May 2021

CARROLL JOYNER RESIDENTIAL

Traffic Impact Analysis

LOCATED IN WAKE FOREST, NC

Prepared for:

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Carroll Joyner Residential Traffic Impact Analysis

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EXECUTIVE SUMMARY

The proposed 131.65-acre site is situated on the west side of Capital Boulevard south of Purnell Road in Wake Forest, North Carolina. The property is currently zoned as General Residential 3 Planned Unit Development (GR3 PUD). The proposed development consists of 168 single family residential units, 137 residential townhomes, and 90 senior adult detached residential units and does require rezoning to the GR-10 Conditional District. The proposed site is to be developed within six years by the year 2027. The proposed development will be accessed via connectivity to the existing Club Villas Drive and the existing Country Club Drive, both of which currently provide full movement access to Capital Boulevard. The western portion of the site will serve the senior adult detached residential units and will have access to Purnell Road via connectivity to Simpson Court. The purpose of this TIA is to analyze the potential traffic impacts of the proposed development on the surrounding roadway network and to identify any roadway improvements necessary to mitigate the impact of the project traffic.

A TIA Scoping Meeting was held on Tuesday, April 6, 2021 and a follow-up Memorandum of Understanding was prepared and submitted to the Town of Wake Forest and North Carolina Department of Transportation (NCDOT). The MOU and subsequent correspondence regarding the scope of the TIA is included in the Appendix of this report. The *NCDOT Congestion Management Capacity Analysis Guidelines* were referenced to perform this traffic study.

As determined by the Town of Wake Forest and NCDOT, the study area includes:

1. Purnell Road and Hogan Drive
2. Capital Boulevard and Purnell Road/Harris Road
3. Capital Boulevard and Club Villas Drive
4. Capital Boulevard and Country Club Drive/Templeridge Road
5. Capital Boulevard and Jenkins Road/Stadium Drive

The proposed development is expected to generate 3,186 daily trips, 228 AM peak hour trips (59 entering, 169 exiting), and 292 PM peak hour trips (183 entering, 109 exiting).

Based on coordination with the Town, a 3% annual growth rate was applied to the existing traffic volumes to determine 2027 background traffic volumes. Approved developments are developments in the area of the proposed site that have been approved but not yet constructed. The traffic from these approved developments is expected to contribute to the background traffic volumes projected for the study intersections. According to the Town and NCDOT, the following approved developments were to be considered in the future year analysis scenarios:

1. Devon Square - 135 single family homes and 150 townhomes located on the east side of Capital Boulevard to the south of Harris Road in Wake Forest with an anticipated buildout year of 2022.
2. Glen Oaks – 225 single family homes and 73 townhomes located on the east side of Capital Boulevard to the north of Wall Road in Wake Forest with an anticipated buildout year of 2022.

To determine the traffic impacts of the proposed development, capacity analyses were performed at the study intersections under the following scenarios:

- Existing (2021) Traffic Conditions
- No-Build (2027) Traffic Conditions

- Buildout (2027) Traffic Conditions
- Buildout (2027) Traffic Conditions with Recommended Improvements

NCDOT and the Town have indicated there are no roadway improvements committed to by others to include in the future analysis for the study intersections.

Based on the capacity analysis presented herein, the following roadway improvements are recommended to be completed **by the developer** to accommodate project traffic:

U.S. 1/Capital Boulevard at Club Villas Drive:

- Stripe the existing eastbound approach of Club Villas Drive to provide two egress lanes on the stem that exists between Capital Boulevard and Wake Union Church Road.

In addition to the improvement listed above, the Town of Wake Forest is requiring the developer to construct the service road along Capital Boulevard within the site in accordance with the Town of Wake Forest's *Comprehensive Transportation Plan*. The service road will provide connectivity when Capital Boulevard is upgraded to a controlled-access facility (NCDOT TIP# U-5307).

INTRODUCTION

The proposed 131.65-acre site is situated on the west side of Capital Boulevard south of Purnell Road in Wake Forest, North Carolina as shown on Figure 1. The property is currently zoned as General Residential 3 Planned Unit Development (GR3 PUD). The proposed development consists of 168 single family residential units, 137 residential townhomes, and 90 senior adult detached residential units and does require rezoning to the GR-10 Conditional District. As shown on Figure 2, the proposed development will be accessed via connectivity to the existing Club Villas Drive and the existing Country Club Drive, both of which currently provide full movement access to Capital Boulevard. The western portion of the site will serve the senior adult detached residential units and will have access to Purnell Road via connectivity to Simpson Court. The proposed site is to be developed within six years by the year 2027.

The purpose of this TIA is to analyze the potential traffic impacts of the proposed development on the surrounding roadway network and to identify any roadway improvements necessary to mitigate the impact of the project traffic. This study includes the analysis of the following traffic scenarios:

- Existing (2021) Traffic Conditions
- No-Build (2027) Traffic Conditions
- Buildout (2027) Traffic Conditions
- Buildout (2027) Traffic Conditions with Recommended Improvements

Based on coordination with the Town, a 3% annual growth rate was applied to the existing traffic volumes to determine 2027 background traffic volumes. Approved developments are developments in the area of the proposed site that have been approved but not yet constructed. The traffic from these approved developments is expected to contribute to the background traffic volumes projected for the study intersections. According to the Town and NCDOT, the following approved developments were to be considered in the future year analysis scenarios:

1. Devon Square - 135 single family homes and 150 townhomes located on the east side of Capital Boulevard to the south of Harris Road in Wake Forest with an anticipated buildout year of 2022.
2. Glen Oaks – 225 single family homes and 73 townhomes located on the east side of Capital Boulevard to the north of Wall Road in Wake Forest with an anticipated buildout year of 2022.

Carroll Joyner Property Residential TIA

Vicinity Map

Figure 1

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Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive.

Wake County, NCDOT Division 5

LEGEND

(#) Intersection #

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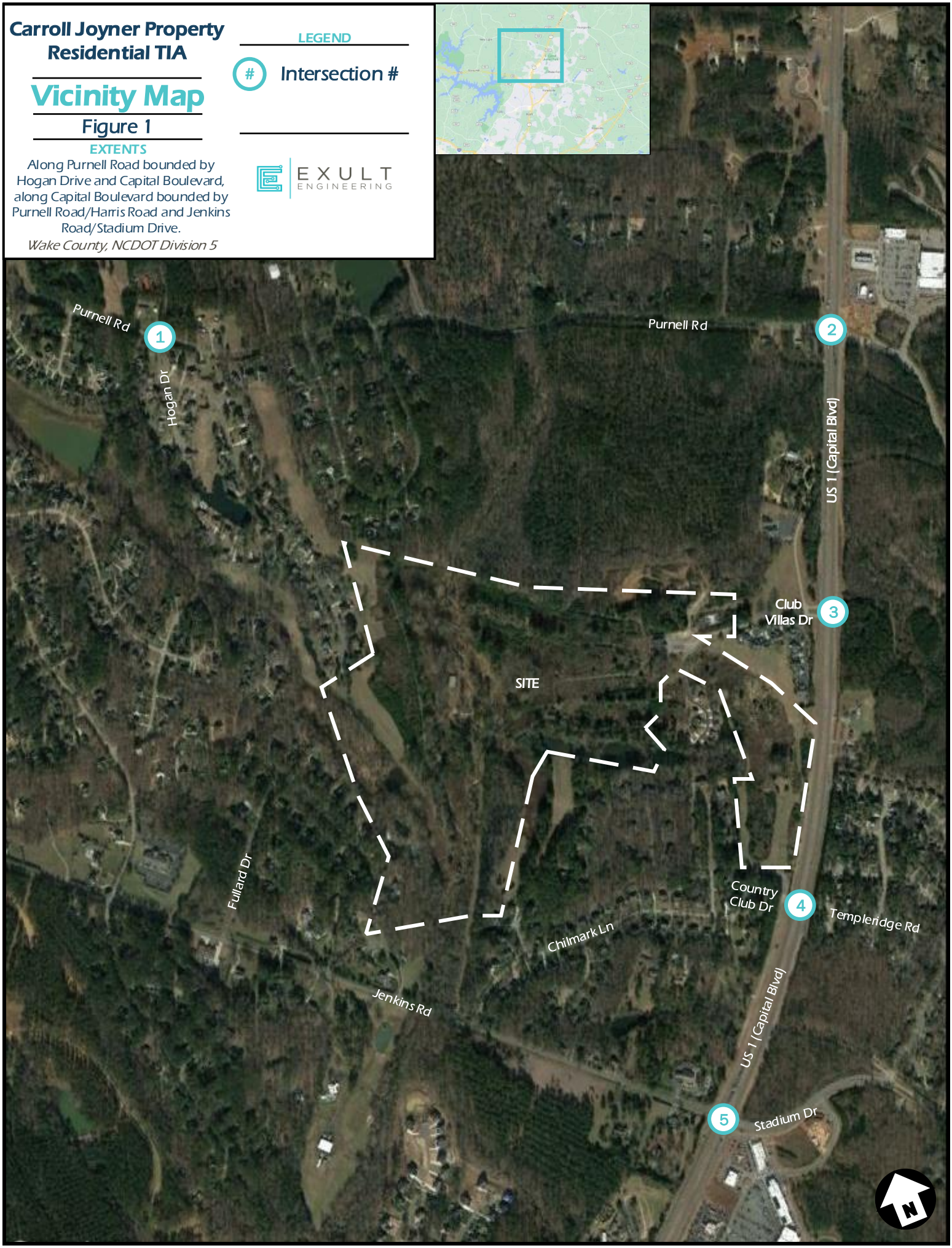

Carroll Joyner Property Residential TIA

Proposed Site Plan

Prepared by McAdams

Figure 2

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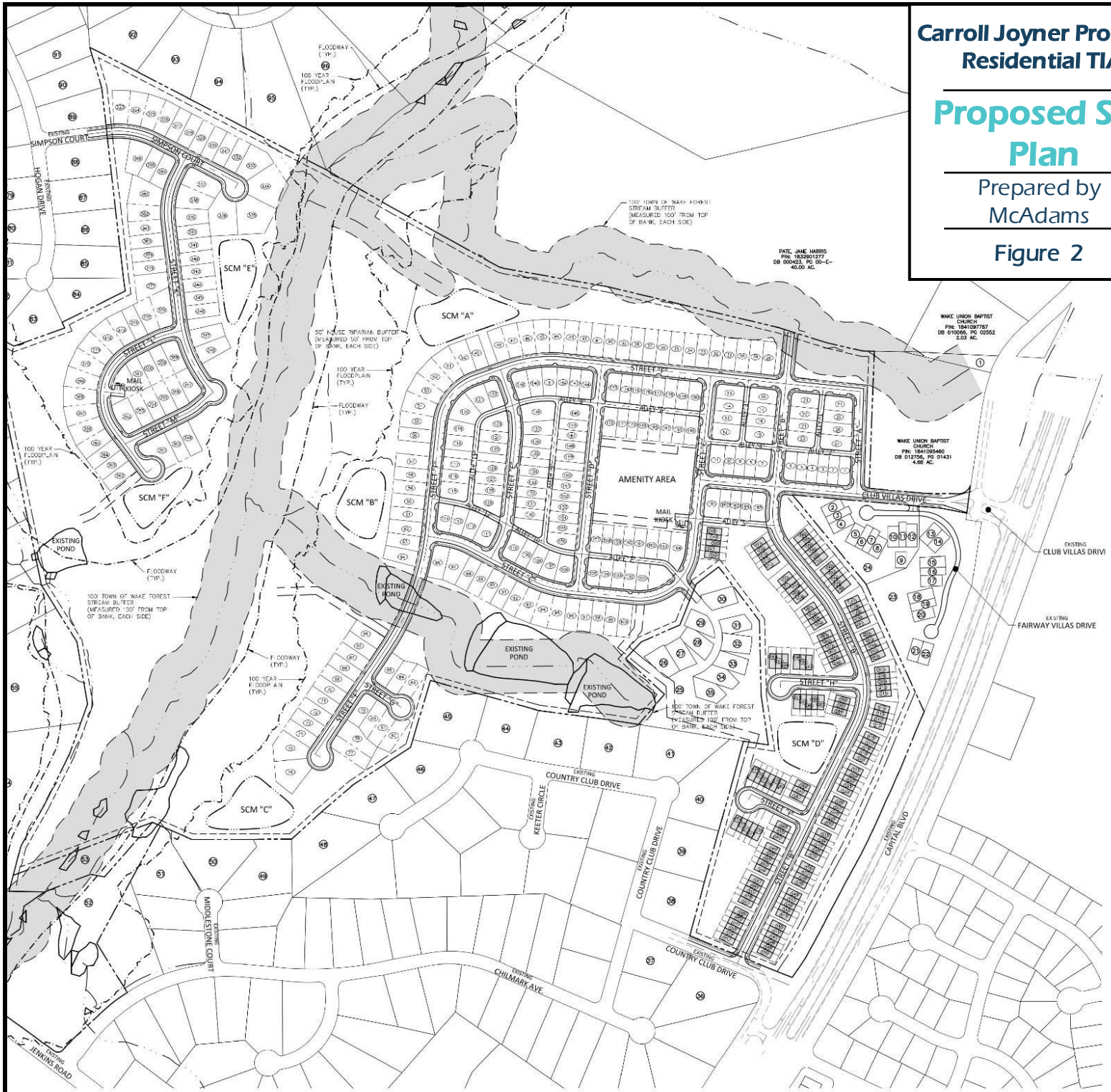
Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive.

Wake County, NCDOT Division 5

EXULT ENGINEERING



EXISTING CONDITIONS

The proposed 131.65-acre site is situated on the west side of Capital Boulevard south of Purnell Road in Wake Forest, North Carolina. The property is currently zoned as General Residential 3 Planned Unit Development (GR3 PUD). Per the Town and NCDOT, the study area for the proposed development includes the following intersections:

1. Purnell Road and Hogan Drive
2. Capital Boulevard and Purnell Road/Harris Road
3. Capital Boulevard and Club Villas Drive
4. Capital Boulevard and Country Club Drive/Templeridge Road
5. Capital Boulevard and Jenkins Road/Stadium Drive

A site visit was performed on Monday, April 12, 2021 to observe existing field conditions, such as lane geometry, posted speed limits, and traffic operations. Figure 3 shows the Existing Lane Geometry at the above existing study intersections.

Existing traffic count data was determined for each study intersection as follows:

1. Capital Boulevard and Purnell Road/Harris Road – Previously collected traffic count data at the study intersection was obtained from the Planet Fitness development study. The count data was collected on Thursday, January 10, 2019. The 3% annual growth rate was applied to the January 2019 traffic count to determine 2021 traffic volumes. This count is the most recent count data available within the project vicinity and was used to adjust through volumes at other study intersections along Capital Boulevard.
2. Purnell Road and Hogan Drive – The above-mentioned 2021 peak hour approach and departure volumes from the intersection of Capital Boulevard and Purnell Road/Harris Road were used in combination with trips generated for the existing Country Club Downs subdivision (57 single family homes) to determine the volumes at Purnell Road and Hogan Drive. The generated trips were assigned onto Purnell Road according to the existing travel pattern.
3. Capital Boulevard and Club Villas Drive – Turning movement traffic volumes only were obtained for the intersection from a previous count collected on Tuesday, October 30, 2018. The count was included in the Devon Square approved development TIA. A growth rate was not applied to the 2018 turning movement volumes because there has not been new development since 2018 within Club Villas Drive. The 2021 peak hour approach/departure volumes from the intersection of Capital Boulevard and Purnell Road/Harris Road were utilized for the through movements along Capital Boulevard to ensure the most recent (2019) data was analyzed.
4. Capital Boulevard and Country Club Drive/Templeridge Road – Existing turning movement traffic volumes at the study intersection were interpolated based on 2015 and 2040 No-Build volumes presented in *U-5307 Traffic Forecast Report Supplement*, dated December 5, 2017. The base year (2015) and future year (2040) turning movement volumes were determined following assumptions presented in the memorandum and interpolated to 2021. The 2021 peak hour approach/departure volumes from the intersection of Capital Boulevard and Club Villas Drive were utilized for the through movements to ensure the most recent (2019) data was applied along Capital Boulevard.

5. Capital Boulevard and Jenkins Road/Stadium Drive – Available traffic count data collected on Wednesday, February 3, 2016 was obtained for the study intersection from the Wake Union Place development TIA. The 3% annual growth rate was applied to the February 2016 turning movement volumes to determine 2021 traffic volumes. As with the surrounding intersections, the through movement volumes at this intersection were adjusted to balance with the 2019 traffic count obtained on Capital Boulevard to ensure the most recent count data was used. It is important to note there was a slight overall reduction in traffic along Capital Boulevard when comparing the 2016 traffic count at the study intersection to the 2019 traffic count volumes along Capital Boulevard. This reduction is supported by NCDOT historical average daily traffic (ADT) volumes reported along Capital Boulevard across this time period. This reduction also corresponds with an increase in traffic along other north-south roadway options (such as the opening of the Rolesville Bypass in 2015). The Rolesville Bypass and U.S. 401 corridor experienced an annual growth rate in traffic volumes of 15% between 2015 and 2017.

The above methodology has been approved by NCDOT and the Town. Traffic count data is included in the Appendix of this report. Figure 4 depicts the 2021 AM and PM Peak Hour Existing Traffic Volumes.

U.S. 1/Capital Boulevard is currently a 4-lane divided roadway with a posted speed limit of 55 miles per hour (mph) in the project vicinity. US 1/Capital Boulevard is classified as a Principal Arterial on the Town of Wake Forest's *Comprehensive Transportation Plan (CTP).* U.S. 1/Capital Boulevard is identified as a future 6-lane Freeway along the study area. US 1/Capital Boulevard has a 2019 average annual daily traffic (AADT) volume of 43,500 vehicles per day on the *NCDOT Interactive Traffic Volume Map*.

Purnell Road (S.R. 1909) is currently a 2-lane roadway with a posted speed limit of 45 miles per hour (mph) in the project vicinity. Purnell Road is classified as a Minor Collector on the Town of Wake Forest's *Comprehensive Transportation Plan (CTP).* Purnell Road has a 2019 average annual daily traffic (AADT) volume of 5,800 vehicles per day on the *NCDOT Interactive Traffic Volume Map*.

Harris Road (S.R. 1931) is currently a 2-lane roadway with a posted speed limit of 45 miles per hour (mph) in the project vicinity. Harris Road is classified as a Major Collector on the Town of Wake Forest's *Comprehensive Transportation Plan (CTP).* Harris Road has a 2019 average annual daily traffic (AADT) volume of 5,900 vehicles per day on the *NCDOT Interactive Traffic Volume Map*.

Club Villas Drive is currently a 2-lane roadway with an unposted, assumed speed limit of 25 miles per hour (mph) in the project vicinity. Club Villas Drive is classified as a local road on the Town of Wake Forest's *Comprehensive Transportation Plan (CTP).* Club Villas Drive is identified as a future 2-lane Minor Collector along the site frontage. Assuming the PM peak hour traffic volume accounts for approximately 10% of the daily traffic volume, Club Villas Drive has an estimated 2021 ADT volume of 250 vehicles per day.

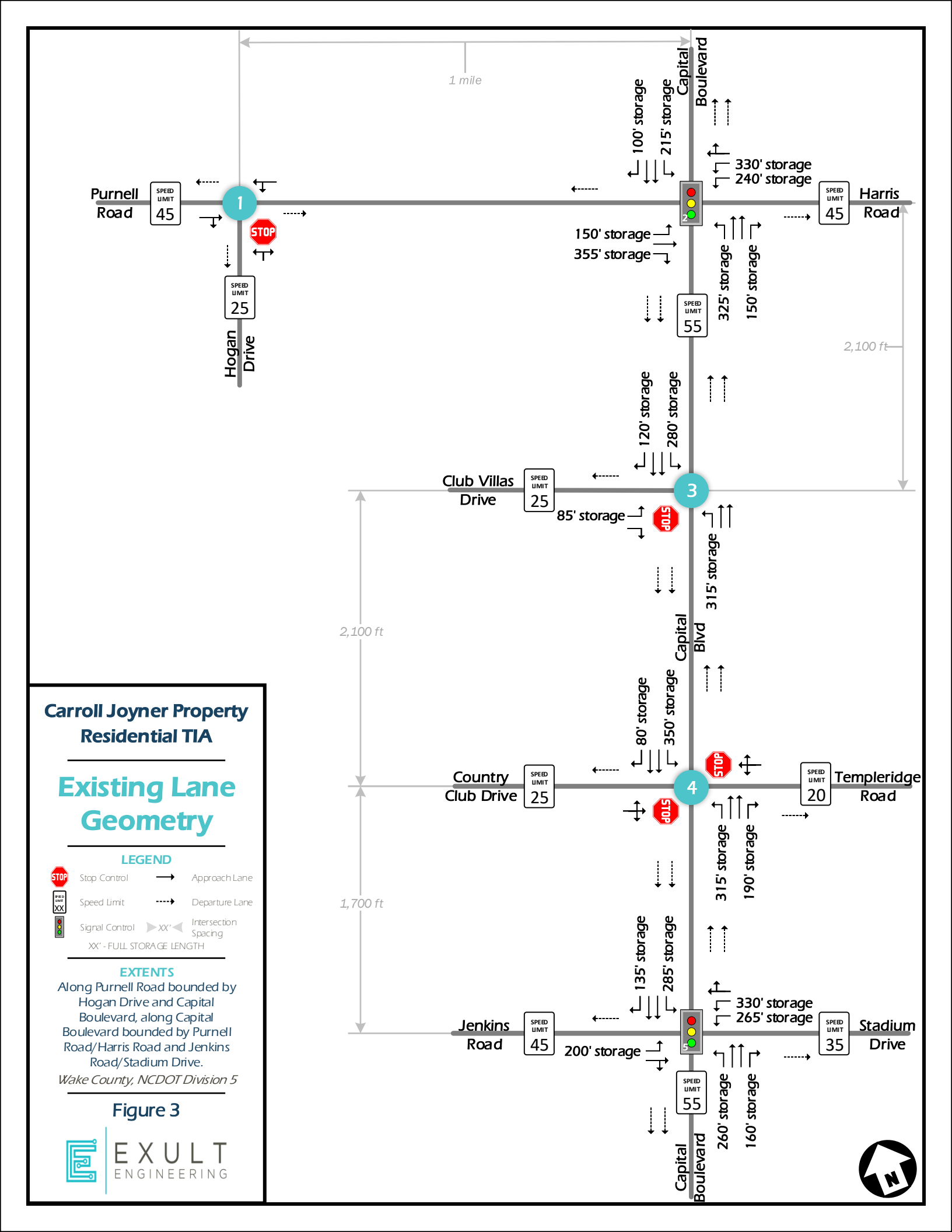
Country Club Drive is currently a 2-lane roadway with a posted speed limit of 25 miles per hour (mph) in the project vicinity. Country Club Drive is classified as a local road on the Town of Wake Forest's *Comprehensive Transportation Plan (CTP).* Assuming the PM peak hour traffic volume accounts for approximately 10% of the daily traffic volume, Country Club Drive has an estimated 2021 ADT volume of 320 vehicles per day.

Templeridge Road is currently a 2-lane roadway with a posted speed limit of 20 miles per hour (mph) in the project vicinity. Templeridge Road is classified as a local road on the Town of Wake Forest's

Comprehensive Transportation Plan (CTP). Templeridge Road is identified as a future 2-lane Minor Collector in the study area. Assuming the PM peak hour traffic volume accounts for approximately 10% of the daily traffic volume, Templeridge Road has an estimated 2021 ADT volume of 460 vehicles per day.

Jenkins Road (S.R. 1926) is currently a 2-lane roadway with a posted speed limit of 45 miles per hour (mph) in the project vicinity. Jenkins Road is classified as a Minor Collector on the Town of Wake Forest's *Comprehensive Transportation Plan (CTP).* Jenkins Road has a 2019 average annual daily traffic (AADT) volume of 7,400 vehicles per day on the *NCDOT Interactive Traffic Volume Map*.

Stadium Drive (S.R. 1930) is currently a 3-lane roadway with a two-way left-turn lane with a posted speed limit of 35 miles per hour (mph) in the project vicinity. Stadium Drive is classified as a Major Collector on the Town of Wake Forest's *Comprehensive Transportation Plan (CTP).* Stadium Drive has a 2019 average annual daily traffic (AADT) volume of 6,200 vehicles per day on the *NCDOT Interactive Traffic Volume Map*.



Carroll Joyner Property Residential TIA

Existing Lane Geometry

LEGEND

- STOP — Stop Control
- SPEED LIMIT XX — Speed Limit
- Signal Control
- → Approach Lane
- ⇢ Departure Lane
- ▶ XX' ◀ Intersection Spacing

XX' - FULL STORAGE LENGTH

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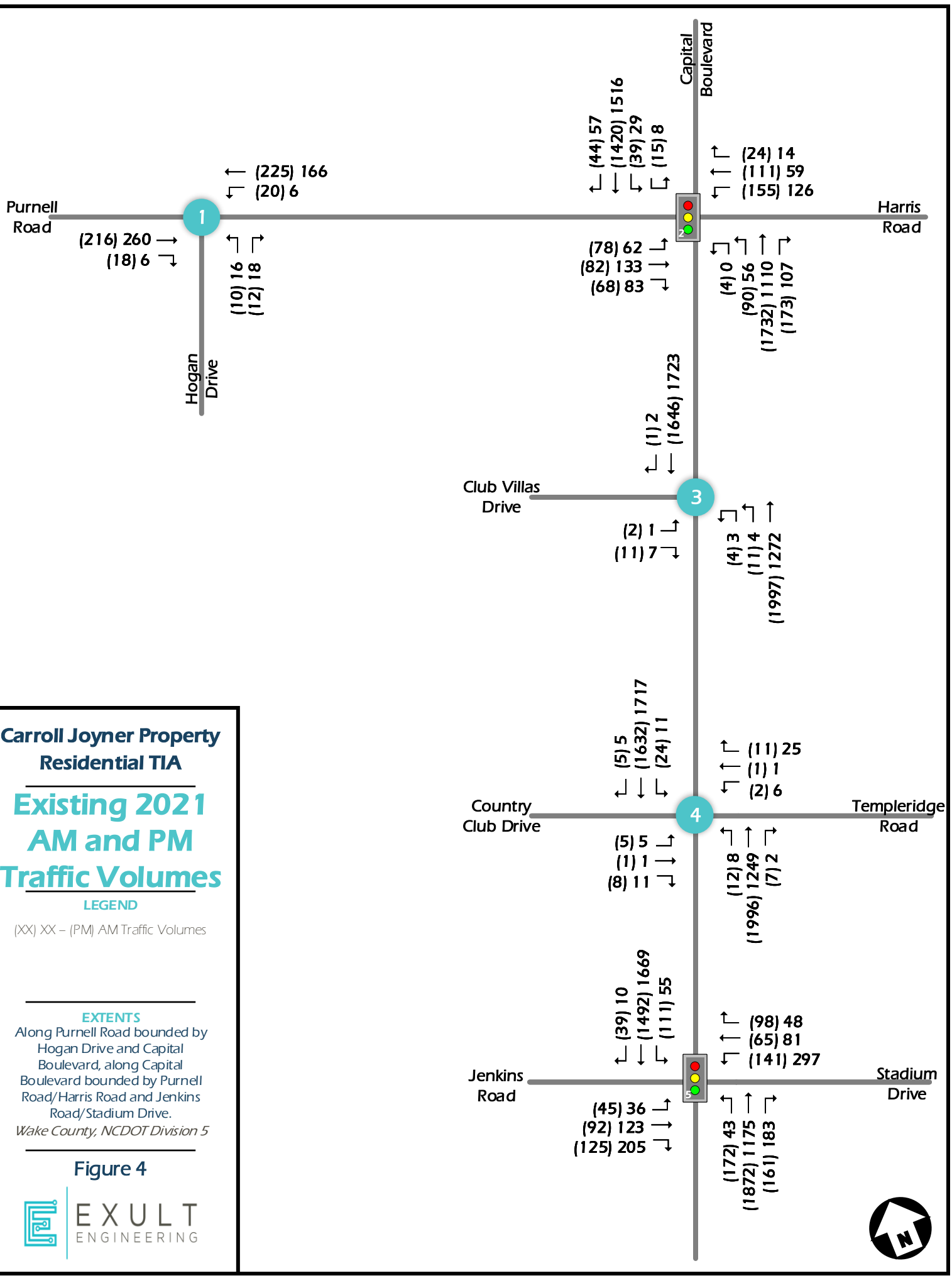
Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive.

Wake County, NCDOT Division 5

Figure 3

EXULT ENGINEERING



Carroll Joyner Property Residential TIA

Existing 2021 AM and PM Traffic Volumes

LEGEND

(XX) XX – (PM) AM Traffic Volumes

EXTENTS

Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive.

Wake County, NCDOT Division 5

Figure 4

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FUTURE CONDITIONS

The projected 2027 background traffic volumes consist of existing 2021 traffic volumes plus background growth. As required by the Town, an annual 3% growth rate was applied to determine 2027 background traffic volumes. Approved developments are developments in the area of the proposed site that have been approved but not yet constructed. The traffic from these approved developments is expected to contribute to the background traffic volumes projected for the study intersections. According to the Town and NCDOT, the following approved developments were to be considered in the future year analysis scenarios:

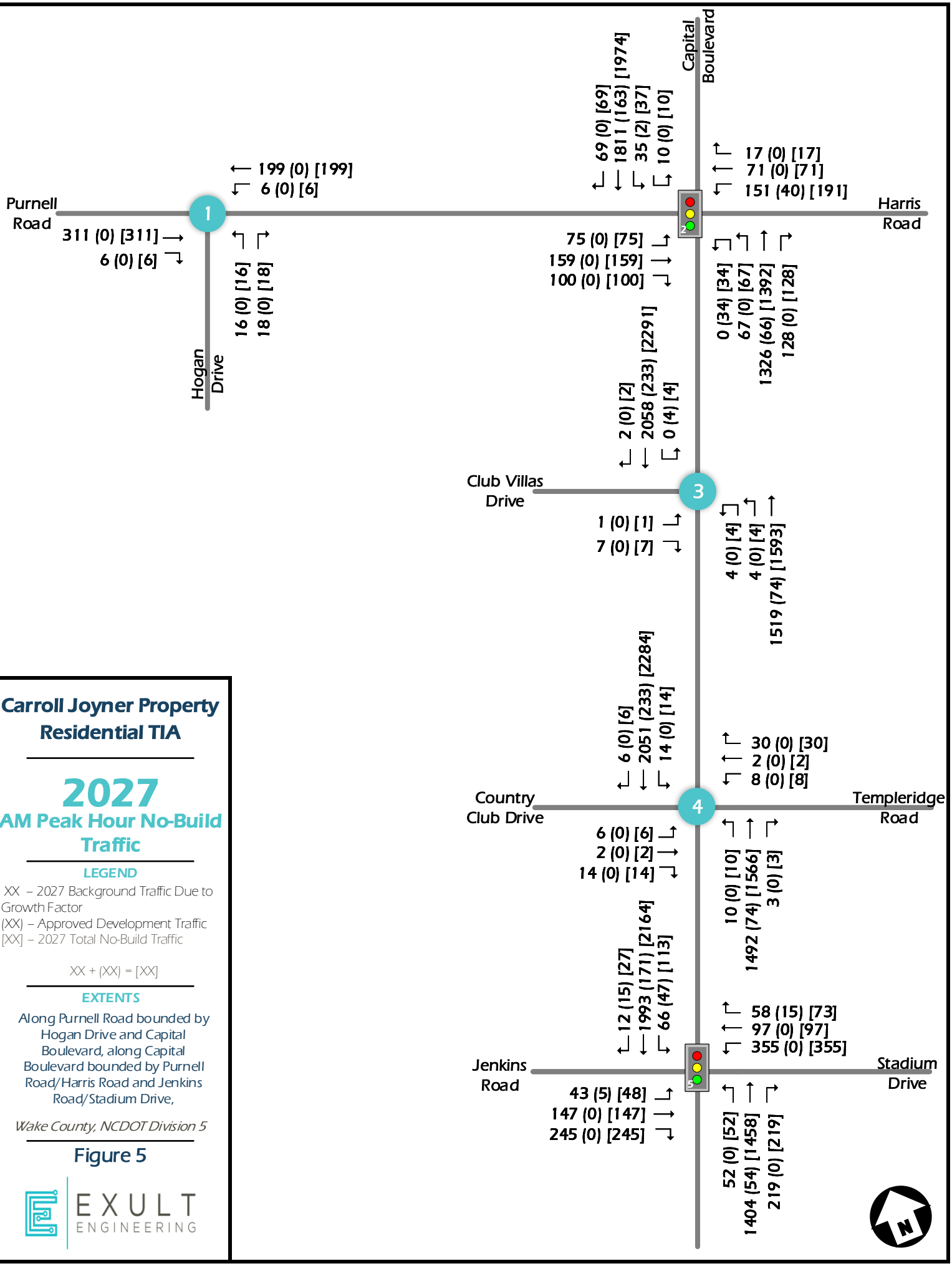
1. Devon Square - 135 single family homes and 150 townhomes located on the east side of Capital Boulevard to the south of Harris Road in Wake Forest with an anticipated buildout year of 2022.
2. Glen Oaks – 225 single family homes and 73 townhomes located on the east side of Capital Boulevard to the north of Wall Road in Wake Forest with an anticipated buildout year of 2022.

Approved development traffic information is included in the Appendix of this report.

Approved development traffic was added to background traffic growth to determine 2027 AM and PM peak hour no-build traffic volumes at the study intersections. Figures 5 and 6 show the 2027 AM Peak Hour No-Build Traffic Volumes and the 2027 PM Peak Hour No-Build Traffic Volumes, respectively. Traffic volume calculations are also included in the Appendix of this report.

NCDOT and the Town have indicated there are no roadway improvements committed to by others to include in the future analysis for the study intersections.

As part of the future Capital Boulevard North Upgrade (TIP# U-5307), Capital Boulevard will be upgraded to a controlled-access facility with future interchanges at strategically identified cross-streets. According to the NCDOT project summary website, construction for this section of the TIP project is currently unfunded with a right-of-way acquisition date of October 2028. Based on coordination with NCDOT, a TIP design year analysis is not required of this development due to the uncertainty in the design of these future interchanges and service roads.



Carroll Joyner Property Residential TIA

2027
AM Peak Hour No-Build Traffic

LEGEND

XX – 2027 Background Traffic Due to Growth Factor
(XX) – Approved Development Traffic
[XX] – 2027 Total No-Build Traffic

XX + (XX) = [XX]

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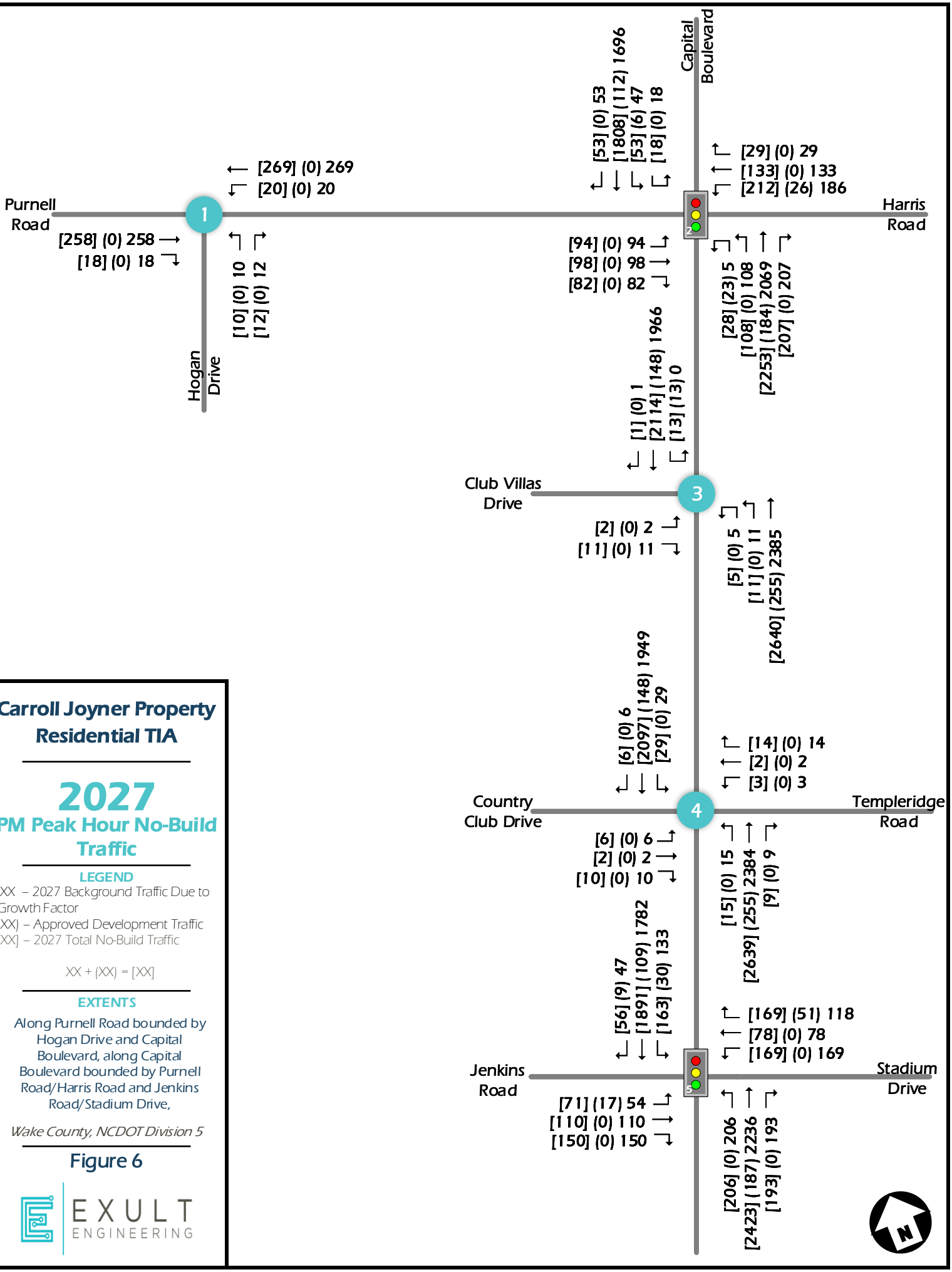
Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive,

Wake County, NCDOT Division 5

Figure 5

EXULT ENGINEERING



Carroll Joyner Property Residential TIA

2027

PM Peak Hour No-Build Traffic

LEGEND

XX – 2027 Background Traffic Due to Growth Factor
(XX) – Approved Development Traffic
[XX] – 2027 Total No-Build Traffic

XX + (XX) = [XX]

EXTENTS

Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive,

Wake County, NCDOT Division 5

Figure 6

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PROPOSED SITE

The proposed 131.65-acre site is situated on the west side of Capital Boulevard south of Purnell Road in Wake Forest, North Carolina. The property is currently zoned as General Residential 3 Planned Unit Development (GR3 PUD). The proposed development consists of 168 single family residential units, 137 residential townhomes, and 90 senior adult detached residential units and does require rezoning to the GR-10 Conditional District. The proposed development will be accessed via connectivity to the existing Club Villas Drive and the existing Country Club Drive, both of which currently provide full movement access to Capital Boulevard. The western portion of the site will serve the senior adult detached residential units and will have access to Purnell Road via connectivity to Simpson Court. The proposed site is to be developed within six years by the year 2027.

Table 1 shows the projected trip generation for the proposed development. The trip generation was based on rates published in the Institute of Transportation Engineers (ITE) *Trip Generation Manual,* 10th Edition. The NCDOT Congestion Management Rates vs. Equations spreadsheet was used for guidance. The proposed development is expected to generate 3,186 daily trips, 228 AM peak hour trips (59 entering, 169 exiting), and 292 PM peak hour trips (183 entering, 109 exiting).

Table 1: Trip Generation

Land Use			Daily	AM Peak Hour			PM Peak Hour		
				Total	Enter	Exit	Total	Enter	Exit
210: Single Family	168	d.u.	1,676	125	31	94	168	106	62
220: Multifamily Low-Rise	137	d.u.	996	65	15	50	79	50	29
251: Senior Adult Housing	90	d.u.	514	38	13	25	45	27	18
Total			**3,186**	**228**	**59**	**169**	**292**	**183**	**109**

References: *Trip Generation Manual*, 10th Edition, Institute of Transportation Engineers, September 2017

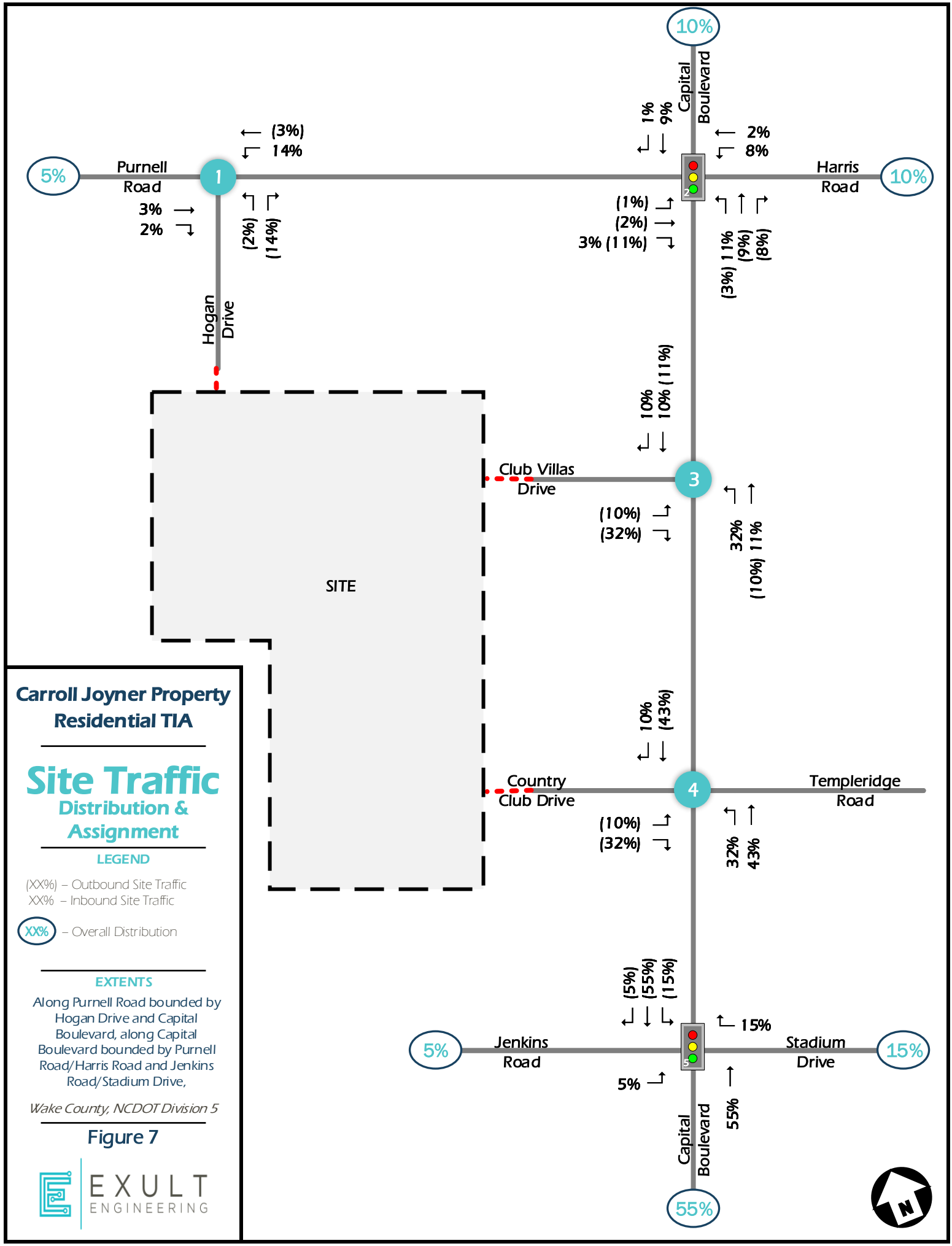
Based on the existing traffic patterns and surrounding opportunities to access retail and office developments, the proposed trip distribution for the site is as follows:

- 10% to/from the north on Capital Boulevard
- 55% to/from the south on Capital Boulevard
- 10% to/from the east on Harris Road
- 15% to/from the east on Stadium Drive
- 5% to/from the west on Purnell Road
- 5% to/from the west on Jenkins Road

The trip generation methodology and site distribution were previously approved by the Town and NCDOT. Figure 7 shows the Site Traffic Distribution and Assignment at each of the study intersections. The trip assignment was applied to the trips generated for the proposed development to determine the projected AM and PM peak hour site traffic. To account for the exclusive access on Purnell Road servicing only the senior adult housing land use of the proposed site, site trips were adjusted throughout the network to ensure the driveway volumes match the appropriate trip generation, The adjusted volumes are detailed in a sketch as well as the intersection volume spreadsheets included in the Appendix of this report.

Due to the existing roadway connectivity of Country Club Drive, the development has a proposed connection to Jenkins Road via Chilmark Avenue. The intersection of Jenkins Road and Chilmark Avenue was not a required study intersection. All of the proposed development traffic for the eastern portion of the site was assigned to the Capital Boulevard intersections (Club Villas Drive and Country Club Drive) to represent a conservative analysis for the study intersections. A minimal amount of project traffic may utilize Chilmark Avenue to access Jenkins Road. However, the total capacity of Chilmark Avenue (9,000 – 10,000 vehicles per day) is expected to accommodate the increased demand due to the development of the proposed site.

The projected AM and PM peak hour site traffic volumes were added to the 2027 no-build traffic volumes to determine the buildout traffic volumes at the study intersections. The projected buildout traffic volumes at the study intersections are shown in Figure 8 (2027 AM Peak Hour Buildout Traffic Volumes) and Figure 9 (2027 PM Peak Hour Buildout Traffic Volumes).



Carroll Joyner Property Residential TIA

Site Traffic Distribution & Assignment

LEGEND

(XX%) – Outbound Site Traffic
XX% – Inbound Site Traffic

XX% – Overall Distribution

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Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive,

Wake County, NCDOT Division 5

Figure 7

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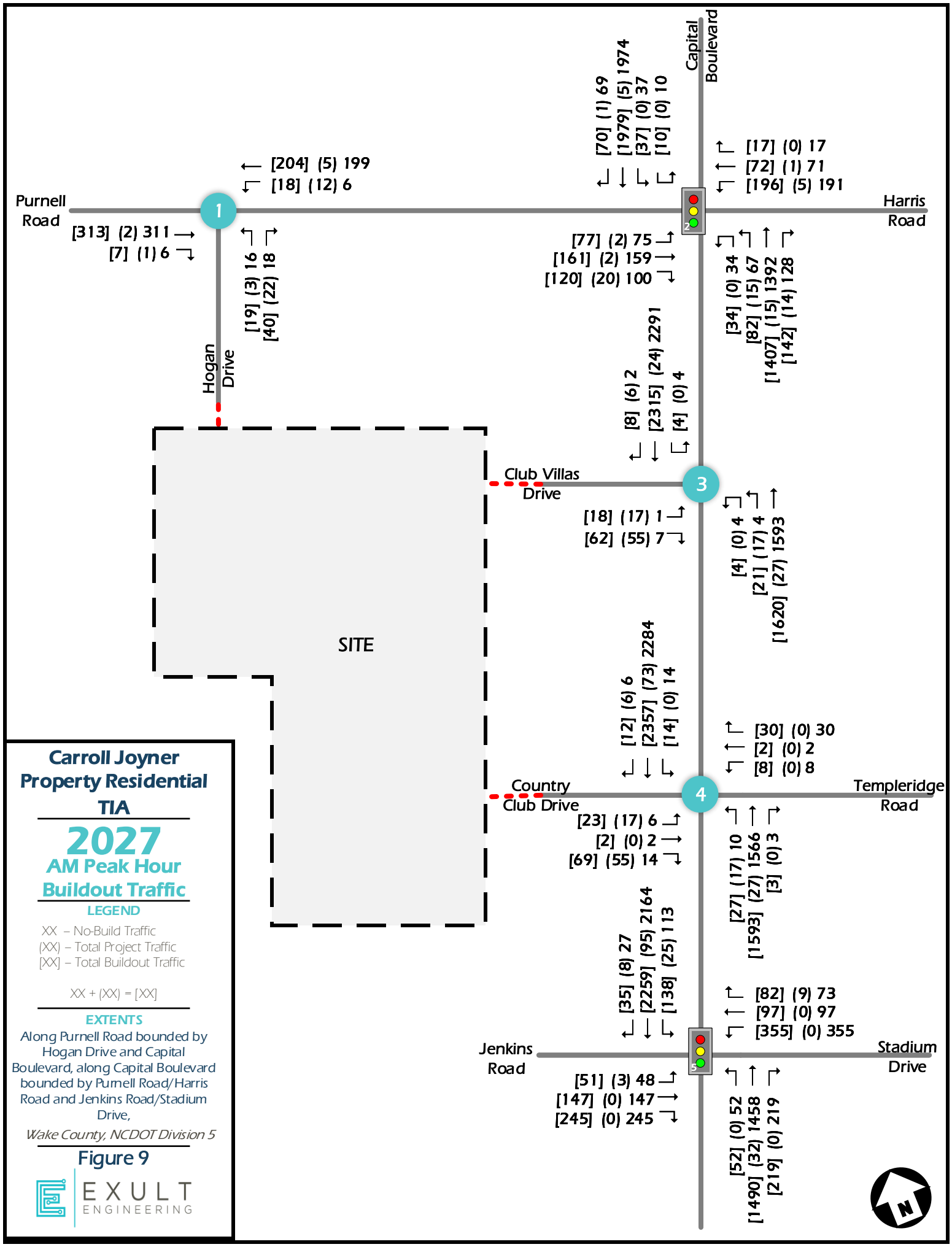

Carroll Joyner Property Residential TIA

2027 AM Peak Hour Buildout Traffic

LEGEND

XX – No-Build Traffic
(XX) – Total Project Traffic
[XX] – Total Buildout Traffic

XX + (XX) = [XX]

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Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive,

Wake County, NCDOT Division 5

Figure 9

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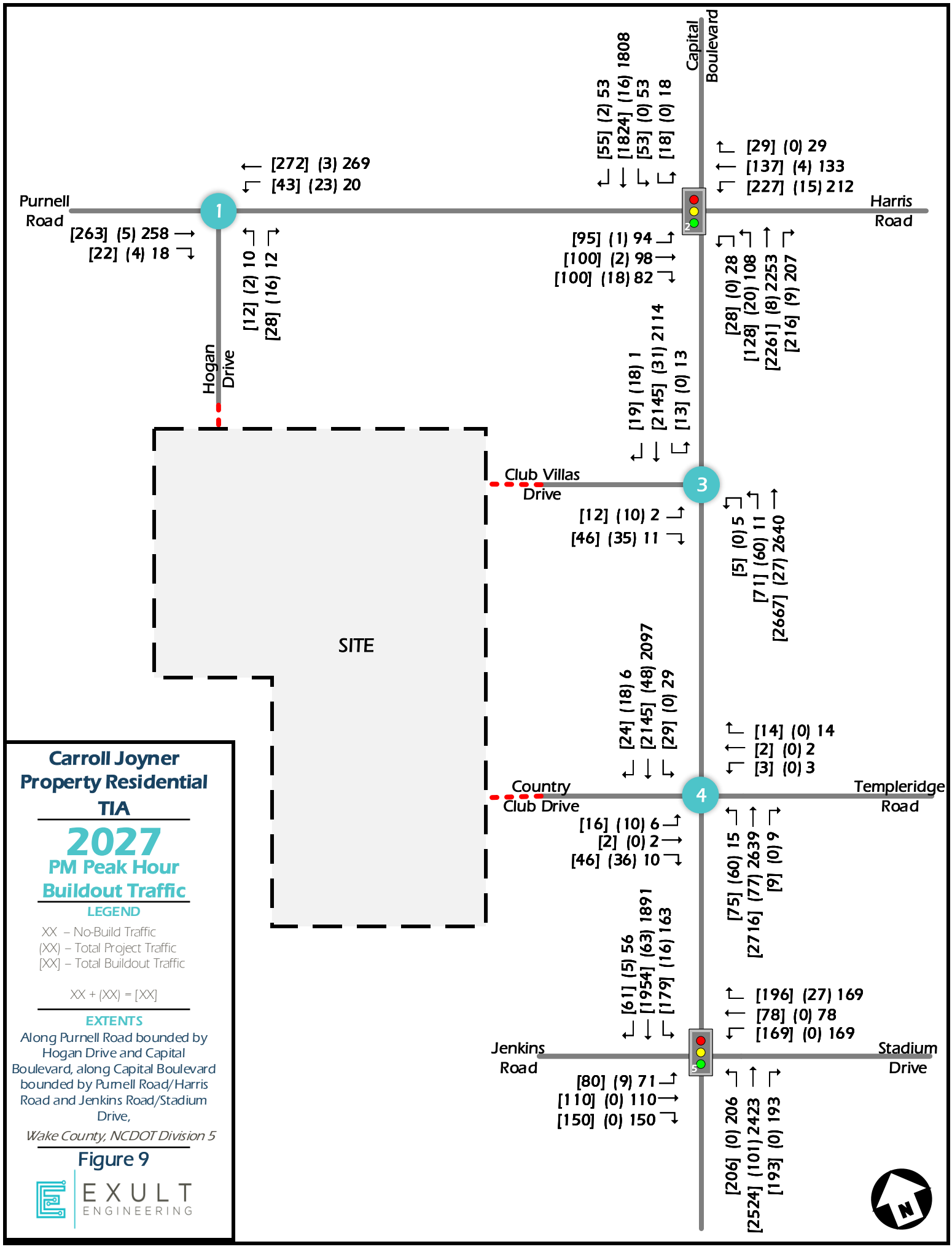

Carroll Joyner Property Residential TIA

2027 PM Peak Hour Buildout Traffic

LEGEND

XX – No-Build Traffic
(XX) – Total Project Traffic
[XX] – Total Buildout Traffic

XX + (XX) = [XX]

EXTENTS

Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive,

Wake County, NCDOT Division 5

Figure 9

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CAPACITY ANALYSIS

The intersections identified within the study area were analyzed under 2021 existing, 2027 no-build, and 2027 buildout conditions to identify the potential traffic impact of the proposed development on the roadway network. Necessary roadway improvements to mitigate the anticipated impact of the proposed site traffic were recommended based on the level-of-service (LOS) analysis results.

The proposed site is to be developed within six years by the year 2027. This study includes the analysis of the following traffic scenarios:

- Existing (2021) Traffic Conditions
- Background (2027) Traffic Conditions
- Buildout (2027) Traffic Conditions
- Buildout (2027) Traffic Conditions with Recommended Improvements

LOS is a qualitative measurement of traffic operations that is a measure of delay time. The Transportation Research Board's *Highway Capacity Manual* (HCM) defines six levels of service for intersections with LOS "A" representing the best operating condition and LOS "F" representing the worst. The following table summarizes the criteria for signalized intersections and stop-controlled intersections.

Table 2: Highway Capacity Manual (LOS and Delay)

Signalized Intersection		Stop-Controlled Intersection	
Level-of-Service (LOS)	Average Control Delay (Seconds per Vehicles)	Level-of-Service (LOS)	Average Control Delay (Seconds per Vehicle)
A	≤ 10.0	A	≤ 10.0
B	> 10.0 and ≤ 20.0	B	> 10.0 and ≤ 15.0
C	> 20.0 and ≤ 35.0	C	> 15.0 and ≤ 25.0
D	> 35.0 and ≤ 55.0	D	> 25.0 and ≤ 35.0
E	> 55.0 and ≤ 80.0	E	> 35.0 and ≤ 50.0
F	> 80.0	F	> 50.0

Version 10.3 of Synchro Professional software was used to determine the LOS, delay, and expected queue length at the signalized and unsignalized intersections. SimTraffic was also used to determine the maximum queue length experienced at the study intersections. This software is based on the analysis procedures defined in the HCM. For unsignalized intersections, Synchro reports were created using the HCM 6th Edition option for unsignalized intersections. Queue lengths for the turn lanes are shown in the summary tables. Detailed Synchro and SimTraffic reports are included in the Appendix of this report.

LOS for a two-way stop-controlled (TWSC) intersection is determined by the control delay and is defined for the minor approaches. Control delay includes initial deceleration delay, queue move-up time, stopped

delay, and final acceleration delay. With respect to field measurements, this summation of control delay is defined as the total time elapsed from the time a vehicle stops at the end of the queue to the time the vehicle departs from the stop line. Capacity analysis results between LOS A and LOS C for the minor street stop-controlled approaches are assumed to represent short delays. Results between LOS D and LOS E for the minor street stop-controlled approaches are assumed to represent moderate delays, and LOS F for the minor street stop-controlled approaches is assumed to represent long delays. It is typical for minor street stop-controlled approaches and driveways intersecting major streets to experience long delays during peak hours, particularly for left-turn movements. However, the majority of the traffic moving through the intersection experiences little or no delay on the major street approaches.

Capacity Analysis Inputs

The *NCDOT Congestion Management Capacity Analysis Guidelines* were referenced to perform this traffic study. The following inputs were used for all intersections:

- Peak Hour Factor (PHF) was based on existing count data by intersection for existing scenarios. When the PHF for existing intersections was not defined, a PHF of 0.90 was used. For no-build and buildout scenarios, a PHF of 0.90 was used.
- The reported heavy vehicles percentages were consistently less than 2% based on collected traffic data. To remain conservative, the heavy vehicle percentage was set to 2% for existing, no-build, and buildout scenarios.
- Right-turns on red were not permitted with the exception of the eastbound right-turn lane on Purnell Road at US 1/Capital Boulevard. Based on coordination with NCDOT, in order to appropriately model this intersection, the northbound U-turn movement on US 1/Capital Boulevard was given protected treatment and the eastbound right-turn movement on Purnell Road was made permissive even though there is an existing overlap phase. To account for removing this overlap phase, right-turns on red were permitted.
- For allowable movements where zero (0) volumes are projected, a value of four (4) was used in the Synchro capacity analysis model.

For unsignalized intersections, queue length for HCM from Synchro is given in terms of number of vehicles. To convert to queue length in feet, an estimated 25'/vehicle was applied.

The following subsections summarize the LOS and queue length results for the capacity analysis under 2021 existing, 2027 background, and 2027 buildout traffic scenarios as well as recommended improvements for each study intersection.

Purnell Road at Hogan Drive

Purnell Road at Hogan Drive is currently an unsignalized intersection. The minor street approach (Hogan Drive) operates under stop control while the major street approaches (Purnell Road) are free-flow.

The capacity analysis results for the intersection are summarized in Table 3 below. The intersection of Purnell Road at Hogan Drive currently operates with short delays for the northbound minor street approach (Hogan Drive) during the AM and PM peak hours.

The intersection is expected to continue to operate with short delays for the minor approach during the AM and PM peak hours under no-build and buildout conditions. The addition of the proposed development project traffic has minimal impact on the operation (delay and anticipated queue length) at the intersection of Purnell Road at Hogan Drive. Therefore, no roadway improvements are recommended to accommodate project traffic at the intersection.

Eastbound Approach of Purnell Road at Hogan Drive

Table 3: Level-of-Service: Purnell Road at Hogan Drive (unsignalized)

Condition	AM Peak		PM Peak	
	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)
2021 Existing	NBLR – B/11.1 WBL – A/7.9	NBLR – 5'/39' WBLT – 0'/31'	NBLR – B/11.1 WBL – A/7.8	NBLR – 3'/35' WBLT – 3'/48'
2027 No-Build	NBLR – B/11.8 WBL – A/8.0	NBLR – 5'/40' WBLT – 0'/26'	NBLR – B/11.7 WBL – A/7.9	NBLR – 3'/52' WBLT – 3'/44'
2027 Buildout	NBLR – B/11.9 WBL – A/8.0	NBLR – 10'/54' WBLT – 3'/47'	NBLR – B/11.7 WBL – A/8.0	NBLR – 5'/64' WBLT – 3'/78'

U.S. 1/Capital Boulevard at Purnell Road/Harris Road

U.S. 1/Capital Boulevard at Purnell Road/Harris Road is currently a signalized intersection. Existing signal plans and timing charts obtained from NCDOT were used for the 2021 analysis scenarios (minimum initial, maximum green, yellow and red time). The signal plan is included in the Appendix of this report. For future no-build and buildout scenarios, the following input values were used in accordance with NCDOT Congestion Management guidelines:

- Cycle length remained consistent with existing scenarios and splits were optimized for future scenarios.
- Left-turn treatment for exclusive left-turn lanes was set to protected only.
- Lost time set to 5 seconds, yellow time set to 5 seconds, and red time set to 2 seconds in future scenarios.
- Default values for vehicle extension and minimum gap were used.

Northbound Approach of U.S. 1/Capital Boulevard at Purnell Road/Harris Road

Table 4 summarizes the capacity analysis results for the signalized intersection of U.S. 1/Capital Boulevard at Purnell Road/Harris Road under 2021 existing, 2027 no-build, and 2027 buildout scenarios. As shown in Table 4 below, the intersection of U.S. 1/Capital Boulevard at Purnell Road/Harris Road currently operates at LOS C during both the AM and PM peak hours. The intersection is expected to operate at LOS D during both the AM and PM peak hours under the 2027 no-build conditions. The intersection is expected to operate at LOS D during the AM peak hour and LOS E during the PM peak hour under the 2027 buildout conditions. The site traffic has minimal impacts on the delay experienced at the study intersection.

The overall level of service would remain at an acceptable LOS D in the PM peak hour at project buildout if right-turns on red were allowed in the capacity analysis model as currently permitted at this intersection. The results of allowing right-turns on red are shown in Table 4 ("2027 Buildout With Right-Turns on Red"). To provide a fair comparison, a no-build scenario allowing right-turns on red was also prepared and the results are included in Table 4.

It is important to note that the eastbound left-turn lane on Purnell Road currently provides 150' of full width storage. The projected queue length during no-build conditions extends beyond the available storage. Because the anticipated queue length at project buildout extends this queue length by only an additional 7 feet during the AM peak hour and 5 feet during the PM peak hour, the developer should not be responsible for extending this turn lane.

According to the guidelines published in NCDOT's *Policy on Street and Driveway Access to North Carolina Highways* (July 2003), mitigation improvements should be identified if the total average delay at the intersection or individual approach increases by 25% or more with the addition of the proposed

development site trips. The total average delay at the intersection and individual approaches increases by less than 25% when comparing no-build conditions to buildout conditions, therefore, no roadway improvements are recommended to accommodate project traffic at the intersection.

It is important to note that this intersection will be reconfigured to an interchange when Capital Boulevard is upgraded to a controlled-access facility.

Table 4: Level-of-Service: U.S. 1/Capital Boulevard at Purnell Road/Harris Road (Signalized)

Condition	AM Peak		PM Peak	
	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)
2021 Existing	Overall – C/20.4 EB – D/44.3 WB – E/66.1 NB – A/7.9 SB – C/20.5	EBL – 85'/107' EBR – 0'/91' WBL – 95'/136' NBL/U – 10'/178' NBR – 9'/254' SBL/U – 24'/333' SBR – 21'/280'	Overall – C/28.4 EB – D/40.8 WB – E/61.4 NB – B/13.7 SB – D/39.5	EBL – 105'/120' EBR – 0'/88' WBL – 112'/172' NBL/U – 24'/377' NBR – 30'/300' SBL/U – 45'/405' SBR – 17'/280'
2027 No-Build	Overall – D/36.8 EB – E/76.9 WB – F/91.9 NB – A/9.4 SB – D/44.3	EBL – 162'/297' EBR – 0'/158' WBL – 177'/249' NBL/U – 140'/244' NBR – 5'/262' SBL/U – 93'/404' SBR – 20'/280'	Overall – D/54.2 EB – E/77.8 WB – F/125.6 NB – E/56.1 SB – C/34.6	EBL – 213'/169' EBR – 0'/128' WBL – 193'/309' NBL/U – 105'/384' NBR – 7'/300' SBL/U – 153'/404' SBR – 14'/280'
2027 No-Build with Right-Turns on Red	Overall – D/36.5 EB – E/73.5 WB – F/91.9 NB – A/9.4 SB – D/44.2	EBL – 138'/302' EBR – 0'/280' WBL – 177'/207' NBL/U – 140'/328' NBR – 0'/297' SBL/U – 93'/404' SBR – 6'/280'	Overall – D/51.7 EB – F/81.5 WB – F/134.0 NB – E/49.5 SB – C/34.5	EBL – 213'/209' EBR – 0'/120' WBL – 193'/275' NBL/U – 104'/370' NBR – 0'/300' SBL/U – 153'/405' SBR – 3'/280'
2027 Buildout	Overall – D/38.4 EB – E/75.5 WB – F/114.7 NB – B/13.0 SB – D/41.8	EBL – 169'/278' EBR – 9'/307' WBL – 195'/289' NBL/U – 168'/379' NBR – 6'/213' SBL/U – 93'/405' SBR – 19'/280'	Overall – E/57.4 EB – E/75.5 WB – F/135.1 NB – E/57.2 SB – D/39.3	EBL – 218'/241' EBR – 0'/132' WBL – 210'/279' NBL/U – 110'/333' NBR – 7'/300' SBL/U – 153'/405' SBR – 15'/280'
2027 Buildout with Right-Turns on Red	Overall – D/38.1 EB – F/84.9 WB – F/114.0 NB – B/10.5 SB – D/41.7	EBL – 169'/311' EBR – 9'/338' WBL – 195'/249' NBL/U – 156'/331' NBR – 0'/134' SBL/U – 93'/404' SBR – 6'/280'	Overall – D/54.9 EB – E/79.4 WB – F/144.0 NB – E/52.1 SB – D/37.1	EBL – 218'/197' EBR – 0'/124' WBL – 210'/300' NBL/U – 112'/364' NBR – 0'/300' SBL/U – 153'/405' SBR – 3'/280'

U.S. 1/Capital Boulevard at Club Villas Drive

U.S. 1/Capital Boulevard at Club Villas Drive is currently an unsignalized intersection. The minor street approach (Club Villas Drive) operates under stop control while the major street approaches (U.S. 1/Capital Boulevard) are free-flow.

The capacity analysis results for the intersection are summarized in Table 5 below. The intersection of U.S. 1/Capital Boulevard at Club Villas Drive currently operates with short delays for the eastbound minor street approach (Club Villas Drive) during the AM and PM peak hours. The intersection is expected to operate with moderate delays for the eastbound minor street approach (Club Villas Drive) during the AM and PM peak hours under 2027 no-build and buildout conditions. It is typical for the stop-controlled minor street approach to experience moderate delays during the peak hours while the major street free-flow approaches experience little to no delay. The addition of the proposed development project traffic has minimal impact on the operation at the intersection of U.S. 1/Capital Boulevard at Club Villas Drive.

Southbound Approach of US 1/Capital Boulevard at Club Villas

In order to appropriately analyze the available median storage at this intersection, two one-way parallel links were modeled in Synchro. The eastbound approach of Club Villas Drive was modeled as a stop-controlled approach, while the movement that has cross into the median storage was modeled as a yield condition (yielding to the northbound Capital Boulevard traffic). Based on conversations with NCDOT, this methodology best represents field operations. The results for the minor street approach reported in Table 5 is the delay experienced at the right-turn stop-controlled movement. In the absence of Synchro reported values for HCM LOS or delay for the remaining movements at the intersection, NCDOT indicated that SimTraffic queues may be used as a measure of operation. No notable problems were observed at the median intersections during SimTraffic simulations.

It is important to note that SimTraffic capabilities can be limited in simulating field conditions. In some cases, such as the southbound right-turn and U-turn movements, free-flow conditions are not represented accurately due to the congested through movements along U.S. 1/Capital Boulevard. Therefore, anticipated queue lengths are likely over-estimated.

As shown on the concept plan, the internal protected storage of the eastbound approach of Club Villas Drive is approximately 300’ to Road “A”, which can accommodate the projected eastbound queue length. The existing Wake Union Church Road has minimal opposing traffic with this queue and the intersection will be reconfigured with the construction of frontage roads when Capital Boulevard is upgraded to a controlled-access facility.

The following roadway improvements are recommended to accommodate project traffic at the intersection:

- Stripe the existing eastbound approach of Club Villas Drive to provide two egress lanes on the stem that exists between Capital Boulevard and Wake Union Church Road.

Table 5: Level-of-Service: U.S. 1/Capital Boulevard at Club Villas Drive (Unsignalized)

Condition	AM Peak		PM Peak	
	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)
2021 Existing	EBR – C/19.4	EBL – -'/5' EBR – 3'/23' NBL/U – -'/35' SBU – -'/-'	EBR – C/18.7	EBL – -'/19' EBR – 3'/27' NBL/U – -'/55' SBU – -'/2'
2027 No-Build	EBR – D/29.0	EBL – -'/15' EBR – 5'/48' NBL/U – -'/40' SBU – -'/186' SBR – -'/120'	EBR – D/26.0	EBL – -'/20' EBR – 5'/36' NBL/U – -'/56' SBU – -'/11' SBR – -'/40'
2027 Buildout	EBR – E/45.6	EBL – -'/286' EBR – 50'/166' NBL/U – -'/112' SBU – -'/370' SBR – -'/200'	EBR – D/32.7	EBL – -'/103' EBR – 28'/117' NBL/U – -'/169' SBU – -'/112' SBR – -'/80'

U.S. 1/Capital Boulevard at Country Club Drive/Templeridge Road

U.S. 1/Capital Boulevard at Country Club Drive/Templeridge Road is currently an unsignalized intersection. The minor street approaches (Country Club Drive and Templeridge Road) operate under stop control while the major street approaches (U.S. 1/Capital Boulevard) are free-flow.

Southbound Approach of U.S. 1/ Capital Blvd at Country Club Dr/ Templeridge Road

The capacity analysis results for the intersection are summarized in Table 6 below. The intersection of U.S.1/Capital Boulevard at Country Club Drive/Templeridge Road currently operates with short delays for the eastbound minor street approach (Country Club Drive) and the westbound minor street approach (Templeridge Road) during the AM and PM peak hours. It is expected to operate with short to moderate delays for the eastbound and westbound minor street approaches (Country Club Drive and Templeridge Road) during the AM and PM peak hours under 2027 no-build conditions. The eastbound and westbound minor street approaches are expected to operate with short to long delays at project buildout. It is typical for the stop-controlled minor street approaches to experience moderate to long delays during the peak hours while the major street free-flow approaches experience little to no delay.

In order to appropriately analyze the available median storage at this intersection, two one-way parallel links were modeled in Synchro. The eastbound approach of Country Club Drive was modeled as a stop-controlled approach, while the movement that has crossed into the median storage was modeled as a yield condition (yielding to the northbound Capital Boulevard traffic). Likewise, the westbound approach of Templeridge Road was modeled as a stop-controlled approach, while the movement that has crossed into the median storage was modeled as a yield condition (yielding to the southbound Capital Boulevard traffic). Based on conversations with NCDOT, this methodology best represents field operations. The results for the minor street approaches reported in Table 6 is the delay experienced at the stop-controlled approaches.

In the absence of Synchro reported values for HCM LOS or delay for the remaining movements at the intersection, NCDOT indicated that SimTraffic queues may be used as a measure of operation. No notable problems were observed at the median intersections during SimTraffic simulations due to the addition of site traffic. The reported queue lengths that extend beyond the available full-width storage at project buildout for the southbound left-turn/U-turn lane and southbound right-turn lane also extend beyond the available full-width storage under no-build conditions. Therefore, the developer should not be responsible for lengthening the existing turn lanes.

It is important to note that SimTraffic capabilities can be limited in simulating field conditions. In some cases, such as with the southbound right-turn and left-turn movements, free-flow conditions are not

represented accurately due to the congested through movements along U.S. 1/Capital Boulevard. Therefore, reported queue lengths are likely overestimated.

Given the existing short stem length, the eastbound queue expected at project buildout may extend onto Country Club Drive. However, there is minimal opposing traffic to this queue and the intersection will be reconfigured with the construction of frontage roads when Capital Boulevard is upgraded to a controlled-access facility.

There are no roadway improvements recommended to accommodate project traffic at the intersection.

Table 6: Level-of-Service: US 1/Capital Boulevard at Country Club Drive/Templeridge Road (Unsignalized)

Condition	AM Peak		PM Peak	
	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)
2021 Existing	EBLR – C/20.0 WBLR – C/15.3	EBLR – 5'/36' WBLR – 8'/60' NBL/U – -'/39' NBR – -'/-' SBL/U – -'/18'	EBLR – C/18.7 WBLR – C/24.1	EBLR – 5'/57' WBLR – 5'/39' NBL/U – -'/41' NBR – -'/-' SBL/U – -'/42'
2027 No-Build	EBLR – D/31.7 WBLR – C/19.4	EBLR – 13'/150' WBLR – 13'/181' NBL/U – -'/109' NBR – -'/-' SBL/U – -'/530' SBR – -'/171'	EBLR – D/26.5 WBLR – E/42.4	EBLR – 10'/109' WBLR – 15'/72' NBL/U – -'/70' NBR – -'/-' SBL/U – -'/339' SBR – -'/129'
2027 Buildout	EBLR – F/71.1 WBLR – C/19.8	EBLR – 100'/178' WBLR – 13'/223' NBL/U – -'/253' NBR – -'/-' SBL/U – -'/529' SBR – -'/172'	EBLR – E/37.5 WBLR – E/45.3	EBLR – 43'/166' WBLR – 18'/136' NBL/U – -'/283' NBR – -'/-' SBL/U – -'/433' SBR – -'/176'

U.S. 1/Capital Boulevard at Jenkins Road/Stadium Drive

U.S. 1/Capital Boulevard at Jenkins Road/Stadium Drive is currently a signalized intersection. Existing signal plans and timing charts obtained from NCDOT were used for the 2021 analysis scenarios (minimum initial, maximum green, yellow and red time). The signal plan is included in the Appendix of this report. For future no-build and buildout scenarios, the following input values were used in accordance with NCDOT Congestion Management guidelines:

- Cycle length remained consistent with existing scenarios and splits were optimized for future scenarios.
- Left-turn treatment for exclusive left-turn lanes was set to protected only.
- Lost time set to 5 seconds, yellow time set to 5 seconds, and red time set to 2 seconds in future scenarios.
- Default values for vehicle extension and minimum gap were used.

Northbound Approach U.S. 1/Capital Blvd at Jenkins Road/Stadium Dr

Table 7 summarizes the capacity analysis results for the signalized intersection of U.S. 1/Capital Boulevard at Jenkins Road/Stadium Drive under 2021 existing, 2027 no-build, and 2027 buildout scenarios. As shown in Table 7 below, the intersection of U.S. 1/Capital Boulevard at Jenkins Road/Stadium Drive currently operates at LOS E during the AM peak hour and LOS D during the PM peak hour. The intersection is expected to operate at LOS F during the AM and PM peak hours under both the 2027 no-build and 2027 buildout conditions. The site traffic has minimal impacts on the delay experienced at the study intersection.

According to the guidelines published in NCDOT's *Policy on Street and Driveway Access to North Carolina Highways* (July 2003), mitigation improvements should be identified if the total average delay at the intersection or individual approach increases by 25% or more with the addition of the proposed development site trips. The total average delay at the intersection and individual approaches increases by less than 25% when comparing no-build conditions to buildout conditions, therefore, no roadway improvements are recommended to accommodate project traffic at the intersection.

Table 7: Level-of-Service: US 1/Capital Boulevard at Jenkins Road/Stadium Drive (Signalized)

Condition	AM Peak		PM Peak	
	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)	LOS and Delay (sec/veh)	Turn Lane Synchro 95% Queue Length/SimTraffic Max Queue Length (feet)
2021 Existing	Overall – E/60.7 EB – F/241.2 WB – E/66.9 NB – C/25.9 SB – D/49.4	EBL – 57'/264' WBL – 204'/258' NBL – 86'/171' NBR – 86'/292' SBL – 81'/304' SBR – 2'/106'	Overall – D/40.3 EB – F/116.4 WB – E/73.6 NB – D/40.9 SB – C/21.2	EBL – 70'/265' WBL – 106'/187' NBL – 233'/480' NBR – 84'/335' SBL – 117'/424' SBR – 5'/235'
2027 No-Build	Overall – F/112.7 EB – F/192.3 WB – F/143.1 NB – D/40.6 SB – F/144.6	EBL – 95'/264' WBL – 338'/386' NBL – 102'/480' NBR – 92'/335' SBL – 131'/425' SBR – 6'/235'	Overall – F/123.6 EB – F/187.5 WB – F/166.6 NB – F/156.5 SB – E/61.1	EBL – 152'/265' WBL – 159'/297' NBL – 426'/480' NBR – 57'/335' SBL – 246'/425' SBR – 8'/235'
2027 Buildout	Overall – F/124.0 EB – F/209.1 WB – F/141.5 NB – D/46.2 SB – F/161.0	EBL – 99'/265' WBL – 338'/386' NBL – 102'/480' NBR – 89'/335' SBL – 156'/425' SBR – 9'/192'	Overall – F/145.9 EB – F/187.4 WB – F/204.6 NB – F/192.5 SB – E/65.6	EBL – 176'/265' WBL – 159'/297' NBL – 438'/480' NBR – 57'/335' SBL – 247'/425' SBR – 7'/235'

The reported queue lengths that extend beyond the available full-width storage at project buildout for the westbound left-turn and the northbound left-turn also extend beyond the available full-width storage under no-build conditions. Therefore, the developer should not be responsible for lengthening the existing turn lanes. There are no improvements recommended at this intersection to accommodate project traffic.

It is important to note that this intersection will be reconfigured when Capital Boulevard is upgraded to a controlled-access facility. The traffic volumes at this intersection will instead be accommodated by a future service road.

RECOMMENDATIONS

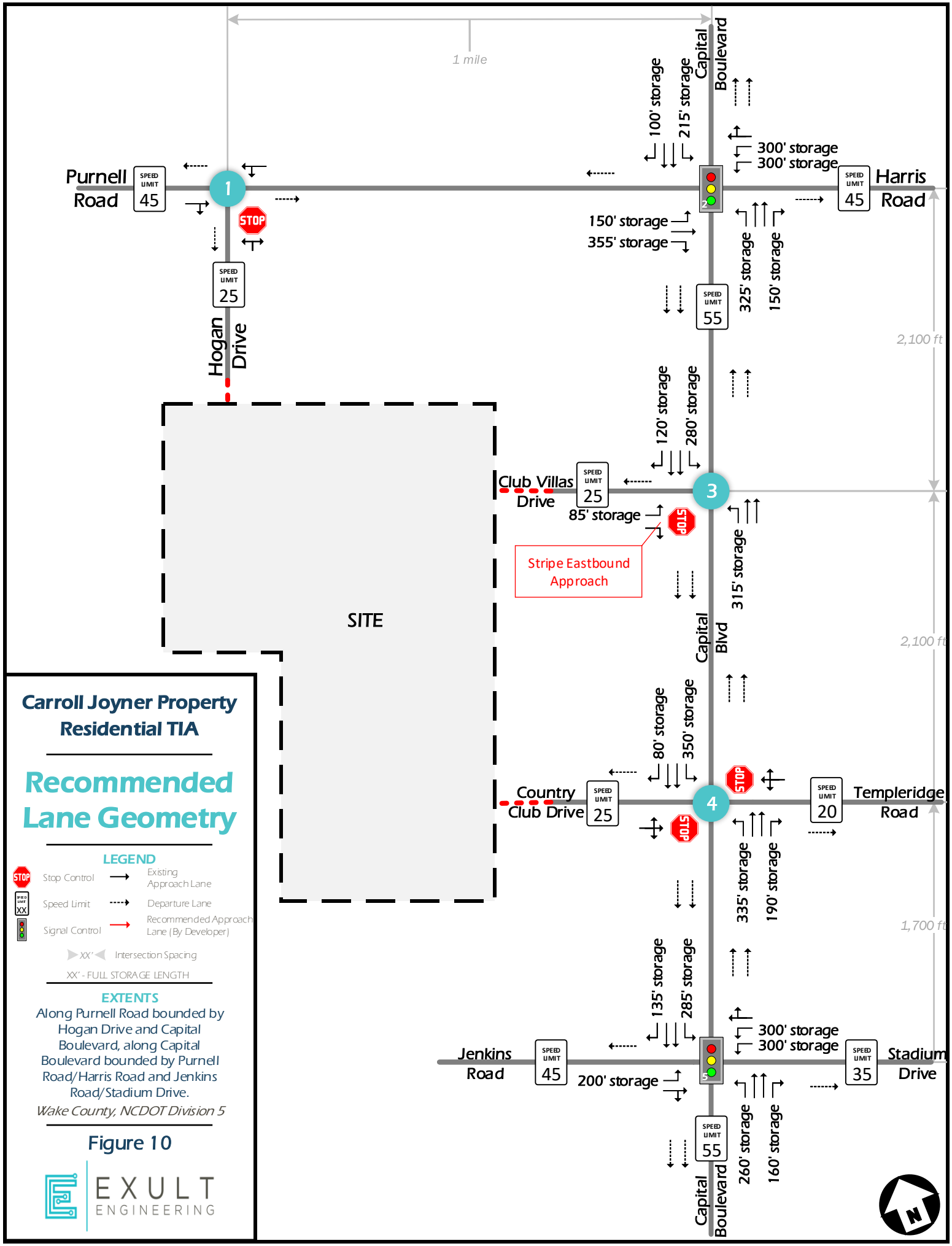
The recommended lane geometry is shown on Figure 10.

Based on the capacity analysis presented herein, the following roadway improvements are recommended to be completed **by the developer** to accommodate project traffic:

U.S. 1/Capital Boulevard at Club Villas Drive:

- Stripe the existing eastbound approach of Club Villas Drive to provide two egress lanes on the stem that exists between Capital Boulevard and Wake Union Church Road.

In addition to the improvement listed above, the Town of Wake Forest is requiring the developer to construct the service road along Capital Boulevard within the site in accordance with the Town of Wake Forest's *Comprehensive Transportation Plan*. The service road will provide connectivity when Capital Boulevard is upgraded to a controlled-access facility (NCDOT TIP# U-5307).



Carroll Joyner Property Residential TIA

Recommended Lane Geometry

LEGEND

- STOP — Stop Control
- SPEED LIMIT XX — Speed Limit
- Signal Control
- Existing Approach Lane
- Departure Lane
- Recommended Approach Lane (By Developer)
- ►XX'◄ Intersection Spacing

XX' - FULL STORAGE LENGTH

EXTENTS

Along Purnell Road bounded by Hogan Drive and Capital Boulevard, along Capital Boulevard bounded by Purnell Road/Harris Road and Jenkins Road/Stadium Drive.

Wake County, NCDOT Division 5

Figure 10

EXULT ENGINEERING