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I. Executive Summary

The Livas Group Architects, P.C. contracted Wilbur Smith Associates on behalf of Saint Augustine's College of Raleigh, North Carolina to conduct a traffic impact study regarding the construction of a new track and football stadium. The stadium will be located in the southeast quadrant of the North State Street/Glascock Street intersection in Raleigh, North Carolina. The stadium is planned for use in the Fall of 2012, which is used as the analysis year for this traffic study.

According to the preliminary conceptual sketch plan, prepared by The Livas Group Architects, P.C., and shown in Figure 1, the stadium will be accessible by three, gated, unsignalized driveway connections to North State Street, opposite Penn Road, Van Buren Road, and Tyler Road, respectively. A fourth, gated, unsignalized driveway will connect to Glascock Street opposite Bennett Street. The driveways will be constructed in conformance with City of Raleigh requirements. The stadium will also be accessible via George "Pup" Williams Drive, an existing campus circulation road.

Saint Augustine College's new track and football stadium will have a capacity of 5,000 attendees. The City of Raleigh requires parking on a ratio of 1 parking space per 5 seats; therefore Saint Augustine's College plans to provide parking for a minimum of 1,000 cars. These will be parked primarily on compacted nonerodible grass surfaces. The College plans to charge a parking fee for use of the stadium parking area. College staff and students will be allowed to park in the regular campus parking lots and walk to the stadium.

A capacity size event (5,000 attendees) will generate approximately 759 vehicle trips entering the stadium area during the peak arrival hour and 992 vehicle trips during the peak hour exiting the stadium. No major improvements such as roadway widening are proposed by this traffic study, though transportation management plans for both pre-game arrival and post-game departure are required to manage stadium traffic.

Figure 1: Proposed Football Stadium

II. Purpose and Scope

Saint Augustine's College recently reinstated their football program with the Fall 2002 season, their first since 1967. Last season, the College used the Broughton High School stadium for their home games. Attendance for the home games has generally averaged approximately 1,900 patrons per game.

The College plans to build an on-campus stadium with 5,000 seats, with the stadium planned to be ready for the Fall 2012 football season., The stadium will be located in the northwest quadrant of the North State Street / Glascock Street intersection in Raleigh, North Carolina. This area is currently undeveloped.

The purpose of this traffic study is to assess the traffic impacts of the football stadium (Figure 1), and to identify any actions that may be appropriate to mitigate the stadium's impacts in order to satisfy the City of Raleigh Municipal Ordinance 10-2145(b-3), which details special use permit transportation requirements for outdoor stadiums, among other uses. Specifically, the ordinance requires that:

- The traffic generated to and from the site will not create unsafe or inefficient parking, loading, vehicular and pedestrian circulation patterns with consideration, among other things, to: the physical character of roads, the classification of roads, accident experience near the site, traffic volumes existing and projected from approved site plans and subdivisions, interference with any other driveway, and response time of nearby emergency services such as fire and hospital.

The project assessment was based on the following:

- Football games are expected to represent the type of events having the largest attendance at the planned facility. The College's football games are usually held on Saturday afternoons, although an occasional game could be held on a Thursday or Friday evening. The primary traffic analyses were made for the peak arrival hour and peak departure hour for a Saturday afternoon game. An analysis was also made for the weekday afternoon peak hour in the special circumstances that the peak arrival hour for the game coincided with the weekday afternoon commute peak hour traffic.

- This analysis focuses on the traffic impacts with a stadium capacity event with 5,000 attendees. This event was assumed to occur in 2015, although it is likely it will be several years before this size of event may actually occur.

- Since large events may occur at the stadium only a few times a year, the proposed mitigation actions center on the development of a transportation management plan and traffic control actions to efficiently route traffic to and from the stadium and minimize disruption to non-stadium traffic and residents.

- The transportation management plan was based on an event with 5,000 attendees. Where appropriate, attendance levels have been identified which various actions may not be necessary. This represents an initial plan, and adjustments to the recommended actions will likely be needed based on the actual observed conditions during the initial games at the new stadium.

The preliminary concept plan for the stadium indicates three primary, gated, driveway connections to North State Street, opposite Penn Road, Van Buren Road, and Tyler Road, respectively. A forth, gated, unsignalized driveway will connect to Glascock Street opposite Bennett Street. Each of these direct access points to the stadium parking areas will be an unsignalized intersection. The stadium parking areas, as well as other parking areas on the campus, could potentially be accessed through the main campus entrance along Oakwood Avenue, via George "Pup" Williams Drive, an existing campus circulation road.

The following intersections were analyzed to assess the traffic impacts from a large event at the proposed stadium:

1. Raleigh Boulevard / Glascock Street
2. Raleigh Boulevard / Oakwood Avenue
3. North State Street / Glascock Street
4. North State Street / Tyler Road
5. North State Street / Van Buren Road
6. North State Street / Penn Road
7. North State Street / Oakwood Avenue
8. Bennett Street / Glascock Street

III. Existing Traffic Conditions

A. Existing Roadway Network

The key roadways in the vicinity of the College are shown in Figure 2. The number of traffic lanes and type of traffic controls are depicted at each of the intersections included in the traffic analyses. The NCDOT Traffic Survey Group provided WSA with 2009 Annual Average Daily Traffic (AADT) counts on some of the roads adjacent to Saint Augustine's College.

In the vicinity of Saint Augustine's College, Raleigh Boulevard is a four-lane street with median that runs along the eastern part of the study area and connects to the I-440 Beltline to both the north and south of the project area. The posted speed limit is 45 mph, except the section between Glascock Street and Milburnie Road which is posted at 35 mph. The 2009 AADT on Raleigh Boulevard between Glascock Street and Oakwood Avenue is approximately 16,000 vehicles per day.

Figure 2: Study Intersections

Oakwood Avenue is located along the south side of the campus and connects to residential areas to the east and west. Currently, Oakwood Avenue is a two-lane road. The main entrance to the campus on Oakwood Avenue is located between the intersections of Tarboro Street and Milburnie Road. The 2009 AADT on Oakwood Avenue just east of State Street is 6,400 vehicles per day.

North State Street serves as the west boundary of the campus. North State Street is 36 feet wide with available on-street parking on the west side of the street where many residential homes are located. North State Street is a two-lane road with a speed limit of 35 mph. An existing entrance to the gym and athletic fields on North State Street is located across from the intersection of Penn Road. In 2009, the AADT along North State Street is approximately 2,300 vehicles per day.

Glascock Street traverses the north side of the campus and connects to residential areas and some businesses to the east and west. Glascock Street is a two-lane road 36 feet wide with on-street parking along the north side of the street where many residential homes are located. The speed limit is 35 mph.

B. Traffic Volumes

WSA conducted weekday evening (4:00 PM to 6:00 PM), Saturday midday (11:00 AM to 2:00 PM), and Saturday afternoon (3:00 PM to 4:00 PM) traffic counts at the intersections in the vicinity of Saint Augustine's College. The weekday and Saturday counts were performed on April 13, 2011 and April 16, 2011, respectively.

The peak one-hour traffic volumes for existing weekday evening, Saturday midday, and Saturday afternoon are illustrated in Figure 3. Detailed traffic count sheets for each time period are included in Appendix A.

C. Public Transportation

Capital Area Transit (CAT) bus route # 10 (Longview) runs every 30 minutes during the peak weekday hours, every 60 minutes during the off-peak weekday hours, and every 60 minutes on the weekends along Oakwood Avenue. There is a bus stop directly in front of the main entrance to the college. On Glascock Street, CAT bus route # 3 (Glascock) runs in intervals of every 30 minutes during the peak weekday hours, every 60 minutes during the off-peak weekday hours, and every 60 minutes on the weekends. There is a bus stop located at the corner of Glascock Street and North State Street in the proximity of the new stadium.

D. Traffic Analysis

The study area intersections were analyzed using the methods outlined in the ***Highway Capacity Manual***[1]**.** The manual defines capacity as, "the maximum rate of flow at which persons or vehicles can be reasonably expected to traverse a point or uniform section of a lane or roadway during a specified time period under prevailing roadway, traffic, and control conditions, usually expressed as vehicles per hour or persons per hour."

Figure 3: 2011 Existing Peak Hour Volumes

Level of service (LOS) is a term used to represent different traffic conditions, and is defined as a, "qualitative measure describing operational conditions within a traffic stream, and their perception by motorist/or passengers." Level of Service varies from Level A, representing free flow to Level F where traffic breakdown conditions are evident. Level B represents good progression with minimal congestion. At Level C, the number of vehicles stopping is significant, although many still pass through the intersection without stopping. Level D represents more congestion, but the overall operations are acceptable. At Level E, freedom to maneuver within the traffic stream is extremely difficult with driver frustration being generally high.

For signalized intersections, service levels are determined for each approach as well as for overall intersection conditions. Within the City of Raleigh, Level of Service E is acceptable for signalized intersections in suburban areas during peak traffic periods. Table 1 presents criteria of each level of service as indicated in the ***Highway Capacity Manual***[1]**.**

For unsignalized intersections service levels are determined for each movement that must yield the right-of-way. These movements are generally the through or turning vehicles from the minor street. At an unsignalized intersection, the primary traffic on the main roadway is virtually uninterrupted. Therefore, the overall level of service is usually much greater than what is represented by the results of the minor street movements. For unsignalized intersections, LOS E represents long delays for the traffic that must yield to the other movements, and LOS F indicates very long delays for the traffic that must yield. With the current method of reporting levels of service for unsignalized intersections, it is not uncommon for left-turn movements from the minor street to operate at LOS F during the peak traffic hours. Table 1 presents criteria of each level of service as indicated in the ***Highway Capacity Manual***[1]**.**

The following intersections are controlled by traffic signals:

- Raleigh Boulevard / Glascock Street
- Raleigh Boulevard / Oakwood Avenue

All of the other intersections in the study area are controlled by STOP signs. Table 2 summarizes the existing Saturday peak hour traffic conditions of the studied intersections. All of the intersections on Saturday operate with acceptable traffic conditions. No intersection has a higher volume/capacity ratio of 0.35 or a worse LOS than B. Detailed traffic analysis reports are included in Appendix B.

Table 1: Level of Service Criteria

SIGNALIZED INTERSECTIONS

Level of Service	Stopped Delay Per Vehicle (sec)
A	≤10.0
B	>10.0 and ≤20.0
C	>20.0 and ≤35.0
D	>35.0 and ≤55.0
E	>55.0 and ≤80.0
F	>80.0

UNSIGNALIZED INTERSECTIONS

Level of Service	Average Total Delay (sec/veh)
A	≤10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

Source: ***Highway Capacity Manual***[2], Special Report 209, Transportation Research Board, National Research Council, Washington, D.C., 2000.

Table 2: Existing Saturday Peak Hour Traffic Conditions						
Intersection	Midday Peak Hour			Afternoon Peak Hour		
	V/C	ADPV	LOS	V/C	ADPV	LOS
1. Raleigh Boulevard / Glascock Street	0.30	7.6	A	0.35	7.7	A
2. Raleigh Boulevard / Oakwood Avenue	0.27	5.7	A	0.32	6.1	A
3. North State Street / Glascock Street (SBL)	0.01	11.9	B	0.01	11.2	B
4. North State Street / Tyler Road (EBL)	0.00	8.8	A	0.00	0.0	A
5. North State Street / Van Buren Road (EBL)	0.00	8.8	A	0.00	8.9	A
6. North State Street / Penn Road (EBL)	0.00	8.8	A	0.00	8.7	A
7. North State Street / Oakwood Avenue (NBL)	0.02	10.2	B	0.02	10.0	A

Notes:
V/C = Ratio of existing volume to intersection capacity
ADPV = Average delay per vehicle, in seconds
LOS = Level of Service (A is excellent, E and F are undesirable)
For STOP sign-controlled intersections, the conditions represent the left turn from the side street.

Table 3 summarizes the existing weekday peak hour traffic conditions of the studied intersections. All of the intersections on a weekday operate with acceptable traffic conditions. No intersection has a higher volume/capacity ratio of 0.44 or a worse LOS than C. Detailed traffic analysis reports are included in Appendix B.

Table 3: Existing Weekday Peak Hour Traffic Conditions			
Intersection	Afternoon Peak Hour		
	V/C	ADPV	LOS
1. Raleigh Boulevard / Glascock Street	0.44	9.1	A
2. Raleigh Boulevard / Oakwood Avenue	0.41	7.2	A
3. North State Street / Glascock Street (NBL)	0.34	18.7	C
4. North State Street / Tyler Road (EBL)	0.00	10.0	A
5. North State Street / Van Buren Road (EBL)	0.00	9.5	A
6. North State Street / Penn Road (EBL)	0.01	9.8	A
7. North State Street / Oakwood Avenue (SBL)	0.22	12.6	B

Notes:
V/C = Ratio of existing volume to intersection capacity
ADPV = Average delay per vehicle, in seconds
LOS = Level of Service (A is excellent, E and F are undesirable)
For STOP sign-controlled intersections, the conditions represent the left turn from the side street.

D. Multimodal Analysis

The multimodal characteristics of the roadway segments located between study intersections were analyzed using the methods outlined in the ***FDOT Quality/Level of Service Handbook***[2]**.** The handbook provides, "tools to quantify multimodal transportation service inside the roadway environment." For pedestrian, bicycle, and public transportation analysis, the level of service thresholds are based on data that includes roadway characteristics, personal vehicle volumes, sidewalk conditions, bicycle lane conditions, and scheduled public transportation services. Within the City of Raleigh, ARTPLAN 2009 is the recommended software for estimating multimodal levels of service.

Table 4 summarizes the existing weekday peak hour multimodal conditions of the roadway segments located between study intersections. All of the roadway segments operate with acceptable pedestrian and bicycle conditions. No segment has a higher score than 4.40 or a worse LOS than D. Two of the roadway segments operate with acceptable public transportation conditions. Neither the Glascock Street not Oakwood Avenue segments have a higher score than 2.53 or a worse LOS than D. Two of the roadway segments, the North State Street and Raleigh Boulevard segments, do not have bus service, resulting in LOS F. Detailed multimodal analysis reports are included in Appendix B.

Table 4: Existing Weekday Peak Hour Multimodal Conditions

Roadway Segment	Pedestrian		Bicycle		Public Transportation	
	Score	LOS	Score	LOS	Score	LOS
Glascock Street	2.81	C	4.04	D	2.42	D
North State Street	2.37	B	3.01	C	0.00	F
Oakwood Avenue	2.47	B	3.54	D	2.53	D
Raleigh Boulevard	3.72	D	4.40	D	0.00	F

Notes:
See ***FDOT Quality/Level of Service Handbook***[2] for LOS/Score thresholds
LOS = Level of Service (A is excellent, E and F are undesirable)

E. Collision Analysis

The City of Raleigh provided Strip Analysis Reports from the NCDOT Traffic Engineering Accident Analysis System for North State Street (Oakwood Avenue to Glascock Street) and Glascock Street (North State Street to Raleigh Boulevard). The City also provided Intersection Analysis Reports for the Glascock Street / Raleigh Boulevard intersection. The following information summarizes all reported crashes for the three-year period dating from April 15, 2008 to April 15, 2011. Detailed collision information is located in Appendix A.

North State Street between Oakwood Avenue and Glascock Street

Along the 0.7 mile section of North State Street between Oakwood Avenue and Glascock Street, there were 16 reported collisions within the study period. The majority of the crashes (7) were "angle." There were also two "sideswipe, same direction" and two "rear end, slow or stop" crashes. No fatalities occurred along this section of roadway during the study period. Approximately 69% of all crashes were property damage only crashes. Overall, this section of roadway has a severity index of 3.31.

According to the City of Raleigh, a severity index of 8.4 or higher indicates that the area is likely to have more serious crashes. This section of roadway has a crash rate of 911 crashes per 100 million vehicle miles. According to information provided by the NCDOT Division of Mobility and Safety Traffic Safety Systems Management Unit, the 2007 – 2009 North Carolina Urban State Highways (Non-System) crash rate was 620 per 100 million vehicle miles. Therefore, these statistics indicate that while the crash rate is greater than the North Carolina average, the types of crashes on this roadway are not extremely severe.

Glascock Street between North State Street and Raleigh Boulevard

Along the 0.44 mile section of Glascock Street between North State Street and Raleigh Boulevard, there were 37 reported crashes within the study period. The majority of the crashes (14) were "angle." There were also five "left turn, same roadway" and five "rear end, slow or stop" crashes. No fatalities occurred along this section of roadway during the study period. Approximately 54% of all crashes were property damage only crashes. Overall, this section of roadway has a severity index of 6.25.

According to the City of Raleigh, a severity index of 8.4 or higher indicates that the area is likely to have more serious crashes. This section of roadway has a crash rate of 1,441 crashes per 100 million vehicle miles. According to information provided by the NCDOT Division of Mobility and Safety Traffic Safety Systems Management Unit, the 2007 – 2009 North Carolina Urban State Highways (Non-System) crash rate was 620 per 100 million vehicle miles. Therefore, these statistics indicate that while the crash rate is more than twice as great as the North Carolina average, the types of crashes on this roadway are not extremely severe.

Glascock Street / Raleigh Boulevard Intersection

At the Glascock Street / Raleigh Boulevard intersection, there were 34 reported crashes within the study period. The majority of the crashes (13) were "angle". There were also five "left turn, same roadway," five "rear end, slow or stop," and 4 "sideswipe, same direction" crashes. No fatalities occurred at this intersection during the study period. Approximately 53% of all crashes were property damage only crashes. Overall, this intersection has a severity index of 6.49.

According to the City of Raleigh, a severity index of 8.4 or higher indicates that the area is likely to have more serious crashes. While this intersection does exceed the 8.4 severity index, there is a pattern of angle crashes and this intersection was cited in the 2009 Highway Safety Improvement Program as meeting crash warrant I-1 (locations with a minimum of 25 total crashes and a minimum of 50% of all crashes were frontal impact crashes and a minimum of 25% of the total crashes occurred in the last two years).

The relatively high incidence of angle crashes appears to be due to poor sight distance for northbound left turning from Raleigh Boulevard onto Glascock Street. This movement is currently controlled by a permitted-left signal and a protected-permitted signal may address some of the angle crashes, though any traffic signal modifications should be studied and approved by the Raleigh Traffic Control Center.

While it is difficult to determine if the stadium traffic would increase the number or severity of collisions at the intersection, the stadium use will be limited to only a few dates per year, and does not warrant a signal timing/phasing modification. Additionally, the stadium traffic control plan, detailed in Section IX, calls for traffic officers at this and all other intersections, which should eliminate collisions or at least greatly decrease the severity of any collision during stadium activities.

IV. Traffic Generation

The traffic generation was estimated based on an event attracting the 5,000-attendee capacity of the stadium, assuming the following:

- 700 on-campus students walk to the stadium, which is approximately two-thirds of the students living on campus
- 300 off-campus students walk to the stadium, which is approximately one-half of the students living off campus
- 500 attendees travel by charter bus or hotel shuttle to the stadium, which are currently used by out-of-town fans of St. Augustine's College and the opposing team fans
- 3,500 attendees travel by personal vehicle to the stadium, with an average of three occupants per vehicle ***(Parking for Institutions and Special Events***[3]**)**
- About 65% of all vehicles arrive in the peak one hour before kickoff, based on estimates from football games at Carter-Finley Stadium provided by McLaurin Parking.
- About 85% of all vehicles depart in the peak one hour after the game, based on estimates from football games at Carter-Finley Stadium provided by McLaurin Parking.

Based on these assumptions, the proposed football stadium would generate demand for approximately 1,167 personal vehicle parking spaces with approximately 759 vehicles entering the stadium area during the peak arrival hour before a game. The proposed football stadium would generate approximately 992 vehicles exiting the stadium during the peak departure hour following a game.

V. Traffic Distribution and Assignment

The directional distribution and routing of stadium traffic was based upon existing traffic patterns in the area. The traffic generated by the stadium was distributed for both a weekday afternoon and Saturday event as follows:

- 1 percent to/from the north on North State Street
- 31 percent to/from the north on Raleigh Boulevard
- 14 percent to/from the west on Glascock Street
- 13 percent to/from the east on Glascock Street
- 5 percent to/from the west on Oakwood Avenue
- 5 percent to/from the east on Oakwood Avenue
- 2 percent to/from the south on North State Street
- 29 percent to/from the south on Raleigh Boulevard

A. Pre-Game Arrival Peak Hour Traffic

Based on the trip distribution, approximately 759 vehicles are expected to arrive in the peak arrival hour before a game and access the stadium as follows:

- 334 vehicles (44%) enter at the New Stadium Driveway / Glascock Street driveway
- 114 vehicles (15%) enter at the North State Street / Tyler Road driveway
- 311 vehicles (41%) enter at the North State Street / Van Buren Road driveway

While St. Augustine staff and students would be allowed to use their regular areas of parking on the campus in specified lots, this report conservatively assumes all student/faculty traffic would access the stadium at the driveways on Glascock Avenue and North State Street, even though some may access campus via the main entrance on Oakwood Avenue. Additionally, the North State Street / Penn Road driveway may be opened to relieve the North State Street / Tyler Road and North State Street / Van Buren Road driveways.

B. Post-Game Departure Peak Hour Traffic

Based on the trip distribution, approximately 992 vehicles are expected to depart in the peak departure hour before a game and access the stadium as follows:

- 436 vehicles (44%) enter at the New Stadium Driveway / Glascock Street driveway
- 149 vehicles (15%) enter at the North State Street / Tyler Road driveway
- 407 vehicles (41%) enter at the North State Street / Van Buren Road driveway

Similar to the arrival assumptions, this report conservatively assumes all student/faculty traffic would exit the stadium at the driveways on Glascock Avenue and North State Street, even though some may exit campus via the main entrance on Oakwood Avenue.

Additionally, the North State Street / Penn Road driveway may be opened to relieve the North State Street / Tyler Road and North State Street / Van Buren Road driveways.

The peak one-hour traffic volumes for both the stadium traffic arrival and departures are illustrated in Figure 4.

VI. Projected Traffic Volumes

A. 2015 Background Traffic Growth

Background growth traffic is based upon historical traffic counts and the increase in traffic volumes due to usage increases and non-specific growth throughout the area. For this project, 2011 volumes were increased by three percent per year to reflect 2015 traffic growth in the area. These traffic volumes are illustrated in Figure 5 for the Saturday arrival, Saturday departure and weekday arrival.

B. 2015 with Stadium Traffic

To obtain total 2015 traffic volumes with the stadium, the stadium traffic was added to the year 2015 background traffic volumes. These trips were distributed throughout the network based on the trip distribution percentages discussed in the previous section. The traffic volumes for Saturday arrival, Saturday departure and weekday afternoon arrival peak traffic hours are illustrated in Figure 6.

Figure 4: Stadium Traffic Arrival and Departure Volumes

Figure 5: 2015 without Stadium Peak Hour Volumes

Figure 6: 2015 with Stadium Peak Hour Volumes

VII. 2015 Traffic Analysis without Stadium

The study area intersections were analyzed using the methods outlined in the ***Highway Capacity Manual***[1]**.** Capacity analyses were performed for 2015 without stadium conditions for all the study area intersections. The Saturday arrival, Saturday departure, and weekday arrival peak hour conditions were analyzed.

A. Saturday Arrival and Departure Peak Hours

Table 5 summarizes the future conditions at the study intersections without the addition of a new football stadium for the Saturday arrival and Saturday departure peak hours. All of the intersections will operate with acceptable traffic conditions in 2015 without the stadium. No intersection has a higher volume/capacity ratio of 0.40 or a worse LOS than B. Detailed traffic analysis reports are included in Appendix B.

Table 5: 2015 without Stadium Saturday Peak Hour Traffic Conditions

Intersection	Midday Peak Hour			Afternoon Peak Hour		
	V/C	ADPV	LOS	V/C	ADPV	LOS
1. Raleigh Boulevard / Glascock Street	0.34	7.9	A	0.40	8.0	A
2. Raleigh Boulevard / Oakwood Avenue	0.30	5.8	A	0.35	6.8	A
3. North State Street / Glascock Street (SBL)	0.01	12.5	B	0.01	11.6	B
4. North State Street / Tyler Road (EBL)	0.00	8.9	A	0.00	0.0	A
5. North State Street / Van Buren Road (EBL)	0.00	8.8	A	0.00	9.0	A
6. North State Street / Penn Road (EBL)	0.01	8.8	A	0.01	8.8	A
7. North State Street / Oakwood Avenue (NBL)	0.03	10.4	B	0.02	10.2	B

Notes:
V/C = Ratio of existing volume to intersection capacity
ADPV = Average delay per vehicle, in seconds
LOS = Level of Service (A is excellent, E and F are undesirable)
For STOP sign-controlled intersections, the conditions represent the left turn from the side street.

B. Weekday Afternoon Arrival Peak Hour

Table 6 summarizes the future conditions at the study intersections without the addition of a new football stadium for the weekday afternoon arrival peak hour, which is assumed to coincide with the peak commute hour traffic. All of the intersections will operate with acceptable traffic conditions in 2015 without the stadium. No intersection has a higher volume/capacity ratio of 0.48 or a worse LOS than C. Detailed traffic analysis reports are included in Appendix B.

Table 6: 2015 without Stadium Weekday Peak Hour Traffic Conditions			
Intersection	**Afternoon Peak Hour**		
	V/C	**ADPV**	**LOS**
1. Raleigh Boulevard / Glascock Street	0.48	9.8	A
2. Raleigh Boulevard / Oakwood Avenue	0.46	7.4	A
3. North State Street / Glascock Street (NBL)	0.43	23.1	C
4. North State Street / Tyler Road (EBL)	0.00	10.2	B
5. North State Street / Van Buren Road (EBL)	0.00	9.6	A
6. North State Street / Penn Road (EBL)	0.02	10.0	B
7. North State Street / Oakwood Avenue (SBL)	0.27	13.6	B
Notes: V/C = Ratio of existing volume to intersection capacity ADPV = Average delay per vehicle, in seconds LOS = Level of Service (A is excellent, E and F are undesirable) For STOP sign-controlled intersections, the conditions represent the left turn from the side street.			

VIII. 2015 Traffic Analysis with Stadium

The study area intersections were analyzed using the methods outlined in the ***Highway Capacity Manual***[1]**.** Capacity analyses were performed for 2015 with stadium conditions for all the study area intersections. The Saturday arrival, Saturday departure, and weekday arrival peak hour conditions were analyzed.

A. Saturday Arrival and Departure Peak Hours

Table 7 summarizes the future conditions at the study intersections with the addition of a new football stadium for the Saturday arrival and Saturday departure peak hours. All of the intersections will operate with acceptable traffic conditions in 2015 with the stadium. No intersection has a higher volume/capacity ratio of 0.68 or a worse LOS than C. Detailed traffic analysis reports are included in Appendix B.

Table 7: 2015 with Stadium Saturday Peak Hour Traffic Conditions						
Intersection	**Midday Peak Hour**			**Afternoon Peak Hour**		
	V/C	**ADPV**	**LOS**	**V/C**	**ADPV**	**LOS**
1. Raleigh Boulevard / Glascock Street	0.40	8.7	A	0.58	13.0	B
2. Raleigh Boulevard / Oakwood Avenue	0.57	6.4	A	0.58	11.8	B
3. North State Street / Glascock Street (SBL)	0.03	13.7	B	0.42	16.0	C
4. North State Street / Tyler Road (EBL)	0.00	9.8	A	0.16	9.4	A
5. North State Street / Van Buren Road (EBL)	0.00	9.1	A	0.54	14.4	B
6. North State Street / Penn Road (EBL)	0.01	9.4	A	0.01	11.7	B
7. North State Street / Oakwood Avenue (NBL)	0.08	14.4	B	0.68	18.8	C
8. Bennett Street / Glascock Street (WBL-Midday, NBL-Afternoon)	0.27	6.5	A	0.58	15.4	C

Notes:
V/C = Ratio of existing volume to intersection capacity
ADPV = Average delay per vehicle, in seconds
LOS = Level of Service (A is excellent, E and F are undesirable)
For STOP sign-controlled intersections, the conditions represent the left turn from the side street.

B. Weekday Afternoon Arrival Peak Hour

Table 8 summarizes the future conditions at the study intersections with the addition of a new football stadium for the weekday afternoon arrival peak hour, which is assumed to coincide with the peak commute hour traffic. All of the intersections will operate with acceptable traffic conditions in 2015 with the stadium. No intersection has a higher volume/capacity ratio of 0.74 or a worse LOS than D. Detailed traffic analysis reports are included in Appendix B.

Table 8: 2015 with Stadium Weekday Peak Hour Traffic Conditions			
Intersection	**Afternoon Peak Hour**		
	V/C	**ADPV**	**LOS**
1. Raleigh Boulevard / Glascock Street	0.54	11.5	B
2. Raleigh Boulevard / Oakwood Avenue	0.74	9.4	A
3. North State Street / Glascock Street (NBL)	0.49	27.3	D
4. North State Street / Tyler Road (EBL)	0.00	13.6	B
5. North State Street / Van Buren Road (EBL)	0.00	10.6	B
6. North State Street / Penn Road (EBL)	0.02	12.5	B
7. North State Street / Oakwood Avenue (SBL)	0.40	20.6	C
8. Bennett Street / Glascock Street	0.34	7.2	C
Notes: V/C = Ratio of existing volume to intersection capacity ADPV = Average delay per vehicle, in seconds LOS = Level of Service (A is excellent, E and F are undesirable) For STOP sign-controlled intersections, the conditions represent the left turn from the side street.			

IX. Proposed Transportation Management Plan

Since the stadium will only be used a limited number of times per year, the transportation management plan is built around the use of temporary traffic management actions to effectively move the vehicles in and out of the stadium. Based on the analysis, no major off-site roadway improvements should be needed to provide safe and efficient ingress and egress. The Transportation Management Plan is intended to enhance traffic operations and public safety in the vicinity of the stadium. The plan should be reviewed by The Raleigh Police Department and adjusted to reflect their comments. Traffic conditions should be monitored during the events at the stadium and the initial transportation management plan modified as appropriate. Based on the analysis and on-site observations of existing traffic conditions, the following actions should be implemented during game day conditions:

A. Pre-game Arrival

Traffic management actions recommended for game day traffic include measures to assist with the ingress of traffic before an event. The pre-game arrival plan requires seven cashiers, six traffic control officers, six parking lot attendants, and five side street barricade volunteers.

Trailblazer/Direction Signs - Signs should be erected at major intersections to direct stadium traffic to those routes that would minimize disruption and delays to both stadium

and non-stadium traffic. Signs directing traffic to the stadium should be placed at the following intersections:

- North State Street / Glascock Street
- Raleigh Boulevard / Glascock Street
- Raleigh Boulevard / Oakwood Avenue
- North State Street / Oakwood Avenue

Additional signs may be placed at the following intersections:

- Tarboro Street / Oakwood Avenue
- Raleigh Boulevard / Milburnie Road

North State Street / Tyler Road Entrance - At the northern site entrance on State Street, traffic cones should be placed to create three separate temporary lanes on State Street just south of the entrance to the stadium. This will allow for a separate left turn lane for traffic to enter into the stadium parking lots. Two traffic control officers should be stationed at this intersection to assist in controlling the traffic flow into the stadium for medium to large size events.

Temporary "No Parking/Passenger Loading/Unloading" signs should be posted along North State Street north of Tyler Road to provide a curbside area near the stadium for use for passenger drop-off and pick-up.

Two cashier lanes to the parking areas are needed to expedite vehicles flow into the parking lot and minimize the chance of queuing into the street. The cashiers should be located about 100 feet from the entrance (4 car-lengths). This distance accommodates one vehicle stopped for the transaction and three vehicles in queue in each entrance lane. This estimate is based on 250 vehicles per lane per hour as the typical design volume that can be accommodated for an entrance lane having payment of a fixed fee to a cashier with no gate ***(Traffic Engineering Handbook[4]),*** a 5,000-attendee stadium event, and a 95% probability that the queue would not extend onto the street.

It is recommended that at least two people be assigned to direct the vehicles to the parking stalls at each lot: one person directing vehicles from the entry driveway into the parking aisle and the other person directing the vehicles to the parking stall in a safe and efficient manner. Without someone directing traffic into the stall, many people will park in the middle of two stalls and thus reducing the number of vehicles that can be parked in the lots.

North State Street / Van Buren Road Entrance - At the southern site entrance on State Street, traffic cones should be placed to create three separate temporary lanes on State Street just south of the entrance to the stadium. This will allow for a separate right turn lane for traffic to enter into the stadium parking lots. Two traffic control officers should be stationed at this intersection to assist in controlling the traffic flow into the stadium for medium to large size events.

Temporary "No Parking/Passenger Loading/Unloading" signs should be posted along North State Street south of Van Buren Road to provide a curbside area near the stadium for use for passenger drop-off and pick-up.

At this entrance, two cashier entry lanes to the parking areas are needed to move the vehicles into the parking lot without causing a long queue to form. The cashiers should be located at least 100 feet from the entrance (4 car-lengths). Two other persons should be assigned to direct the vehicles to the parking stalls.

Bennett Street / Glascock Street Entrance - At the Bennett Street / Glascock Street entrance, traffic cones should be placed to create temporary lanes in order to provide a separate left turn lane for traffic to enter into the stadium parking lots from the east on Glascock Street. The turn lane should extend back at least 100 feet to allow holding space for the vehicles. There is one residential driveway that is 120 feet east of Bennett Street that could have its left turns affected during the peak arrival. Two traffic control officers should be stationed at the Bennett Street intersection to assist in controlling the traffic flow for stadium events when a medium to large scale event is anticipated.

At this entrance, two cashier entry lanes to the parking areas are needed to move the vehicles into the parking lot without causing a long queue to form. The cashiers should be located at least 100 feet from the entrance (4 car-lengths). Two other persons should be assigned to direct the vehicles to the parking stalls.

North State Street / Penn Road Entrance – This gate should be primarily used for official vehicle access (emergency vehicles, team buses, etc), remaining closed at all other times. Activity at the other entrances should be monitored to observe whether or not this gate should be opened for arriving traffic to access the stadium parking. If the gate is open for arriving traffic, a single entry lane and parking cashier could be located at a convenient point to allow traffic turnaround.

Side Street Temporary Barricades – Barricades on the side streets along North State Street are not necessary, but may be helpful in keeping attendees from parking on the neighborhood side streets. One volunteer or college student should monitor each barricade at Monroe Drive, Tyler Road, Hamilton Road, Van Buren Road, and Penn Road and allow access only to those who live on the street.

B. Post-game Departure

Traffic management actions recommended for game day traffic include measures to assist with the egress of traffic after an event. The post-game departure plan requires six traffic control officers, one parking lot attendant, and five side street barricade volunteers.

Trailblazer/Directional Signs – Signs should be placed to direct the exiting vehicles towards I-440 and disperse the traffic over multiple routes. Signs directing the traffic to I-440 should be placed at the following intersections:

- North State Street / Hamilton Road

- North State Street / Van Buren Road
- Bennett Road / Glascock Street
- North State Street / Glascock Street
- Raleigh Boulevard / Glascock Street
- Raleigh Boulevard / Oakwood Avenue
- North State Street / Oakwood Avenue

Additional signs may be placed at the following intersections:

- Tarboro Street / Oakwood Avenue
- Raleigh Boulevard / Milburnie Road

Glascock Street / Bennett Street Exit – At the stadium exit onto Glascock Street, separate left and right turn lanes, separated by traffic cones, should be provided to expedite traffic flow onto Glascock Street. Trailblazer signs at the exit would direct I-440 traffic to turn right and travel to Raleigh Boulevard. A traffic control officer should be stationed at the Bennett Street intersection to assist in controlling the traffic flow for medium to large size stadium events.

North State Street / Hamilton Street Exit - At the stadium exit onto North State Street, all exiting traffic State Street should be directed to turn left (southward). A traffic control officer should be placed at this intersection to help direct the flow out of the stadium for medium to large-size events. The forced left-turn is to avoid traffic exiting the stadium onto northbound North State Street, then turning right onto Glascock Street, and delaying the stadium traffic that is exiting out of the Glascock stadium driveway.

North State Street / Glascock Street – A traffic control officer should be stationed at the intersection of North State Street and Glascock Street to help with traffic flow when the stadium is expecting a medium to large-sized event.

North State Street / Oakwood Avenue - A traffic control officer should be stationed at the intersection of North State Street and Oakwood Avenue to help with traffic flow when the stadium is expecting a medium to large-sized event.

Raleigh Boulevard / Glascock Street – For a medium to large-sized event, traffic control officers should be stationed at this intersection to manually direct traffic and give increased preference to the traffic leaving the stadium. The traffic signal would be set on flashing mode. This action will expedite traffic flow away from the stadium. Two traffic control officers will likely be needed for this intersection.

North State Street / Penn Road Entrance – This gate should be primarily used for official vehicle egress (emergency vehicles, team buses, etc), remaining closed at all other times. One parking lot attendant should monitor this driveway.

Side Street Temporary Barricades – Barricades on the side streets should remain in place until most of the stadium traffic has departed. One volunteer or college student

should monitor each barricade at Monroe Drive, Tyler Road, Hamilton Road, Van Buren Road, and Penn Road and allow access only to those who live on the street.

X. References

[1]**Highway Capacity Manual**, Special Report 209, Transportation Research Board, National Research Council, Washington, D.C., 2000.

[2]**FDOT Quality/Level of Service Handbook**, Florida Department of Transportation, Tallahassee, Florida, 2009.

[3]**Parking for Institutions and Special Events**, The Eno Foundation for Transportation, Inc., Westport, Connecticut, 1982.

[4]**Traffic Engineering Handbook,** 6th Edition, Institute of Transportation Engineers, Washington, D.C., 2009.