



# **HENRY CHAPEL RESIDENTIAL DEVELOPMENT**

Traffic Impact Analysis

Belmont, North Carolina

Prepared for:

**City of Belmont**

February 9, 2018

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**Traffic Impact Analysis for  
Henry Chapel Residential Development  
Belmont, North Carolina**

**Prepared for:**

**City of Belmont  
Belmont, North Carolina**

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## 1.0 Executive Summary

The purpose of this Traffic Impact Analysis (TIA) is to evaluate the vehicular traffic impacts on the surrounding transportation infrastructure as a result of the proposed Henry Chapel residential development. The primary objectives of the study are:

- To estimate trip generation and distribution for the proposed development.
- To perform intersection capacity analyses for the identified study area.
- To determine the potential traffic impacts of the proposed development.
- To develop recommendations to mitigate the proposed development's traffic impacts.

The proposed Henry Chapel development is located north of Henry Chapel Road and east of S Point Road (NC 273) in Belmont, North Carolina. Based on the site plan provided by the applicant, the proposed development is currently envisioned to consist of 628 single-family homes.

For the purposes of this TIA, the development is assumed to be completed (built-out) in 2025. Based on the provided site plan, the proposed development will be accessed via the following proposed access points:

- Driveway #1 (Timber Ridge Road) – A connection to Timber Ridge Road, which currently stubs to the east for a potential future connection; this connection would provide access to S Point Road (NC 273) by connecting to Colonial Drive then Forest Hill Road within the South Hill Estates development
- Driveway #2 – A full-movement, unsignalized driveway connection to Henry Chapel Road approximately 1,500 feet east of S Point Road (NC 273)
- Driveway #3 – A full-movement, unsignalized driveway connection to Henry Chapel Road approximately 1,200 feet east of Driveway #2

A TIA scoping meeting was held with the City of Belmont, North Carolina Department of Transportation (NCDOT) and representatives of the applicant in Belmont on November 28, 2017, to obtain background information and to ascertain the scope and parameters to be included in this TIA. A Memorandum of Understanding (MOU) was developed based on discussions from this meeting that documented all scoping parameters to be used for the TIA and was reviewed and agreed upon by the City of Belmont, NCDOT and the applicant. The approved MOU is included in the **Appendix**.

The following AM and PM peak-hour scenarios were analyzed to determine the proposed development's transportation impacts on the surrounding network:

- 2017 Existing Conditions
- 2025 Background Conditions
- 2025 Build-out Conditions
- 2030 Build-out Conditions + 5 years

Based on coordination with the applicant and agencies at the TIA scoping meeting, this TIA evaluated operations under each of the AM and PM peak-hour scenarios above for the following study area intersections:

1. S Point Road (NC 273) and Armstrong Road (NC 273)
2. S Point Road (NC 273) and Henry Chapel Road
3. S Point Road (NC 273) and Forest Hill Road

4. Forest Hill Road and Colonial Drive
5. Colonial Drive and Timber Ridge Road/Driveway #1
6. S Point Road (NC 273) and Stowe Road/McKee Farm Lane
7. S Point Road (NC 273) and South Point High School/Red Raider Run
8. S Point Road (NC 273) and R L Stowe Road/Nixon Road
9. Henry Chapel Road and Driveway #2 (build-out only)
10. Henry Chapel Road and Driveway #3 (build-out only)

Note that proposed Driveway #1 is shown on the provided site plan to connect to Timber Ridge Road, which currently stubs to the east. Timber Ridge Road is a narrow residential street within the South Hill Estates neighborhood. From Timber Ridge Road, a driver must then access Colonial Drive and then Forest Hill Drive to access S Point Road (NC 273). This access to S Point Road (NC 273) was initially proposed by the applicant to remain full-movement (as it exists) and install a traffic signal if warrants were met. However, with this being the most northern (and for most drivers, first) access from S Point Road (NC 273), if both Forest Hill Road and Henry Chapel Road intersections were signalized, the majority of traffic would likely utilize the Forest Hill Road access. This would promote heavy traffic associated with the Henry Chapel development through the South Hill Estates neighborhood. Given the context of this neighborhood and through coordination with City of Belmont staff, an unsignalized left-over access at Forest Hill Road was requested to be evaluated, with the intent to promote the majority of traffic to instead utilize the proposed signalized, full-movement access at Henry Chapel Road.

Kimley-Horn was retained to determine the potential traffic impacts of this development (in accordance with the traffic study guidelines in the *NCDOT Policy on Street and Driveway Access to North Carolina Highways* and set forth by the *City of Belmont Land Development Code – Section 16.14 Traffic Impact Analysis*), and to identify transportation improvements that may be required to mitigate these impacts. This report presents trip generation, distribution, capacity analyses, crash analyses and recommendations for transportation improvements required to mitigate anticipated traffic demands produced by the subject development.

Based on the capacity analyses performed at each of the identified study intersections, along with review of auxiliary turn-lane warrants, signal warrants and crash analyses contained herein, the following improvements are recommended to mitigate the impact of the proposed development on the adjacent street network:

**S Point Road (NC 273) and Armstrong Road (NC 273)**

- Southbound right-turn bypass lane along S Point Road (NC 273) with a minimum of 100' of storage

**S Point Road (NC 273) and Henry Chapel Road**

- Installation of a traffic signal upon meeting applicable MUTCD warrants
- Southbound left-turn lane along S Point Road (NC 273) that serves as a drop lane at Henry Chapel Road extending from R L Stowe Road
- Westbound right-turn lane along Henry Chapel Road with a minimum of 200' of storage
- Additional northbound through lane along S Point Road (NC 273) that provides a minimum of 400' of storage and extends north to drop as a right-turn lane at R L Stowe Road

**S Point Road (NC 273) and Forest Hill Road**

- Modify access control to provide southbound and northbound left-over access, restricting side-street left and through movements
- Southbound left-turn lane along S Point Road (NC 273) with a minimum of 100' of storage
- Northbound left-turn lane along S Point Road (NC 273) with a minimum of 50' of storage
- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

**S Point Road (NC 273) and Stowe Road/McKee Farm Road**

- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

**S Point Road (NC 273) and South Point High School/Red Raider Run**

- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

**S Point Road (NC 273) and R L Stowe Road/Nixon Road**

- Widen the westbound approach of R L Stowe Road to include dual left-turn lanes with a shared through/right-turn lane; shared through/right-turn lane to include a minimum of 275' of storage
- Additional receiving lane southbound along S Point Road (NC 273) that drops as a southbound left-turn lane at the proposed traffic signal at Henry Chapel Road
- Extend the existing northbound right-turn lane along S Point Road (NC 273) to 400 feet south of Henry Chapel Road to serve as the additional northbound through lane along S Point Road (NC 273) and drop as the right-turn lane at R L Stowe Road

**Henry Chapel Road and Driveway #2**

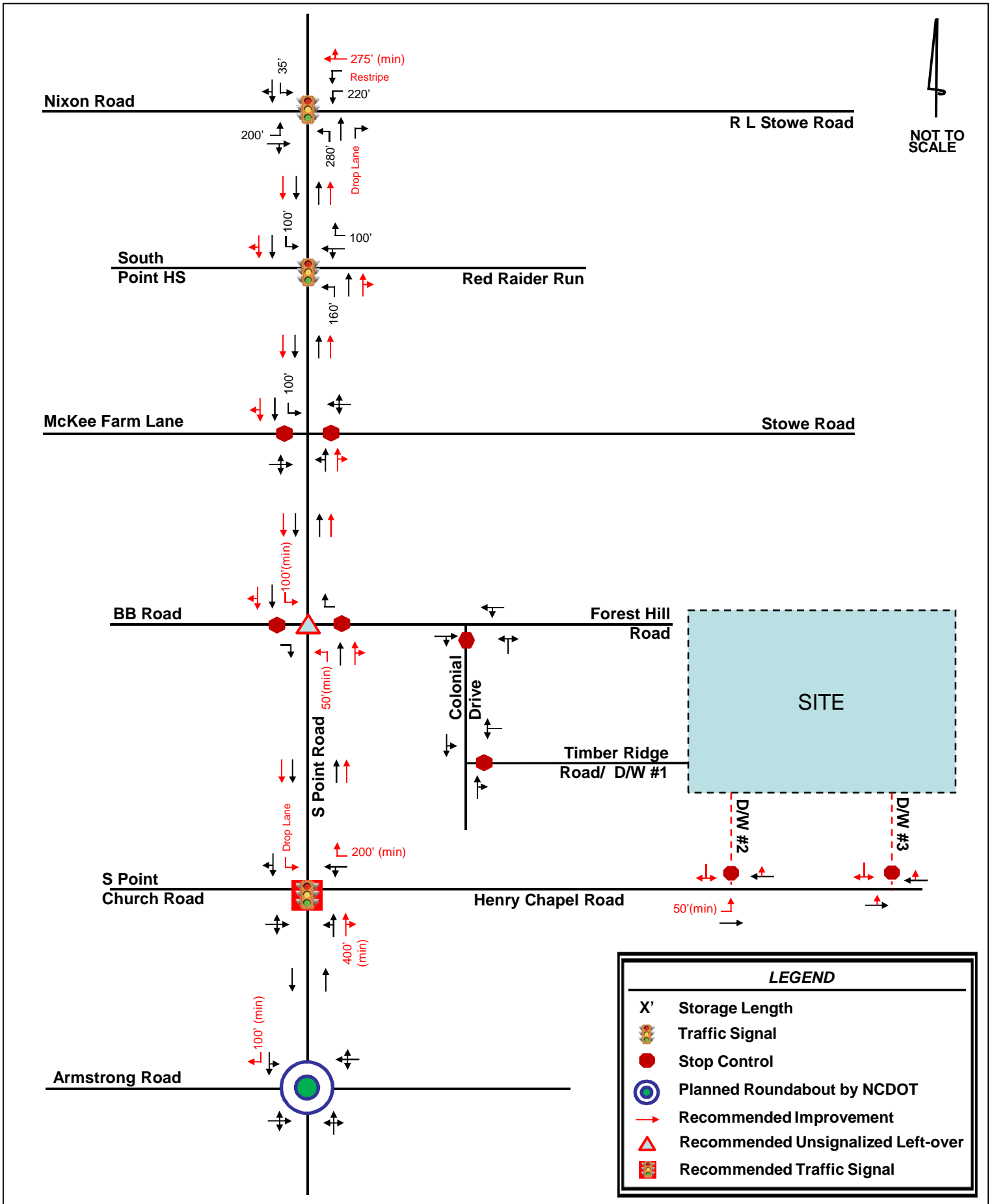
- Eastbound left-turn lane along Henry Chapel Road with a minimum storage length of 50'
- Single southbound egress and single ingress lane along Driveway #2

**Henry Chapel Road and Driveway #3**

- Single southbound egress and single ingress lane along Driveway #3

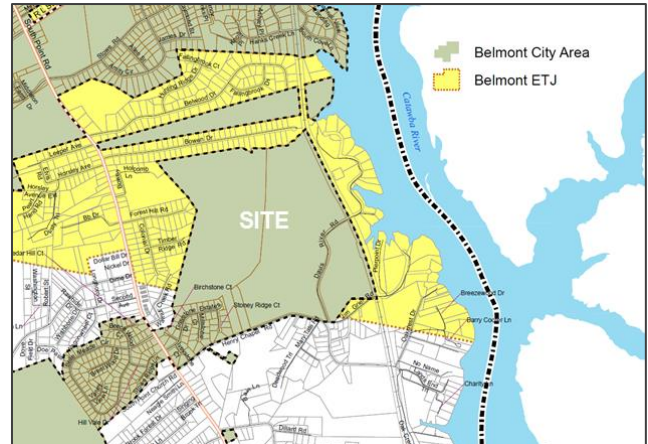
The recommended improvements within the study area are shown in **Figure 1.1**. The recommendations shown on this figure are subject to approval by NCDOT and the City of Belmont. All additions and attachments to the State and City roadway system shall be properly permitted, designed and constructed in conformance to standards maintained by the agencies.





## 2.0 Introduction

The proposed Henry Chapel development is located north of Henry Chapel Road and east of S Point Road (NC 273) in Belmont, North Carolina, as shown to the right. Based on the site plan provided by the applicant, the proposed development is currently envisioned to consist of 628 single-family homes. For the purposes of this TIA, the development is assumed to be completed (built-out) in 2025. Based on the provided site plan, the proposed development will be accessed via the following proposed access points:



- Driveway #1 (Timber Ridge Road) – A connection to Timber Ridge Road, which currently stubs to the east for a potential future connection; this connection would provide access to S Point Road (NC 273) by connecting to Colonial Drive then Forest Hill Road within the South Hill Estates development
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Kimley-Horn was retained to determine the potential traffic impacts of this development (in accordance with the traffic study guidelines in the *NCDOT Policy on Street and Driveway Access to North Carolina Highways* and set forth by the *City of Belmont Land Development Code – Section 16.14 Traffic Impact Analysis*), and to identify transportation improvements that may be required to mitigate these impacts. This report presents trip generation, distribution, capacity analyses, turn-lane and signal warrant analyses, crash analyses and recommendations for transportation improvements required to mitigate anticipated traffic demands produced by the subject development.

### 3.0 Existing Traffic Conditions

Existing traffic conditions were coordinated with City of Belmont and NCDOT staff and collected through field observations and turning-movement counts to establish the existing conditions baseline analysis.

#### 3.1 STUDY AREA

Based on coordination with City and NCDOT staff, the study area for this TIA includes the following existing intersections:

1. S Point Road (NC 273) and Armstrong Road (NC 273)
2. S Point Road (NC 273) and Henry Chapel Road
3. S Point Road (NC 273) and Forest Hill Road
4. Forest Hill Road and Colonial Drive
5. Colonial Drive and Timber Ridge Road
6. S Point Road (NC 273) and Stowe Road/McKee Farm Lane
7. S Point Road (NC 273) and South Point High School/Red Raider Run
8. S Point Road (NC 273) and R L Stowe Road/Nixon Road

**Figure 3.1** shows the study area intersections and the site location, **Figure 3.2** shows the proposed site plan for the development as provided by the applicant and **Figure 3.3** shows the existing roadway geometry at the study intersections.

The primary roadways in the vicinity of the site are S Point Road (NC 273), Armstrong Road (NC 273), R L Stowe Road, Nixon Road, Stowe Road, and Henry Chapel Road.

S Point Road (NC 273) is a two-lane, undivided minor arterial with intermittent turn lanes throughout the study area, with a speed of 45 mph south of Stowe Road and 35 mph north of Stowe Road. S Point Road (NC 273) serves as the primary north/south route along the peninsula formed between the Catawba River and South Fork River where portions of Belmont and Gaston County exists. This route serves both North Carolina and South Carolina commuters via a bridged connection to York County, South Carolina. S Point Road (NC 273) carries an average daily traffic (ADT) volume of 8,300 vehicles per day (vpd) south of Henry Chapel Road, 12,000 vpd just north of Forest Hill Road and 16,000 vpd just south of R L Stowe Road based on the NCDOT ADT maps. During the AM peak hour, the traffic flow is heavily distributed northbound towards I-85, Belmont, Charlotte and Gastonia, and the heavy southbound flow is experienced during the PM peak hour.

Armstrong Road (NC 273) is a two-lane, undivided minor arterial running east-west and connects S Point Road (NC 273) to NC 279, a primary connection into York County, South Carolina. Armstrong Road (NC 273) has a speed limit of 45 mph and an ADT volume 6,000 vpd based on NCDOT ADT maps.

R L Stowe Road is a two-lane local road that connects S Point Road (NC 273) to Keener Boulevard (NC 273). R L Stowe Road has a speed limit of 45 mph and a 2016 ADT volume of 9,600 vpd east of S Point Road (NC 273).

Nixon Road is a two-lane, undivided local road that primarily carries residential traffic and school traffic to-and-from South Point High School. Nixon Road has a speed limit of 25 mph and a 2016 ADT volume of 3,400 vpd west of S Point Road (NC 273).

Stowe Road and Henry Chapel Road are both two-lane, undivided local roads that primarily carry residential traffic. Stowe Road and Henry Chapel Road both have posted speed limits of 35 mph. NCDOT reported a 2016 ADT volume of 630 vpd on Henry Chapel Road, while no available ADT volume data is available for Stowe Road.

### 3.2 EXISTING TRAFFIC VOLUME DEVELOPMENT

AM (6:30-8:30 AM) and PM (2:30-7:00 PM) intersection turning-movement, heavy-vehicle, pedestrian and bicycle counts were performed by National Data & Surveying Services on Wednesday, December 13, 2017, at the following intersections:

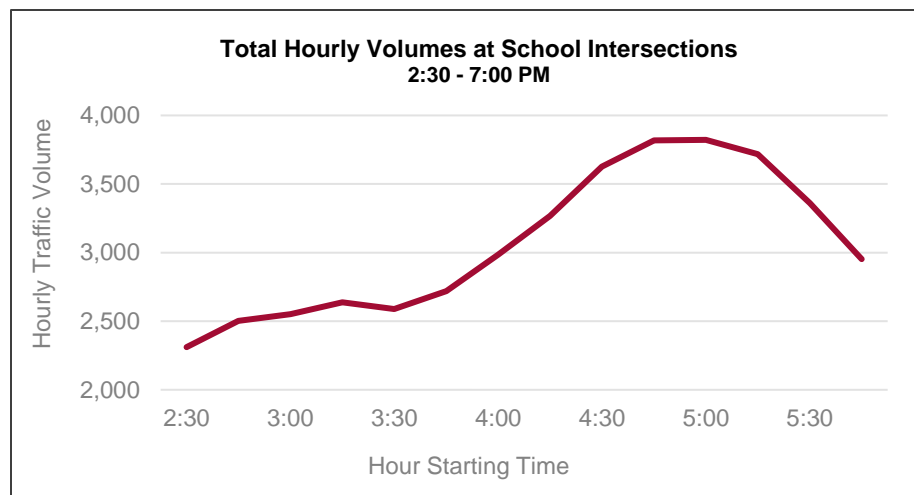
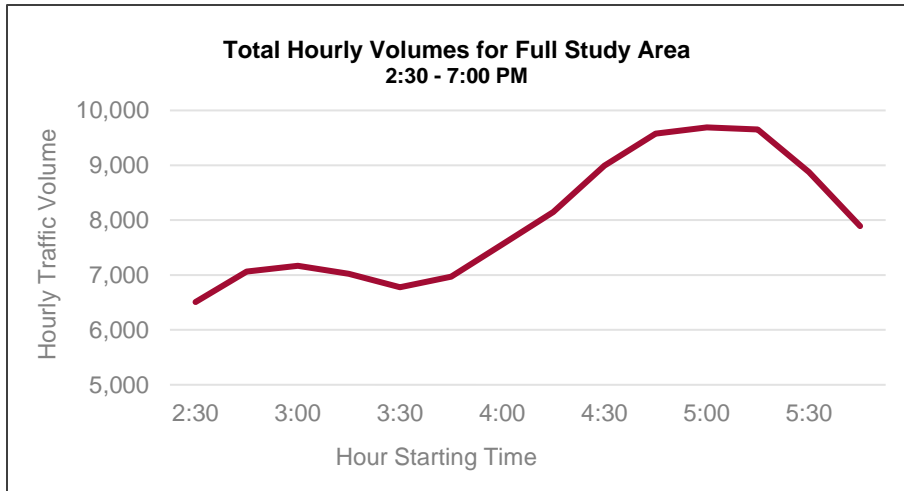
1. S Point Road (NC 273) and Armstrong Road (NC 273)
2. S Point Road (NC 273) and Henry Chapel Road
3. S Point Road (NC 273) and Forest Hill Road
4. Forest Hill Road and Colonial Drive
5. Colonial Drive and Timber Ridge Road
6. S Point Road (NC 273) and Stowe Road/McKee Farm Lane
7. S Point Road (NC 273) and South Point High School/Red Raider Run
8. S Point Road (NC 273) and R L Stowe Road/Nixon Road

The specific AM and PM peak hours identified through the data collection differed amongst some of the study intersections. The peak hour of each individual intersection was used as the baseline data to represent the highest collected traffic volumes within the specified count timeframes, and were then balanced up between intersections. The peak hours for each of the intersections are shown in **Table 3.1**.

**Table 3.1 – AM & PM Intersection Peak Hours**

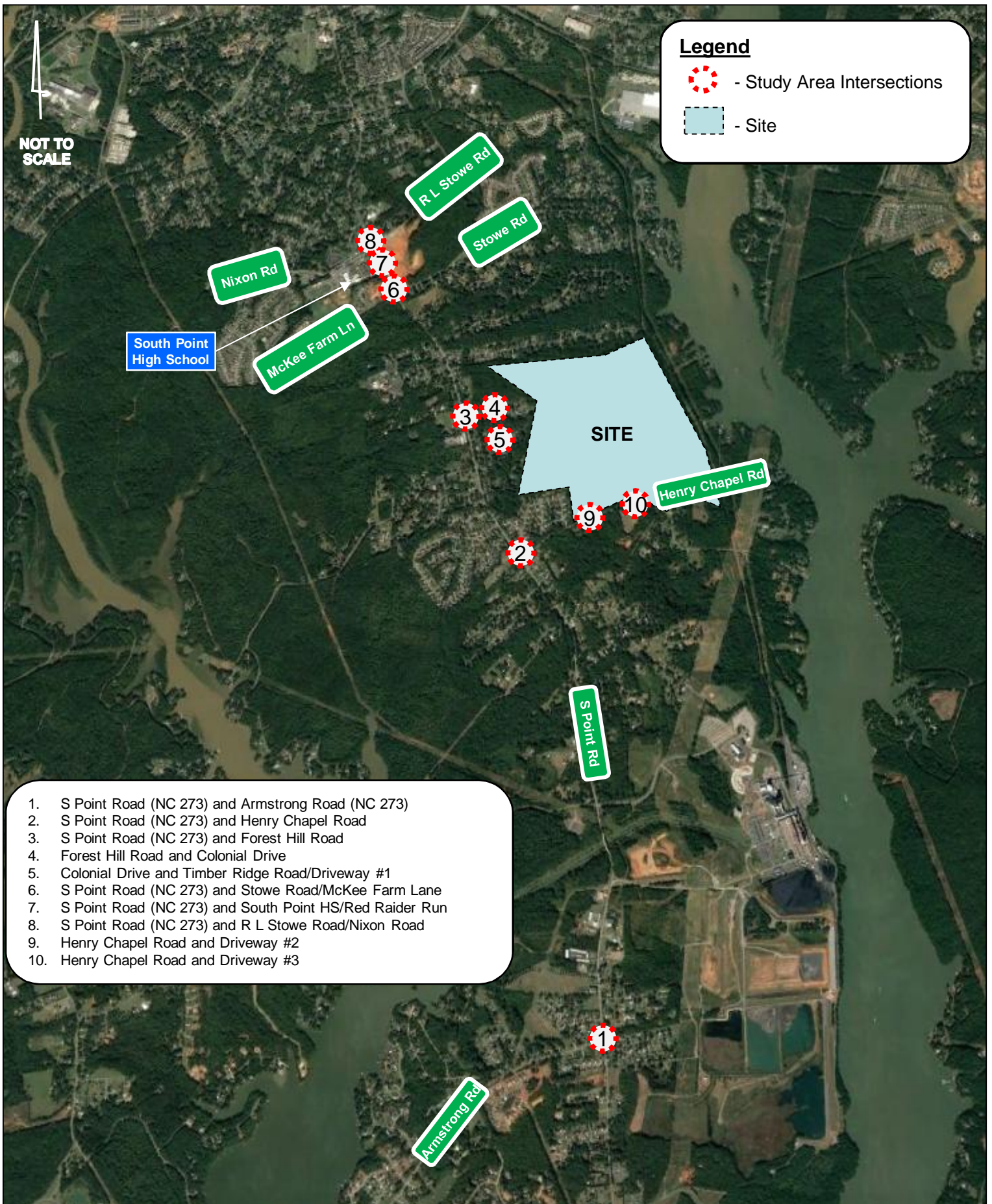
| Intersection                            | AM Peak Hour      | PM Peak Hour      |
|---|-------------------|-------------------|
| 1. S Point Rd and Armstrong Rd          | 7:00 AM - 8:00 AM | 4:45 PM - 5:45 PM |
| 2. S Point Rd and Henry Chapel Rd       | 7:00 AM - 8:00 AM | 5:00 PM - 6:00 PM |
| 3. S Point Rd and Forest Hill Rd        | 7:00 AM - 8:00 AM | 4:45 PM - 5:45 PM |
| 4. Forest Hill Rd and Colonial Dr       | 7:00 AM - 8:00 AM | 5:15 PM - 6:15 PM |
| 5. Colonial Dr and Timber Ridge Rd      | 6:30 AM - 7:30 AM | 4:30 PM - 5:30 PM |
| 6. S Point Rd and Stowe Rd/McKee Farm   | 7:00 AM - 8:00 AM | 5:15 PM - 6:15 PM |
| 7. S Point Rd and S Point HS/Red Raider | 7:00 AM - 8:00 AM | 5:15 PM - 6:15 PM |
| 8. S Point Rd and R L Stowe Rd/Nixon Rd | 7:15 AM - 8:15 AM | 5:15 PM - 6:15 PM |

The graphs on the following page show the hourly variations of total traffic volumes collected within the study area (graph on the left) during the 2:30 – 7:00 PM timeframe along with the total traffic volumes collected at only the intersections near South Point High School, intersections 6-8 (graph on the right).

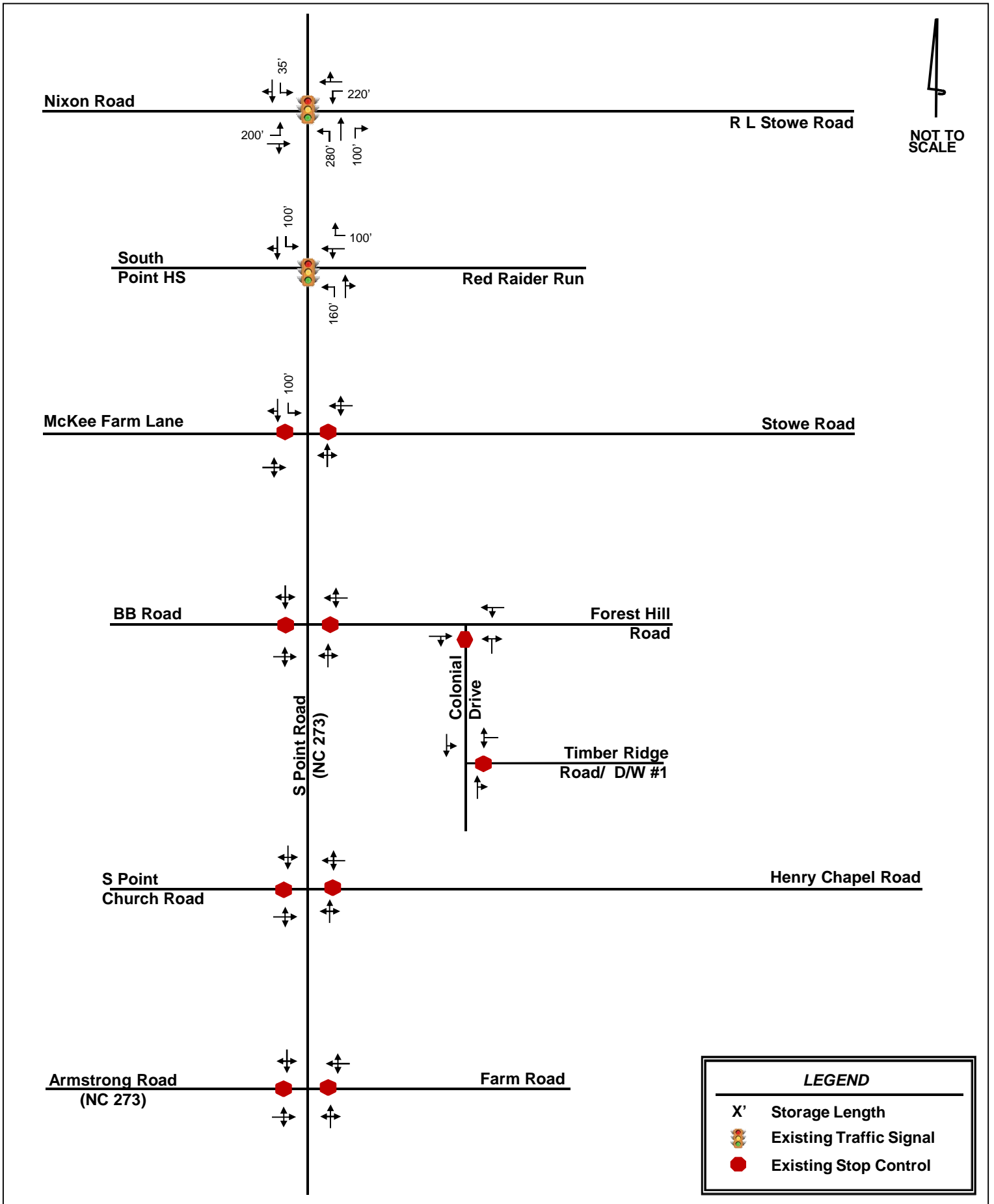


Volume balancing was performed between study area intersections where reasonable. No volume balancing was performed along S Point Road (NC 273) between the Armstrong Road (NC 273), Henry Chapel Road, Forest Hill Road, and Stowe Road intersections due to the spacing of the intersections and the presence of residential and other driveways between these locations. Peak-hour intersection turning-movement count data is provided in the **Appendix**.

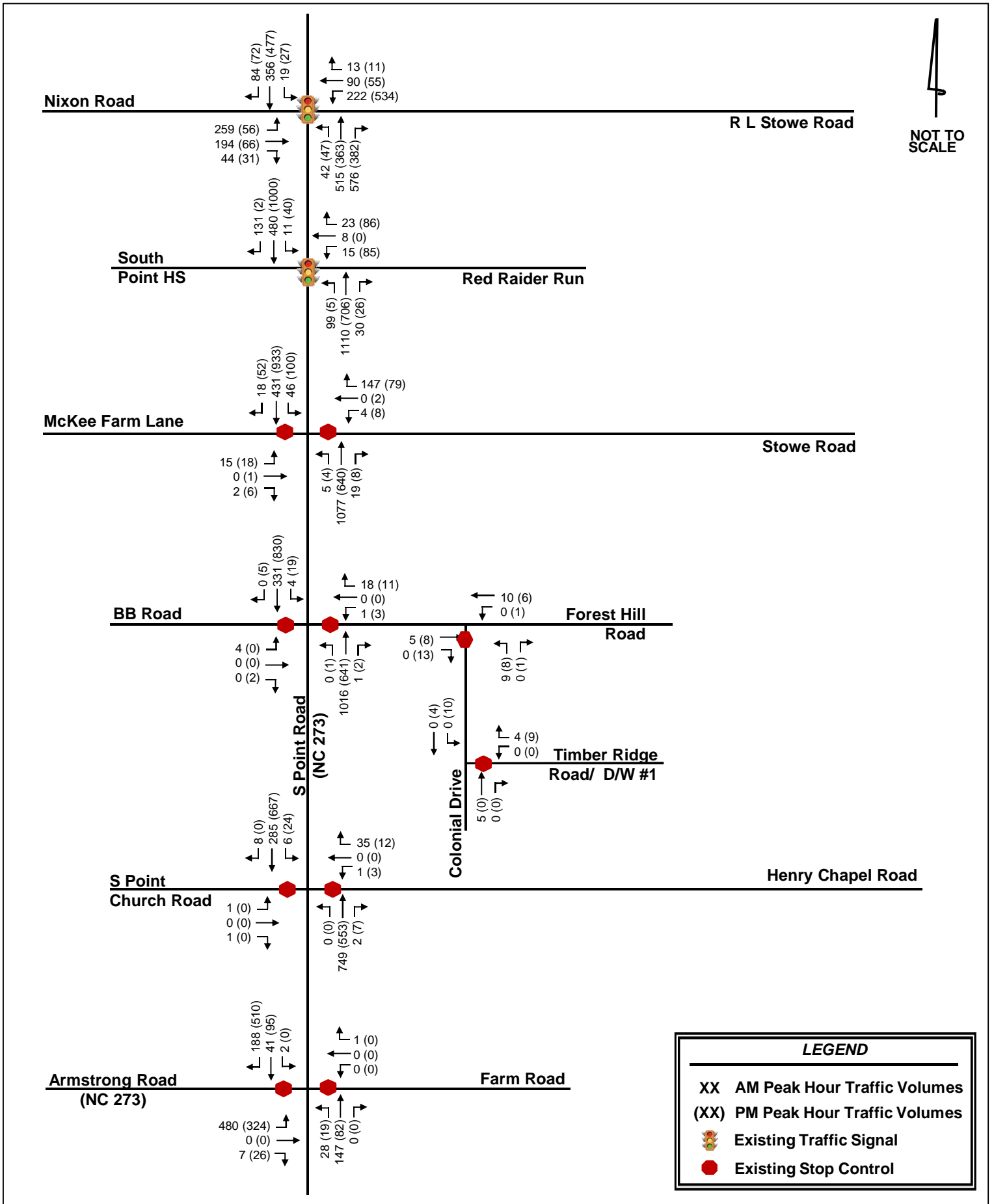
**Figure 3.4** illustrates the 2017 existing AM and PM peak-hour traffic volumes.











## 4.0 Background Traffic Volume Development

Projected background (non-project) traffic is defined as the expected growth or change in traffic volumes on the surrounding roadway network between the year the existing counts were collected (2017) and the expected build-out year (2025) absent the construction and opening of the proposed project. This includes both non-specific general growth based on historical increase in local traffic volumes (historical background growth), along with specific growth and/or change in traffic volumes caused by either approved, but not yet fully-constructed, off-site developments and/or planned transportation projects specifically identified within the vicinity of the proposed development.

### 4.1 HISTORICAL BACKGROUND GROWTH TRAFFIC

Historical background growth is the increase in existing traffic volumes due to usage increases and non-specific growth throughout the area, and accounts for growth that is independent of specific off-site developments or planned transportation projects. Historical background growth traffic is calculated using an annual growth rate, which is applied to the existing traffic volumes up to the future horizon years. As shown in the approved MOU, an annual growth rate of four percent (4%) was applied to the 2017 existing peak-hour traffic volumes to calculate base 2025 and 2030 background traffic volumes. This growth rate was determined based on review of historical NCDOT ADT maps, specifically along S Point Road (NC 273), in coordination with NCDOT and City of Belmont staff.

The southern portion of Belmont is uniquely situated along a peninsula formed between the Catawba River and South Fork River, where S Point Road (NC 273) serves as the only north/south collector route along the peninsula. Therefore, as the southern portion of the peninsula has developed, and continues to develop, most, if not all, generated traffic is forced to use S Point Road (NC 273). Additionally, this route also serves South Carolina commuters via a bridged connection to York County, South Carolina. The upper state of South Carolina, and in particular York County, has experienced tremendous growth over the past decade, specifically new residential developments bringing in new residents looking to commute to Charlotte for work. The impacts of this growth are felt in Belmont and Gaston County and along S Point Road (NC 273). Based on NCDOT ADT maps, S Point Road (NC 273) has experienced 7.7% annual growth between 2012 and 2016 south of the proposed site near Plant Allen Road, and 4.5% annual growth between the same timeframe just north of the site near Bowen Road. Considering that this study also includes growth from four specific approved developments (described in Section 4.2), the non-specific annual growth rate determined and agreed to be used to calculate base 2025 and 2030 background traffic volumes was slightly lower at 4% per year.

It is important to note that this growth rate was not applied to the South Hill Estates development, which includes Forest Hill Road, Colonial Drive and Timber Ridge Road, since this neighborhood is considered to be nearly, if not fully, built-out.

### 4.2 APPROVED DEVELOPMENTS

At the direction of the City of Belmont and NCDOT, four approved developments that are expected to impact traffic volumes within the study area were included in the background traffic volumes for this TIA. These developments, land uses and intensities, and build-out percentages are outlined in **Table 4.1**. The table also identifies which of these developments has an associated TIA, and the improvements required by these respective developments.

**Table 4.1 – Approved Developments**

| Development                            | Land Use/Intensity  | % Build-out                   | TIA Included? | Required Improvements   |
|--|---|-------------------------------|---------------|---|
| Amberlee<br>(Nixon Rd)                 | 164 Single-Family units   | 0%                            | No            | No required improvements at study intersections.<br>(widening Nixon Rd west of S. Point Rd)   |
| Rivermist<br>(N of Bowen Rd)           | 86 Single-Family units  | 0%                            | No            | No required improvements at study intersections.<br>(SBL on S Point Rd at site drive)   |
| McLean<br>(Armstrong Rd)               | 810 Single-Family units<br>100 Multifamily units<br>125,000 SF Shopping Center  | 10%                           | Yes           | No required improvements at study intersections.  |
| Belmont Town Center<br>(N of Stowe Rd) | 16 Single-Family units<br>92 Townhome units<br>27,800 SF General Office<br>21,600 SF Shopping Center<br>53,000 SF Supermarket<br>4,330 SF Fast Food Restaurant<br>14 FP Gas Station | 60%<br>(of approved trip gen) | Yes           | <ul style="list-style-type: none"> <li>- Construct new connection between R L Stowe Road and Stowe Road</li> <li>-At S Point Rd/R L Stowe Rd/Nixon Rd: <ul style="list-style-type: none"> <li>- Reduce NBL storage to 280'</li> </ul> </li> <li>-At S Point Road and South Point HS D/W <ul style="list-style-type: none"> <li>- Install a traffic signal at entrance to HS</li> <li>- Construct NBL w/ ~175'</li> <li>- Construct SBL w/ ~100'</li> <li>- Construct WBT/R and WBR</li> </ul> </li> </ul> |

Based on discussions with the City of Belmont and NCDOT, a middle school is proposed south of South Point High School; however, this school has not been approved, and a TIA will be required prior to approval. Therefore, the school was not included in this TIA as an approved development.

There was no TIA required for the Amberlee and Rivermist residential developments. Therefore, a trip generation analysis was performed using the trip generation rates published in *Trip Generation* (Institute of Transportation Engineers, Tenth Edition, 2017). Given the similar land use between these residential approved developments and the proposed Henry Chapel development, these trips were assigned to the network based on a similar trip distribution as approved in the MOU.

Volumes for the McLean and Belmont Town Center developments were obtained from the *Hope Armstrong Peninsula Development TIA* (J.M. Teague, May 2014) and the *Belmont Town Center Revised TIA* (Ramey Kemp, July 2015), respectively. The existing turning-movement splits were used to carry and assign volumes appropriately at study area intersections that were not included in the approved TIAs.

Required and planned as part of the Belmont Town Center, a new roadway connection will be constructed between Stowe Road and R L Stowe Road east of the existing Harris Teeter. This connection is expected to provide benefit to the S Point Road (NC 273) intersections with both Stowe Road and R L Stowe Road by allowing the residential traffic east along Stowe Road to utilize this connection to access R L Stowe Road without accessing S Point Road (NC 273). Reassignment percentages of background traffic were obtained from the *Belmont Town Center Revised TIA* (Ramey Kemp, July 2015) and applied to the 2025 background volumes. These calculations are provided in the **Appendix**.

It should be noted that some of the improvements required of the identified approved developments (and listed in both the MOU and **Table 4.1**) were not included as modifications between 2017 existing and 2025 background conditions as these have already been constructed since the time the respective TIA was approved and are reflected as existing laneage in this study.

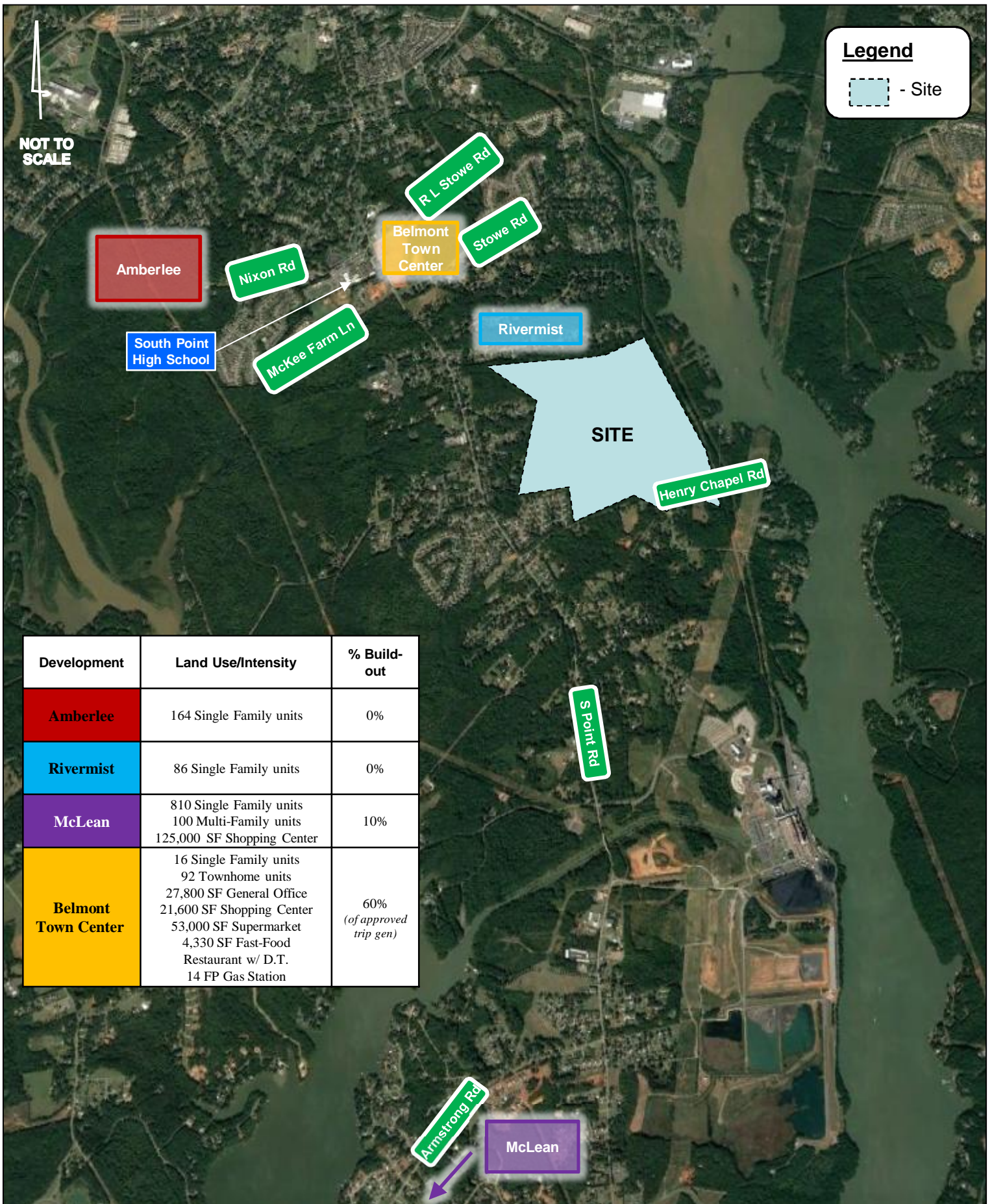
**Figure 4.1** helps illustrate the location of each of these four approved developments. Approved development calculations are also provided in the **Appendix**. **Figures 4.2** and **4.3** show the

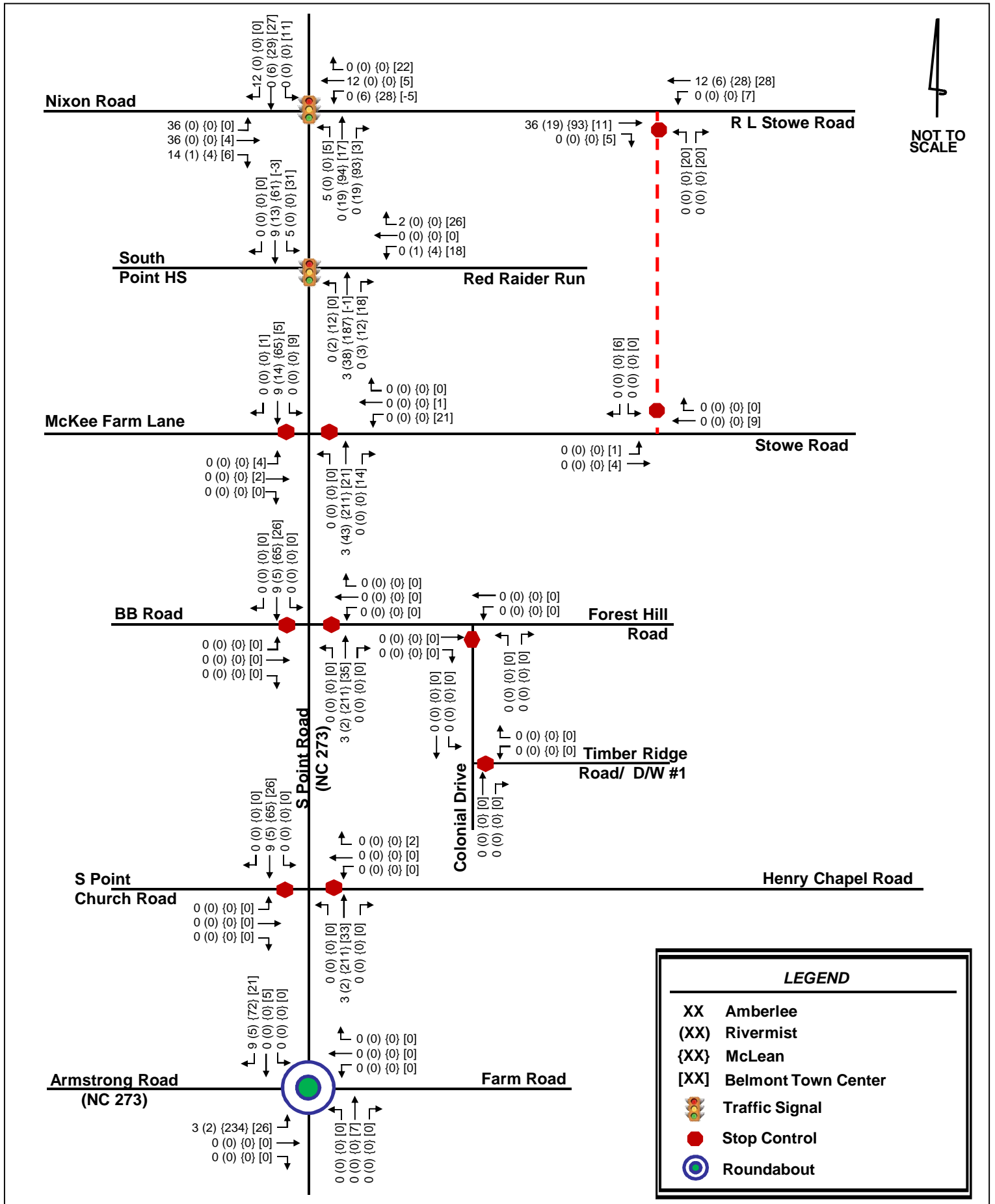
breakdown of AM and PM peak-hour approved development trips, respectively, added to the background traffic volumes at the study area intersections.

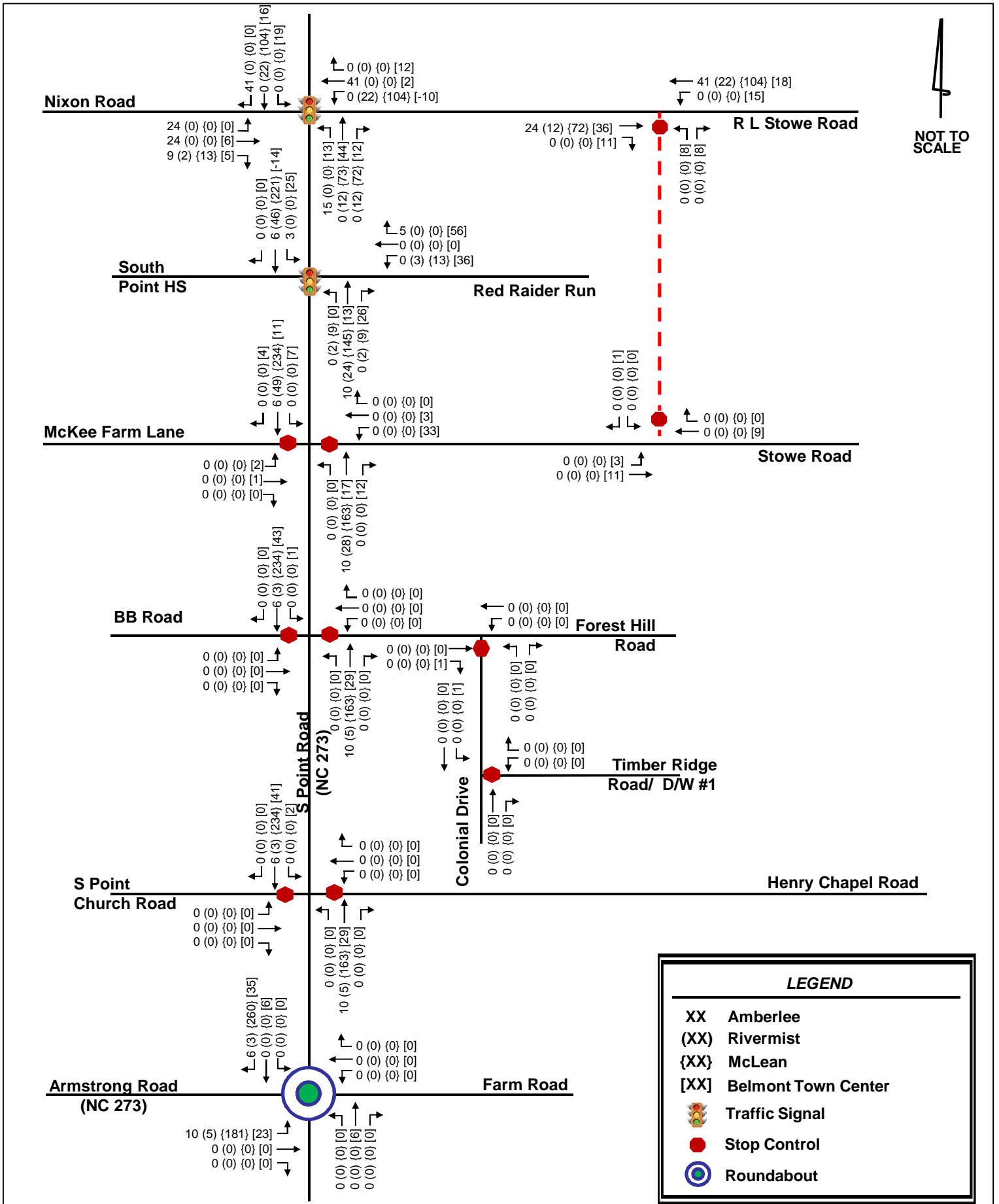
### 4.3 PLANNED TRANSPORTATION PROJECTS

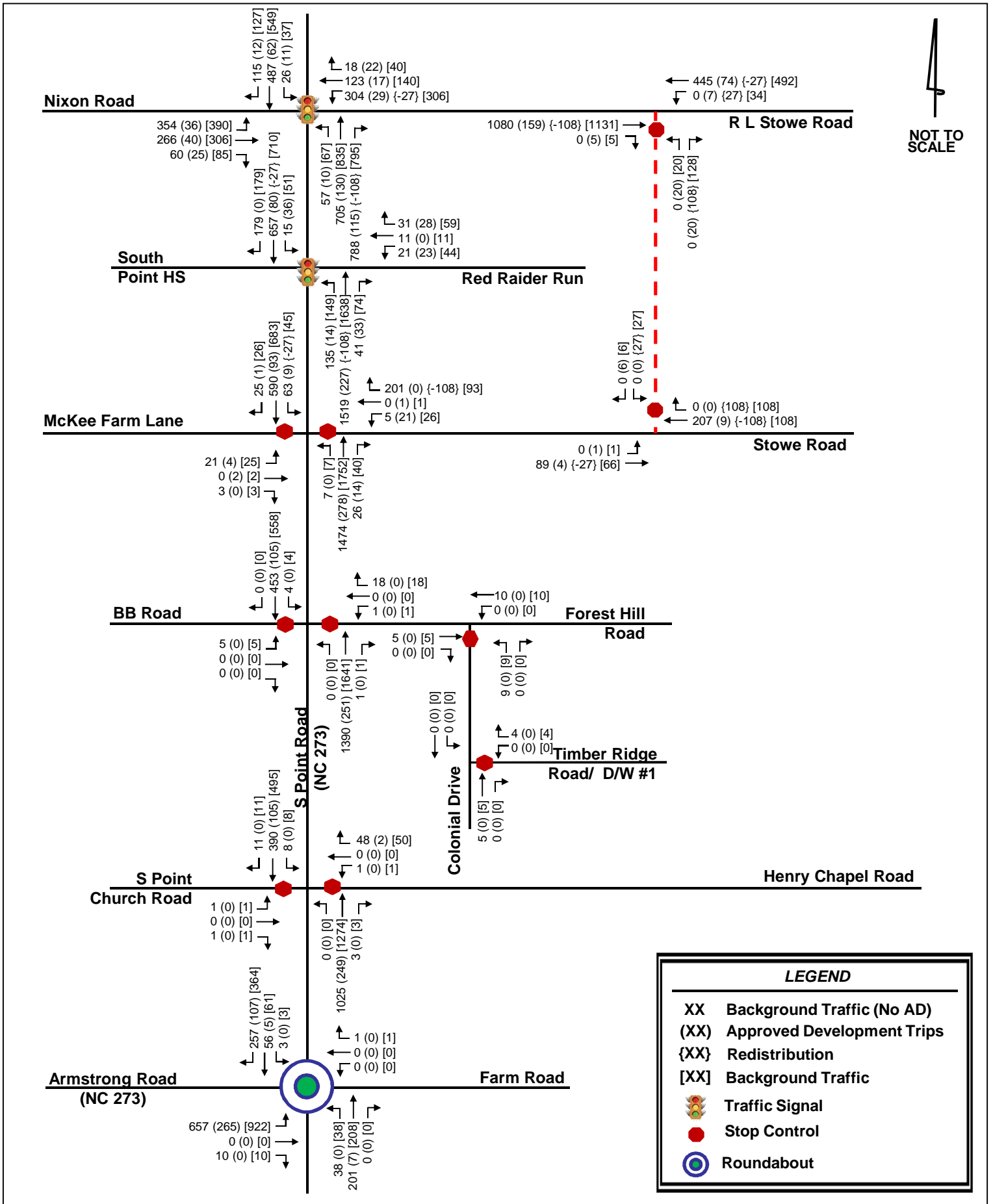
Based on discussions with NCDOT, the currently unsignalized intersection of S Point Road (NC 273) at Armstrong Road (NC 273) is planned to be converted to a single-lane roundabout. This project is currently seeking funding for design and construction. Given this, NCDOT requested that this intersection be analyzed as a roundabout in future conditions.

**Figures 4.4** and **4.5** show the 2025 background AM and PM peak-hour traffic volumes, respectively, that include the historical growth traffic and approved development trips.

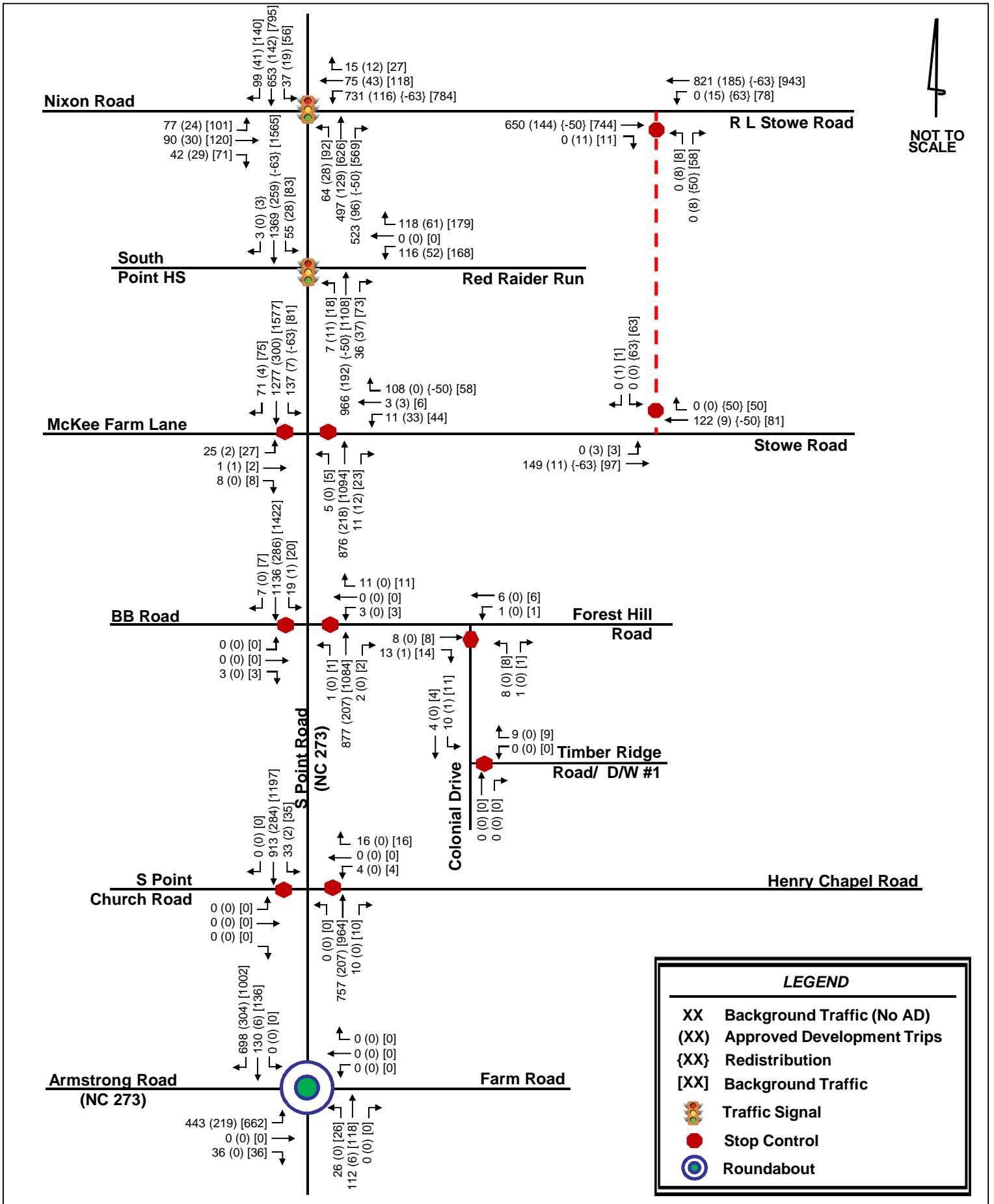












## 5.0 Site Traffic Volume Development

Site traffic developed for this TIA is defined as the vehicle trips expected to be generated and added to the study area by construction of the proposed development, and the distribution and assignment of that traffic throughout the surrounding network.

### 5.1 SITE ACCESS

Based on the provided site plan, the proposed development will be accessed via the following proposed access points:

- Driveway #1 (Timber Ridge Road) – A connection to Timber Ridge Road, which currently stubs to the east for a potential future connection; this connection would provide access to S Point Road (NC 273) by connecting to Colonial Drive then Forest Hill Road within the South Hill Estates development
- Driveway #2 – A full-movement, unsignalized driveway connection to Henry Chapel Road approximately 1,500 feet east of S Point Road (NC 273)
- Driveway #3 – A full-movement, unsignalized driveway connection to Henry Chapel Road approximately 1,200 feet east of Driveway #2

Note that proposed Driveway #1 is shown on the site plan to connect to Timber Ridge Road, which currently stubs to the east. Timber Ridge Road is a narrow residential street within the South Hill Estates neighborhood. From Timber Ridge Road, a driver must then access Colonial Drive and then Forest Hill Drive to access S Point Road (NC 273) as shown in the image on the right. This access to S Point Road (NC 273) was initially proposed to remain full-movement (as it exists) and become signalized if warrants were met. However, with this being the most northern (and for most drivers, first) access from S Point Road (NC 273), if both Forest Hill Road and Henry Chapel Road intersections were signalized, the majority of traffic would likely utilize the Forest Hill Road access. This would promote heavy traffic associated with the Henry Chapel development through the South Hill Estates neighborhood. Given the context of this neighborhood and through coordination with City of Belmont staff, an unsignalized left-over access at Forest Hill Road was requested to be evaluated, with the intent to promote the majority of traffic to instead utilize the proposed signalized, full-movement access at Henry Chapel Road.



This TIA evaluated both the full-movement and left-over alternatives at Forest Hill Road, impacting the traffic assignment and operations within the immediate vicinity of the site. Section 6 describes these analyses in more detail.

**5.2 TRAFFIC GENERATION**

The traffic generation potential of the proposed development was determined using the trip generation rates published in *Trip Generation* (Institute of Transportation Engineers, Tenth Edition, 2017) for all land uses.

Based on the site plan provided by the applicant, the proposed development is envisioned to include 628 single-family homes.

**Table 5.1** summarizes the projected trip generation for the proposed residential development. During a typical weekday, the proposed development has the potential to generate 465 and 622 net new external trips during the AM and PM peak hours, respectively.

| Table 5.1 - Trip Generation                                    |           |              |                               |            |            |              |            |            |
|--|-----------|--------------|-------------------------------|------------|------------|--------------|------------|------------|
| Land Use   | Intensity | Daily        | AM Peak Hour                  |            |            | PM Peak Hour |            |            |
|  |           |              | Total                         | In         | Out        | Total        | In         | Out        |
| Single-Family Homes  | 628 DU    | 5,928        | 465                           | 116        | 349        | 622          | 392        | 230        |
| <b>Net New External Trips</b>                                  |           | <b>5,928</b> | <b>465</b>                    | <b>116</b> | <b>349</b> | <b>622</b>   | <b>392</b> | <b>230</b> |
| Note: Trip generation was calculated using the following data: |           |              |                               |            |            |              |            |            |
| Daily Traffic Generation                                       |           |              |                               |            |            |              |            |            |
| Single-Family Homes  | [ITE 210] | =            | T = 9.44 X; (50% in, 50% out) |            |            |              |            |            |
| AM Peak-Hour Traffic Generation                                |           |              |                               |            |            |              |            |            |
| Single-Family Homes  | [ITE 210] | =            | T = 0.74 X; (25% in, 75% out) |            |            |              |            |            |
| PM Peak-Hour Traffic Generation                                |           |              |                               |            |            |              |            |            |
| Single-Family Homes  | [ITE 210] | =            | T = 0.99 X; (63% in, 37% out) |            |            |              |            |            |

**5.3 SITE TRAFFIC DISTRIBUTION AND ASSIGNMENT**

The proposed development’s trips were assigned to the surrounding network based on existing peak-hour turning movements, surrounding land uses, locations of similar land uses and population densities in the area. The following site traffic distribution was reviewed and approved as part of the MOU by the City of Belmont, NCDOT and the applicant:

- 40% to/from the north along S Point Road (273)
- 40% to/from the east (and north) along R L Stowe Road
- 10% to/from the west (and south) along Armstrong Road (NC 273)
- 5% to/from the east along Red Raider Run (into Belmont Town Center)
- 5% to/from South Point High School (in via South Point High School driveway off of S Point Rd across from Red Raider Run, and out via high school driveway on Nixon Road)

As previously discussed in Section 5.1, the proposed access to S Point Road (NC 273) from Forest Hill Road via Timber Ridge Road (Driveway #1) was initially proposed to remain a full-movement intersection and become signalized if warrants were met. However, given the context of the South Hill Estates neighborhood and through coordination with City of Belmont staff, an unsignalized left-over access at Forest Hill Road was requested to be evaluated, with the intent to promote the majority of traffic to instead utilize the proposed signalized, full-movement access at the Henry

Chapel Road/S Point Road (NC 273) intersection. This TIA evaluated both the full-movement signalized and left-over unsignalized alternatives at Forest Hill Road, impacting the traffic assignment and operations within the immediate vicinity of the site. The overall site traffic distribution and assignment for the full-movement signalized and the left-over unsignalized alternatives are shown in **Figures 5.1A** and **5.1B**, respectively.

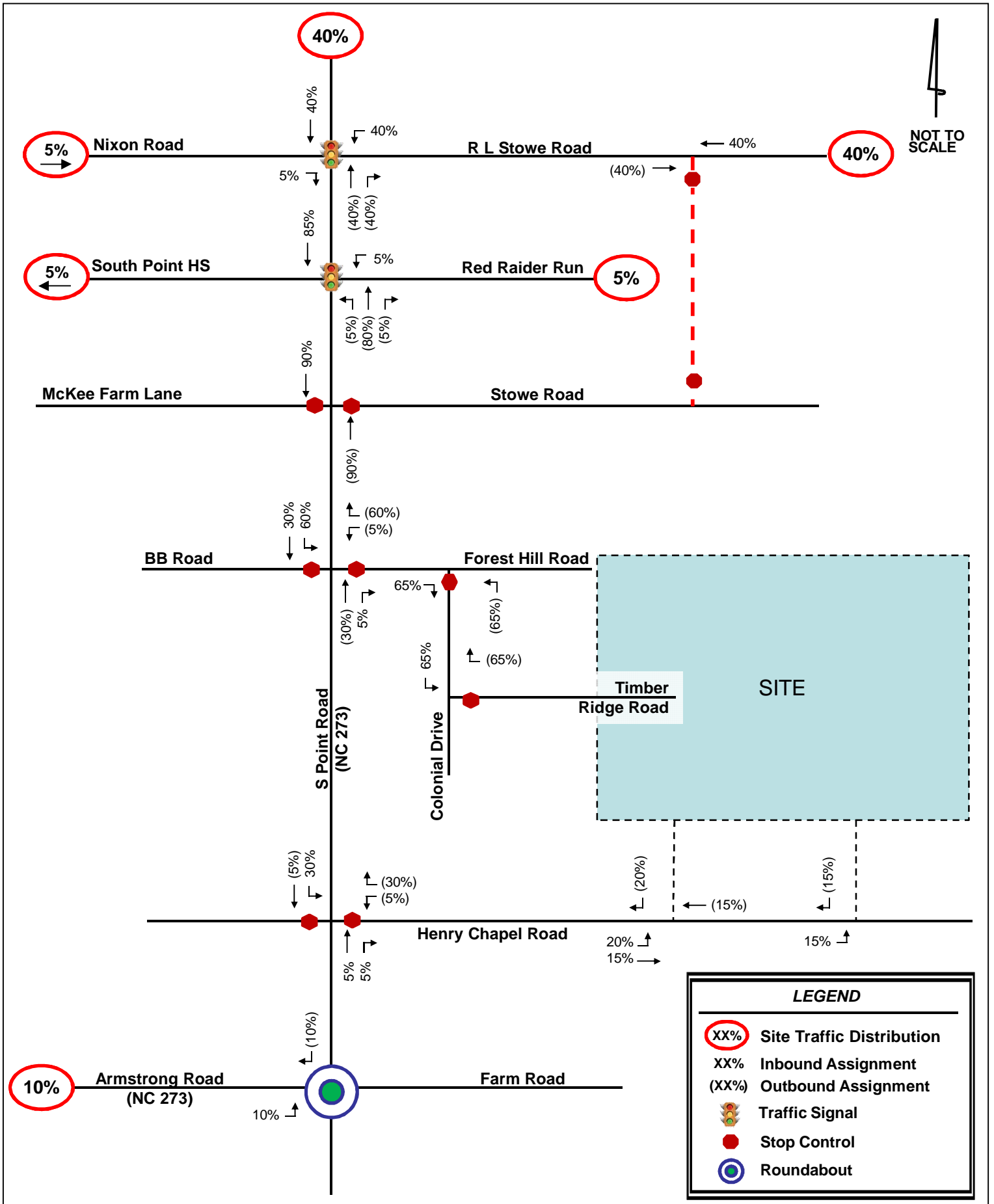
#### **5.4 2025 BUILD-OUT TRAFFIC VOLUMES**

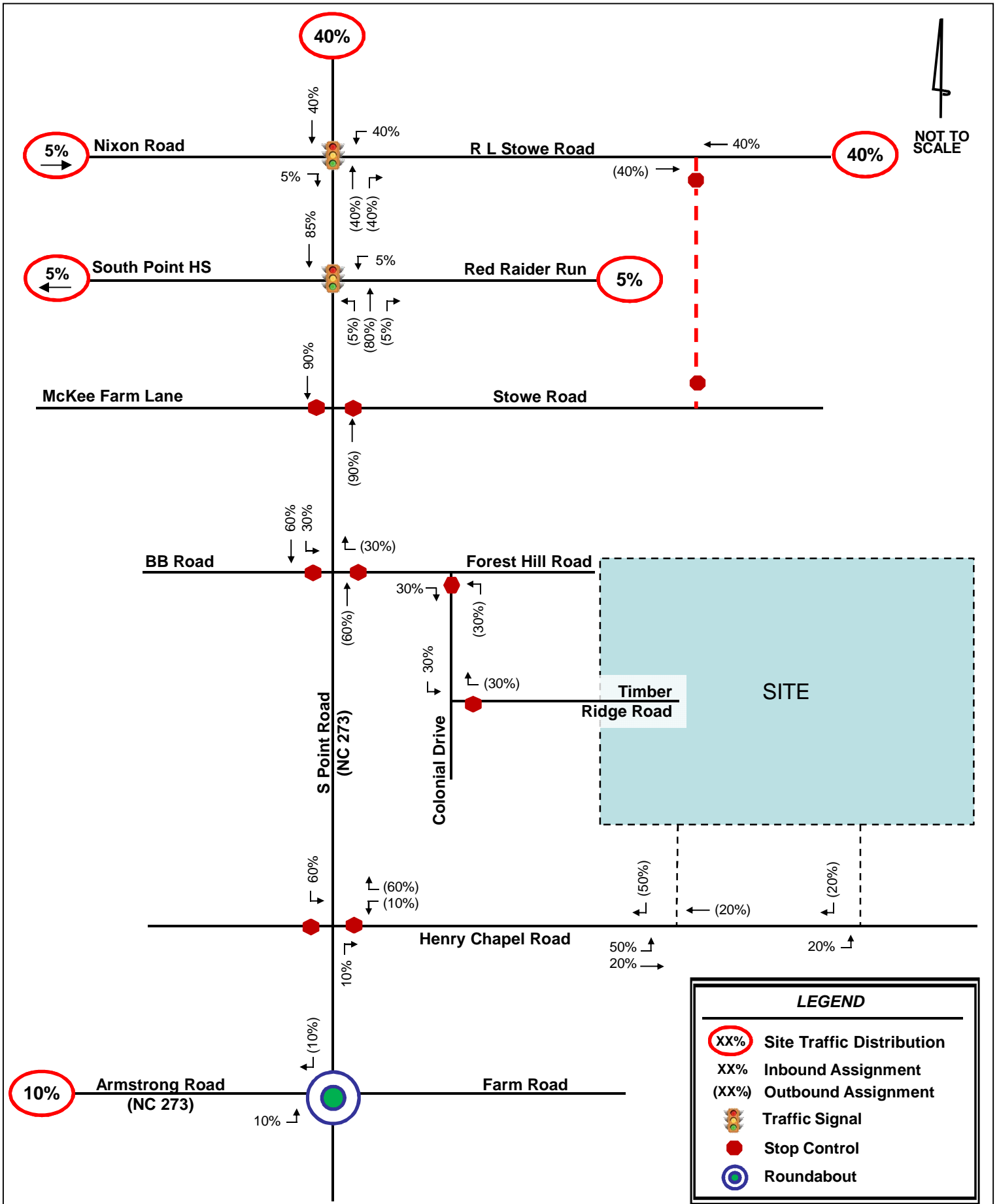
The 2025 build-out traffic volumes include the assignment of the projected site traffic generation added to the 2025 background traffic volumes. **Figures 5.2A** and **5.3A** show the projected 2025 build-out traffic volumes for the AM and PM peak hours under the full-movement signalized alternative at Forest Hill Road, respectively. **Figures 5.2B** and **5.3B** show the projected 2025 build-out traffic volumes for the AM and PM peak hours under the left-over unsignalized alternative at Forest Hill Road, respectively.

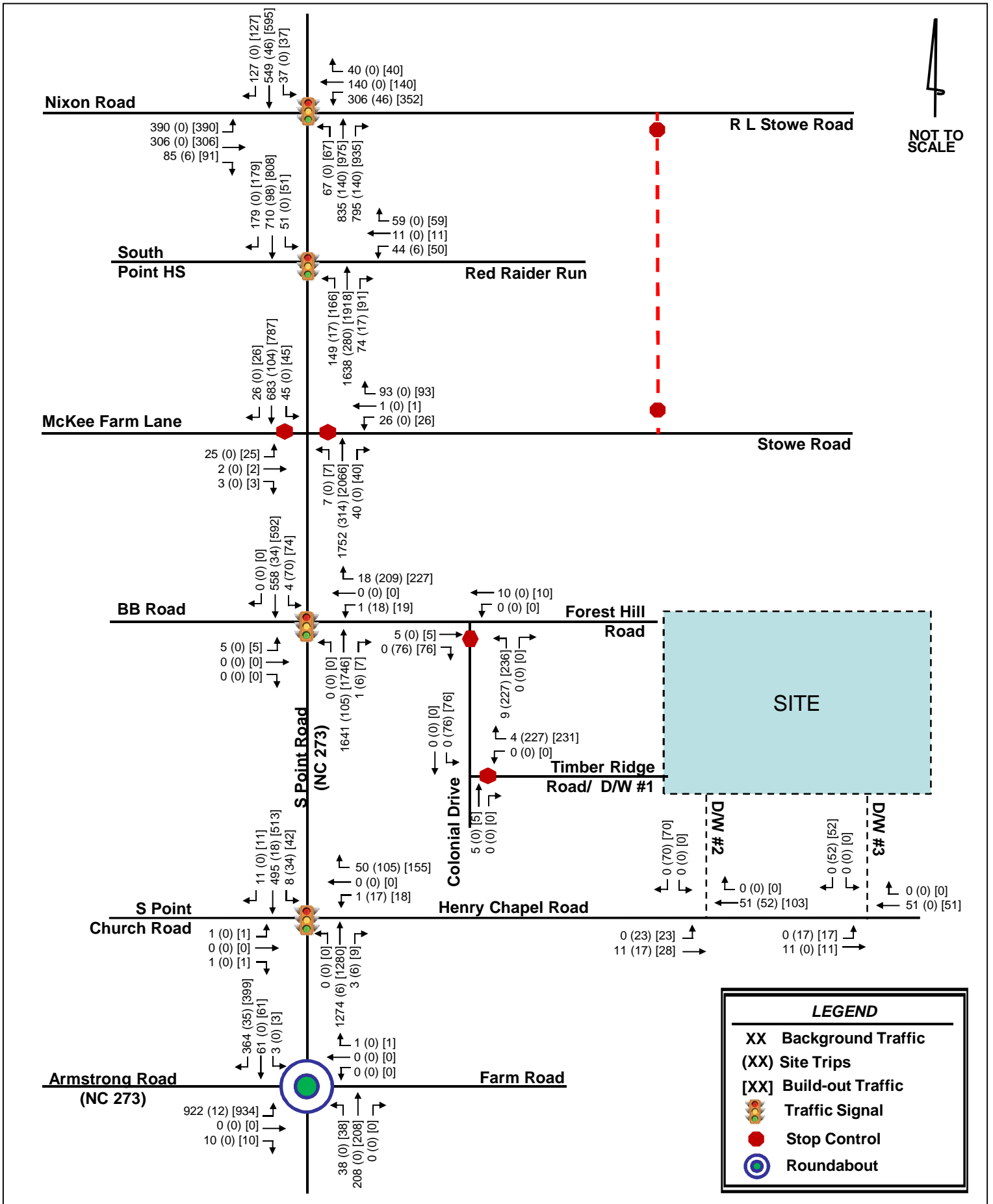
#### **5.5 2030 BUILD-OUT TRAFFIC VOLUMES**

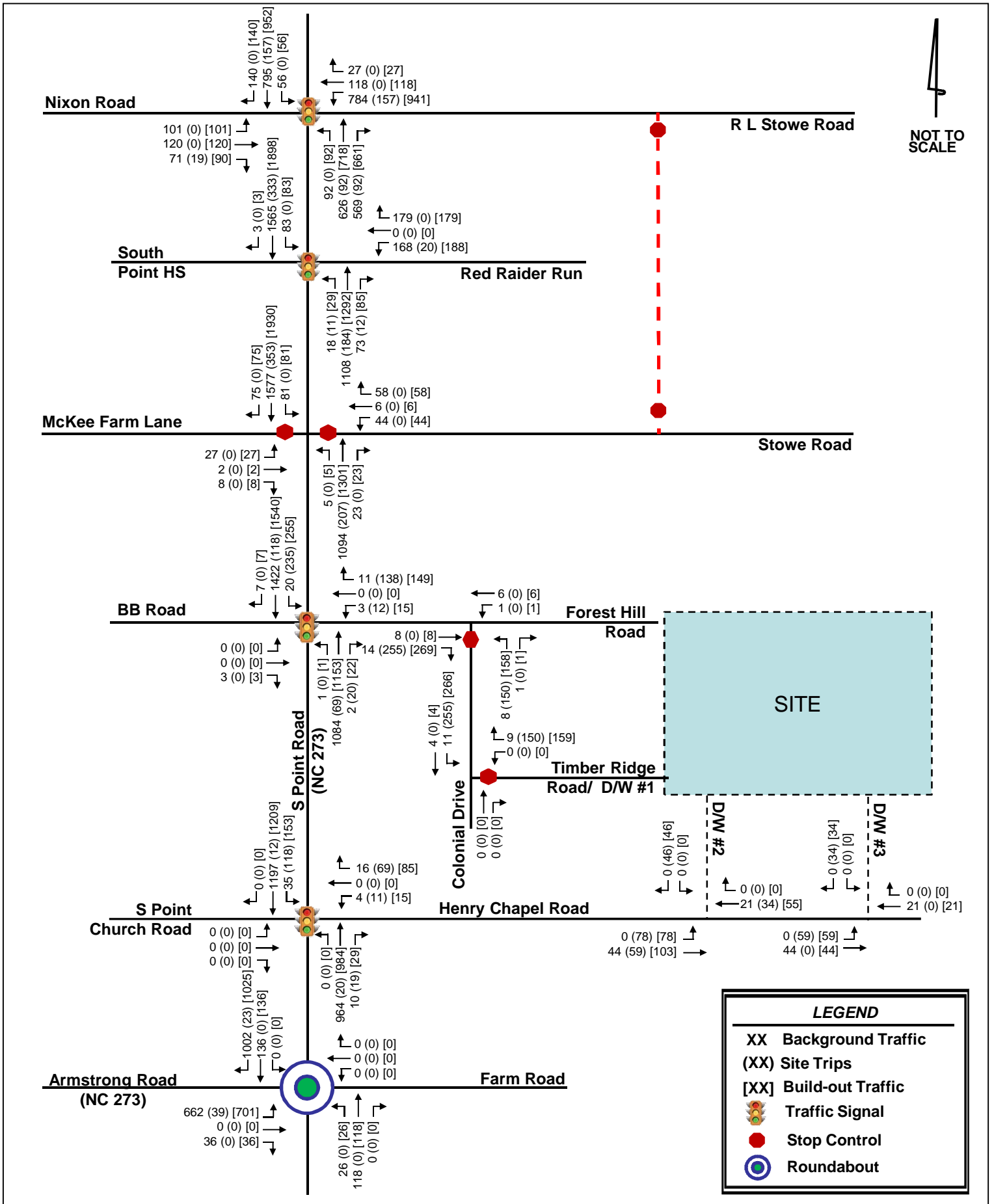
As required by the *City of Belmont Land Development Code – Section 16.14 Traffic Impact Analysis*, an analysis scenario of five years after the build-out year was performed. The 2030 build-out traffic volumes include the approved development traffic and the assignment of the proposed site traffic generation added to the 2030 base background traffic volumes. Given the recommendations determined through the 2025 analyses, 2030 analyses were only performed under the unsignalized, left-over alternative at Forest Hill Road. **Figure 5.4** shows the projected 2030 AM and PM peak-hour build-out traffic volumes.

Intersection volume development worksheets for all intersections and driveways within the study network are provided in the **Appendix**.

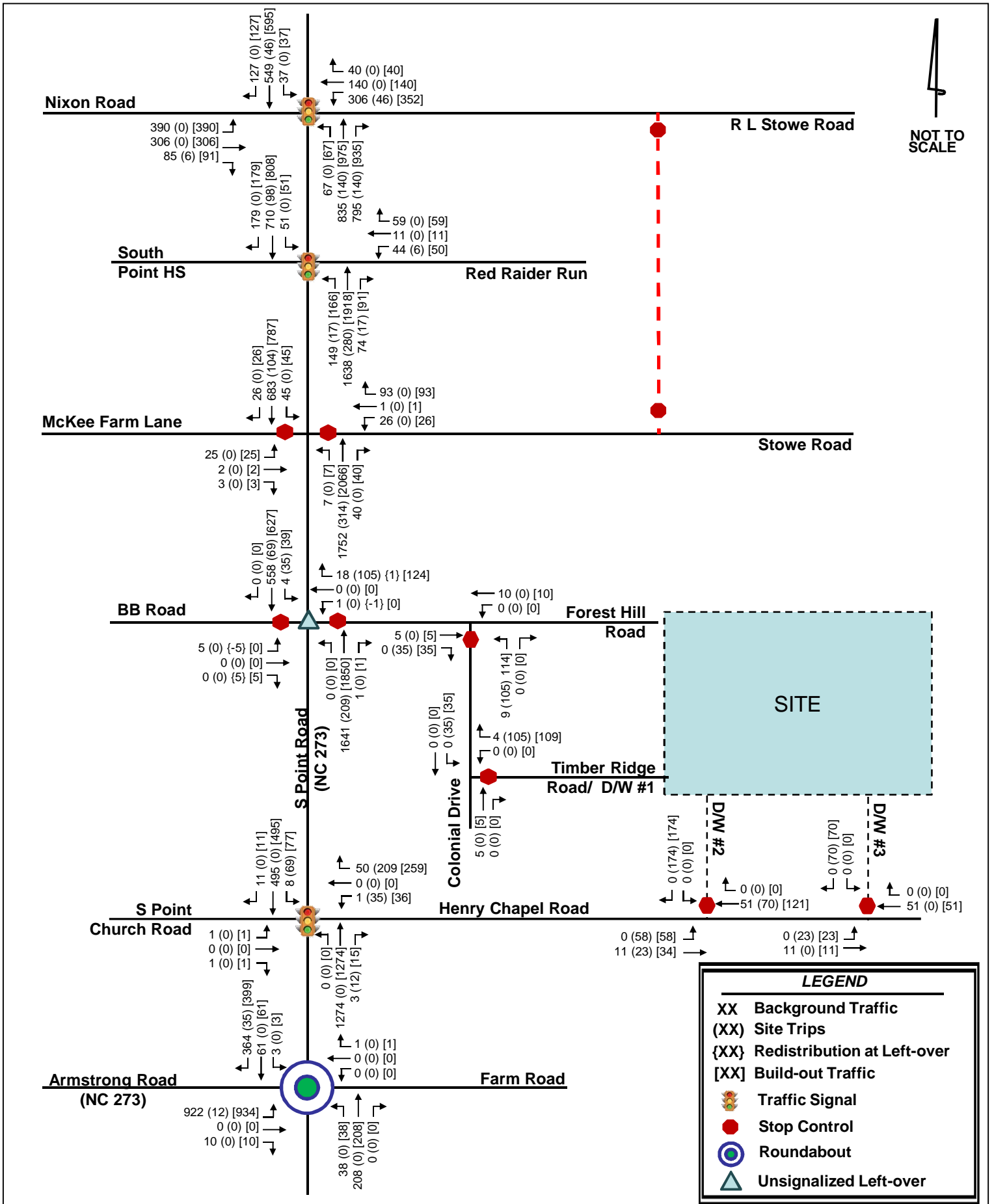


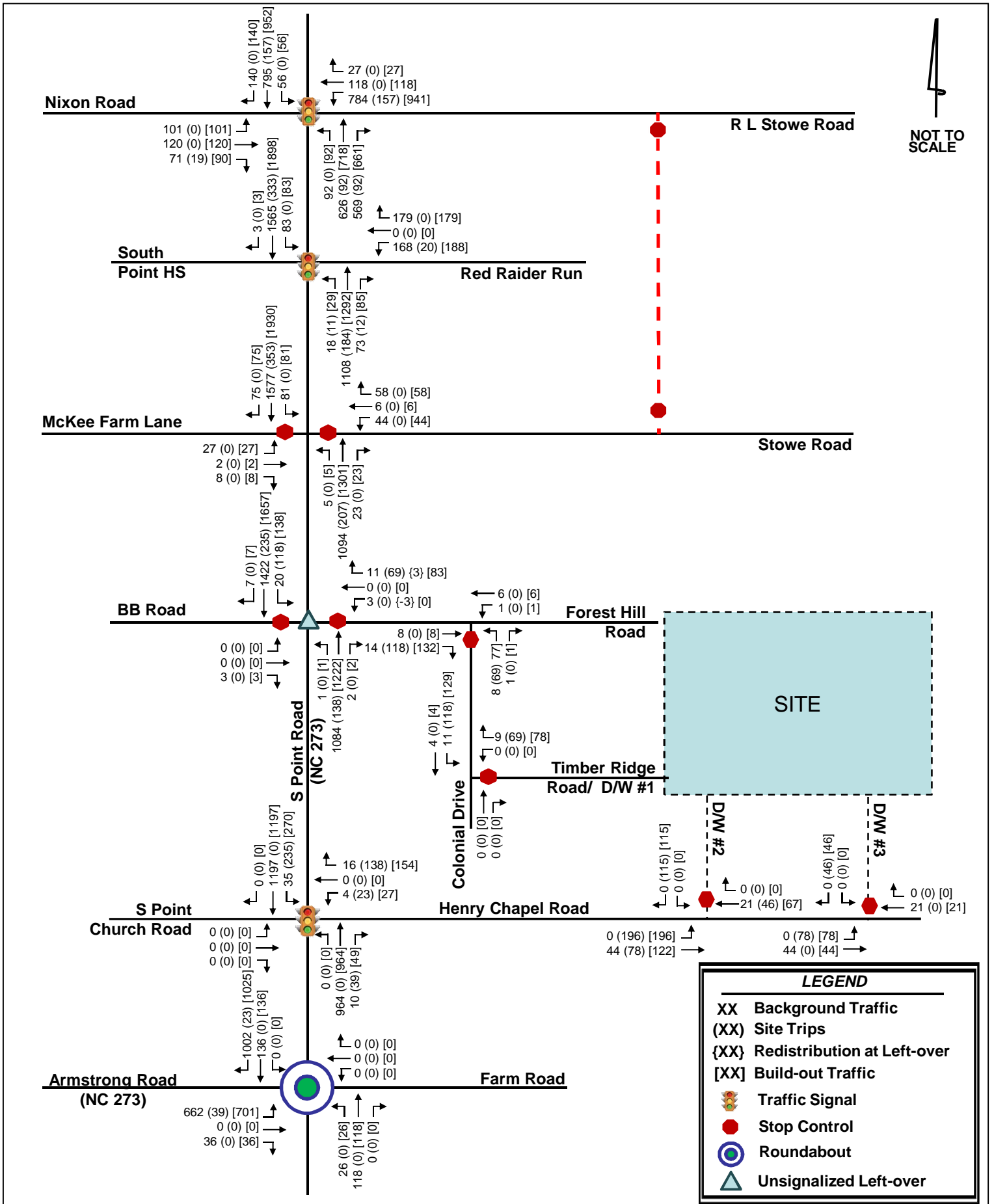


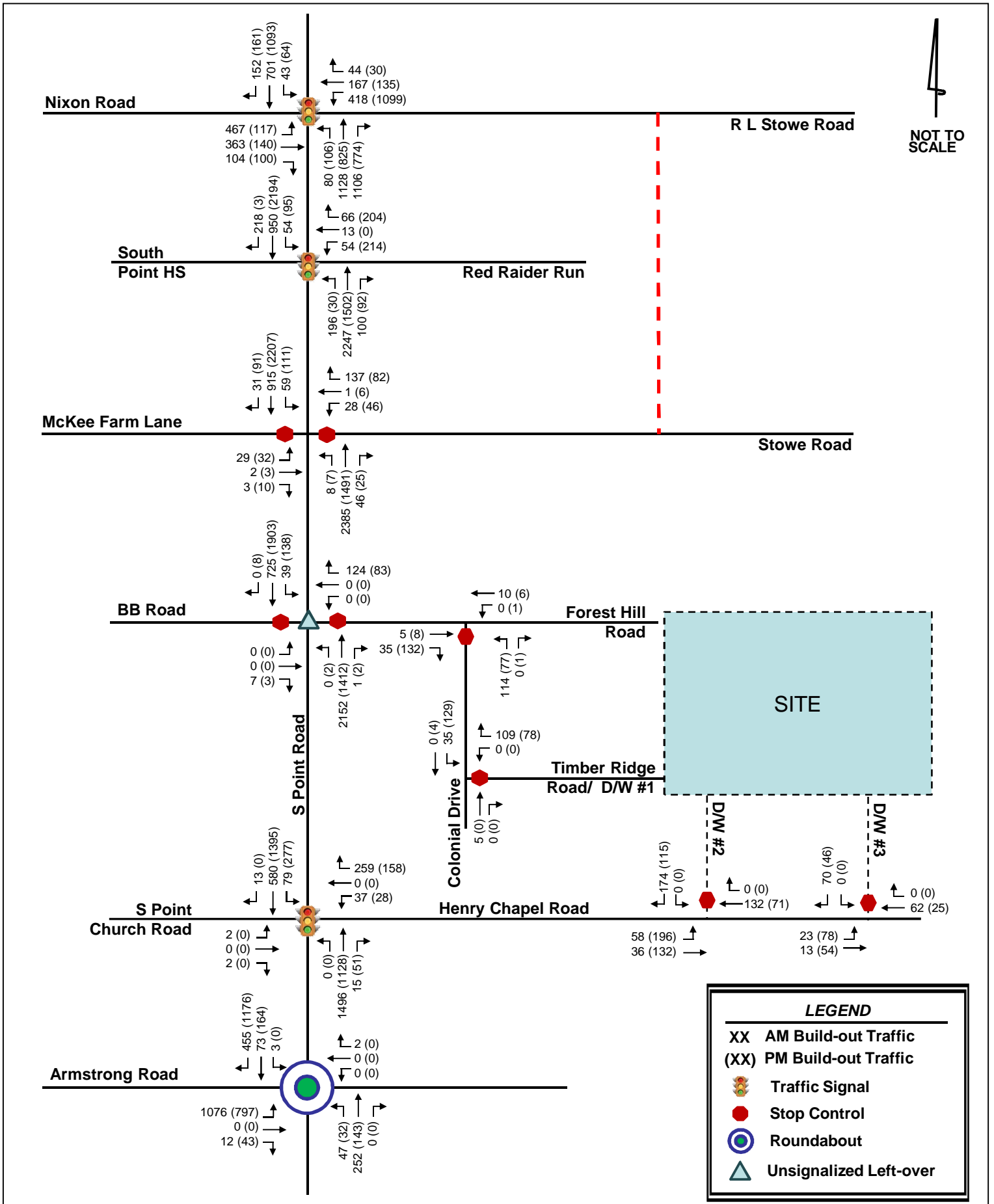












## 6.0 Capacity Analysis

Based on the requirements set forth by the *City of Belmont Land Development Code – Section 16.14 Traffic Impact Analysis* and in accordance with the traffic study guidelines in the *NCDOT Policy on Street and Driveway Access to North Carolina Highways*, capacity analyses were performed at the study area intersections for each of the following AM and PM peak-hour scenarios:

- 2017 Existing Conditions
- 2025 Background Conditions
- 2025 Build-out Conditions
- 2030 Build-out Conditions + 5 years

Capacity analyses were performed for the AM and PM peak hours using the Synchro Version 9 software to determine the operating characteristics at the signalized and stop-controlled intersections of the adjacent street network and to evaluate the impacts of the proposed development. Capacity is defined as the maximum number of vehicles that can pass over a particular road segment, or through a particular intersection, within a specified period of time under prevailing operational, geometric and controlling conditions within a set time duration. SIDRA Version 7 software was used to determine operating characteristics, Level-of-Service (LOS) and delay for the planned roundabout at the S Point Road (NC 273)/Armstrong Road (NC 273) intersection under 2025 and 2030 background and build-out conditions. SIDRA is typically used to analyze roundabout operations using a macroscopic model that uses gap acceptance and lane utilization to determine capacity, where capacity is based on the size of time gaps between vehicles that motorists choose when entering a roundabout. These software programs use methodologies contained in the *Highway Capacity Manual (HCM)* to determine the operating characteristics of an intersection.

The *Highway Capacity Manual (HCM)* defines LOS as a “quantitative stratification of a performance measure or measures representing quality of service”, and is used to “translate complex numerical performance results into a simple A-F system representative of travelers’ perceptions of the quality of service provided by a facility or service”. The HCM defines six levels of service, LOS A through LOS F, with A having the best operating conditions from the traveler’s perspective and F having the worst. However, it must be understood that “the LOS letter result hides much of the complexity of facility performance”, and that “the appropriate LOS for a given system element in the community is a decision for local policy makers”. According to the HCM, “for cost, environmental impact, and other reasons, roadways are typically designed not to provide LOS A conditions during peak periods but instead to provide some lower LOS that balances individual travelers’ desires against society’s desires and financial resources. Nevertheless, during low-volume periods of the day, a system element may operate at LOS A.”

LOS for a two-way stop-controlled (TWSC) intersection is determined by the control delay at the side-street approaches, typically during the highest volume periods of the day, the AM and PM peak periods. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. With respect to field measurements, control delay is defined as the total elapsed time from the time a vehicle stops at the end of the queue to the time the vehicle departs from the stop line. It is typical for stop sign-controlled side streets and driveways intersecting major streets to experience long delays during peak hours, particularly for left-turn movements. The majority of the traffic moving through the intersection on the major street experiences little or no delay.

LOS for signalized intersections is reported for the intersection as a whole, also typically during the highest volume periods of the day, the AM and PM peak periods. One or more movements at an intersection may experience a low level-of-service, while the intersection as a whole may operate acceptably.

LOS for roundabout intersections is also reported for the intersection as a whole, but uses the same control delay thresholds as the stop-controlled intersections. However, if the volume-to-capacity ratio on an approach of the intersection is greater than 1.0, that approach or intersection is reported as LOS F regardless of the reported control delay.

**Table 6.0-A** and **6.0-B** list the LOS control delay thresholds published in the HCM for unsignalized (TWSC and roundabout) and signalized intersections, respectively, as well as the unsignalized operational descriptions assumed herein.

| Table 6.0-A<br>Vehicular LOS Control Delay Thresholds for<br>Unsignalized Intersections |   |                 |
|---|---|-----------------|
| Level-of-Service  | Average Control Delay per Vehicle [sec/veh] |                 |
| A   | ≤ 10  | Short Delays    |
| B   | > 10 – 15                                   |                 |
| C   | > 15 – 25                                   |                 |
| D   | > 25 – 35                                   | Moderate Delays |
| E   | > 35 – 50                                   |                 |
| F   | > 50  | Long Delays     |

| Table 6.0-B<br>Vehicular LOS Control Delay Thresholds for<br>Signalized Intersections |   |
|---|---|
| Level-of-Service  | Average Control Delay per Vehicle [sec/veh] |
| A   | ≤ 10  |
| B   | > 10 – 20                                   |
| C   | > 20 – 35                                   |
| D   | > 35 – 55                                   |
| E   | > 55 – 80                                   |
| F   | > 80  |

NCDOT staff provided the signal geometric plans for the following signalized intersections:

- S Point Road (NC 273) and South Point High School/Red Raider Run
- S Point Road (NC 273) and R L Stowe Road/Nixon Road

The provided signal plans were used in the development of the existing conditions Synchro network and the cycle lengths and splits were optimized given the timing inputs and in accordance with NCDOT Congestion Management guidelines.

Based on discussions with NCDOT, the signal at R L Stowe/Nixon Road is currently be upgraded to convert the current side-street left-turn phases from permitted to split phasing along with addition of pedestrian timings. This also allows the northbound right-turn movement to operate with an overlap phase during the westbound approach split phase. This was reflected in all future analyses,

and the splits were again optimized given the planned improvements under background conditions. These timings were maintained throughout the build-out analyses except where signal improvements were recommended. It should be noted that permitted-protected left-turn phasing and right-turn-on-red (RTOR) operations were permitted in the model based on the existing signal plans to more accurately reflect existing signal operations. Signal geometric plans are included in the **Appendix**.

Mitigation for traffic impacts caused by the proposed development were noted and recommended based on City of Belmont and NCDOT mitigation requirements. When determining the proposed development's traffic impact to the study area intersections, the 2025 build-out conditions were compared to the 2025 background conditions. Based on the *City of Belmont Land Development Code*, "the applicant shall be required to identify mitigation improvements to the roadway network if at least one of the following conditions exists when comparing future year background conditions to future year build-out conditions:

- a) the total average delay at an intersection or individual approach increases by 25% or greater, while maintaining the same LOS,
- b) the LOS degrades by at least one level,
- c) or the LOS is "D" or worse in background conditions and the proposed project shows a negative impact on the intersection or approach"

Capacity analysis reports generated by Synchro Version 9 software and SIDRA Version 7 software are included in the **Appendix**. Additionally, queuing and blocking reports generated by the SimTraffic microsimulation model are included in the **Appendix**.

**6.1 S POINT ROAD (NC 273) AND ARMSTRONG ROAD (NC 273)**

**Table 6.1** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the currently unsignalized, TWSC intersection of S Point Road (NC 273) and Armstrong Road (NC 273). This intersection is assumed to be converted to a future roundabout based on input from NCDOT. The table below shows unsignalized analyses reported by Synchro under 2017 conditions, and shows roundabout analyses reported by SIDRA under 2025 and 2030 conditions.

| Table 6.1 – S Point Road (NC 273) and Armstrong Road (NC 273) |                |           |          |          |          |       |              |
|---|----------------|-----------|----------|----------|----------|-------|--------------|
| Condition   | Measure        | EB        | WB       | NB       | SB       |       | Intersection |
|   |                | EBLTR     | WBTR     | NBLTR    | SBLT     | SBR   |              |
| <b>AM Peak Hour</b>   |                |           |          |          |          |       |              |
| 2017 Existing   | LOS (Delay)    | F (218.9) | A (9.3)  | A (2.1)  | A (0.3)  |       |              |
|   | Synchro 95th Q | 779'      | 0'       | 3'       | 0'       |       |              |
| 2025 Background   | LOS (Delay)    | C (23.6)  | B (11.7) | D (26.8) | A (6.8)  |       | C (19.6)     |
|   | SIDRA 95th Q   | 427'      | 1'       | 97'      | 64'      |       |              |
| 2025 Build-Out  | LOS (Delay)    | C (24.8)  | B (11.9) | D (27.7) | A (7.2)  |       | C (20.3)     |
|   | SIDRA 95th Q   | 454'      | 1'       | 99'      | 72'      |       |              |
| 2025 Build-Out IMP (A,B) - SBR                                | LOS (Delay)    | C (24.8)  | B (11.9) | D (27.7) | A (6.0)  |       | C (20.0)     |
|   | SIDRA 95th Q   | 454'      | 1'       | 99'      | 7'       | 57'   |              |
| 2030 Build-Out (B)  | LOS (Delay)    | F (54.3)  | B (14.5) | F (63.0) | A (6.6)  |       | E (42.4)     |
|   | SIDRA 95th Q   | 1707'     | 2'       | 224'     | 8'       | 71'   |              |
| <b>PM Peak Hour</b>   |                |           |          |          |          |       |              |
| 2017 Existing   | LOS (Delay)    | E (49.4)  | A (0.0)  | A (1.6)  | A (0.0)  |       |              |
|   | Synchro 95th Q | 240'      | 0'       | 2'       | 0'       |       |              |
| 2025 Background   | LOS (Delay)    | B (14.5)  | A (7.5)  | B (10.1) | E (48.4) |       | D (33.6)     |
|   | SIDRA 95th Q   | 187'      | 1'       | 30'      | 3524'    |       |              |
| 2025 Build-Out  | LOS (Delay)    | C (16.1)  | A (7.9)  | B (10.8) | F (54.1) |       | E (37.3)     |
|   | SIDRA 95th Q   | 224'      | 1'       | 32'      | 3768'    |       |              |
| 2025 Build-Out IMP (A,B) - SBR                                | LOS (Delay)    | C (16.3)  | A (7.9)  | B (10.8) | D (25.0) |       | C (20.9)     |
|   | SIDRA 95th Q   | 231'      | 1'       | 32'      | 14'      | 713'  |              |
| 2030 Build-Out (B)  | LOS (Delay)    | D (27.3)  | A (9.2)  | B (14.3) | F (53.5) |       | E (41.2)     |
|   | SIDRA 95th Q   | 479'      | 1'       | 47'      | 18'      | 3514' |              |
| (A): Full-movement, signalized scenario at Forest Hill Rd     |                |           |          |          |          |       |              |
| (B): Left-over, unsignalized scenario at Forest Hill Rd       |                |           |          |          |          |       |              |

This intersection is currently unsignalized with stop control on the eastbound and westbound approaches of Armstrong Road (NC 273) and Farm Road, and operates similar to a tee-intersection, since the westbound approach of Farm Road serves as a low-volume, residential driveway. The highest demand is seen on the southbound approach and the stop-controlled, eastbound approach, as shown in **Figure 3.4**, and as evidenced by the Highway 273 designation, which runs from north to south along S Point Road until it intersects with the east-west aligned Armstrong Road to get to and from South Carolina. **Table 6.1** highlights the issue with stop-controlling the eastbound left-turn movement, particularly during the AM peak hour, when the eastbound approach is currently operating with long delays and queues serving traffic from South Carolina, the McLean residential development and other parts of Gaston County commuting to Charlotte and eastern Gaston County for work. As discussed in Section 4, this traffic is expected to grow. Based on input from NCDOT, this intersection is planned to be converted to a single-lane roundabout to better accommodate the unbalanced approaches. This project is currently seeking funding for design and construction. Given this, NCDOT requested that this intersection be

analyzed as a roundabout in future conditions. Therefore, 2025 background and 2025 build-out conditions were analyzed under a single-lane roundabout configuration.

**Table 6.1** shows the overall intersection is expected to operate at LOS D during the PM peak hour, while the southbound approach of S Point Road (NC 273) is expected to operate at LOS E during the PM peak hour under 2025 background conditions. When the proposed site traffic is added to the 2025 background volume, the LOS degrades from LOS D to LOS E for the overall intersection and LOS E to LOS F for the southbound approach. Given the negative impact caused by the project, identification of mitigation improvements is required. The following improvement is recommended to mitigate the added overall intersection and southbound approach delay caused by the addition of site traffic:

- Southbound right-turn bypass lane along S Point Road (NC 273) with a minimum of 100' of storage

Under the planned single-lane approach, the high-volume southbound right-turn traffic would be forced to yield to traffic already inside the roundabout before entering the roundabout. Though the northbound through and eastbound left-turn traffic do not directly conflict with the southbound right, the high number of added northbound throughs and eastbound lefts would slow the southbound traffic to wait to be sure this traffic exited the roundabout to the north before entering. This issue would be mitigated by adding the southbound right-turn bypass lane where this traffic would only need to yield to northbound left-turn and westbound through traffic that has already exited the roundabout, each of which are low-volume movements. Additionally, by removing the southbound right-turn traffic from the roundabout, it would also be expected to benefit the eastbound traffic under the same concept.

With this improvement in place, the negative operational impacts to the overall intersection and southbound approach are mitigated to LOS C and LOS D, respectively, during the PM peak hour.

The minimum of 100 feet of storage is recommended based on the short queues shown for the southbound through/right lane. The major right-turn traffic would be expected to be able to access the right-turn lane with the recommended 100 feet of storage in place, as the through/right queues would not be expected to routinely extend to obstruct the right-turn traffic from entering the right-turn lane and bypassing the roundabout.



## 6.2 S POINT ROAD (NC 273) AND HENRY CHAPEL ROAD

**Table 6.2** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the currently unsignalized, TWSC intersection of S Point Road (NC 273) and Henry Chapel Road.

| <b>Table 6.2 – S Point Road (NC 273) and Henry Chapel Road</b> |                |          |           |       |          |          |        |              |
|--|----------------|----------|-----------|-------|----------|----------|--------|--------------|
| Condition  | Measure        | EB       | WB        |       | NB       | SB       |        | Intersection |
|  |                | EBLTR    | WBTL      | WBR   | NBLTR    | SBL      | SBTR   |              |
| <b>AM Peak Hour</b>  |                |          |           |       |          |          |        |              |
| 2017 Existing  | LOS (Delay)    | C (23.8) | C (18.7)  |       | A (0.0)  | A (0.8)  |        |              |
|  | Synchro 95th Q | 3'       | 15'       |       | 0'       | 2'       |        |              |
| 2025 Background  | LOS (Delay)    | F (77.6) | E (39.4)  |       | A (0.0)  | A (0.5)  |        |              |
|  | Synchro 95th Q | 3'       | 37'       |       | 0'       | 1'       |        |              |
| 2025 Build-Out   | LOS (Delay)    | F (Err)  | F (373.6) |       | A (0.0)  | A (2.9)  |        |              |
|  | Synchro 95th Q | Err      | 354'      |       | 0'       | 8'       |        |              |
| 2025 Build-Out IMP (1A) - Signal w/ SBL                        | LOS (Delay)    | A (0.0)  | D (39.0)  |       | C (33.6) | A (8.3)  |        | C (26.9)     |
|  | Synchro 95th Q | 0'       | #163'     |       | #1701'   | 91'      | 101'   |              |
| 2025 Build-Out IMP (1B) - Signal w/ SBL                        | LOS (Delay)    | A (0.0)  | F (98.6)  |       | E (68.0) | B (19.3) |        | E (59.0)     |
|  | Synchro 95th Q | 0'       | #421'     |       | #1821'   | #186'    | 163'   |              |
| 2025 Build-Out IMP (2B) - Signal w/ SBL, WBR                   | LOS (Delay)    | A (0.0)  | E (63.6)  |       | D (46.0) | B (12.0) |        | D (39.2)     |
|  | Synchro 95th Q | 0'       | 78'       | #318' | #1674'   | 136'     | 98'    |              |
| 2025 Build-Out IMP (3B) - Signal w/ SBL, WBR, 2 NBTs           | LOS (Delay)    | A (0.0)  | C (24.8)  |       | B (15.9) | A (6.8)  |        | B (14.7)     |
|  | Synchro 95th Q | 0'       | 53'       | 187'  | 382'     | 85'      | 108'   |              |
| 2030 Build-Out (B)   | LOS (Delay)    | A (0.0)  | C (27.2)  |       | B (19.3) | A (6.7)  |        | B (16.8)     |
|  | Synchro 95th Q | 0'       | 54'       | 195'  | 508'     | 87'      | 137'   |              |
| <b>PM Peak Hour</b>  |                |          |           |       |          |          |        |              |
| 2017 Existing  | LOS (Delay)    | A (0.0)  | C (20.8)  |       | A (0.0)  | A (1.0)  |        |              |
|  | Synchro 95th Q | 0'       | 9'        |       | 0'       | 3'       |        |              |
| 2025 Background  | LOS (Delay)    | A (0.0)  | F (66.9)  |       | A (0.0)  | A (3.3)  |        |              |
|  | Synchro 95th Q | 0'       | 25'       |       | 0'       | 5'       |        |              |
| 2025 Build-Out   | LOS (Delay)    | A (0.0)  | F (712.2) |       | A (0.0)  | B (13.0) |        |              |
|  | Synchro 95th Q | 0'       | 280'      |       | 0'       | 28'      |        |              |
| 2025 Build-Out IMP (1A) - Signal w/ SBL                        | LOS (Delay)    | A (0.0)  | C (28.9)  |       | C (30.4) | B (18.3) |        | C (23.7)     |
|  | Synchro 95th Q | 0'       | 82'       |       | 1026'    | #264     | 640'   |              |
| 2025 Build-Out IMP (1B) - Signal w/ SBL                        | LOS (Delay)    | A (0.0)  | D (46.9)  |       | D (41.5) | C (24.7) |        | C (32.6)     |
|  | Synchro 95th Q | 0'       | #190'     |       | #1332'   | #468'    | 662'   |              |
| 2025 Build-Out IMP (2B) - Signal w/ SBL, WBR                   | LOS (Delay)    | A (0.0)  | C (24.2)  |       | D (35.5) | B (18.6) |        | C (25.4)     |
|  | Synchro 95th Q | 0'       | 66'       | 99'   | #1320'   | #468'    | 615'   |              |
| 2025 Build-Out IMP (3B) - Signal w/ SBL, WBR, 2 NBTs           | LOS (Delay)    | A (0.0)  | C (20.8)  |       | B (16.9) | B (15.0) |        | B (16.1)     |
|  | Synchro 95th Q | 0'       | 62'       | 110'  | 387'     | 352'     | 634'   |              |
| 2030 Build-Out (B)   | LOS (Delay)    | A (0.0)  | C (30.3)  |       | B (18.3) | C (21.7) |        | C (20.9)     |
|  | Synchro 95th Q | 0'       | 63'       | 140'  | 485'     | 362'     | #1672' |              |

(A): Full-movement, signalized scenario at Forest Hill Rd

(B): Left-over, unsignalized scenario at Forest Hill Rd

**Table 6.2** shows the stop-controlled westbound approach of Henry Chapel Road is expected to operate with moderate delays during the AM peak hour and long delays during the PM peak hour under 2025 background conditions. The increase in delay on the side streets between existing and background conditions is primarily due to the reduction in the gaps available to be able to turn onto the mainline, caused by the growth in traffic volume along S Point Road (NC 273).

When the proposed site traffic is added to the 2025 background volume, significant delay is added to this intersection, particularly for the westbound approach along Henry Chapel Road. Given the negative impact caused by the project, identification of mitigation improvements is required. The following options for laneage improvements were evaluated at this intersection to develop recommendations to mitigate the increase in delay and to accommodate the added site traffic, while minimizing disruption to the background traffic:

- 1A. Signalized w/ southbound left-turn lane – *Full-movement, signalized scenario at Forest Hill*
- 1B. Signalized w/ southbound left-turn lane – *Left-over, unsignalized scenario at Forest Hill*
2. Signalized w/ southbound left-turn lane, westbound right-turn lane
3. Signalized w/ southbound left-turn lane, westbound right-turn lane, 2 northbound through lanes

As discussed in Section 5, proposed Driveway #1 is shown on the provided site plan to connect to Timber Ridge Road, which currently stubs to the east. Timber Ridge Road is a narrow residential street within the South Hill Estates neighborhood. From Timber Ridge Road, a driver must then access Colonial Drive and then Forest Hill Drive to access S Point Road (NC 273). This access to S Point Road (NC 273) was initially proposed to remain full-movement (as it exists) with the addition of a traffic signal if warrants were met. However, with this being the most northern (and for most drivers, first) access from S Point Road (NC 273), if both Forest Hill Road and Henry Chapel Road intersections were signalized, the majority of traffic would likely utilize the Forest Hill Road access. This would promote heavy traffic associated with the Henry Chapel development to travel through the South Hill Estates neighborhood. Given the context of this neighborhood and through coordination with City of Belmont staff, an unsignalized left-over access at Forest Hill Road was requested to be evaluated, with the intent to promote the majority of traffic to instead utilize the proposed signalized, full-movement access at Henry Chapel Road.

Evaluation under a full-movement signal at the S Point Road (NC 273)/Forest Hill Road intersection under build-out conditions is indicated by the “(A)” shown in each of the tables throughout Section 6 of this TIA. Evaluation under left-over, unsignalized control at the S Point Road (NC 273)/Forest Hill Road intersection under build-out conditions is indicated by the “(B)” shown in each of the tables throughout Section 6 of this TIA. Under the two conditions, vehicles are expected, and in some cases forced, to be routed differently depending on the access control at the Forest Hill Road intersection. This was reflected in the two assignments presented in Section 5.4.

#### Option 1 – Signalized w/ Southbound Left-Turn Lane

The type of access control identified at the Forest Hill Road intersection would have a significant impact to Henry Chapel Road under build-out conditions. As previously shown in **Figures 5.1A** and **5.1B**, this TIA assumed approximately two-thirds of the site traffic from the north to utilize the Forest Hill Road access if it were to operate under full-movement, signalized conditions, sending the remaining one-third of site traffic from the north to utilize Henry Chapel Road. However, when the access assumption for the Forest Hill Road intersection is converted to an unsignalized left-over, two-thirds of the traffic is expected to utilize Henry Chapel Road as the primary entrance to the proposed development, and Forest Hill Road would accommodate secondary traffic.

**Table 6.2** shows that the overall intersection would be expected to operate at LOS C during both the AM and PM peak hours with the installation of a traffic signal along with a southbound left-turn lane under the full-movement, signalized (A) scenario at Forest Hill Road. Henry Chapel Road would likely act as the secondary entrance under this scenario, with the majority of the proposed

site traffic utilizing the northern entrance at Forest Hill Road. Since this scenario would promote a significant amount of traffic through the South Hill Estates neighborhood, this would not be the preferred access scenario.

**Table 6.2** shows that if Forest Hill Road were to instead operate as the secondary entrance, promoting more site traffic to utilize Henry Chapel Road, the overall intersection of S Point Road (NC 273)/Henry Chapel Road would be expected to operate at LOS E during the AM peak hour and LOS C during the PM peak hour with the installation of a traffic signal along with a southbound left-turn lane.

As noted above, mitigation requirements are based on a comparison of background to build-out conditions, requiring in most cases operations for both the approaches and overall intersection to be mitigated back to background conditions; however, when signalization is recommended under build-out conditions, establishing a direct comparison between these two conditions becomes difficult. As previously shown in **Tables 6.0A** and **6.0B**, LOS thresholds are defined differently and the overall intersection LOS is not determined for unsignalized intersections. Therefore, recommendations for this intersection were determined based on the overall intersection operating acceptably at LOS D with specific consideration for the mainline northbound and southbound approaches, since these movements are high volume and currently operate with little to no delay prior to introduction of the proposed site.

With the main entrance to the proposed site assumed to be at Henry Chapel Road under build-out conditions, the westbound approach volume is expected to be relatively heavy, particularly during the AM peak hour where **Figure 5.2B** shows 259 vehicles for the westbound right and 36 vehicles for the westbound left-turn movement. This heavy demand causes significant delay for the westbound approach, but also demands more green time, reducing the amount of time available for the mainline northbound and southbound movements. This causes particular issues for the heavy northbound approach during the AM peak hour, where the volume is at or near capacity for a single-lane signalized approach. **Table 6.2** reflects this where the westbound and northbound approaches are expected to operate at LOS F and LOS E, respectively, while the overall intersection is expected to operate at LOS E with extensive queuing along the northbound approach.

*Option 2 – Signalized w/ Southbound Left-Turn Lane, Westbound Right-Turn Lane*

**Table 6.2** shows that the installation of an exclusive westbound right-turn lane along Henry Chapel Road would be expected to improve operations for the overall intersection to LOS D during the AM peak hour, while also improving operations for each of the approaches. Providing the westbound right-turn lane not only improves the efficiency of the westbound approach during its green phase by increasing its capacity to two lanes, but also provides additional green time for westbound right-turn traffic during an overlap phase with the southbound left-turn phase. Additionally, it allows westbound right-turn traffic to turn right on red, though this would likely not provide significant benefit during the AM peak hour due to the steady conflicting northbound volume.

Though the overall intersection is expected to operate at LOS D, further review shows that issues would still be expected along individual approaches, particularly the northbound approach. As previously discussed, the northbound approach is near or at capacity for a signalized single-lane approach during both the AM and PM peak hours. Focusing on just the AM peak hour, **Table 6.2** shows that this approach is expected to operate with an average of 46 seconds of delay per vehicle and the 95<sup>th</sup> percentile queue is expected to extend nearly 1,700 feet, extending just past Boat Club

Road and the existing Sunoco Gas Station to the south. The 46 average seconds of delay per vehicle is important to note due to the high number of vehicles this reflects, over 1,200 vehicles during the AM peak hour and over 900 vehicles during the PM peak hour. For a movement/approach that currently experiences little to no delay without the site, the introduction of a traffic signal needed to accommodate the proposed site would be considered a significant impact to the current traffic along S Point Road (NC 273).

Option 3 – Signalized w/ Southbound Left-Turn, Westbound Right-Turn, 2 Northbound Throughs

**Table 6.2** shows that the installation of an additional northbound through lane along S Point Road (NC 273) would increase the capacity to accommodate the proposed traffic signal and would be expected to improve operations and queueing at each of the approaches and overall intersection during both the AM and PM peak hours. The overall intersection would be improved from a LOS D to LOS B during the AM peak hour and LOS C to LOS B during the PM peak hour. Most notably, the LOS on the northbound approach would be improved to LOS B during both peak hours, and the queueing would be substantially reduced to less than 400 feet based on Synchro's 95<sup>th</sup> percentile queues. Further evaluation of the SimTraffic model shows that the maximum northbound queue is shown to be 225 feet during the AM peak hour and 254 feet during the PM peak hour, further validating the improved operations expected under this option. Based on these results, the additional northbound through lane is recommended to include a minimum of 400 feet of full storage; therefore, this lane is recommended to develop with appropriate taper to provide a minimum of 400 feet of two northbound through lanes prior to the signalized intersection.

Note that SimTraffic also showed the maximum queue expected for the recommended westbound right-turn lane to be 191 feet during the AM peak hour under these conditions.

Based on the evaluation of the three options shown above, the following improvements are recommended to mitigate the added delay caused by the addition of site traffic:

- Installation of a traffic signal upon meeting applicable MUTCD warrants
- Southbound left-turn lane along S Point Road (NC 273) that serves as a drop lane at Henry Chapel Road extending from the north through the study area
- Westbound right-turn lane along Henry Chapel Road with a minimum of 200' of storage
- Additional northbound through lane along S Point Road (NC 273) that provides a minimum of 400' of storage and extends north through the study area

Traffic signal warrants for this intersection were performed under build-out conditions and are discussed in Section 7.2.

### 6.3 S POINT ROAD (NC 273) AND FOREST HILL ROAD

**Table 6.3** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the currently unsignalized, TWSC intersection of S Point Road (NC 273) and Forest Hill Road.

| Table 6.3 – S Point Road (NC 273) and Forest Hill Road |                |           |           |           |          |        |              |
|--|----------------|-----------|-----------|-----------|----------|--------|--------------|
| Condition  | Measure        | EB        | WB        | NB        | SB       |        | Intersection |
|  |                | EBLTR     | WBLTR     | NBLTR     | SBL      | SBTR   |              |
| <b>AM Peak Hour</b>                                    |                |           |           |           |          |        |              |
| 2017 Existing  | LOS (Delay)    | F (75.0)  | D (29.0)  | A (0.0)   | A (0.6)  |        |              |
|  | Synchro 95th Q | 21'       | 12'       | 0'        | 2'       |        |              |
| 2025 Background  | LOS (Delay)    | F (328.6) | F (63.4)  | A (0.0)   | A (0.4)  |        |              |
|  | Synchro 95th Q | 25'       | 23'       | 0'        | 1'       |        |              |
| 2025 Build-Out   | LOS (Delay)    | F (Err)   | F (Err)   | A (0.0)   | B (10.9) |        |              |
|  | Synchro 95th Q | Err       | Err       | 0'        | 27'      |        |              |
| 2025 Build-Out IMP (A) - Signal w/ SBL                 | LOS (Delay)    | E (71.0)  | F (210.3) | F (190.4) | B (15.0) |        | F (148.3)    |
|  | Synchro 95th Q | 22'       | #442'     | #2760'    | #176'    | 142'   |              |
| 2025 Build-Out IMP (B) - LO w/ SBL                     | LOS (Delay)    | B (13.3)  | F (590.4) | A (0.0)   | A (1.2)  |        |              |
|  | Synchro 95th Q | 1'        | 317'      | 0'        | 14'      | 0'     |              |
| 2025 Build-Out IMP (B) - LO w/ SBL, 2 NB/SBTs          | LOS (Delay)    | B (10.6)  | E (41.3)  | A (0.0)   | A (1.2)  |        |              |
|  | Synchro 95th Q | 1'        | 86'       | 0'        | 14'      | 0'     |              |
| 2030 Build-Out (B)                                     | LOS (Delay)    | B (11.1)  | F (72.2)  | A (0.0)   | A (1.4)  |        |              |
|  | Synchro 95th Q | 1'        | 127'      | 0'        | 20'      | 0'     |              |
| <b>PM Peak Hour</b>                                    |                |           |           |           |          |        |              |
| 2017 Existing  | LOS (Delay)    | C (15.7)  | C (22.3)  | A (0.1)   | A (0.9)  |        |              |
|  | Synchro 95th Q | 1'        | 9'        | 0'        | 3'       |        |              |
| 2025 Background  | LOS (Delay)    | D (32.6)  | F (124.0) | A (0.1)   | A (6.7)  |        |              |
|  | Synchro 95th Q | 2'        | 29'       | 0'        | 3'       |        |              |
| 2025 Build-Out   | LOS (Delay)    | E (38.2)  | F (Err)   | A (0.2)   | A (2.7)  |        |              |
|  | Synchro 95th Q | 2'        | Err       | 0'        | 78'      |        |              |
| 2025 Build-Out IMP (A) - Signal w/ SBL                 | LOS (Delay)    | A (0.3)   | C (30.0)  | F (123.3) | E (72.2) |        | F (89.1)     |
|  | Synchro 95th Q | 0'        | #117'     | #1822'    | #537'    | #2106' |              |
| 2025 Build-Out IMP (B) - LO w/ SBL                     | LOS (Delay)    | E (44.9)  | E (43.5)  | A (0.0)   | A (1.2)  |        |              |
|  | Synchro 95th Q | 2'        | 63'       | 0'        | 32'      | 0'     |              |
| 2025 Build-Out IMP (B) - LO w/ SBL, 2 NB/SBTs          | LOS (Delay)    | C (18.4)  | C (16.9)  | A (0.0)   | A (1.2)  |        |              |
|  | Synchro 95th Q | 1'        | 22'       | 0'        | 32'      | 0'     |              |
| 2030 Build-Out (B)                                     | LOS (Delay)    | C (21.6)  | C (19.8)  | A (0.0)   | A (1.3)  |        |              |
|  | Synchro 95th Q | 1'        | 27'       | 1'        | 42'      | 0'     |              |

(A): Full-movement, signalized scenario at Forest Hill Rd  
 (B): Left-over, unsignalized scenario at Forest Hill Rd

**Table 6.3** shows the stop-controlled westbound approach of Forest Hill Road is expected to operate with long delays during both the AM and PM peak hours under 2025 background conditions. The increase in delay on the side streets between existing and background conditions is primarily due to the reduction in the gaps available to be able to turn onto the mainline, caused by the growth in traffic volume along S Point Road (NC 273).

When the proposed site traffic is added to the 2025 background volume, significant delay is added to this intersection. Given the negative impact caused by the project, identification of mitigation improvements is required. The following options for laneage improvements were evaluated at this intersection to develop recommendations to mitigate the increase in delay and to accommodate the added site traffic, while minimizing disruption to the background traffic:

1. Signalized w/ southbound left-turn lane
2. Left-over w/ southbound left-turn lane
3. Left-over w/ southbound left-turn lane, 2 northbound/southbound through lanes

Option 1 – Signalized w/ Southbound Left-Turn Lane

As previously discussed in Section 5 and Section 6.2, proposed Driveway #1 is shown on the provided site plan to connect to Timber Ridge Road, which currently stubs to the east. Timber Ridge Road is a narrow residential street within the South Hill Estates neighborhood. From Timber Ridge Road, a driver must then access Colonial Drive and then Forest Hill Drive to access S Point Road (NC 273). This access to S Point Road (NC 273) was initially proposed to remain full-movement (as it exists) and become signalized if warrants were met. With this being the most northern (and for most drivers, first) access from S Point Road (NC 273), the majority of traffic would be expected to utilize the Forest Hill Road access if it were signalized.

Under this access configuration with a signal installed along with a southbound left-turn lane, **Table 6.3** shows that this intersection would be expected to operate at LOS F during both the AM and PM peak hours with extensive queueing on most approaches.

Additionally, of similar note, this would promote heavy traffic associated with the Henry Chapel development through the South Hill Estates neighborhood. Given the context of this neighborhood and through coordination with City of Belmont staff, this access configuration is not preferred.

Option 2 – Left-Over w/ Southbound Left-Turn Lane

An alternative access configuration, an unsignalized left-over for the southbound approach from S Point Road (NC 273) onto Forest Hill Road, was requested by City staff to be evaluated, with the intent to promote the majority of site traffic to instead utilize the proposed signalized, full-movement access at Henry Chapel Road. This configuration would prohibit side street left and through movements. Under this change in access control at Forest Hill Road (and indirectly Driveway #1), site traffic would be expected, and in some cases forced, to be routed differently than if this intersection were to operate under signalized, full-movement control.

As previously shown in **Figures 5.1A** and **5.1B**, this TIA assumed approximately two-thirds of the site traffic from the north to utilize the Forest Hill Road access if it were to operate under full-movement, signalized conditions. However, this assignment would switch to expect approximately two-thirds of the site traffic to utilize Henry Chapel Road instead, and sending the remaining one-third of the site traffic from the north to Forest Hill Road if it were set up as a secondary entrance to the proposed development.

**Table 6.3** shows that if Forest Hill Road were to instead operate as the secondary entrance under unsignalized control and limiting to left-over access, promoting more site traffic to bypass this entrance/exit and instead utilize Henry Chapel Road, the westbound approach of Forest Hill Road would be expected to operate at LOS F during the AM peak hour and LOS E during the PM peak hour. Limited gaps would be available to turn onto the mainline due to the heavy traffic volume along S Point Road (NC 273). The site is expected to add a significant amount of volume to the northbound, southbound and westbound approaches of this intersection, further limiting the gaps available along S Point Road (NC 273), while also increasing the side-street demand for those gaps along Forest Hill Road.

Under build-out conditions, both the northbound and southbound approaches are expected to operate over capacity for a single-lane approach, with the volume to capacity ratio (v/c) expected to be 1.21 for the northbound approach during the AM peak hour and 1.09 for the southbound approach during the PM peak hour. This v/c ratio, particularly for the northbound approach during the AM peak hour, indicates westbound traffic from Forest Hill Road (and indirectly Driveway #1) would likely have major issues finding gaps to turn onto S Point Road (NC 273), reflected by the average delay per vehicle of 590 seconds, nearly 10 minutes, as shown in **Table 6.3**.

*Option 3 – Left-Over w/ Southbound Left-Turn Lane, 2 Northbound/Southbound Through Lanes*

Considering the recommended improvements described in Section 6.2 at the S Point Road (NC 273)/Henry Chapel Road intersection, the benefit from the increase in throughput capacity would only be fully realized if the additional through lanes along S Point Road (NC 273) were extended to a logical terminus where a significant amount of traffic is dispersed. However, traffic volumes increase along S Point Road (NC 273) heading north from Henry Chapel Road beyond Forest Hill Road, and do not disperse away from S Point Road (NC 273) until R L Stowe Road. Therefore, the two northbound and two southbound through lanes along S Point Road (NC 273) are recommended to extend through the Forest Hill Road intersection.

This recommendation also addresses the mainline capacity issues discussed above and the added capacity allows for additional gaps for both westbound right-turn and southbound left-turn traffic accessing South Hill Estates and the proposed Henry Chapel residential development. **Table 6.3** shows that this option is expected to significantly reduce delay and queueing at this intersection, and improve the v/c ratios to acceptable levels, 0.81 for the northbound approach during the AM peak hour and 0.72 for the southbound approach during the PM peak hour.

Note that further evaluation of the SimTraffic model shows that the maximum queue expected for the recommended southbound left-turn lane is shown to be 81 feet during the PM peak hour; therefore, installation of a southbound left-turn lane with a minimum of 100 feet of storage is recommended.

Based on the evaluation of the three options shown above, the following improvements are recommended to mitigate the added delay caused by the addition of site traffic:

- Modify access control to provide southbound and northbound left-over access, restricting side-street left and through movements
- Southbound left-turn lane along S Point Road (NC 273) with a minimum of 100' of storage
- Northbound left-turn lane along S Point Road (NC 273) with a minimum of 50' of storage
- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

Review of auxiliary turn-lane warrants at this intersection can be seen in Section 7.0.

## 6.4 FOREST HILL ROAD AND COLONIAL DRIVE

**Table 6.4** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the unsignalized tee-intersection of Forest Hill Road and Colonial Drive.

| Table 6.4 – Forest Hill Road and Colonial Drive             |                |         |         |          |              |
|---|----------------|---------|---------|----------|--------------|
| Condition   | Measure        | EB      | WB      | NB       | Intersection |
|   |                | EBTR    | WBLT    | NBLR     |              |
| <b>AM Peak Hour</b>   |                |         |         |          |              |
| 2017 Existing   | LOS (Delay)    | A (0.0) | A (0.0) | A (8.7)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 1'       |              |
| 2025 Background   | LOS (Delay)    | A (0.0) | A (0.0) | A (8.6)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 1'       |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i> | LOS (Delay)    | A (0.0) | A (0.0) | B (10.2) |              |
|   | Synchro 95th Q | 0'      | 0'      | 28'      |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>     | LOS (Delay)    | A (0.0) | A (0.0) | A (9.2)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 11'      |              |
| 2030 Build-Out (B)  | LOS (Delay)    | A (0.0) | A (0.0) | A (9.2)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 11'      |              |
| <b>PM Peak Hour</b>   |                |         |         |          |              |
| 2017 Existing   | LOS (Delay)    | A (0.0) | A (2.4) | A (8.7)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 1'       |              |
| 2025 Background   | LOS (Delay)    | A (0.0) | A (0.9) | A (8.7)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 1'       |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i> | LOS (Delay)    | A (0.0) | A (1.0) | B (10.6) |              |
|   | Synchro 95th Q | 0'      | 0'      | 20'      |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>     | LOS (Delay)    | A (0.0) | A (0.9) | A (9.4)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 8'       |              |
| 2030 Build-Out (B)  | LOS (Delay)    | A (0.0) | A (0.9) | A (9.4)  |              |
|   | Synchro 95th Q | 0'      | 0'      | 8'       |              |
| (A): Full-movement, signalized scenario at Forest Hill Rd   |                |         |         |          |              |
| (B): Left-over, unsignalized scenario at Forest Hill Rd     |                |         |         |          |              |

**Table 6.4** shows the stop-controlled northbound approach of Colonial Drive is expected to operate with short delays during both the AM and PM peak hours under 2025 background conditions.

When the proposed site traffic is added to the 2025 background volume under the traffic assignment scenario of full-movement, signalized control at Forest Hill Road where the majority of site traffic would be expected to traverse through the South Hill Estates neighborhood, the LOS on the northbound approach degrades from LOS A to LOS B during both the AM and PM peak hours. However, as previously discussed in Sections 6.2 and 6.3, this access configuration is not preferred.

With the Forest Hill Road intersection at S Point Road (NC 273) evaluated as a secondary access point to the proposed site, less traffic is expected to traverse through the South Hill Estates neighborhood. **Table 6.4** shows that under this preferred access configuration, the northbound approach is expected to continue to operate at LOS A during both the AM and PM peak hours under 2025 build-out conditions. Since the proposed development is not expected to have a significant adverse impact on operations at this intersection, no improvements are recommended for capacity purposes. Review of auxiliary turn lane warrants at this intersection can be seen in Section 7.0.



## 6.5 COLONIAL DRIVE AND TIMBER RIDGE ROAD/DRIVEWAY #1

**Table 6.5** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the existing unsignalized tee-intersection of Colonial Drive and Timber Ridge Road. Under build-out conditions, the existing Timber Ridge Road is proposed to connect Driveway #1 for the proposed development.

| Table 6.5 – Colonial Drive and Timber Ridge Road/Driveway #1 |                |         |         |         |              |
|--|----------------|---------|---------|---------|--------------|
| Condition  | Measure        | WB      | NB      | SB      | Intersection |
|  |                | WBLR    | NBTR    | SBTL    |              |
| <b>AM Peak Hour</b>  |                |         |         |         |              |
| 2017 Existing  | LOS (Delay)    | A (8.4) | A (0.0) | A (0.0) |              |
|  | Synchro 95th Q | 1'      | 0'      | 0'      |              |
| 2025 Background  | LOS (Delay)    | A (8.4) | A (0.0) | A (0.0) |              |
|  | Synchro 95th Q | 0'      | 0'      | 0'      |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i>  | LOS (Delay)    | A (9.4) | A (0.0) | A (7.4) |              |
|  | Synchro 95th Q | 23'     | 0'      | 4'      |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>      | LOS (Delay)    | A (8.8) | A (0.0) | A (7.3) |              |
|  | Synchro 95th Q | 9'      | 0'      | 2'      |              |
| 2030 Build-Out (B)   | LOS (Delay)    | A (8.8) | A (0.0) | A (7.3) |              |
|  | Synchro 95th Q | 9'      | 0'      | 2'      |              |
| <b>PM Peak Hour</b>  |                |         |         |         |              |
| 2017 Existing  | LOS (Delay)    | A (8.4) | A (0.0) | A (4.9) |              |
|  | Synchro 95th Q | 1'      | 0'      | 1'      |              |
| 2025 Background  | LOS (Delay)    | A (8.3) | A (0.0) | A (5.4) |              |
|  | Synchro 95th Q | 1'      | 0'      | 1'      |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i>  | LOS (Delay)    | A (9.0) | A (0.0) | A (7.6) |              |
|  | Synchro 95th Q | 15'     | 0'      | 17'     |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>      | LOS (Delay)    | A (8.6) | A (0.0) | A (7.2) |              |
|  | Synchro 95th Q | 7'      | 0'      | 7'      |              |
| 2030 Build-Out (B)   | LOS (Delay)    | A (8.6) | A (0.0) | A (7.2) |              |
|  | Synchro 95th Q | 7'      | 0'      | 7'      |              |
| (A): Full-movement, signalized scenario at Forest Hill Rd    |                |         |         |         |              |
| (B): Left-over, unsignalized scenario at Forest Hill Rd      |                |         |         |         |              |

**Table 6.5** shows the stop-controlled westbound approach of Timber Ridge Road is expected to operate with short delays during both the AM and PM peak hours under 2025 background conditions.

When the proposed site traffic is added to the 2025 background volume, the uncontrolled southbound approach of Colonial Drive remains at LOS A, but the average approach delay increases by greater than 25%. However, this is due to experiencing zero background volume on this approach during the AM peak hour along with low volume (15 vehicles) during the PM peak hour. Note that the southbound left-turn traffic during the PM peak hour is not shown to experience any conflicting northbound volume, as shown in **Figure 4.5**. Therefore, laneage improvements, including an exclusive southbound left-turn lane, would not be expected to provide significant benefit. Given the LOS A operations under build-out conditions, no improvements are recommended for capacity purposes. Review of auxiliary turn lane warrants at this intersection can be seen in Section 7.0.

**6.6 S POINT ROAD (NC 273) AND STOWE RD/MCKEE FARM LN**

**Table 6.6** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the unsignalized TWSC intersection of S Point Road (NC 273) and Stowe Road/McKee Farm Lane.

| Table 6.6 – S Point Road (NC 273) and Stowe Road/McKee Farm Lane |                |         |           |           |         |     |              |
|--|----------------|---------|-----------|-----------|---------|-----|--------------|
| Condition  | Measure        | EB      | WB        | NB        | SB      |     | Intersection |
|  |                | EBLTR   | WBLTR     | NBLT      | SBL     | SBT |              |
| <b>AM Peak Hour</b>  |                |         |           |           |         |     |              |
| 2017 Existing  | LOS (Delay)    | F (Err) | F (155.7) | A (0.5)   | A (1.3) |     |              |
|  | Synchro 95th Q | Err     | 227'      | 1'        | 11'     | 0'  |              |
| 2025 Background  | LOS (Delay)    | F (Err) | F (Err)   | A (0.0)   | A (1.2) |     |              |
|  | Synchro 95th Q | Err     | Err       | 1'        | 15'     | 0'  |              |
| 2025 Build-Out   | LOS (Delay)    | F (Err) | F (Err)   | A (0.0)   | A (1.4) |     |              |
|  | Synchro 95th Q | Err     | Err       | 1'        | 22'     | 0'  |              |
| 2025 Build-Out IMP - 2 NB/SBTs                                   | LOS (Delay)    | F (Err) | F (Err)   | A (0.2)   | A (1.5) |     |              |
|  | Synchro 95th Q | Err     | Err       | 1'        | 23'     | 0'  |              |
| 2030 Build-Out   | LOS (Delay)    | F (Err) | F (Err)   | A (0.3)   | A (2.8) |     |              |
|  | Synchro 95th Q | Err     | Err       | 1'        | 50'     | 0'  |              |
| <b>PM Peak Hour</b>  |                |         |           |           |         |     |              |
| 2017 Existing  | LOS (Delay)    | F (Err) | F (577.7) | A (0.5)   | A (1.0) |     |              |
|  | Synchro 95th Q | Err     | 250'      | 1'        | 12'     | 0'  |              |
| 2025 Background  | LOS (Delay)    | F (Err) | F (Err)   | F (79.3)  | A (0.6) |     |              |
|  | Synchro 95th Q | Err     | Err       | 13'       | 14'     | 0'  |              |
| 2025 Build-Out   | LOS (Delay)    | F (Err) | F (Err)   | F (660.3) | A (0.6) |     |              |
|  | Synchro 95th Q | Err     | Err       | 33'       | 18'     | 0'  |              |
| 2025 Build-Out IMP - 2 NB/SBTs                                   | LOS (Delay)    | F (Err) | F (Err)   | A (0.4)   | A (0.6) |     |              |
|  | Synchro 95th Q | Err     | Err       | 2'        | 18'     | 0'  |              |
| 2030 Build-Out   | LOS (Delay)    | F (Err) | F (Err)   | A (2.2)   | A (0.9) |     |              |
|  | Synchro 95th Q | Err     | Err       | 5'        | 35'     | 0'  |              |

**Table 6.6** shows the stop-controlled side-street approaches of Stowe Road and McKee Farm Lane currently experience long delays during both the AM and PM peak hours, and are expected to experience further delay and continue to operate with long delays under 2025 background conditions. The increase in delay on the side streets between existing and background conditions is primarily due to the reduction in the gaps available to be able to turn onto the mainline, caused by the growth in traffic volume along S Point Road (NC 273).

Also note the increase in delay on the northbound approach of S Point Road (NC 273) during the PM peak hour between existing and background conditions. As shown in **Figure 4.5**, the existing northbound left-turn traffic remains constant through background conditions at five vehicles; however, the conflicting southbound traffic during the PM peak hour increases to over capacity at a v/c ratio of 1.08, indicating there is a lack of gaps for not only the side-street traffic, but also the northbound left-turn traffic. The analysis shows that this causes extensive delay for the steady northbound through traffic each time a northbound left-turn vehicle approaches and waits for an acceptable gap to turn. There is currently no northbound left-turn lane at this intersection.

When the proposed site traffic is added to the 2025 background volume, this issue is further exacerbated and gaps are reduced along the mainline even further, increasing the v/c ratio to 1.31 for the southbound traffic during the PM peak hour. **Table 6.6** shows that the average delay along the northbound approach increases to 660 seconds per vehicle (11 minutes), while the delays on the side-street approaches are well over theoretical capacity during both peak hours and cannot

be calculated. Note that the 11 minutes per vehicle reflects the average for an approach that is expected to include over 1,300 vehicles per hour.

Considering the recommended improvements described in Sections 6.2 and 6.3 south along S Point Road (NC 273) at Henry Chapel Road and Forest Hill Road, the benefit from the increase in throughput capacity would only be fully realized if the additional through lanes along S Point Road (NC 273) were extended to a logical terminus where a significant amount of traffic is dispersed. However, traffic volumes increase along S Point Road (NC 273) heading north from Henry Chapel Road and Forest Hill Road, and do not disperse away from S Point Road (NC 273) until R L Stowe Road. Therefore, the two northbound and two southbound through lanes along S Point Road (NC 273) are recommended to extend through the Stowe Road/McKee Farm Lane intersection.

This recommendation also addresses the mainline capacity issues discussed above and the added capacity allows for additional gaps for the northbound left-turn traffic and the side street traffic. **Table 6.3** shows that this improvement is expected to significantly reduce delay along the northbound approach, and improve the v/c ratio to 0.84 for the southbound approach during the PM peak hour.

Note that the delay and LOS for the side streets are still over the theoretical capacity during both peak hours and cannot be calculated. It is not uncommon for minor-street, stop-controlled approaches to experience long delays in the peak hours due to major street volumes. Being currently unsignalized, the analysis shows that modifying access control at this intersection, such as installing a traffic signal, would be required to reduce the side-street delay at this intersection during the peak hours. However, because this issue is shown prior to build-out conditions of the proposed site, signalization of this intersection is not recommended to mitigate the impacts of the proposed development. Additionally, as discussed in Section 4.2, the planned connection between Stowe Road and R L Stowe Road as part of the approved Belmont Town Center development is expected to provide relief as an alternate route for the westbound approach volume.

Given the negative impact caused by the project, the following improvements are recommended to mitigate the added delay caused by the addition of site traffic:

- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

Review of auxiliary turn-lane warrants at this intersection can be seen in Section 7.0.

## 6.7 S POINT ROAD (NC 273) AND S POINT HS/RED RAIDER RUN

**Table 6.7** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the signalized intersection of S Point Road (NC 273) and South Point High School/Red Raider Run. Red Raider Run serves as a signalized driveway to Belmont Town Center, which is currently only partially open and still developing based on the approved plan described in Section 4.2. Note that the eastbound approach serves as an entrance only for South Point High School; therefore, there is no exiting volume, and thus no operations reported for the eastbound approach.

| Table 6.7 – S Point Road (NC 273) and South Point HS/Red Raider Run |                |          |      |           |        |           |        |              |
|---|----------------|----------|------|-----------|--------|-----------|--------|--------------|
| Condition   | Measure        | WB       |      | NB        |        | SB        |        | Intersection |
|   |                | WBTL     | WBR  | NBL       | NBTR   | SBL       | SBTR   |              |
| <b>AM Peak Hour</b>   |                |          |      |           |        |           |        |              |
| 2017 Existing   | LOS (Delay)    | D (40.1) |      | C (20.3)  |        | B (20.0)  |        | C (20.8)     |
|   | Synchro 95th Q | 32'      | 21'  | 31'       | #1378' | 5'        | 430'   |              |
| 2025 Background   | LOS (Delay)    | D (49.6) |      | F (156.5) |        | B (18.7)  |        | F (107.9)    |
|   | Synchro 95th Q | 102'     | 69'  | 48'       | #2784' | 52'       | 761'   |              |
| 2025 Build-Out  | LOS (Delay)    | E (55.8) |      | F (254.2) |        | C (29.5)  |        | F (177.0)    |
|   | Synchro 95th Q | 112'     | 81'  | 53'       | #3447' | 51'       | 1001'  |              |
| 2025 Build-Out IMP - 2 NBTs   | LOS (Delay)    | C (34.3) |      | B (19.9)  |        | D (43.5)  |        | C (27.8)     |
|   | Synchro 95th Q | 82'      | 53'  | #163'     | #1033' | 29'       | #1075' |              |
| 2025 Build-Out IMP - 2 NB/SBTs                                      | LOS (Delay)    | C (26.9) |      | B (18.1)  |        | A (9.2)   |        | B (15.6)     |
|   | Synchro 95th Q | 82'      | 26'  | 57'       | #1034' | 30'       | 283'   |              |
| 2030 Build-Out  | LOS (Delay)    | C (27.6) |      | D (37.5)  |        | B (11.0)  |        | C (28.9)     |
|   | Synchro 95th Q | 88'      | 31'  | 80'       | #1329' | 34'       | 386'   |              |
| <b>PM Peak Hour</b>   |                |          |      |           |        |           |        |              |
| 2017 Existing   | LOS (Delay)    | C (22.5) |      | B (19.2)  |        | B (17.4)  |        | B (18.7)     |
|   | Synchro 95th Q | 113'     | 19'  | 3'        | #515'  | 15'       | #808'  |              |
| 2025 Background   | LOS (Delay)    | E (58.9) |      | D (41.8)  |        | F (132.7) |        | F (90.6)     |
|   | Synchro 95th Q | #295'    | 156' | 9'        | #1600' | #115'     | #2454' |              |
| 2025 Build-Out  | LOS (Delay)    | E (69.0) |      | F (100.9) |        | F (250.8) |        | F (176.9)    |
|   | Synchro 95th Q | #348'    | 191' | 16'       | #2046' | #115'     | #3192' |              |
| 2025 Build-Out IMP - 2 NBTs   | LOS (Delay)    | E (66.5) |      | B (12.6)  |        | F (257.0) |        | F (146.9)    |
|   | Synchro 95th Q | #335'    | 205' | 14'       | 446'   | 30'       | #3209' |              |
| 2025 Build-Out IMP - 2 NB/SBTs                                      | LOS (Delay)    | D (47.6) |      | B (16.4)  |        | C (22.1)  |        | C (22.5)     |
|   | Synchro 95th Q | 289'     | 199' | 15'       | 496'   | 35'       | 941'   |              |
| 2030 Build-Out  | LOS (Delay)    | E (66.9) |      | B (18.3)  |        | E (74.9)  |        | D (52.9)     |
|   | Synchro 95th Q | #356'    | 243' | 16'       | 711'   | 74'       | #1450' |              |

**Table 6.7** shows the overall intersection is expected to operate at LOS F during both the AM and PM peak hours under 2025 background conditions. When the proposed site traffic is added to the 2025 background volume, the overall intersection delay increases while expected to continue to operate at LOS F. Given the negative impact caused by the project, identification of mitigation improvements is required. The following options for laneage improvements were evaluated at this intersection to develop recommendations to mitigate the increase in delay and to accommodate the added site traffic, while minimizing disruption to the background traffic:

1. Two northbound through lanes
2. Two northbound/southbound through lanes

### Option 1 – Two Northbound Through Lanes

As previously discussed at other intersections along S Point Road (NC 273), the through volume along this highway is near or at capacity under 2025 background conditions during the peak hours.

When proposed site traffic is added, this roadway becomes further stressed. **Table 6.7** shows that during the AM peak hour under 2025 build-out conditions, the northbound approach is expected to operate with an average of 254 seconds of delay per vehicle (over four minutes) and the 95<sup>th</sup> percentile queue length is expected to extend nearly 3,500 feet, extending nearly to Forest Hill Road. The v/c ratio for this approach is expected to be 1.56 under AM peak-hour build-out conditions. Also note that the v/c ratio for the southbound approach during the PM peak hour is expected to be 1.52.

**Table 6.7** shows that the installation of an additional northbound through lane along S Point Road (NC 273) would be expected to improve operations for this intersection during the AM peak hour; however, this improvement does not address the traffic impacts to the southbound approach during the PM peak hour.

Option 2 – Two Northbound/Southbound Through Lanes

**Table 6.7** shows that the installation of an additional northbound and southbound through lane along S Point Road (NC 273) would be expected to improve operations and queuing and mitigate the traffic impacts caused by the proposed site at this intersection during both peak hours. With these improvements in place, the intersection is expected to operate at LOS B during the AM peak hour and LOS C during the PM peak hour.

Additionally, with consideration for the recommended improvements described in Sections 6.2, 6.3 and 6.6 south along S Point Road (NC 273), the benefit from the increase in throughput capacity would only be fully realized if the additional through lanes along S Point Road (NC 273) were extended to a logical terminus where a significant amount of traffic is dispersed. However, traffic volumes increase along S Point Road (NC 273) heading north from Henry Chapel Road and Forest Hill Road, and do not disperse away from S Point Road (NC 273) until R L Stowe Road. Therefore, the two northbound and two southbound through lanes along S Point Road (NC 273) are recommended to extend through the South Point High School/Red Raider Run intersection.

This recommendation addresses the mainline capacity issues discussed above, improving the v/c ratio for the northbound approach during the AM peak hour from 1.56 to 0.87 and the southbound approach during the PM peak hour from 1.52 to 0.89.

Given the negative impact caused by the project, the following improvements are recommended to mitigate the added delay caused by the addition of site traffic:

- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

## 6.8 S POINT ROAD (NC 273) AND R L STOWE RD/NIXON RD

**Table 6.8** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the signalized intersection of S Point Road (NC 273) and R L Stowe Road/Nixon Road.

| <b>Table 6.8 – S Point Road (NC 273) and R L Stowe Road/Nixon Road</b> |                |           |       |           |        |           |        |        |           |        |              |
|--|----------------|-----------|-------|-----------|--------|-----------|--------|--------|-----------|--------|--------------|
| Condition  | Measure        | EB        |       | WB        |        | NB        |        |        | SB        |        | Intersection |
|  |                | EBL       | EBTR  | WBL       | WBTR   | NBL       | NBT    | NBR    | SBL       | SBTR   |              |
| <b>AM Peak Hour</b>  |                |           |       |           |        |           |        |        |           |        |              |
| 2017 Existing  | LOS (Delay)    | C (24.9)  |       | C (26.7)  |        | B (15.7)  |        |        | C (21.8)  |        | C (20.4)     |
|  | Synchro 95th Q | 137'      | 114'  | #175'     | 45'    | 25'       | 262'   | 105'   | 12'       | 194'   |              |
| 2025 Background  | LOS (Delay)    | F (115.7) |       | F (94.6)  |        | E (61.5)  |        |        | D (46.2)  |        | E (74.4)     |
|  | Synchro 95th Q | #621'     | #608' | #509'     | 229'   | #153'     | #1113' | 558'   | #100'     | #802'  |              |
| 2025 Build-Out   | LOS (Delay)    | F (118.1) |       | F (128.3) |        | F (104.1) |        |        | D (53.4)  |        | F (100.5)    |
|  | Synchro 95th Q | #621'     | #622' | #605'     | 229'   | #136'     | #1390' | #1095' | #100'     | #896'  |              |
| 2025 Build-Out IMP - WBL, WBLTR  | LOS (Delay)    | F (141.1) |       | F (149.3) |        | E (72.8)  |        |        | D (42.8)  |        | F (90.5)     |
|  | Synchro 95th Q | #714'     | #715' | #556'     | #549'  | #138'     | #1465' | #1210' | #120'     | 845'   |              |
| 2025 Build-Out IMP - Dual WBLs, WBTR                                   | LOS (Delay)    | F (130.7) |       | E (69.0)  |        | E (72.9)  |        |        | D (38.3)  |        | E (77.1)     |
|  | Synchro 95th Q | #633'     | #635' | #242'     | #266'  | #127'     | #1302' | #1094' | #100'     | 752'   |              |
| 2030 Build-Out   | LOS (Delay)    | F (208.8) |       | F (88.9)  |        | F (140.6) |        |        | E (61.1)  |        | F (132.2)    |
|  | Synchro 95th Q | #794'     | #782' | #313'     | #338'  | #173'     | #1603' | #1462' | #120'     | #1078' |              |
| <b>PM Peak Hour</b>  |                |           |       |           |        |           |        |        |           |        |              |
| 2017 Existing  | LOS (Delay)    | A (8.6)   |       | D (40.9)  |        | B (15.9)  |        |        | D (40.3)  |        | C (28.6)     |
|  | Synchro 95th Q | 30'       | 37'   | #434'     | 30'    | #54'      | 216'   | 62'    | 24'       | #432'  |              |
| 2025 Background  | LOS (Delay)    | E (67.7)  |       | F (402.6) |        | E (61.2)  |        |        | F (107.6) |        | F (165.5)    |
|  | Synchro 95th Q | 153'      | 259'  | #1493'    | 185'   | #219'     | 688'   | 102'   | 83'       | #1400' |              |
| 2025 Build-Out   | LOS (Delay)    | E (69.2)  |       | F (568.2) |        | E (77.3)  |        |        | F (189.0) |        | F (241.4)    |
|  | Synchro 95th Q | 153'      | #293' | #1831'    | 185'   | #219'     | #917'  | 163'   | #140'     | #1740' |              |
| 2025 Build-Out IMP - WBL, WBLTR  | LOS (Delay)    | E (77.6)  |       | F (441.9) |        | E (70.2)  |        |        | F (115.0) |        | F (184.1)    |
|  | Synchro 95th Q | 164'      | #334' | #1212'    | #1201' | #239'     | 771'   | 173'   | 76'       | #1703' |              |
| 2025 Build-Out IMP - Dual WBLs, WBTR                                   | LOS (Delay)    | E (62.1)  |       | F (329.5) |        | D (51.8)  |        |        | F (122.6) |        | F (148.0)    |
|  | Synchro 95th Q | 143'      | 260'  | #814'     | 193'   | #201'     | 720'   | 153'   | 75'       | #1539' |              |
| 2030 Build-Out   | LOS (Delay)    | E (65.9)  |       | F (452.7) |        | F (80.0)  |        |        | F (210.3) |        | F (217.3)    |
|  | Synchro 95th Q | 162'      | #330' | #975'     | 219'   | #239'     | #988'  | 298'   | #118'     | #1859' |              |

**Table 6.8** shows the overall intersection is expected to operate at LOS E during the AM peak hour and LOS F during the PM peak hour under 2025 background conditions. When the proposed site traffic is added to the 2025 background volume, the overall intersection degrades from LOS E to LOS F during the AM peak hour and the overall intersection delay increases while expected to continue to operate at LOS F during the PM peak hour. Given the negative impact caused by the project, identification of mitigation improvements is required. The following options for laneage improvements were evaluated at this intersection to develop recommendations to mitigate the increase in delay and to accommodate the added site traffic, while minimizing disruption to the background traffic:

1. Convert the WBT/R to WBL/T/R
2. Install additional westbound left-turn lane

Option 1 – Convert the WBT/R to WBL/T/R

**Table 6.8** shows that the site is expected to add significant delay particularly to the westbound and southbound approaches during the PM peak hour. As shown in **Figure 5.3B**, the site is expected to add 157 trips (40% of the total entering site traffic) to each of these approaches. As discussed throughout this TIA, and as evidenced by the existing traffic volumes, this intersection is where a major portion of traffic disperses away from S Point Road (NC 273) heading northbound, but also

the point where two heavy traffic streams combine onto S Point Road (NC 273) heading southbound. The combination of these heavy flows southbound creates a particular issue because these two heavy movements, the southbound through and westbound left, conflict with one another. The heavy southbound volume demands green time from the signal, which reduces the amount available for the westbound approach, and vice versa.

One option evaluated was to convert the existing westbound through/right-turn lane into a shared left/through/right-turn lane, creating dual westbound left-turn movements. From a signal phasing perspective, this option is feasible based on the signal improvement project at this intersection currently being designed by NCDOT to install split phasing along the eastbound and westbound approaches. This laneage configuration can only be accommodated under split phasing operations.

Note that a second receiving lane would be required under this option. This additional receiving lane southbound along S Point Road (NC 273) would be consistent with the recommendations at the downstream intersections along S Point Road (NC 273) where additional through lanes are recommended to increase capacity and mitigate the proposed site traffic.

However, as shown in **Table 6.8**, this recommendation does not fully mitigate the impacts from the proposed site traffic. Under this option, the overall intersection would still be expected to operate with more delay during both peak hours than the expected delay under background conditions.

#### Option 2 – Install Additional Westbound Left-Turn Lane

The second option evaluated was similar to Option 1 described above in that it operates under dual westbound left-turn lanes, yet Option 2 would not reduce the capacity for the existing westbound through/right lane. Instead, this option would require widening of the westbound approach to include dual left-turn lanes with a shared through/right-turn lane. Based on review of the approach volumes, the westbound through/right lane would develop with appropriate taper from the R L Stowe alignment, allowing the predominant left-turn movement to be better accommodated with adequate storage. The westbound through/right lane is recommended to accommodate a minimum of 275 feet of storage.

**Table 6.8** shows that this option would be expected to improve operations and queuing and mitigate the traffic impacts caused by the proposed site at this intersection during both peak hours. Note that the complexities and flexibilities with signalization can make it difficult to fully mitigate every approach back to background conditions at signalized intersections, especially when multiple approaches are already at capacity under background conditions. Therefore, efforts to mitigate the overall intersection delay was used as the primary mitigation measure at this intersection.

As discussed above, a second receiving lane would be required southbound along S Point Road (NC 273) with this improvement. This would be consistent with the recommendations at the downstream intersections along S Point Road (NC 273) where additional through lanes are recommended to increase capacity and mitigate the proposed site traffic. This second southbound through lane is recommended to begin as a receiving lane from R L Stowe Road and drop as a southbound left-turn lane at the proposed traffic signal at Henry Chapel Road. Additionally, the northbound right-turn lane along S Point Road (NC 273) at R L Stowe Road currently includes 100 feet of full-width storage. This turn lane is recommended to be extended to serve as the additional northbound through lane along S Point Road (NC 273) from a minimum of 400 feet south of Henry Chapel Road to drop as the right-turn lane at R L Stowe Road.

Based on the evaluation of the two options discussed above, the following improvements are recommended to mitigate the added delay caused by the addition of site traffic:

- Widen the westbound approach of R L Stowe Road to include dual left-turn lanes with a shared through/right-turn lane; shared through/right-turn lane to include a minimum of 275' of storage
- Additional receiving lane southbound along S Point Road (NC 273) that drops as a southbound left-turn lane at the proposed traffic signal at Henry Chapel Road
- Extend the existing northbound right-turn lane along S Point Road (NC 273) to 400 feet south of Henry Chapel Road to serve as the additional northbound through lane along S Point Road (NC 273) and drop as the right-turn lane at R L Stowe Road

## 6.9 HENRY CHAPEL ROAD AND DRIVEWAY #2

**Table 6.9** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the proposed full-movement intersection of Henry Chapel Road and Driveway #2. Driveway #2 is proposed to access Henry Chapel Road approximately 1,500 feet east of S Point Road (NC 273).

| Table 6.9 – Henry Chapel Road and Driveway #2               |                |         |         |          |              |
|---|----------------|---------|---------|----------|--------------|
| Condition   | Measure        | EBLT    | WBTR    | SBLR     | Intersection |
|   |                |         |         |          |              |
| <b>AM Peak Hour</b>   |                |         |         |          |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i> | LOS (Delay)    | A (3.5) | A (0.0) | A (9.2)  |              |
|   | Synchro 95th Q | 1'      | 0'      | 7'       |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>     | LOS (Delay)    | A (4.9) | A (0.0) | A (10.0) |              |
|   | Synchro 95th Q | 3'      | 0'      | 20'      |              |
| 2030 Build-Out (B)  | LOS (Delay)    | A (4.8) | A (0.0) | B (10.1) |              |
|   | Synchro 95th Q | 3'      | 0'      | 20'      |              |
| <b>PM Peak Hour</b>   |                |         |         |          |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i> | LOS (Delay)    | A (3.5) | A (0.0) | A (8.8)  |              |
|   | Synchro 95th Q | 4'      | 0'      | 4'       |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>     | LOS (Delay)    | A (5.2) | A (0.0) | A (9.2)  |              |
|   | Synchro 95th Q | 12'     | 0'      | 11'      |              |
| 2030 Build-Out (B)  | LOS (Delay)    | A (5.1) | A (0.0) | A (9.2)  |              |
|   | Synchro 95th Q | 13'     | 0'      | 11'      |              |
| (A): Full-movement, signalized scenario at Forest Hill Rd   |                |         |         |          |              |
| (B): Left-over, unsignalized scenario at Forest Hill Rd     |                |         |         |          |              |

The southbound egress lane was assumed to include a single lane based on the width provided in the current site plan and based on the assignment of site traffic where little to no site traffic is expected to turn left out of the site. As shown in **Table 6.9**, the southbound approach is expected to operate with short delays during both the AM and PM peak hours under build-out conditions.

Review of auxiliary turn-lane warrants at this intersection can be seen in Section 7.0. No further improvements are recommended at this intersection for capacity purposes.



**6.10 HENRY CHAPEL ROAD AND DRIVEWAY #3**

**Table 6.10** summarizes the LOS, control delay and 95<sup>th</sup> percentile queue lengths at the proposed full-movement intersection of Henry Chapel Road and Driveway #3. Driveway #3 is proposed to access Henry Chapel Road approximately 1,200 feet east of Driveway #2.

| Table 6.10 – Henry Chapel Road and Driveway #3              |                |         |         |         |              |
|---|----------------|---------|---------|---------|--------------|
| Condition   | Measure        | EBLT    | WBTR    | SBLR    | Intersection |
|   |                |         |         |         |              |
| <b>AM Peak Hour</b>   |                |         |         |         |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i> | LOS (Delay)    | A (4.5) | A (0.0) | A (8.8) |              |
|   | Synchro 95th Q | 1'      | 0'      | 5'      |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>     | LOS (Delay)    | A (5.1) | A (0.0) | A (8.9) |              |
|   | Synchro 95th Q | 1'      | 0'      | 6'      |              |
| 2030 Build-Out (B)  | LOS (Delay)    | A (4.8) | A (0.0) | A (8.9) |              |
|   | Synchro 95th Q | 1'      | 0'      | 6'      |              |
| <b>PM Peak Hour</b>   |                |         |         |         |              |
| 2025 Build-Out (A) -<br><i>Full Movement at Forest Hill</i> | LOS (Delay)    | A (4.4) | A (0.0) | A (8.5) |              |
|   | Synchro 95th Q | 3'      | 0'      | 3'      |              |
| 2025 Build-Out (B) -<br><i>Left-over at Forest Hill</i>     | LOS (Delay)    | A (4.9) | A (0.0) | A (8.6) |              |
|   | Synchro 95th Q | 4'      | 0'      | 4'      |              |
| 2030 Build-Out (B)  | LOS (Delay)    | A (4.6) | A (0.0) | A (8.6) |              |
|   | Synchro 95th Q | 4'      | 0'      | 4'      |              |
| (A): Full-movement, signalized scenario at Forest Hill Rd   |                |         |         |         |              |
| (B): Left-over, unsignalized scenario at Forest Hill Rd     |                |         |         |         |              |

The southbound egress lane was assumed to include a single lane based on the width provided in the current site plan and based on the assignment of site traffic where little to no site traffic is expected to turn left out of the site. As shown in **Table 6.10**, the southbound approach is expected to operate with short delays during both the AM and PM peak hours under build-out conditions.

Review of auxiliary turn-lane warrants at this intersection can be seen in Section 7.0. No further improvements are recommended at this intersection for capacity purposes.

## 7.0 Turn Lane & Signal Warrants

### 7.1 AUXILIARY TURN LANE WARRANT ANALYSIS

Warrants for additional turn-lane improvements for unsignalized intersections beyond those necessary for capacity were determined based on a review of the figure titled 'Warrant for Left and Right-Turn Lanes' found on page 80 in the *NCDOT Policy On Street And Driveway Access to North Carolina Highways*. The results of the warrants for left and right-turn lanes under 2025 background and build-out conditions are summarized by intersection below and included in the **Appendix**.

#### 2025 Background Conditions

No auxiliary turn lanes were warranted at stop-controlled intersections under 2025 background conditions.

#### 2025 Build-out Conditions

##### ***S Point Road and Forest Hill Road***

- Southbound left-turn lane along S Point Road (NC 273) with a minimum storage length of 500'

The auxiliary turn-lane warrant figures provided by NCDOT report recommended storage lengths typically based on conflicting traffic volumes within a single lane of traffic. However, as discussed in Section 6.3, two northbound through lanes are recommended, allowing for additional gaps for the southbound left-turn vehicles. Additionally, based on discussions with City of Belmont staff, this location should not be intended to serve as a primary entrance to the proposed Henry Chapel development. Instead, Henry Chapel Road is recommended to serve as the primary access. Accommodating 500 feet of southbound left-turn storage at Forest Hill Road would be expected to further promote the use of this access into the proposed development, thus adding significant traffic through the South Hill Estate neighborhood. Therefore, a southbound left-turn lane with 100 feet of storage is recommended to be constructed at this intersection, as discussed in Section 6.3.

##### ***Forest Hill Road and Colonial Drive***

- Eastbound right-turn lane along Forest Hill Road with a minimum storage length of 100'

Under 2025 build-out conditions, the eastbound right-turn volume is expected to serve as 87% and 94% of the total eastbound approach volumes during the AM and PM peak hours, respectively. The largest eastbound through volume is expected to be less than 10 vehicles. Therefore, an eastbound right-turn lane is not recommended to be constructed given the limited benefit expected from separating the through and right-turn volume. Additionally, installing this turn lane would likely promote additional site traffic through this neighborhood.

##### ***Henry Chapel Road and Driveway #2***

- Eastbound left-turn lane along Henry Chapel Road with a minimum storage length of 50'

## 7.2 TRAFFIC SIGNAL WARRANT ANALYSIS

Based on the approved MOU, a traffic signal warrant analysis was performed for the 2025 build-out year for the intersections of S Point Road (NC 273) at Henry Chapel Road and S Point Road (NC 273) at Forest Hill Road, based on the guidelines published by the Federal Highway Administration (FHWA) in the *Manual on Uniform Traffic Control Devices (MUTCD), 2009 Edition*. Signal warrant analyses were based on existing weekday traffic volumes collected over a 13-hour period at each intersection and developed by adding 2025 historical growth traffic, approved development traffic, along with proposed site traffic.

For signal warrant analysis, the MUTCD provides the following standards:

- An engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether installation of a traffic control signal is justified at a particular location.
- The investigation of the need for a traffic control signal shall include an analysis of factors related to the existing operation and safety at the study location and the potential to improve these conditions, and the applicable factors contained in the following signal warrants:
  - Warrant 1, Eight-Hour Vehicular Volume
  - Warrant 2, Four-Hour Vehicular Volume
  - Warrant 3, Peak Hour
  - Warrant 4, Pedestrian Volume
  - Warrant 5, School Crossing
  - Warrant 6, Coordinated Signal System
  - Warrant 7, Crash Experience
  - Warrant 8, Roadway Network
  - Warrant 9, Intersection Near a Grade Crossing

Warrant 1 Condition A is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic signal. Warrant 1 Condition B is intended for application where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. If a combination of Condition A and Condition B are not satisfied, Warrant 1 may be satisfied by Condition C.

Warrant 2 is intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic signal.

Warrant 3 is intended for use at a location where traffic conditions are such that for a minimum of one hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street.

A traffic control signal should not be installed unless one or more of the above warrants are met. However, the satisfaction of a traffic signal warrant or warrants should not in itself require the installation of a traffic control signal.

**Table 7.1** shows the results of the signal warrant analyses for S Point Road (NC 273) at Henry Chapel Road under both 2025 background and build-out conditions, along with number of hours satisfied against the number of hours required. Build-out conditions reflects volumes under the preferred scenario with left-over access at Forest Hill Road, with the intent for Henry Chapel Road to serve as the primary access for the proposed development.

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*Henry Chapel Residential Development  
Traffic Impact Analysis*

| <b>Table 7.1 – S Point Road (NC 273) at Henry Chapel Road</b><br><b>Traffic Signal Warrant Analysis Results</b><br>Criteria satisfied/not satisfied (hours satisfied/required) |                          |                           |
|--|--------------------------|---------------------------|
| Warrant  | 2025 Background          | 2025 Build-Out            |
| 1A (Eight Hour)  | Not Satisfied (0/8)      | Not Satisfied (3/8)       |
| 1B (Eight Hour)  | Not Satisfied (0/8)      | Satisfied (12/8)          |
| 1C (Eight Hour)  | Not Satisfied (0/8, 0/8) | Not Satisfied (2/8, 12/8) |
| 2 (Four Hour)  | Not Satisfied (0/4)      | Satisfied (12/4)          |
| 3 (Peak Hour)  | Not Satisfied (0/1)      | Satisfied (12/1)          |

Based on results shown in **Table 7.1**, Warrants 1B, 2, and 3 are all met with the addition of the proposed site traffic at this intersection. Signal warrant calculations are included in the **Appendix**.

**Table 7.2** shows the results of the signal warrant analyses for S Point Road (NC 273) at Forest Hill Road under both 2025 background and build-out conditions, along with number of hours satisfied against the number of hours required. Build-out conditions reflects volumes under the preferred scenario with left-over access at Forest Hill Road.

| <b>Table 7.2 – S Point Road at Forest Hill Road</b><br><b>Traffic Signal Warrant Analysis Results</b><br>Criteria satisfied/not satisfied (hours satisfied/required) |                          |                          |
|--|--------------------------|--------------------------|
| Warrant  | 2025 Background          | 2025 Build-Out           |
| 1A (Eight Hour)  | Not Satisfied (0/8)      | Not Satisfied (0/8)      |
| 1B (Eight Hour)  | Not Satisfied (0/8)      | Not Satisfied (1/8)      |
| 1C (Eight Hour)  | Not Satisfied (0/8, 0/8) | Not Satisfied (0/8, 0/8) |
| 2 (Four Hour)  | Not Satisfied (0/4)      | Not Satisfied (0/4)      |
| 3 (Peak Hour)  | Not Satisfied (0/1)      | Not Satisfied (0/1)      |

Based on results shown in **Table 7.2**, a traffic signal is not warranted for any vehicular volume-based warrant for this intersection without or without the addition of proposed site traffic. Signal warrant calculations are included in the **Appendix**.

## 8.0 Crash Data Analysis

Crash data was obtained at study intersections for crashes that occurred between December 1, 2014, and November 30, 2017. Over this three-year period, 32 total crashes were reported at the eight existing study intersections. Note that there were no reported crashes at the study intersections of Forest Hill Road/Colonial Drive and Colonial Drive/Timber Ridge Road. Therefore, only the crash data at the intersections along S Point Rd (NC 273) were used in the crash summaries outlined in this section. The breakdown of crashes at these six study intersections by severity, frequency and accident type can be seen the tables below.

**Table 8.1 – Crash Severity Summary**

| Crash Type           | Number of Crashes |
|----------------------|-------------------|
| Fatal Crashes        | 0                 |
| Class A              | 1                 |
| Class B              | 1                 |
| Class C              | 10                |
| Property Damage Only | 20                |
| <b>Total</b>         | <b>32</b>         |

**Table 8.1** above displays the total number of crashes by severity type from most to least severe. As shown, there were no fatal crashes reported in the study area intersections over the past three years. ‘Class A’ incidents are crashes in which serious injury is suspected, which can include significant loss of blood or broken bones, and ‘Class B’ incidents are crashes in which minor injury is suspected, such as bruises or minor cuts. There was one of each of these crash types within the study area reported over the three years. There were 10 ‘Class C’ crashes reported, which are defined as crashes wherein possible injuries occur. Possible injuries are injuries reported by the person or indicated by his/her behavior, but no wounds or injuries are physically present, such as limping or complaint of neck pain. There were 20 crashes in which only property damage occurred, meaning no injury was reported in 62% of the recorded crashes at the study intersections.

**Table 8.2 – Accident Frequency Summary**

| Location                    | Crashes/100 MEV |
|-----------------------------|-----------------|
| Armstrong Road              | 77.12           |
| Henry Chapel Road           | 7.42            |
| R L Stowe Road / Nixon Road | 66.19           |
| <b>Average</b>              | <b>49.52</b>    |

Crash rates per 100 million entering vehicles (MEV) can only be reported for intersections with adequate ADT information. Therefore, crash rates could only be presented at the S Point Road (NC 273) intersections at Armstrong Road (NC 273), Henry Chapel Road, and R L Stowe Road/Nixon Road. Their rates resulted in a weighted average crash rate of 49.52 crashes per 100 MEV, with the highest rate occurring at the intersection of S Point Road (NC 273) and Armstrong Road (NC 273) intersection. As mentioned in Sections 4.3 and 6.1, this intersection currently has a planned project seeking funding to convert the two-way, stop-controlled intersection to a roundabout. Although this project is not classified as a SPOT Safety project, roundabout conversions in general are typically performed at intersections with high crash rates in order to address safety issues, such as a high number of crashes. The roundabout is assumed to have a positive impact on this rate upon completion.

**Table 8.3 – Accident Type Summary**

| Accident Type                         | Armstrong Rd | Henry Chapel Rd | Forest Hill Rd | Stowe Rd/ McKee Farm Ln | South Point HS Drive | R L Stowe Rd/ Nixon Rd |
|---------------------------------------|--------------|-----------------|----------------|-------------------------|----------------------|------------------------|
| <b>Angle</b>                          | 0            | 0               | 0              | 2                       | 0                    | 2                      |
| <b>Left-Turn, Different Roadways</b>  | 3            | 0               | 1              | 0                       | 0                    | 0                      |
| <b>Left-Turn, Same Roadway</b>        | 1            | 0               | 1              | 0                       | 0                    | 0                      |
| <b>Other Non-Collision</b>            | 1            | 0               | 0              | 0                       | 0                    | 0                      |
| <b>Ran off Road - Right</b>           | 0            | 0               | 0              | 1                       | 0                    | 0                      |
| <b>Rear End, Slow or Stop</b>         | 0            | 1               | 4              | 0                       | 2                    | 10                     |
| <b>Right-Turn, Different Roadways</b> | 1            | 0               | 0              | 0                       | 0                    | 1                      |
| <b>Sideswipe Same Direction</b>       | 0            | 0               | 0              | 0                       | 0                    | 1                      |
| <b>Total</b>                          | <b>6</b>     | <b>1</b>        | <b>6</b>       | <b>3</b>                | <b>2</b>             | <b>14</b>              |

At the six study intersections, the most common crash type was a rear-end collision caused by a slowing or stopping vehicle, with over 50% of crashes. This crash type is often associated with mainline traffic along a corridor with unsignalized turning movements with the lack of turn lanes onto side-streets. These crashes are typically on the lower end of the severity spectrum, which correlates with the data presented in **Table 8.1**.

In addition to intersection crash data, potentially hazardous location reports were obtained from the North Carolina Highway Safety Improvement Program (HSIP). The HSIP has a systematic process used to identify areas with safety concerns throughout the state, based on warrant criteria, crash rates and patterns, and field investigations. After a review of these reports, it is noted that no study intersections or roadway segments within the study area are currently considered a potential safety hazard.

## 9.0 Recommendations

Based on the capacity analyses performed at each of the identified study intersections, along with review of auxiliary turn-lane warrants, signal warrants and crash analyses contained herein, the following improvements are recommended to mitigate the impact of the proposed development on the adjacent street network:

### **S Point Road (NC 273) and Armstrong Road (NC 273)**

- Southbound right-turn bypass lane along S Point Road (NC 273) with a minimum of 100' of storage

### **S Point Road (NC 273) and Henry Chapel Road**

- Installation of a traffic signal upon meeting applicable MUTCD warrants
- Southbound left-turn lane along S Point Road (NC 273) that serves as a drop lane at Henry Chapel Road extending from R L Stowe Road
- Westbound right-turn lane along Henry Chapel Road with a minimum of 200' of storage
- Additional northbound through lane along S Point Road (NC 273) that provides a minimum of 400' of storage and extends north to drop as a right-turn lane at R L Stowe Road

### **S Point Road (NC 273) and Forest Hill Road**

- Modify access control to provide southbound and northbound left-over access, restricting side-street left and through movements
- Southbound left-turn lane along S Point Road (NC 273) with a minimum of 100' of storage
- Northbound left-turn lane along S Point Road (NC 273) with a minimum of 50' of storage
- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

### **S Point Road (NC 273) and Stowe Road/McKee Farm Road**

- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

### **S Point Road (NC 273) and South Point High School/Red Raider Run**

- Additional northbound through lane along S Point Road (NC 273)
- Additional southbound through lane along S Point Road (NC 273)

### **S Point Road (NC 273) and R L Stowe Road/Nixon Road**

- Widen the westbound approach of R L Stowe Road to include dual left-turn lanes with a shared through/right-turn lane; shared through/right-turn lane to include a minimum of 275' of storage
- Additional receiving lane southbound along S Point Road (NC 273) that drops as a southbound left-turn lane at the proposed traffic signal at Henry Chapel Road
- Extend the existing northbound right-turn lane along S Point Road (NC 273) to 400 feet south of Henry Chapel Road to serve as the additional northbound through lane along S Point Road (NC 273) and drop as the right-turn lane at R L Stowe Road

### **Henry Chapel Road and Driveway #2**

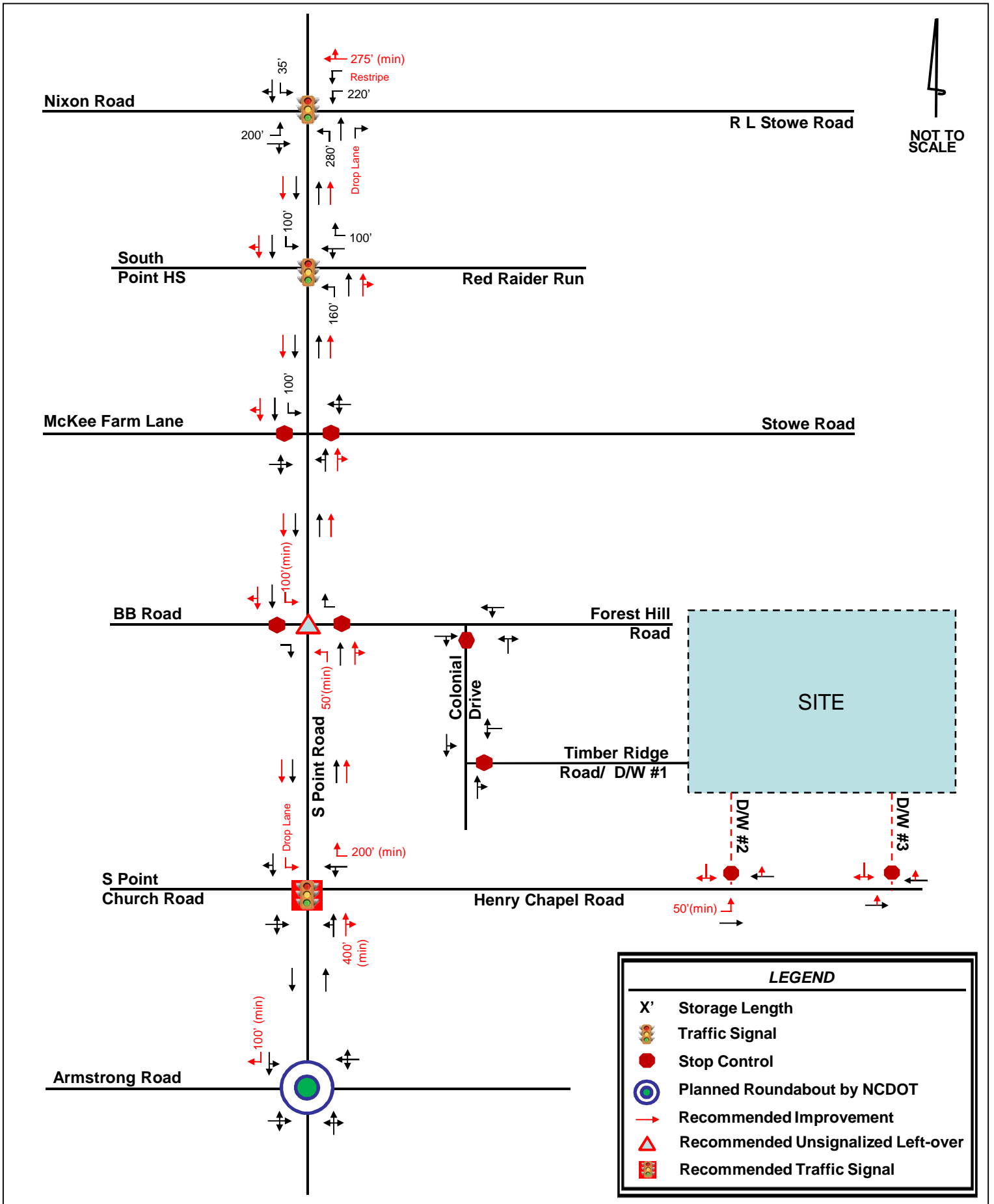
- Eastbound left-turn lane along Henry Chapel Road with a minimum storage length of 50'
- Single southbound egress and single ingress lane along Driveway #2

**Henry Chapel Road and Driveway #3**

- Single southbound egress and single ingress lane along Driveway #3

The recommended improvements within the study area are shown in **Figure 9.1**. The recommendations shown on this figure are subject to approval by NCDOT and the City of Belmont. All additions and attachments to the State and City roadway system shall be properly permitted, designed and constructed in conformance to standards maintained by the agencies.





**APPENDIX**