4 Project 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: year 2015 (TIA Phase 1) and 2030 (TIA Phase 2). This study update has a modified horizon year for the analysis of the second phase of development from the year 2025 to 2030. 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. This section summarizes the development programs assumed for the site for these two phases, the projected trip generation, the methodology used to determine the trip distribution and assignment associated with the project, and the intersection and roadway segment capacity analysis and results. The analysis also assesses the generalized anticipated traffic impacts to the streets within the surrounding residential communities and identifies traffic calming measures that may mitigate any future traffic impacts.

Also as part of this study, a parking supply sensitivity analysis was performed that is intended to identify the relative traffic 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 than the base scenario proposed by the University for 2015 (TIA Phase 1) and more constrained than the base scenario for 2030 (TIA Phase 2).

In addition to determining the impacts of vehicular traffic generated by the site, this study also assesses the projected project impacts on the local transit system and the surrounding pedestrian and bicycle networks.

4.1 Carolina North Development Program (2015 & 2030)

4.1.1 2015 (TIA Phase 1) Development Program

For the program analyzed in the 2015 (TIA Phase 1) scenario, a little over half of the planned 800,000 square feet development will be academic buildings, with most of the rest of the development split between private development, 200 housing units, and a small amount of civic/retail space (see Table 4-1). To support this development, approximately 1,525 parking spaces are planned. These parking spaces serve a variety of activities on the site, as summarized in Table 4-1.

Table 4-1: 2015 (TIA Phase 1) Carolina North Development Program

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

The parking supply defined in Table 4-1 was determined using the following parking ratios:

- 0.5 parking spaces per person (main campus ratio) for 820 academic employees
- 0.25 spaces per commuting student (main campus ratio) for 850 students.
- 0.20 spaces per 1,000 square feet for academic visitors
- 2.5 spaces per 1,000 square feet for private uses
- 1.5 spaces per 1,000 square feet for civic/retail buildings
- 1.25 spaces per housing unit (main campus ratio).
- 35 spaces per recreational field

4.1.2 2030 (TIA Phase 2) Development Program

Between 2015 (TIA Phase 1) and 2030 (TIA Phase 2) scenarios an additional 2.2 million square feet of development is occurs at Carolina North (see Table 1-2). While academic space will add nearly 900,000 square feet and will continue to be the single largest use at

Carolina North, it will account for a smaller share of the total development (roughly one-third), compared with over half of the development in 2015 (TIA Phase 1). Private development and housing units each add 520,000 and 550,000 square feet of space, respectively, and will continue to account for roughly one-quarter of the development each. For the 2030 (TIA Phase 2) scenario, health care uses are introduced into Carolina North and will account for approximately seven percent of the development. Civic and retail space will represent a larger share of the Carolina North development plan, though still a small portion of the total. The proposed 2030 (TIA Phase 2) development program is depicted in Figure 4-1. All figures can be found at the end of the chapter.

Additional parking spaces will be added between 2015 (TIA Phase 1) and 2030 (TIA Phase 2), bringing the total to 5,835 parking spaces, as summarized in Table 4-2. The parking ratios used to derive the 2030 (TIA Phase 2) parking supply are the same as those described for 2015 (TIA Phase 1) with the addition of the following for the Health Care building program:

- 0.5 parking spaces per health care employee
- 2.5 spaces per 1,000 square feet for health care patients and visitors

Table 4-2: 2030 (TIA Phase 2) Carolina North Development Program

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

4.2 Preliminary Evaluation of the Carolina North Site Plan

The 3 million square foot phase of the Carolina North development is depicted in Figure 4-1. This figure illustrates a master plan-level concept for the site and does not define many design details that would be the subject of a site plan review. Some additional details on the transportation elements of the plan are defined in the *Carolina North Design Guidelines* (2008) and the *Carolina North Plan* (2007). This section defines some issues for further exploration given what can be gleaned from the master plan layout, and identifies issues that should be the subject of additional review and dialog as the design of the site progresses. A detailed site plan illustrating specific roadway, sidewalks, and intersection configurations as well as traffic control should be developed and reviewed by the Town in advance of specific building approvals. Key issues identified for specific locations on the site plan are summarized in Figure 4-2. Additional issues that apply on a corridor-wide or plan-wide basis are summarized below.

4.2.1 Entry Drive

Municipal Drive is reconstructed as "Entry Drive." The proposed cross section appears to be a four-lane, median-divided roadway with additional street-side landscaping along both the north and south sides of the roadway. The roadway includes 27-foot carriageways which can accommodate two travel lanes and a bicycle lane, as depicted in the *Design Guidelines*. Some early comments on the layout as presented include:

- Additional turn lanes will be needed at the Martin Luther King, Jr. Boulevard intersection.
- The pedestrian crossing located just to the west of Martin Luther King, Jr. Boulevard may be inadvisable due to vehicle queuing approaching the intersection.
- Room for bus stops/pull-outs should be considered as the design is developed
- Sight-distance and traffic control at the western bend of this roadway, where another road serves the western end of the site, will be challenging to provide.
- On-street parking to support storefront retail activities should be considered.
- The traffic demands for a longer-term build-out may suggest additional east-west roads on the site.
- The sidewalk widths should be reviewed in detail to make sure they support a comfortable walking environment, any street side cafes or other public ground floor uses that may spill into the sidewalk, transit waiting areas, street furniture, and other sidewalk features.

4.2.2 Estes Drive Connector

In the 3 million square foot phase of development, the Entry Drive turns southward and connects with Estes Drive Extension. The roadway passes through additional development area before reaching Estes Drive Extension. A representative cross-section

for this roadway is not provided in the *Design Guidelines*. Some early comments on the layout as presented include:

- The cross-section of this roadway needs to be defined as design progresses.
- The intersection of the Connector Road should align with the intersection of Estes Drive Extension & Airport Drive. Signalization of this intersection will be necessary at some point in the development build-out. Crosswalks should be provided where this roadway intersects other side roads and parking access roads.
- The distance between Estes Drive Extension and the first intersecting road within the site is short and may be impacted by queuing at later phases of development.
- Supplemental turn lanes will be needed at the Estes Drive Extension intersection.
- Room for additional bus stops/pull-outs should be considered as the design is developed.
- Sight-distance requirements will determine the allowable curvature of the roadway as it approaches Estes Drive Extension.

4.2.3 Central Green Way

In the 3 million square foot phase of development, the Central Green Way provides an additional east-west connection between the Estes Drive Connector and Martin Luther King, Jr. Boulevard. A two-way transit-only corridor is shown along the north side of the Central Green Way. A representative cross-section for this roadway is provided in the *Design Guidelines*. Some early comments on the layout as presented include:

- The busway does not appear to provide significant utility as a transit corridor for these early phases of development. It may effectively serve a circulator shuttle within the property. If this is the case, a means of turning around without using the major external roadways would be helpful.
- Sidewalks are not shown along the roadway. These will be needed to provide linkages to the bus stops.
- The cross-section of this roadway needs to be defined as design progresses. A 26-foot travel way may be adequate to support two-way transit operations, two-way general traffic operations, or one-way traffic flow with on-street parking. A wider cross-section would be needed to accommodate two-way traffic with bicycle lanes, or two-way traffic circulation with on-street parking or bicycle lanes.
- Pedestrian crossing locations along this roadway need to be well defined and highly visible.
- Crosswalks should be provided where this roadway intersects other side roads and parking access roads.
- The intent of the intersection design with Martin Luther King, Jr. Boulevard is unclear from the diagram. Entering and exiting the site at this location may be

impacted by queues from the adjacent intersection of Martin Luther King, Jr. Boulevard & Estes Drive.
- Room for additional bus stops/pull-outs should be considered as the design is developed.

4.2.4 Parking Location and Sizing

In the 3 million square foot phase of development, three major parking structures and a remote surface lot are depicted. The parking facilities appear to be located centrally, providing reasonable walking distances between buildings and parking structures. The sizes and uses of these parking facilities have not been defined at this time. Further refinement of the parking plan should be provided as the project develops. Some parking issues to consider include:

- Parking structures located deep within the site will require entering and exiting vehicular traffic to circulate through the entire project before reaching major streets.
- The parking supply in use should be tightly managed to match the development occupancy even though the amount of parking may be built in larger increments.
- Options for shared-parking between recreational, civic/retail, and daytime uses should be considered to minimize the total amount of parking on the site while meeting demand patterns for each use.
- The parking supply and access should be controlled so that trip generation can be monitored continuously.

4.2.5 Pedestrian and Bicycle Network

The master plan layout and design guidelines provide an overview of the pedestrian and bicycle network on the site. These diagrams and descriptions outline a general approach to the pedestrian and bicycle system serving the Carolina North site. Additional details need to be defined as this system develops, including:

- The connectivity of bicycle lanes on the streets within the site
- Provision of additional bicycle lanes on streets beyond the site boundaries
- Dismount zones (if any) for bicycles and decisions about shared or exclusive use of path facilities within the site
- Adequacy of walkway, sidewalk, and shared-use path designs
- Provisions of crosswalks and warning signage
- Accommodation of pedestrians and bicyclists in traffic signal phasing, timing, and detection.
- Provision for connections through buildings and access building entrances/exits
- Connections to transit and the provision of space for bus stops and waiting areas
- The design of parking entries and exits and building service locations as they cross pedestrian and bicycle routes

4.2.6 Transit Access

The master plan layout and design guidelines define a transit spine along the Central Green Way. If transit routes enter the site boundaries during the 800,000 square foot development phase, they will likely use this transit spine and the Entry Drive to loop through the site. However, the density of use on the site may not warrant diversion of transit routes onto the site at this point. It would be beneficial to establish the Estes Connector Road to support transit operations early in the development build-out.

In the 3 million square foot development phase, it may be easier and more efficient for buses to circulate through the site using Airport Drive, the Estes Drive Connection and the Entry Drive as a diversion from Martin Luther King, Jr. Boulevard. In this phase, it does not appear that the transit spine will be necessary to provide transit service to the site. In later phases of development, as activity increases on the western end of the site, the transit spine will likely be necessary again.

At a minimum, the Estes Drive Connector, Entry Drive, and Central Green Way should be designed to accommodate 60-foot articulated transit buses (and 40-foot transit buses) so that route flexibility is preserved.

4.2.7 Loading & Service Needs

The master plan diagrams do not identify building service locations. As the on-site roadway network is designed, paths for larger vehicles should be defined and curb radii and roadway widths defined to allow access to these facilities.

4.3 Trip Generation

The following section presents details regarding the rates and methodology used to calculate site generated trips, trip generation and mode split shifts, and the parking supply scenarios which alter mode choice. When compared to national standards, the trip generation rates specific to the University Main Campus were found to provide modestly higher traffic volume estimates and thus provide a more conservative analysis of traffic impacts. In addition, the parking space-based trip generation estimates provide a more consistent analysis of the traffic impacts of varying the parking supply.

4.3.1 Methodology

In order to estimate the volume of traffic generated by the proposed development in the years 2015 (TIA Phase 1) and 2030 (TIA Phase 2), empirical parking space trip generation rates (i.e. the number of vehicular trips generated per parking space) were determined to be the most appropriate method to estimate the volume of traffic generated by most elements of the proposed development.

Use of ITE Trip Generation Rates vs. Empirical data

When empirical data is not available, trip generation rates published by the Institute of Transportation Engineers (ITE) *Trip Generation*[5] are typically used to forecast site-generated trips. These trip generation rates are published for a variety of land uses and calculated based on information from studies across the country. While these trip generation rates are generally appropriate to estimate the volume of vehicular traffic generated by a specific sized development, the rates do not take into account regional or local nuances specific to the context of the future development, such as available transit service or the limited availability of parking. Furthermore, there are very limited data within the pool of ITE studies specific to vehicular travel for university and college campuses. For this study, ITE trip generation data were used only in the estimates of traffic for residential units and for civic/retail space.

Parking-Based Trip Generation Rates

The parking generation rates presented in Table 4-3 were applied to the number of proposed parking spaces for the respective land uses at Carolina North. The parking trip generation rates were initially developed as part of a study conducted during the fall of 2001 and presented in the recent University of North Carolina at Chapel Hill Development Plan TIA[6]. These rates are based on data from gate operations and visitor counts at various University and UNC Health Care parking areas. As noted, some of these rates were updated based on more recent counts taken at specific lots that are

[5] Trip Generation; Eighth Edition; Institute of Transportation Engineers; Washington, D.C.; 2008.
[6] The University of North Carolina at Chapel Hill Development Plan – Transportation Impact Analysis, December 2007 (amended January 2008)

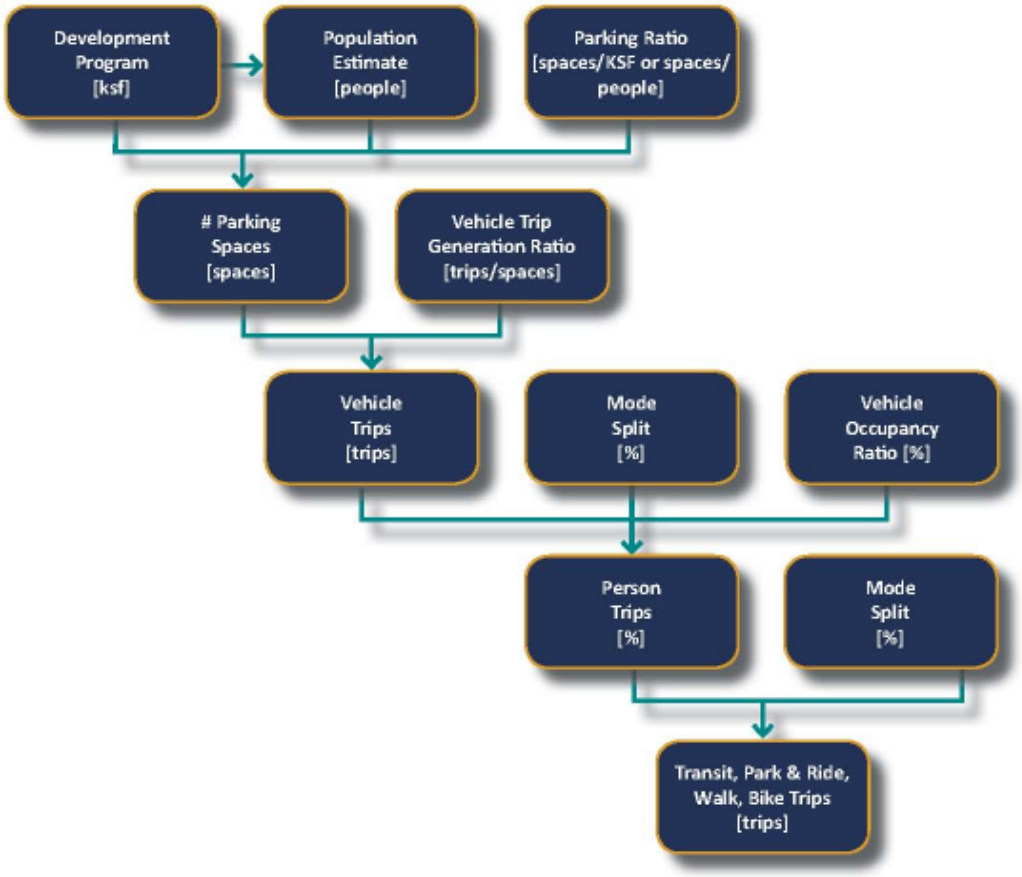
more representative of the anticipated land uses at Carolina North. In addition, these trip generation rates are updated with estimated trip rates during the midday timeframe.

Table 4-3: Parking Generation Rates

User Type	Trip Rates (Trips per Space)						
	Weekday	AM In	AM Out	Midday In	Midday Out	PM In	PM Out
Medical Clinic Visitor	10.6	0.810	0.280	0.480	0.490	0.200	0.640
University Visitor	7.6	0.410	0.130	0.510	0.360	0.710	0.590
Employee	3.6	0.360	0.070	0.290	0.200	0.130	0.300
Commuter Student	3.6	0.330	0.050	0.228	0.175	0.270	0.340

Figure presents a general representation of the trip generation methodology when parking generations rates are used. In the case that parking-based trip generation rates were not available for specific uses, ITE Trip Generation rates or other sources are used and noted.

Figure 4-3: Trip Generation Methodology



Mode Share

There is a strong relationship between mode share and the availability of parking spaces. Currently, parking on the University's main campus is limited and this affects the mode choice of the staff, faculty, and students who travel to campus. Parking restrictions for the baseline condition on the Carolina North campus were anticipated to be similar to those on the University's main campus.

Using the 2007 University Campus Commuting Survey, mode share assumptions were made for the baseline conditions on the Carolina North campus. Table 4-4 presents the mode share assumptions for University employees and commuting students. In addition, mode share for non-University affiliated trips are presented based on information from the Town of Chapel Hill Transportation Management Plan.

Table 4-4: Mode Share

Mode	Employee/Staff /Faculty	Commuting Students	Chapel Hill
Drive Alone (not park-and-ride)	57.5%	24.4%	89.3%
Park-and-ride	15.1%	8.7%	4.4%
Bus	9.1%	32.1%	2.8%
Carpool	5.2%	6.4%	2.0%
Dropped off by Friend/ Spouse	2.8%	4.4%	0.9%
Bicycle	2.8%	6.4%	0.3%
Walk	2.6%	12.2%	0.2%
Telework from Home	1.4%	2.4%	0.2%
Other	1.7%	1.7%	-
Vanpool	1.1%	0.5%	-
Total	**100%**	**100%**	**100%**

Table 4-5 and Table 4-6 provide a summary of site generated trips during the AM and PM peak hours for each mode for the 2015 (TIA Phase 1) and 2030 (TIA Phase 2) scenarios, respectively. Table 4-7 shows the summary of site generated trips during the Midday peak hour for both the 2015 (TIS Phase 1) and 2030 (TIA Phase 2) scenarios. The methodology and development program is consistent with the Spring 2009 TIA and therefore presents the same trip generation projections as the previous study.

Table 4-5: 2015 (TIA Phase 1) Development Program Trip Generation – AM & PM

		Total Person-Trips							Total Vehicle-Trips							Total Park-and-Ride Trips							Total Transit-Trips							Total Walk/Bike/Other-Trips						
			AM			PM				AM			PM				AM			PM				AM			PM				AM			PM		
	Land Use	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total
Academic	Centers and Institutes I	691	69	13	83	25	58	83	432	43	8	52	16	36	52	104	10	2	12	4	9	12	63	6	1	8	2	5	8	37	4	1	4	1	3	4
	Centers and Institutes II	518	52	10	62	19	43	62	324	32	6	39	12	27	39	78	8	2	9	3	7	9	47	5	1	6	2	4	6	28	3	1	3	1	2	3
	Centers and Institutes III																																			
	Interdisciplinary Research Center																																			
	Research																																			
	School of Public Health																																			
	School of Public Health Students																																			
	Office/Classroom																																			
	School of Law	1,152	115	22	138	42	96	138	720	72	14	86	26	60	86	174	17	3	21	6	14	21	105	10	2	13	4	9	13	62	6	1	7	2	5	7
	School of Law Students	2,473	227	34	261	185	234	419	765	70	11	81	57	72	130	470	43	7	50	35	44	80	794	73	11	84	60	75	135	247	23	3	26	19	23	42
	Support																																			
	Academic Visitors/Service	689	37	12	49	64	54	118	623	34	11	44	58	48	107	30	2	1	2	3	2	5	19	1	0	1	2	1	3	3	0	0	0	0	0	1
Private	Innovation Center	1,163	116	23	139	42	97	139	727	73	14	87	26	61	87	176	18	3	21	6	15	21	106	11	2	13	4	9	13	63	6	1	7	2	5	7
	Corporate Partners	1,429	143	28	171	52	119	171	893	89	17	107	32	74	107	216	22	4	26	8	18	26	130	13	3	16	5	11	16	77	8	2	9	3	6	9
Housing[1]	University affiliates	1,095	13	136	149	48	17	65	103	1	13	14	4	2	6	0	0	0	0	0	0	0	493	6	61	67	21	8	29	493	6	61	67	21	8	29
	Non-University affiliates	452	6	24	30	31	17	48	393	5	21	26	27	15	42	0	0	0	0	0	0	0	33	0	2	2	2	1	3	2	0	0	0	0	0	0
Service	Services (Retail, commercial, civic, etc.)[2]	475	NA	NA	NA	20	26	46	47	NA	NA	NA	2	3	5	0	NA	NA	NA	0	0	0	47	NA	NA	NA	2	3	5	380	NA	NA	NA	16	21	37
	Recreational Fields[3]	231	2	2	5	46	21	67	21	0	0	0	4	2	6	0	0	0	0	0	0	0	104	1	1	2	21	9	30	104	1	1	2	21	9	30
	UNC Healthcare Employee																																			
	UNC Healthcare Visitor																																			
	TOTAL TRIPS	**10,369**	**781**	**304**	**1,085**	**574**	**781**	**1,355**	**5,049**	**420**	**115**	**535**	**265**	**399**	**665**	**1,248**	**120**	**22**	**141**	**65**	**109**	**174**	**1,941**	**126**	**84**	**210**	**124**	**135**	**259**	**1,497**	**57**	**71**	**128**	**87**	**84**	**171**

[1]Housing is assumed to be occupied by University affiliates and their spouses. For analysis purposes, it was assumed that 75% of the residents living in Carolina North housing will be affiliated with the University and 25% of the residents will not be affiliated with the University. Travel patterns for a comparable university were used to estimate the trip generation of University affiliates residing on Carolina North. ITE trip generation rates (ITE LUC 220, 8th Edition) were used to estimate vehicular trip generation for Non-University affiliates.

[2]ITE Trip Generation LUC 814 Specialty Retail (8th Edition) was used to estimate vehicular trip generation for *Services (Retail, commercial, civic, etc.)* land use.

[3] ITE Trip Generation LUC 448 Soccer Complex (8th Edition) was used to estimate vehicular trip generation for *Recreational Fields* land use.

Table 4-6: 2030 (TIA Phase 2) Development Program Trip Generation – AM & PM

		Total Person-Trips							Total Vehicle-Trips							Total Park-and-Ride Trips							Total Transit-Trips							Total Walk/Bike/Other-Trips						
			AM			PM				AM			PM				AM			PM				AM			PM				AM			PM		
	Land Use	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total	Daily	In	Out	Total	In	Out	Total
Academic	Centers and Institutes I	634	63	12	76	23	53	76	396	40	8	47	14	33	47	96	10	2	11	3	8	11	58	6	1	7	2	5	7	34	3	1	4	1	3	4
	Centers and Institutes II	490	49	10	58	18	41	58	306	31	6	37	11	26	37	74	7	1	9	3	6	9	45	4	1	5	2	4	5	26	3	1	3	1	2	3
	Centers and Institutes III	835	84	16	100	30	70	100	522	52	10	62	19	44	62	126	13	2	15	5	11	15	76	8	1	9	3	6	9	45	5	1	5	2	4	5
	Interdisciplinary Research Center	835	84	16	100	30	70	100	522	52	10	62	19	44	62	126	13	2	15	5	11	15	76	8	1	9	3	6	9	45	5	1	5	2	4	5
	Research	1,094	109	21	131	40	91	131	684	68	13	82	25	57	82	165	17	3	20	6	14	20	100	10	2	12	4	8	12	59	6	1	7	2	5	7
	School of Public Health	893	89	17	107	32	74	107	558	56	11	67	20	47	67	135	13	3	16	5	11	16	81	8	2	10	3	7	10	48	5	1	6	2	4	6
	School of Public Health Students	3,346	307	46	353	251	316	567	1,035	95	14	109	78	98	175	636	58	9	67	48	60	108	1,074	98	15	113	81	101	182	335	31	5	35	25	32	57
	Office/Classroom	1,008	92	14	106	76	95	171	630	58	9	67	47	60	107	152	14	2	16	11	14	26	92	8	1	10	7	9	16	54	5	1	6	4	5	9
	School of Law	1,152	115	22	138	42	96	138	720	72	14	86	26	60	86	174	17	3	21	6	14	21	105	10	2	13	4	9	13	62	6	1	7	2	5	7
	School of Law Students	2,473	227	34	261	185	234	419	765	70	11	81	57	72	130	470	43	7	50	35	44	80	794	73	11	84	60	75	135	247	23	3	26	19	23	42
	Support	432	43	8	52	16	36	52	270	27	5	32	10	23	32	65	7	1	8	2	5	8	39	4	1	5	1	3	5	23	2	0	3	1	2	3
	Academic Visitors/Service	2,152	116	37	153	201	167	368	1,946	105	33	138	182	151	333	0	0	0	0	0	0	0	155	8	3	11	14	12	27	11	1	0	1	1	1	2
Private	Innovation Center	1,163	116	23	139	42	97	139	727	73	14	87	26	61	87	176	18	3	21	6	15	21	106	11	2	13	4	9	13	63	6	1	7	2	5	7
	Corporate Partners	8,917	892	173	1,065	322	743	1,065	5,573	557	108	666	201	464	666	1,347	135	26	161	49	112	161	811	81	16	97	29	68	97	482	48	9	58	17	40	58
Housing[1]	UNC affiliates	3,741	50	509	559	179	65	243	353	5	48	53	17	6	23	0	0	0	0	0	0	0	1,683	22	229	251	80	29	109	1,683	22	229	251	80	29	109
	Non-UNC affiliates	1,339	20	81	102	83	45	128	1,164	18	71	88	73	39	112	0	0	0	0	0	0	0	96	1	6	7	6	3	9	7	0	0	1	0	0	1
Service	Services (Retail, commercial, civic, etc.)[2]	3,093	NA	NA	NA	85	108	193	303	NA	NA	NA	8	11	19	0	NA	NA	NA	0	0	0	309	NA	NA	NA	9	11	19	2,474	NA	NA	NA	68	87	155
	Recreational Fields[3]	231	2	2	5	46	21	67	21	0	0	0	4	2	6	0	0	0	0	0	0	0	104	1	1	2	21	9	30	104	1	1	2	21	9	30
	UNC Healthcare Employee	2,304	230	45	275	83	192	275	1,440	144	28	172	52	120	172	348	35	7	42	13	29	42	210	21	4	25	8	17	25	124	12	2	15	4	10	15
	UNC Healthcare Visitor	5,892	450	156	606	111	356	467	5,326	407	141	548	100	322	422	0	0	0	0	0	0	0	424	32	11	44	8	26	34	29	2	1	3	1	2	2
	TOTAL TRIPS	**42,024**	**3,139**	**1,244**	**4,384**	**1,895**	**2,969**	**4,863**	**23,261**	**1,929**	**554**	**2,484**	**990**	**1,736**	**2,726**	**4,089**	**398**	**73**	**471**	**197**	**355**	**551**	**6,438**	**416**	**310**	**726**	**347**	**417**	**764**	**5,957**	**186**	**260**	**446**	**255**	**272**	**528**

[1]Housing is assumed to be occupied by UNC affiliates and their spouses. For analysis purposes, it was assumed that 75% of the residents living in Carolina North housing will be affiliated with UNC and 25% of the residents will not be affiliated with UNC. Travel patterns for a comparable university were used to estimate the trip generation of UNC affiliates residing on Carolina North. ITE trip generation rates (ITE LUC 220, 8th Edition) were used to estimate vehicular trip generation for Non-University affiliates.

[2]ITE Trip Generation LUC 814 Specialty Retail (8th Edition) was used to estimate vehicular trip generation for *Services (Retail, commercial, civic, etc.)* land use.

[3] ITE Trip Generation LUC 448 Soccer Complex (8th Edition) was used to estimate vehicular trip generation for *Recreational Fields* land use.

Table 4-7: 2015 (TIA Phase 1) & 2030 (TIA Phase 2) Development Program Trip Generation-Midday

		2015 (TIA Phase 1) Development Program Trip Generation																2030 Development Program Trip Generation															
		Total Person-Trips				Total Vehicle-Trips				Total Park-and-Ride Trips				Total Transit-Trips				Total Person-Trips				Total Vehicle-Trips				Total Park-and-Ride Trips				Total Transit-Trips			
			Midday				Midday				Midday				Midday				Midday				Midday				Midday				Midday		
	Land Use	**Daily**	**In**	**Out**	**Total**	**Daily**	**In**	**Out**	**Total**	**Daily**	**In**	**Out**	**Total**	**Daily**	**In**	**Out**	**Total**	**Daily**	**In**	**Out**	**Total**	**Daily**	**In**	**Out**	**Total**	**Daily**	**In**	**Out**	**Total**	**Daily**	**In**	**Out**	**Total**
Academic	Centers and Institutes I	691	56	38	94	432	35	24	59	104	2	3	5	63	2	2	4	634	51	35	86	396	32	22	54	96	2	3	5	58	2	1	3
	Centers and Institutes II	518	42	29	71	324	26	18	44	78	2	2	4	47	2	1	3	490	39	27	67	306	25	17	42	74	1	2	4	45	2	1	3
	Centers and Institutes III																	835	67	46	114	522	42	29	71	126	3	4	6	76	3	2	0
	Interdisciplinary Research Center																	835	67	46	114	522	42	29	71	126	3	4	6	76	3	2	0
	Research																	1,094	88	61	149	684	55	38	93	165	3	5	8	100	4	2	0
	School of Public Health																	893	72	50	122	558	45	31	76	135	3	4	7	81	3	2	0
	School of Public Health Students																	3,346	212	163	375	1,035	66	50	116	636	13	19	32	1,074	36	28	0
	Office/Classroom																	1,008	84	55	139	630	51	35	86	152	3	5	8	92	3	2	
	School of Law	1,152	93	64	157	720	58	40	98	174	3	5	9	105	4	3	6	1,152	93	64	157	720	58	40	98	174	3	5	9	105	4	3	6
	School of Law Students	2,473	157	121	277	765	49	37	86	470	9	14	23	794	27	21	48	2,473	157	121	277	765	49	37	86	470	9	14	23	794	27	21	48
	Support																	432	35	24	59	270	22	15	37	65	1	2	3	39	1	1	
	Academic Visitors/Service	689	46	33	79	623	42	30	71	30	1	1	2	19	1	0	1	2,152	144	102	246	1,946	131	92	223	0	0	0	0	155	5	4	9
Private	Innovation Center	1,163	94	65	158	727	59	40	99	176	4	5	9	106	4	3	6	1,163	94	65	158	727	59	40	99	176	4	5	9	106	4	3	6
	Corporate Partners	1,429	115	79	195	893	72	50	122	216	4	6	11	130	5	3	8	8,917	718	495	1,214	5,573	449	310	759	1,347	27	40	67	811	29	20	49
Housing[1]	University affiliates	1,095	30	76	107	103	3	7	10	0	0	0	0	493	8	21	30	3,741	114	287	401	353	11	27	38	0	0	0	0	1,683	29	72	101
	Non-University affiliates	452	19	20	39	393	16	18	34	0	0	0	0	33	1	1	2	1,339	52	63	115	1,164	45	55	100	0	0	0	0	96	3	3	6
Service	Services (Retail, commercial, civic, etc.)[2]	475	20	26	46	47	2	3	5	0	0	0	0	47	1	2	3	3,093	85	108	193	303	8	11	19	0	0	0	0	309	8	10	19
	Recreational Fields[3]	231	24	12	36	21	2	1	3	0	0	0	0	104	4	2	6	231	24	12	36	21	2	1	3	0	0	0	0	104	4	2	6
	UNC Healthcare Employee																	2,304	186	128	314	1,440	116	80	196	348	7	10	17	210	7	5	0
	UNC Healthcare Visitor																	5,892	267	272	539	5,326	241	246	487	0	0	0	0	424	13	13	0
	TOTAL TRIPS	**10,369**	**696**	**563**	**1,259**	**5,049**	**363**	**267**	**630**	**1,248**	**25**	**37**	**62**	**1,941**	**58**	**58**	**116**	**42,024**	**2,650**	**2,224**	**4,874**	**23,261**	**1,547**	**1,206**	**2,753**	**4,089**	**82**	**123**	**204**	**6,438**	**189**	**197**	**256**

[1]Housing is assumed to be occupied by University affiliates and their spouses. For analysis purposes, it was assumed that 75% of the residents living in Carolina North housing will be affiliated with the University and 25% of the residents will not be affiliated with the University. Travel patterns for a comparable university were used to estimate the trip generation of University affiliates residing on Carolina North. ITE trip generation rates (ITE LUC 220, 8th Edition) were used to estimate vehicular trip generation for Non-University affiliates. Midday vehicle trips calculated by averaging AM and PM peak hour vehicle trip generation volumes.

[2]ITE Trip Generation LUC 814 Specialty Retail (8th Edition) was used to estimate vehicular trip generation for *Services (Retail, commercial, civic, etc.)* land use. Midday vehicle trips calculated by averaging AM and PM peak hour vehicle trip generation volumes.

[3] ITE Trip Generation LUC 448 Soccer Complex (8th Edition) was used to estimate vehicular trip generation for *Recreational Fields* land use. Midday vehicle trips calculated by averaging AM and PM peak hour vehicle trip generation volumes.

4.4 Trip Distribution

The directional distribution of the vehicular traffic approaching and departing the site is a function of residential population densities, the location of employment, existing travel patterns, and the efficiency of the existing roadway system. Since the proposed development is a mix of different uses (research and design, office, academic, residential and supporting retail), the directional distributions for each trip type were considered separately.

4.4.1 Methodology

Trips generated by Carolina North can be divided into three categories: trips to the development, trips from the development, and trips within the development. Trips from outside the development arrive from locations within Chapel Hill and from the general Triangle Region. Trips made to and from the proposed project during the peak hours are expected to be predominantly home-to-work and work-to-home trips in the morning and evening peak hours, respectively, for employees and staff of the development. Trips related to the academic facilities at Carolina North will occur throughout day. The academic trips to and from the Carolina North facilities will typically occur between housing at Carolina North, academic facilities at Carolina North, and their counterparts at the main campus.

Two primary data sets were used to analyze the distribution of trips to and throughout the study area. The Triangle Regional travel forecasting model and existing University place of residence information. Each of these data sets was used to:

- Estimate the distribution of trips arriving from outside the study area (external) and from TAZs within the study area (internal)
- Estimate the distribution of trips between six external gateways (see Figure 4-4)
- Estimate the distribution of trips between each individual TAZ

Triangle Regional Travel Demand Model

The Triangle regional travel forecasting model (TRM) was used to estimate the percent of trips that will enter and exit Carolina North from six gateways and from individual TAZs in Chapel Hill and Carrboro home based work trips. The TRM was also used to determine the distribution of trips produced and attracted by individual TAZs within the Town of Chapel Hill and Carrboro. This distribution was based on the anticipated residential and employment densities of each TAZ under future conditions.

Based on anticipated Triangle Region residential and employment densities projected for the years 2015 and 2030 by the TRM, distribution percentages were assigned to each gateway using the commuter shed of the regional roadway network. After further evaluation of gateway distribution percentages, it was determined that the TRM underestimates the travel time between Gateways 3 and 4 and the site, particularly along NC 54. As such, travel time runs were conducted during the morning and evening peak

hours to determine the actual travel times from the same point on I-40 to the Carolina North site using several gateway access points and roadways. The results of these travel time runs are shown in Table 4-8 and indicate that the TRM underestimated travel time to and from Carolina North from three gateways in the AM peak period and PM peak.

- The TRM underestimated travel time from Gateway 4 to Carolina North by five to seven minutes in the PM peak period.
- The TRM underestimated travel time from Carolina North to Gateway 4 by 12 minutes in the PM peak period.

Table 4-8: Difference between Actual and Model Predicted Travel Times (min) through Gateway 4

Gateway	Travel Route	AM Peak Period		PM Peak Period	
		To Site	From Site	To Site	From Site
1	I-40, Martin Luther King, Jr. Blvd	4.42	0.85	2.42	0.98
3	I-40, 15-501, Estes Dr, Martin Luther King, Jr. Blvd	0.09	-1.04	3.14	2.32
4	NC-54, Raleigh Rd, Hillsborough, Rd, Martin Luther King, Jr. Blvd	2.33	3.84	7.16	12.05
4	NC 54, 15-501, Estes Dr, Martin Luther King, Jr. Blvd	4.28	4.53	5.22	12.17

Table 4-9 shows the actual travel times to and from Carolina North and the I-40/NC-54 interchange. The shortest travel time to and from Carolina North in the PM is via Gateway 1, with a travel time about half that of Gateway 4. During the AM peak period, the travel time differences are less pronounced, but Gateway 1 and Gateway 3 remain the fastest options for traveling to and from Carolina North.

Table 4-9: Actual Travel Times to/from Carolina North (min) through Gateway 4

Gateway	Travel Route	AM Peak Period		PM Peak Period	
		To Site	From Site	To Site	From Site
1	I-40, Martin Luther King, Jr. Blvd	13.72	10.02	12.40	11.02
3	I-40, 15-501, Estes Dr, Martin Luther King, Jr. Blvd	12.35	11.50	17.00	16.25
4	NC-54, Raleigh Rd, Hillsborough, Rd, Martin Luther King, Jr. Blvd	13.27	14.00	19.12	24.43
4	NC 54, 15-501, Estes Dr, Martin Luther King, Jr. Blvd	14.52	13.87	16.67	24.05

Based on the results of these travel time runs, the gateway distribution percentages were adjusted, assuming that more people will travel to and from Carolina North via Gateway 1 than Gateways 3 and 4. Table 4-10 provides the adjusted gateway distribution by constituent.

Table 4-10 Gateway Distribution

Gateway (Arrival)	Gateway Distribution		
	Employees	CN Residents	Commuter Students
1	35%	51%	45%
3	22%	32%	28%
4	8%	11%	10%
6	22%	3%	10%
7	4%	1%	3%
8	8%	1%	4%

Use of University Employee and Student Place of Residence Data

University data was used to determine trip distribution for commuter students. The University provided the number of commuter students that live in TAZs within the Triangle Region. These TAZs were geo-coded and the distribution of residents living inside and outside of the gateways was determined. Using the same methodology as described above, the distribution at the gateways was determined and adjusted for commuter students. The number of students living in each TAZ within the study area was used to determine the distribution of student residences throughout the study area.

University data was also used to determine the distribution patterns for medical employees. It was determined that residential patterns for employees of medical uses was similar to that of other employees; the only exception was that a higher percentage of medical use employees lived outside of the study area than inside the study area, 80 percent to 20 percent respectively. For other employees, these figures were 60 percent and 40 percent respectively. Table 4-11 provides the distribution of site generated trips originating from and destined to inside the study area versus originating from and destined to inside the study area by constituent group.

Table 4-11: Site Generated Trips Originating Inside Study Area versus Outside Study Area

Commuter Type	Originating/Destined Within Study Area (Internal)	Originating/Destined Outside Study Area (External)
General Employee	40%	60%
Medical Employee	20%	80%
Commuter Student	40%	60%
Carolina North Resident	65%	35%

Trip distribution to and from each gateway and individual TAZ to/from the Carolina North site was determined to distribute trips through study area intersections. To simplify the analysis, TAZs were grouped into seven districts within Chapel Hill and Carrboro. The gateways and districts are shown in Figure 4-4.

Figure 4-5, Figure 4-6, and Figure 4-7 provide the complied distribution patterns for employees, commuter students, and residents of the Carolina North site.

4.5 Project Trip Assignments and Build Scenario Peak Hour Volumes

The trip distributions were then used in combination with the projected trip generation rates for the 2015 (TIA Phase 1) and 2030 (TIA Phase 2) build scenarios to determine the site generated peak hour traffic volumes for the years 2015 (TIA Phase 1) and 2030 (TIA Phase 2). These site-generated peak hour volumes are illustrated in the Appendix. These volumes were then added to the 2015 (TIA Phase 1) and 2030 (TIA Phase 2) No-Build peak hour traffic volume networks to obtain the Build scenario peak hour traffic volumes for weekday AM, weekday midday, and weekday PM. These Build Scenario peak hour traffic volumes are presented graphically in Figure 4-8 to Figure 4-13.

4.6 Future Build Operations Analysis

4.6.1 2015 (TIA Phase 1) Build without Mitigation Scenario Intersection Analysis

The future lane geometry and the 2015 (TIA Phase 1) Build peak hour traffic volumes at the study area intersections were input into Synchro 7 software to conduct the year 2015 (TIA Phase 1) Build without Mitigation scenario traffic capacity analysis. It should be noted that no potential traffic mitigation measures associated with the Carolina North development were considered in this scenario, including signal timing changes. The Highway Capacity Manual (HCM) output reports generated by the Synchro 7 software were used for this analysis. The capacity analysis results for the intersections included in the 2015 (TIA Phase 1) study area are summarized within Table 4-12. The intersection Levels-of-Service (LOS) for the 2015 (TIA Phase 1) without Mitigation scenario is presented graphically in Figure 4-14.

When comparing the results for the 2015 (TIA Phase 1) Build without Mitigation scenario to the 2015 (TIA Phase 1) No-Build scenario, the following intersections were found to operate at overall LOS E or F and the overall LOS deteriorated due to traffic volumes generated by the Carolina North development:

- Martin Luther King, Jr. Boulevard (NC 86) & I-40 Eastbound Ramps – AM
- Martin Luther King, Jr. Boulevard (NC 86) & Weaver Dairy Road – AM
- Martin Luther King, Jr. Boulevard (NC 86) & Piney Mountain Road/Municipal Drive – AM
- Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive – AM, Midday & PM
- Estes Drive & Caswell Road – AM & PM
- Estes Drive & Franklin Street – Midday

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 – AM & PM

Table 4-12: 2015 (TIA Phase 1) Build Intersection Levels-of-Service (#1 to #52)

INT #	INTERSECTION	INTERSECTION CONTROL TYPE	APP	WEEKDAY AM PEAK HOUR			WEEKDAY MIDDAY PEAK HOUR			WEEKDAY PM PEAK HOUR		
				Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)
1	MLK Blvd (NC 86) & Whitfield Rd	Traffic Signal	WB	E	B	14.6	E	B	10.8	E	C	22.3
			NB	A			A			B		
			SB	A			A			A		
2	MLK Blvd (NC 86) & I-40 WB Ramps	Traffic Signal	WB	E	D	35.9	E	C	33.5	F	D	43.1
			NB	B			C			B		
			SB	D			C			D		
3	MLK Blvd (NC 86) & I-40 EB Ramps	Traffic Signal	EB	F	F	89.6	E	B	18.2	E	C	32.3
			NB	B			B			C		
			SB	A			A			B		
4	MLK Blvd (NC 86) & Eubanks Rd	Traffic Signal	EB	E	C	31.6	E	A	9.3	E	B	18.6
			NB	B			A			B		
			SB	D			A			A		
6	MLK Blvd (NC 86) & Weaver Dairy Rd	Traffic Signal	EB	E	E	56.5	E	D	42.0	E	F	105.2
			WB	F			E			F		
			NB	D			C			F		
			SB	D			D			C		
10	MLK Blvd (NC 86) & Piney Mountain Rd/ Municipal Dr	Traffic Signal	EB	E	E	67.5	E	B	17.9	E	C	32.2
			WB	E			E			E		
			NB	F			B			C		
			SB	A			A			B		
11	MLK Blvd (NC 86) & Estes Dr	Traffic Signal	EB	F	E	63.1	F	E	59.2	F	F	111.6
			WB	D			E			F		
			NB	C			C			F		
			SB	C			E			F		
12	MLK Blvd (NC 86) & Airport Dr	Stop Sign	EB	C	-	-	D	-	-	F	-	-
			NB	-			-			-		
			SB	-			-			-		
13	MLK Blvd (NC 86) & Hillsborough St/ Umstead Dr	Traffic Signal	EB	E	B	15.2	E	B	15.9	E	C	23.5
			WB	E			E			E		
			NB	B			A			B		
			SB	A			A			A		
14	Columbia St (NC 86) & Rosemary St	Traffic Signal	EB	C	D	40.7	C	C	33.1	D	D	52.0
			WB	C			C			D		
			NB	D			D			D		
			SB	E			D			D		
18	Columbia St (NC 86) & South Rd/ McCauley Street	Traffic Signal	EB	D	C	21.2	D	C	25.4	E	D	44.6
			WB	D			D			D		
			NB	A			A			D		
27	Homestead Rd & Rogers Rd	Stop Sign	EB	F	-	-	B	-	-	E	-	-
			NB	-			-			-		
			SB	-			-			-		
31	Estes Dr Ext & Airport Dr	Stop Sign	EB	-	-	-	-	-	-	-	-	-
			WB	-			-			-		
			NB	E			C			F		
32	Estes Dr Ext & Seawell School Rd	Traffic Signal	EB	A	B	11.9	A	A	9.5	A	C	32.0
			WB	B			B			E		
			SB	B			B			B		
35	NC 54 & Main St	Traffic Signal	EB	B	C	21.1	C	C	31.2	B	C	24.5
			WB	C			C			C		
			NB	C			D			D		
			SB	D			D			D		
37	Greensboro St & Weaver St	Traffic Signal	EB	C	C	26.1	B	D	42.4	B	D	53.2
			WB	C			E			D		
			NB	C			D			F		
			SB	C			C			D		
42	Estes Dr & Caswell Rd	Traffic Signal	EB	A	E	68.2	A	B	12.1	A	F	93.0
			WB	F			B			F		
			NB	B			B			B		
			SB	B			B			B		
43	Estes Dr & Franklin St	Traffic Signal	EB	D	D	42.2	F	E	56.9	F	F	134.2
			WB	D			D			E		
			NB	C			D			F		
			SB	D			D			F		

4.6.2 2015 (TIA Phase 1) Build without Mitigation Scenario Roadway Segment Analysis

In addition to intersection analysis, analysis of 21 roadway segments identified by the Town was also performed. The Town's *Guidelines for Traffic Impact Analysis* require that the roadway segments are analyzed based on a daily volume/capacity ratio where the threshold capacities are established by roadway classification. The results are posted in Table 4-13. When comparing the table to the 2015 (TIA Phase 1) No-Build scenario, the following additional roadway segments are projected to exceed a V/C of over 1.0 in the year 2015 Build without Mitigation scenario due to traffic generated by Carolina North:

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

All other roadway segments projected to operate at a V/C over 1.0 during the 2015 (TIA Phase 1) scenario were projected to operate at this level during the No-Build scenario, and are therefore not caused by traffic generated by the Carolina North development.

Table 4-13: 2015 (TIA Phase 1) Build Roadway Segment Capacity Analysis

ID	Roadway Section	Town Classification	V/C Ratio*			
			AM	Midday	PM	AADT
1	Martin Luther King, Jr. Blvd (NC 86) between Clyde Rd and Hilltop MHP	Major Arterial	0.38	0.26	0.49	
2	Eubanks Rd between Martin Luther King, Jr. Blvd (NC 86) and Northwood Dr	Collector				1.61
3	Martin Luther King, Jr. Blvd (NC 86) between Perkins Dr and Northwood Dr	Major Arterial	0.90	0.70	1.04	
4	Weaver Dairy Rd between Lonebrook Rd and Martin Luther King, Jr. Blvd (NC 86)	Minor Arterial	0.85	0.37	0.84	
5	Weaver Dairy Rd between Timberlyne Rd and Weatherstone Dr	Minor Arterial	1.25	1.00	1.26	
6	Seawell School Rd between Homestead Rd and Savannah Terrace	Collector				0.71
7	Homestead Rd between Martin Luther King, Jr. Blvd (NC 86) & Brookstone Dr	Minor Arterial	1.19	0.90	1.30	
8	Martin Luther King, Jr. Blvd (NC 86) between Dixie Ln and Homestead Rd	Major Arterial	0.96	0.73	1.07	
9	Seawell School Rd between Hanover Pl and Railroad Crossing	Collector				0.59
10	Estes Dr Ext between Seawell School Rd and Umstead Rd	Minor Arterial	1.61	1.03	1.65	
11	Estes Dr Ext between Martin Luther King, Jr. Blvd (NC 86) and UNC Driveway	Minor Arterial	1.38	1.03	1.48	
12	Martin Luther King, Jr. Blvd (NC 86) between Estes Dr and YMCA Driveway	Major Arterial	0.87	0.68	0.97	
13	Estes Dr between Halifax Rd and Granville Rd	Minor Arterial	1.37	1.39	1.87	
14	Martin Luther King, Jr. Blvd (NC 86) between Bolin Heights Rd and Longview St	Major Arterial	0.65	0.57	0.74	
15	Hillsborough St between North St and Rosemary St	Collector				1.30
16	Hillsborough St between Martin Luther King, Jr. Blvd (NC 86) and Bolinwood Dr	Collector				1.16
17	Martin Luther King, Jr. Blvd (NC 86) between Piney Mountain Rd and Estes Dr	Major Arterial	1.01	0.95	1.35	
18	Piney Mountain Rd between Timber Hollow Ct and Woodshire Ln	Collector				0.52
19	Piney Mountain Rd between Oosting Dr and Lake Ellen Dr	Collector				0.47
20	Kingston Dr between Balsam Ct and Kingston Ct	Collector				0.28
21	Homestead Rd between Hearthstone Ln and Seawell School Rd	Minor Arterial	1.62	0.75	1.35	

4.6.3 2030 (TIA Phase 2) Build without Mitigation Scenario Intersection Analysis

The future lane geometry and the 2030 (TIA Phase 2) Build peak hour traffic volumes at the study area intersections were input into Synchro 7 software to conduct the year 2030 (TIA Phase 2) Build without Mitigation scenario traffic capacity analysis. It should be noted that no potential traffic mitigation measures associated with the Carolina North development were considered in this scenario, including signal timing changes. The Highway Capacity Manual (HCM) output reports generated by the Synchro 7 software were used for this analysis. The capacity analysis results for the intersections included in the 2030(TIA Phase 2) study area are summarized within Table 4-15 to Table 4-17. The intersection Level-of-Service (LOS) for the 2030 (TIA Phase 2) without Mitigation scenario is presented graphically in Figure 4-15.

When comparing the results for the 2030 (TIA Phase 2) Build without Mitigation scenario to the 2030 (TIA Phase 2) No-Build scenario, the following intersections were found to operate at overall LOS E or F and the overall LOS deteriorated due to traffic volumes generated by the Carolina North development. 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 - PM
- Martin Luther King, Jr. Boulevard (NC 86) & I-40 Eastbound Ramps - PM
- Martin Luther King, Jr. Boulevard (NC 86) & Eubanks Road - AM
- Martin Luther King, Jr. Boulevard (NC 86) & Homestead Road - AM, Midday & PM
- Martin Luther King, Jr. Boulevard (NC 86) & Piney Mountain Road/Municipal Drive - AM, Midday & PM
- Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive - Midday
- Columbia Street (NC 86) & Rosemary Street - AM & Midday
- Pittsboro Street (NC 86) & McCauley Street - PM
- US 15-501 & Mount Carmel Church Road/Culbreth Road - PM
- Homestead Road/Dairyland Road & Old NC 86 - AM
- Estes Drive Extension & Seawell School Road - AM & PM
- Estes Drive Extension & Greensboro Street - AM & PM
- Greensboro Street & Weaver Street - AM & Midday
- Greensboro Street & Main Street - AM, Midday & PM
- Estes Drive & Caswell Road - AM & Midday
- Estes Drive & Franklin Street - AM
- Franklin Street & Ephesus Church Road - PM
- Franklin Street at Elliott Road - Midday
- Fordham Boulevard (US 15-501) & Sage Drive/Scarlet Drive - Midday
- Fordham Boulevard (US 15-501) & Eastowne Drive/BCBS Drive - AM
- Fordham Boulevard (US 15-501) & Eastowne Drive/Lakeview Drive - AM
- Fordham Boulevard (US 15-501) & I-40 Eastbound Ramps - PM
- Fordham Boulevard (US 15-501) & I-40 Westbound Ramps - AM & Midday

The following two-way STOP controlled intersections were 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:

- Martin Luther King, Jr. Boulevard (NC 86) & Airport Drive - AM
- Homestead Road and Weaver Dairy Road - Midday
- Estes Drive Extension & Airport Drive - AM

Screen Line Analysis – Martin Luther King Jr. Boulevard (NC 86) and Estes Drive

As requested by the Town, a screen-line analysis was performed surrounding on all four approaches surrounding the intersection of Martin Luther King, Jr. Boulevard (NC 86) & Estes Drive in order to determine the traffic volume changes by analysis scenario. The analysis is presented in Table 4-14 which presents the traffic contribution by existing traffic, background growth, other developments, and Carolina North.

Table 4-14: Screen Line Analysis at Martin Luther King, Jr. Boulevard & Estes Drive

		MARTIN LUTHER KING, JR. BOULEVARD			
		NORTH OF ESTES DRIVE		SOUTH OF ESTES DRIVE	
		2015 Build	2030 Build	2015 Build	2030 Build
AM Peak Hour	Existing Traffic	2,243	2,243	1,668	1,668
	Background Growth	283	798	210	593
	Other Developments	193	193	155	155
	Carolina North	350	206	92	416
PM Peak Hour	Existing Traffic	2,756	2,756	2,132	2,132
	Background Growth	348	981	268	758
	Other Developments	343	343	275	275
	Carolina North	435	229	115	456
		ESTES DRIVE			
		EAST OF MARTIN LUTHER KING, JR. BLOULEVARD		WEST OF MARTIN LUTHER KING, JR. BLOULEVARD	
		2015 Build	2030 Build	2015 Build	2030 Build
AM Peak Hour	Existing Traffic	1,141	1,141	926	926
	Background Growth	144	407	115	330
	Other Developments	48	48	8	8
	Carolina North	150	598	107	392
PM Peak Hour	Existing Traffic	1,473	1,473	1,207	1,207
	Background Growth	186	524	152	429
	Other Developments	82	82	12	12
	Carolina North	189	761	131	532

Figure 4-16: 2015 (TIA Phase 1) Screen-Line Analysis - AM Peak Hour

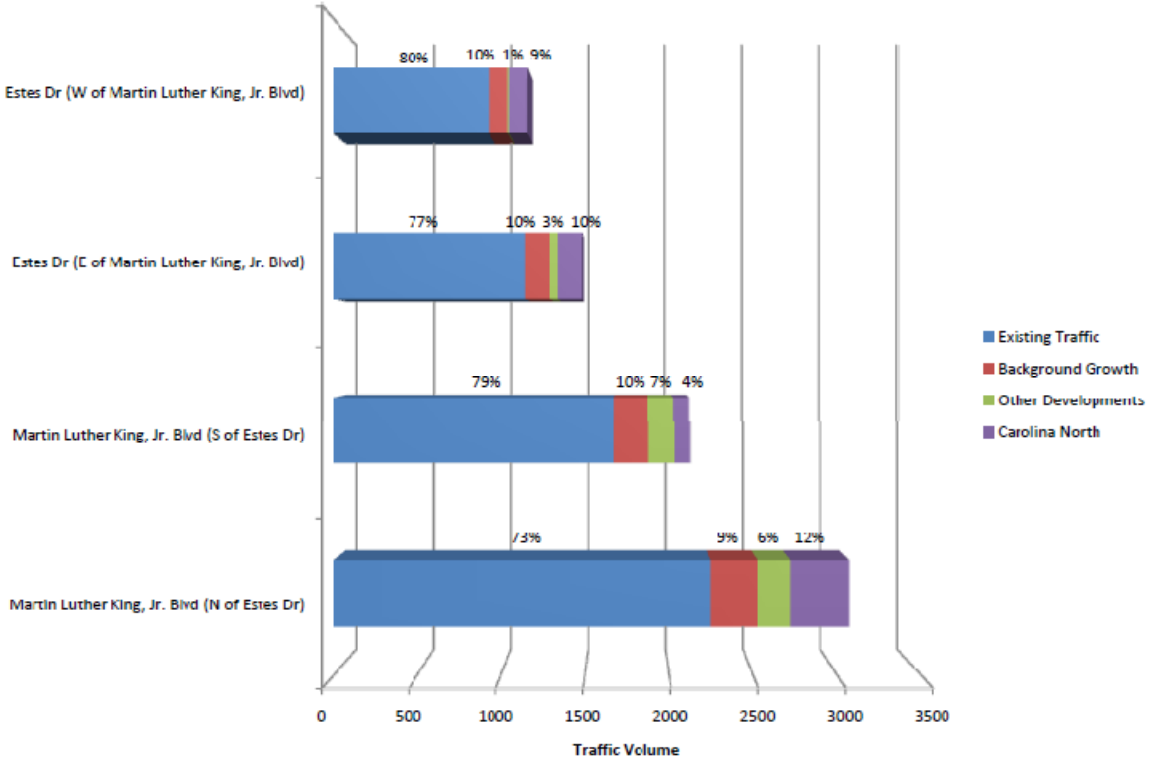


Figure 4-17: 2015 (TIA Phase 1) Screen-Line Analysis - PM Peak Hour

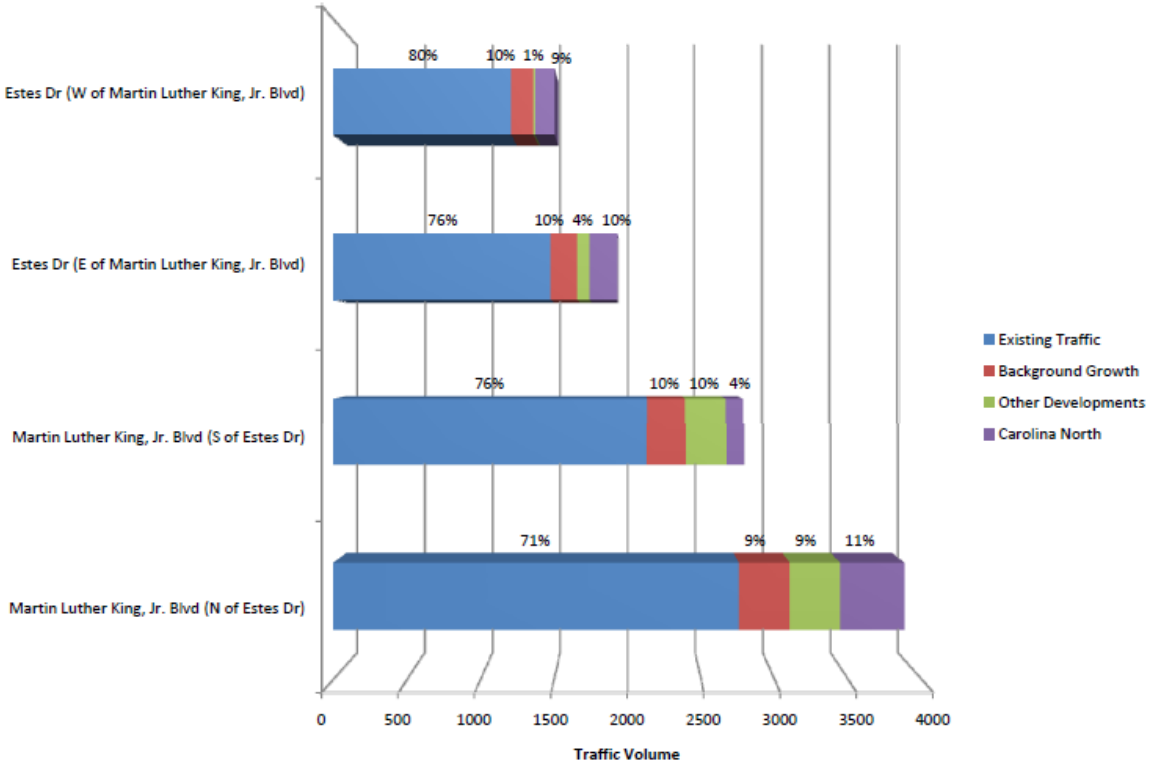


Figure 4-18: 2030 (TIA Phase 2) Screen-Line Analysis - AM Peak Hour

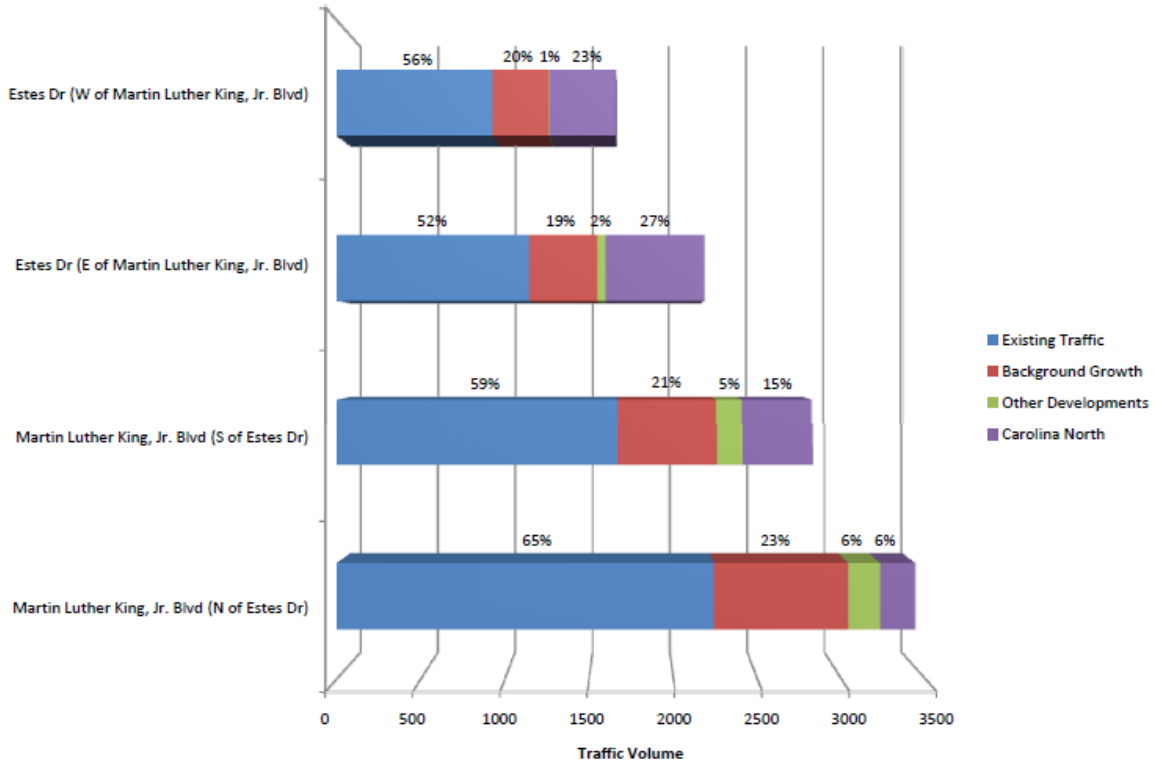


Figure 4-19: 2030 (TIA Phase 2) Screen-Line Analysis - PM Peak Hour

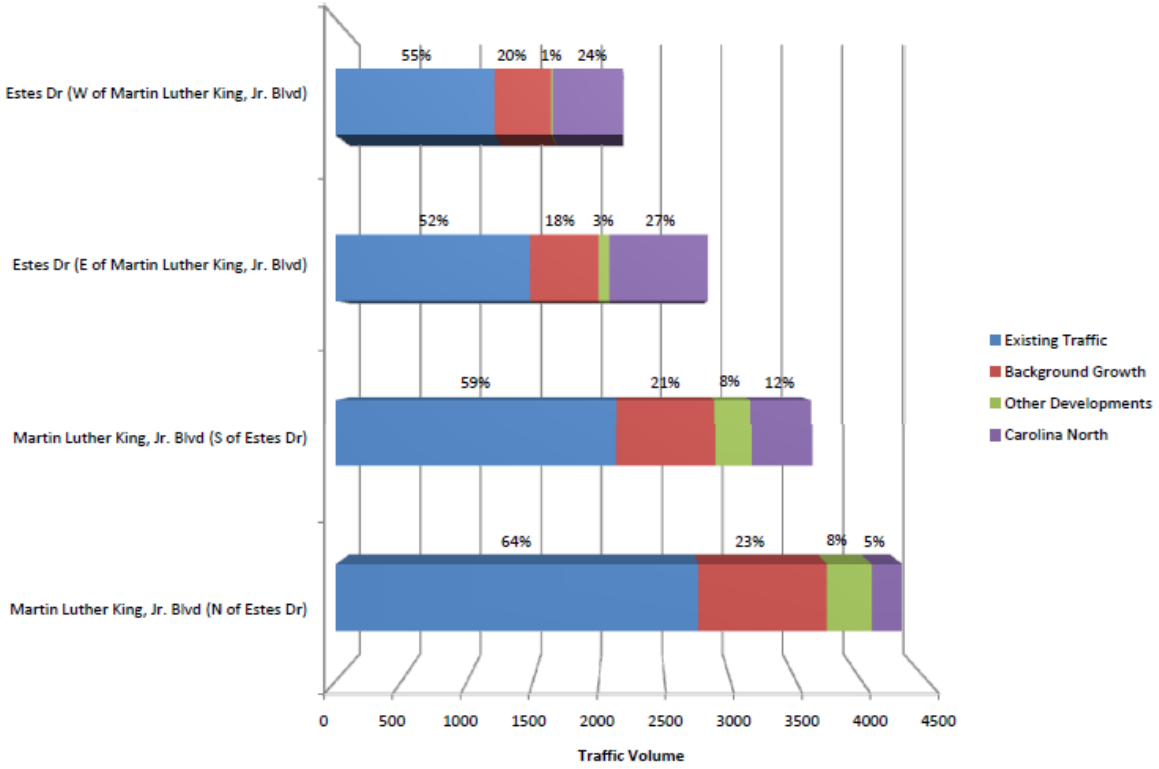


Table 4-15: 2030 (TIA Phase 2) Build Intersection Levels-of-Service (#1 to #18)

INT #	INTERSECTION	INTERSECTION CONTROL TYPE	APP	WEEKDAY AM PEAK HOUR			WEEKDAY MIDDAY PEAK HOUR			WEEKDAY PM PEAK HOUR		
				Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)
1	MLK Blvd (NC 86) & Whitfield Rd	Traffic Signal	WB	E	B	14.0	E	A	9.7	E	E	76.9
			NB	A			A			F		
			SB	A			A			B		
2	MLK Blvd (NC 86) & I-40 WB Ramps	Traffic Signal	WB	F	D	49.5	E	C	33.9	F	E	63.1
			NB	B			C			B		
			SB	D			C			D		
3	MLK Blvd (NC 86) & I-40 EB Ramps	Traffic Signal	EB	F	F	151.6	E	B	16.7	F	F	105.7
			NB	B			B			F		
			SB	A			A			C		
4	MLK Blvd (NC 86) & Eubanks Rd	Traffic Signal	EB	E	F	105.6	E	B	17.4	F	D	53.1
			NB	B			A			C		
			SB	F			B			B		
5	MLK Blvd (NC 86) & Perkins Dr	Traffic Signal	WB	E	B	15.8	E	B	20.0	E	C	28.2
			NB	A			A			B		
			SB	B			C			C		
6	MLK Blvd (NC 86) & Weaver Dairy Rd	Traffic Signal	EB	E	F	169.5	E	D	51.6	E	F	184.6
			WB	F			F			F		
			NB	E			D			F		
			SB	F			C			F		
7	MLK Blvd (NC 86) & Westminster Dr	Traffic Signal	WB	E	B	12.3	E	A	6.9	F	C	20.2
			NB	A			A			C		
			SB	A			A			A		
8	MLK Blvd (NC 86) & Homestead Rd	Traffic Signal	EB	D	F	84.5	D	F	94.4	D	F	98.4
			WB	E			E			E		
			NB	B			C			D		
			SB	F			F			F		
9	MLK Blvd (NC 86) & Northfield Dr	Traffic Signal	EB	E	B	12.5	E	A	6.5	E	C	23.6
			NB	A			A			C		
			SB	B			A			C		
10	MLK Blvd (NC 86) & Piney Mountain Rd/ Municipal Dr	Traffic Signal	EB	E	F	113.0	E	E	72.6	F	F	106.2
			WB	E			E			E		
			NB	F			F			F		
			SB	F			C			C		
11	MLK Blvd (NC 86) & Estes Dr	Traffic Signal	EB	F	F	157.0	F	F	193.2	F	F	226.5
			WB	F			F			F		
			NB	D			C			F		
			SB	D			F			F		
12	MLK Blvd (NC 86) & Airport Dr	Stop Sign	EB	F	-	-	F	-	-	F	-	-
			NB	-						-		
			SB	-						-		
13	MLK Blvd (NC 86) & Hillsborough St/ Umstead Dr	Traffic Signal	EB	E	C	21.8	E	B	18.8	D	C	33.7
			WB	E			E			F		
			NB	C			B			C		
			SB	A			A			B		
14	Columbia St (NC 86) & Rosemary St	Traffic Signal	EB	C	E	64.3	C	E	56.6	F	F	134.3
			WB	C			C			F		
			NB	D			E			F		
			SB	F			E			F		
15	Columbia St (NC 86) & Franklin St	Traffic Signal	EB	D	D	47.7	E	E	64.7	E	F	123.7
			WB	D			D			D		
			NB	E			F			F		
			SB	D			D			F		
16	Columbia St (NC 86) & Cameron Ave	Traffic Signal	EB	C	F	138.0	C	F	209.6	C	F	303.9
			WB	C			C			D		
			NB	F			F			F		
			SB	F			F			F		
18	Columbia St (NC 86) & South Rd/ McCauley Street	Traffic Signal	EB	D	C	21.8	D	C	27.0	E	D	53.8
			WB	D			D			E		
			NB	A			B			D		

Table 4-16: 2030 (TIA Phase 2) Build Intersection Levels-of-Service (#19 to #36)

INT #	INTERSECTION	INTERSECTION CONTROL TYPE	APP	WEEKDAY AM PEAK HOUR			WEEKDAY MIDDAY PEAK HOUR			WEEKDAY PM PEAK HOUR		
				Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)
19	Pittsboro St (NC 86) & McCauley St	Traffic Signal	EB	C	C	33.3	C	C	22.7	C	E	55.2
			WB	D			D			E		
			SB	C			B			E		
20	Columbia St (NC 86) & Manning Dr/ Pittsboro St	Traffic Signal	EB	D	C	32.5	E	C	28.1	D	C	33.6
			WB	A			C			C		
			NB	C			B			D		
21	Columbia St (NC 86) & Mason Farm Rd/ Westwood Dr	Traffic Signal	EB	C	E	79.9	C	C	30.5	C	F	202.8
			WB	C			C			F		
			NB	F			D			F		
			SB	C			B			F		
22	Columbia St (NC 86) & Fordham Blvd (NC 54) WB Ramps	Traffic Signal	WB	E	C	20.4	E	C	26.0	F	F	108.4
			NB	A			A			D		
			SB	B			B			F		
23	Columbia St (US 15-501) & Fordham Blvd (NC 54) EB Ramps	Traffic Signal	EB	D	C	32.0	D	C	21.0	F	D	42.3
			NB	D			C			C		
			SB	A			A			C		
24	Columbia St (US 15-501) & Mt Carmel Church Rd / Culbreth Rd	Traffic Signal	EB	F	F	172.5	D	C	26.6	D	E	59.0
			WB	F			D			D		
			NB	F			C			F		
			SB	A			B			D		
25	Homestead Rd & Weaver Dairy Rd	Stop Sign	EB	-	-	-		-	-	-	-	-
			WB	-						-		
			SB	F			E			F		
26	Homestead Rd & Seawell School Rd	Traffic Signal	EB	F	F	215.9	B	A	8.6	E	C	23.8
			WB	C			A			A		
			NB	B			B			B		
27	Homestead Rd & Rogers Rd	Stop Sign	EB	F	-	-	C	-	-	F	-	-
			NB	-						-		
			SB	-						-		
28	Homestead Rd & High School Rd	Traffic Signal	WB	B	F	197.1	B	B	10.2	B	A	9.6
			NB	F			B			B		
			SB	A			A			A		
29	Homestead Rd/ Dairyland Rd & Old NC 86	Traffic Signal	EB	F	F	87.2	C	B	18.5	C	D	38.3
			WB	B			B			B		
			NB	C			B			B		
			SB	F			B			F		
31	Estes Dr Ext & Airport Dr	Stop Sign/ Traffic Signal	EB	F	F	309.5	F	F	261.5	F	F	385.7
			WB	B			C			F		
			NB	F			D			E		
			SB	F			F			F		
32	Estes Dr Ext & Seawell School Rd	Traffic Signal	EB	F	F	92.3	A	C	32.2	A	F	200.4
			WB	B			E			F		
			SB	B			B			C		
33	Estes Dr Ext & Greensboro St	Traffic Signal	WB	F	E	57.4	A	D	42.1	B	F	83.1
			NB	C			B			B		
			SB	D			F			F		
35	NC 54 & Main St	Traffic Signal	EB	C	C	34.0	C	C	34.0	B	C	30.2
			WB	C			C			C		
			NB	C			D			D		
			SB	F			D			D		

Table 4-17: 2030 (TIA Phase 2) Build Intersection Levels-of-Service (#37 to #52)

INT #	INTERSECTION	INTERSECTION CONTROL TYPE	APP	WEEKDAY AM PEAK HOUR			WEEKDAY MIDDAY PEAK HOUR			WEEKDAY PM PEAK HOUR		
				Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)	Approach LOS	Overall LOS	Overall Delay (s)
37	Greensboro St & Weaver St	Traffic Signal	EB	C	E	78.8	C	F	115.6	C	F	150.4
			WB	D			F			E		
			NB	F			F			F		
			SB	D			E			F		
38	Greensboro St & Main St	Traffic Signal	EB	C	F	83.7	C	E	64.5	D	F	114.8
			WB	C			B			C		
			NB	D			C			D		
			SB	F			F			F		
39	Greensboro St & Merritt Mill Rd/ NC 54 WB Ramp	Traffic Signal	WB	D	B	14.8	B	B	10.8	C	D	43.2
			NB	A			A			C		
			SB	A			B			E		
42	Estes Dr & Caswell Rd	Traffic Signal	EB	C	F	295.4	B	F	89.8	E	F	302.3
			WB	F			F			F		
			NB	B			B			B		
			SB	B			B			B		
43	Estes Dr & Franklin St	Traffic Signal	EB	F	F	135.2	F	F	166.7	F	F	305.2
			WB	E			F			F		
			NB	D			F			F		
			SB	F			F			F		
44	Franklin St & Elliott Rd	Traffic Signal	EB	C	D	40.2	F	F	84.5	F	F	170.4
			WB	D			D			E		
			NB	D			F			F		
			SB	D			D			D		
45	Franklin St & Ephesus Church Rd	Traffic Signal	EB	A	B	13.0	B	D	41.0	E	E	64.4
			WB	B			B			B		
			NB	D			F			F		
46	Fordham Blvd (US 15-501) & Erwin Rd/Europa Dr	Traffic Signal (Super Street)	EB	A	C	21.2	A	B	18.2	A	C	23.6
			WB	B			A			B		
			NB	F			F			F		
			SB	E			E			E		
	US 15-501 & South U-Turn	Traffic Signal (Super Street)	EB	C	C	29.4	F	F	111.3	F	F	307.6
			SB	D			D			D		
	US 15-501 & North U-Turn	Traffic Signal (Super Street)	WB	D	D	47.9	C	C	30.6	F	F	130.8
			NB	F			F			E		
47	Fordham Blvd (US 15-501) & Sage Rd/Scarlet Dr	Traffic Signal	EB	D	F	122.3	E	F	110.8	F	F	196.4
			WB	F			F			F		
			NB	F			F			F		
			SB	E			E			E		
48	Fordham Blvd (US 15-501) & Eastowne Dr/BSBC Dr	Traffic Signal	EB	C	E	72.8	D	D	40.1	F	F	123.3
			WB	F			C			E		
			NB	E			E			E		
			SB	F			F			F		
49	Fordham Blvd (US 15-501) & Eastowne Dr/ Lakeview Dr	Traffic Signal	EB	E	F	88.9	C	D	36.8	D	F	165.7
			WB	E			C			D		
			NB	E			E			E		
			SB	F			F			F		
50	Fordham Blvd (US 15-501) & I-40 EB Ramps	Traffic Signal	EB	E	D	42.7	C	C	23.0	F	F	88.2
			WB	B			A			D		
			SB	E			E			E		
51	Fordham Blvd (US 15-501) & I-40 WB Ramps	Traffic Signal	EB	C	F	99.8	C	F	88.1	F	F	153.4
			WB	F			F			F		
			NB	E			D			D		
52	Weaver Dairy Rd & Kingston Dr/ McClamroch Cir	Traffic Signal	EB	B	B	12.2	A	A	7.4	B	C	27.3
			WB	A			A			D		
			NB	B			B			B		
			SB	B			B			B		

4.6.4 2030 (TIA Phase 2) Build without Mitigation Scenario Roadway Segment Analysis

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. The results are posted in Table 4-18. 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 due to traffic generated by Carolina North. 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, and are therefore not caused by traffic generated by the Carolina North development.

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

Table 4-18: 2030 (TIA Phase 2) Build Roadway Segment Capacity Analysis

ID	Roadway Section	Town Classification	V/C Ratio*			
			AM	Midday	PM	AADT
1	Martin Luther King, Jr. Blvd (NC 86) between Clyde Rd and Hilltop MHP	Major Arterial	0.70	0.45	0.79	
2	Eubanks Rd between Martin Luther King, Jr. Blvd (NC 86) and Northwood Dr	Collector				2.44
3	Martin Luther King, Jr. Blvd (NC 86) between Perkins Dr and Northwood Dr	Major Arterial	1.27	0.95	1.35	
4	Weaver Dairy Rd between Lonebrook Rd and Martin Luther King, Jr. Blvd (NC 86)	Minor Arterial	1.02	0.44	0.99	
5	Weaver Dairy Rd between Timberlyne Rd and Weatherstone Dr	Minor Arterial	1.49	1.18	1.50	
6	Seawell School Rd between Homestead Rd and Savannah Terrace	Collector				0.85
7	Homestead Rd between Martin Luther King, Jr. Blvd (NC 86) & Brookstone Dr	Minor Arterial	1.58	1.19	1.68	
8	Martin Luther King, Jr. Blvd (NC 86) between Dixie Ln and Homestead Rd	Major Arterial	1.36	1.01	1.46	
9	Seawell School Rd between Hanover Pl and Railroad Crossing	Collector				0.72
10	Estes Dr Ext between Seawell School Rd and Umstead Rd	Minor Arterial	2.08	1.65	2.21	
11	Estes Dr Ext between Martin Luther King, Jr. Blvd (NC 86) and UNC Driveway	Minor Arterial	1.61	1.49	2.29	
12	Martin Luther King, Jr. Blvd (NC 86) between Estes Dr and YMCA Driveway	Major Arterial	1.09	0.80	1.14	
13	Estes Dr between Halifax Rd and Granville Rd	Minor Arterial	2.07	2.22	2.56	
14	Martin Luther King, Jr. Blvd (NC 86) between Bolin Heights Rd and Longview St	Major Arterial	0.81	0.76	0.93	
15	Hillsborough St between North St and Rosemary St	Collector				1.57
16	Hillsborough St between Martin Luther King, Jr. Blvd (NC 86) and Bolinwood Dr	Collector				1.41
17	Martin Luther King, Jr. Blvd (NC 86) between Piney Mountain Rd and Estes Dr	Major Arterial	1.24	1.06	1.56	
18	Piney Mountain Rd between Timber Hollow Ct and Woodshire Ln	Collector				0.66
19	Piney Mountain Rd between Oosting Dr and Lake Ellen Dr	Collector				0.60
20	Kingston Dr between Balsam Ct and Kingston Ct	Collector				0.31
21	Homestead Rd between Hearthstone Ln and Seawell School Rd	Minor Arterial	2.10	1.00	1.73	

4.7 Transit Impacts

The Carolina North project will be heavily dependent upon transit service for commuters and for residents of Carolina North. Among the questions answered by the analyses in this section of the report are:

- What elements of the Carolina North transit demand can be met by the existing transit system?
- What enhanced or new transit services are needed to accommodate all elements of the Carolina North transit demand?
- Will Carolina North transit riders displace other Chapel Hill transit users due to capacity constraints anywhere in the transit system?

The following transit discussion presents summary findings focused on transit capacity for bus route segments near the Carolina North site. It should be noted that for the purpose of this analysis, the maximum acceptable volume to capacity threshold was assumed to be 0.8. In addition, 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.

4.7.1 2015 (TIA Phase 1) Transit Impacts

The 2015 (TIA Phase 1) No-Build condition for transit has significant excess capacity to and from the Carolina North site. Inbound available capacity is 928 passengers during the morning peak hour and outbound available capacity is 566 passengers in the evening peak hour. Midday capacity between the Carolina North site and downtown is 459 inbound to the Carolina North site and 507 outbound from the Carolina North site.

The 2015 (TIA Phase 1) development program will add 246 transit trips during the morning peak hour, 178 during the midday peak hour, and 244 during the evening peak hour. Table 4-19 shows the available transit capacity on the routes serving Carolina North for the 2015 conditions with the proposed Phase One development program in place. After adding the transit trips associated with the project, there remains significant capacity among the transit routes serving the Carolina North site. 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.

There is sufficient capacity on all individual routes during the morning, midday, and evening peak hours.

4.7.2 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 906 passengers during the morning peak hour and outbound available capacity is 488 passengers in the evening peak hour. Midday capacity between the Carolina North site and downtown is 414 inbound to the Carolina North site and 461 outbound from the Carolina North site.

The 2030 (TIA Phase 2) Carolina North development will add over 800 transit trips to the baseline condition during the morning peak hour, almost 600 during the midday peak hour, and nearly 800 during the evening peak hour. Table 4-19 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. 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 following capacity deficits exist:

- Overcapacity by 223 passengers during the morning peak hour approaching Carolina North in the southbound direction.
- Overcapacity by 25 passengers during the midday peak hour approaching Carolina North in the northbound direction.
- Overcapacity by 88 passengers during the midday peak hour departing Carolina North in the northbound direction.
- 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 slightly 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 4-19 shows a comparison of the available capacity both departing and approaching the Carolina North development between the 2009 Existing, 2015 No-Build, 2015 Build, 2030 No-Build, and 2030 Build conditions. Routes exceeding available capacity are shaded.

Table 4-19: Available Capacity APPROACHING and DEPARTING Carolina North Comparison

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.

4.7.3 Park-and-Ride Space Needs

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 4-20. 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.

As previously stated, the completion of the Main Campus Development Plan includes additional parking structures that will free up park-and-ride spaces that are now occupied by Main Campus employees. The availability of additional park-and-ride spaces could potentially offset the future demand from Carolina North for more spaces. Moreover, the potential need for additional buses, many of which are specifically to serve the increased park-and-ride use, could also be correspondingly reduced. Given the uncertainty of the timing of future projects on the Main Campus and at Carolina North, the availability and need for more park-and-ride spaces should be continually monitored before additional facilities are built or buses to serve them are purchased.

Table 4-20: 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.

4.8 Pedestrian and Bicycle Analysis

The pedestrian and bicycle facilities were reevaluated based on the projected increase in traffic volumes from the Carolina North development area using the Pedestrian LOS and Bicycle LOS calculations as outline in Section 2.3.3 and Section 2.4.3, respectively. For purposes of this analysis, it was assumed that the existing roadway and sidewalk conditions would remain unchanged. The Pedestrian LOS results under the 2015 Build conditions are shown in Figure 4-20 while the 2030 Build conditions are shown in Figure 4-21. The Bicycle LOS results under the 2015 Build conditions are shown in Figure 4-22 while the 2030 Build Conditions are shown in Figure 4-23.

As previously stated, these are recently developed methodologies that have not been adopted by the Town of Chapel, but are methodologies that are being applied in other localities. They are used in this study solely to identify locations that may require improvements to provide a high pedestrian and bicycle 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 and 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.

In addition to the segments identified under the 2009 Existing and 2015 No-Build conditions, the Pedestrian LOS analysis has revealed that the following roadway segments are anticipated to deteriorate from LOS D or better to operate at LOS E or LOS F under the 2015 Build conditions:

- West side of Martin Luther King, Jr. Boulevard to the south of Homestead Drive
- South side of Estes Drive to the east of Martin Luther King, Jr. Boulevard
- North and south sides of Municipal Drive to the east of Martin Luther King, Jr. Boulevard

In addition to the segments identified under the previous conditions, the Pedestrian LOS analysis has revealed that the following roadway segments are anticipated to deteriorate from LOS D or better to operate at LOS E or LOS F under the 2030 Build conditions:

- East side of Martin Luther King, Jr. Boulevard to the north of Hillsborough Street
- West side of Martin Luther King, Jr. Boulevard north and south of Northfield Drive and between Airport Drive and Hillsborough Street
- South side of Rosemary Street to the west of Columbia Street
- North side of Airport Drive to the west of Martin Luther King, Jr. Boulevard

- North side of Homestead Road to the west of Martin Luther King, Jr. Boulevard

In addition to the segments identified under the 2009 Existing and 2015 No-Build conditions, the Bicycle LOS analysis has revealed that the following roadway segments are anticipated to deteriorate from LOS D or better to operate at LOS E or LOS F under the 2015 Build conditions:

- West side of Martin Luther King, Jr. Boulevard to the south of Piney Mountain Road and between Hillsborough Street and Rosemary Street
- South side of Estes Drive to the east of Martin Luther King, Jr. Boulevard
- South side of Municipal Drive to the west of Martin Luther King, Jr. Boulevard
- South side of Homestead Road to the west of Weaver Dairy Road
- West side of Seawell School Road between High School Road and Estes Drive

In addition to the segments identified under the previous conditions, the Bicycle LOS analysis has revealed that the following roadway segments are anticipated to deteriorate from LOS D or better to operate at LOS E or LOS F under the 2030 Build conditions:

- East side of Martin Luther King, Jr. Boulevard to the north of Hillsborough Street
- North side of Estes Drive to the east of Martin Luther King, Jr. Boulevard
- South side of Homestead Road to the east of Weaver Dairy Road

As stated earlier in the report, a poor LOS under this methodology does not imply that pedestrians or bicyclists will be unable to travel along these particular segments. This analysis merely identifies locations where these users will feel less comfortable during peak vehicular traffic periods and that upgrades to pedestrian and bicycle accommodations at these points would be warranted and provide a measurable benefit.

4.9 Parking Supply Sensitivity Analysis

This section of the study evaluates the effects of modifying parking supply assumptions on traffic and transit operations. The prior sections of this report present traffic and transit analyses based on an assumed parking component for each of the two phases of the Carolina North development plan. For the parking supply sensitivity analysis, two additional trip generation scenarios are developed for both the 2015 (TIA Phase 1) Carolina North program and the 2030 (TIA Phase 2) Carolina North program.

4.9.1 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 equivalent to those on the University's main campus, as described earlier in the trip generation section.

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 parking assumptions for the two 2015 (TIA Phase 1) parking sensitivity scenarios are shown in Table 4-21.

- 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.

Table 4-21: 2015 (TIA Phase 1) Parking Sensitivity Scenarios

Land Use	Size	Early Phase Ratios		Baseline University Main Campus Ratios		Constrained Ratios (-10%)	
		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**

Parking Sensitivity Scenarios Trip Generation

Table 4-22 and Table 4-23 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 4-21.

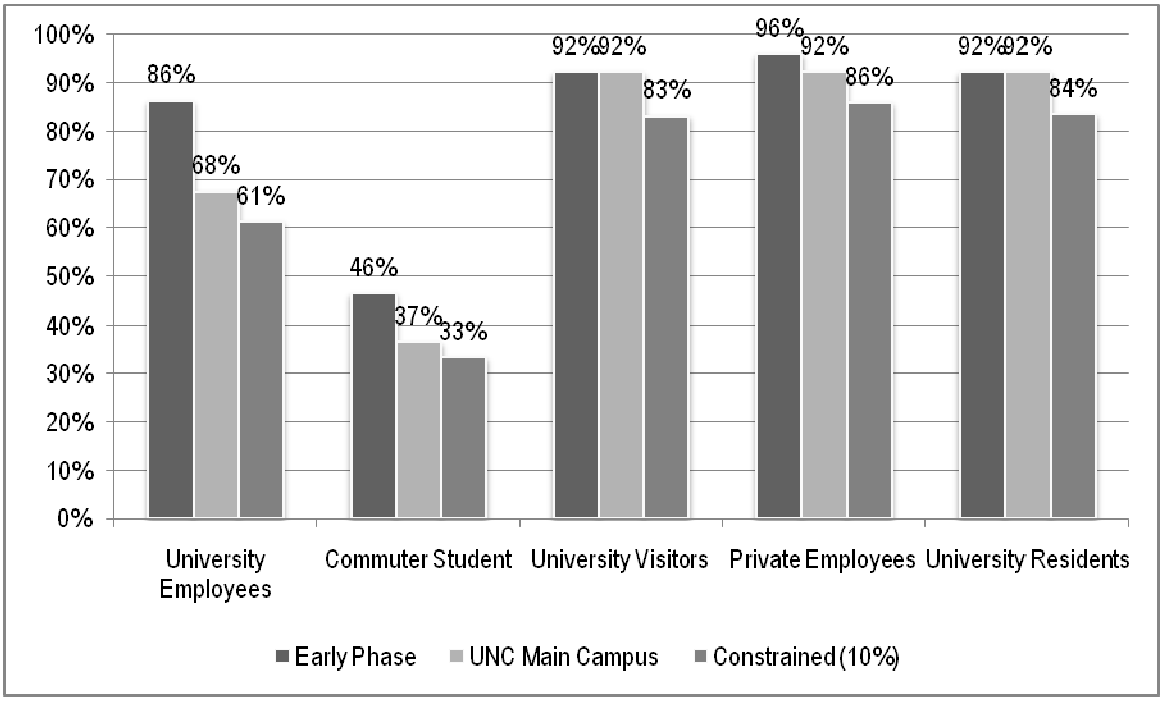
Table 4-22: Trip Generation for 2015 (TIA Phase 1) Early Phase Parking Scenario

		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 4-23: Trip Generation for 2015 (TIA Phase 1) Constrained (-10%) Parking 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 4-24: 2015 (TIA Phase 1) Auto Mode Shift Due to Changes in Parking Ratio



Transit Trip Generation

The parking scenarios affect vehicle trips within Chapel Hill as well as trips external to Chapel Hill. For the assessment of the 2015 (TIA Phase 1) parking sensitivity scenarios, the trip distribution assumptions used for the baseline traffic analyses are used to allocate the vehicle trips among internal and external trips. For the evaluation of transit impacts, changes in external vehicle trips affect park-and-ride utilization. That is, every external trip that is displaced by parking supply reductions is re-directed to park-and-ride. Changes in internal vehicle trips affect the use of local transit, as well as walking, biking and carpooling mode choices. For this evaluation half of all internal vehicle trip changes are assumed to affect the utilization of local transit.

Table 4-24 and Table 4-25 list the changes in transit trips for local bus trips and for boardings and alightings at park-and-ride locations, compared to those for the baseline parking scenario. The "In" trips reference trips destined for Carolina North. "Out" trips reference those departing Carolina North. The changes in transit trips for the Early Phase Parking scenario are negative since the additional parking supply will draw people away from transit and park-and-ride and they will instead drive to the campus.

Table 4-24: Change in Transit Trips for 2015 (TIA Phase 1) Early Phase Parking Scenario

		AM Peak Hour			Midday Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total	In	Out	Total
Local Bus Trips	(170)	(17)	(3)	(20)	(13)	(9)	(22)	(8)	(15)	(23)
Park-and-Ride Shuttle Trips	(509)	(50)	(9)	(59)	(10)	(15)	(25)	(25)	(44)	(69)

Table 4-25: Change in Transit Trips for 2015 (TIA Phase 1) Constrained (-10%) Parking Scenario

		AM Peak Hour			Midday Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total	In	Out	Total
Local Bus Trips	116	9	3	12	8	6	14	6	9	15
Park-and-Ride Shuttle Trips	314	27	7	34	6	9	15	16	25	41

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.

2015 (TIA Phase 1) Headway and Fleet Sensitivity Scenarios

Table 4-26 shows the headway required to operate each route in the Base, "Early Phase", and "Constrained Parking" scenarios, if existing vehicle capacities are maintained. There are no changes in headways or the number of vehicles required during the peak hour.

Table 4-26: 2015 (TIA Phase 1) Parking Sensitivity Transit Impact

	Headway (min)			Vehicles		
Route	Base	Early Phase	-10% Parking	Base	Early Phase	-10% Parking
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	20	20	20	3	3	3
Total				**21**	**21**	**21**

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% 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.

4.9.2 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 5,835 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. These ratios are the same as current parking space ratios at the University main campus.

The two parking sensitivity scenarios both have a lower supply of parking spaces. The parking assumptions for the two parking sensitivity scenarios are shown in Table 4-27.

- 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.

Table 4-27: 2030 (TIA Phase 2) Parking Sensitivity Scenarios

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)	70,000 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**

Parking Sensitivity Scenarios Trip Generation

Table 4-28 and Table 4-29 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 4-27.

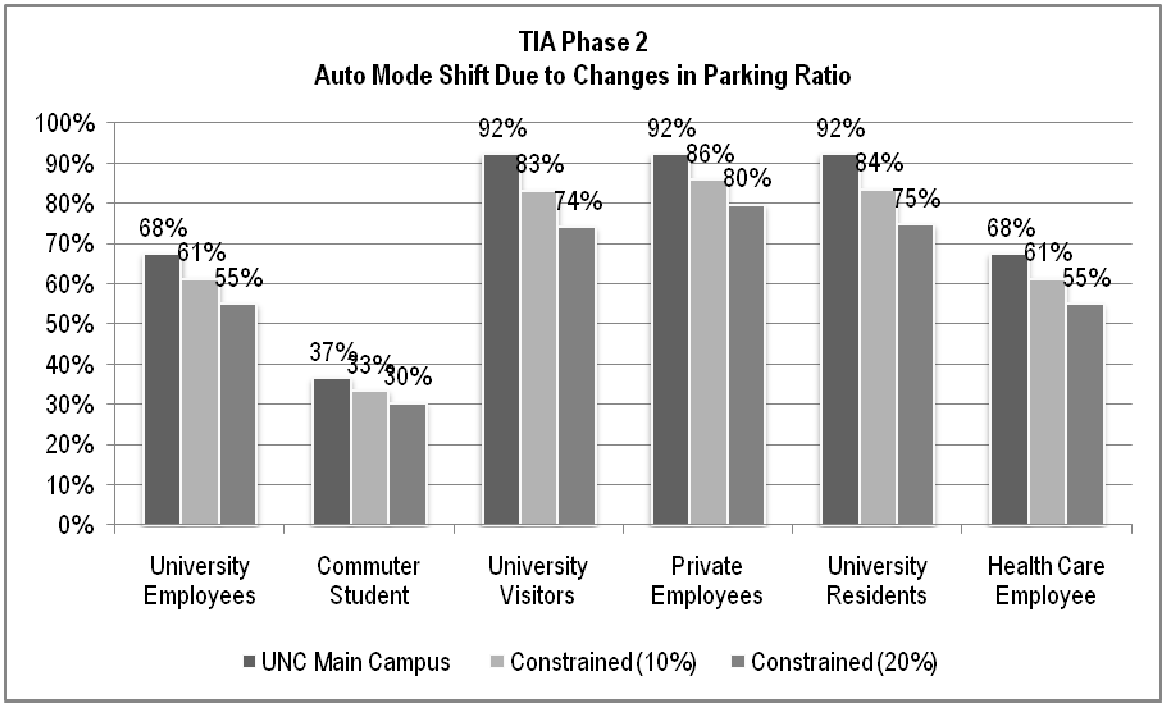
Table 4-28: Trip Generation for 2030 (TIA Phase 2) Constrained (-10%) Parking Scenario

		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 4-29: Trip Generation for 2030 (TIA Phase 2) Constrained (-20%) Parking 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 4-25: 2030 (TIA Phase 2) Auto Mode Shift Due to Changes in Parking Ratio



Transit Trips for 2030 (TIA Phase 2) Parking Sensitivity Scenarios

As with the evaluation of transit impacts of the 2015 (TIA Phase 1) parking sensitivity scenarios, changes in external vehicle trips for the 2030 (TIA Phase 2) parking sensitivity scenarios are assumed to affect park-and-ride utilization on a 1:1 basis. Changes in internal vehicle trips affect the use of local transit, as well as walking, biking and carpooling mode choices. Half of all internal vehicle trip changes are assumed to affect the utilization of local transit.

Table 4-30 and Table 4-31 list the changes in transit trips for local bus trips and for boardings and alightings at park-and-ride locations, compared to those for the baseline parking scenario. The "In" trips reference trips destined for Carolina North. "Out" trips reference those departing Carolina North.

Table 4-30: Change in Transit Trips for 2030 (TIA Phase 2) Constrained (-10%) Parking Scenario

		AM Peak Hour			Midday Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total	In	Out	Total
Local Bus Trips	507	40	13	53	33	26	59	22	37	59
Park-and-Ride Shuttle Trips	1497	128	33	161	30	45	75	63	114	177

Table 4-31: Change in Transit Trips for 2030 (TIA Ph. 2) Constrained (-20%) Parking Scenario

		AM Peak Hour			Midday Peak Hour			PM Peak Hour		
	Daily	In	Out	Total	In	Out	Total	In	Out	Total
Local Bus Trips	1,015	81	27	108	66	53	118	44	74	118
Park-and-Ride Shuttle Trips	2995	255	67	322	60	90	150	126	228	354

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

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%)" 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%)" 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%)" 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%)" 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.

2030 (TIA Phase 2) Parking Sensitivity Scenarios

Table 4-32 shows the headway required to operate each route in the Base, "Constrained Ratio (-10%)", and "Constrained Ratio (-20%)" scenarios, if existing vehicle capacities are maintained. Of note is that the headway for the NS is reduced to 4 minutes in both the "Constrained Ratio (-10%)" and "Constrained Ratio (-20%)" scenarios. Table 4-32 also shows the headway and the number of buses required to operate each route in the Base, "Constrained Ratio (-10%)", and "Constrained Ratio (-20%)" scenarios. Compared with the Base Scenario, three additional buses are required to operate the "Constrained Ratio (-10%)" scenario and six more buses are required to operate the "Constrained Ratio (-20%)" scenario.

Table 4-32: 2030 (TIA Phase 2) Parking Sensitivity Transit Impact

Route	Headway			Vehicles		
	Base	-10% Parking	-20% Parking	Base	-10% Parking	-20% Parking
A	18	15	15	5	6	6
G	15	15	15	7	7	7
HS	30	30	30	2	2	2
NS	5	4	4	14	16	19
NU	12	12	12	3	3	3
T	12	12	12	5	5	5
Total				**36**	**39**	**42**

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% and -20%) 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% 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% parking reduction, the -10% parking reductions 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.

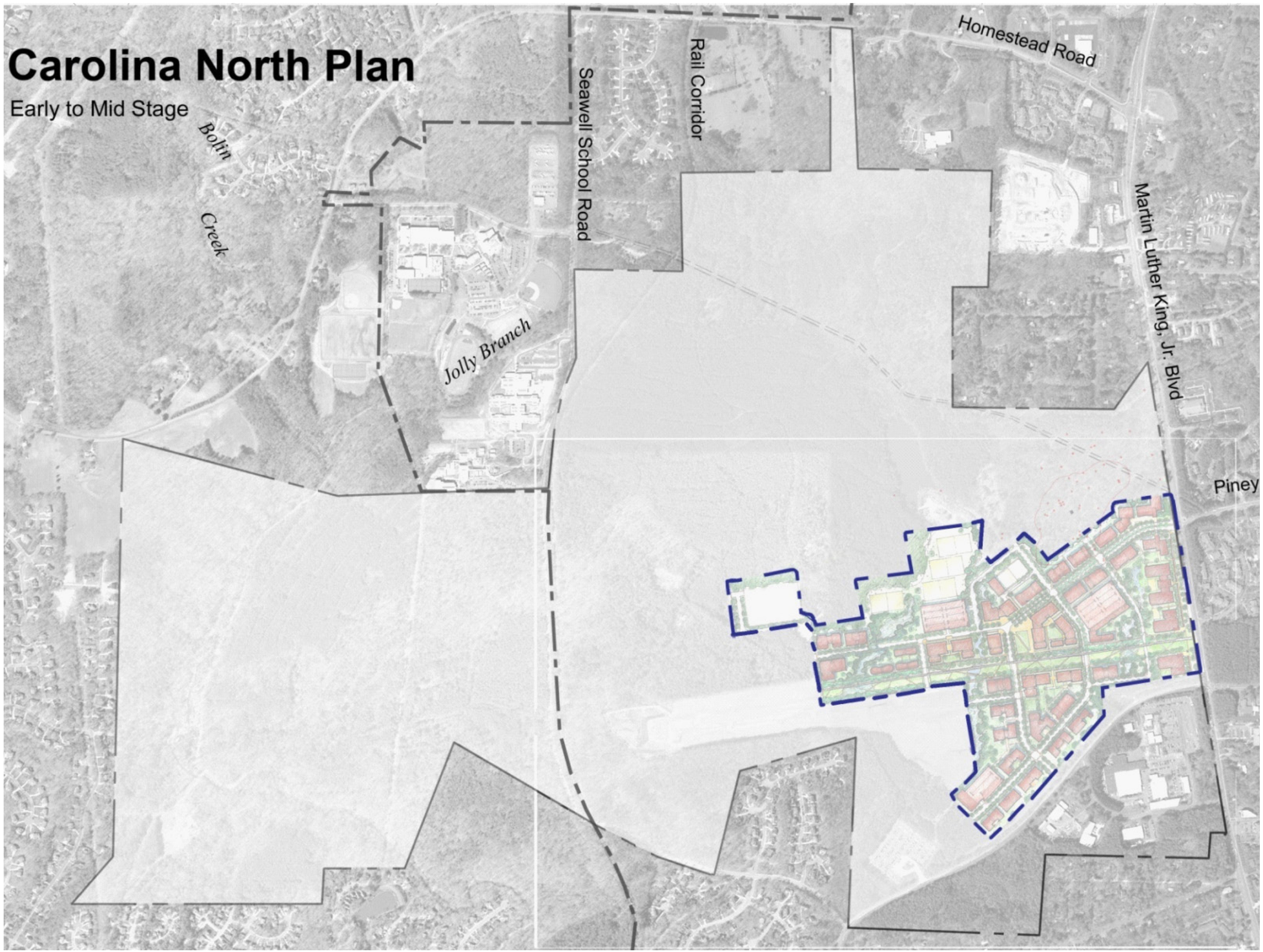
However, if after the parking was reduced by 20 percent, it was found that all the mitigation measures were not needed, then the -10% sensitivity analysis was conducted. The sensitivity analysis was conducted at the following key study intersections where the new trips from the proposed development would 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%" and "2030 Build -20%" 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%" 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. 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.



NTS

Source: University of North Carolina at Chapel Hill

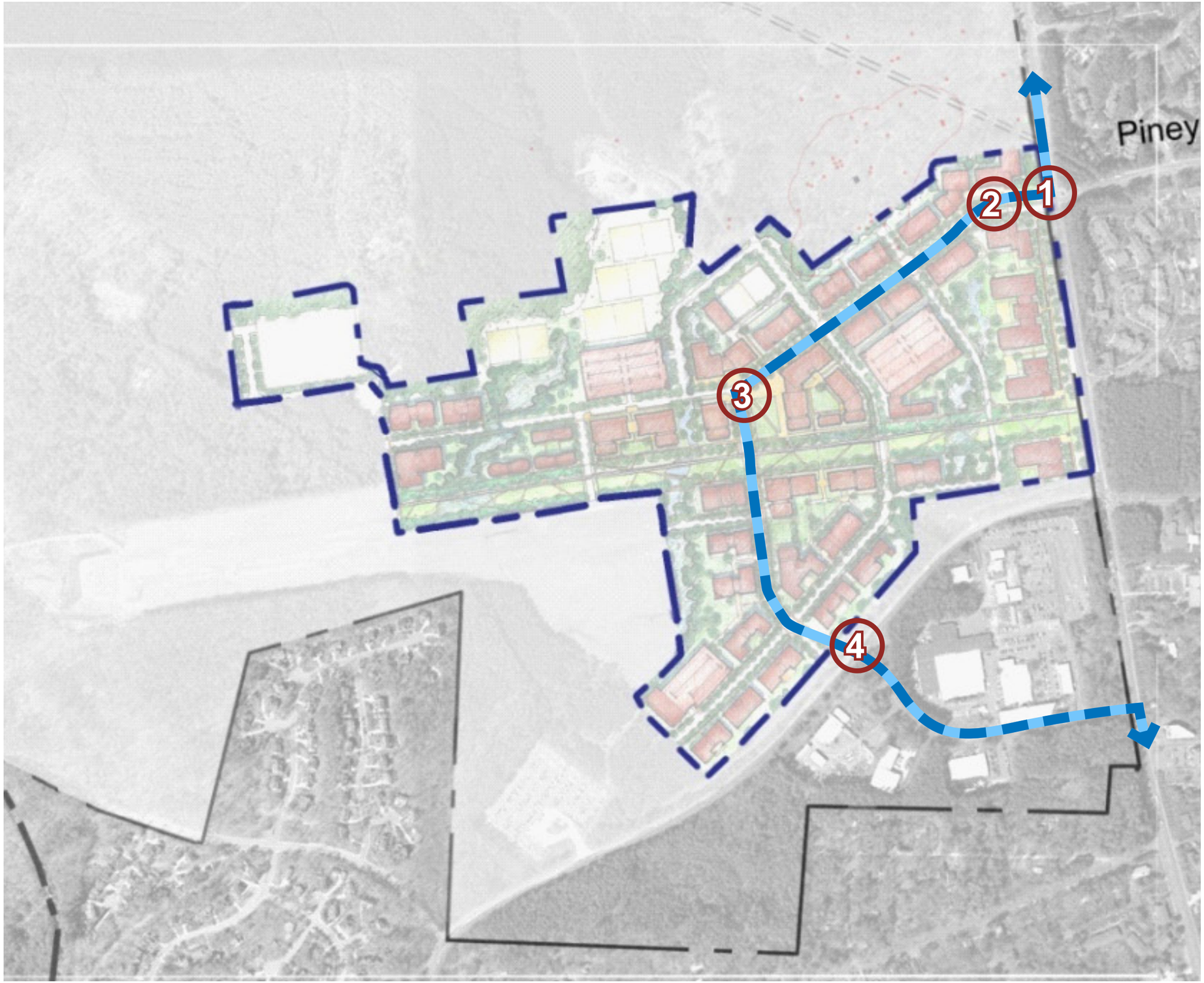
CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-1

2030 (TIA Phase 2) Carolina North Program

Chapel Hill, North Carolina

VHB *Vanasse Hangen Brustlin, Inc.*



LEGEND

1. MLK intersection configuration and long-term feasibility
2. Crosswalk location may not be feasible
3. Sight distance and traffic control concerns
4. Alignment with Airport Road and intersection configuration

On-site transit route for 3,000,000ft² phase

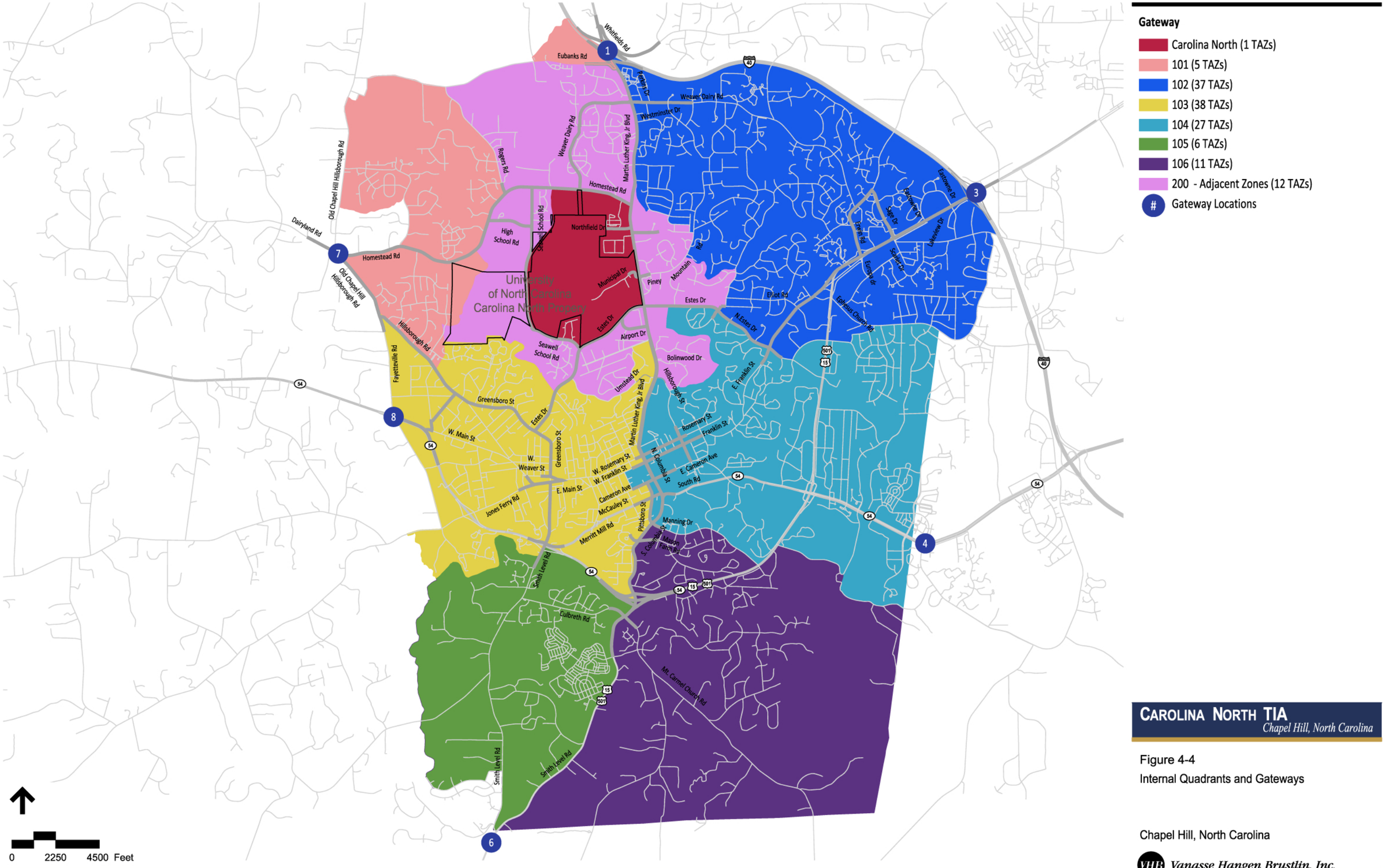
NTS

Source: University of North Carolina at Chapel Hill

CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-2
Site Plan Review

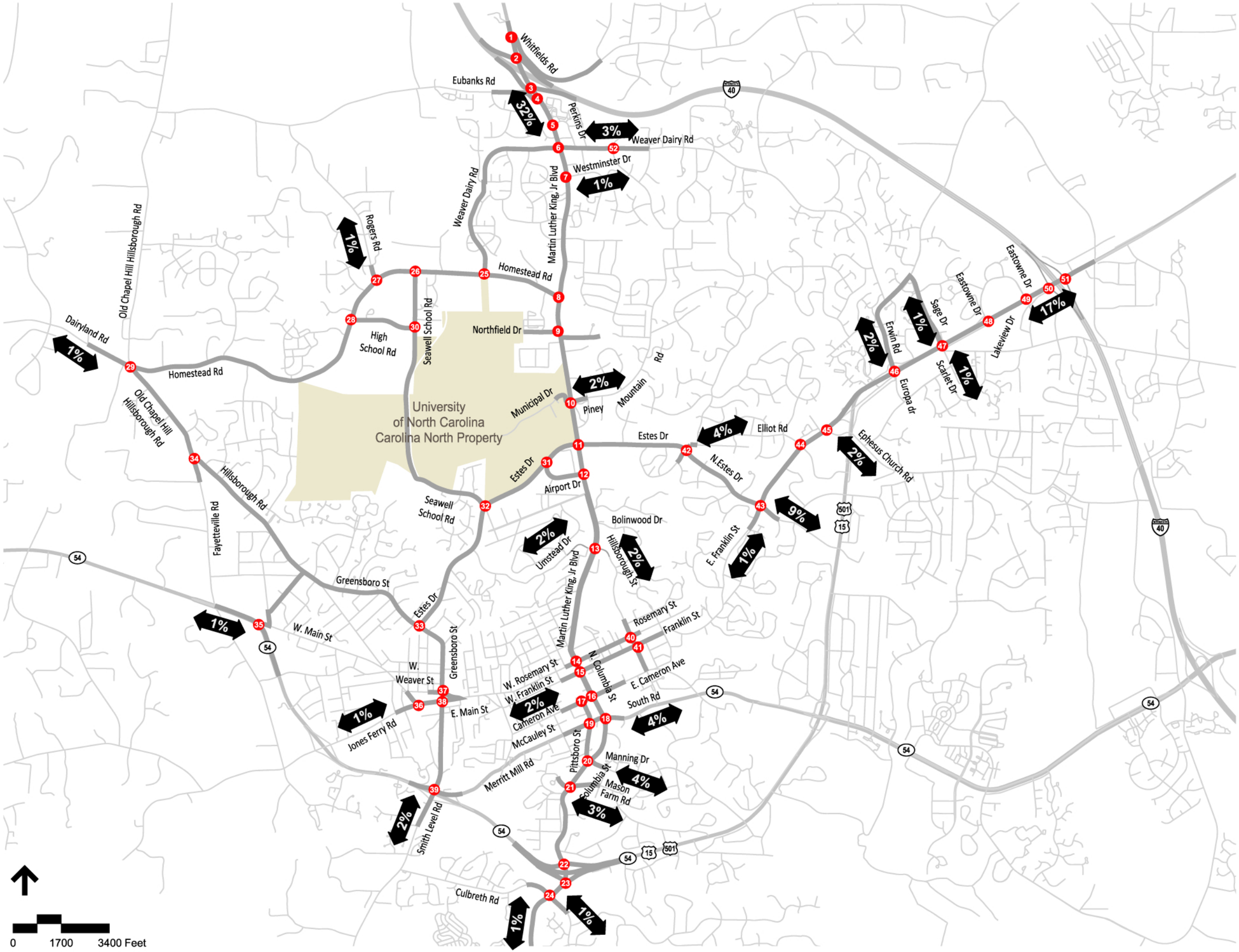
Chapel Hill, North Carolina



CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-4
Internal Quadrants and Gateways

Chapel Hill, North Carolina



Legend

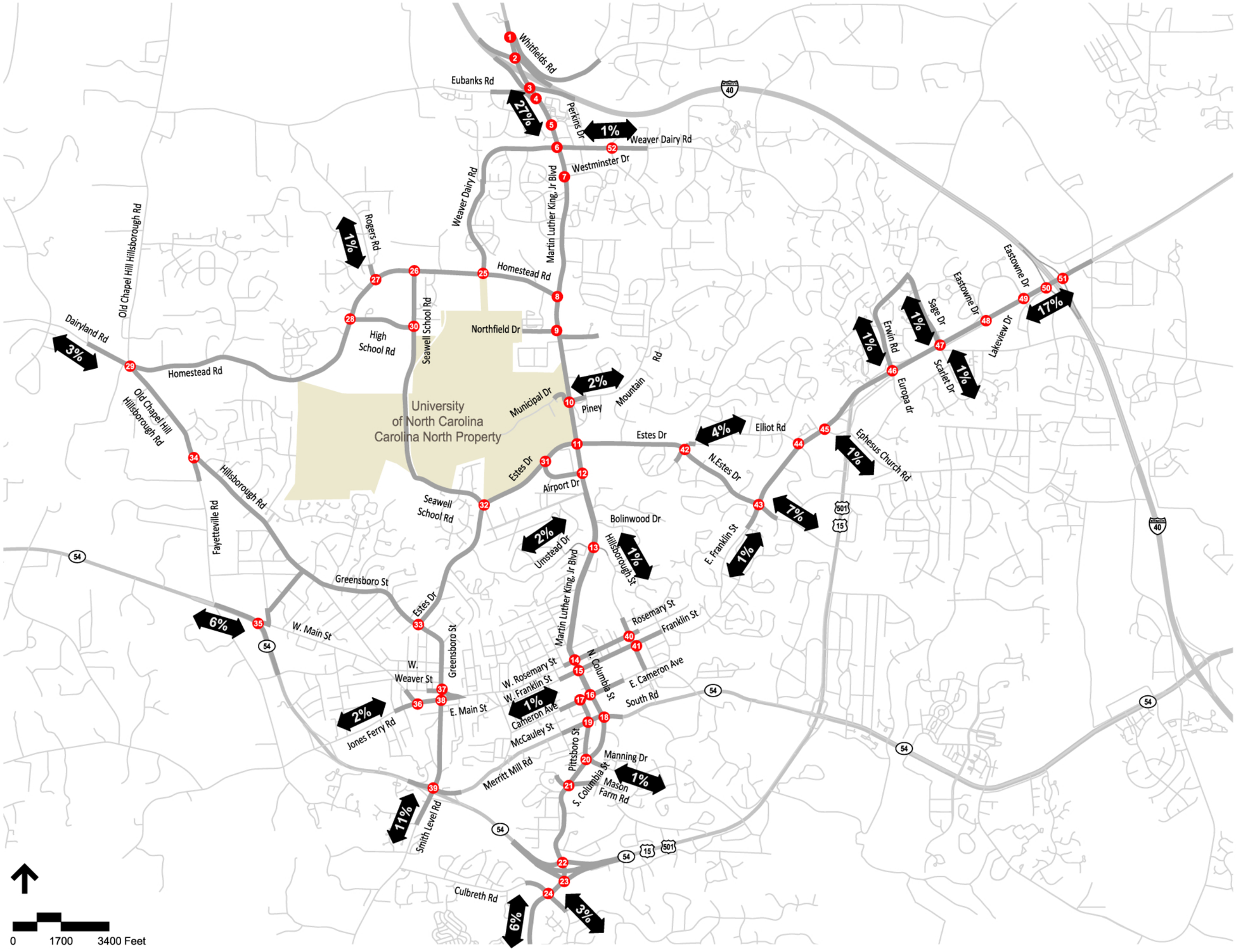
XX% Percent Trip Distribution

CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-5
Resident Trip Distribution

Chapel Hill, North Carolina

VHB *Vanasse Hangen Brustlin, Inc.*



Legend

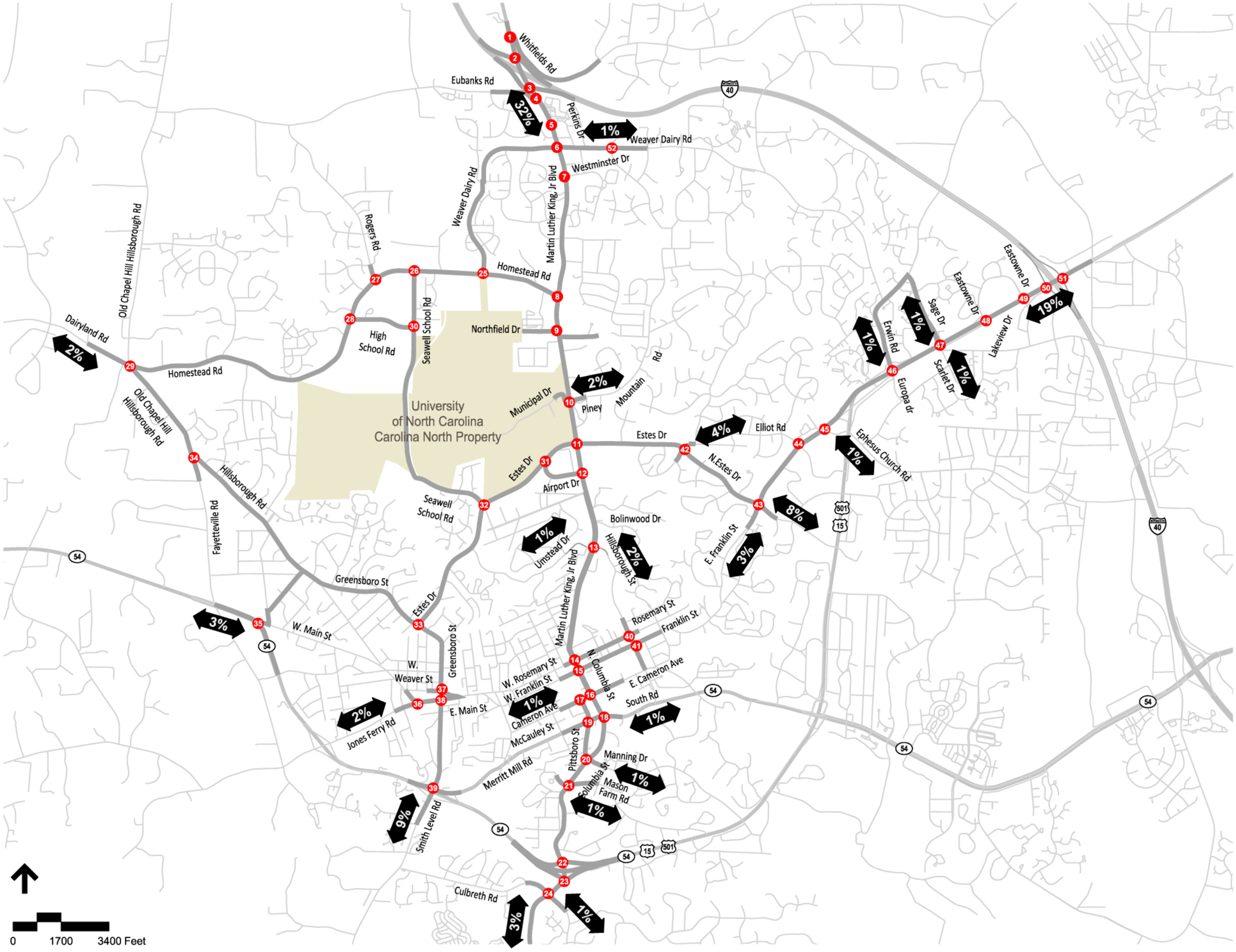
XX% Percent Trip Distribution

CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-6
Employee Trip Distribution

Chapel Hill, North Carolina

VHB *Vanasse Hangen Brustlin, Inc.*



0 1700 3400 Feet

Legend

XX% Percent Trip Distribution

CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-7
Student Trip Distribution

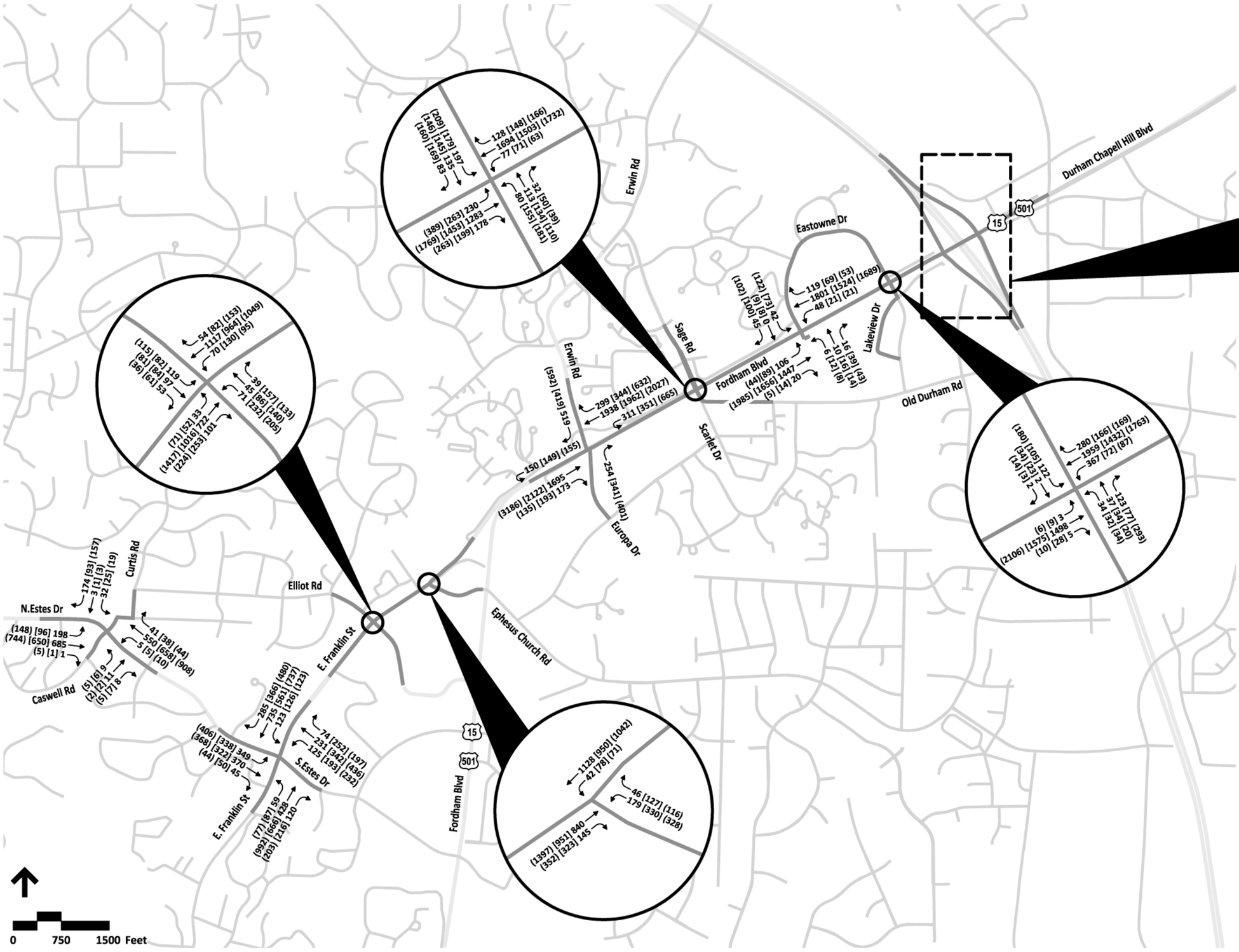
Chapel Hill, North Carolina

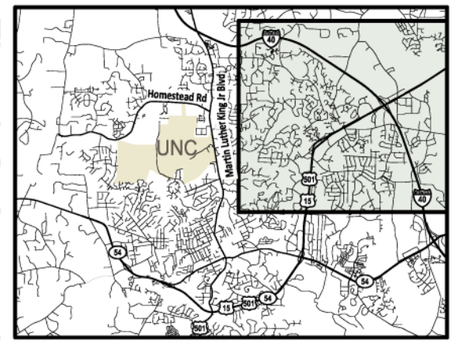
Vanasse Hangen Brustlin, Inc.

CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-8
2015 (TIA Phase 1) Peak Hour Build Traffic Volumes (Quadrant 1)

Chapel Hill, North Carolina





CAROLINA NORTH TIA
Chapel Hill, North Carolina

Figure 4-9
2015 (TIA Phase 1) Peak Hour Build Traffic Volumes (Quadrant 2)

Chapel Hill, North Carolina