462	191	109	n/a	37	n/a	150	101	87	75	73	52	438	398	385	341	375	237
NU	180	145	140	n/a	124	n/a	60	55	54	45	52	21	180	169	167	147	162	98
T	120	35	22	n/a	-17	n/a	120	89	85	77	71	41	120	79	73	57	54	5
Total	*1122*	*634*	*521*	n/a	*347*	n/a	*630*	*500*	*474*	*425*	*423*	*274*	*978*	*869*	*847*	*726*	*804*	*431*

Source: Chapel Hill Transit, as compiled by VHB.

Note: Build capacities are reported for the AM peak hour and PM peak hour direction only. Off peak direction travel was not analyzed.

[1] Available capacities on Route G in northbound direction during PM peak hour are based on Spring 2009 data.

5.3.3 Park-and-Ride Impacts

Based on other projected growth, it appears that all of the currently available park-and-ride capacity will be fully used by 2015 (TIA Phase 1), and that there will be a shortfall of park-and-ride spaces in the future, even without any development of the Carolina North site. Thus, none of the park-and-ride activity associated with the Carolina North project can be accommodated without additional park-and-ride capacity being developed.

The number of park-and-ride spaces required to accommodate the Carolina North project is shown in Table 15. The 2015 (TIA Phase 1) program requires 400 to 500 park-and-ride spaces and the 2030 (TIA Phase 2) program requires 1,500 to 1,600 park-and-ride spaces.

For the purposes of this analysis, park-and-ride capacity for Carolina North was added to the facilities served by the existing bus service without transfers (Eubanks and Southern Village). Approximately 94 percent of the park-and-ride capacity is therefore in the vicinity of the Eubanks lot at the northern end of the NS route and 6 percent is at the Southern Village lot at the southern end of the NS route. This park-and-ride capacity may be added in other locations based on site feasibility and assessment. If the park-and-ride spaces are located elsewhere, additional new bus service may be needed to connect these lots to the Carolina North site. Ultimately, the amount and location of the additional park-and-ride spaces that will be provided will be reviewed and determined as part of the development of the Chapel Hill Transit Short Range Transit Plan.

During this period, other development by the University or within the Town of Chapel Hill (including the construction of new parking garages) may affect the availability of park-and-ride capacity. These changes may influence the need to construct additional park-and-ride spaces.

Table 15: Park-and-Ride Space Needs for Carolina North

	2015 TIA Phase 1	2030 TIA Phase 2
Daily park-and-ride cars	578	1,893
Oversell/turnover factor	1.25	1.25
Required parking spaces	**462**	**1,514**

Note: Oversell/turnover factor is from *The University of North Carolina at Chapel Hill Development Plan Transportation Impact Analysis*, January 2008. It is consistent with an analysis of bus ridership patterns at park-and-ride locations.

5.4 Parking Supply and Sensitivity Analysis

Parking supply sensitivity analysis were conducted to determine the affect of modifying the parking ratios for the 2015 (TIA Phase 1) and 2030 (TIA Phase 2) Build Scenarios. The changes associated with these scenarios are summarized in Table 16 and Table 17.

Table 16: 2015 (TIA Phase 1) Parking Sensitivity Scenarios – 800,000 sf

		Early Phase Ratios		Baseline University Main Campus Ratios		Constrained Ratios (-10%)	
Land Use	Size	Parking Ratio	Parking Supply	Parking Ratio	Parking Supply	Parking Ratio	Parking Supply
Centers and Institutes I	240 Employees	0.65	156	0.50	120	0.45	108
Centers and Institutes II	180 Employees	0.65	117	0.50	90	0.45	81
School of Law	400 Employees	0.65	260	0.50	200	0.45	180
School of Law Students	850 Commuter Students	0.33	281	0.25	213	0.23	191
Academic Visitors/Service	410,000 GSF	0.20	82	0.20	82	0.18	74
Innovation Center	81,000 GSF	2.65	214	2.50	202	2.25	182
Corporate Partners	99,000 GSF	2.65	262	2.50	248	2.25	223
University affiliate Housing	150 Units	1.25	188	1.25	188	1.13	169
Non-University affiliate Housing	50 Units	1.25	63	1.25	63	1.13	56
Services (Retail, commercial, civic)	10,000 GSF	1.50	15	1.50	15	1.35	14
Recreational Fields	3 Fields	35	105	35	105	32	95
TOTALS			**1,743**		**1,526**		**1,373**

Table 17: 2030 (TIA Phase 2) Parking Sensitivity Scenarios – 3,000,000 sf

Land Use	Size	Baseline University Main Campus Ratios		Constrained Ratios (-10%)		Constrained Ratios (-20%)	
		Parking Ratio	Parking Supply	Parking Ratio	Parking Supply	Parking Ratio	Parking Supply
Centers and Institutes I	220 Employees	0.50	110	0.45	99	0.40	88
Centers and Institutes II	170 Employees	0.50	85	0.45	77	0.40	68
Centers and Institutes III	290 Employees	0.50	145	0.45	131	0.40	116
Interdisciplinary Research Center	290 Employees	0.50	145	0.45	131	0.40	116
Research	380 Employees	0.50	190	0.45	171	0.40	152
School of Public Health	310 Employees	0.50	155	0.45	140	0.40	124
School of Public Health Students	1,150 Commuter Students	0.25	288	0.23	259	0.20	230
Office/Classroom	350 Employees	0.50	175	0.45	158	0.40	140
School of Law	400 Employees	0.50	200	0.45	180	0.40	160
School of Law Students	850 Commuter Students	0.25	213	0.23	191	0.20	170
Support	150 Employees	0.50	75	0.45	68	0.40	60
Academic Visitors/Service	1,280,000 GSF	0.20	256	0.18	230	0.16	205
Innovation Center	81,000 GSF	2.50	202	2.25	182	2.00	161
Corporate Partners	619,000 GSF	2.50	1,548	2.25	1,393	2.00	1,239
University affiliate Housing	563 Units	1.25	703	1.13	633	1.00	563
Non-University affiliate Housing	188 Units	1.25	234	1.13	211	1.00	188
Services (Retail, commercial, civic)	140,000 GSF	1.50	105	1.35	95	1.20	84
Recreational Fields	3 Fields	35	105	32	95	28	84
UNC Healthcare Employees	800 Employees	0.50	400	0.45	360	0.40	320
UNC Healthcare Patients and Visitors	200,000 GSF	2.50	500	2.25	450	2.00	400
TOTALS			**5,834**		**5,254**		**4,668**

5.4.1 2015 (TIA Phase 1) Parking Sensitivity Scenarios

The baseline condition for the 2015 (TIA Phase 1) Carolina North development program assumes a parking supply of 1,526 spaces. The parking supply was determined based on per-person and per-square foot parking ratios that represent current parking space ratios at the University main campus.

The two parking sensitivity scenarios for 2015 (TIA Phase 1) consist of one that has an increased supply of parking spaces and one that has a decreased supply of parking spaces.

- The "Early Phase Ratio" has a parking supply of 1,743 spaces. This is a 14 percent increase over the baseline parking supply scenario. The overall parking ratio for the Early Phase Ratio scenario is equivalent to one parking space per 460 square feet of development, as compared to the baseline condition of one parking space per 525 square feet of development.

  The Early Phase Ratio scenario includes more parking for employees and for commuting students. The amount of parking for residents and visitors is the same as for the baseline parking assumptions.

- The "Constrained Ratio" for the 2015 (TIA Phase 1) development program has a parking supply of 1,373 spaces. The Constrained Ratio scenario equals an across-the-board 10 percent reduction for parking among all user groups and facilities. The overall parking ratio for the Constrained Ratio scenario is equivalent to one parking space per 585 square feet of development.

Parking Sensitivity Scenarios Trip Generation

Table 18 and Table 19 present the estimated trip generation for each of the parking sensitivity scenarios for the 2015 Build Condition based on the parking ratios presented in Table 16.

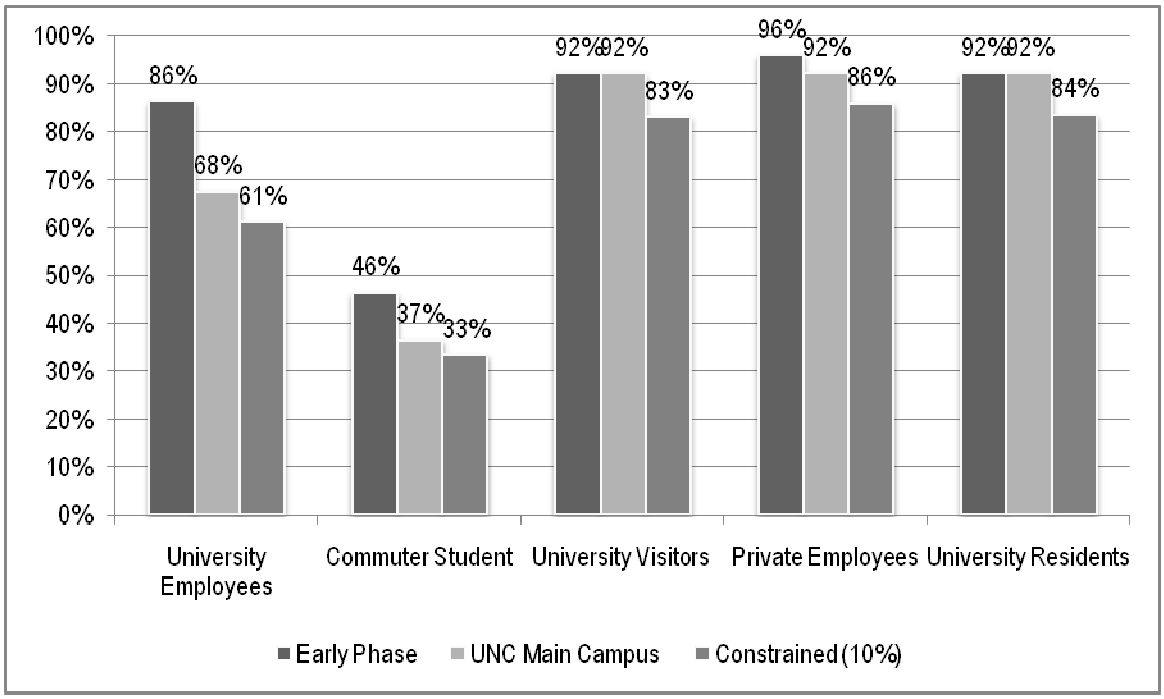
Table 18: Trip Generation for 2015 (TIA Phase 1) Early Phase Parking Scenario

		AM Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total
Vehicle	5,833	496	129	625	303	467	770
Park-and-Ride	739	70	13	83	40	65	105
Local Transit	1,771	109	81	190	116	120	236
Walk/Bike/Other	1,327	40	68	108	79	69	148

Table 19: Trip Generation for 2015 (TIA Phase 1) Constrained Parking (-10%) Scenario

		AM Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total
Vehicle	4,544	378	104	482	239	359	598
Park-and-Ride	1,562	147	29	176	81	134	215
Local Transit	2,057	135	87	222	130	144	274
Walk/Bike/Other	1,613	66	74	140	93	93	186

Figure 12: TIA Phase 1 Auto Mode Shift Due to Changes in Parking Ratio



Traffic Impacts of 2015 (TIA Phase 1) Parking Sensitivity Scenarios

A Parking Sensitivity analysis was conducted for the year 2015 (TIA Phase 1), and evaluated the impacts of a 14 percent increase in parking over the proposed baseline for the "Early Phase Ratio", and a 10 percent reduction in parking for the "Constrained" scenario. All 18 intersections of the 2015 (TIA Phase 1) study area were evaluated under the "Early Phase Ratio", while for the "Constrained" scenario only the intersection of Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive was evaluated as per the requirement of the Town of Chapel Hill.

The results of the "Early Phase Ratio" sensitivity analysis showed that a 14 percent growth in parking would result in marginal changes to the operations of all included in

the 2015 study area. Each intersection is expected to operate at or near the same level-of-service as the baseline conditions with no intersections degrading to unacceptable levels-of-service that were not already LOS E or F.

The "Constrained" 10 percent analysis was conducted for the Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive intersection only. The analysis showed that a 10 percent reduction in parking would not change the results of the Build scenarios during the year 2015 (TIA Phase 1). The 10 percent reduction in site trips resulted in 35 less trips during the AM peak hour and 20 less trips during the PM peak hour. This is less than a one percent decrease in the traffic at the intersection.

Transit Impacts of 2015 (TIA Phase 1) Parking Sensitivity Scenarios

The two 2015 (TIA Phase 1) parking sensitivity scenarios are found to have no substantial impact on local transit. The "Early Phase Ratio" 2015 (TIA Phase 1) scenario, that has an increased parking supply, would lower transit ridership compared to the baseline condition since more people would be able to drive to Carolina North. The "Constrained Parking" 2015 (TIA Phase 1) scenario has less parking and thus more transit ridership, but any increase in local transit ridership is relatively low and, as it is spread out among many bus routes.

The most significant impact of the 2015 (TIA Phase 1) parking sensitivity scenarios is with utilization of park-and-ride lots.

- The "Early Phase Ratio" 2015 (TIA Phase 1) scenario reduces the required Carolina North park-and-ride spaces from 462 under the baseline scenario to 331, a decrease of 131 spaces.
- The "Constrained Parking" 2015 (TIA Phase 1) scenario increases the required Carolina North park-and-ride spaces from the 462 of the baseline scenario to 553, an increase 91 spaces.

5.4.2 2030 (TIA Phase 2) Parking Sensitivity Scenarios

The baseline condition for the 2030 (TIA Phase 2) Carolina North development program assumes a parking supply of 5,834 spaces. The parking supply was determined based on the same per-person and per-square foot parking ratios used for the 2015 (TIA Phase 1) baseline parking calculations, and are intended to represent current parking space ratios at the University main campus. The two parking sensitivity scenarios both have a lower supply of parking spaces.

- The "Constrained Ratio (-10%)" has a parking supply of 5,254 spaces. This Constrained Ratio scenario equals an across-the-board 10 percent reduction for parking among all user groups and facilities. The overall parking ratio for the Constrained Ratio scenario is equivalent to one parking space per 570 square feet of development, as compared to the baseline condition of one parking space per 515 square feet of development.

- The "Constrained Ratio (-20%)" has a parking supply of 4,668 spaces. This Constrained Ratio scenario equals an across-the-board 20 percent reduction for parking among all user groups and facilities. The overall parking ratio for the Constrained Ratio scenario is equivalent to one parking space per 640 square feet of development, as compared to the baseline condition of one parking space per 515 square feet of development.

Parking Sensitivity Scenarios Trip Generation

Table 20 and Table 21 present the estimated trip generation for each of the parking sensitivity scenarios for the 2030 Build Condition based on the parking ratios presented in Table 17.

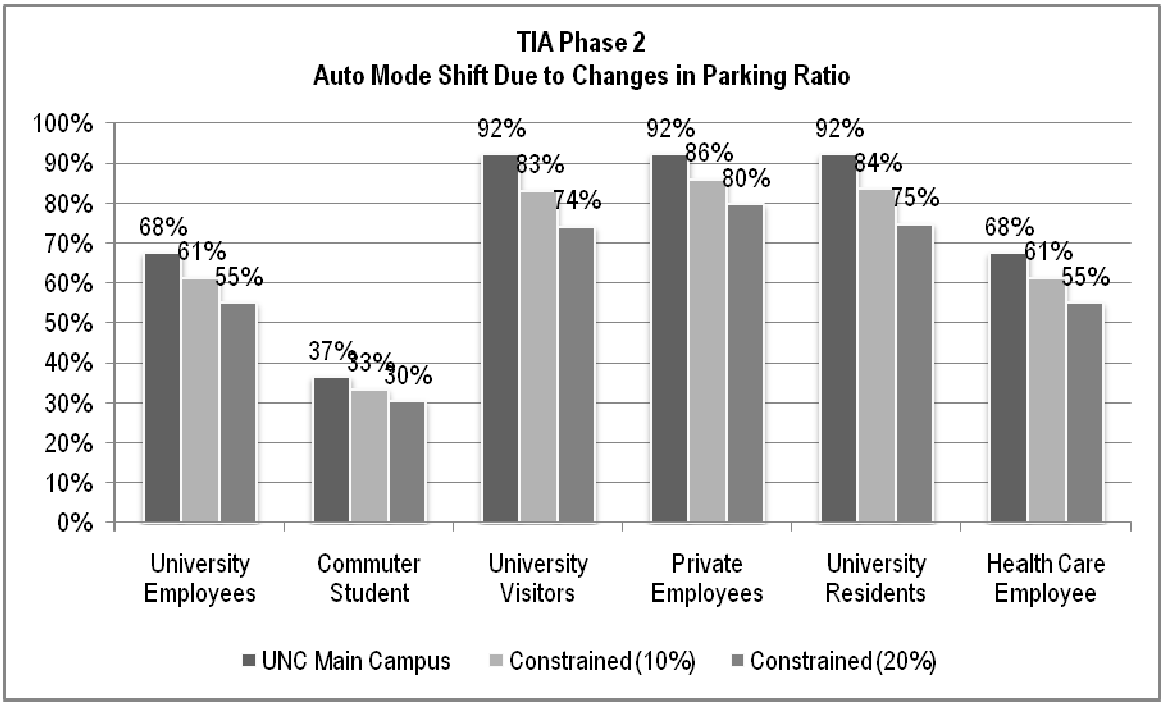
Table 20: Trip Generation for 2030 (TIA Phase 2) Constrained Parking (-10%) Scenario

		AM Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total
Vehicle	20,935	1,736	499	2,235	891	1,563	2,454
Park-and-Ride	5,586	526	106	632	260	469	728
Local Transit	6,945	456	323	779	369	454	823
Walk/Bike/Other	6,464	226	273	499	277	309	587

Table 21: Trip Generation for 2030 (TIA Phase 2) Constrained Parking (-20%) Scenario

		AM Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total
Vehicle	18,609	1,543	444	1,987	792	1,389	2,181
Park-and-Ride	7,084	653	140	793	323	583	905
Local Transit	7,453	497	337	834	391	491	882
Walk/Bike/Other	6,972	267	287	554	299	346	646

Figure 13: TIA Phase 2 Auto Mode Shift Due to Changes in Parking Ratio



Traffic Impacts of 2030 (TIA Phase 2) Parking Sensitivity Scenarios

A sensitivity analysis was performed to see the effects of the constrained parking scenarios (both -10 percent and -20 percent) for some of the key intersections that were observed to operate at levels-of-service E or F under the 2030 (TIA Phase 2) Build without Mitigation Scenario. For this analysis, site generated trips were first reduced for the -20 percent parking scenario, and capacity analysis conducted to determine if the proposed mitigations for the Build conditions were still needed. Where it was found that proposed Build mitigations were still needed after the -20 percent parking reduction, the -10 percent parking reduction analysis was deemed unnecessary. This approach follows the premise that if the mitigations were required for the Build conditions with no reductions, and they were again shown to be needed after the parking was reduced by 20 percent, then by extension they would be required for the scenario where parking was reduced by 10 percent.

However, if after the parking was reduced by 20 percent, it was found that all the mitigation measures were not needed, then the -10 percent sensitivity analysis was conducted. The sensitivity analysis was conducted at the following key study intersections where the new trips from the proposed development would have the most significant impacts:

- Martin Luther King, Jr. Boulevard (NC 86) & Weaver Dairy Road
- Martin Luther King, Jr. Boulevard (NC 86) & Homestead Road

- Martin Luther King, Jr. Boulevard (NC 86) & Piney Mountain Road/Municipal Drive
- Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive
- Martin Luther King, Jr. Boulevard (NC 86) & Airport Drive
- Estes Drive Extension & Airport Drive
- Greensboro Street & Main Street
- Estes Drive & Caswell Road
- Estes Drive & Franklin Street

These intersections are generally nearest to the proposed development, as the further away you get from the development, the lesser the effects of the site trips on the intersection, and also the effects of the trip reductions in the sensitivity analysis.

Traffic capacity analysis was performed for "2030 Build -10 percent" and "2030 Build - 20 percent" scenarios using the Synchro 7 software. As in the case with the 2030 (TIA Phase 2) Build without Mitigation Scenario, intersection levels-of-service (LOS) and overall delay in seconds per vehicle based on the HCM methodologies as reported in the Synchro 7 software were used for this analysis.

Results from the "2030 Build –20 percent" scenarios were compared to the "2030 Build" without Mitigation scenario. Even though the overall intersection delays appeared to decrease as expected with the reduced site generated trips, most of the intersections would continue to operate at the same LOS grade during the morning and evening peak hours. For critical intersections, the 20 percent reduction in site trips translated to an approximate 5 percent reduction in intersection traffic. As you move further away from the site, the 20 percent reduction in site trips become less significant at the intersections and therefore does not change the results of the 2030 Build with mitigation analysis.

Transit Impacts of 2030 (TIA Phase 2) Parking Sensitivity Scenarios

The two 2030 (TIA Phase 2) parking sensitivity scenarios have a modest impact on local transit since the additional transit trips are spread out among many transit routes. The "Constrained Parking (-10 percent)" 2030 (TIA Phase 2) scenario adds about 60 trips per hour to the local transit ridership compared to the baseline condition. The "Constrained Parking (-20 percent)" 2030 (TIA Phase 2) scenario adds a maximum of about 120 trips per hour to the local transit ridership compared to the baseline condition.

The 2030 (TIA Phase 2) parking sensitivity scenarios have substantial impacts on park-and-ride requirements.

- The "Constrained Parking (-10 percent)" 2030 (TIA Phase 2) scenario increases the required Carolina North park-and-ride spaces from 1,514 under the baseline scenario to 1,867, an increase of more than 350 spaces.
- The "Constrained Parking (-20 percent)" 2030 (TIA Phase 2) scenario increases the required Carolina North park-and-ride spaces from 1,514 under the baseline scenario to 2,204, an increase of about 700 spaces.

6 Transportation Findings/Potential Mitigation Measures

This section discusses potential measures to offset the impacts of the Carolina North development. The measures are focused on traffic, transit, pedestrian, and bicycle improvements, as well as traffic calming. It should be noted that the measures in this report represent one way to mitigate the Carolina North impacts, based on the preliminary analysis of the consultant team. Further exploration of these measures, taking into account changes to the development plan and transportation system will be required to define specific mitigation plans for different phases of the project. Therefore, the measures as described in this document may or may not be included as part of the Development Agreement between the Town of Chapel Hill and the University of North Carolina.

6.1 Roadway Facilities

Potential improvements to signal timing, signal warrant analysis, and traffic calming are identified at several intersections and along several roadways in the study area for both scenarios.

6.1.1 2015 (TIA Phase 1) Potential Roadway Mitigation Measures

In order to address the intersection impacts for the 2015 (TIA Phase 1) development scenario, potential improvements to the affected intersections were reviewed. Figure 14 shows the potential mitigation measures that offset Carolina North's traffic impacts for the 2015 (TIA Phase 1) scenario. As the figure shows, most of the impacts for this first phase of development are addressed through signal system adjustments. The site driveway (Municipal Drive) and the westbound approach of Weaver Dairy Road at Martin Luther King, Jr. Boulevard (NC 86) require the addition of turn lanes.

6.1.2 2030 (TIA Phase 2) Potential Roadway Mitigation Measures

More extensive improvements are likely needed to accommodate the 2030 (TIA Phase 2) scenario. Figure 15 shows the potential mitigation measures that were determined to offset Carolina North's traffic impacts for the year 2030 (TIA Phase 2) scenario. As the figure shows, many more intersections may need signal timing adjustments and turn lane additions to maintain their level-of-service. More extensive reconstruction may also be needed of Martin Luther King, Jr. Boulevard (NC 86) and Estes Drive in the immediate vicinity of the site. Furthermore, signalization or roundabout treatments need to be evaluated intersections that are currently stop controlled.

Most notably, substantial reconstruction of Martin Luther King, Jr. Boulevard & Estes Drive in the immediate vicinity of the site may be needed to accommodate the site access requirements and additional traffic volumes generated by the project. Although applicable to all of the potential measures identified, these locations may require detailed alternatives analysis to test different concepts for improvements to these roadways.

6.2 Impact on Adjacent Neighborhoods/Traffic Calming

A concern raised by a number of residents in different neighborhoods is the potential for cut-through and higher speed traffic generated by Carolina North on local and neighborhood streets. A recent survey of Town residents regarding these issues was conducted and the results of that survey have been reviewed. Additionally, the trip generation and distribution for Carolina North have been reviewed to identify cut-through routes that may be susceptible to cut-through traffic. These routes and potential traffic calming measures are described below and highlighted in Figure 16. Traffic calming measures may be implemented at the following locations to address concerns of potential for cut-through and higher speed traffic generated by Carolina North on local and neighborhood streets. It should be noted that of the streets below, only the first four are projected to carry traffic generated by the Carolina North development:

- Piney Mountain Road*
- Hillsborough Street (Chapel Hill)*
- Seawell School Road*
- North Elliott Road/Curtis Road/Caswell Road*
- North Lakeshore Drive
- Barclay Road
- Northwood Road

* Roads projected to carry traffic generated by Carolina North

6.3 Transit Service

The transit demand for the Carolina North project requires new transit services and modifications to existing transit services. As with the existing transit services in Chapel Hill, the elements of the transit service will be a mix of service that is integrated into the local transit system and some services, such as park-and-ride shuttles, that will be dedicated to the project.

Route capacity is one component of the transit system's ability to serve Carolina North. In addition to the capacity of the system, one must consider the suitability of the current route structure to serve Carolina North. The majority of the existing system is designed to connect areas to the downtown and University campus. As a result, transfers will be required for many local riders to access Carolina North. This system structure suggests that more significant changes will be needed once Carolina North achieves a scale warranting more direct service.

Below is a discussion of potential measures to offset the impacts to transit of the Carolina North development. It should be noted that the potential transit mitigation measures identified in this document will be reviewed as part of the development of the Chapel Hill Transit Short Range Transit Plan and incorporated into the analysis of future service needs.

6.3.1 Potential Park-and-Ride Mitigation Measures

The existing park-and-ride system is expected to reach capacity even without the additional demand from the Carolina North project. The Carolina North development is likely to need around 400 to 500 for the 2015 (TIA Phase 1) Scenario and 1,500 to 1,600 park-and-ride spaces for the 2030 (TIA Phase 2) Scenario. This analysis assumes that these additional park-and-ride users will all be accommodate on at the Eubanks and Southern Village lots and delivered to the Carolina North site via the NS Route. However, these park-and-ride spaces could be provided in a number of other locations as envisioned in the draft *Chapel Hill-Carrboro Long Range Transit Plan*. These other locations would need to be connected to the site with a dedicated express route between the park-and-ride location and Carolina North. Additional regional transit service may be a substitute for park-and-ride spaces.

6.3.2 Potential Local Bus Service Mitigation Measures

The Carolina North project will add riders to the local transit system and there are some impacts on the existing users of the transit system that could be mitigated by the following:

- There will be substantial numbers of transit riders at Carolina North, and, for them to be able to conveniently use the system, it will be necessary to divert some existing bus routes into the campus. This will add to the length of these bus routes, perhaps five or 10 minutes each loop, and in some cases additional vehicles will need to be operated to maintain current headways. Overall, approximately 16 new buses are project to be needed, of which 13 are due to Carolina North during Phase 2 of Carolina North in the year 2030.
- Increased traffic, both related to the project and ambient background traffic will cause additional travel-time delays along sections of Martin Luther King, Jr. Boulevard (NC 86) beyond that which already exists. These increased delays will adversely impact the efficiency of the transit routes operating along Martin Luther King, Jr. Boulevard (NC 86). The signal modernization project would help maintain effective bus operations in the near term, as early as Phase 1 in the year 2015. In the longer term, a system of dedicated bus lanes and signal priority will further help to maintain the efficiency of bus operations and quality of service for transit passengers.

6.3.3 Potential Frequency and Fleet Requirements

The following two sections review the fleet and operating expansions for the two phases of Carolina North analyzed in this TIA.

2015 (TIA Phase 1) Frequency and Fleet Requirements

Carolina North is not projected to require any headway adjustments and fleet expansions over the No-Build condition in order to adequately serve the projected ridership in both 2015 (TIA Phase 1) based on the analysis performed in this study, due to an excess of capacity anticipated on the routes serving the site. The following table presents the existing, 2015 No-Build, and 2015 Build peak headway and vehicle requirements projected in this analysis.

Table 22: Comparison of Peak Headway and Potential Vehicle Requirements (2015 – TIA Phase 1)

	Headway			Vehicles		
Route	Existing	No-Build	Build	Existing	No-Build	Build
A	30	30	30	3	3	3
G	26	26	26	4	4	4
HS	30	30	30	2	2	2
NS	10	10	10	7	7	7
NU	18	18	18	2	2	2
T	30	20	20	2	3	3
Total				**20**	**21**	**21**

2030 (TIA Phase 2) Frequency and Fleet Requirements

In order to meet 2030 (TIA Phase 2) No-Build ridership, frequency needs to be increased on Route NS and Route T. These headway reductions require an addition of three (3) vehicles to the fleet serving these routes. In addition, spare vehicles would be required to support each of these routes.

To support 2030 (TIA Phase 2) Build condition ridership, additional service is needed. Headways are reduced further on the A, G, NS, NU, and T. The most significant service expansions are on the G and the NS. The headway reductions require an addition of 13 vehicles to the fleet serving these routes beyond those required to serve the No-Build. In addition, spare vehicles would be required to support each of these routes. Additional operating funds will also be needed to provide this expanded service.

Table 23: Comparison of Peak Headway and Potential Vehicle Requirements (2030 – TIA Phase 2)

Route	Headway			Vehicles		
	Existing	No-Build	Build	Existing	No-Build	Build
A	30	30	18	3	3	5
G	26	26	18	4	4	6
HS	30	30	30	2	2	2
NS	10	8	5	7	9	15
NU	18	18	12	2	2	3
T	30	20	12	2	3	5
Total				**20**	**23**	**36**

6.4 Pedestrian Facilities

In order to identify potential mitigation measures for the pedestrian facilities surrounding the site, an analysis was performed to determine the Pedestrian LOS for select roadway segments in the study area in accordance with TRB's Multimodal Level of Service Analysis for Urban Streets (NCHRP Report 616). Pedestrian LOS reflects the perspective of pedestrians sharing the roadside environment with motor vehicles. This assessment is based primarily on the existence of a sidewalk, lateral separation between pedestrians and motorized vehicles, motorized vehicle volumes, and motorized vehicle speeds. Similar to analyzing vehicular traffic, each level is assigned a letter from A to F, with LOS A representing the best pedestrian accommodations and LOS F representing the worst. It should be noted that this is a recently developed methodology that has not been adopted by the Town of Chapel, but is a methodology that is gaining wider acceptance in other localities. It is used in this study solely to identify locations that may require potential improvements to mitigate impacts generated by Carolina North, and is not intended to identify improvements that will be required as part of the development.

Several potential mitigation measures for the pedestrian facilities have been identified to allow pedestrians reasonable access to the Carolina North development. General mitigation measures include installing ADA compliant pedestrian facilities, constructing/improving sidewalks, improving lighting, and improving transit stop facilities, more specific measures are suggested below:

Martin Luther King, Jr. Boulevard (NC 86)

- Provide continuous sidewalk with a planting strip and street trees along Martin Luther King, Jr. Boulevard (NC 86) from Homestead Road to Hillsborough Street/Umstead Drive on both sides of the roadway (Based on the analysis, it is

desirable to match existing sidewalk width south of Airport Drive and provide a minimum of 6' to 12' planting strips).

- Construct sidewalk across driveways to complete sidewalk network. It is important that the sidewalk be consistent in its design so that there is a clear differentiation between the sidewalk and the driveway.
- Install continental-style crosswalks and pedestrian countdown signals at all legs of signalized intersections along Martin Luther King Jr. Boulevard (NC 86) including at Municipal Drive and Estes Drive.
- Narrow curb-radii at intersections to 25 feet maximum where feasible to slow turning cars and shorten-pedestrian crossing distances.
- Convert (TWLTL) to a planted raised median with median refuges at (warranted) mid-block crossing locations.
- Conduct analysis to determine if and what type of mid-block crossings are warranted.
- Widen intersections to allow for turning bays and for 8-foot pedestrian refuge areas in the median. Pedestrian signals and push buttons should be installed in the median refuge.
- Stripe 11-foot travel lanes to slow traffic.
- Add transit stops in the vicinity of the pedestrian access points.

Estes Drive

- Provide continuous sidewalk along Estes Drive Extension from Seawell School Road to Martin Luther King, Jr. Boulevard (NC 86) on both sides of the roadway (Based on the analysis, it is desirable to provide a 5' minimum sidewalk width and a 4' minimum planting strip width).
- Add transit stops in the vicinity of the pedestrian access points to Carolina North.

Seawell School Road

- Provide continuous sidewalk along Seawell School Road from Estes Drive to Homestead Road on both sides of the roadway (Based on the analysis, it is desirable to provide a 5' minimum sidewalk width and a 4' minimum planting strip width).

Homestead Road

- Provide continuous sidewalk along Homestead Road from Martin Luther King, Jr. Boulevard (NC 86) to Seawell School Road on both sides of the roadway (Based on the analysis, it is desirable to provide a 5' minimum sidewalk width and a 4' to 8' minimum planting strip width).

Airport Drive

- Provide continuous sidewalk along Airport Drive from Martin Luther King, Jr. Boulevard (NC 86) to Estes Drive on both sides of the roadway (Based on the

analysis, it is desirable to provide a 5' minimum sidewalk width and a 4' minimum planting strip width).

Potential pedestrian facility mitigation measures are illustrated in Figure 17. The redesign of the major roads adjacent to the site will need to account for these sidewalk and pedestrian crossing needs.

6.5 Bicycle Facilities

An evaluation of the bicycle facilities within ½ mile of the proposed access points of the Carolina North was also conducted in accordance with TRB's *Multimodal Level of Service Analysis for Urban Streets* (NCHRP Report 616). Bicycle LOS reflects the bicyclist's perspective of sharing the roadway environment with motor vehicle traffic. This assessment is based primarily the average effective width of the outside through lane, the motorized vehicle volumes, the motorized vehicle speeds, the heavy vehicle (truck) volumes, and the pavement condition. It should be noted that this is a recently developed methodology that has not been adopted by the Town of Chapel, but is a methodology that is gaining wider acceptance in other localities. It is used in this study solely to identify locations that may require potential improvements to mitigate impacts generated by Carolina North, and is not intended to identify improvements that will be required as part of the development.

The analysis revealed that the primary potential mitigation measure that would be needed to bring bicycle operations to LOS D or better in the study area is to stripe four- to five-foot (exclusive of the width of the gutter) bike lanes on both sides of the roadway in the following corridors:

- Martin Luther King, Jr. Boulevard from Homestead Road (NC 86) to Franklin Street
- Estes Drive from Seawell School Road to Caswell Road
- Seawell School Road from Estes Drive to Homestead Road
- Homestead Road from Martin Luther King, Jr. Boulevard (NC 86) to Seawell School Road
- Airport Drive from Martin Luther King, Jr. Boulevard (NC 86) to Estes Drive

As previously noted, the 2007 study presented several possible design alternatives for Martin Luther King, Jr. Boulevard that included bike lanes. If implemented, the design should be consistent throughout the bicycle corridor surrounding the development, whenever possible. Bicycle facility potential mitigations are illustrated in Figure 18. The redesign of the major roads adjacent to the site will need to account for these bicycle facility needs.

7 Greenhouse Gas/Emissions Analysis

Two specific analyses were conducted in connection with the air quality assessment for each of the phases of the project: a mesoscale analysis and a greenhouse gas analysis.

7.1 Mesoscale Analysis

The mesoscale analysis was prepared for the Carolina North development to determine project-related ozone precursor emissions. The predominant source of ozone precursor emissions is from project generated traffic.

Using EPA-recommended air quality modeling techniques, total pollutant emissions were calculated. The mesoscale study area includes all the roadway links and intersections that are projected to experience an increase of ten percent or more in traffic due to the development and that experience Level-of-Service (LOS) designation of D or lower under existing or future conditions.

The ozone mesoscale analysis demonstrates that the Carolina North development is in compliance with the EPA standards on ozone (NO_X and VOC) emissions. The development will incorporate reasonable and feasible mitigation measures to reduce VOC and NO_X emissions for the build condition.

The 2015 (TIA Phase 1) sensitivity analysis includes two scenarios: the "early phase" scenario, which entails more parking than in the base scenario; and the "constrained' scenario, which entails less parking than in the base. The mesoscale analysis of the "early phase" scenario shows increases in NO_X and VOC emissions. The mesoscale analysis of the "constrained" scenario shows a decrease in emissions.

The 2030 (TIA Phase 2) sensitivity analysis includes two scenarios – Constrained Ratio (-10 percent) and Constrained Ratio (-20 percent) – both of which entail fewer parking spaces than in the base scenario. In the mesoscale analysis, both constrained parking scenarios reduce NO_X and VOC emissions, with the Constrained Ratio (-20 percent) scenario resulting in even greater reductions in emissions than the Constrained Ratio (-10 percent) scenario.

Table 24 summarizes the project related VOC and NO_X emissions.

Figure 19 and Figure 20 provide a summary and visual representation of the VOC and NO_X background and project generated emissions.

Table 24: Mesoscale Ozone Analysis Results (with Mitigation)[1]

Pollutant	2009 Existing Condition	2015 No-Build Condition	2015 Build Condition	Build / No-Build Difference
Volatile Organic Compounds	267.0	168.1	172.4	+4.3
Oxides of Nitrogen	285.5	191.5	196.9	+5.4
Pollutant	**2009[3] Existing Condition**	**2030 No-Build Condition**	**2030 Build Condition**	**Build / No-Build Difference**
Volatile Organic Compounds	226.8	125.3	146.8	+21.5
Oxides of Nitrogen	250.7	90.8	106.7	+15.9

1 Kilograms per Day

2 The potential mitigation measures are described in Chapter 5 – *Potential Mitigation Measures*. Mobile source improvements include the proposed roadway/traffic improvements and parking constraint scenarios.

3 The analysis reviewed key roadway links within the study area. For the 2015 analysis, 21 key study area roadway links were evaluated. For the 2030 analysis, 18 key study area roadway links were evaluated.

Figure 19: 2015 (TIA Phase 1) Project-Related NOX and VOC Emissions

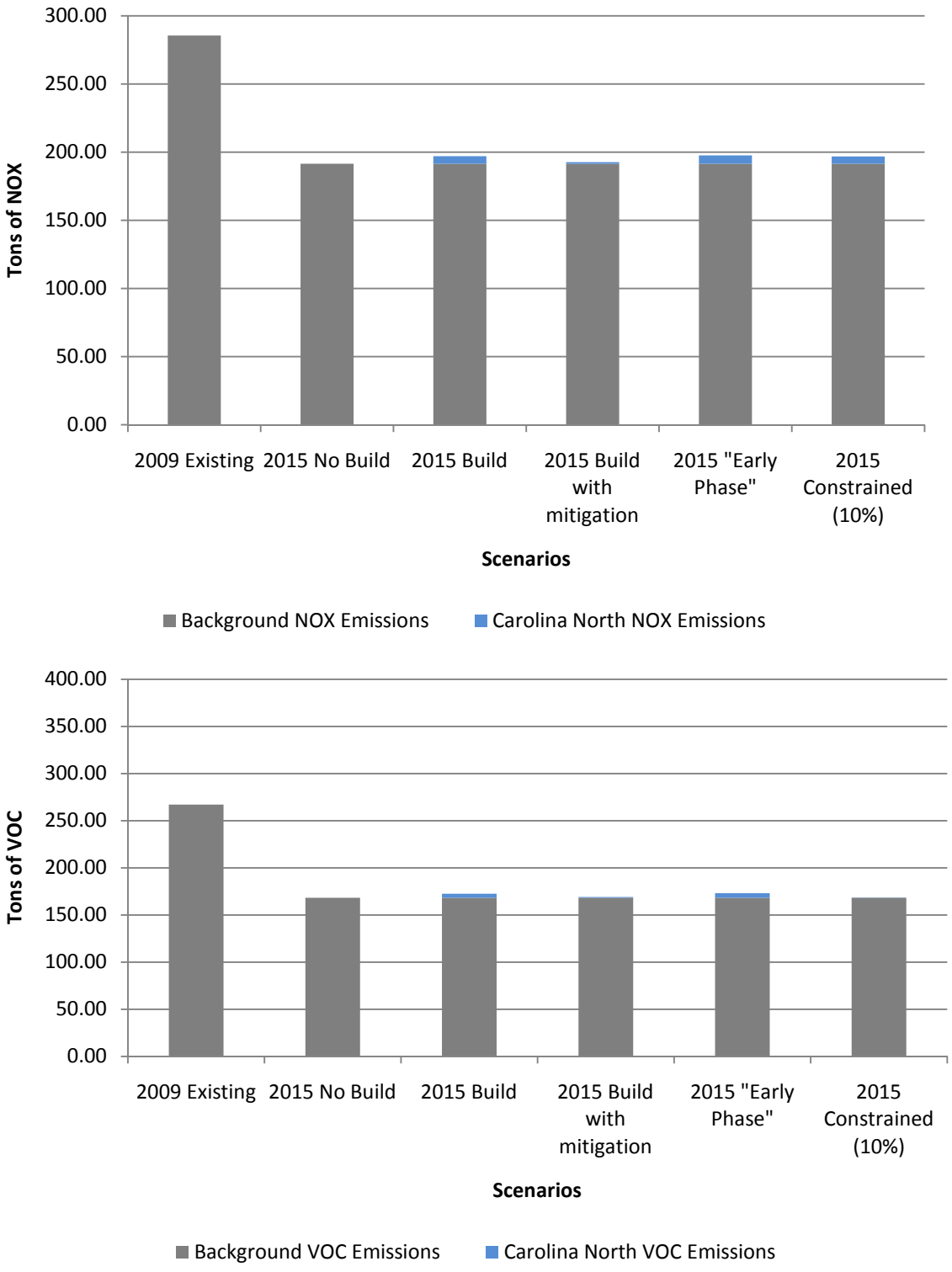
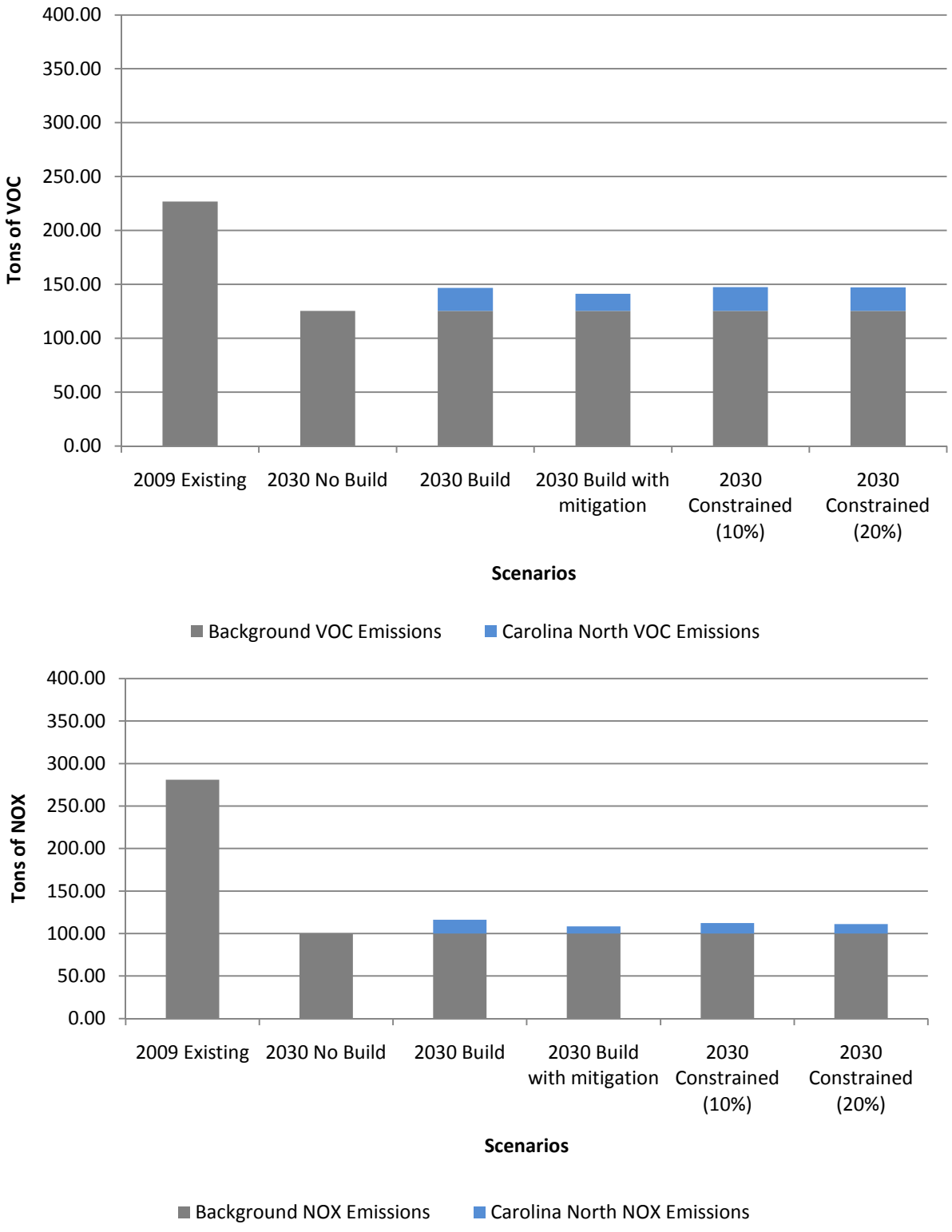


Figure 20: 2030 (TIA Phase 2) Project-Related NOX and VOC Emissions



7.1.1 Conclusion of Mesoscale Analysis

The air quality study demonstrates that the Carolina North Development project complies with the Clean Air Act Amendments (CAAA). The ozone mesoscale analysis demonstrates that the Project will result in an increase of VOC and NO_X emissions, as compared to the No-Build Condition. The Project will incorporate reasonable and feasible mitigation measures to reduce VOC and NO_X emissions. These mitigation measures include the potential intersection and roadway improvements as well as various parking constraint scenarios. The implementation of these mitigation measures will help reduce the VOC and NO_X emissions associated with the Project.

The 2015 (TIA Phase 1) sensitivity analysis includes two scenarios: the "early phase" scenario, which entails more parking than in the base scenario; and the "constrained' scenario, which entails less parking than in the base. The mesoscale analysis of the "early phase" scenario shows increases in NOx and VOC emissions. The mesoscale analysis of the "constrained" scenario shows a decrease in emissions.

The 2030 (TIA Phase 2) sensitivity analysis includes two scenarios – Constrained Ratio (-10 percent) and Constrained Ratio (-20 percent) – both of which entail fewer parking spaces than in the base scenario. In the mesoscale analysis, both constrained parking scenarios reduce NOx and VOC emissions, with the Constrained Ratio (-20 percent) scenario resulting in even greater reductions in emissions than the Constrained Ratio (-10 percent) scenario.

7.2 Greenhouse Gas Analysis

The Greenhouse Gas (GHG) mobile source analysis was conducted following procedures similar to the ozone mesoscale analysis. The mobile source analysis estimated the area-wide GHG emissions from vehicle traffic for a time period of one year. The change in GHG emissions from traffic were based on the average yearly traffic volumes, roadway lengths and vehicle emissions factors for existing and new trips for weekday and weekend conditions. Mobile source GHG emissions are based upon the traffic volumes, the distance traveled and the GHG emission rates.

The GHG assessment indicated that the mitigations identified in the 2015 Build with Mitigation will result in a six percent reduction in mobile source GHG emissions, compared to the Build without Mitigation scenario. This reduction is due to the proposed signal timing improvements of the study area roadways as well as the on-site traffic flow improvements.

Table 25 summarizes the GHG emissions analysis.

Figure 21 and Figure 22 provide a summary and visual representation of the VOC and NO_X background and project generated emissions.

Table 25: Mobile Source CO2 Emissions[1]

Pollutant	2009 Existing Condition	2015 No-Build Condition	2015 Build Condition	2015 Build with Mitigation[2]	2015 "Early Phase" Build[2]	2015 "Constrained" Build (10%)[2]
Total Carbon Dioxide (CO_2)	64,310.1	76,635.5	78,641.5	78,227.3	78,876.0	78,451.3
Project Emissions			+2,006.0	+1,591.7	+2,240.4	+1,815.8
Change from Build				-414.2	+234.5	-190.2
Pollutant	**2009 Existing Condition**	**2030 No-Build Condition**	**2030 Build Condition**	**2030 Build with Mitigation[2]**	**2030 "Constrained" Build (10%)[2]**	**2030 "Constrained" Build (20%)[2]**
Total Carbon Dioxide (CO_2)	55,840.7	65,226.0	76,633.1	76,088.1	76,424.0	76,268.7
Project Emissions			+11,407.1	+10,862.2	+11,198.0	+11,042.7
Change from Build				-545.0	-209.1	-364.4

1 Tons per Year

2 The potential mitigation measures are described in Chapter 5 – *Potential Mitigation Measures.* Mobile source improvements include the proposed roadway/traffic improvements and parking constraint scenarios.

3 The analysis reviewed key roadway links within the study area. For the 2015 analysis, 21 key study area roadway links were evaluated. For the 2030 analysis, 18 key study area roadway links were evaluated.

Figure 21: 2015 (TIA Phase 1) Project-Related CO2 Emissions

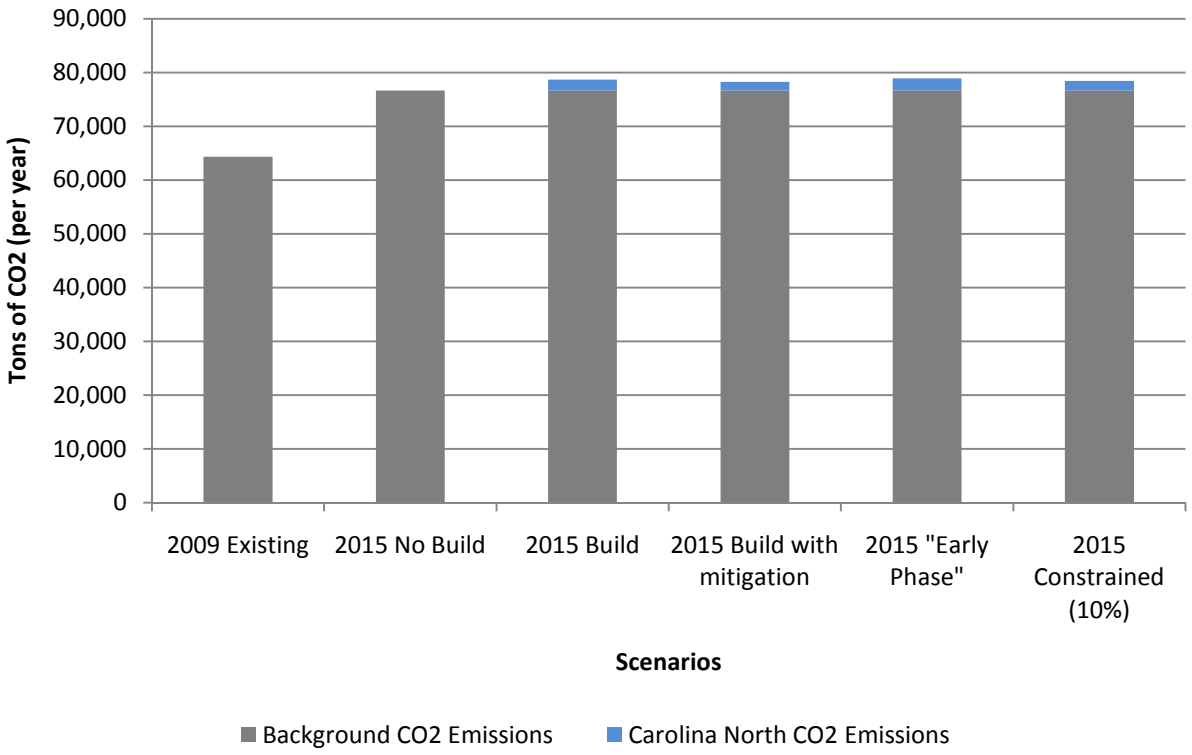


Figure 22: 2030 (TIA Phase 2) Project-Related CO2 Emissions