LINCOLN COUNTY PLANNING & INSPECTIONS DEPARTMENT
302 NORTH ACADEMY STREET, SUITE A, LINCOLNTON, NORTH CAROLINA 28092
704-736-8440 OFFICE 704-736-8434 INSPECTION REQUEST LINE 704-732-9010 FAX

To: Board of Commissioners
Planning Board

From: Randy Hawkins, Zoning Administrator

Date: November 20, 2015

Re: PD #2015-3
Eastwood Homes, applicant
Parcel ID# 32663, 33004, 34511, 34512, 54013, 58901, 71175 and portions of 30054 and 51301

The following information is for use by the Lincoln County Board of Commissioners and Planning Board at their joint meeting/public hearing on December 7, 2015.

REQUEST

The applicant is requesting the rezoning of 151 acres from R-T (Transitional Residential) to PD-R (Planned Development Mixed Use) to permit up to 302 single-family detached homes. Under the Lincoln County Unified Development Ordinance, any proposed subdivision with 50 or more lots is subject to approval through the planned development process. The applicant is also proposing lots smaller in size than the minimum area permitted in the R-T district.

A concept plan and guidelines for the proposed development have been submitted as part of the rezoning application and would serve as the master plan for the development if the rezoning request is approved. A traffic impact analysis has also been submitted.

SITE AREA AND DESCRIPTION

The property is located on the east side of N.C. 16 bypass about 1,500 feet south of South Pilot Knob Road and included portions of Freemont Lane and Avenel Lane. It is adjoined by property R-T and PD-MU (Planned Development Mixed Use, specifically the single-family portion of The Gates at Waterside Crossing). Land uses in this area include residential and agricultural. A solar farm has been approved for the adjoining property to the south. Public water and sewer are available in this area. This property is located in a WS-IV Protected Area watershed district. None of the property is located in a floodplain.

PLAN CONFORMANCE

This property is part of an area designated by the Lincoln County Land Use Plan as Mixed Residential, suitable for densities ranging from 2 to 8 units per acre, proportional to the amount of open space preserved. The proposed density is 2 homes per acre, with 25% open space.

UDO COMPLIANCE

Under the UDO's watershed regulations, the maximum density for subdivisions in a WS-IV Protected Area is two homes per acre if streets include curb and gutter, as is proposed in this case.

The UDO requires that a planned development include a minimum of 12.5% recreation and open space.

Subdivisions with more than 250 lots are required to have at least two access points plus a stub-out for a future connection point. This proposal calls for an access point on N.C. 16 Business, a connection via Avenel Lane to Sedgebrook Drive West for access to South Pilot Knob Road, and a stub-out that would allow a future connection to South Pilot Knob Road. The plan also complies with the UDO's subdivision standards for internal connectivity, block length and cul-de-sac length.

The UDO requires an applicant to provide road improvements to maintain the service level of an intersection if it is impacted by a proposed development. In this case, the traffic analysis identifies four intersections that would be affected and recommends improvements to mitigate the impacts. NCDOT has reviewed the traffic study and is in agreement with the findings and recommendations. The applicant has included the recommended improvements in the guidelines for the development.

STAFF'S RECOMMENDATION

Staff recommends that the rezoning request be approved. See proposed statement on following page for rationale.

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Zoning Amendment
Staff's Proposed Statement of Consistency and Reasonableness

Case No. **PD #2015-3**

Applicant **Eastwood Homes**

Parcel ID# **32663, 33004, 34511, 34512, 54013, 58901, 71175, 30054 and 51301**

Location **east side of N.C. 16 bypass about 1,500 feet south of Pilot Knob Road**

Proposed amendment **rezone from R-T to PD-R to permit 302 lot for single-family detached homes**

This proposed amendment **is consistent** with the Lincoln County Comprehensive Land Use Plan and other adopted plans in that:

This property is located in an area designated by the Land Use Plan as Mixed Residential, suitable for densities of 2 to 8 homes per acre. The rezoning plan calls for a density of 2 homes per acre.

This proposed amendment **is reasonable and in the public interest** in that:

This property is located in an area that is primarily residential. The plan for this subdivision meets all of the requirements of the Unified Development Ordinance. At least 25% of the property will be set aside as recreation and open space. Amenities will be provided as part of the master plan, including natural pedestrian trails, a playground and a picnic area. As part of the plan, traffic improvements will be provided by the developer to mitigate the impacts of the subdivision.

Planned Development Rezoning Application

Lincoln County Planning and Inspections Department
Zoning Administrator
302 N. Academy St., Lincolnton, NC 28092
Phone: (704)736-8440 Fax: (704)732-9010

PART I

Applicant Name ____**Eastwood Homes**_____

Applicant Address ____**2857 Westport Road, Charlotte, NC 8208**_____

Applicant Phone Number __**704-399-4663**_____

Property Owner Name _____**See Attached**_____

Property Owner Address _____ **See Attached** _____

Property Owner Phone Number ___ **See Attached** _____

PART II

Property Location ____**S 16 Business Hwy**_____

Property ID (10 digits) ____**See Attached**_____ Property size _____

Parcel # (5 digits) _____ Deed Book(s) _____ Page(s) _____

PART III

Existing Zoning District __**R-T**_____ Proposed Zoning District __**PD-R**_____

Briefly describe how the property is being used and any existing structures. __**Mostly vacant land with a few Homes**_____

Briefly described the proposed planned development. _____**Single Family Subdivision**_____

_____

_

***SEE PLANNING DEPT. FOR PLANNED DEVELOPMENT FEES.**

I hereby certify that all knowledge of the information provided for this application and attachments is true and correct to the best of my knowledge.

_____ 9/17/15

Applicant's Signature Date

Carrington Subdivision Owners Information					
Owner Name	**Address**	**Parel ID**	**Size**	**Parcel #**	**DB/PG**
Ralph Z. Sifford	663 Avenel Lane	4601593043	22.79	32663	387/682
Ken Lawing Builderins, INC	3539 St James Church Road	4601499781	8.19	58901	846/251
Dorothy Lawing	411 S Pilot Knob Road	4601494480	3.39	34511	99E/433
Dorothy Lawing	411 S Pilot Knob Road	4601483266	43.88	34512	99E/433
Dorothy Lawing	411 S Pilot Knob Road	4601496136	1.65	71175	99E/433
Daniel Lee Parks	737 Freemont Lane	4601487755	4.35	33004	932/640
Gary M Duckworth	857 S Hwy 16	4601563475	53.12	30054	1266/135
Gary M Duckworth	857 S Hwy 16	4601269542	114.86	51301	633/69
LTJ Properties, LLC	1418 Nature Preserve Trail	4601660889	36.79	54013	1885/514

Carrington Neighborhood Meeting Minutes

Date: **Thursday, October 29, 2015 – 7:00 pm**
Location: **East Lincoln Community Center, 8160 Optimist Club Rd, Denver, NC**
Purpose: **Lincoln County community involvement meeting to provide information regarding the Carrington Subdivision proposal and to receive comments prior to a public hearing.**

Presenters: **Steve Bailey, ESP Associates, P.A.; Robert Davis, and Mike Kemp, Eastwood Homes**

Introduction:

Robert Davis introduced the team. Steve Bailey presented a Powerpoint slideshow describing the proposed development and associated traffic improvements. The floor was then opened for questions.

Open Discussion

1. Stormwater – Three storm water ponds located on the site will catch stormwater runoff and treat and filter the water. The topo area surrounding the south pond will remain as is and will not affect the adjoining properties.
2. Setback requirements – The proposed development includes a Class B buffer around the perimeter of the project. Residential lots will have a front setback of 10 feet with 20 feet to the garage, a side setback of 5 feet or 10 feet for corner lots and a rear setback of 20 feet. Note: The 30 foot setback requirement mentioned does not apply to this project's proposed classification.
3. Traffic study – Other proposed developments (i.e., Cottonwood) were included in the traffic study. The study will be available to the public once it's approved by the DOT.
4. Highway capacity analysis – The developers are working with the Congestion Management Division of the DOT on this.
5. Construction vehicle traffic and parking – Developer agrees that construction vehicles for this project will enter from the Hwy.16 proposed site drive and will not be permitted to drive through The Gates community and Avenel Lane.
6. Property located at proposed road improvements – Developer will acquire or be given access by the property owners to make the proposed road improvements.
7. The Gates/Avenel Lane connection – Several residents of The Gates community expressed concerns that their neighborhood will become a frequent cut-through for Carrington residents and visitors. Mr. Bailey stated that the vast majority of the new traffic will enter and exit directly onto Hwy. 16.
8. Relocation of mailboxes along Avenel Lane – Developer can only move existing mailboxes that are in the right-of-way. If relocation is required, they will be shifted as little as possible.
9. Status updates on development – In approximately one month there will be a public hearing held for this development.
10. Home price and size range – The homes to be built will be between 2,000 and 3,500 square feet, depending on lot size and other factors. The price range is anticipated to be approximately $250,000 to $350,000.
11. Schools – According to Andrew Bryant, the Lincoln County schools that will serve this community will remain within capacity with the addition of this community's eligible student population.
12. Projected Timeline for the project is:
    - Zoning approval: December 2015
    - Begin preliminary construction phase mid-2016
    - Actual house construction to start at the end of 2016, early 2017.
13. Hwy. 73 – This traffic is already a concern for area residents and travelers and needs to be considered when doing the road improvements.

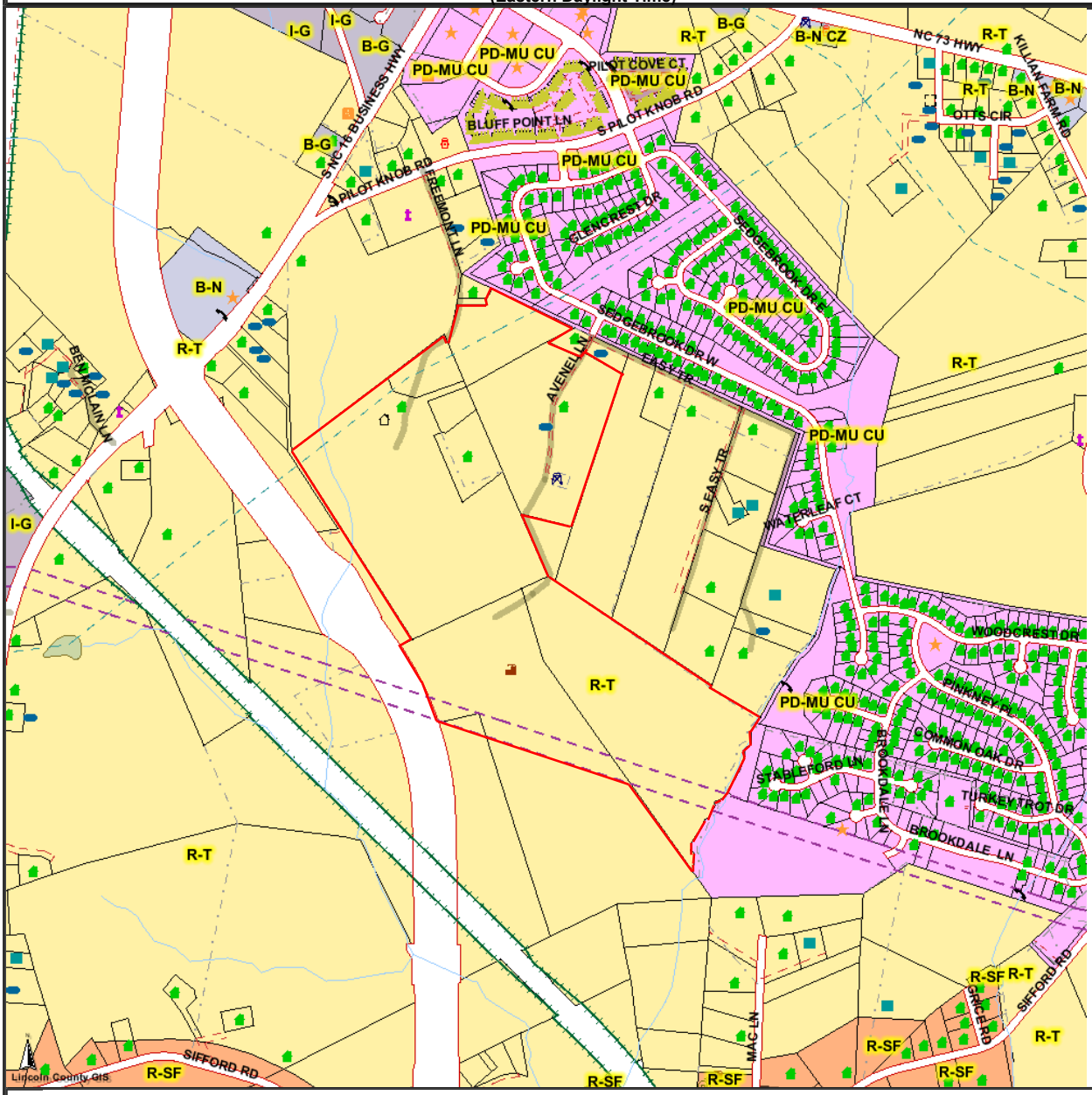
Project boundary outlined in red

Scale: 1 Inch = 1200 Feet

LINCOLN COUNTY GIS

(Eastern Daylight Time)

Wed Oct 28 2015 08:35:07 GMT-0400



Structures
- Outbuilding
- Site-built Home
- Business
- Industry
- Utility Service
- Church
- Government, School
- Fire Department
- Mobile Home
- Apartment, Condominium
- Manufactured Home
- Cellular Tower
- (cont)

- Mobile Home Space
- UnAddressed Mobile Home
- Child Facility
- Active Poultry House
- Inactive Poultry House
- Home Site

County Boundaries
- County Line
- Township Line

Map Features
- Road Easement
- (cont)

- Conflict Line
- Major Rivers, Creeks
- Creeks
- Interior Lot Line
- Drainage Easement
- Utility Easement

Right-of-Ways
- Roads
- Railroads
- Public Walkway
- Parcels
- Private Roads

City Jurisdictions
- (cont)

- City of Lincolnton
- ETJ
- Town of Maiden

Zoning Districts
- B-C
- B-G
- B-N
- C-B
- CBT
- G-B
- GMC
- I-G
- I-L
- N-B
- (cont)

- O-I
- O-R
- P-B
- PD-C
- PD-I
- PD-MU
- PD-R
- P-MU
- R-10
- R-14
- R-15
- R-20
- R-25
- R-8
- (cont)

- R-CR
- RMF
- R-MF
- R-MR
- R-O
- ROS
- R-R
- R-S
- R-SF
- R-T
- Lake Norman

PD-R REPORT
CARRINGTON SUBDIVISION
S NC 16 BUSINESS HWY
LINCOLN COUNTY, NC

1. PROJECT INFORMATION

Carrington Subdivision is a proposed single family residential community proposing a mix of single family detached homes on an approximately 151 acre site on the east side of South NC16 Business Hwy (see PD-R Plan). The project will include Parcel ID numbers 58901, 34511, 34512, 71175, 33004, 54013, 32663, 30054, and 51301. The current plan features 302 single family lots with a density of up to 2.0 lots per acre with curb and gutter.

Access to the site will be from S NC 16 Business Hwy and Avenel Lane. Land uses surrounding the site include single family residential homes. The Preliminary Development Concept Plan with vicinity map is included for reference.

A key feature of the proposed community will be the ample open spaces and the community amenity. A minimum of 25% of the site will be left undeveloped as natural buffer area and/or passive and active open space.

The property is currently zoned R-T. Proposed zoning will be PD-R. The property is located in the Mountain Island Lake IV Protected Watershed that allows 2 units per acre under the low density option with curb and gutter.

2. GENERAL PROVISIONS

The Planned Development Concept Plan is intended to reflect a generalized arrangement of the site in terms of lot layout, street network, and open space areas. Final lot configuration, placement and size of individual site elements, streets alignments, etc. may be altered or modified within the limits of the Ordinance as described in Section 9.5.13, and the standards established within these conditional notes during the design development (platting) and construction phases. The Petitioner reserves the right to make minor modifications and adjustments to the approved Planned Development Concept Plan, including minor reconfiguring lots and street layouts, subject to staff approval, provided that the total number of residential units does not exceed the maximum permitted. Any major modifications will require resubmittal to the Board of Commissioners.

3. DEVELOPMENT STANDARDS

Pursuant to Sections 2.4.9 and 9.5 of the Lincoln County Unified Development Ordinance entitled Planned Development Districts and Planned Development Review respectively; the Petitioner seeks to obtain approval of the use of the following Development Standards concurrently with the approval of the Rezoning Petition. These standards, as established both by the conditional notes as set out below and as depicted on the Planned Concept Plan shall be followed for development of the property. Unless

otherwise approved as part of these conditional notes, the Lincoln County Unified Development Ordinance shall prevail when developing the site.

Each home shall contain no less than 2 different materials on all four sides exclusive of trim. These materials may consist of brick, stucco, stone, architectural concrete, cement fiber board, vinyl siding, wood, or shakes.

A. PERMITTED USES

1) The project shall be limited detached single family residential dwellings along with any incidental or accessory uses.
2) Uses on the Common Open Space (COS) may include pool, clubhouse, landscaping, fences, walls, berms, pedestrian trails, recreational uses, entry signage, monuments, and storm water BMPs (if required).

B. DENSITY

Gross residential density for the project will not exceed 2.0 lots per acre with curb and gutter streets. Open space areas shall be included in the calculations for gross residential density.

C. LOT STANDARDS

The proposed development includes a Class 'B' buffer around the perimeter of the project. Existing vegetation will be used to meet the buffer requirements where possible. Residential lots will have the following setbacks:

Front Setback:	10 feet (20 feet to garage)
Side Setback:	5 feet (10 feet for corner lots)
Rear Setback:	20 feet

Building height shall be limited to 40 feet. Lot platting will meet Lincoln County subdivision regulations.

D. GENERAL SITE DESIGN

The following items are offered as part of this development:

1) Streets within the subdivision shall be designed per NCDOT standards. Roadways will be dedicated to NCDOT for maintenance once density requirements are met.

2) The project will contain the following amenity features. These proposed amenities will be installed no later than recordation of the 100^{th} lot.

   a. Picnic tables with outdoor grills

b. Child play equipment (Tot Lot)
c. Landscape areas
d. Enhanced entry
e. Natural pedestrian trails
f. A signage plan shall be submitted for the development at the time construction drawings are prepared for the first section of the development. All signage shall conform to standards of the Lincoln County Unified Development Ordinance. Signage shall be monument style constructed of stone or brick material with integrated fencing or other similar mixture of materials at the petitioner's discretion, which complement the architectural characteristics of the neighborhood.
g. A landscaped median will be provided in the entry road at the main entrance.

3) Canopy street trees shall be placed at 40 feet on center along both sides of the proposed streets. Any existing trees in excess of 6 caliper inches within 20 feet of the right of way shall be credited for one required tree to be planted. Driveway locations may vary the placement of street trees.

4) Decorative lighting shall be used through the project. Street lighting shall be of an acorn style or similar fixture type.

5) Mail box kiosks will be located and reviewed by the Postmaster.

6) Dry utilities for telephone, cable TV, electricity, and natural gas will be provided by local utility companies. Utilities within the community shall be placed underground. The main feed lines and transformers from the main road may be located above ground.

7) Garbage collection will be provided by a private service and included in homeowner association dues.

8) Open Space

a. The project will offer 25+/-% of common open space. Common open space will be provided as generally depicted on the Planned Development Concept Plan. A portion of the open space will be active open space.
b. The project will offer a Class B perimeter buffers as required by the Lincoln County UDO.

E. STORMWATER COMPLIANCE

The development will be subject to Lincoln County's storm water management regulations in place at the time of preliminary plat submittal. Storm water BMPs will be incorporated into the design if required by stream crossing permits (401/404). Stream buffers shall be provided along all jurisdictional streams in accordance with NCDENR and Lincoln County requirements.

F. ESTABLISHMENT OF A PROPERTY ASSOCIATION

A Property Management Association shall be established and will be responsible for maintaining all rights-of-way landscaping, signs, amenity features, storm water BMPs (if required), trails, and common open space areas. The documents covering the structure of the association shall be filed with the recorded final plat.

G. RESTRICTIVE COVENANTS

Restrictive Covenants will be created and recorded prior to final plat recordation, to establish, among other items, permitted uses and maintenance responsibility of the property management association. Restrictive covenants will include language that ensures stream buffers, perimeter buffers, and setback areas are protected.

H. VEHICULAR ACCESS AND ROAD IMPROVEMENTS

1) Vehicular access: Access will be provided via two main entrances on S. 16 Business Hwy and Avenel Lane.

2) Improvements to Existing Roads: A Traffic Impact Analysis (TIA) has been prepared for this project and is being reviewed by NCDOT. Any improvements by developer required by NCDOT will installed per their requirements. Any improvement will be installed based on the timeline determined by NCDOT and the traffic engineer's phasing analysis. Below is a list of the improvements detailed in the TIA. Some of these improvements are recommended below to accommodate the site trips and mitigate existing and projected deficiencies in the future No Build Conditions. These improvements are necessitated by the collective impacts of the background traffic growth, off-site developments, and site trips. While the site trips represent a relatively small percentage (3% to 8%) of the overall intersection traffic demands during peak hours, the delays may increase disproportionally when the subject intersections or approaches operate at or near capacity. It may be appropriate for the developer to contribute towards, or implement elements of these improvements. In the event that individual off-site developments are delayed or canceled, the roadway improvements may be reevaluated as the traffic demands may differ from those analyzed in this study.

a. Phase I (49 units) Improvements:

NC 16 Business at Site Entrance

- *Southbound:* Construct a southbound left-turn lane on NC 16 Business with 150 feet of storage and appropriate deceleration and taper lengths. Install milling / resurfacing as required by NCDOT.
- *Westbound:* Construct the site entrance with two exit lanes. The right-turn exit lane should have a 100 feet storage and appropriate deceleration and taper lengths.

NC 16 Business at S Pilot Knob Road (by Cottonwood Village)

- *Northbound:* Construct a northbound right-turn lane on NC 16 Business with 125 feet of storage and appropriate deceleration and taper lengths.

b. Phase II (115 units) Improvements:

NC 16 Business at Waterside Crossing Blvd

- *Southbound:* Revise the existing pavement markings to provide a through lane and a left-turn lane with 150 feet of storage and appropriate deceleration and taper lengths.

- *Northbound:* Revise the existing pavement markings to provide a center TWLT lane between the Advanced Auto Parts Entrance and the Waterside Crossing Blvd intersection. Install roadway widening as needed to maintain a minimum of 100' northbound right-turn lane.

NC 73 at NC 16 Business

- *Northbound*: Construct a northbound through/right-turn shared lane with 175 feet of storage and appropriate deceleration and taper lengths.

- *Signal:* Install signal upgrades to accommodate the proposed lane assignments.

c. Phase III (138 units) Full Buildout Improvements:

NC 73 at NC 16 Business (full buildout site trips represent 3%+/- of peak hour demands)

- *Northbound*: Revise the northbound pavement markings to provide an exclusive left-turn lane, a left-turn/through shared lane, and through/right-turn shared lane.

- *Southbound:* Remove and reconstruct the right-turn channelizing island so that the southern edge of the island is shifted 12' north of the existing location. Repave and install new pavement markings as needed after the island removal. Install a new stop line for the southbound right-turn lane.

- *Westbound:* Extend the existing right-turn lane by approximately 150' to the eastern entrance of the Kangaroo gas station (to provide 320'+/- of storage), and revise the pavement markings to convert the right-turn lane to a through/right-turn shared lane.

- *Signal:* Install signal upgrades to accommodate the proposed lane assignments, provide split phasing for the northbound and southbound approaches, and signalize the southbound right-turn movement with permitted/overlap (with eastbound left-turn) phasing.

NC 73 at Pilot Knob Road (site trips represent 4%+/- of peak hour demands)

- *Northbound:* Construct a northbound right-turn lane with 230 feet of storage and appropriate deceleration and taper lengths.

- *Westbound:* Extend the existing left-turn lane by approximately 110 feet to provide a total of 275 feet of storage with appropriate deceleration and taper lengths.

- *Signal:* install signal upgrades to accommodate the proposed lane assignments, provide protected/permissive signal phases for the westbound left-turn and southbound left-turn movements, and provide permitted/overlap phasing for the northbound right-turn movement.

NC 16 Business at S Pilot Knob Road (full buildout site trips represent 14%+/- of peak

hour demands)

- *Signal:* Install an actuated traffic signal at this intersection with appropriate signal heads, poles, loop detectors, junction boxes, etc. Signal warrant analysis shall be performed before the signal installation, and the signal installation must be approved by NCDOT.

I. PERMITTING

The Petitioner understands that all permits from Lincoln County and appropriate agencies must be obtained prior to grading or construction activities.

J. CONSTRUCTION SCHEDULE AND PHASING

The development of the site will be completed in six (6) phases as shown on the PDR Plan.

K. MODEL HOMES/SALES OFFICES

Model homes may be constructed within residential areas at the developer's discretion. Mobile temporary sales offices shall be allowed at the developer's discretion and shall be subject to any special permits required by Lincoln County.

L. WATER AND SEWER AVAILABILITY

The Petitioner understands that water and sewer availability must be approved by Lincoln County prior to development. It is the Petitioner's responsibility to incur all permit fees, availability fees, infrastructure costs for providing the water and sewer throughout the project for all buildings. The Petitioner will comply with all the County's water and sewer standards.

M. APPLICABLE ORDINANCES

Development will be subject to the standards and requirements of the UDO in effect at the date of submission of the application for rezoning.

N. BINDING EFFECT

All conditions applicable to the development of the property approved with this rezoning, unless amended by the manner provided in the UDO, shall be binding to the Petitioner and subsequent owners of the Site and their assigns.

O. AMENDMENTS TO THE APPROVED CONDITIONAL DISTRICT PLAN

It is understood that the owner of the property must apply for any future amendments to the Development Standards, Conditional Notes and in accordance to the provisions of the UDO, Section 9.5.13.

Development Data:

Developer Information:	Eastwood Homes 2857 Westport Road Charlotte, NC 28208
Tax Parcels:	32263, 33004, 34511, 34512, 51301, 54013, 58901 & 71175
Total Site Acreage:	+/- 151 Acres
v	
Location:	Lincoln County, NC
Zoning:	
Existing:	R-T
Proposed:	PD-R
Total Units Shown:	302 Lots (2.0/Acre)
Minimum Proposed Lot Width:	50' Wide
Setbacks:	
Front:	10' (20' to garage)
Side:	5' (10' for corner lots)
Rear:	20'
Density:	2.0 DU/AC*
*Final density will be dependent on final boundary survey.	
Watershed:	WS-IV Protected*
*Maximum Density: 2 lots/ acre with curb.	

General Notes :

1. Base information provided by Lincoln County GIS Data and should be verified for accuracy.
2. All site plan, zoning, and wetland information utilized in the preparation of this Planned Development Concept Plan is considered to be preliminary in nature and subject to change and final verification.
3. Draft - Do not rely on this document.
4. Sidewalks shall be located on one side of each proposed street.
5. A Class 'B' buffer is required around the project perimeter.

Floodplain Information
Floodplain information obtained from FEMA FIRM Panels 3710460100 and 3710460200J effective date of study on August 17, 2007.

Stream/Wetland Information
Stream/Wetland information is based on preliminary information provided to ESP by Lincoln County GIS data. For purposes of preparation of this Planned Development Concept Plan, any potential wetland areas and stream features depicted on the plan are considered to be preliminary in nature and approximate in location. The Planned Development Concept Plan will need to be revised once all agencies approved on-site wetland/stream and appropriate jurisdictional boundaries are surveyed and verified with acceptable levels of accuracy- unit loss may occur.

Access Points/Driveways/Streets
1. Proposed project site entrance locations are considered preliminary in nature and need to be verified for adequate sight distance.
2. All roadway and street systems are considered to be preliminary and will need to be verified for sufficiency to satisfy or exceed minimum requirements established in the Lincoln County Unified Development Ordinance and applicable standards identified by NCDOT. Street connections are conceptual and may be subject to change based on agency input and review.

Open Space/Tree Save
Open Space and Tree Save areas are conceptual and preliminary. The exact location of these areas may change as the client finalizes decisions regarding final layout, product allocation, and as other spatially dependent project components such as stormwater areas, wetland areas, utility features, and buffers, (as applicable) for this project are better defined.

Potential Stormwater Quality
Location of proposed stormwater areas are conceptual and preliminary and still need to be determined. The exact size and location of these areas will change as the client finalizes decisions regarding final layout, product allocation, and as other proposed changes to the project are better defined. Layout and unit count subject to change based on final design of stormwater quality areas.

Public Information
ESP Associates is not responsible for plan deficiencies created by incorrect, incomplete, missing or outdated information derived from public sources such as GIS, Planning and Zoning departments.

ESP

ESP Associates, P.A.

P.O. Box 7030 3475 Lakemont Blvd.
Charlotte, NC 28241 Fort Mill, SC 29708
NC - 704.583.4949 SC - 803.802.2440
www.espassociates.com

CLIENT

EASTWOOD HOMES

Eastwood Homes
2857 Westport Road
Charlotte, NC 28208

PROJECT

CARRINGTON SUBDIVISION

SHEET TITLE

PLANNED DEVELOPMENT CONCEPT PLAN

PROJECT LOCATION	*LINCOLN COUNTY, NC*

GRAPHIC SCALE

300 0 150 300 600

1 INCH = 300 FT.

PROJECT NUMBER	*DU08*
DRAWING NAME	*DU08 - Concept Sketch.psd*
DATE	*September 14, 2015*
DRAWN BY	*SB/GW*
CHECKED BY	*MK*

AGENCY / SUBMITTAL REVISION

NO.	DATE	BY	REVISION
1	10/8/15	CL	COUNTY REVISIONS
2	10/30/15	GW	COUNTY REVISIONS

Traffic Impact Analysis
Carrington Subdivision
Lincoln County, NC

Prepared for:
Eastwood Homes
2857 Westport Road
Charlotte, NC 28208

Prepared by:
Accelerate Engineering, PLLC
November 16, 2015

Accelerate Engineering, PLLC
License No. P-1442

140 Preston Executive Drive, Suite 100D, Cary, NC 27513
(919) 263-5678 | (704) 666-5811 www.AccelerateEng.com

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EXECUTIVE SUMMARY

Carrington Subdivision is a proposed residential development located on a 151-acre tract near the southeastern corner of the NC 16 Business and S Pilot Knob Road intersection in Lincoln County, NC. The proposed development will include a total of 302 single family units constructed in three phases – 49 units in Phase I (2016), 115 units in Phase II (2017), and 138 units in Phase III (2018 & 2019). The site is estimated to generate 3,027 daily trips, including 227 AM peak hour trips and 302 PM peak hour trips.

The subject development is proposed to have two access points. The main entrance will connect to NC 16 Business and for a new T-intersection approximately 375 feet south of S Pilot Knob Road. A secondary site access is provided via the existing Avenel Lane and Sedgebrook Drive intersection.

After discussions with the County and NCDOT, the following eight intersections are included as part of the area of influence for the proposed development.

NC 16 Business and NC 73…….....*Signalized 4-legged intersection*
Pilot Knob Rd and NC 73……..*Signalized 4-legged intersection*
NC 16 Business and Waterside Crossing Blvd…….*Unsignalized 4-legged intersection*
S Pilot Knob Rd and Waterside Crossing Blvd…….*Unsignalized 4-legged intersection*
NC 16 Business and S Little Egypt Rd…….*Unsignalized 4-legged intersection*
S Pilot Knob Rd and Freemont Ln……...*Unsignalized T- intersection*
NC 16 Business and S Pilot Knob Rd……...…...*Unsignalized T- intersection*
Avenel Ln and Sedgebrook Dr…….…...Unsignalized T- intersection
NC 16 Business and Site Entrance……...…...*Unsignalized T- intersection*

For the purposes of the Traffic Impact Analysis (TIA), the full build-out of the site will be completed, opened, and fully occupied in 2019. Thus, the design year in this study is 2020, or one year past build-out. This study evaluated the following four scenarios for the study intersections:

1. The "**2015 Existing Conditions Analysis**" evaluates the current intersection operational performance.
2. The "**2020 No Build Analysis**" examines the future traffic conditions where the proposed development is not constructed. This analysis takes into account background traffic growth (1% per year), nearby approved developments (Trilogy Lake Norman, Rivercross, and Cottonwood Village) and their committed transportation improvements.
3. The "**2020 Build Analysis**" evaluates the intersection operational performance after distributing site generated trips through the study area intersections, and,

4. The "**2020 Build with Improvements Analysis**" identifies and evaluates the mitigation measures, if there is any degradation in the operational performance when comparing scenarios 2 and 3 above.

This traffic study evaluated the intersection traffic operational performance through the intersection capacity / Level of Service (LOS) analysis, traffic simulations and queue analysis for weekday AM and PM peak hours. LOS is a letter designated by the average vehicle delay time at an approach to an intersection with "A" representing little or no delay and "F" representing high levels of congestion. LOS D or better is considered acceptable. Delay and LOS results for unsignalized intersections are reported for each approach while signalized intersections add a composite delay (based on a weighted average of the approaches) and LOS for the overall intersection. The traffic analysis results are summarized below:

2015 Existing Conditions Analysis

The NC 73 and NC 16 Business intersection currently has unacceptable LOS and delays on the northbound approach and westbound approach during the PM peak hour. The delays are directly related to the heavy turning movements on the northbound, southbound, and eastbound approaches. Queues on the northbound NC 16 Business approach may spill back to the intersection of NC 16 Business and Waterside Crossing Blvd. At the NC 73 and Pilot Knob Road intersection, traffic simulations show that the southbound left-turn movement may not have adequate acceptable gaps, and may develop extensive queuing during certain peak arrival times. All the other study intersections appear to operate at acceptable LOS.

2020 No-Build Analysis

With the background traffic growth and the nearby proposed developments, the LOS analyses show that the vehicle delays will increase at most of the study intersections. The NC 73 and NC 16 Business intersection is expected to operate at LOS D (48.9 seconds) during the AM peak hour, and LOS F (93.7 seconds) during the PM peak hour. Traffic simulations suggest the delays are likely higher due to the queue blockages. Congestion at this intersection, similar to the Existing Condition Analysis, will negatively impact the upstream intersections.

At the NC 73 and Pilot Knob Road intersection, southbound left-turn traffic is expected to have increased difficulty finding acceptable gaps without a protected southbound left-turn signal phase. All the other study intersections appear to have reasonable operational performance, with higher delays expected at Stop sign controlled minor street approaches.

2020 Build Analysis

When comparing the 2020 No-Build Condition Analysis to the 2020 Build Condition Analysis, the NC 73 and NC 16 Business intersection LOS will degrade from D to E during the AM peak hour, and continue to operate at LOS F with increased delays. At the NC 73 and Pilot Knob Road intersection, the southbound approach LOS will degrade to from D to F (85+ seconds of delays) during both peak hours. At the intersection of NC 16 Business and Waterside Crossing Blvd, the AM peak westbound approach LOS is expected to degrade from D to E (41.7 seconds). The PM approach delays are estimated to increase from 58.7 seconds to 105.9 seconds, due to the addition of site traffic and the worsening downstream congestion at the NC 73 and NC 16 Business intersection.

At the unsignalized NC 16 Business and S Pilot Knob Road intersection, the S Pilot Knob Road approach delays are expected to increase to 169.7 seconds (LOS F) during the PM peak hour. Preliminary analysis shows that the Peak Hour Signal Warrant is estimated to be met for both the AM and PM peak hours.

The proposed Site Entrance, which was analyzed as a one-lane approach, is expected to operate at LOS C during the AM peak hour and LOS E (49.9 seconds) during the PM peak hour. It is typical for minor street approaches to experience higher delays at unsignalized intersections. All the other study intersections appear to operate at acceptable LOS.

2020 Build with Improvements Analysis

Comparing the Build Condition with the No Build Condition traffic analysis results, LOS degradations and/or significant delay increases (25% or greater) were identified at the NC 73 / NC 16 Business intersection, the NC 73 / Pilot Knob Road intersection, the NC 16 Business / Waterside Crossing Blvd Intersection, as well as the NC 16 Business / S Pilot Knob Road intersection. Improvement options were evaluated to develop recommendations as discussed below.

Conclusions and Recommendations

The traffic analyses identified off-site improvement needs at the proposed site entrance intersection and four existing intersections, which currently have or are expected to have similar operational deficiencies in the 2020 No Build Conditions. It is noted that NCDOT had recently conducted a NC 73 Corridor Study, and has plans (STIP project R-5721) to widen NC 73 to a multi-lane facility from NC 16 Business to W Catawba Avenue in Cornelius, NC. These corridor improvements however are not expected be constructed by 2020, the design year of this traffic study. Based on the capacity analysis and traffic simulation results, turn lane warrant analysis, previous traffic studies and recommendations, as well as engineering judgment, the following improvements are recommended.

Phase I (49 units) Improvements:

NC 16 Business at Site Entrance

- *Southbound:* Construct a southbound left-turn lane on NC 16 Business with 150 feet of storage and appropriate deceleration and taper lengths. Install milling / resurfacing as required by NCDOT.
- *Westbound:* Construct the site entrance with two exit lanes. The right-turn exit lane should have a 100 feet storage and appropriate deceleration and taper lengths.

NC 16 Business at S Pilot Knob Road (by Cottonwood Village)

- *Northbound:* Construct a northbound right-turn lane on NC 16 Business with 125 feet of storage and appropriate deceleration and taper lengths.

Note: The proposed right-turn lane is warranted by the existing traffic volumes, and was required for the Cottonwood Village development. If the subject development is required to install this right-turn lane, it may be appropriate to trade improvement responsibilities.

Additional off-site improvements are recommended below to accommodate the site trips and mitigate existing and projected deficiencies in the future No Build Conditions. These improvements are necessitated by the collective impacts of the background traffic growth, off-site developments, and site trips. While the site trips represent a relatively small percentage (3% to 8%) of the overall intersection traffic demands during peak hours, the delays may increase disproportionally when the subject intersections or approaches operate at or near capacity. It may be appropriate for the developer to contribute towards, or implement elements of these improvements. In the event that individual off-site developments are delayed or canceled, the roadway improvements may be reevaluated as the traffic demands may differ from those analyzed in this study.

Phase II (115 units) Improvements:

NC 16 Business at Waterside Crossing Blvd

- *Southbound:* Revise the existing pavement markings to provide a through lane and a left-turn lane with 150 feet of storage and appropriate deceleration and taper lengths.
- *Northbound:* Revise the existing pavement markings to provide a center TWLT lane between the Advanced Auto Parts Entrance and the Waterside Crossing Blvd intersection. Install roadway widening as needed to maintain a minimum of 100’ northbound right-turn lane.
- *Milling and Resurfacing*: Install milling and resurfacing as required by NCDOT.

NC 73 at NC 16 Business

- Northbound: Construct a northbound through/right-turn shared lane with 175 feet of storage and appropriate deceleration and taper lengths.
- *Signal:* Install signal upgrades to accommodate the proposed lane assignments.

NC 73 Closed Loop System (By NCDOT)

- Signal Timing: optimize signal timings for the NC 73 CLS including the NC 16 Business intersection and the Pilot Knob Road intersection.

Phase III (138 units) Full Buildout Improvements:

NC 73 at NC 16 Business (full buildout site trips represent 3%+/- of peak hour demands)

- Northbound: Revise the northbound pavement markings to provide an exclusive left-turn lane, a left-turn/through shared lane, and through/right-turn shared lane.
- *Southbound:* Remove and reconstruct the right-turn channelizing island so that the southern edge of the island is shifted 12' north of the existing location. Repave and install new pavement markings as needed after the island removal. Install a new stop line for the southbound right-turn lane.
- *Westbound:* Extend the existing right-turn lane by approximately 150' to the eastern entrance of the Kangaroo gas station (to provide 320'+/- of storage), and revise the pavement markings to convert the right-turn lane to a through/right-turn shared lane.
- *Signal:* Install signal upgrades to accommodate the proposed lane assignments, provide split phasing for the northbound and southbound approaches, and signalize the southbound right-turn movement with permitted/overlap (with eastbound left-turn) phasing.

NC 73 at Pilot Knob Road (site trips represent 4%+/- of peak hour demands)

- *Northbound:* Construct a northbound right-turn lane with 230 feet of storage and appropriate deceleration and taper lengths.
- *Westbound:* Extend the existing left-turn lane by approximately 110 feet to provide a total of 275 feet of storage with appropriate deceleration and taper lengths.
- *Signal:* install signal upgrades to accommodate the proposed lane assignments, provide protected/permissive signal phases for the westbound left-turn and southbound left-turn movements, and provide permitted/overlap phasing for the northbound right-turn movement.

NC 73 Closed Loop System (By NCDOT)

- Signal Timing: optimize signal timings for the NC 73 CLS including the NC 16 Business intersection and the Pilot Knob Road intersection.

NC 16 Business at S Pilot Knob Road (full buildout site trips represent 14%+/- of peak hour demands)

- *Signal:* Install an actuated traffic signal at this intersection with appropriate signal heads, poles, loop detectors, junction boxes, etc. Signal warrant analysis shall be performed before the signal installation, and the signal installation must be approved by NCDOT.

Note: This study assumed a future 125' northbound right-turn lane on NC 16 Business which was previously required for the Cottonwood Village Development (Phases 2&3). Without the proposed right-turn lane, the signal may still operate at LOS B but with longer queues during peak hours.

The analyses show that the proposed widening and new traffic pattern at the NC 73 and NC 16 Business intersection will provide better intersection operational performance than the No Build Conditions during both AM and PM peak hours. At the NC 73 and Pilot Knob Road intersection, the improvements will enable the intersection to operate at an overall LOS C with a significant reduction in delays on the southbound approach. The NC 16 Business and Waterside Crossing Blvd intersection, with the proposed turn-lane / pavement marking revisions, is expected to maintain the current operational performance.

The NC 16 Business and S Pilot Knob Road intersection is expected to operate at LOS B or better during both AM and PM peak hours, once the proposed signal are implemented with or without the proposed northbound right-turn lane (by Cottonwood Village). The proposed turn lanes at the Site Entrance intersection will provide adequate storage capacity.

With the proposed improvements, all of the study intersections are expected to operate with similar or better operational performance when compared with the No Build conditions.

INTRODUCTION

Carrington Subdivision is a proposed residential development located on a 151-acre tract near the southeastern corner of the NC 16 Business and S Pilot Knob Road intersection in Lincoln County, NC. The proposed development will include 302 single family units. Figure 1 illustrates the location of the site and surrounding area.

The subject development is proposed to have two access points. The main entrance will be located on NC 16 Business approximately 375 feet south of S Pilot Knob Road. A secondary site access is provided via the existing Avenel Lane and Sedgebrook Drive intersection. Figure 2 shows the Site Plan.

After discussions with the County and NCDOT, the following eight intersections are included as part of the area of influence for the proposed development. Appendix A Memorandum of Understanding summarizes the study area and other key assumptions.

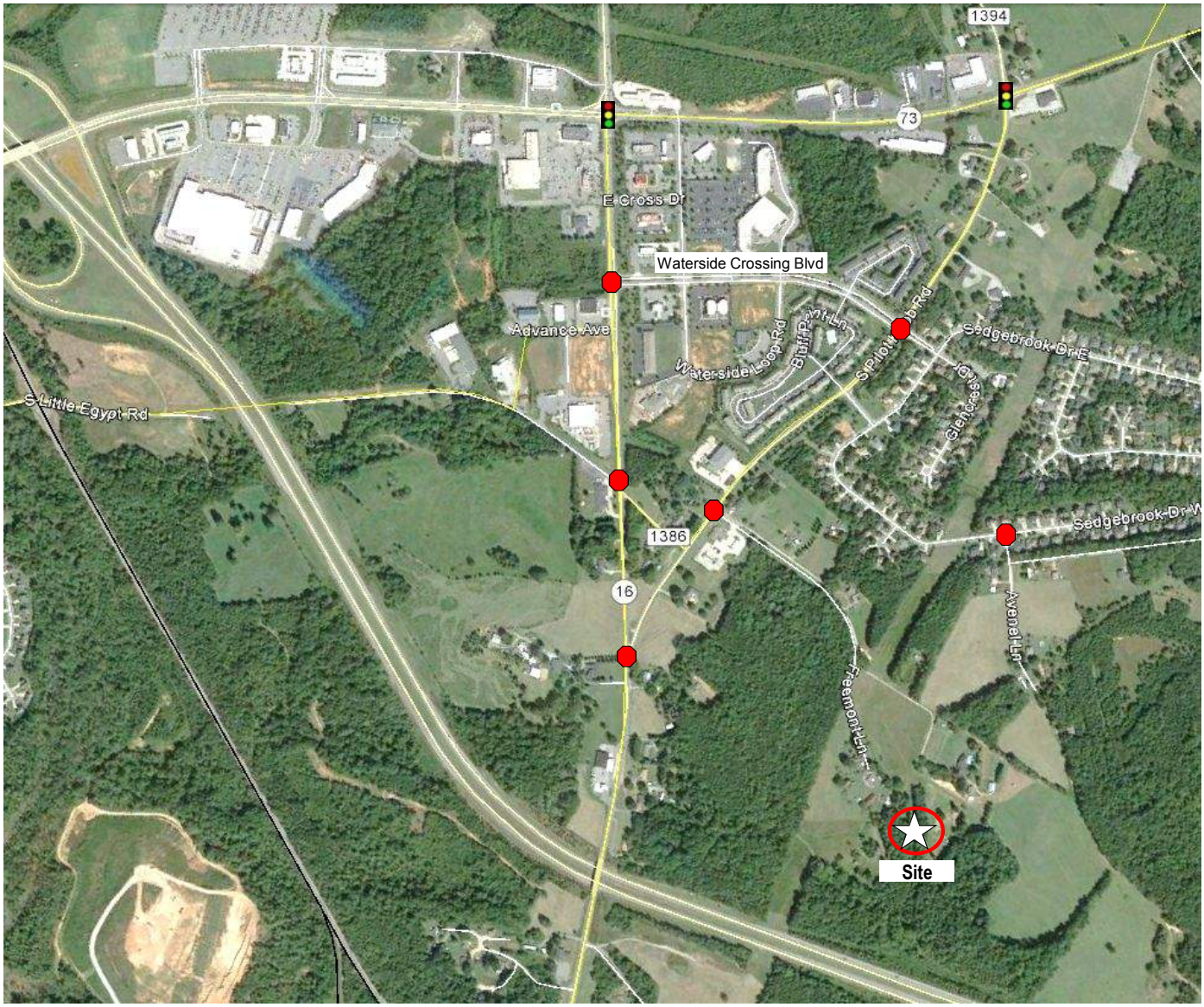
NC 16 Business and NC 73…….....*Signalized 4-legged intersection*
Pilot Knob Rd and NC 73……..*Signalized 4-legged intersection*
NC 16 Business and Waterside Crossing Blvd…….*Unsignalized 4-legged intersection*
S Pilot Knob Rd and Waterside Crossing Blvd…….*Unsignalized 4-legged intersection*
NC 16 Business and S Little Egypt Rd…….*Unsignalized 4-legged intersection*
S Pilot Knob Rd and Freemont Ln……...*Unsignalized T- intersection*
NC 16 Business and S Pilot Knob Rd……...…...*Unsignalized T- intersection*
Avenel Ln and Sedgebrook Dr…….…...*Unsignalized T- intersection*
NC 16 Business and Site Entrance……...…...*Unsignalized T- intersection*

The traffic signals on NC 73 are part of the NC 73 Closed Loop System (CLS). Based on the signal timing plans obtained from NCDOT, the eight-phase NC 73/NC 16 Business signal runs on a 100-second cycle length in AM peak hour, and a 120-second cycle length in the PM peak hour. The NC 73/Pilot Knob Road signal, which is the master signal, only has two signal phases and runs on half-cycle lengths (50 seconds in the AM peak, and 60 seconds in the PM peak).

The existing intersection lane configuration is shown in Figure 3. Below is a detailed description of the existing study area roadway network. All Average Annual Daily Traffic (AADT) information provided in this description was obtained from the North Carolina Department of Transportation (NCDOT) via the following website: http://www.ncdot.gov/travel/statemapping/trafficvolumemaps/.

N

**Not to Scale



Study Area Intersections:

1. NC 16 Bus. @ NC 73
2. NC 16 Bus. @ Waterside Crossing Blvd
3. NC 16 Bus. @ S Little Egypt Rd
4. NC 16 Bus. @ S Pilot Knob Rd
5. S Pilot Knob Rd @ Freemont Ln
6. S Pilot Knob Rd @ Waterside Crossing Blvd
7. S Pilot Knob Rd @ NC 73
8. Sedgebrook Dr @ Avenel Ln

Legend	
	Signalized Intersection
	Unsignalized Intersection
	Future Site

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Figure 1
Study Area

Figure 2 Site Plan

Development Data:

Developer Information:	Eastwood Homes 2857 Westport Road Charlotte, NC 28208
Tax Parcels:	32263, 33004, 34511, 34512, 51301, 54013, 58901 & 71175
Total Site Acreage:	+/- 151 Acres
Location:	Lincoln County, NC
Zoning:	
Existing:	R-T
Proposed:	PD-R
Total Units Shown:	302 Lots (2.0/Acre)
Minimum Proposed Lot Width:	50' Wide
Setbacks:	
Front:	10' (20' to garage)
Side:	5' (10' for corner lots)
Rear:	20'
Density:	2.0 DU/AC* *Final density will be dependent on final boundary survey.
Watershed:	WS-IV Protected* *Maximum Density: 2 lots/ acre with curb.

General Notes :

1. Base information provided by Lincoln County GIS Data and should be verified for accuracy.
2. All site plan, zoning, and wetland information utilized in the preparation of this Planned Development Concept Plan is considered to be preliminary in nature and subject to change and final verification.
3. Draft - Do not rely on this document.
4. Sidewalks shall be located on one side of each proposed street.
5. A Class 'B' buffer is required around the project perimeter.

Floodplain Information
Floodplain information obtained from FEMA FIRM Panels 3710460100 and 3710460200J effective date of study on August 17, 2007.

Stream/Wetland Information
Stream Wetland information is based on preliminary information provided to ESP by Lincoln County GIS data. For purposes of preparation of this Planned Development Concept Plan, any potential wetland areas and stream features depicted on the plan are considered to be preliminary in nature and approximate in location. The Planned Development Concept Plan will need to be revised once all agencies approved on-site wetland/stream and appropriate jurisdictional boundaries are surveyed and verified with acceptable levels of accuracy- unit loss may occur.

Access Points/Driveways/Streets
1. Proposed project site entrance locations are considered preliminary in nature and need to be verified for adequate sight distance.
2. All roadway and street systems are considered to be preliminary and will need to be verified for sufficiency to satisfy or exceed minimum requirements established in the Lincoln County Unified Development Ordinance and applicable standards identified by NCDOT. Street connections are conceptual and may be subject to change based on agency input and review.

Open Space/Tree Save
Open Space and Tree Save areas are conceptual and preliminary. The exact location of these areas may change as the client finalizes decisions regarding final layout, product allocation, and as other spatially dependent project components such as stormwater areas, wetland areas, utility features, and buffers, (as applicable) for this project are better defined.

Potential Stormwater Quality
Location of proposed stormwater areas are conceptual and preliminary and still need to be determined. The exact size and location of these areas will change as the client finalizes decisions regarding final layout, product allocation, and as other proposed changes to the project are better defined. Layout and unit count subject to change based on final design of stormwater quality areas.

Public Information
ESP Associates is not responsible for plan deficiencies created by incorrect, incomplete, missing or outdated information derived from public sources such as GIS, Planning and Zoning departments.

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CLIENT

EASTWOOD HOMES

Eastwood Homes
2857 Westport Road
Charlotte, NC 28208

PROJECT

CARRINGTON SUBDIVISION

SHEET TITLE

PLANNED DEVELOPMENT CONCEPT PLAN

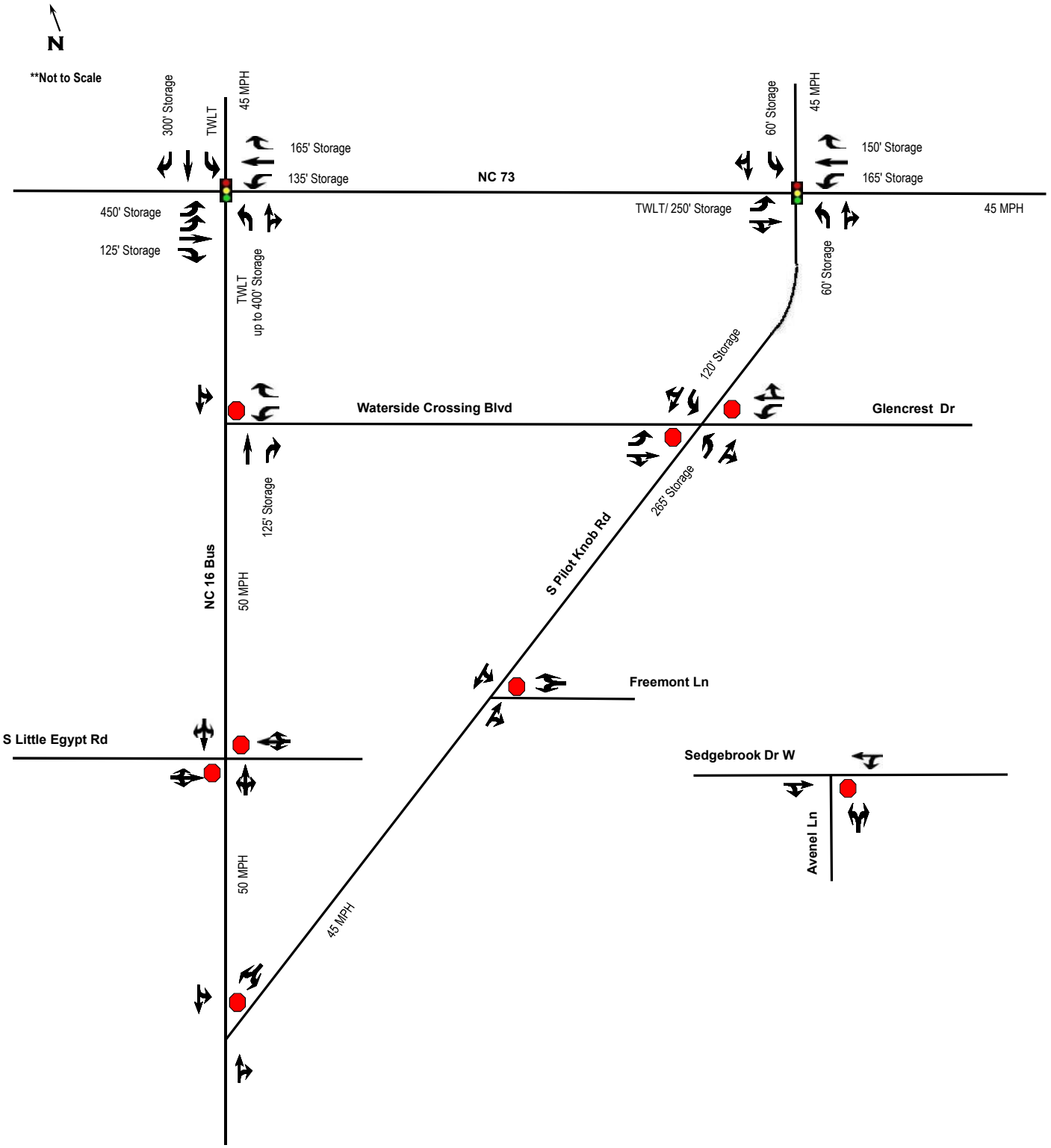
PROJECT LOCATION	LINCOLN COUNTY, NC

GRAPHIC SCALE
300 0 150 300 600
1 INCH = 300 FT.

PROJECT NUMBER	DU08
DRAWING NAME	DU08 - Concept Sketch.psd
DATE	September 14, 2015
DRAWN BY	SB/CI
CHECKED BY	ML

AGENCY / SUBMITTAL REVISION

NO.	DATE	BY	REVISION
1	10/8/15	CL	COUNTY REVISIONS



Legend	
	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
	Existing Lane

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Figure 3
Existing Intersection Configuration

NC 73 is an east-west roadway that transitions from a five-lane facility to a two-lane roadway through the study area. It provides access to Huntersville to the east and Lincolnton to the west. The land use along NC 73 is primary commercial between NC 16 Business and Pilot Knob Road. The 2014 AADT on NC 73 was 27,000 vehicles per day (vpd) west of NC 16 Business, and 16,000 vph east of NC 16 Business. The speed limit along this road is 45 miles per hour (mph).

NC 16 Business is a north-south roadway that transitions from a three-lane facility to a two-lane roadway through the study area. It provides access to access to Denver to the north and Lowesville to the south. The land use along NC 16 Business is commercial. The 2014 AADT on NC 16 Business was 12,000 vpd south of NC 73. The speed limit along this facility is 45 mph north of Waterside Crossing Blvd, and 50 mph south of Waterside Crossing Blvd.

S Pilot Knob Road (SR 1394) is a north-south two-lane roadway connecting NC 16 Bus to NC 73. The land use along this roadway is residential with some commercial. The 2014 AADT on Pilot Knob Road was 4,400 vpd south of NC 73. The posted speed limit on this roadway is 45 mph.

Waterside Crossing Blvd (SR 2039) is an east-west two-lane roadway providing access to shopping and housing between NC 16 Business and S Pilot Knob Road. The land use along this roadway is a mix of commercial and residential. There was no AADT available for this road. The posted speed limit along this road is 25 mph.

On the east side of NC 16 Bypass, ***S little Egypt Road*** is an east-west two-lane roadway approximately half a mile in length. It terminates at the western end before the NC 16 Bypass, and connects to NC 16 Business and S Pilot Knob Road at the eastern ends. S Little Egypt Road provides access to several existing businesses and the proposed Cottonwood Village Development. The section between NC 16 Business and S Pilot Knob Road is currently unpaved. There is no AADT data or speed limit sign available for this road.

Freemont Lane, Sedgebrook Drive, and ***Avenel Lane*** are all two-lane residential streets. Both Sedgebrook Drive and Avenel Lane are located inside "The Gates at Waterside Crossing" neighborhood.

METHODOLOGY

This traffic study evaluated the intersection traffic operational performance through the intersection capacity / Level of Service (LOS) analysis, traffic simulations, and queue analysis. The intersection LOS is a measurement of average delay incurred at an intersection for a particular movement or approach. LOS is defined by the Transportation Research Board's Highway Capacity Manual 2010 (HCM). The following tables list the HCM criteria for both signalized (HCM Exhibit 18-4) and unsignalized intersections (HCM Exhibit 19-1). In addition, an intersection or approach will automatically become LOS F if the Volume-to-Capacity (V/C) ratio exceeds 1.0.

Signalized Intersection HCM Exhibit 18-4

LOS	Control Delay (s/veh)
A	≤10
B	> 10 - 20
C	> 20 - 35
D	> 35 - 55
E	> 55 - 80
F	> 80

Unsignalized Intersection HCM Exhibit 19-1

LOS	Control Delay (s/veh)
A	≤10
B	> 10 - 15
C	> 15 - 25
D	> 25 - 35
E	> 35 - 50
F	> 50

According to industry standards, any signalized intersection or any approach of an unsignalized intersection is considered acceptable if the LOS is D or better with the LOS A representing little or no delay. Intersections or approaches with a LOS of E or F are considered substandard and may need mitigation to improve the operational performance.

Existing volumes, traffic flow characteristics, and intersection geometrics collected during field visits, as well as projected travel demands and patterns were used to determine the level of service. The LOS analysis for signalized and unsignalized intersections was completed through the use of Synchro, version 9, which categorizes the LOS based on HCM methodology and criteria. Sidra Intersection, Version 6.1, is used for roundabout analysis, where applicable, as recommended by the NCDOT Congestion Management Section. In addition, ten one-hour microscopic traffic simulations were conducted in Simtraffic, a simulation program, for each analysis scenario. The simulation runs not only account for the stochastic nature of traffic flow but also provide finer details in traffic operations.

For the purposed of the Traffic Impact Analysis (TIA), the site is assumed to be completed, opened, and fully occupied in 2019. Thus the design year in this study is 2020, or one year past build-out. This study evaluated the following four scenarios for the study intersections:

1. The "**2015 Existing Conditions Analysis**" evaluates the current intersection operational performance.
2. The "**2020 No Build Analysis**" examines the future traffic conditions where the proposed development is not constructed. This analysis takes into account background traffic growth (1% per year), nearby approved developments and any committed transportation improvements.
3. The "**2020 Build Analysis**" evaluates the intersection operational performance after distributing site generated trips through the study area intersections, and,
4. The "**2020 Build with Improvements Analysis**" identifies and evaluates the mitigation measures, if there is any degradation in the operational performance when comparing scenarios 2 and 3 above.

The eight existing study intersections were analyzed in all scenarios while the proposed main site entrance was evaluated in the future year "Build" and "Build with Improvements" scenarios only. Traffic counts were conducted at all existing locations to help determine site trip distribution patterns. Intersection analyses were performed for both the weekday AM (peak hour between 7-9 AM) and PM (peak hour between 4-6 PM) peak hours in all scenarios.

In accordance with the NCDOT Capacity Analysis Guidelines, no "Right Turn on Red" (RTOR) is allowed in this study. In addition, a Peak Hour Factor (PHF) of 0.90 is used for analyses. The existing traffic signals are analyzed with the actual signal phasing for the Existing Condition Analyses. The signal lost times are adjusted to remain 5 seconds for all the analysis conditions. As no major geometric changes are anticipated at the NC 73 and Pilot Knob Road intersection (two-phase signal), protected-permissive left-turn signal phasing is proposed and analyzed for the future improvement conditions.

2015 EXISTING CONDITION ANALYSIS

Traffic counts for the existing intersections were collected between the hours of 7:00 - 9:00 AM and 4:00 - 6:00 PM on Thursday May 14th, 2015. The peak hour traffic counts are provided in Appendix B and depicted in Figure 4. Appendix C includes photos for the study intersections.

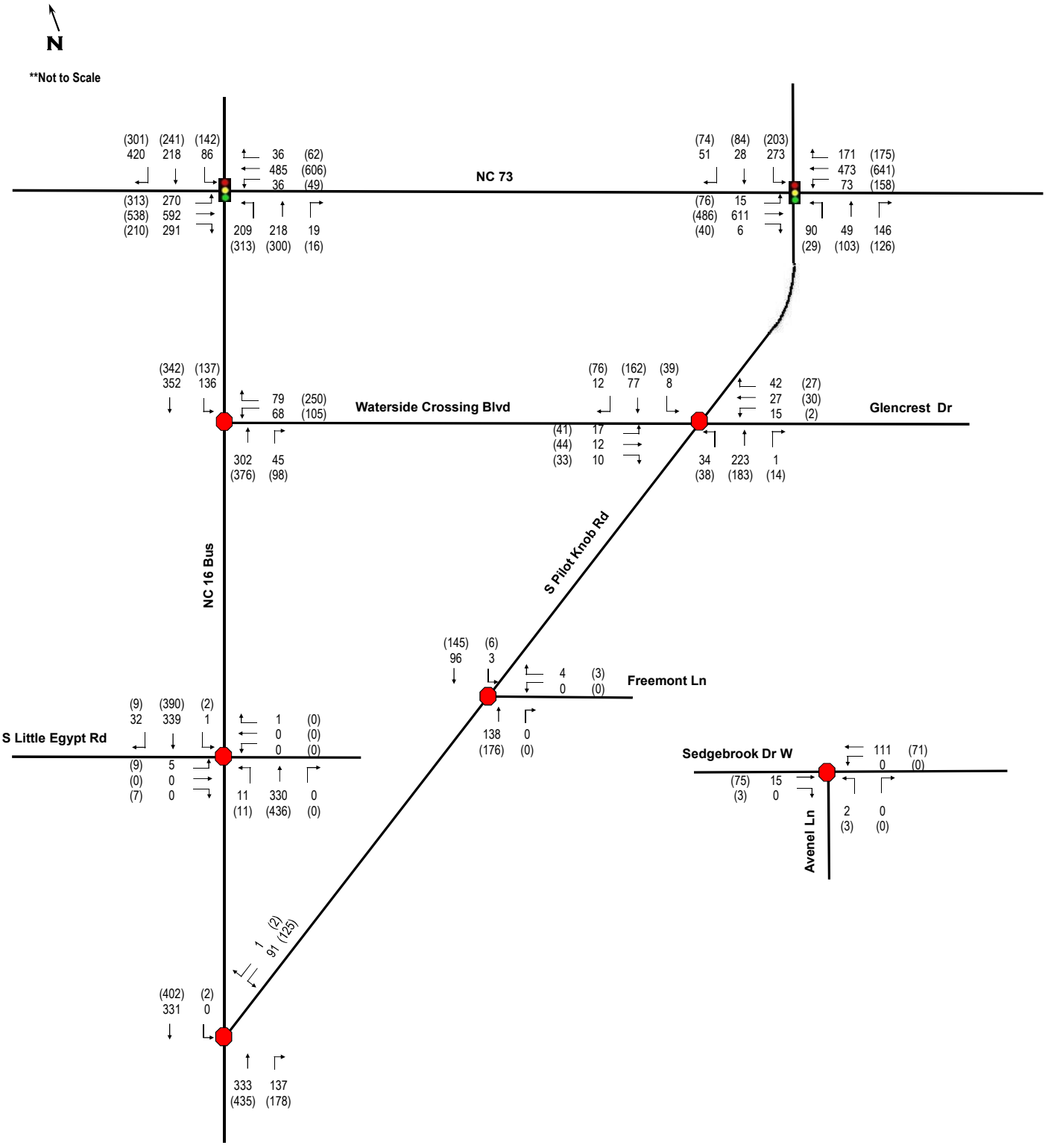
The traffic signals on NC 73 are part of the NC 73 Closed Loop System (CLS). The current signal plans and timing schedules were obtained from NCDOT and provided in Appendix D. Existing volumes, traffic flow characteristics, signal configuration and timing parameters, and intersection geometrics collected during field visits were used to determine the intersection level of service.

Table 1 lists the LOS results from the 2015 Existing Conditions analysis. Delay and LOS results are reported for each intersection approach. Intersection average delays (based on a weighted average of the approaches) and LOS are also reported for signalized intersections. Queue analysis results are summarized in Table 2. Detailed analysis and simulation output sheets are included in Appendix F.

Table 1: Level of Service Analysis – 2015 Existing Conditions

Intersection	Approach		Existing (2015)			
			AM		PM	
			Delay (sec)	LOS	Delay (sec)	LOS
NC 73 @ NC 16 Bus	signalized	Intersection Average	**35.9**	**D**	**59.5**	**E**
		EB - NC 73	35.5	D	39.4	D
		WB - NC73	40.5	D	56.5	E
		NB - NC 16 Bus	54.3	D	114.9	F
		SB - NC 16 Bus	21.7	C	42.7	D
NC 73 @ Pilot Knob Rd	signalized	Intersection Average	**19.0**	**B**	**16.3**	**B**
		EB - NC 73	18.4	B	8.5	A
		WB - NC73	11.4	B	14.0	B
		NB - Pilot Knob Rd	16.6	B	21.6	C
		SB - Pilot Knob Rd	37.7	D	31.7	C
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	3.4	A	3.8	A
		WB - Waterside Crossing Blvd	19.7	C	25.7	D
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NB - S Pilot Knob Rd	1.0	A	1.3	A
		SB - S Pilot Knob Rd	0.6	A	1.1	A
		EB - Waterside Crossing Blvd	12.2	B	15.1	C
		WB - Glencrest Dr	11.6	B	13.3	B
NC 16 Bus @ S Little Egypt Rd	unsignalized	NB - NC 16 Bus	0.4	A	0.3	A
		SB - NC 16 Bus	0.0	A	0.1	A
		EB - S Little Egypt Rd	17.0	C	16.6	C
		WB - S Little Egypt Rd	10.3	B	0.0	A
S Pilot Knob Rd @ Freemont Ln	unsignalized	NB - S Pilot Knob Rd	0.0	A	0.0	A
		SB - S Pilot Knob Rd	0.2	A	0.4	A
		WB - Freemont Ln	9.0	A	9.3	A
NC 16 Bus @ S pilot Knob Rd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	0.0	A	0.1	A
		WB - S Pilot Knob Rd	19.7	C	34.8	D
Sedgebrook Dr @ Avenel Ln	unsignalized	EB - Sedgebrook Dr	0.0	A	0.0	A
		WB - Sedgebrook Dr	0.0	A	0.0	A
		NB - Avenel Ln	9.2	A	9.4	A

Unacceptable Delay/LOS



Legend	
——	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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Lincoln County, NC

Figure 4
2015 Existing Peak Hour Traffic Volumes

Table 2: Queue Analysis – 2015 Existing Conditions

Intersection	Turn Lane		Storage Length (ft)	Existing (2015)			
				AM		PM	
				95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)
NC 73 @ NC 16 Bus	signalized	EBL	450	#150	202	#207	199
		EBR	125	170	225	118	225
		WBL	135	m48	216**	m69	234**
		WBR	165	m26	264**	m45	265**
		NBL	TWLT 400+/-	#282	287	#522	499
		SBL	TWLT 1,000+	113	144	#239	276
		SBR	300	0	0	0	40
NC 73 @ Pilot Knob Rd	signalized	EBL	TWLT 250 +/-	m8	73	m39	108
		WBL	165	43	111	84	154
		WBR	150	58	132	56	147
		NBL	60	52	113	28	90
		SBL	60	#203	160*	#195	160*
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NBR	125	0	2	0	70
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NBL	265	2	27	3	39
		SBL	120	1	14	2	35

Queue length greater than storage length

m: queue is metered by upstream signal #: volume exceeds capacity

*: spillback to adjacent through lane **: no/little storage blockage

The LOS analyses show that the NC 73 and NC 16 Business intersection currently operates at LOS D in the AM peak hour, and LOS E (59.5 seconds of delay) in the PM peak hour. Most of the PM delays occur on the westbound approach (LOS E, 56.5 seconds) and northbound approach (LOS F, 114.9 seconds). Traffic simulations, which take into account the turn-lane blockages and gap acceptance behaviors, suggest that the PM peak hour delays are likely higher on the westbound approach (LOS F, 85.7 seconds) and northbound approach (LOS F, 171.4 seconds). The max queues observed during the simulation runs also indicate storage length deficiencies for the eastbound right-turn lane and the northbound left-turn lane. The max queue results for the westbound left-turn lane and the westbound right-turn lane appear to be skewed by the adjacent through traffic. During simulations, queues on the westbound through lane may block access to the left-turn or right-turn lane. The left-turn or right-turn vehicles do not appear to spill back to the westbound through lane.

At the NC 73 and Pilot Knob Road intersection, while the capacity analysis shows the intersection operates at LOS B during both AM and PM peak hours, traffic simulations reveal that the southbound left-turn movement likely experiences higher delays (LOS F). The southbound left-turn volumes represent 78% of the approach volumes in the AM peak hour, and 56% in the PM peak hour. The northbound right-turn volumes, in the meanwhile, account for approximately half of the northbound approach volumes during both peak hours. As the southbound left-turn vehicles have to yield to the northbound right-turn traffic as well as the northbound through traffic, the acceptable gaps are very

limited within its 20-second signal phase splits. The relatively short (60-foot) southbound left-turn bay and the heavy left-turn movement may, during certain peak arrival times, make the southbound through lane a de facto extended left-turn lane.

At the intersection of NC 16 Business and Waterside Crossing Blvd, the capacity analysis shows acceptable LOS (D or better) during peak hours for the Stop sign controlled westbound approach. The traffic simulations suggest that the downstream delays and queue at the NC 73 and NC 16 Business intersection could significantly increase the westbound delays, especially during the PM peak hour when the average westbound approach delays could be over 100 seconds.

The capacity analysis and traffic simulations show that all the other study intersections appear to operate at acceptable LOS, although the Stop sign controlled S Pilot Knob Road approach may have up to one-minute delays during the PM peak hour at its intersection with NC 16 Business. It is typical for minor street approaches to experience higher delays at unsignalized intersections.

2020 NO-BUILD ANALYSIS

The proposed development is scheduled to be completed in 2019. The analysis was performed for one year past build-out (2020) to assume full capacity and "normalized" traffic patterns. After discussions with the County and NCDOT, an annual growth rate of 1% was applied to the existing (2015) traffic volumes to estimate the future (2020) background traffic volumes, as shown in Figure 5. In addition, the following three nearby approved developments were included in the future condition analyses.

Trilogy Lake Norman

- 590 residential units (Phases 1 through 4) located on the south side of NC 73 between Ingleside Farm Road and Little Egypt Rd.
- Trips from this development were distributed to the study area network based on the previous traffic study and existing traffic patterns.
- No improvements are committed or planned for the Carrington Subdivision TIA study area.

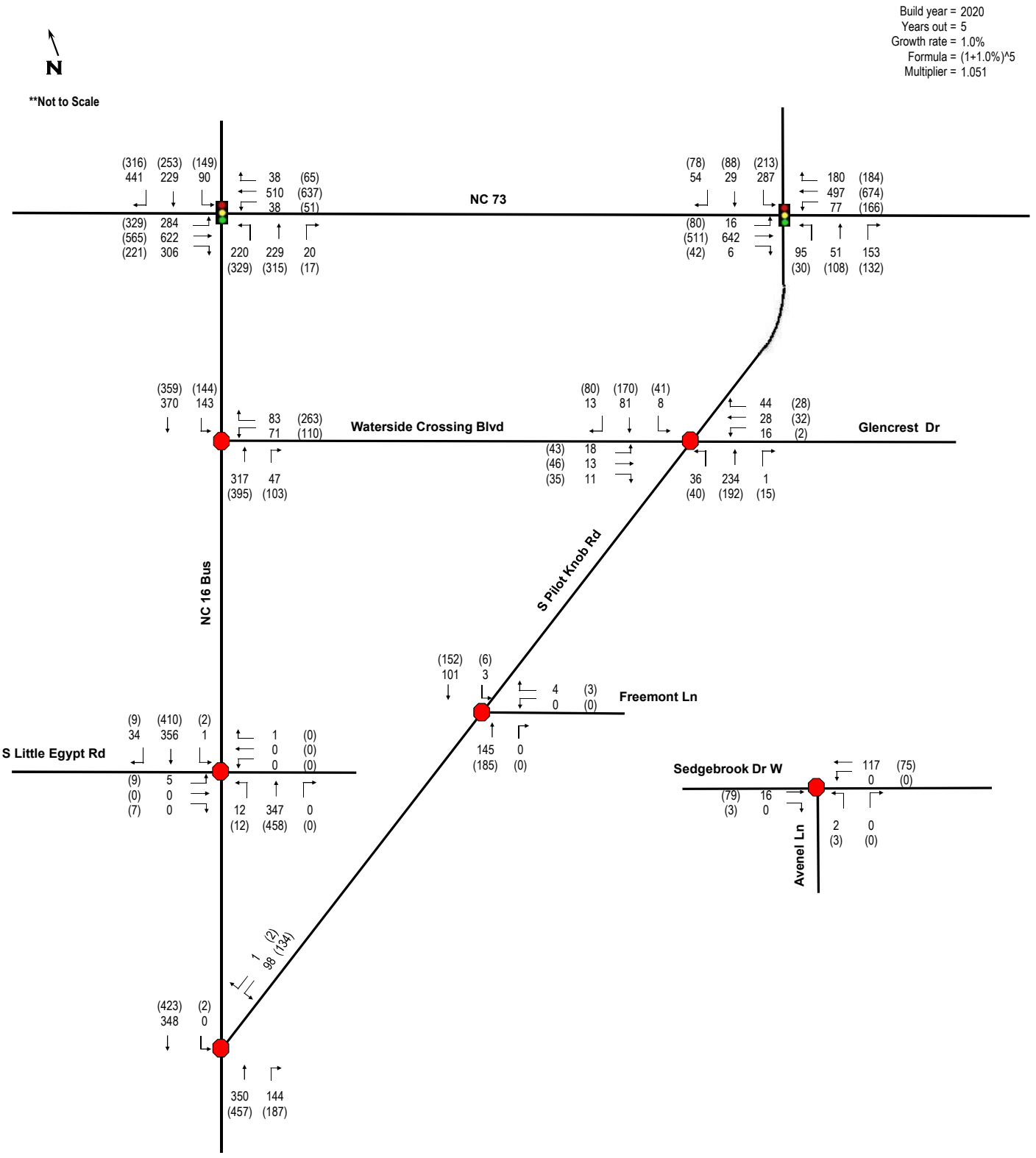
Rivercross

- A mixed-use development (220 single family units, 240 apartments, and 100,000 SF retail space) located on the west side of NC 16 Business south of Triangle Circle.
- Trips from this development were distributed to the study area network based on the previous traffic study and existing traffic patterns.
- No improvements are committed or planned for the Carrington Subdivision TIA study area.

Cottonwood Village

- A mixed-use development (254 apartments, 60,000 SF office space, and a 144-room hotel) located north of S Little Egypt Road between NC 16 and NC 16 Business.
- Trips from this development were distributed to the study area network based on the previous traffic study and existing traffic patterns.
- The following off-site improvements were also included in the future condition analyses.
    1. NC 16 Business and S Little Egypt Road: a 50' northbound left-turn lane
    2. NC 16 Business and S Pilot Knob: a 125' northbound right-turn lane
    3. NC 16 Business and Waterside Crossing Blvd: stripe the westbound approach to provide a left-turn lane and a right-turn lane

Figures 6 through 8 show the peak hour off-site development trips. The 2020 No-Build peak hour traffic volumes, as shown in Figure 9, include both background traffic growth and off-site development trips. The Figure 10 "2020 No Build Intersection Configuration" illustrates the turn-lane improvements to be installed by the Cottonwood Village development.



Legend	
——	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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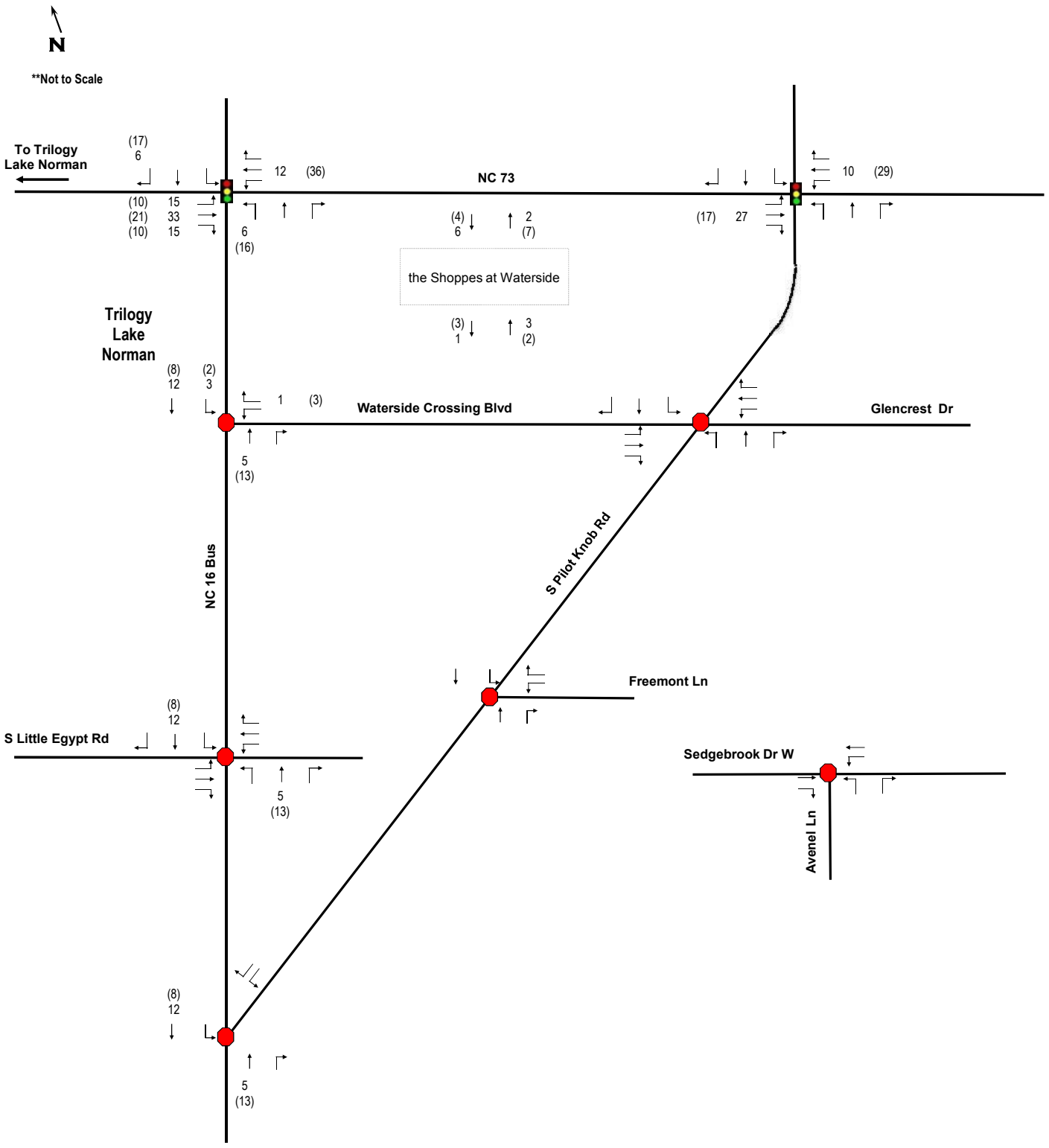
Figure 5
2020 Background Peak Hour Traffic Volumes



Legend	
——	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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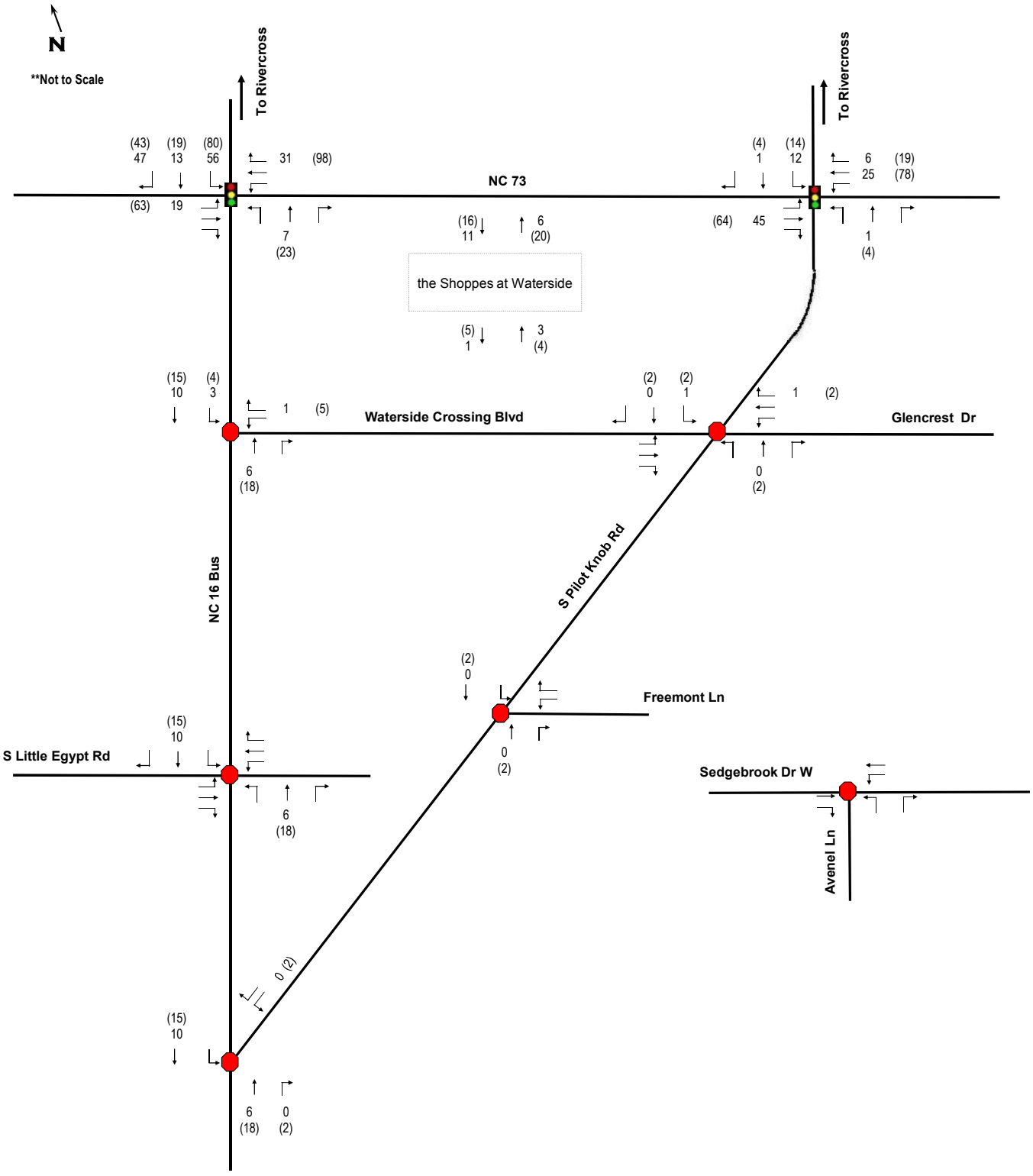
Figure 6
Trilogy Lake Norman
Peak Hour Trips



Legend	
——	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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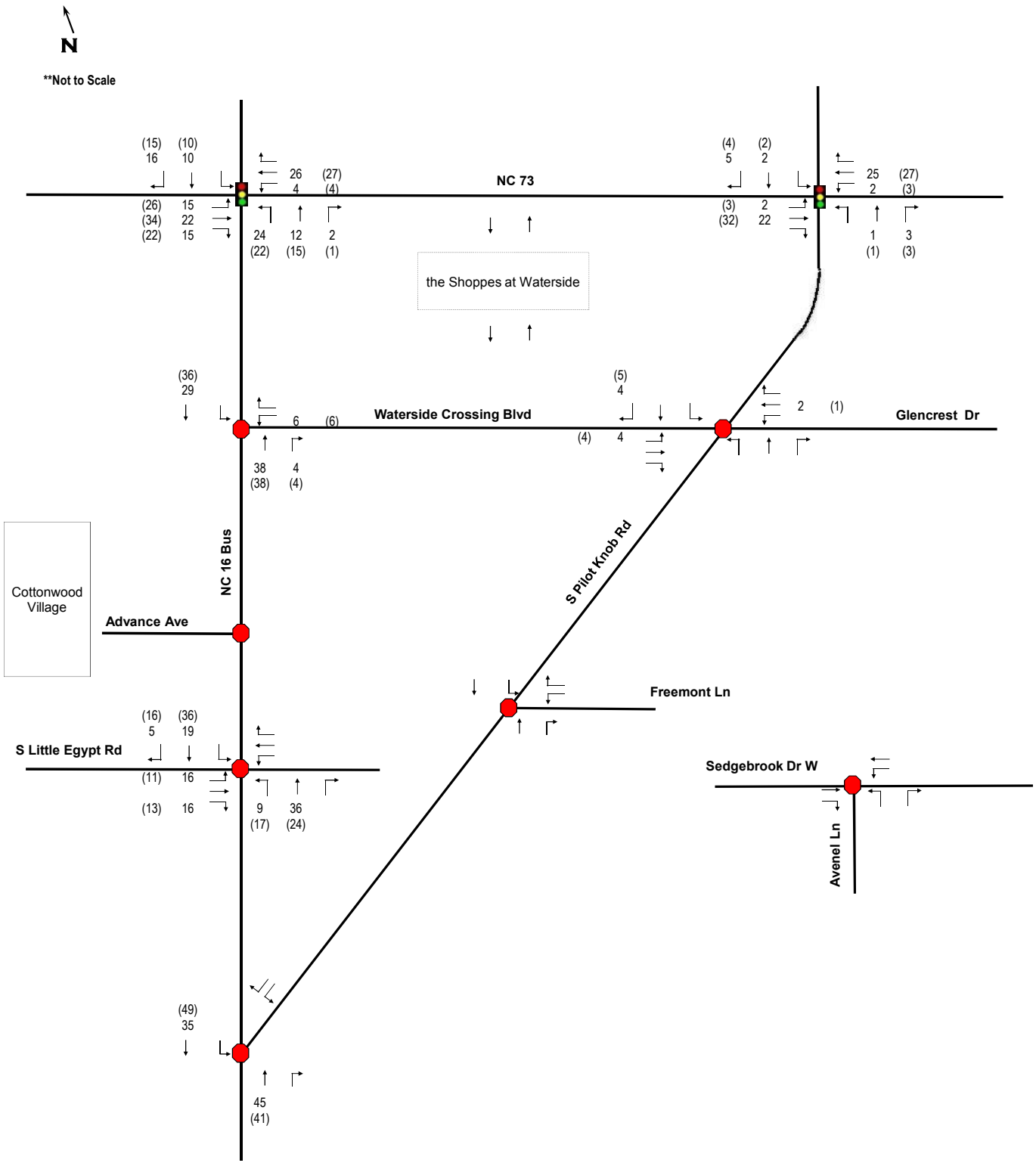
Figure 7
Rivercross Peak Hour Trips



Legend	
——	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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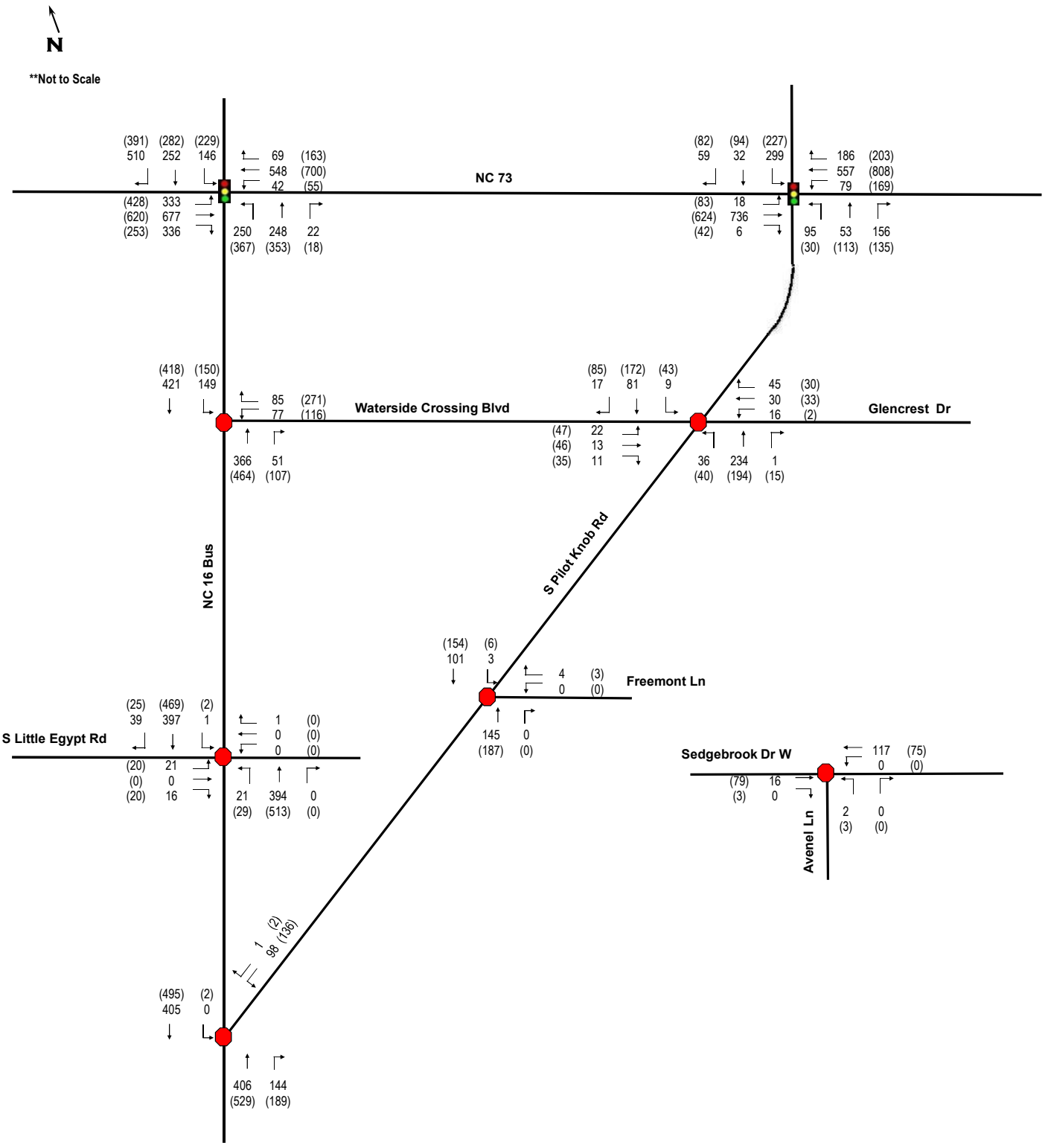
Figure 8
Cottonwood Village
Peak Hour Trips



Legend	
——	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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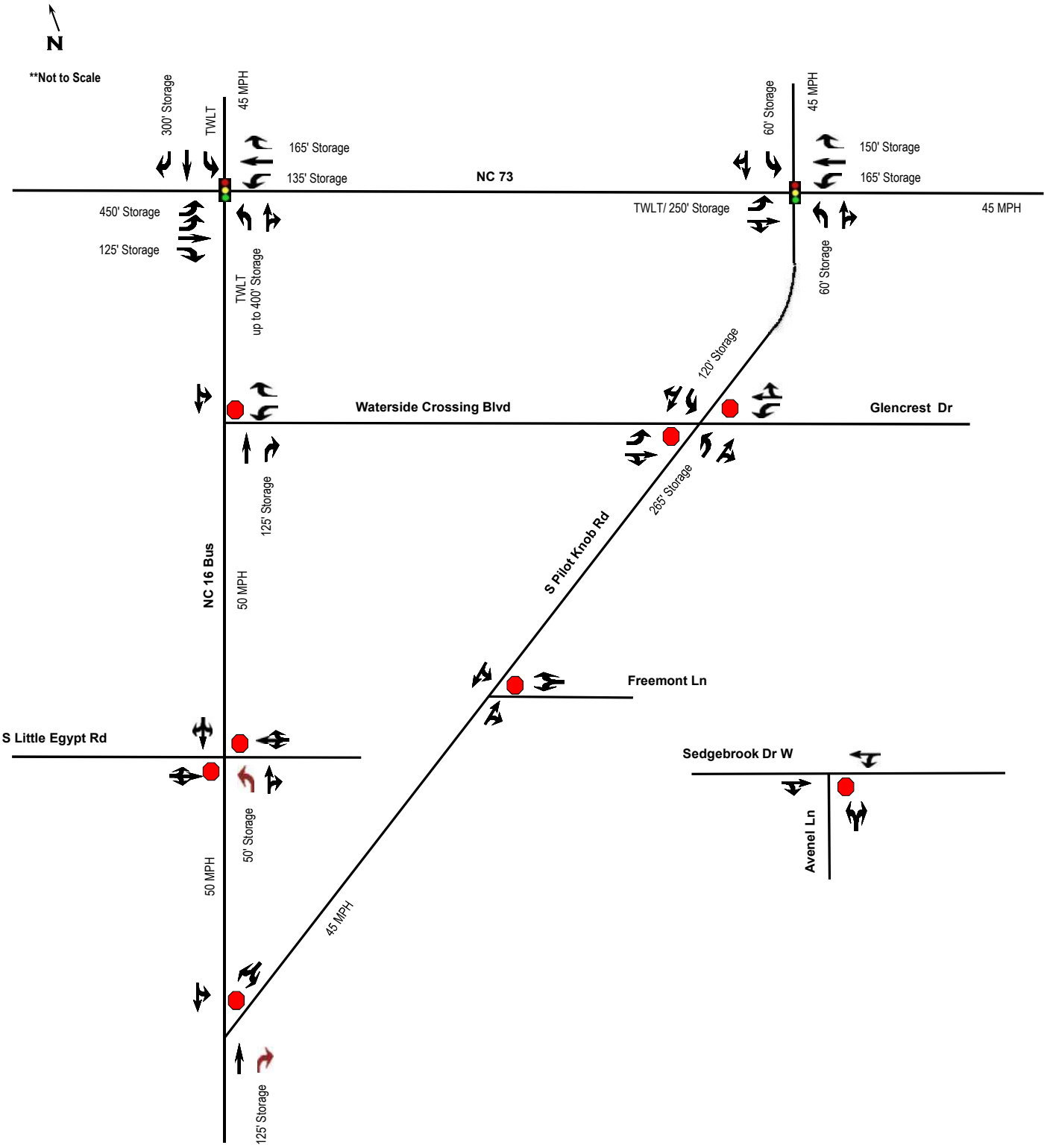
Figure 9
2020 No Build Peak Hour Traffic Volumes



Legend	
	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
	Existing Lane
	Future Lane (Cottonwood Village)

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Figure 10
2020 No Build Condition
Intersection Configuration

The LOS and queue results of the 2020 No-Build analyses are displayed in Tables 3 and 4, respectively.

Table 3: Level of Service Analysis – 2020 No-Build

Intersection	Approach		No Build (2020)			
			AM		PM	
			Delay (sec)	LOS	Delay (sec)	LOS
NC 73 @ NC 16 Bus	signalized	Intersection Average	**48.9**	**D**	**93.7**	**F**
		EB - NC 73	47.9	D	63.0	E
		WB - NC73	55.3	E	81.4	F
		NB - NC 16 Bus	75.5	E	174.5	F
		SB - NC 16 Bus	30.6	C	84.6	F
NC 73 @ Pilot Knob Rd	signalized	Intersection Average	**23.8**	**C**	**24.8**	**C**
		EB - NC 73	24.9	C	11.9	B
		WB - NC73	14.7	B	24.0	C
		NB - Pilot Knob Rd	16.9	B	24.4	C
		SB - Pilot Knob Rd	46.3	D	51.9	D
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	3.7	A	4.3	A
		WB - Waterside Crossing Blvd	30.6	D	58.7	F
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NB - S Pilot Knob Rd	1.0	A	1.3	A
		SB - S Pilot Knob Rd	0.7	A	1.1	A
		EB - Waterside Crossing Blvd	12.7	B	16.3	C
		WB - Glencrest Dr	11.9	B	14.1	B
NC 16 Bus @ S Little Egypt Rd	unsignalized	NB - NC 16 Bus	0.4	A	0.5	A
		SB - NC 16 Bus	0.0	A	0.1	A
		EB - S Little Egypt Rd	17.8	C	22.2	C
		WB - S Little Egypt Rd	10.8	B	0.0	A
S Pilot Knob Rd @ Freemont Ln	unsignalized	NB - S Pilot Knob Rd	0.0	A	0.0	A
		SB - S Pilot Knob Rd	0.2	A	0.3	A
		WB - Freemont Ln	9.1	A	9.3	A
NC 16 Bus @ S pilot Knob Rd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	0.0	A	0.1	A
		SWB - S Pilot Knob Rd	23.1	C	51.3	F
Sedgebrook Dr @ Avenel Ln	unsignalized	EB - Sedgebrook Dr	0.0	A	0.0	A
		WB - Sedgebrook Dr	0.0	A	0.0	A
		NB - Avenel Ln	9.3	A	9.4	A

Unacceptable Delay/LOS

With the background traffic growth and the nearby proposed developments, the LOS analyses show that the vehicle delays will increase at most of the study intersections. The NC 73 and NC 16 Business intersection is expected to operate at LOS D (48.9 seconds) during the AM peak hour, and LOS F (93.7 seconds) during the PM peak hour. The peak hour intersection average delays are approximately 36% and 57% higher than the corresponding AM and PM peak hour delays in the Existing Conditions. Similar to the Existing Condition Analysis, traffic simulations suggest the delays are likely higher due to the queue blockages. The simulations also show that, during the PM peak hour, the through traffic queues on the southbound and westbound approaches may block access to the turn lanes, which seems to skew the max queue length estimates for the adjacent turning movements (labeled with ** in the Table 4).

At the NC 73 and Pilot Knob Road intersection, traffic simulations again show higher delays (LOS F) than the capacity analysis (LOS D 46~52 seconds) for the southbound approach during both AM and PM peak hours, as the acceptable gaps become more limited without a protected southbound left-turn signal phase. The queues caused by the left-turn vehicles may extend approximately 2,000' feet during peak hours, based on the simulation (max queue) results for the adjacent southbound through lane.

Table 4: Queue Analysis – 2020 No-Build

Intersection	Turn Lane		Storage Length {Future Storage} (ft)	No Build (2020)			
				AM		PM	
				95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)
NC 73 @ NC 16 Bus	signalized	EBL	450	#205	530**	#325	488
		EBR	125	203	225	143	225
		WBL	135	m50	235**	m63	234**
		WBR	165	m43	265**	m94	265**
		NBL	TWLT 400+/-	#355	452	#630	500
		SBL	TWLT 1,000+	#228	320	#422	1,155**
		SBR	300	0	39	0	400**
NC 73 @ Pilot Knob Rd	signalized	EBL	TWLT 250 +/-	m7	135	m27	132
		WBL	165	#77	106	#162	264
		WBR	150	63	137	65	250**
		NBL	60	55	102	28	130
		SBL	60	#228	160*	#229	160*
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NBR	125	0	45	0	225**
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NBL	265	2	25	3	96
		SBL	120	1	25	3	112
NC 16 Bus @ S Little Egypt Rd	unsignalized	NBL	{50}	2	10	2	28
NC 16 Bus @ S Pilot Knob Rd	unsignalized	NBR	{125}	0	0	0	0

Queue length greater than storage length

m: queue is metered by upstream signal #: volume exceeds capacity

*: spillback to adjacent through lane **: no/little storage blockage

At the NC 16 Business and Waterside Crossing Blvd intersection, the capacity analysis shows the Stop sign controlled westbound approach LOS will degrade from D in the Existing Condition to F in the No Build Condition during the PM peak hour. This approach LOS will remain to operate at LOS D during the AM peak hour. The traffic simulations suggest the queues on northbound NC 16 Business may spill back from the downstream traffic signal on NC 73, and block access to the Waterside Crossing Blvd intersection during the PM peak hour. The PM peak northbound right-turn "max queue" of 225 feet at this location is an indication of the downstream congestion rather than the lack of its storage capacity.

The proposed northbound right-turn lane at the intersection of NC 16 Business and S Pilot Knob Road is expected to be constructed by the Cottonwood Village Development (Phase 2), and will help to maintain the current intersection performance during the AM peak hour. During the PM peak hour while the capacity analysis show a LOS F (51.3 seconds) for the S Pilot Knob Road approach, traffic simulations

suggest lower delays (LOS E, 38.3 seconds). It is typical for minor street approaches to experience higher delays at unsignalized intersections. All the other study intersections appear to have acceptable LOS.

SITE ACCESS

The proposed main entrance, as shown in Figure 2 Site Plan, will connect to NC 16 Business and form a new T-intersection approximately 375 feet south of S Pilot Knob Road. A secondary site access is provided via a new connector to the existing Avenel Lane and Sedgebrook Drive intersection in the adjacent The Gates at Waterside Crossing neighborhood.

SITE TRIP GENERATION AND DISTRIBUTION

The proposed subdivision will include 302 detached single family units. Table 5 below shows the site trip estimates based on the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 9th Edition, and the North Carolina Department of Transportation (NCDOT) Congestion Management Section's Capacity Analysis Guidelines.

Table 5: Carrington Subdivision Trip Generation

ITE CODE	LAND USE	SIZE		Average Daily Trips (24 Hours)			AM Peak Hour (one hour between 7and 9am)			PM Peak Hour (one hour between 4 and 6pm)		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
210	Single Family	302	DU	1,438	1,438	2,875	57	170	227	190	112	302

Source: ITE Trip Generation 9th Edition, ITE Trip Generation Handbook 2nd Edition, and NCDOT Congestion Management Capacity Analysis Guidelines.

The proposed development is estimated to generate 2,875 daily trips, including 227 trips (57 entering and 170 exiting) during the AM peak hour and 302 new trips (190 entering and 112 exiting) during the PM peak hour.

Site trips are distributed based on the 2015 peak hour intersection turning movement counts and engineering judgement. It is estimated that 30% of the site traffic will head west on NC 73 towards NC 16 and Lincolnton, 28% will head east on NC 73 towards I-77, 20% will head south on NC 16 Business, 15% will head north via NC 16 Business and N Pilot Knob Rd, and the remaining 7% will enter the nearby "The Shoppes at Waterside" shopping center anchored by a Harris Teeter. Ingress trips are assumed to follow the same patterns. It is also estimated that the main entrance will accommodate 90% of the site traffic. The remaining 10% site trips would enter/exit via the Avenel Lane connector and The Gates at Waterside Crossing neighborhood entrance(s) on S Pilot Knob Road.

Figure 11 illustrates the site trip distribution patterns. The site trip volumes, as shown in Figure 12, were computed by multiplying site trip distribution percentages by the peak hour site trip estimates.

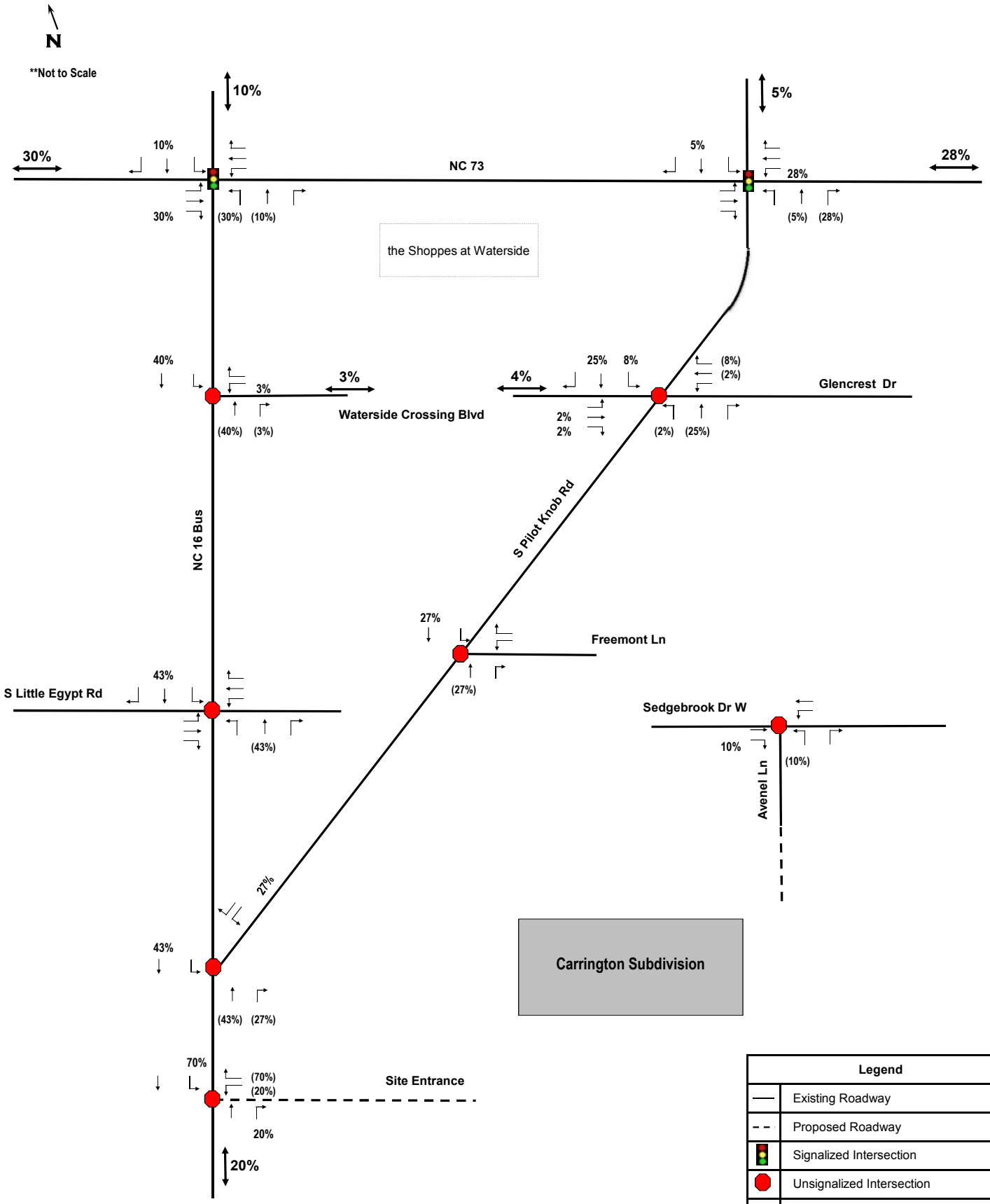

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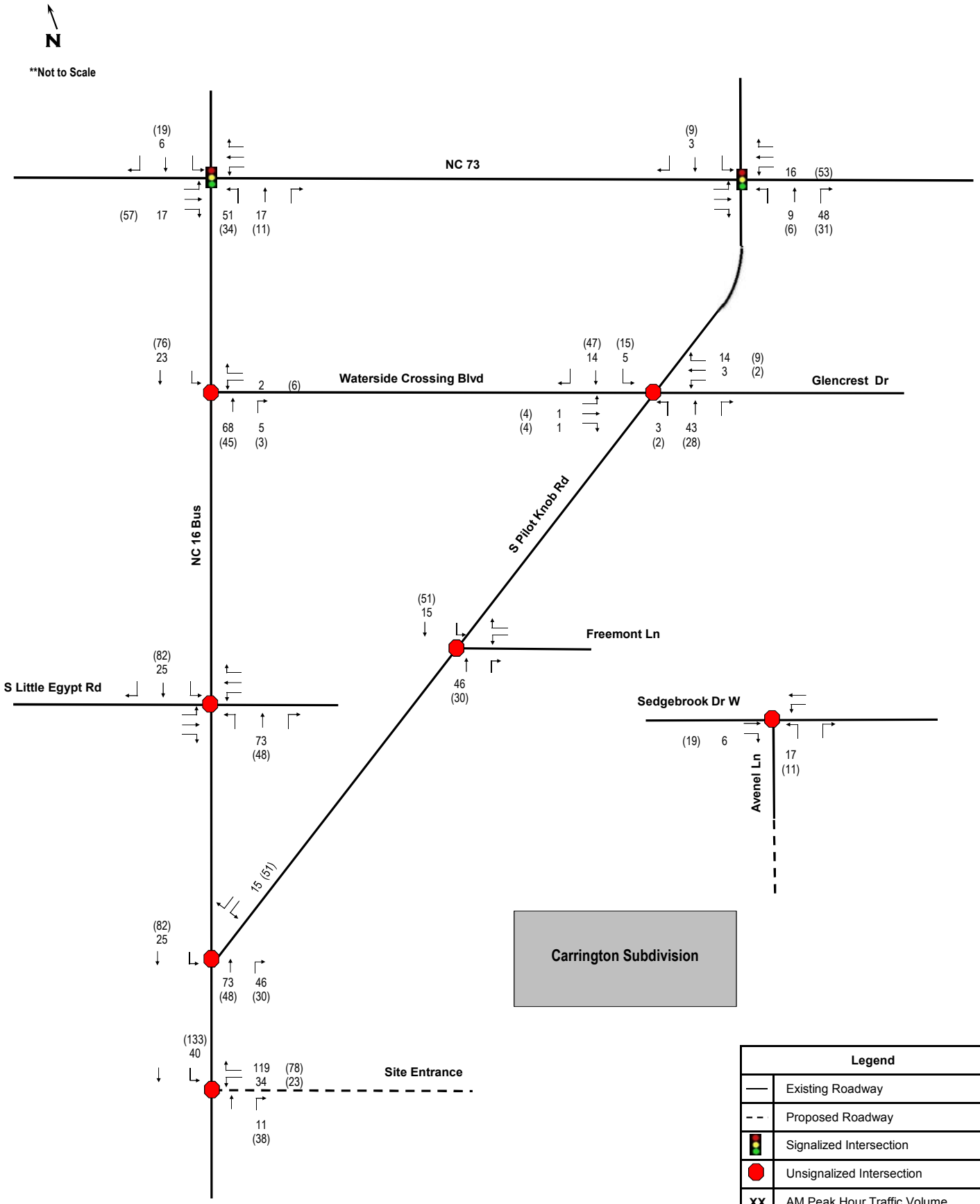
Figure 11
Site Trip Distribution



Legend	
——	Existing Roadway
- - -	Proposed Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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Figure 12
Peak Hour Site Trips

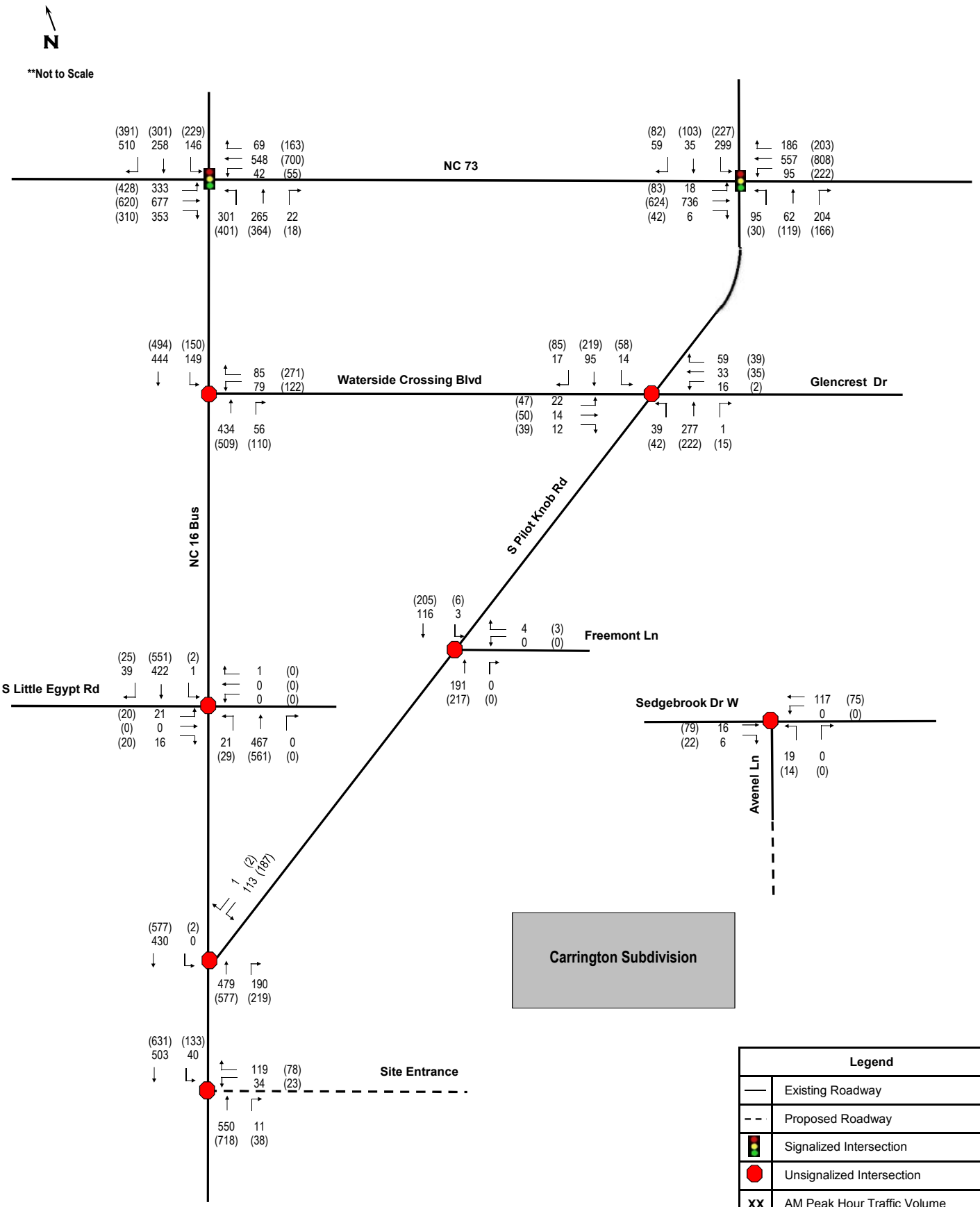

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Figure 13
2020 Build Peak Hour Traffic Volumes

2020 BUILD ANALYSIS

The 2020 Build Analysis adds the site trips to the traffic volumes used in the 2020 No-Build Analysis. Figure 13 on the previous page shows the 2020 Build traffic volumes for the AM and PM peak hour conditions. The proposed main Site Entrance on NC 16 Business was analyzed as a one-lane approach with Stop sign control. LOS and Queue Analysis results for the 2020 Build Analysis are shown in Tables 6 and 7, respectively.

Table 6: Level of Service Analysis - 2020 Build

Intersection	Approach		Build (2020)			
			AM		PM	
			Delay (sec)	LOS	Delay (sec)	LOS
NC 73 @ NC 16 Bus	signalized	Intersection Average	**56.0**	**E**	**101.4**	**F**
		EB - NC 73	47.8	D	61.0	E
		WB - NC73	55.6	E	81.3	F
		NB - NC 16 Bus	114.2	F	208.9	F
		SB - NC 16 Bus	31.1	C	89.5	F
NC 73 @ Pilot Knob Rd	signalized	Intersection Average	**31.0**	**C**	**34.4**	**C**
		EB - NC 73	24.7	C	11.3	B
		WB - NC73	16.3	B	30.8	C
		NB - Pilot Knob Rd	18.9	B	29.0	C
		SB - Pilot Knob Rd	85.5	F	91.1	F
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	3.9	A	4.4	A
		WB - Waterside Crossing Blvd	41.7	E	105.9	F
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NB - S Pilot Knob Rd	0.9	A	1.2	A
		SB - S Pilot Knob Rd	0.9	A	1.3	A
		EB - Waterside Crossing Blvd	14.1	B	19.5	C
		WB - Glencrest Dr	12.8	B	15.5	C
NC 16 Bus @ S Little Egypt Rd	unsignalized	NB - NC 16 Bus	0.4	A	0.4	A
		SB - NC 16 Bus	0.0	A	0.1	A
		EB - S Little Egypt Rd	20.1	C	27.2	D
		WB - S Little Egypt Rd	11.5	B	0.0	A
S Pilot Knob Rd @ Freemont Ln	unsignalized	NB - S Pilot Knob Rd	0.0	A	0.0	A
		SB - S Pilot Knob Rd	0.2	A	0.3	A
		WB - Freemont Ln	9.4	A	9.5	A
NC 16 Bus @ S pilot Knob Rd	unsignalized	Intersection Average	--	--	--	--
		NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	0.0	A	0.1	A
		WB - S Pilot Knob Rd	30.5	D	169.7	F
Sedgebrook Dr @ Avenel Ln	unsignalized	EB - Sedgebrook Dr	0.0	A	0.0	A
		WB - Sedgebrook Dr	0.0	A	0.0	A
		NB - Avenel Ln	9.4	A	9.6	A
NC 16 Bus @ Site Entrance	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	1.2	A	4.6	A
		WB - Site Entrance	24.4	C	49.9	E

Unacceptable Delay/LOS

Table 7: Queue Analysis - 2020 Build

Intersection	Turn Lane		Storage Length {Future Storage} (ft)	Build (2020)			
				AM		PM	
				95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)
NC 73 @ NC 16 Bus	signalized	EBL	450	#205	390	#325	489
		EBR	125	215	225	180	225
		WBL	135	m50	223**	m64	235**
		WBR	165	m43	265**	m94	265**
		NBL	TWLT 400+/-	#441	500	#696	500
		SBL	TWLT 1,000+	#228	303	#422	1237**
		SBR	300	0	40	0	400**
NC 73 @ Pilot Knob Rd	signalized	EBL	TWLT 250 +/-	m7	131	m27	160
		WBL	165	#95	159	#215	265
		WBR	150	63	149	65	250**
		NBL	60	55	139	28	158
		SBL	60	#245	160*	#242	160*
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NBR	125	0	225**	0	225**
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NBL	265	2	31	3	175
		SBL	120	1	22	4	128**
NC 16 Bus @ S Little Egypt Rd	unsignalized	NBL	{50}	2	49	3	58**
NC 16 Bus @ S Pilot Knob Rd	unsignalized	NBR	{125}	0	15	0	28

Queue length greater than storage length

m: queue is metered by upstream signal #: volume exceeds capacity

*: spillback to adjacent through lane **: no/little storage blockage

When comparing the 2020 No-Build Condition Analysis to the 2020 Build Condition Analysis, the NC 73 and NC 16 Business intersection will degrade from D (48.9 seconds) to E (56.0 seconds) during the AM peak hour. The PM peak hour LOS will continue to be F with the average intersection delays increased from 93.7 seconds to 101.4 seconds. Traffic simulations also show longer queues on the northbound NC 16 Business approach during the AM peak hour. During the PM peak hour, the through traffic queues on the southbound and westbound approaches may block access to the adjacent turn lanes, and thus may skew the max queue estimates for the turning movements (labeled with ** in the Table 7).

At the NC 73 and Pilot Knob Road intersection, the capacity analysis shows the southbound approach LOS will degrade from D in the No Build Condition to F (85+ seconds of delays) in the Build Conditions during the peak hours. The queue analysis also shows longer queues on the westbound approach during the PM peak hour, which can be attributed to the increased traffic volumes, limited left-turn storage length, and the lack of protected left-turn signal phase.

At the intersection of NC 16 Business and Waterside Crossing Blvd, the AM peak westbound approach LOS is expected to degrade from D (30.6 seconds) in the No Build Condition to E (41.7 seconds) in the Build Condition. The PM approach delays are estimated to increase from 58.7 seconds to 105.9 seconds

according to the capacity analysis, due to the addition of site traffic and the worsening congestion at the downstream signal at the NC 73 and NC 16 Business intersection.

At the NC 16 Business and S Pilot Knob Road intersection, the average delays on the Stop sign controlled S Pilot Knob Rd approach are expected to increase from 23.1 seconds (LOS C) in the No Build Condition to 30.5 seconds (LOS D) in the Build Condition during the AM peak hour. During the PM peak hour, the S Pilot Knob Rd approach delays are estimated to increase from 51.3 seconds (LOSF) to 169.7 seconds (LOS F). Preliminary signal warrant analysis shows that both the AM and PM peak hour traffic volumes would meet the Peak Hour Signal Warrant. Additional information on the peak hour signal warrant analysis can be found in Appendix G.

The proposed Site Entrance, which was analyzed as a one-lane approach, is expected to operate at LOS C (24.4 seconds) during the AM peak hour and LOS E (49.9 seconds) during the PM peak hour. It is typical for minor street approaches to experience higher delays at unsignalized intersections. The capacity analyses show that all the other study intersections appear to operate at acceptable LOS.

2020 BUILD WITH IMPROVEMENTS ANALYSIS

NCDOT requires improvements to the roadway network if:

1. The average delay at an intersection or individual approach increases by 25% or greater, or
2. The Level of Service degrades by at least one level, while comparing the future No-Build results to Build results.
3. Level of Service is "F".

In addition, NCDOT's *Policy on Street and Driveway Access to North Carolina Highway* specifies left-turn and right-turn lane warrants based on conflicting traffic volumes.

Comparing the No Build Condition and Build Condition traffic analyses results, LOS degradations and/or significant delay increases (25% or greater) were identified at the NC 73 / NC 16 Business intersection, the NC 73 / Pilot Knob Road intersection, the NC 16 Business / Waterside Crossing Blvd Intersection, as well as the NC 16 Business / S Pilot Knob Road intersection. Most of these intersections have or are expected to have similar operational deficiencies in the 2020 No Build Conditions.

It is also noted that the NCDOT Congestion Management Section in 2014 conducted a corridor study, to assist the on-going planning efforts of NCDOT and the NC 73 Council of Planning, for a 13-mile section of the NC 73 corridor from NC 27 / Lincolnton to SR 1395 (Club Drive) near the Mecklenburg County line. This study identified both interim improvements and practical improvement recommendations along NC 73 for the design year 2021. In addition, NCDOT also has plans (STIP project R-5721) to widen NC 73 to a multi-lane facility from NC 16 Business to W Catawba Avenue in Cornelius, NC. These planned improvements however are not expected be constructed by 2020, the design year of this traffic study.

The following improvements are recommended based on the capacity and queue analysis results, turn lane warrant analysis, previous traffic studies and recommendations, as well as engineering judgment,

NC 16 Business at S Pilot Knob Road (site trips represent 14%+/- of peak hour demands)

- *Signal:* Install an actuated traffic signal at this intersection with appropriate signal heads, poles, loop detectors, junction boxes, etc. Signal warrant analysis shall be performed before the signal installation, and the signal installation must be approved by NCDOT.

Note: This study assumed a future 125' northbound right-turn lane on NC 16 Business which was previously required for the Cottonwood Village Development (Phases 2&3). Without the proposed right-turn lane, the signal may still operate at LOS B but with longer queues during peak hours.

NC 16 Business at Site Entrance (site trips represent 17%+/- of peak hour demands)

- *Southbound:* Construct a southbound left-turn lane on NC 16 Business with 150 feet of storage and appropriate deceleration and taper lengths. Install milling and/or resurfacing as required.
- *Westbound:* Construct the site entrance with two exit lanes. The right-turn exit lane should have a 100 feet storage and appropriate deceleration and taper lengths.

Additional off-site improvements are recommended below to accommodate the site trips and mitigate existing and projected deficiencies in the future No Build Conditions. These improvements are necessitated by the collective impacts of the background traffic growth, off-site developments, and site trips. While the site trips represent a relatively small percentage (3% to 8%) of the overall intersection traffic demands during peak hours, the delays may increase disproportionally when the subject intersections or approaches operate at or near capacity. It may be appropriate for the developer to contribute towards, or implement elements of these improvements. In the event that individual off-site developments are delayed or canceled, the roadway improvements may be reevaluated as the traffic demands may differ from those analyzed in this study.

NC 73 Closed Loop System (By NCDOT)

- Signal Timing: optimize signal timings for the NC 73 CLS including the NC 16 Business intersection and the Pilot Knob Road intersection.

NC 73 at NC 16 Business (site trips represent 3%+/- of peak hour demands)

- Northbound: Construct a northbound through/right-turn shared lane with 175 feet of storage and appropriate deceleration and taper lengths. Revise the northbound pavement markings to provide an exclusive left-turn lane, a left-turn/through shared lane, and through/right-turn shared lane.
- *Southbound:* Remove and reconstruct the right-turn channelizing island so that the southern edge of the island is shifted 12’ north of the existing location. Repave and install new pavement markings as needed after the island removal. Install a new stop line for the southbound right-turn lane.
- *Westbound:* Extend the existing right-turn lane by approximately 150’ to the eastern entrance of the Kangaroo gas station (to provide 320’+/- of storage), and revise the pavement markings to convert the right-turn lane to a through/right-turn shared lane.
- *Signal:* Install signal upgrades to accommodate the proposed lane assignments, provide split phasing for the northbound and southbound approaches, and signalize the southbound right-turn movement with permitted/overlap (with eastbound left-turn) phasing.

NC 73 at Pilot Knob Road (site trips represent 4%+/- of peak hour demands)

- *Northbound:* Construct a northbound right-turn lane with 230 feet of storage and appropriate deceleration and taper lengths.
- *Westbound:* Extend the existing left-turn lane by approximately 110 feet to provide a total of 275 feet of storage with appropriate deceleration and taper lengths.
- *Signal:* install signal upgrades to accommodate the proposed lane assignments, provide protected/permissive signal phases for the westbound left-turn and southbound left-turn movements, and provide permitted/overlap phasing for the northbound right-turn movement.

NC 16 Business at Waterside Crossing Blvd (site trips represent 8%+/- of peak hour demands)

- *Southbound:* Revise the existing pavement markings to provide a through lane and a left-turn lane with 150 feet of storage and appropriate deceleration and taper lengths.
- *Northbound:* Revise the existing pavement markings to provide a center TWLT lane between the Advanced Auto Parts Entrance and the Waterside Crossing Blvd intersection. Install roadway widening as needed to maintain a minimum of 100' northbound right-turn lane.
- *Milling and Resurfacing*: Install milling and resurfacing as required by NCDOT.

Tables 8 and 9 summarize the LOS and queue analysis of the 2020 Build with Improvements Scenario. The analyses show that the proposed widening and new traffic pattern at the NC 73 and NC 16 Business intersection will provide better intersection operational performance than the No Build Conditions during both AM and PM peak hours. The current free-flow southbound right-turn movement, under the proposed configuration, will be controlled by a traffic signal which would allow it to run concurrently with the eastbound dual left-turn movement. The southbound approach is expected to have higher delays (LOS D 43.6 seconds) in the AM peak hour, and reduced delays (LOS E, 63.9 seconds) in the PM peak hour when compared to the No Build Conditions. The northbound approach delays are estimated to be reduced by more than 50% during the PM peak hour, the worst period of the day. Both NC 73 approaches are also expected to have significant delay reductions and operate at LOS D or better during peak hours.

It is recognized that, even with the proposed improvements, the NC 73 and NC 16 Business intersection may still operate at LOS E during the PM peak hour, and that certain existing or proposed storage lengths may not be adequate during the peak arrival periods. The proposed improvements are not designed to address all the existing and projected deficiencies. Rather they are practical mitigation measures that can provide similar or better intersection operations when compared to the No Build Conditions.

Table 8: Level of Service Analysis - 2020 Build with Improvements

Intersection	Approach		Build (2020) with Improvements			
			AM		PM	
			Delay (sec)	LOS	Delay (sec)	LOS
NC 73 @ NC 16 Bus	signalized	Intersection Average	**48.0**	**D**	**57.3**	**E**
		EB - NC 73	32.2	C	50.8	D
		WB - NC73	41.5	D	39.0	D
		NB - NC 16 Bus	98.8	F	82.3	F
		SB - NC 16 Bus	43.6	D	63.9	E
NC 73 @ Pilot Knob Rd	signalized	Intersection Average	**28.7**	**C**	**30.0**	**C**
		EB - NC 73	27.2	C	26.4	C
		WB - NC73	12.1	B	21.8	C
		NB - Pilot Knob Rd	43.2	D	52.3	D
		SB - Pilot Knob Rd	53.5	D	44.3	D
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	2.3	A	2.3	A
		WB - Waterside Crossing Blvd	16.3	C	23.3	C
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NB - S Pilot Knob Rd	0.9	A	1.2	A
		SB - S Pilot Knob Rd	0.9	A	1.3	A
		EB - Waterside Crossing Blvd	14.1	B	19.5	C
		WB - Glencrest Dr	12.8	B	15.5	C
NC 16 Bus @ S Little Egypt Rd	unsignalized	NB - NC 16 Bus	0.4	A	0.4	A
		SB - NC 16 Bus	0.0	A	0.1	A
		EB - S Little Egypt Rd	13.3	B	15.3	C
		WB - S Little Egypt Rd	10.9	B	0.0	A
S Pilot Knob Rd @ Freemont Ln	unsignalized	NB - S Pilot Knob Rd	0.0	A	0.0	A
		SB - S Pilot Knob Rd	0.2	A	0.3	A
		WB - Freemont Ln	9.4	A	9.5	A
NC 16 Bus @ S pilot Knob Rd	unsignalized (Future Signal)	Intersection Average	**9.3**	**A**	**12.5**	**B**
		NB - NC 16 Bus	8.1	A	10.3	B
		SB - NC 16 Bus	10.0	B	13.9	B
		WB - S Pilot Knob Rd	13.6	B	17.6	B
Sedgebrook Dr @ Avenel Ln	unsignalized	EB - Sedgebrook Dr	0.0	A	0.0	A
		WB - Sedgebrook Dr	0.0	A	0.0	A
		NB - Avenel Ln	9.4	A	9.6	A
NC 16 Bus @ Site Entrance	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A
		SB - NC 16 Bus	0.7	A	1.8	A
		WB - Site Entrance	19.4	C	51.2	F

Unacceptable Delay/LOS

At the NC 73 and Pilot Knob Road intersection, the proposed turn-lane and traffic signal improvements will help to deliver LOS C during both AM and PM peak hours. The new protected left-turn signal phase for the southbound approach will help to reduce the southbound queues during peak hours.

With the proposed turn-lane / pavement marking improvements at the NC 16 Business and Waterside Crossing Blvd intersection, the capacity analysis shows that the westbound approach delays are expected to be similar to those in the existing conditions.

Table 9: Queue Analysis - 2020 Build with Improvements

Intersection	Turn Lane		Storage Length {Future Storage} (ft)	Build (2020) with Improvements			
				AM		PM	
				95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)
NC 73 @ NC 16 Bus	signalized	EBL	450	152	237	#301	405
		EBR	125	198	225	180	225
		WBL	135	m57	170**	m69	234**
		WBR	165 {320 Thru/RT}	295	300	458	370
		NBL	TWLT 400+/-	#318	305	#435	350
		NBTR	{175}	#268	257	#370	267
		SBL	TWLT 1,000+	160	261	#316	387
		SBR	300	#463	468	384	522
NC 73 @ Pilot Knob Rd	signalized	EBL	TWLT 250 +/-	m4	330**	m66	409**
		WBL	165 {275}	68	164	#223	348**
		WBR	150	52	200**	51	250**
		NBL	60	120	141	57	136
		NBR	{230}	194	238	185	210
		SBL	60	#337	160*	#279	159*
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NBR	125	0	3	0	18
		SBL	{150}	14	88	17	106
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NBL	265	2	26	3	44
		SBL	120	1	24	4	42
NC 16 Bus @ S Little Egypt Rd	unsignalized	NBL	{50}	2	10	3	29
NC 16 Bus @ S Pilot Knob Rd	unsignalized (future signal)	NBR	{125}	0	49	0	90
NC 16 Bus @ Site Entrance	unsignalized	SBL	{150}	4	48	17	114
		WBR	{100}	--	95	--	86

Queue length greater than storage length
m: queue is metered by upstream signal #: volume exceeds capacity
*: spillback to adjacent through lane **: no/little storage blockage

The NC 16 Business and S Pilot Knob Road intersection is expected to operate at LOS A (9.3 seconds) during the AM and LOS B (12.5 seconds) during the PM peak hour, once the proposed signal and turn-lane improvements are implemented. Without the proposed 125' northbound right-turn lane, the new traffic signal is estimated to operate at LOS B during both AM and PM peak hours, although the queues likely will be longer.

At the NC 16 Business and Site Entrance intersection, the traffic analyses show the proposed turn lanes will provide adequate storage capacity during peak hours. During the PM peak hour, the westbound approach will remain operating at LOS F (51.2 seconds) due to the heavy through traffic on NC 16 Business. It is typical for minor street approaches to experience higher delays at unsignalized intersections.

The analysis shows that all the other study intersections appear to operate at acceptable LOS. Figure 14 illustrates the proposed intersection configurations.

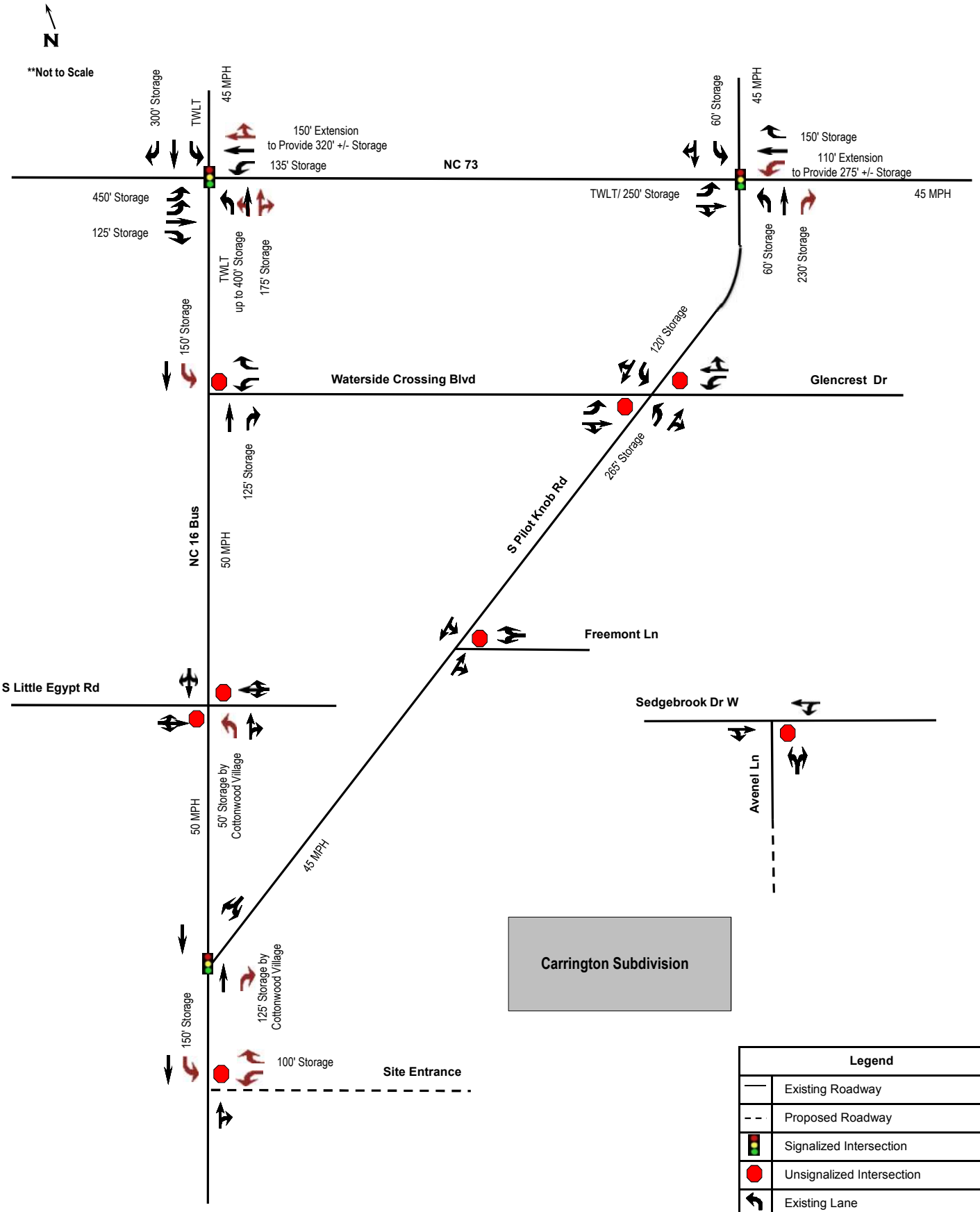

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Figure 14
2020 Build Condition Proposed Intersection Configuration

PHASING ANALYSIS

The proposed 302-lot residential development is scheduled to be constructed in three different phases. Phase I will include 49 units and will be completed in 2016. The Site Entrance on NC 16 Business will be the only access point. Phase II will include 115 units and will be completed in 2017. The Avenel Lane connector will be completed during Phase II. The remaining 138 units will be completed in Phase III with the full buildout in 2019. Table 10 summarizes the site trip estimates for the three development phases.

Table 10: Development Phase Site Trip Estimates

Phase	Development Schedule	Total Size		Average Daily Trips			AM Peak Hour			PM Peak Hour		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
I	49 Lots in 2016	49	DU	233	233	466	9	28	37	31	18	49
II	115 Lots in 2017	164	DU	781	781	1,561	31	92	123	103	61	164
III	138 Lots in 2018 & 2019	302	DU	1,438	1,438	2,875	57	170	227	190	112	302

Source: ITE Trip Generation 9th Edition, ITE Trip Generation Handbook 2nd Edition, and NCDOT Congestion Management Capacity Analysis Guidelines.

Additional traffic analyses were conducted to determine the improvement implementation schedule.

Phase I Improvements Analysis

Since the Phase I development will generate less than 50 trips per hour and will be completed in the near future, the improvements for Phase I should be designed to maintain the existing traffic operational performance. To simplify the traffic analyses, the Phase I site trips (as shown in Figure 15) were added directly to the existing traffic volumes to model the Phase I traffic conditions. No growth factor or off-site development trips were included in the Phase I Improvements traffic analyses. Figure 16 shows the Phase I Build Condition AM and PM peak hour traffic volumes.

The following improvements are recommended for the Phase I Development. Tables 11 and 12 summarize the Phase I Improvements capacity and queue analysis results.

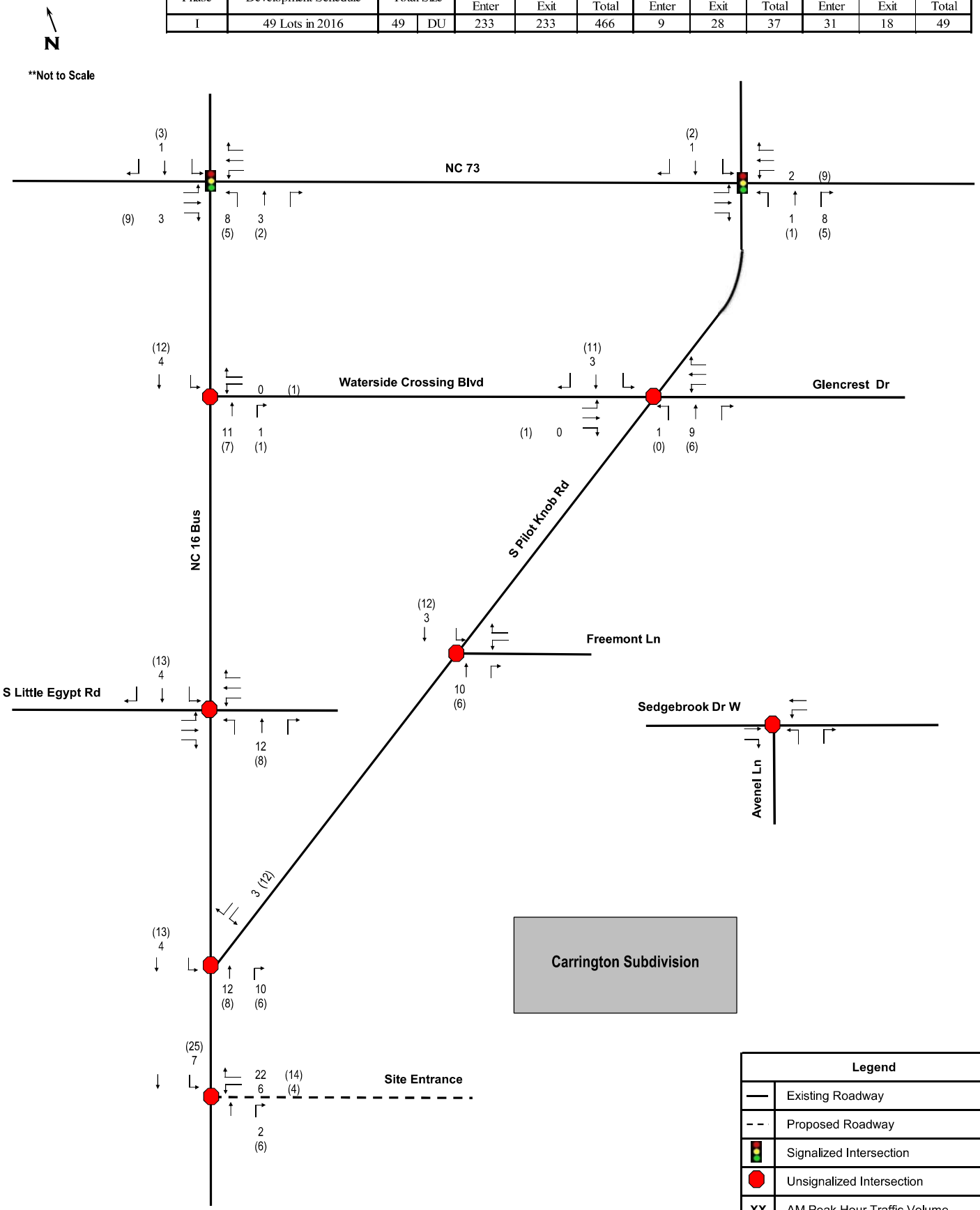
NC 16 Business at Site Entrance

- *Southbound:* Construct a southbound left-turn lane on NC 16 Business with 150 feet of storage and appropriate deceleration and taper lengths. Install milling and/or resurfacing as required by NCDOT.
- *Westbound:* Construct the site entrance with two exit lanes. The right-turn exit lane should have a 100 feet storage and appropriate deceleration and taper lengths.

NC 16 Business at S Pilot Knob Road (by Cottonwood Village)

- *Northbound:* Construct a northbound right-turn lane on NC 16 Business with 125 feet of storage and appropriate deceleration and taper lengths.

Phase	Development Schedule	Total Size		Average Daily Trips			AM Peak Hour			PM Peak Hour		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
I	49 Lots in 2016	49	DU	233	233	466	9	28	37	31	18	49



Legend	
—	Existing Roadway
- -	Proposed Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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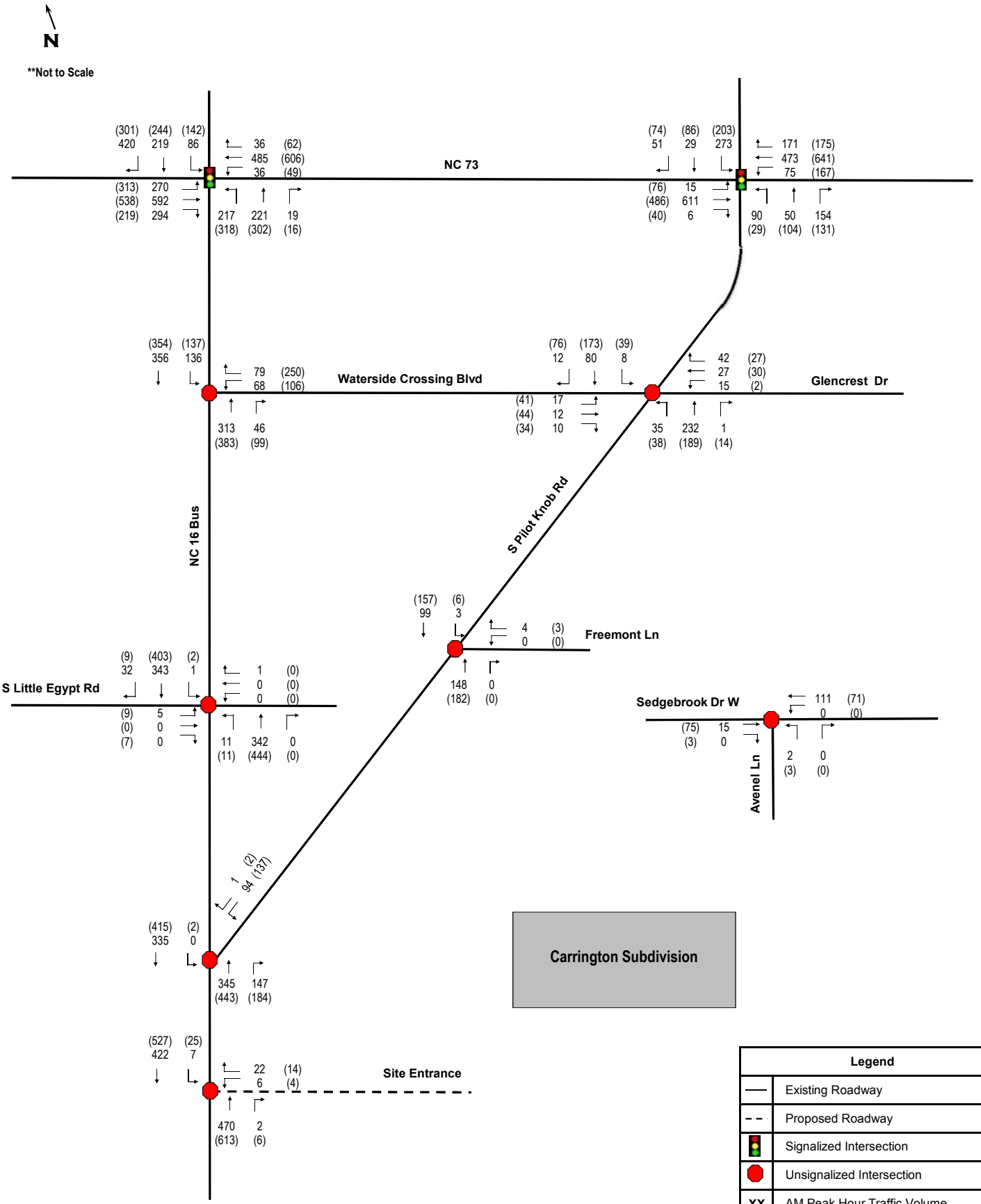
Figure 15
Phase I Development
Peak Hour Site Trips



Legend	
——	Existing Roadway
- - -	Proposed Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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Figure 16
Phase I Build Peak Hour Traffic Volumes

Table 11: Level of Service Analysis – Phase I Improvements

Intersection	Approach		Existing (2015)				Phase I Build with Improvements			
			AM		PM		AM		PM	
			Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
NC 73 @ NC 16 Bus	signalized	Intersection Average	**35.9**	**D**	**59.5**	**E**	**36.4**	**D**	**60.3**	**E**
		EB - NC 73	35.5	D	39.4	D	35.4	D	39.2	D
		WB - NC73	40.5	D	56.5	E	40.4	D	56.5	E
		NB - NC 16 Bus	54.3	D	114.9	F	57.3	E	118.7	F
		SB - NC 16 Bus	21.7	C	42.7	D	21.8	C	43.0	D
NC 73 @ Pilot Knob Rd	signalized	Intersection Average	**19.0**	**B**	**16.3**	**B**	**19.1**	**B**	**16.7**	**B**
		EB - NC 73	18.4	B	8.5	A	18.5	B	9.0	A
		WB - NC73	11.4	B	14.0	B	11.5	B	15.0	B
		NB - Pilot Knob Rd	16.6	B	21.6	C	16.7	B	21.3	C
		SB - Pilot Knob Rd	37.7	D	31.7	C	37.7	D	30.6	C
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A	0.0	A	0.0	A
		SB - NC 16 Bus	3.4	A	3.8	A	3.4	A	3.8	A
		WB - Waterside Crossing Blvd	19.7	C	25.7	D	20.3	C	27.2	D
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NB - S Pilot Knob Rd	1.0	A	1.3	A	1.0	A	1.2	A
		SB - S Pilot Knob Rd	0.6	A	1.1	A	0.6	A	1.0	A
		EB - Waterside Crossing Blvd	12.2	B	15.1	C	12.4	B	15.4	C
		WB - Glencrest Dr	11.6	B	13.3	B	11.7	B	13.6	B
NC 16 Bus @ S Little Egypt Rd	unsignalized	NB - NC 16 Bus	0.4	A	0.3	A	0.4	A	0.3	A
		SB - NC 16 Bus	0.0	A	0.1	A	0.0	A	0.1	A
		EB - S Little Egypt Rd	17.0	C	16.6	C	17.4	C	17.1	C
		WB - S Little Egypt Rd	10.3	B	0.0	A	10.4	B	0.0	A
S Pilot Knob Rd @ Freemont Ln	unsignalized	NB - S Pilot Knob Rd	0.0	A	0.0	A	0.0	A	0.0	A
		SB - S Pilot Knob Rd	0.2	A	0.4	A	0.2	A	0.3	A
		WB - Freemont Ln	9.0	A	9.3	A	9.1	A	9.3	A
NC 16 Bus @ S pilot Knob Rd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A	0.0	A	0.0	A
		SB - NC 16 Bus	0.0	A	0.1	A	0.0	A	0.1	A
		WB - S Pilot Knob Rd	19.7	C	34.8	D	18.3	C	31.5	D
Sedgebrook Dr @ Avenel Ln	unsignalized	EB - Sedgebrook Dr	0.0	A	0.0	A	0.0	A	0.0	A
		WB - Sedgebrook Dr	0.0	A	0.0	A	0.0	A	0.0	A
		NB - Avenel Ln	9.2	A	9.4	A	9.2	A	9.4	A
NC 16 Bus @ Site Entrance	unsignalized	NB - NC 16 Bus	--	--	--	--	0.0	A	0.0	A
		SB - NC 16 Bus	--	--	--	--	0.1	A	0.4	A
		WB - Site Entrance	--	--	--	--	13.4	B	16.1	C

Unacceptable Delay/LOS

Table 12: Queue Analysis – Phase I Improvements

Intersection	Turn Lane		Storage Length {Future Storage} (ft)	Existing (2015)				Phase I Build with Improvements			
				AM		PM		AM		PM	
				95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)
NC 73 @ NC 16 Bus	signalized	EBL	450	#150	202	#207	199	#150	243	#207	210
		EBR	125	170	225	118	225	173	225	123	225
		WBL	135	m48	216**	m69	234**	m48	234**	m69	234**
		WBR	165	m26	264**	m45	265**	m26	244**	m45	265**
		NBL	TWLT 400+/-	#282	287	#522	499	#297	311	#532	500
		SBL	TWLT 1,000+	113	144	#239	276	113	170	#239	264
		SBR	300	0	0	0	40	0	0	0	119
NC 73 @ Pilot Knob Rd	signalized	EBL	TWLT 250 +/-	m8	73	m39	108	m8	71	m41	116
		WBL	165	43	111	84	154	45	91	94	186
		WBR	150	58	132	56	147	58	128	56	152**
		NBL	60	52	113	28	90	52	103	28	75
		SBL	60	#203	160*	#195	160*	#204	160*	#196	160*
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NBR	125	0	2	0	70	0	2	0	94
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NBL	265	2	27	3	39	2	30	3	34
		SBL	120	1	14	2	35	1	26	2	36
NC 16 Bus @ S Pilot Knob Rd	unsignalized (future signal)	NBR	{125}	--	--	--	--	0	3	0	6
NC 16 Bus @ Site Entrance	unsignalized	SBL	{150}	--	--	--	--	1	28	2	35
		WBR	{100}	--	--	--	--	--	39	--	40

Queue length greater than storage length

m: queue is metered by upstream signal #: volume exceeds capacity

*: spillback to adjacent through lane **: no/little storage blockage

At the intersection of NC 16 Business and S Pilot Knob Road, the need for the proposed 125-foot northbound right-turn lane exists now due to the high right-turn volumes (137 vph in the AM peak hour, 178 vph in the PM peak hour). The proposed right-turn lane was also previously required for the Cottonwood Village development. If the subject development is required to install this proposed right-turn lane prior to the Cottonwood Village development, it might be appropriate to trade improvement responsibilities.

Phase II Improvements Analysis

Upon the completion of the Phase II development in 2017, a total of 164 single-family units will be constructed, which roughly represents the midpoint (54%) in both the development scope and schedule. For analysis purposes, the Phase II No Build baseline traffic volumes (Figure 17) are assumed to be the average of Existing Condition volumes and 2020 No Build traffic volumes which already take into account the background traffic growth and off-site trips. The Phase II Build condition traffic volumes (Figure 19) include both the No Build baseline volumes and the development trips (Figure 18).

The following improvements are recommended for the Phase II Development. Tables 13 and 14 summarize the Phase II Improvements capacity and queue analysis results.

NC 16 Business at Waterside Crossing Blvd

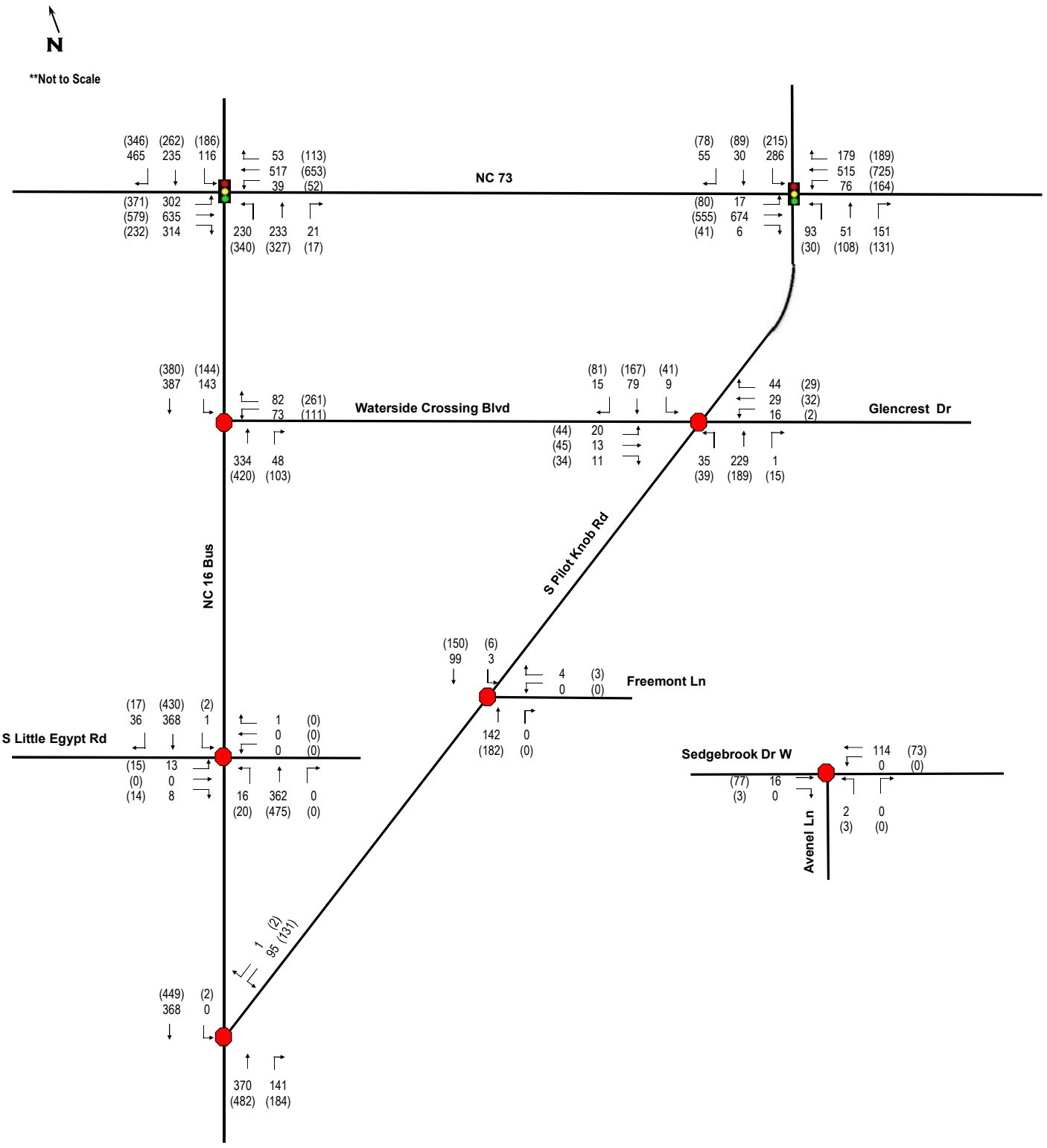
- *Southbound:* Revise the existing pavement markings to provide a through lane and a left-turn lane with 150 feet of storage and appropriate deceleration and taper lengths.
- *Northbound:* Revise the existing pavement markings to provide a center TWLT lane between the Advanced Auto Parts Entrance and the Waterside Crossing Blvd intersection. Install roadway widening as needed to maintain a minimum of 100’ northbound right-turn lane.
- *Milling and Resurfacing*: Install milling and resurfacing as required by NCDOT.

NC 73 at NC 16 Business

- Northbound: Construct a northbound through/right-turn shared lane with 175 feet of storage and appropriate deceleration and taper lengths.
- *Signal:* Install signal upgrades to accommodate the proposed lane assignments.

NC 73 Closed Loop System (By NCDOT)

- Signal Timing: optimize signal timings for the NC 73 CLS including the NC 16 Business intersection and the Pilot Knob Road intersection.



Legend	
——	Existing Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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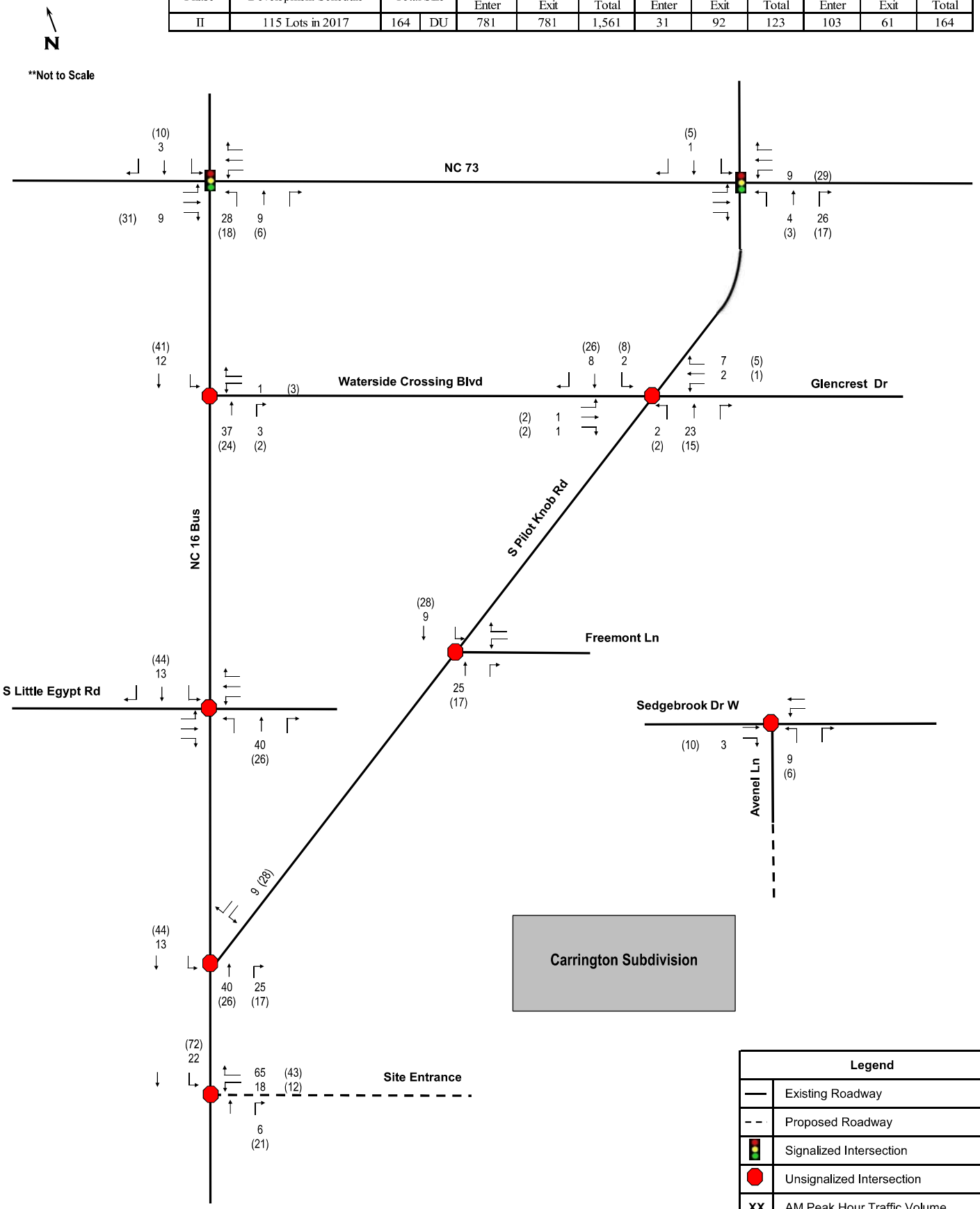
Figure 17
Phase II No Build Peak Hour Traffic Volumes

Phase	Development Schedule	Total Size		Average Daily Trips			AM Peak Hour			PM Peak Hour		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
II	115 Lots in 2017	164	DU	781	781	1,561	31	92	123	103	61	164



Legend	
—	Existing Roadway
- -	Proposed Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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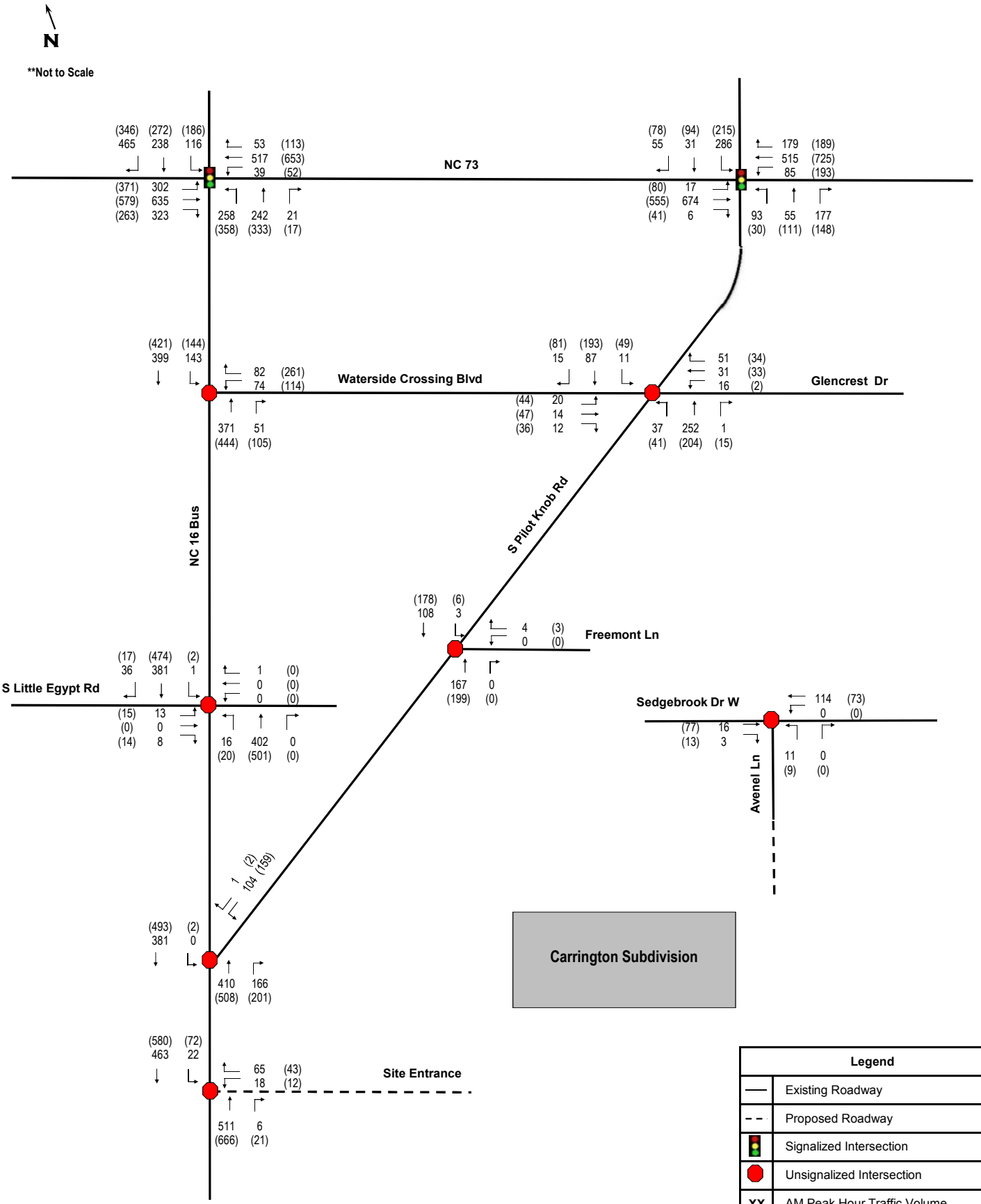
Figure 18
Phase II Development
Peak Hour Site Trips



Legend	
——	Existing Roadway
- - -	Proposed Roadway
	Signalized Intersection
	Unsignalized Intersection
XX	AM Peak Hour Traffic Volume
(XX)	PM Peak Hour Traffic Volume

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Carrington Subdivision TIA

Lincoln County, NC

Figure 19
Phase II Build Peak Hour Traffic Volumes

Table 13: Level of Service Analysis – Phase II Improvements

Intersection	Approach		Phase II No Build				Phase II Build with Improvements			
			AM		PM		AM		PM	
			Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
NC 73 @ NC 16 Bus	signalized	Intersection Average	**41.2**	**D**	**73.9**	**E**	**43.4**	**D**	**65.1**	**E**
		EB - NC 73	40.6	D	47.9	D	40.6	D	53.8	D
		WB - NC73	45.6	D	66.1	E	45.8	D	75.0	E
		NB - NC 16 Bus	65.0	E	145.8	F	76.2	E	82.5	F
		SB - NC 16 Bus	24.8	C	58.5	E	24.9	C	56.5	E
NC 73 @ Pilot Knob Rd	signalized	Intersection Average	**21.3**	**C**	**19.6**	**B**	**23.4**	**C**	**22.0**	**C**
		EB - NC 73	21.0	C	11.1	B	28.3	C	12.1	B
		WB - NC73	13.1	B	19.2	B	16.9	B	23.0	C
		NB - Pilot Knob Rd	16.8	B	22.0	C	14.9	B	21.1	C
		SB - Pilot Knob Rd	42.5	D	34.2	C	35.0	C	37.3	D
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A	0.0	A	0.0	A
		SB - NC 16 Bus	3.5	A	4.0	A	2.3	A	2.4	A
		WB - Waterside Crossing Blvd	24.0	C	36.7	E	14.7	B	19.0	C
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NB - S Pilot Knob Rd	1.0	A	1.3	A	1.0	A	1.3	A
		SB - S Pilot Knob Rd	0.7	A	1.1	A	0.7	A	1.2	A
		EB - Waterside Crossing Blvd	12.5	B	15.7	C	13.1	B	17.3	C
		WB - Glencrest Dr	11.8	B	13.8	B	12.2	B	14.5	B
NC 16 Bus @ S Little Egypt Rd	unsignalized	NB - NC 16 Bus	0.4	A	0.3	A	0.3	A	0.3	A
		SB - NC 16 Bus	0.0	A	0.1	A	0.0	A	0.1	A
		EB - S Little Egypt Rd	16.2	C	19.0	C	12.5	B	13.7	B
		WB - S Little Egypt Rd	10.6	B	0.0	A	10.9	B	0.0	A
S Pilot Knob Rd @ Freemont Ln	unsignalized	NB - S Pilot Knob Rd	0.0	A	0.0	A	0.0	A	0.0	A
		SB - S Pilot Knob Rd	0.2	A	0.3	A	0.2	A	0.3	A
		WB - Freemont Ln	9.1	A	9.3	A	9.2	A	9.4	A
NC 16 Bus @ S pilot Knob Rd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A	0.0	A	0.0	A
		SB - NC 16 Bus	0.0	A	0.1	A	0.0	A	0.1	A
		WB - S Pilot Knob Rd	22.7	C	48.9	E	22.8	C	60.7	F
Sedgebrook Dr @ Avenel Ln	unsignalized	EB - Sedgebrook Dr	0.0	A	0.0	A	0.0	A	0.0	A
		WB - Sedgebrook Dr	0.0	A	0.0	A	0.0	A	0.0	A
		NB - Avenel Ln	9.3	A	9.4	A	9.3	A	9.5	A
NC 16 Bus @ Site Entrance	unsignalized	NB - NC 16 Bus	--	--	--	--	0.0	A	0.0	A
		SB - NC 16 Bus	--	--	--	--	0.4	A	1.1	A
		WB - Site Entrance	--	--	--	--	15.2	C	20.5	C

Unacceptable Delay/LOS

Table 14: Queue Analysis – Phase II Improvements

Intersection	Turn Lane		Storage Length {Future Storage} (ft)	Phase II No Build				Phase II Build with Improvements			
				AM		PM		AM		PM	
				95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)
NC 73 @ NC 16 Bus	signalized	EBL	450	#178	226	#267	319	#178	345	#278	354
		EBR	125	187	225	131	225	193	225	134	225
		WBL	135	m48	234**	m66	234**	m46	234**	m60	235**
		WBR	165	m35	265**	m73	265**	m33	265**	m66	265**
		NBL	TWLT 400+/-	#321	417	#577	500	#369	434	#541	493
		NBTR	{175}	--	--	--	--	--	130	--	180**
		SBL	TWLT 1,000+	#171	185	#334	518	#171	188	231	767
		SBR	300	0	0	0	240	0	0	0	360**
NC 73 @ Pilot Knob Rd	signalized	EBL	TWLT 250 +/-	m8	49	m42	110	m9	197	m42	192
		WBL	165	#70	104	#139	203	#86	162	#184	265
		WBR	150	61	121	61	232**	70	186**	77	250**
		NBL	60	54	106	28	72	48	98	24	77
		SBL	60	#216	160*	#210	160*	#202	160*	#187	160*
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NBR	125	0	0	0	205**	0	2	0	119
		SBL	{150}	--	--	--	--	13	80	15	117
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NBL	265	2	22	3	60	2	31	3	32
		SBL	120	1	25	3	37	1	23	3	36
NC 16 Bus @ S Little Egypt Rd	unsignalized	NBL	{50}	1	14	2	10	1	5	2	14
NC 16 Bus @ S Pilot Knob Rd	unsignalized (future signal)	NBR	{125}	--	--	--	--	0	3	0	9
NC 16 Bus @ Site Entrance	unsignalized	SBL	{150}	--	--	--	--	2	31	8	58
		WBR	{100}	--	--	--	--	--	66	--	64

Queue length greater than storage length

m: queue is metered by upstream signal #: volume exceeds capacity

*: spillback to adjacent through lane **: no/little storage blockage

CONCLUSIONS AND RECOMMENDATIONS

Carrington Subdivision is a proposed 151-acre residential development consisting of 302 single family detached units. The subject development will be constructed in three phases – 49 units in Phase I (2016), 115 units in Phase II (2017), and 138 units in Phase III (2018 & 2019). It is estimated that the site will generate 3,027 daily trips, including 227 AM peak hour trips and 302 PM peak hour trips.

The Existing Condition Analysis indicates that the NC 73 and NC 16 Business intersection currently has unacceptable LOS and delays on the northbound approach and westbound approach during the PM peak hour. The delays are directly related to the heavy turning movements on the northbound, southbound, and eastbound approaches. Queues on the northbound NC 16 Business approach may spill back to the intersection of NC 16 Business and Waterside Crossing Blvd. At the NC 73 and Pilot Knob Road intersection, traffic simulations show that the southbound left-turn movement may not have adequate acceptable gaps, and may develop extensive queuing during certain peak arrival times.

The 2020 No Build analyses take into account the background traffic growth (1% per year), three approved nearby developments and their roadway improvements. The 2020 Build Condition analysis examined the traffic performance with the site trips added to the study network. Comparing the Build Condition with the No Build Condition traffic analysis results, LOS degradations and/or significant delay increases (25% or greater) were identified at the NC 73 / NC 16 Business intersection, the NC 73 / Pilot Knob Road intersection, the NC 16 Business / Waterside Crossing Blvd Intersection, as well as the NC 16 Business / S Pilot Knob Road intersection. Most of these intersections have or are expected to have similar operational deficiencies in the 2020 No Build Conditions.

It is noted that NCDOT had recently conducted a NC 73 Corridor Study, and has plans (STIP project R-5721) to widen NC 73 to a multi-lane facility from NC 16 Business to W Catawba Avenue in Cornelius, NC. These corridor improvements however are not expected be constructed by 2020, the design year of this traffic study. Based on the traffic analysis results, turn lane warrant analysis, previous traffic studies and recommendations, as well as engineering judgment, the following improvements are recommended.

Phase I (49 units) Improvements:

NC 16 Business at Site Entrance

- *Southbound:* Construct a southbound left-turn lane on NC 16 Business with 150 feet of storage and appropriate deceleration and taper lengths. Install milling / resurfacing as required by NCDOT.
- *Westbound:* Construct the site entrance with two exit lanes. The right-turn exit lane should have a 100 feet storage and appropriate deceleration and taper lengths.

NC 16 Business at S Pilot Knob Road (by Cottonwood Village)

- *Northbound:* Construct a northbound right-turn lane on NC 16 Business with 125 feet of storage and appropriate deceleration and taper lengths.

Note: The proposed right-turn lane is warranted by the existing traffic volumes, and was required for the Cottonwood Village development. If the subject development is required to install this right-turn lane, it may be appropriate to trade improvement responsibilities.

Additional off-site improvements are recommended below to accommodate the site trips and mitigate existing and projected deficiencies in the future No Build Conditions. These improvements are necessitated by the collective impacts of the background traffic growth, off-site developments, and site trips. While the site trips represent a relatively small percentage (3% to 8%) of the overall intersection traffic demands during peak hours, the delays may increase disproportionally when the subject intersections or approaches operate at or near capacity. It may be appropriate for the developer to contribute towards, or implement elements of these improvements. In the event that individual off-site developments are delayed or canceled, the roadway improvements may be reevaluated as the traffic demands may differ from those analyzed in this study.

Phase II (115 units) Improvements:

NC 16 Business at Waterside Crossing Blvd

- *Southbound:* Revise the existing pavement markings to provide a through lane and a left-turn lane with 150 feet of storage and appropriate deceleration and taper lengths.
- *Northbound:* Revise the existing pavement markings to provide a center TWLT lane between the Advanced Auto Parts Entrance and the Waterside Crossing Blvd intersection. Install roadway widening as needed to maintain a minimum of 100' northbound right-turn lane.
- *Milling and Resurfacing*: Install milling and resurfacing as required by NCDOT.

NC 73 at NC 16 Business

- Northbound: Construct a northbound through/right-turn shared lane with 175 feet of storage and appropriate deceleration and taper lengths.
- *Signal:* Install signal upgrades to accommodate the proposed lane assignments.

NC 73 Closed Loop System (By NCDOT)

- Signal Timing: optimize signal timings for the NC 73 CLS including the NC 16 Business intersection and the Pilot Knob Road intersection.

Phase III (138 units) Full Buildout Improvements:

NC 73 at NC 16 Business (full buildout site trips represent 3%+/- of peak hour demands)

- Northbound: Revise the northbound pavement markings to provide an exclusive left-turn lane, a left-turn/through shared lane, and through/right-turn shared lane.
- *Southbound:* Remove and reconstruct the right-turn channelizing island so that the southern edge of the island is shifted 12' north of the existing location. Repave and install new pavement markings as needed after the island removal. Install a new stop line for the southbound right-turn lane.
- *Westbound:* Extend the existing right-turn lane by approximately 150' to the eastern entrance of the Kangaroo gas station (to provide 320'+/- of storage), and revise the pavement markings to convert the right-turn lane to a through/right-turn shared lane.
- *Signal:* Install signal upgrades to accommodate the proposed lane assignments, provide split phasing for the northbound and southbound approaches, and signalize the southbound right-turn movement with permitted/overlap (with eastbound left-turn) phasing.

NC 73 at Pilot Knob Road (site trips represent 4%+/- of peak hour demands)

- *Northbound:* Construct a northbound right-turn lane with 230 feet of storage and appropriate deceleration and taper lengths.
- *Westbound:* Extend the existing left-turn lane by approximately 110 feet to provide a total of 275 feet of storage with appropriate deceleration and taper lengths.
- *Signal:* install signal upgrades to accommodate the proposed lane assignments, provide protected/permissive signal phases for the westbound left-turn and southbound left-turn movements, and provide permitted/overlap phasing for the northbound right-turn movement.

NC 73 Closed Loop System (By NCDOT)

- Signal Timing: optimize signal timings for the NC 73 CLS including the NC 16 Business intersection and the Pilot Knob Road intersection.

NC 16 Business at S Pilot Knob Road (full buildout site trips represent 14%+/- of peak hour demands)

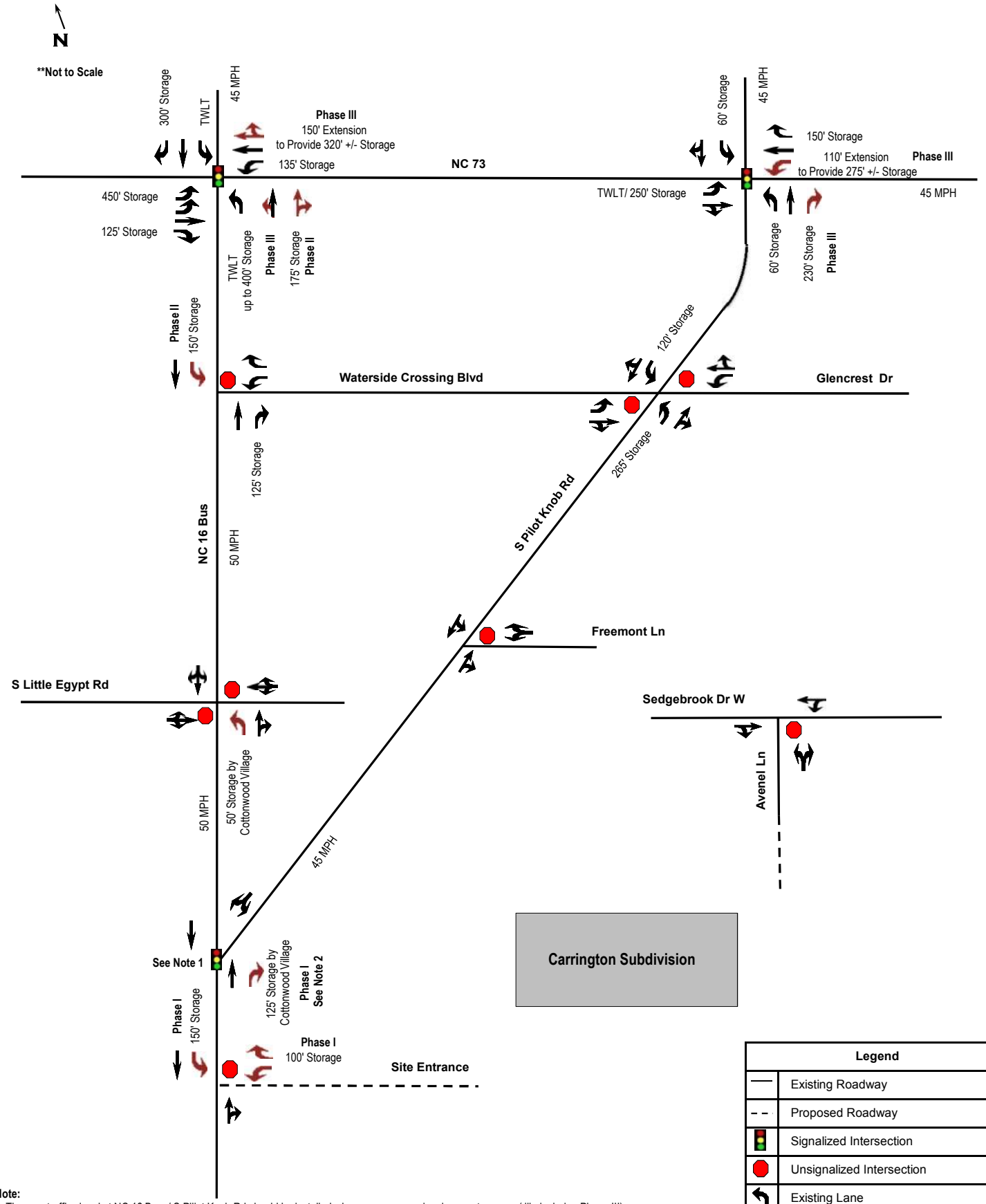
- *Signal:* Install an actuated traffic signal at this intersection with appropriate signal heads, poles, loop detectors, junction boxes, etc. Signal warrant analysis shall be performed before the signal installation, and the signal installation must be approved by NCDOT.

Note: This study assumed a future 125' northbound right-turn lane on NC 16 Business which was previously required for the Cottonwood Village Development (Phases 2&3). Without the proposed right-turn lane, the signal may still operate at LOS B but with longer queues during peak hours.

The analyses show that the proposed widening and new traffic pattern at the NC 73 and NC 16 Business intersection will provide better intersection operational performance than the No Build Conditions during both AM and PM peak hours. At the NC 73 and Pilot Knob Road intersection, the improvements will enable the intersection to operate at an overall LOS C with a significant reduction in delays on the southbound approach. The NC 16 Business and Waterside Crossing Blvd intersection, with the proposed turn-lane / pavement marking revisions, is expected to maintain the current operational performance.

The NC 16 Business and S Pilot Knob Road intersection is expected to operate at LOS B or better during both AM and PM peak hours, once the proposed signal are implemented with or without the proposed northbound right-turn lane (by Cottonwood Village). The proposed turn lanes at the Site Entrance intersection will provide adequate storage capacity.

With the proposed improvements, all of the study intersections are expected to operate with similar or better operational performance when compared with the No Build conditions. Figure 20 illustrates the proposed intersection improvements for each development phases. Tables 15 and 16 on the following pages summarize the capacity analysis and queue analysis results for this study, respectively.



Legend	
	Existing Roadway
	Proposed Roadway
	Signalized Intersection
	Unsignalized Intersection
	Existing Lane
	Future Lane

Note:
1. The new traffic signal at NC 16 Bus. / S Piliot Knob Rd should be installed when one or more signal warrants are me(likely during Phase III).
2. The proposed right-turn lane is warranted by the current traffic volumes and was previously required for the Cottonwood Village development.

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Figure 20
Proposed Intersection Improvements

Table 15: LOS Analysis Summary

Intersection	Approach		Existing (2015)				No Build (2020)				Build (2020)				Build (2020) with Improvements			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
NC 73 @ NC 16 Bus	signalized	Intersection Average	**35.9**	**D**	**59.5**	**E**	**48.9**	**D**	**93.7**	**F**	**56.0**	**E**	**101.4**	**F**	**48.0**	**D**	**57.3**	**E**
		EB - NC 73	35.5	D	39.4	D	47.9	D	63.0	E	47.8	D	61.0	E	32.2	C	50.8	D
		WB - NC73	40.5	D	56.5	E	55.3	E	81.4	F	55.6	E	81.3	F	41.5	D	39.0	D
		NB - NC 16 Bus	54.3	D	114.9	F	75.5	E	174.5	F	114.2	F	208.9	F	98.8	F	82.3	F
		SB - NC 16 Bus	21.7	C	42.7	D	30.6	C	84.6	F	31.1	C	89.5	F	43.6	D	63.9	E
NC 73 @ Pilot Knob Rd	signalized	Intersection Average	**19.0**	**B**	**16.3**	**B**	**23.8**	**C**	**24.8**	**C**	**31.0**	**C**	**34.4**	**C**	**28.7**	**C**	**30.0**	**C**
		EB - NC 73	18.4	B	8.5	A	24.9	C	11.9	B	24.7	C	11.3	B	27.2	C	26.4	C
		WB - NC73	11.4	B	14.0	B	14.7	B	24.0	C	16.3	B	30.8	C	12.1	B	21.8	C
		NB - Pilot Knob Rd	16.6	B	21.6	C	16.9	B	24.4	C	18.9	B	29.0	C	43.2	D	52.3	D
		SB - Pilot Knob Rd	37.7	D	31.7	C	46.3	D	51.9	D	85.5	F	91.1	F	53.5	D	44.3	D
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NB - NC 16 Bus	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A
		SB - NC 16 Bus	3.4	A	3.8	A	3.7	A	4.3	A	3.9	A	4.4	A	2.3	A	2.3	A
		WB - Waterside Crossing Blvd	19.7	C	25.7	D	30.6	D	58.7	F	41.7	E	105.9	F	16.3	C	23.3	C
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NB - S Pilot Knob Rd	1.0	A	1.3	A	1.0	A	1.3	A	0.9	A	1.2	A	0.9	A	1.2	A
		SB - S Pilot Knob Rd	0.6	A	1.1	A	0.7	A	1.1	A	0.9	A	1.3	A	0.9	A	1.3	A
		EB - Waterside Crossing Blvd	12.2	B	15.1	C	12.7	B	16.3	C	14.1	B	19.5	C	14.1	B	19.5	C
		WB - Glencrest Dr	11.6	B	13.3	B	11.9	B	14.1	B	12.8	B	15.5	C	12.8	B	15.5	C
NC 16 Bus @ S Little Egypt Rd	unsignalized	NB - NC 16 Bus	0.4	A	0.3	A	0.4	A	0.5	A	0.4	A	0.4	A	0.4	A	0.4	A
		SB - NC 16 Bus	0.0	A	0.1	A	0.0	A	0.1	A	0.0	A	0.1	A	0.0	A	0.1	A
		EB - S Little Egypt Rd	17.0	C	16.6	C	17.8	C	22.2	C	20.1	C	27.2	D	13.3	B	15.3	C
		WB - S Little Egypt Rd	10.3	B	0.0	A	10.8	B	0.0	A	11.5	B	0.0	A	10.9	B	0.0	A
S Pilot Knob Rd @ Freemont Ln	unsignalized	NB - S Pilot Knob Rd	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A
		SB - S Pilot Knob Rd	0.2	A	0.4	A	0.2	A	0.3	A	0.2	A	0.3	A	0.2	A	0.3	A
		WB - Freemont Ln	9.0	A	9.3	A	9.1	A	9.3	A	9.4	A	9.5	A	9.4	A	9.5	A
NC 16 Bus @ S pilot Knob Rd	unsignalized (Future Signal)	Intersection Average	--	--	--	--	--	--	--	--	--	--	--	--	**9.3**	**A**	**12.5**	**B**
		NB - NC 16 Bus	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	8.1	A	10.3	B
		SB - NC 16 Bus	0.0	A	0.1	A	0.0	A	0.1	A	0.0	A	0.1	A	10.0	B	13.9	B
		WB - S Pilot Knob Rd	19.7	C	34.8	D	23.1	C	51.3	F	30.5	D	169.7	F	13.6	B	17.6	B
Sedgebrook Dr @ Avenel Ln	unsignalized	EB - Sedgebrook Dr	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A
		WB - Sedgebrook Dr	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A
		NB - Avenel Ln	9.2	A	9.4	A	9.3	A	9.4	A	9.4	A	9.6	A	9.4	A	9.6	A
NC 16 Bus @ Site Entrance	unsignalized	NB - NC 16 Bus	--	--	--	--	--	--	--	--	0.0	A	0.0	A	0.0	A	0.0	A
		SB - NC 16 Bus	--	--	--	--	--	--	--	--	1.2	A	4.6	A	0.7	A	1.8	A
		WB - Site Entrance	--	--	--	--	--	--	--	--	24.4	C	49.9	E	19.4	C	51.2	F

Unacceptable Delay/LOS

Table 16: Queue Analysis Summary

Intersection	Turn Lane		Storage Length {Future Storage} (ft)	Existing (2015)				No Build (2020)				Build (2020)				Build (2020) with Improvements			
				AM		PM		AM		PM		AM		PM		AM		PM	
				95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)	95th% Queue (ft)	Max Queue (ft)
NC 73 @ NC 16 Bus	signalized	EBL	450	#150	202	#207	199	#205	530**	#325	488	#205	390	#325	489	152	237	#301	405
		EBR	125	170	225	118	225	203	225	143	225	215	225	180	225	198	225	180	225
		WBL	135	m48	216**	m69	234**	m50	235**	m63	234**	m50	223**	m64	235**	m57	170**	m69	234**
		WBR	165 {320 Thru/RT}	m26	264**	m45	265**	m43	265**	m94	265**	m43	265**	m94	265**	295	300	458	370
		NBL	TWLT 400+/-	#282	287	#522	499	#355	452	#630	500	#441	500	#696	500	#318	305	#435	350
		NBTR	{175}	--	--	--	--	--	--	--	--	--	--	--	--	#268	257	#370	267
		SBL	TWLT 1,000+	113	144	#239	276	#228	320	#422	1,155**	#228	303	#422	1237**	160	261	#316	387
		SBR	300	0	0	0	40	0	39	0	400**	0	40	0	400**	#463	468	384	522
NC 73 @ Pilot Knob Rd	signalized	EBL	TWLT 250 +/-	m8	73	m39	108	m7	135	m27	132	m7	131	m27	160	m4	330**	m66	409**
		WBL	165 {275}	43	111	84	154	#77	106	#162	264	#95	159	#215	265	68	164	#223	348**
		WBR	150	58	132	56	147	63	137	65	250**	63	149	65	250**	52	200**	51	250**
		NBL	60	52	113	28	90	55	102	28	130	55	139	28	158	120	141	57	136
		NBR	{230}	--	--	--	--	--	--	--	--	--	--	--	--	194	238	185	210
		SBL	60	#203	160*	#195	160*	#228	160*	#229	160*	#245	160*	#242	160*	#337	160*	#279	159*
NC 16 Bus @ Waterside Crossing Blvd	unsignalized	NBR	125	0	2	0	70	0	45	0	225**	0	225**	0	225**	0	3	0	18
		SBL	{150}	--	--	--	--	--	--	--	--	--	--	--	--	14	88	17	106
S Pilot Knob Rd @ Waterside Crossing Blvd	unsignalized	NBL	265	2	27	3	39	2	25	3	96	2	31	3	175	2	26	3	44
		SBL	120	1	14	2	35	1	25	3	112	1	22	4	128**	1	24	4	42
NC 16 Bus @ S Little Egypt Rd	unsignalized	NBL	{50}	--	--	--	--	2	10	2	28	2	49	3	58**	2	10	3	29
NC 16 Bus @ S Pilot Knob Rd	unsignalized (future signal)	NBR	{125}	--	--	--	--	0	0	0	0	0	15	0	28	0	49	0	90
NC 16 Bus @ Site Entrance	unsignalized	SBL	{150}	--	--	--	--	--	--	--	--	--	--	--	--	4	48	17	114
		WBR	{100}	--	--	--	--	--	--	--	--	--	--	--	--	--	95	--	86

Queue length greater than storage length

m: queue is metered by upstream signal
*: spillback to adjacent through lane
#: volume exceeds capacity
**: no/little storage blockage