

**FINAL**

## TRAFFIC IMPACT ANALYSIS

For

### Wake Union Place

Wake Forest, North Carolina

Prepared For:

#### Town of Wake Forest

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Wake Forest, North Carolina 27587

Prepared By:



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June 16, 2008

(WSA Project No. 102226)



6/16/08

# Table of Contents

	<u>Page No.</u>
<b>I. Executive Summary .....</b>	<b>i</b>
<b>II. Introduction .....</b>	<b>1</b>
<b>III. Inventory of Traffic Conditions .....</b>	<b>1</b>
A. Study Area .....	1
B. Existing Conditions .....	4
C. Projected Roadway Improvements .....	7
<b>IV. Traffic Generation .....</b>	<b>9</b>
<b>V. Traffic Distribution .....</b>	<b>9</b>
<b>VI. Projected Traffic Volumes.....</b>	<b>13</b>
A. Existing Traffic .....	13
B. Historical Growth Traffic.....	13
C. Approved Development Traffic.....	13
D. Total Traffic.....	19
<b>VII. Site Access .....</b>	<b>19</b>
<b>VIII. Traffic Analysis .....</b>	<b>19</b>
A. Capital Boulevard / Jenkins Road.....	22
B. Capital Boulevard / Wake Union Church Road / Street B .....	24
C. US 1 Northbound Ramp / Durham Road.....	26
D. US 1 Southbound Ramp / Durham Road .....	27
E. Durham Road / Cloverleaf Park Drive .....	28
F. Durham Road / Retail Drive.....	29
G. Durham Road / Wake Union Church Road .....	30
H. Wake Union Church Road / Kearney Road .....	31
I. Kearney Road / Biscay Lane .....	32
J. Wake Union Church Road / Street A .....	33
K. Jenkins Road / Street A.....	34
L. Street B / Street A .....	35
<b>IX. Roundabout Analysis.....</b>	<b>36</b>
<b>X. Recommendations .....</b>	<b>36</b>
<b>XI. Conclusions.....</b>	<b>37</b>
<b>XII. References .....</b>	<b>39</b>

# Table of Contents

## APPENDICES

Appendix A	Traffic Data
Appendix B	Capacity Software Output

## LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	<u>Page No.</u>
1	Traffic Generation .....	9
2	Level of Service Criteria .....	20
3	Level of Service – Capital Boulevard / Jenkins Road.....	23
4	Level of Service – Capital Boulevard / Wake Union Church Road / Street B ....	25
5	Level of Service – US 1 Northbound Ramp / Durham Road .....	26
6	Level of Service – US 1 Southbound Ramp / Durham Road .....	27
7	Level of Service – Durham Road / Cloverleaf Park Drive .....	28
8	Level of Service – Durham Road / Retail Drive.....	29
9	Level of Service – Durham Road / Wake Union Church Road .....	30
10	Level of Service – Wake Union Church Road / Kearney Road .....	31
11	Level of Service – Kearney Road / Biscay Lane .....	32
12	Level of Service – Wake Union Church Road / Street A .....	33
13	Level of Service – Jenkins Road / Street A.....	34
14	Level of Service – Street B / Street A .....	35
15	Roundabout Analysis Summary.....	36

# Table of Contents

## LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	<u>Page No.</u>
1	Vicinity Map .....	2
2	Site Plan Sketch .....	3
3	Existing Lane Configurations and Traffic Control.....	8
4	Direction of Approach and Departure .....	11
4A	Direction of Approach and Departure with Jenkins Road Cut-Through .....	12
5	Existing 2008 AM & PM Peak Hour Traffic Volumes.....	14
6	Projected 2011 AM Peak Hour No-Build Out Traffic Volumes.....	15
6A	Projected 2011 PM Peak Hour No-Build Out Traffic Volumes .....	16
7	Projected 2011 AM Peak Hour Build Out Traffic Volumes .....	17
7A	Projected 2011 PM Peak Hour Build Out Traffic Volumes .....	18
8	Recommended Lane Configurations and Traffic Control.....	38

## **I. Executive Summary**

### **Introduction**

The proposed Wake Union Place development is planned to be located along the west side of Capital Boulevard, at the intersection of Capital Boulevard and Wake Union Church Road, in Wake Forest, North Carolina. This proposed development is planned to consist of approximately 373,005 square feet of retail and five (5) outparcels.

The purpose of this report is to evaluate the proposed development in terms of projected traffic conditions, evaluate the ability of the adjacent roadways to accommodate the additional traffic volumes, and to recommend transportation improvements needed to mitigate congestion that may result from the additional site traffic. This report presents trip generation, trip distribution, traffic analyses, and recommendations for transportation improvements needed to meet anticipated traffic demands. This report examines existing conditions, 2011 No-Build conditions, and 2011 Build Out conditions.

### **Site Access**

According to the Preliminary Sketch Plan provided by Kimley-Horn and Associates, Inc. the development is proposed to have one (1) full-movement access to Capital Boulevard at the existing Wake Union Church Road / Capital Boulevard intersection. Additionally the development will provide a realignment of Wake Union Church Road (Future Street A) and a connection to the neighboring subdivision of St. Ives via Lola Lane. Analysis performed as part of this study indicated a need for an additional access to Jenkins Road with the extension of the proposed "Street A" within the development.

### **Trip Generation**

The proposed development is expected to generate approximately 24,323 trips per average weekday with 923 new trips occurring during the morning peak hour and 1,551 new trips occurring during the afternoon peak hour.

### **Capacity Analysis**

A summary of the Highway Capacity Software Analysis analyzed using Synchro version 7.0 is shown in the following table:

Wake Union Place Level-of-Service Summary						
	2008 Existing		2011 No-Build		2011 Build Out	
Intersection	AM	PM	AM	PM	AM	PM
Capital Boulevard / Jenkins Road	D (56.1)	D (40.4)	F (170.9) F (109.1)*	F (184.8) F (155.0)*	F (185.0) F (135.0)*	F (455.1) F (250.9)*
Capital Boulevard / Wake Union Church Road / Street B	B (19.4)	D (47.9)	F (86.7) E (64.7)*	F (149.0) F (126.6)*	F (137.5) E (64.1)**	F (345.0) F (145.5)**
US 1 Northbound Ramp / Durham Road	C (26.5)	C (23.1)	C (24.0)	B (15.9)	C (23.1)	B (14.9)
US 1 Southbound Ramp / Durham Road	C (20.4)	B (11.2)	C (22.9)	B (13.1)	C (23.2)	B (15.0)
Durham Road / Cloverleaf Park Drive	B (19.0)	C (21.6)	C (23.8)	C (26.1)	C (23.6)	C (26.0)
Durham Road / Retail Drive	B (18.2)	B (19.1)	C (21.1)	C (22.9)	C (21.5)	C (22.8)
Durham Road / Wake Union Church Road	# (10.3) F (107.4) SB	# (35.2) F (352.4) SB	# (6.7) F (51.3) SB	# (14.6) F (98.2) SB	# (12.4) F (86.2) SB	# (48.5) F (299.5) SB
Wake Union Church Road / Kearney Road	# (2.8) B (13.2) SB	# (4.2) D (25.9) SB	# (2.9) B (14.2) SB	# (5.1) D (33.4) SB	# (3.1) C (16.7) SB	# (9.6) F (75.5) SB
Kearney Road / Biscay Lane	# (2.3) A (9.0) WB	# (0.7) A (9.7) WB	# (2.3) A (9.1) WB	# (0.7) A (9.9) WB	# (2.1) A (9.2) WB	# (0.7) B (10.1) WB
Wake Union Church Road / Street A	N/A	N/A	N/A	N/A	# (11.7) B (12.4) EB	# (100.6) F (166.2) EB
Jenkins Road / Street A	N/A	N/A	N/A	N/A	# (6.0) C (15.2) NB	# (17.1) E (40.9) NB
Street B / Street A	N/A	N/A	N/A	N/A	# (13.6) B (14.9) WB	# (187.7) F (154.7) WB
<u>Note:</u> # - No letter value assigned by Synchro, only overall intersection delay * - With Optimized Timings ** - With additional NB left turn lane and addition eastbound right lane						

The signalized **Capital Boulevard / Jenkins Road** intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS D during the AM and PM peak hours. The intersection is expected to operate at LOS F in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing, with an additional westbound left turn lane on Stadium Drive (built by others), and the addition of approved development traffic. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to continue to operate at LOS F with increases of 14.1 and 270.3 seconds of delay per vehicle during the AM and PM peak hours, respectively. To alleviate some of the substantial delay, it is recommended that the signal timing be optimized with a cycle length of 140 seconds. With this improvement, the overall intersection delay is expected to decrease by 50.0 and 204.2 seconds of delay per vehicle during the AM and PM peak hours, respectively.

WSA investigated the possibility of turn lane improvements at this intersection, but these improvements did not substantially reduce the projected delays in the 2011 Build conditions. Due to the limited right-of-way along Jenkins Road, it is not feasible to install dual left turn lanes from Capital Boulevard onto Jenkins Road.

The signalized **Capital Boulevard / Wake Union Church Road** intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS B during the AM peak hour and at LOS D during the PM peak hour. The intersection is expected to operate at LOS F in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing and the addition of approved development traffic. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with increases of 50.8 and 196.0 seconds of delay per vehicle during the AM and PM peak hours, respectively. The project team was unable to develop turn lane or signal timing improvements at this intersection that will allow it to operate at a reasonable level of service (LOS) in the AM or PM peak hour. In order to improve traffic operations, it is recommended that the signal timing be optimized to a 140 seconds cycle length, an additional northbound left turn lane be constructed on Capital Boulevard, and a right turn lane be constructed on Street B. With these improvements, the overall intersection delay is expected to decrease by 73.4 and 199.5 seconds per vehicle during the AM and PM peak hours, respectively.

The signalized **US 1 Northbound Ramp / Durham Road** intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS C during the AM and PM peak hours. The intersection is expected to continue to operate at LOS C in the AM peak hour and at LOS B during the PM peak hour for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with decreases of 0.9 and 1.0 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended at this intersection.

The signalized **US 1 Southbound Ramp / Durham Road** intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS C during the AM peak hour and LOS B during the PM peak hour. The intersection is expected to continue to operate at LOS C during the AM peak hour and LOS B during the PM peak hour for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with increases of 0.3 and 1.9 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

The signalized **Durham Road / Cloverleaf Park Drive** intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS B during the AM and PM peak hours. The intersection is expected to continue to operate at LOS B in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with decreases of

0.2 seconds of delay per vehicle during the AM peak hour and 0.1 seconds of delay during the PM peak hour. No improvements are recommended at this intersection.

The signalized **Durham Road / Retail Drive** intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS B during the AM and PM peak hours. The intersection is expected to operate at LOS C in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with changes in delay of 0.4 and -0.1 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Capacity analyses indicate that the unsignalized intersection of **Durham Road / Wake Union Church Road** currently operates with minimal overall delay during the AM and PM peak hours. The major eastbound and westbound movement in the existing scenario is operating at LOS A during the AM and PM peak hours. However the southbound minor street movements are operating with heavy delays during the PM peak hour due to the heavier through volumes along Durham Road. The southbound minor movement is expected to operate at LOS F during the AM and PM peak hours in 2011 without the proposed development with a reduction in delay of 56.1 and 254.2 seconds per vehicle. This reduction in delay is the result of the completion of the NC 98 Bypass and the reduction in vehicular traffic along Durham Road. For the 2011 Build scenario with the additional site traffic at the intersection, the southbound minor movement is expected to operate at LOS F during the AM and PM peak hours with increases of 34.9 and 201.3 seconds of delay per vehicle during the AM and PM peak hours, respectively, with delays expected to be less than the 2008 existing conditions. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Capacity analyses indicate that the unsignalized intersection of **Wake Union Church Road / Kearney Road** currently operates with minimal overall delay during the AM and PM peak hours. The major eastbound and westbound movement in the existing is operating at LOS A during the AM and PM peak hours. However the southbound and northbound minor street movements are operating with moderate delays during the PM peak hour due to the heavier through volumes along Wake Union Church Road. The southbound minor movement is expected to operate at LOS B during the AM peak hour and at LOS D during the PM peak hour without the proposed development in 2011. For the 2011 Build scenario with the additional site traffic at the intersection, the southbound minor movement is expected to operate at LOS C during the AM peak hour and at LOS F during the PM peak hour with increases of 2.5 and 42.1 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Capacity analyses indicate that the unsignalized intersection of **Kearney Road / Biscay Lane** currently operates with minimal overall delay during the AM and PM peak hours. The minor westbound movement in the existing is operating at LOS A during the AM and PM peak hours. The minor westbound approach is expected to continue to operate at LOS A during the AM and

PM peak hours without the proposed development. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at LOS A during the AM peak hour and LOS B during the PM peak hour with increases of 0.1 and 0.2 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

The proposed intersection of **Wake Union Church Road / Street A** is predicted to operate with overall delays of 11.7 and 100.6 seconds per vehicle in the AM and PM peak hours, respectively after project buildout. Delays during the PM peak hour are expected to be moderate to heavy, which is not uncommon at unsignalized intersections during peak hours. In order to improve traffic operations, the intersection was modeled as a single-lane roundabout. As a single-lane roundabout, this intersection is projected to operate at LOS A in the AM peak hour and LOS B in the PM peak hour.

The **Jenkins Road / Street A** intersection is the recommended secondary access point / connection for the proposed development. The proposed intersection is predicted to operate with overall delays of 6.0 and 17.1 seconds per vehicle in the AM and PM peak hours, respectively after project buildout. A westbound left turn lane on Jenkins Road is recommended to be constructed with a minimum of 200 feet of storage.

The proposed, all-way stop controlled intersection of **Street B / Street A** is predicted to operate with overall delays of 13.6 and 187.7 seconds per vehicle in the AM and PM peak hours, respectively after project buildout. Delays during the PM peak hour are expected to be moderate to heavy, which is not uncommon at unsignalized intersections during peak hours. In order to improve traffic operations, the intersection was modeled as a single-lane roundabout. As a single-lane roundabout, this intersection is projected to operate at LOS A in the AM peak hour and LOS B in the PM peak hour.

## **Recommendations**

This study shows that the proposed Wake Union Place development will add traffic on adjacent roadways and intersections and will have a significant effect on traffic operations in the vicinity of the development. The Jenkins Road and Wake Union Church Road intersections with Capital Boulevard are projected to operate at LOS F in 2011 without the project and the project team was unable to recommend any type of turn lane additions or signal timing improvements at these intersections that will allow the intersections to operate at a reasonable level of service (LOS) in the AM or PM peak hour. The following improvements are recommended as a reasonable effort to mitigate some of the delay at the subject intersections and are based on the analysis performed, on-site observations of existing traffic conditions, and North Carolina Department of Transportation (NCDOT) turn lane warrants.

## **Recommended Improvements by the Developer**

### Capital Boulevard / Wake Union Church / Street B

- Construct the site access roads to meet NCDOT standards.

- Construct an additional northbound left turn lane on Capital Boulevard with a minimum of 600 feet of full width storage.
- Construct a eastbound right turn lane on Street B with a minimum of 200 feet of full width storage.
- Lengthen the existing northbound left turn lane on Capital Boulevard to provide a minimum of 600 feet of full width storage.

Jenkins Road / Street A

- Construct a westbound left turn lane on Jenkins Road with a minimum of 200 feet of full width storage

Street B / Street A

- Construct as a single-lane roundabout

Wake Union Church Road / Street A

- Construct as a single-lane roundabout as shown on the site plan

Site Access Roadways

- Construct the site access roads to meet NCDOT standards.

## **Conclusions**

This study shows that the proposed development will have a large negative impact on traffic operations along the study area roadway network. The Jenkins Road and Wake Union Church Road intersections with Capital Boulevard are projected to operate at LOS F in 2011 without the proposed development. To improve traffic conditions internally to the site and at the proposed main access point of Capital Boulevard and Street B, a connection to Jenkins Road must be made in order to give the site traffic an additional access point. However, the improvements recommended in this report will not be sufficient to bring the Capital Boulevard intersections up to acceptable levels of service with lengthy delays still expected in the build conditions. Based on the large amount of traffic on Capital Boulevard, the effects from the proposed development, and the Wake Forest Crossing development, no amount of turn lane additions or signal timing improvements will provide sufficient capacity to provide for a reasonable LOS.

In contrast, the intersections along Durham Road are expected to operate with reasonable LOS with or without the proposed development. While some diversion of project traffic to Durham Road is expected, due to the lengthy delays on Capital Boulevard, these intersections should operate with reasonable levels of service and delay in the AM and PM peak hours.

## **II. Introduction**

The proposed Wake Union Place development is planned to be located along the west side of Capital Boulevard, at the intersection of Capital Boulevard and Wake Union Church Road, in Wake Forest, North Carolina. This proposed development is planned to consist of approximately 373,005 square feet of retail and five (5) outparcels. The site location is illustrated in Figure 1.

The purpose of this report is to evaluate the proposed development in terms of projected traffic conditions, evaluate the ability of the adjacent roadways to accommodate the additional traffic volumes, and to recommend transportation improvements needed to mitigate congestion that may result from the additional site traffic. This report presents trip generation, trip distribution, traffic analyses, and recommendations for transportation improvements needed to meet anticipated traffic demands. This report examines existing conditions, 2011 No-Build conditions, and 2011 Build Out conditions.

## **III. Inventory of Traffic Conditions**

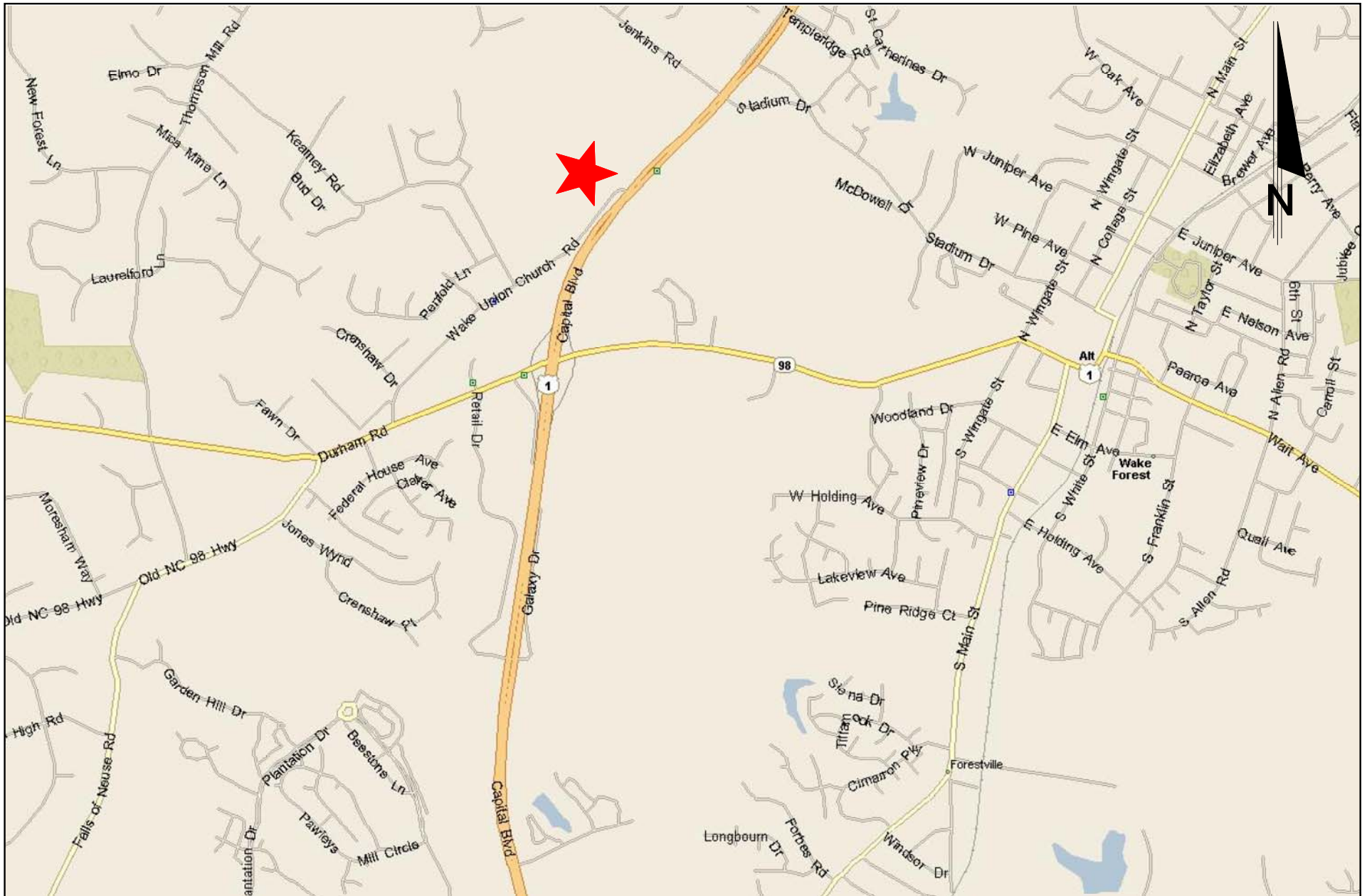
### **A. Study Area**

The following intersections will be analyzed to determine the associated impacts from the proposed development:

- ◆ Capital Boulevard / Jenkins Road (signalized)
- ◆ Capital Boulevard / Wake Union Church Road / (Future Street B (signalized) )
- ◆ US 1 Northbound Ramp / Durham Road (signalized)
- ◆ US 1 Southbound Ramp / Durham Road (signalized)
- ◆ Durham Road / Cloverleaf Park Drive (signalized)
- ◆ Durham Road / Retail Drive (signalized)
- ◆ Durham Road / Wake Union Church Road (unsignalized)
- ◆ Wake Union Church Road / Kearney Road (unsignalized)
- ◆ Kearney Road / Biscay Lane (unsignalized)
- ◆ Wake Union Church Road / Future Street A (unsignalized)
- ◆ Jenkins Road / Street A (unsignalized)
- ◆ Street B / Street A (unsignalized) / Lola Lane

According to the Preliminary Sketch Plan provided by Kimley-Horn and Associates, Inc. the development is proposed to have one (1) full-movement access to Capital Boulevard at the existing Wake Union Church Road / Capital Boulevard intersection. Additionally the development will provide a realignment of Wake Union Church Road (Future Street A) and a connection to the neighboring subdivision of St. Ives via Lola Lane. There may also be additional access to Jenkins Road with the extension of the proposed "Street A" within the development.

Figure 2 illustrates the property where the development will be constructed.



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WAKE UNION PLACE  
 TRAFFIC IMPACT ANALYSIS  
 WAKE FOREST, NORTH CAROLINA

VICINITY MAP

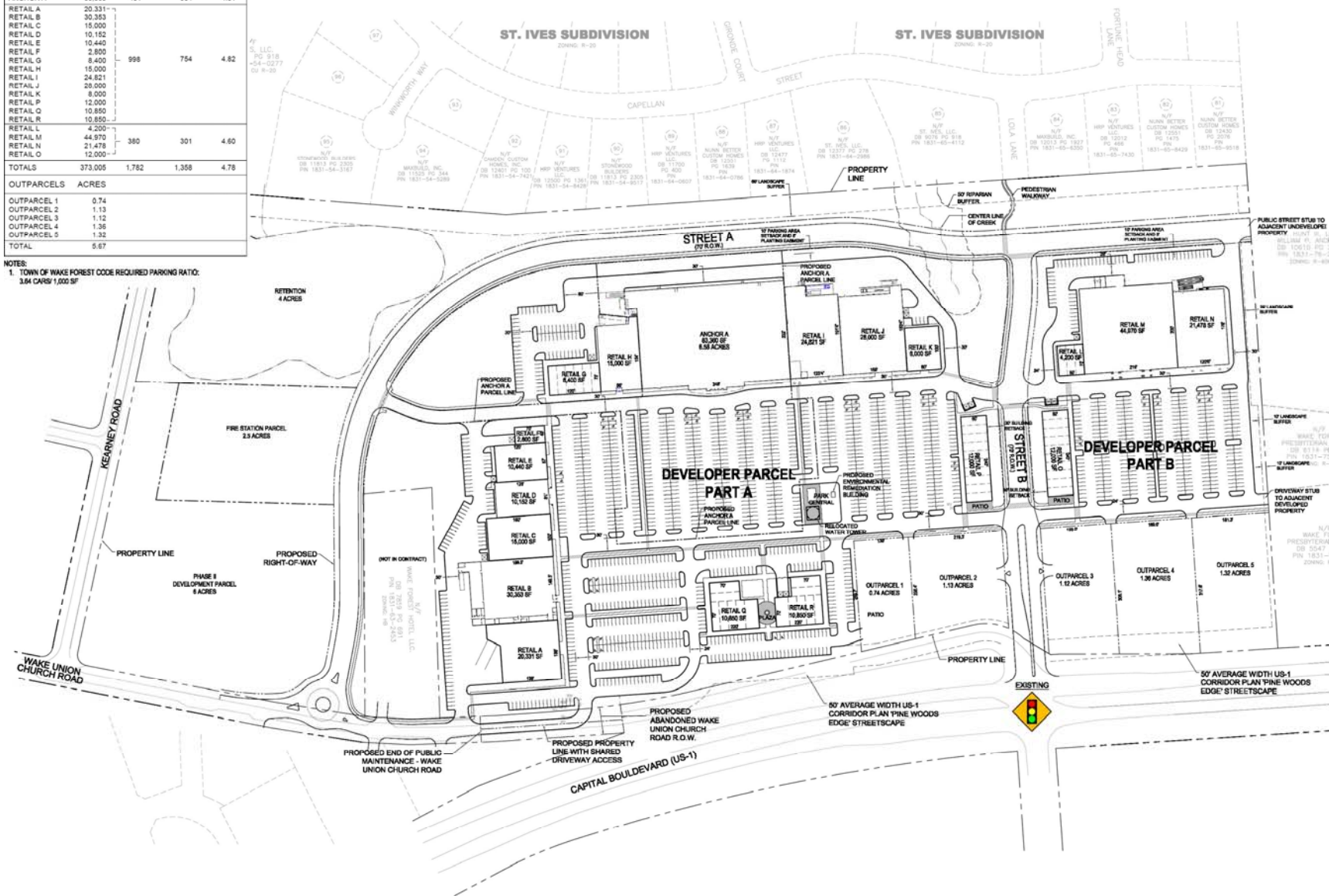
FIGURE: 1

SCALE:  
 NONE

# **SITE SUMMARY:**

RETAIL	AREA (S.F.)	PARKING PROVIDED	PARKING REQUIRED	RATIO
ANCHOR A	83,360	401	304	4.81
RETAIL A	20,331			
RETAIL B	30,353			
RETAIL C	15,000			
RETAIL D	10,152			
RETAIL E	10,440			
RETAIL F	2,800			
RETAIL G	8,400	998	754	4.82
RETAIL H	15,000			
RETAIL I	24,821			
RETAIL J	20,000			
RETAIL K	8,000			
RETAIL L	12,000			
RETAIL M	10,850			
RETAIL N	4,200			
RETAIL O	44,970	380	301	4.60
RETAIL P	21,478			
RETAIL Q	12,000			
TOTALS	373,005	1,762	1,358	4.78
OUTPARCELS	ACRES			
OUTPARCEL 1	0.74			
OUTPARCEL 2	1.13			
OUTPARCEL 3	1.12			
OUTPARCEL 4	1.36			
OUTPARCEL 5	1.32			
TOTAL	5.67			

NOTES:  
1. TOWN OF WAKE FOREST CODE REQUIRED PARKING RATIO:  
3.64 CARS/1,000 SF



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WAKE UNION PLACE  
TRAFFIC IMPACT ANALYSIS  
WAKE FOREST, NORTH CAROLINA

SITE PLAN SKETCH

FIGURE 2

SCALE:  
NONE

## B. Existing Conditions

The following section briefly describes the roadways in the vicinity of the proposed development.

**Capital Boulevard (US 1)** is a four-lane major thoroughfare in the project vicinity. It serves as a north-south connector that connects the Wake Forest area to Raleigh. The 2005 Average Daily Traffic (ADT) volume reported by NCDOT<sup>1</sup> indicated that Capital Boulevard carries approximately 34,000 vehicles per day (VPD) just north of the Jenkins Road intersection. The speed limit on Capital Boulevard is 55 mph in the project vicinity.



*Capital Boulevard looking north*

**Durham Road (NC 98)** is a two-lane roadway approximately 24-feet wide, with 60 feet of right-of-way from the Retail Drive intersection westward. Durham Road is a five-lane roadway in the vicinity of the Capital Boulevard (US 1) interchange. The 2005 Average Daily Traffic (ADT) volume reported by NCDOT<sup>1</sup> indicated that Durham Road carries approximately 13,000 vehicles per day (VPD) east of the Capital Boulevard (US 1) interchange. The surrounding land uses is primarily commercial/retail. The posted speed limit on Durham Road is 35 mph.



*Durham Road looking east*

**Cloverleaf Park Drive** is a two-lane collector street with 50 feet of right-of-way in the vicinity of the project that extends into commercial/retail developments from Durham Road to the north and south. The posted speed limit on Cloverleaf Park Drive is 35 mph.



*Cloverleaf Park Drive looking north*

**Retail Drive** is a two-lane roadway with 50 feet of right-of-way in the vicinity of the project that extends into commercial/retail developments from Durham Road to the north and south. Retail Drive is proposed to eventually connect with the NC 98 Business interchange with Capital Boulevard. The speed limit on Retail Drive is 35 mph.



*Retail Drive looking north*

**Jenkins Road (SR 1926)** is a two-lane roadway with 50 feet of right-of-way in the vicinity of the project that extends from the Thompson Mill Road to the west and connects with Capital Boulevard to the east. The 2008 Average Daily Traffic (ADT) volume recorded by Greene Transportation Solutions, PC indicated that Jenkins Road carries approximately 4,800 vehicles per day (VPD) just west of the Capital Boulevard intersection. The speed limit on Jenkins Road is 45 mph.



*Jenkins Road looking west at  
Capital Boulevard*

**Wake Union Church Road (SR 1929)** is a two-lane roadway approximately 24-feet wide, with 60 feet of right-of-way, that connects downtown Capital Boulevard to the east with Durham Road to the west. The surrounding land uses is primarily commercial. The 2008 Average Daily Traffic (ADT) volume recorded by Greene Transportation Solutions, PC indicated that Wake Union Church Road carries approximately 7,400 vehicles per day (VPD) just west of the Capital Boulevard intersection. The posted speed limit on Wake Union Church Road is 45 mph.



*Wake Union Church Road looking west*

**Kearney Road** is a two-lane roadway approximately 24-feet wide, with 60 feet of right-of-way, that connects Wake Union Church Road to the south with Thompson Mill Road to the north. The surrounding land uses is primarily residential. The posted speed limit on Kearney Road is 35 mph.



*Kearney Road looking north*

**Biscay Lane** is a two-lane roadway approximately 24-feet wide, with 60 feet of right-of-way, that connects to Kearney Road to the west with St. Ives subdivision to the east. The surrounding land uses is residential. The posted speed limit on Biscay Lane is 25 mph.

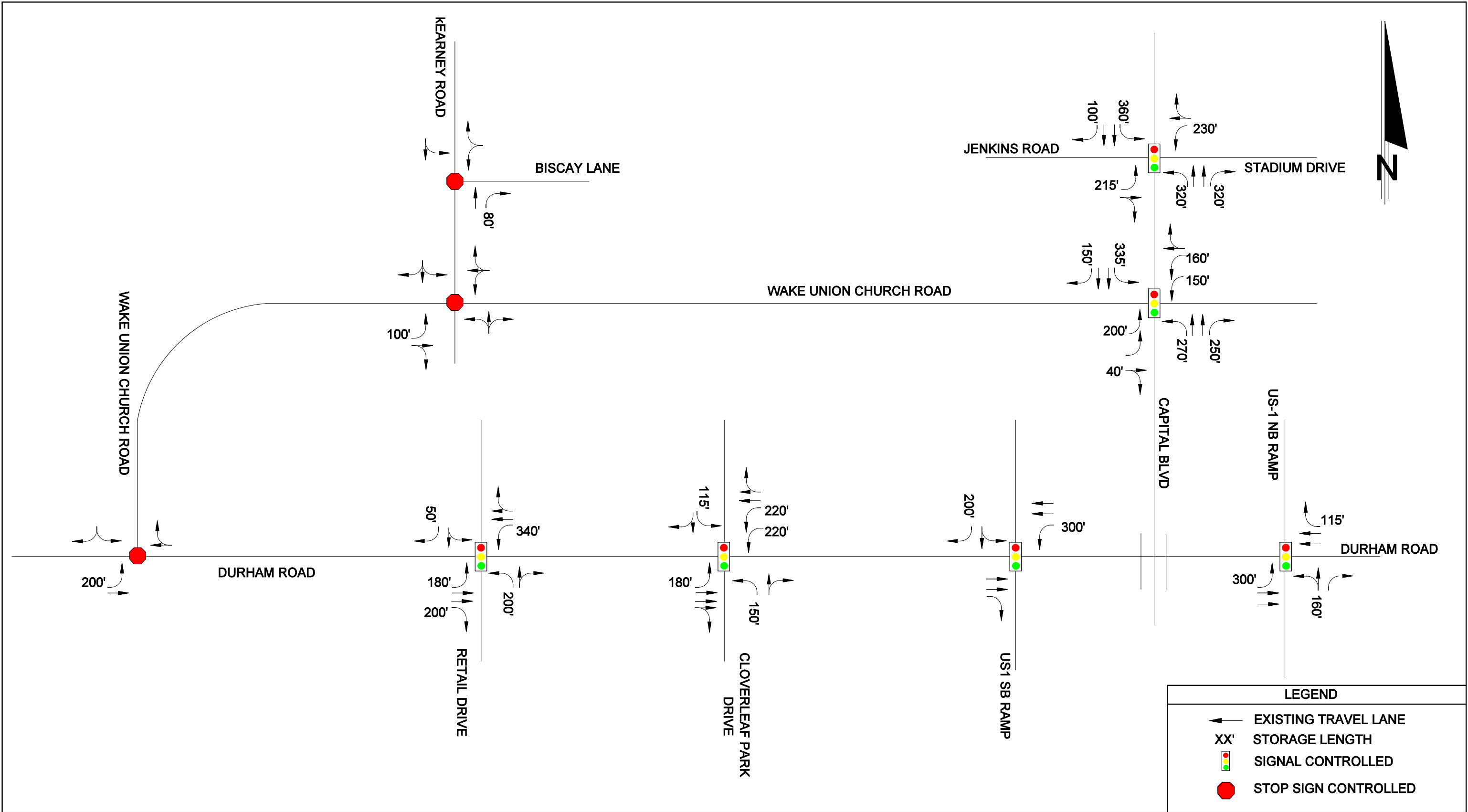


*Kearney Road looking north at Biscay Lane*

The existing lane configurations and traffic control for this area are shown on Figure 3.

### **C. Projected Roadway Improvements**

Currently, there is one (1) known significant transportation improvement project in the vicinity of the proposed development that will be constructed by 2011. TIP project R-2809 is proposing to tie NC 98 (just west of Thompson Road) to Capital Boulevard to form the remainder of the NC 98 Bypass. Right of Way is currently being acquired, but for the purposes of this report, completion of the project is assumed to take place by 2011. Based on the traffic forecast report completed by NCDOT in 1997, a 50% reduction was taken for the northbound left turning movement off of Capital Boulevard onto Durham Road at the US-1/NC 98 northbound ramp intersection as well as a 50% reduction taken for the eastbound right turning movement at the US-1/NC 98 southbound ramp intersection. A 20% reduction was also taken for the westbound/eastbound through movements at the US-1/NC 98 northbound ramp intersection. These reductions are also reflected along the Durham Road corridor.



#### IV. Traffic Generation

The amount of traffic generated by a new development is a function of the size and type of development. Once the proposed land use data for the site are known, the number of trips generated by the development can be estimated. Trip generation data for this report was determined in accordance with the procedures outlined in the Institute of Transportation Engineers (ITE) report entitled *Trip Generation*<sup>2</sup>. Trip generation estimates were developed in terms of vehicle trips per average weekday.

Traffic impact is determined by estimating the total number of daily vehicle trips, as well as the number of peak hour vehicle trips. It should be recognized that a percentage of these trips are assumed to remain within the proposed site. Due to the mix of retail uses within the proposed Wake Union Place development, an internal capture rate of 5% was assumed to account for the reduction in peak hour trips the proposed development will generate during an average weekday.

Table 1 summarizes the estimated traffic generation for the proposed development.

<b>Table 1</b> <b>ITE Traffic Generation<sup>2</sup></b> <b>(Vehicles)</b>						
Land Use (LU Code)	Density	24 Hour Two-way Weekday Volume	AM Peak		PM Peak	
			In	Out	In	Out
Shopping Center	373,005 s.f.	20,201	210	134	716	776
<i>Internal Capture (-5%)</i>			-10	-7	-35	-38
<i>Pass Bys (-26% PM)</i>			-	-	-177	-192
Drive-in Bank	4 drive-in lanes	1,645	99	96	166	154
<i>Internal Capture (-5%)</i>			-5	-5	-8	-8
<i>Pass Bys (-47% PM)</i>			-	-	-74	-69
Fast Food w/ Drive Thru (2)	10,000 s.f.	4,962	280	268	242	224
<i>Internal Capture (-5%)</i>			-14	-13	-12	-11
<i>Pass Bys (-49% AM / -50% PM)</i>			-130	-124	-114	-106
High Turnover / Sit Down Rest	8,000 s.f.	1,017	56	52	83	67
<i>Internal Capture (-5%)</i>			-3	-3	-5	-5
<i>Pass Bys (-43% PM)</i>			-	-	-34	-27
Quality Rest	8,000 s.f.	720	37	8	45	27
<i>Internal Capture (-5%)</i>			-2	-0	-2	-1
<i>Pass Bys (-44% PM)</i>			-	-	-19	-11
Subtotal			682	558	1252	1248
Total Pass By's			-130	-125	-419	-405
<i>Internal Capture (-5%)</i>			-34	-28	-62	-63
<b>Total New Trips</b>		<b>24,323</b>	<b>518</b>	<b>405</b>	<b>771</b>	<b>780</b>

Table 1 indicates the proposed development is expected to generate approximately 24,323 trips per average weekday with 923 trips occurring during the morning peak hour and 1,551 trips occurring during the afternoon peak hour.

## **V. Traffic Distribution**

In order to properly determine the impact of the traffic generated by the proposed development, it is necessary to determine the distribution of traffic to and from the development. These percentages are based on the projected traffic patterns and population and employment centers in the area.

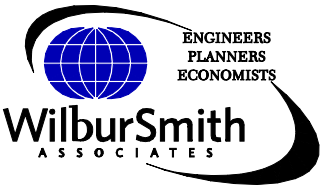
The traffic generated by for this project was distributed as follows:

- 45% to/from the south on Capital Boulevard
- 25% to/from the north on Capital Boulevard
- 10% to/from the east on Durham Road
- 13% to/from the west on Durham Road
- 5% to/from the east on Stadium Road
- 3% to/from the north on Kearney Road

As indicated here, very little project traffic, if any, is expected to utilize Lola Lane to access the proposed development, given the long distance between the exit of the development and Kearney Road. However, some residents of the adjacent St. Ives subdivision may use the project roadways to access Capital Boulevard, although the impact of this traffic is expected to be minor.

These distributions are illustrated on Figures 4 and 4A. Figure 4A assumes a connection with Jenkins Road using Street A, however the global distributions remain the same as shown above.





## **VI. Projected Traffic Volumes**

### **A. Existing Traffic**

Morning (7-9 am) and afternoon (4-6 pm) peak hour traffic counts were taken by Greene Transportation Solutions, PC at the following locations:

- ◆ Capital Boulevard / Jenkins Road
- ◆ Capital Boulevard / Wake Union Church Road
- ◆ US 1 Northbound Ramp / Durham Road
- ◆ US 1 Southbound Ramp / Durham Road
- ◆ Durham Road / Cloverleaf Park Drive
- ◆ Durham Road / Retail Drive
- ◆ Durham Road / Wake Union Church Road
- ◆ Wake Union Church Road / Kearney Road
- ◆ Kearney Road / Biscay Lane

Additionally, 48 hour tube counts were taken by Greene Transportation Solutions, PC at the following locations:

- ◆ Jenkins Road
- ◆ Wake Union Church Road

Raw count data for these locations are included in Appendix A. These traffic volumes are shown on Figure 5.

### **B. Historical Traffic Growth**

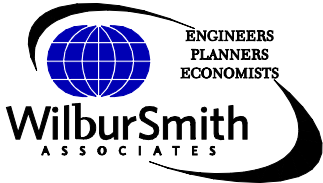
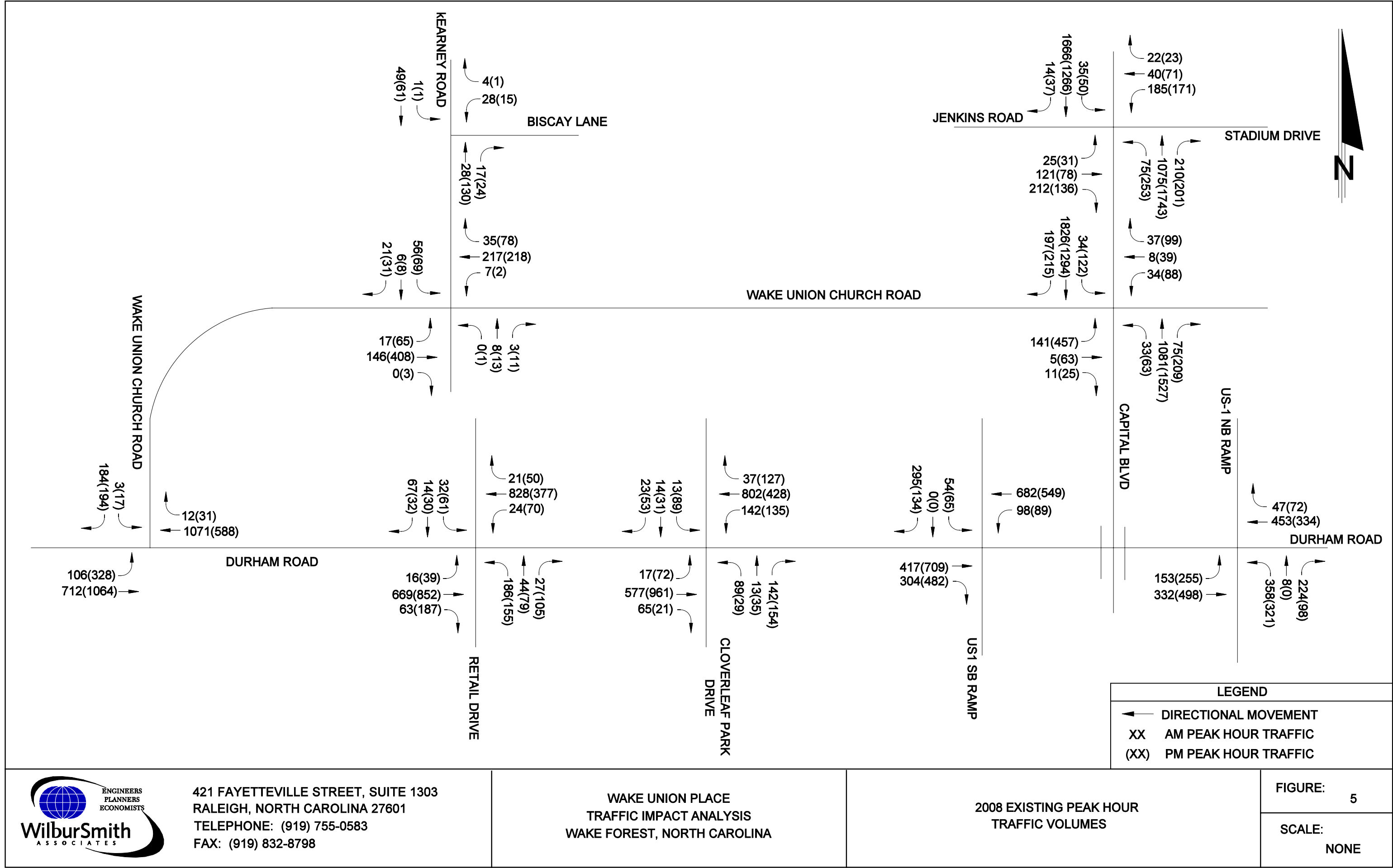
Historical growth traffic is the increase in traffic volumes due to usage increases and non-specific growth throughout the area. For this project, volumes were increased by 3.0 percent per year to the year 2011 to reflect anticipated background traffic volumes. These traffic volumes are illustrated as “no-build traffic” on Figures 6, 6A, 7, and 7A.

### **C. Approved Development Traffic**

Approved development traffic is traffic generated by specific approved but not yet constructed projects within the vicinity of the subject project. There is one (1) known approved development project in the immediate vicinity of the proposed development.

#### **Wake Forest Crossing Shopping Center**

This development is located adjacent the proposed Wake Union Place development, on the east side of Capital Boulevard, with approximately 192,000 square feet of retail and seven (7) outparcels. For the purposes of trip generation, three (3) fast food restaurants, two (2) high-turnover/sit down restaurants, a quality restaurant, and a drive-in bank were assumed as the outparcels. As a part of the build out of the Wake Forest Crossing Shopping Center, an additional westbound left turn lane will be constructed on Stadium Drive and is included in the 2011 No-Build and Build analyses. Site traffic from this development is included as Approved Development traffic on Figures 6 and 6A. A table displaying the trip generation used for the Wake Forest Crossing Shopping Center is included in Appendix A.

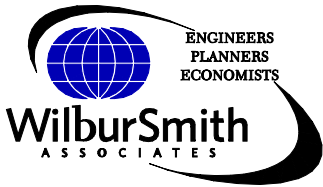
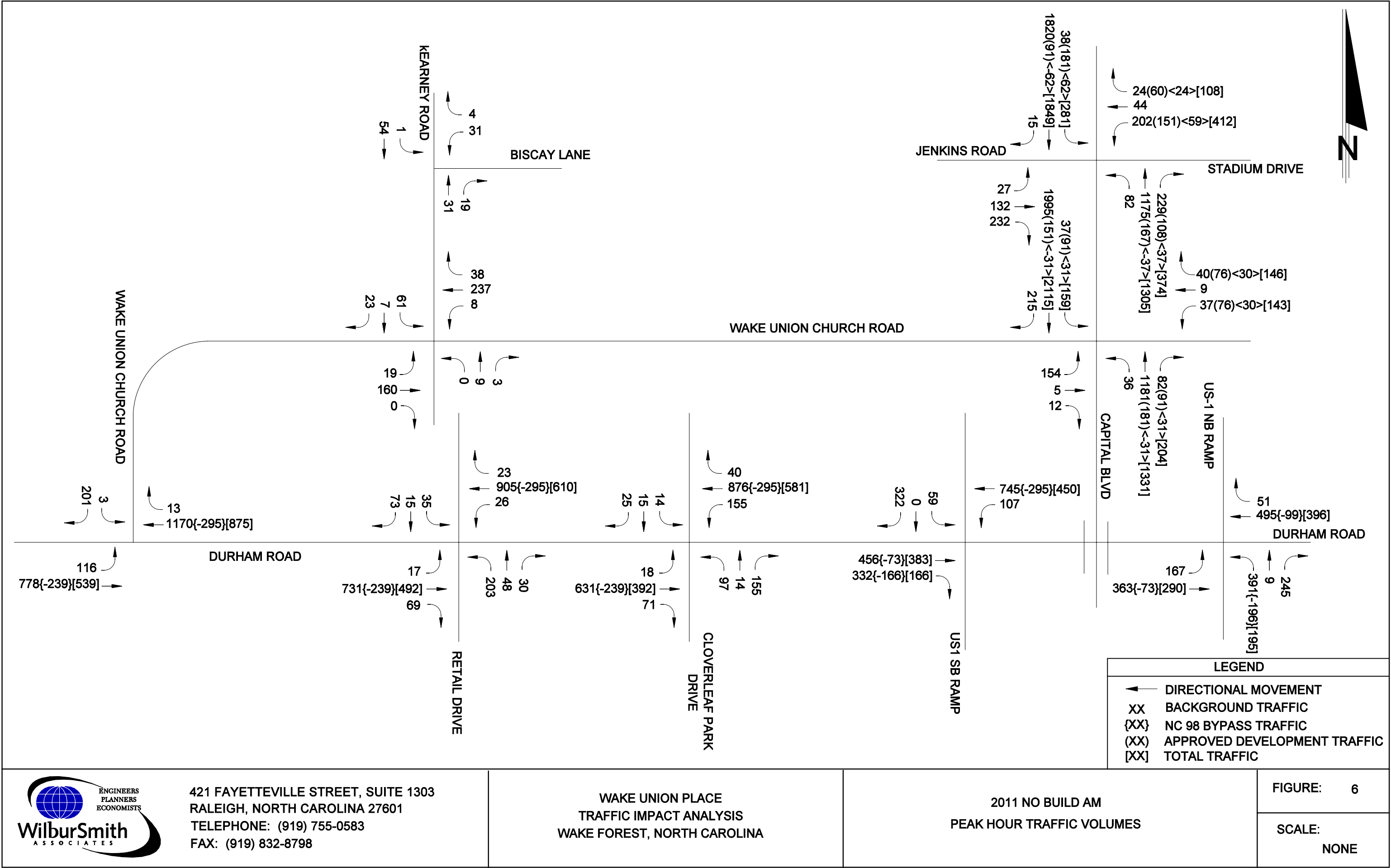


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WAKE UNION PLACE  
TRAFFIC IMPACT ANALYSIS  
WAKE FOREST, NORTH CAROLINA

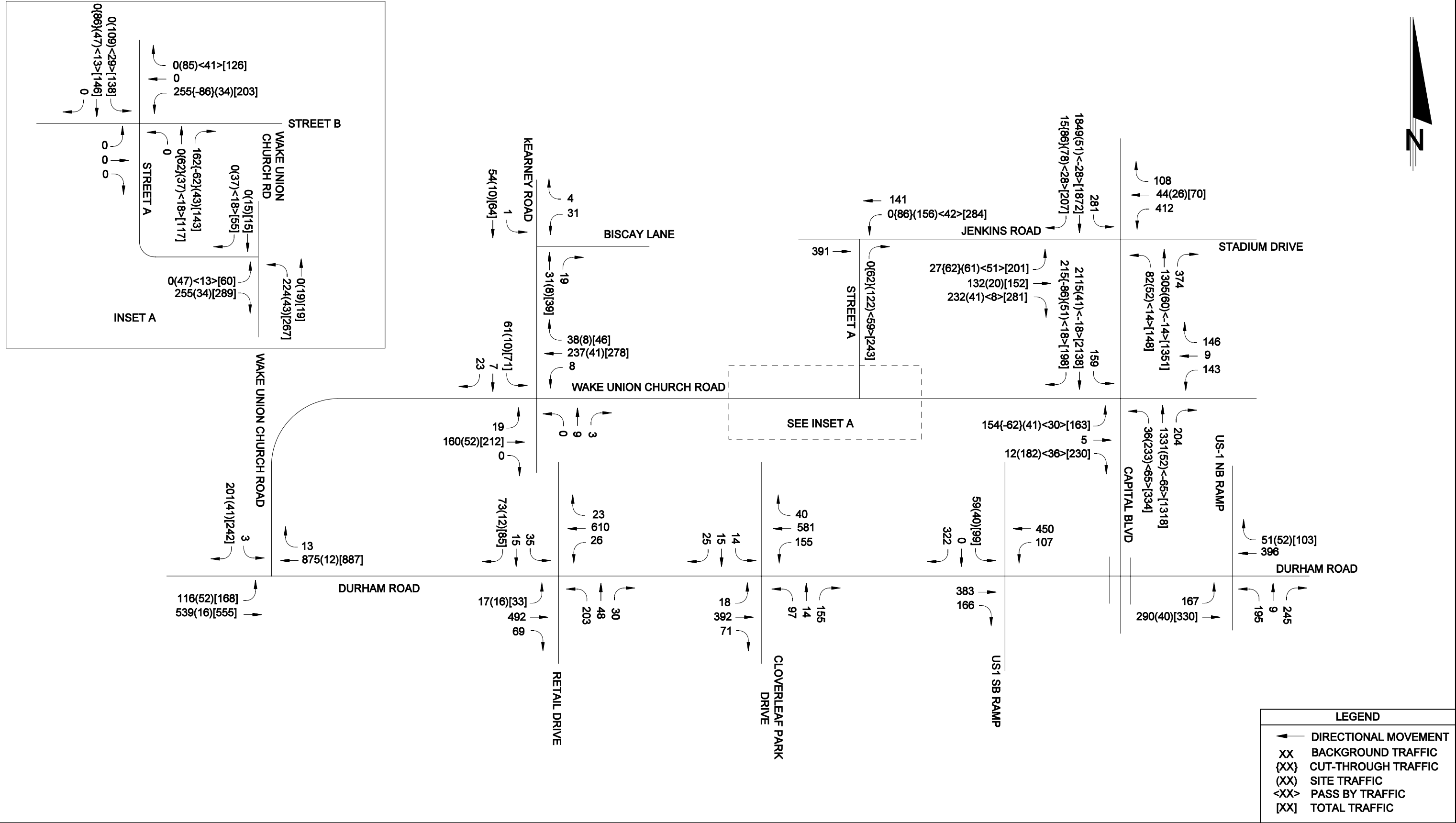
2008 EXISTING PEAK HOUR  
TRAFFIC VOLUMES

FIGURE: 5  
SCALE: NONE



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WAKE UNION PLACE  
TRAFFIC IMPACT ANALYSIS  
WAKE FOREST, NORTH CAROLINA

2011 BUILD AM  
PEAK HOUR TRAFFIC VOLUMES

FIGURE: 7

SCALE:  
NONE



#### **D. Total Traffic**

To obtain total 2011 Build Out traffic volumes, the site traffic was added to the no-build traffic volumes. The AM and PM peak-hour turning movements for the studied intersections were then calculated and analyzed for the 2011 Build Out year. These traffic volumes are illustrated on Figures 7 and 7A.

#### **VII. Site Access**

According to the Preliminary Sketch Plan provided by Kimley-Horn and Associates, Inc. the development is proposed to have one (1) full-movement access to Capital Boulevard at the existing Wake Union Church Road / Capital Boulevard intersection. Additionally the development will provide a realignment of Wake Union Church Road (Future Street A) and a connection to the neighboring subdivision of St. Ives via Lola Lane. There may also be additional access to Jenkins Road with the extension of the proposed "Street A" within the development.

#### **VIII. Traffic Analysis**

The study area intersections were analyzed using the methods outlined in the *Highway Capacity Manual*<sup>3</sup> and Synchro Version 7.0 Software. The Highway Capacity 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."

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 pertain to each approach as well as an overall value. The unsignalized intersection analysis method in the Highway Capacity Manual assigns LOS values for each movement that yields the right-of-way, but not to the overall intersection. This movement is generally a secondary movement from a 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. Synchro Version 7.0 will calculate an amount of delay for the overall intersection, but will not assign a LOS value. Therefore, the overall intersection delay as well as the amount of delay on the minor street is reported in the summary tables of this report. Generally, Level of Service D is acceptable for signalized intersections in suburban areas during peak periods. With the current method of reporting levels of service for unsignalized intersections, it is not uncommon for some of the minor street movements to be operating at a LOS F during the peak hours.

Table 2 presents criteria of each level of service as indicated in the *Highway Capacity Manual*<sup>3</sup>.

**TABLE 2  
LEVEL OF SERVICE CRITERIA**

<b>SIGNALIZED INTERSECTIONS</b>	
<b><u>Level of Service</u></b>	<b><u>Stopped Delay Per Vehicle (sec)</u></b>
A	$\leq 10.0$
B	$> 10.0$ and $\leq 20.0$
C	$> 20.0$ and $\leq 35.0$
D	$> 35.0$ and $\leq 55.0$
E	$> 55.0$ and $\leq 80.0$
F	$> 80.0$
<b>UNSIGNALIZED INTERSECTIONS</b>	
<b><u>Level of Service</u></b>	<b><u>Average Total Delay (sec/veh)</u></b>
A	$\leq 10$
B	$> 10$ and $\leq 15$
C	$> 15$ and $\leq 25$
D	$> 25$ and $\leq 35$
E	$> 35$ and $\leq 50$
F	$> 50$

Source: *Highway Capacity Manual*<sup>3</sup>, Special Report 209, Transportation Research Board, National Research Council, Washington, D.C., 1998

Capacity analyses were performed for existing conditions, 2011 No Build, and 2011 Build Out conditions for the following intersections:

- ◆ Capital Boulevard / Jenkins Road (signalized)
- ◆ Capital Boulevard / Wake Union Church Road / Street B (signalized)
- ◆ US 1 Northbound Ramp / Durham Road (signalized)
- ◆ US 1 Southbound Ramp / Durham Road (signalized)
- ◆ Durham Road / Cloverleaf Park Drive (signalized)
- ◆ Durham Road / Retail Drive (signalized)
- ◆ Durham Road / Wake Union Church Road (unsignalized)
- ◆ Wake Union Church Road / Kearney Road (unsignalized)
- ◆ Kearney Road / Biscay Lane (unsignalized)
- ◆ Wake Union Church Road / Street A (unsignalized)
- ◆ Jenkins Road / Street A (unsignalized)
- ◆ Street B / Street A (unsignalized)

The AM and PM peak hours were analyzed for the studied intersections. Synchro 7.0 calculated the level of service and delay for each intersection using methods outlined in the *Highway Capacity Manual*<sup>13</sup>.

Currently the site plan for the proposed Wake Union Place development does not plan for a connection to Jenkins Road, leaving only the main access to Capital Boulevard and access to Wake Union Church Road and the neighboring subdivision of St. Ives. WSA analyzed the development as planned with this access serving the majority of project traffic. Based on this analysis, all movements at the intersection of Street B and Capital Boulevard are predicted to operate at LOS F in the AM and PM peak hours, resulting in long queues along Capital Boulevard and within the site. Based on conversations with Town staff, a connection (Street A) to Jenkins Road is recommended and will be assumed in the following sections. This will not only give site traffic an alternative route to avoid congestion, but it will also give the background traffic an alternate route which use Wake Union Church Road to access Capital Boulevard.

All capacity analyses are included in Appendix B and are briefly summarized in the following sub-sections.

## **A. Capital Boulevard / Jenkins Road**

The signalized Capital Boulevard / Jenkins Road intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS D during the AM and PM peak hours. The intersection is expected to operate at LOS F in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing, with an additional westbound left turn lane on Stadium Drive (built by others), and the addition of approved development traffic. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to continue to operate at LOS F with increases of 14.1 and 270.3 seconds of delay per vehicle during the AM and PM peak hours, respectively. To alleviate some of the substantial delay, it is recommended that the signal timing be optimized with a cycle length of 140 seconds. With this improvement, the overall intersection delay is expected to decrease by 50.0 and 204.2 seconds of delay per vehicle during the AM and PM peak hours, respectively.

WSA investigated the possibility of turn lane improvements at this intersection, but these improvements did not substantially reduce the projected delays in the 2011 Build conditions. Due to the limited right-of-way along Jenkins Road, it is not feasible to install dual left turn lanes from Capital Boulevard onto Jenkins Road.

Table 3 summarizes the LOS and average delay per vehicle at the intersection of Capital Boulevard / Jenkins Road.

<b>Table 3</b> <b>Level-of-Service</b> <b>Capital Boulevard / Jenkins Road</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
▪ <b>2008 Existing</b>	<b>D (56.1)</b>	<b>D (40.4)</b>
NBT	C (26.5)	D (36.4)
NBL	E (57.9)	D (47.8)
SBT	D (41.0)	C (34.6)
SBL	E (57.1)	E (56.4)
EBT	D (53.5)	D (44.2)
EBL	C (33.2)	D (36.7)
WBT	C (33.9)	D (38.0)
WBL	F (418.9)	F (134.7)
▪ <b>2011 No Build</b>	<b>F (170.9)</b>	<b>F (184.8)</b>
NBT	C (33.9)	E (75.3)
NBL	D (48.9)	D (47.8)
SBT	E (68.9)	C (34.1)
SBL	F (575.8)	F (1027.3)
EBT	E (78.4)	D (52.6)
EBL	C (35.0)	D (41.6)
WBT	D (38.2)	D (54.5)
WBL	F (1085.3)	F (670.4)
▪ <b>2011 Build</b>	<b>F (185.0)</b> <b>F (135.0)*</b>	<b>F (455.1)</b> <b>F (250.9)*</b>
NBT	F (99.7)	F (374.3)
NBL	F (232.4)	F (408.1)
SBT	E (190.8)	F (101.7)
SBL	F (222.6)	F (406.3)
EBT	D (42.9)	D (39.8)
EBL	D (36.1)	F (472.6)
WBT	C (30.9)	C (34.5)
WBL	F (233.9)	F (268.7)

\* - With Optimized Timings

## **B. Capital Boulevard / Wake Union Church Road / Street B**

The signalized Capital Boulevard / Wake Union Church Road intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS B during the AM peak hour and at LOS D during the PM peak hour. The intersection is expected to operate at LOS F in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing and the addition of approved development traffic. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with increases of 50.8 and 196.0 seconds of delay per vehicle during the AM and PM peak hours, respectively. The project team was unable to develop turn lane or signal timing improvements at this intersection that will allow it to operate at a reasonable level of service (LOS) in the AM or PM peak hour. In order to improve traffic operations, it is recommended that the signal timing be optimized to a 140 seconds cycle length, an additional northbound left turn lane be constructed on Capital Boulevard, and a right turn lane be constructed on Street B. With these improvements, the overall intersection delay is expected to decrease by 73.4 and 199.5 seconds per vehicle during the AM and PM peak hours, respectively.

Based on *NCDOT Driveway Manual*, it is recommended that a westbound right turn lane be constructed on Street B at the proposed Site Access and an additional northbound left turn lane be constructed on Capital Boulevard. The following are the minimal turn lane parameters per NCDOT standards and guidelines:

- Construct the site access roads to meet NCDOT standards.
- Construct an additional northbound left turn lane on Capital Boulevard with a minimum of 600 feet of full width storage
- Construct a eastbound right turn lane on Street B with a minimum of 200 feet of full width storage
- Lengthen the existing northbound left turn lane on Capital Boulevard to provide a minimum of 600 feet of full width storage

Table 4 summarizes the LOS and average delay per vehicle at the intersection of Capital Boulevard / Wake Union Church Road.

<b>Table 4</b> <b>Level-of-Service</b> <b>Capital Boulevard / Wake Union Church Road / Street B</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
▪ <b>2008 Existing</b>	<b>B (19.4)</b>	<b>D (47.9)</b>
NBT	B (17.6)	E (68.0)
NBL	E (56.8)	E (59.8)
SBT	B (17.1)	C (24.7)
SBL	E (67.2)	F (90.6)
EBT	D (52.6)	D (40.7)
EBL	D (51.9)	D (50.5)
WBT	D (51.1)	F (110.0)
WBL	D (46.3)	D (51.6)
▪ <b>2011 No Build</b>	<b>F (86.7)</b>	<b>F (149.0)</b>
NBT	C (29.6)	F (145.6)
NBL	D (54.9)	E (63.5)
SBT	F (141.2)	D (46.2)
SBL	F (158.7)	F (658.9)
EBT	E (56.1)	D (44.8)
EBL	D (52.0)	D (52.7)
WBT	E (63.0)	F (711.7)
WBL	D (41.1)	E (56.2)
▪ <b>2011 Build</b>	<b>F (137.5) E (64.1)**</b>	<b>F (345.0) F (145.5)**</b>
NBT	C (26.0)	F (164.2)
NBL	F (165.7)	F (188.1)
SBT	E (65.8)	F (138.7)
SBL	E (55.6)	F (194.6)
EBT	F (117.1)	F (110.9)
EBL	F (85.2)	F (207.1)
WBT	F (184.7)	F (214.8)
WBL	E (74.9)	F (97.1)

\*\* - With additional NB left turn lane and addition eastbound right lane

### **C. US 1 Northbound Ramp / Durham Road**

The signalized US 1 Northbound Ramp / Durham Road intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS C during the AM and PM peak hours. The intersection is expected to continue to operate at LOS C in the AM peak hour and at LOS B during the PM peak hour for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with decreases of 0.9 and 1.0 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended at this intersection.

Table 5 summarizes the LOS and average delay per vehicle at the intersection of US 1 Northbound Ramp / Durham Road.

<b>Table 5 Level-of-Service US 1 Northbound Ramp / Durham Road</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
▪ 2008 Existing	C (26.5)	C (23.1)
▪ 2011 No Build	C (24.0)	B (15.9)
▪ 2011 Build	C (23.1)	B (14.9)

#### **D. US 1 Southbound Ramp / Durham Road**

The signalized US 1 Southbound Ramp / Durham Road intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS C during the AM peak hour and LOS B during the PM peak hour. The intersection is expected to continue to operate at LOS C during the AM peak hour and LOS B during the PM peak hour for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with increases of 0.3 and 1.9 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Table 6 summarizes the LOS and average delay per vehicle at the intersection of US 1 Southbound Ramp / Durham Road.

<b>Table 6 Level-of-Service US 1 Southbound Ramp / Durham Road</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
▪ 2008 Existing	C (20.4)	B (11.2)
▪ 2011 No Build	C (22.9)	B (13.1)
▪ 2011 Build	C (23.2)	B (15.0)

## E. Durham Road / Cloverleaf Park Drive

The signalized Durham Road / Cloverleaf Park Drive intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS B during the AM and PM peak hours. The intersection is expected to continue to operate at LOS B in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with decreases of 0.2 seconds of delay per vehicle during the AM peak hour and 0.1 seconds of delay during the PM peak hour. No improvements are recommended at this intersection.

Table 7 summarizes the LOS and average delay per vehicle at the intersection of Durham Road / Cloverleaf Park Drive.

<b>Table 7</b> <b>Level-of-Service</b> <b>Durham Road / Cloverleaf Park Drive</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
▪ 2008 Existing	B (19.0)	C (21.6)
▪ 2011 No Build	C (23.8)	C (26.1)
▪ 2011 Build	C (23.6)	C (26.0)

## F. Durham Road / Retail Drive

The signalized Durham Road / Retail Drive intersection was analyzed using signal timing provided by NCDOT. Analyses indicate that the intersection currently operates at LOS B during the AM and PM peak hours. The intersection is expected to operate at LOS C in the AM and PM peak hours for the 2011 No Build scenario with the existing signal timing. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at the same levels of service as the 2011 No Build scenario with changes in delay of 0.4 and -0.1 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Table 8 summarizes the LOS and average delay per vehicle at the intersection of Durham Road / Retail Drive.

<b>Table 8 Level-of-Service Durham Road / Retail Drive</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
▪ 2008 Existing	B (18.2)	B (19.1)
▪ 2011 No Build	C (21.1)	C (22.9)
▪ 2011 Build	C (21.5)	C (22.8)

## G. Durham Road / Wake Union Church Road

Capacity analyses indicate that the unsignalized intersection of Durham Road / Wake Union Church Road currently operates with minimal overall delay during the AM and PM peak hours. The major eastbound and westbound movement in the existing is operating at LOS A during the AM and PM peak hours. However the southbound minor street movements are operating with heavy delays during the PM peak hour due to the heavier through volumes along Durham Road. The southbound minor movement is expected to operate at LOS F during the AM and PM peak hours without the proposed development with a reduction in delay of 56.1 and 254.2 seconds per vehicle. This reduction in delay is the result of the completion of the NC 98 Bypass and the reduction in vehicle traffic along Durham Road. For the 2011 Build scenario with the additional site traffic at the intersection, the southbound minor movement is expected to operate at LOS F during the AM and PM peak hours with increases of 34.9 and 201.3 seconds of delay per vehicle during the AM and PM peak hours, respectively, with delays expected to be less than the 2008 existing conditions. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Table 9 summarizes the LOS and average delay per vehicle at the Durham Road / Wake Union Church Road intersection.

<b>Table 9</b> <b>Level-of-Service</b> <b>Durham Road / Wake Union Church Road</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
2008 Existing	# (10.3)	# (35.2)
EBL - Durham Road	B (12.8)	B (11.6)
WB - Durham Road	A (0.0)	A (0.0)
SB - Wake Union Church Road	F (107.4)	F (352.4)
2011 No Build	# (6.7)	# (14.6)
EBL - Durham Road	B (11.3)	B (10.2)
WB - Durham Road	A (0.0)	A (0.0)
SB - Wake Union Church Road	F (51.3)	F (98.2)
2011 Build	# (12.4)	# (48.5)
EBL - Durham Road	B (12.1)	B (11.2)
WB - Durham Road	A (0.0)	A (0.0)
SB - Wake Union Church Road	F (86.2)	F (299.5)
EB-Eastbound, WB-Westbound, NB-Northbound, SB-Southbound, L-Left, R-Right, T-Thru		

# - No letter value assigned by Synchro, only overall intersection delay

## H. Wake Union Church Road / Kearney Road

Capacity analyses indicate that the unsignalized intersection of Wake Union Church Road / Kearney Road currently operates with minimal overall delay during the AM and PM peak hours. The major eastbound and westbound movement in the existing is operating at LOS A during the AM and PM peak hours. However the southbound and northbound minor street movements are operating with moderate delays during the PM peak hour due to the heavier through volumes along Wake Union Church Road. The southbound minor movement is expected to operate at LOS B during the AM peak hour and at LOS D during the PM peak hour without the proposed development. For the 2011 Build scenario with the additional site traffic at the intersection, the southbound minor movement is expected to operate at LOS C during the AM peak hour and at LOS F during the PM peak hour with increases of 2.5 and 42.1 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Table 10 summarizes the LOS and average delay per vehicle at the Wake Union Church Road / Kearney Road intersection.

<b>Table 10</b> <b>Level-of-Service</b> <b>Wake Union Church Road / Kearney Road</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
2008 Existing	# (2.8)	# (4.2)
EBL - Wake Union Church Road	A (7.8)	A (8.1)
WB - Wake Union Church Road	A (0.0)	A (0.1)
SB - Kearney Road	B (13.2)	D (25.9)
NB - Driveway	B (11.9)	C (16.7)
2011 No Build	# (2.9)	# (5.1)
EBL - Wake Union Church Road	A (7.9)	A (8.2)
WB - Wake Union Church Road	A (0.0)	A (0.1)
SB - Kearney Road	B (14.2)	D (33.4)
NB - Driveway	B (12.4)	C (18.3)
2011 Build	# (3.1)	# (9.6)
EBL - Wake Union Church Road	A (8.1)	A (8.5)
WB - Wake Union Church Road	A (0.2)	A (0.1)
SB - Kearney Road	C (16.7)	F (75.5)
NB - Driveway	B (13.6)	C (22.3)
EB-Eastbound, WB-Westbound, NB-Northbound, SB-Southbound, L-Left, R-Right, T-Thru		

# - No letter value assigned by Synchro, only overall intersection delay

## I. Kearney Road / Biscay Lane

Capacity analyses indicate that the unsignalized intersection of Kearney Road / Biscay Lane currently operates with minimal overall delay during the AM and PM peak hours. The minor westbound movement in the existing is operating at LOS A during the AM and PM peak hours. The minor westbound approach is expected to continue to operate at LOS A during the AM and PM peak hours without the proposed development. For the 2011 Build scenario with the additional site traffic at the intersection, the intersection is expected to operate at LOS A during the AM peak hour and LOS B during the PM peak hour with increases of 0.1 and 0.2 seconds of delay per vehicle during the AM and PM peak hours, respectively. No improvements are recommended to alleviate the increase in delay due to the projected site traffic.

Table 11 summarizes the LOS and average delay per vehicle at the Kearney Road / Biscay Lane intersection.

<b>Table 11</b> <b>Level-of-Service</b> <b>Kearney Road / Biscay Lane</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
2008 Existing	# (2.3)	# (0.7)
WB – Biscay Lane	A (9.0)	A (9.7)
SB – Kearney Road	A (0.2)	A (0.1)
NB – Kearney Road	A (0.0)	A (0.0)
2011 No Build	# (2.3)	# (0.7)
WB – Biscay Lane	A (9.1)	A (9.9)
SB – Kearney Road	A (0.1)	A (0.1)
NB – Kearney Road	A (0.0)	A (0.0)
2011 Build	# (2.1)	# (0.7)
WB – Biscay Lane	A (9.2)	B (10.1)
SB – Kearney Road	A (0.1)	A (0.1)
NB – Kearney Road	A (0.0)	A (0.0)
EB-Eastbound, WB-Westbound, NB-Northbound, SB-Southbound		

# - No letter value assigned by Synchro, only overall intersection delay

## J. Wake Union Church Road / Street A

The proposed intersection of Wake Union Church Road / Street A is predicted to operate with overall delays of 11.7 and 100.6 seconds per vehicle in the AM and PM peak hours, respectively after project buildout. Delays during the PM peak hour are expected to be moderate to heavy, which is not uncommon at unsignalized intersections during peak hours. In order to improve traffic operations, the intersection was modeled as a single-lane roundabout and is discussed in the following section.

The following roadway improvements are recommended to be incorporated in the development of the site plan:

- Construct the site access roads to meet NCDOT standards.

Table 12 summarizes the LOS and average delay per vehicle at the Wake Union Church Road / Street A intersection.

<b>Table 12</b> <b>Level-of-Service</b> <b>Wake Union Church Road / Street A</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
2011 Build	# (11.7)	# (100.6)
WB – Street A	B (11.7)	E (40.3)
SB – Wake Union Church Road	A (8.4)	B (11.9)
NB – Wake Union Church Road	B (12.4)	F (166.2)
EB-Eastbound, WB-Westbound, NB-Northbound, SB-Southbound		

# - No letter value assigned by Synchro, only overall intersection delay

## K. Jenkins Road / Street A

The Jenkins Road / Street A intersection is the recommended secondary access point / connection for the proposed development. The proposed intersection is predicted to operate with overall delays of 6.0 and 17.1 seconds per vehicle in the AM and PM peak hours, respectively after project buildout. A westbound left turn lane on Jenkins Road is recommended to be constructed with a minimum of 200 feet of storage.

Based on *NCDOT Driveway Manual*, the following roadway improvements are recommended to be incorporated in the development of the site plan:

- Construct the site access roads to meet NCDOT standards.
- Construct a westbound left turn lane on Jenkins Road with a minimum of 200 feet of full width storage

Table 13 summarizes the LOS and average delay per vehicle at the Jenkins Road / Street A intersection.

<b>Table 13</b> <b>Level-of-Service</b> <b>Jenkins Road / Street A</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
2011 Build	# (6.0)	# (17.1)
EB – Jenkins Road	A (0.0)	A (0.0)
WBL – Jenkins Road	A (9.4)	A (9.8)
NB - Street A	C (15.2)	E (40.9)
EB-Eastbound, WB-Westbound, NB-Northbound, SB-Southbound, L-Left, R-Right, T-Thru		

# - No letter value assigned by Synchro, only overall intersection delay

## L. Street B / Street A

The proposed, all-way stop controlled intersection of Street B / Street A is predicted to operate with overall delays of 13.6 and 187.7 seconds per vehicle in the AM and PM peak hours, respectively after project buildout. Delays during the PM peak hour are expected to be moderate to heavy, which is not uncommon at unsignalized intersections during peak hours. In order to improve traffic operations, the intersection was modeled as a single-lane roundabout and is discussed in the following section.

The following roadway improvements are recommended to be incorporated in the development of the site plan:

- Construct the site access roads to meet NCDOT standards.

Table 14 summarizes the LOS and average delay per vehicle at the Street B / Street A intersection.

<b>Table 14</b> <b>Level-of-Service</b> <b>Street B / Street A</b>		
<b>Condition</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
2011 Build	# (13.6)	# (187.7)
EB – Street B	A (0.0)	A (0.0)
WB – Street B	B (14.9)	F (154.7)
SB – Street A	B (13.7)	F (72.3)
NB – Street A	B (11.8)	F (283.8)
EB-Eastbound, WB-Westbound, NB-Northbound, SB-Southbound		

# - No letter value assigned by Synchro, only overall intersection delay

## X. Roundabout Analysis

The intersections of Wake Union Church Road / Street A and Street B / Street A were originally modeled and analyzed as all-way stop controlled intersections. During the PM peak hour, some moderate delays are forecasted for both intersections which are not uncommon during the afternoon peak hour. However, to improve traffic operations and enhance traffic flow within the site, both intersections were analyzed as single-lane roundabouts. *SIDRA version 3.2* capacity analysis output is included in Appendix B. The following table summarizes the results of the analysis:

<b>Table 15</b> <b>Roundabout Analysis</b> Level of Service Summary		
<b>Movement</b>	<b>AM Peak LOS (Delay)</b>	<b>PM Peak LOS (Delay)</b>
Wake Union Church / Street A	A (9.3)	B (10.7)
WB - Street A	A (7.4)	A (7.7)
SB - Wake Union Church Road	A (7.4)	B (10.7)
NB - Wake Union Church Road	B (12.1)	B (12.9)
Street B / Street A	A (9.2)	B (13.3)
EB - Street B	A (0.0)	A (0.0)
WB - Street B	B (10.7)	B (13.3)
SB - Street A	A (9.9)	B (12.2)
NB - Street A	A (6.6)	B (12.7)
EB-Eastbound, WB-Westbound, NB-Northbound, SB-Southbound		

With all movements expected to operate at either LOS A or B during both peak hours, the results show that both intersections are expected to function at substantially more efficient levels as roundabouts over the conventional, all-way stop controlled intersection design. Not only will the roundabouts improve traffic operations within the site, but also add focal points and enhance the overall visual appeal of the development. Therefore, the intersections of the Wake Union Church Road / Street A and Street B / Street A are recommended to be constructed as single-lane roundabouts.

## IX. Recommendations

This study shows that the proposed Wake Union Place development will add traffic on adjacent roadways and intersections and will have a significant effect on traffic operations in the vicinity of the development. The Jenkins Road and Wake Union Church Road intersections with Capital Boulevard are projected to operate at LOS F in the 2011 without the project and the project team was unable to develop turn lane or signal timing improvements at these intersections that will allow the intersections to operate at a reasonable level of service (LOS) in the AM or PM peak hour. The following improvements are recommended as a reasonable effort to mitigate some of the delay at the subject intersections and are based on the analysis

performed, on-site observations of existing traffic conditions, and North Carolina Department of Transportation (NCDOT) turn lane warrants.

### **Recommended Improvements by the Developer**

#### Capital Boulevard / Wake Union Church / Street B

- Construct the site access roads to meet NCDOT standards.
- Construct an additional northbound left turn lane on Capital Boulevard with a minimum of 600 feet of full width storage
- Construct a eastbound right turn lane on Street B with a minimum of 200 feet of full width storage
- Lengthen the existing northbound left turn lane on Capital Boulevard to provide a minimum of 600 feet of full width storage

#### Jenkins Road / Street A

- Construct a westbound left turn lane on Jenkins Road with a minimum of 200 feet of full width storage

#### Street B / Street A

- Construct as a single-lane roundabout

#### Wake Union Church Road / Street A

- Construct as a single-lane roundabout as shown on the site plan

#### Site Access Roadways

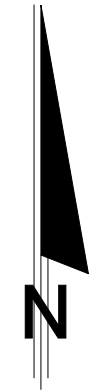
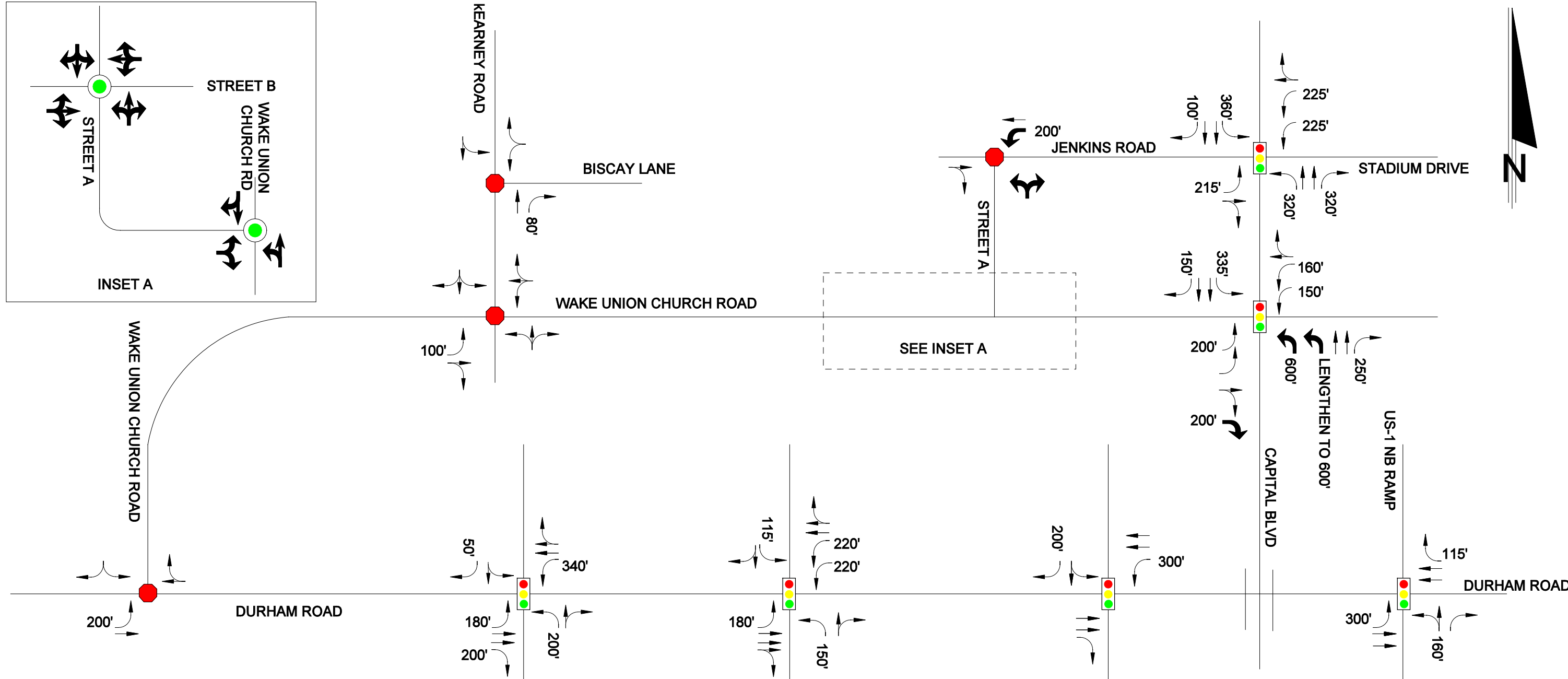
- Construct the site access roads to meet NCDOT standards.

The recommended lane configurations and traffic control are shown in Figure 8.

## **XI. Conclusions**

This study shows that the proposed development will have a large negative impact on traffic operations along the study area roadway network. The Jenkins Road and Wake Union Church Road intersections with Capital Boulevard are projected to operate at LOS F in 2011 without the proposed development. To improve traffic conditions internally to the site and at the proposed main access point of Capital Boulevard and Street B, a connection to Jenkins Road must be made in order to give the site traffic an additional access point. However, the improvements recommended in this report will not be sufficient bring the Capital Boulevard intersections up to acceptable levels of service with lengthy delays still expected in the build conditions. Based on the large amount of traffic on Capital Boulevard and the effects from the proposed development and the Wake Forest Crossing development, no amount of turn lane or signal timing improvements will provide sufficient capacity to provide for a reasonable LOS.

In contrast, the intersections along Durham road are expected to operate with reasonable LOS with or without the proposed development. While some diversion of project traffic to Durham Road is expected, due to the lengthy delays on Capital Boulevard, these intersections should operate with reasonable levels of service and delay in the AM and PM peak hours.



LEGEND	
	EXISTING TRAVEL LANE
XX'	STORAGE LENGTH
	CONSTRUCTED BY DEVELOPMENT
	SIGNAL CONTROLLED
	STOP SIGN CONTROLLED
	ROUNDBABOUT

## **XII. References**

<sup>1</sup>*2005 Annual Average Daily Traffic Volumes*, North Carolina Department of Transportation, 2005.

<sup>2</sup>*Trip Generation*, 7th Edition, Institute of Transportation Engineers, Washington, D.C., 2003.

<sup>3</sup>*Highway Capacity Manual*, Special Report 209, Transportation Research Board, National Research Council, Washington, D.C., 1998.