US 601 Corridor Study

Yadkinville, NC

Prepared for

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Executive Summary

Project Background

This report provides capacity and safety analyses for a portion of US 601 corridor in Yadkin County, NC. The overall objective of this transportation analysis effort is to identify the safety and operational deficiencies of this area and present the North Carolina Department of Transportation (NCDOT) with alternative measures that address the deficiencies.

The study will focus primarily on US 601 from SR 1146 (Lee Avenue) north of US 421 to SR 1742 (Sharon Road) south of US 421. Additionally, Carolina Avenue from Lee Avenue to Maple Street will also be analyzed as part of this study.

The following intersections were included in the study area and were analyzed for existing and future conditions:

- US 601 (South State Street) and SR 1146 (Lee Avenue) (*signalized*)
- US 601 (South State Street) and Maple Street (*unsignalized*)
- US 601 (South State Street) and SR 1415 (Beroth Drive) (*unsignalized*)
- US 601 (South State Street) and US 421 Northbound (NB) Ramps/SR 1421 (Pine Street) (*signalized*)
- US 601 (South State Street) and US 421 Southbound (SB) Ramps (*signalized*)
- US 601 (South State Street) and SR 1742 (Sharon Road)/Shopping Center Driveway (*signalized*)
- SR 1146 (Lee Avenue) and Carolina Avenue (*unsignalized*)
- West Maple Street and Carolina Avenue (*unsignalized*)
- SR 1421 (Pine Street) and US 421 NB Exit Slip Ramp (*unsignalized*)

This report summarizes the efforts that have gone into developing the recommendations, including the results of a road safety evaluation for improving safety and operations along the corridor.

Safety Analysis

A road safety evaluation was conducted at the onset of this project to identify the collision trends within the study area. Five years of reported crash data were obtained from NCDOT and were reviewed. The data indicate that there were 219

crashes reported along US 601 from SR 1742 (Sharon Road) to SR 1146 (Lee Avenue) within the analysis period. One fatality occurred along northbound US 601 under the US 421 bridge, between the southbound and northbound ramps. There were 71 (approximately 32%) non-fatal injury collisions and 147 (approximately 67%) collisions resulting in property damage only. The total crash rate along the corridor was 1,189.33 crashes per 100 million miles travelled which is more than double the statewide average for similar urban United States Routes (452.52). The most prevalent collision type within the study area was rear end crashes (33%), followed by left turn crashes (29%) and angle crashes (16%).

The most frequent number of crashes occurred at the unsignalized US 601 and Beroth Drive intersection (67) followed by the signalized US 601 and Lee Avenue intersection (31).

Once the historic data was evaluated, an on-site field assessment was conducted by members of the project team in a similar manner as a Federal Highway Administration (FHWA) Road Safety Audit (RSA), where the team specifically identifies roadway characteristics or deficiencies that may be contributing to the collision activity reported in the data. With each issue identified, a suggested improvement was developed to address the potential deficiency. The list of possible countermeasures was further refined into feasible recommendations that were also categorized as near-term, intermediate, and long-term improvements.

No-Build Capacity Analysis

AM, Midday and PM peak period capacity analyses were performed for existing conditions as well as for two future periods. To obtain the future year volumes, a one percent (1%) growth rate was applied to the existing turning movement volumes. In addition, trips expected to be generated from a few planned developments along the corridor were included in addition to the background growth. This report examines the following scenarios as part of this study:

- Existing (2013) Conditions – Reflects 2013 volumes with current lane configurations
- No-Build (2023) Conditions – Reflects 2023 volumes with current lane configurations
- No-Build (2033) Conditions – Reflects 2033 volumes with current lane configurations

Under the existing conditions, all the signalized intersections in the study area operate at an overall LOS C or better during AM, Midday and PM peak periods. All the unsignalized intersections operate at LOS D or better.

Under the No-Build (2023) and No-Build (2033) scenarios, all the signalized intersections continue to operate at acceptable levels of service with slight increase in delay. The US 601 and US 421 NB Ramps/Pine Street intersection is projected to

drop from an overall LOS C to D during the PM peak hour. The stop-controlled eastbound Beroth Drive approach is projected to operate at LOS F during the Midday and PM peak hours.

Table ES - 1 summarizes the level of service results across Existing (2013), No-Build (2023) and No-Build (2033) scenarios.

Table ES - 1 Existing (2013) and No-Build (2023 and 2033) Level of Service Results

ID	Intersection Name	Control	Existing 2013			No-Build 2023			No-Build 2033		
			AM	Midday	PM	AM	Midday	PM	AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	A (WB-B)	B (WB-B)	B (WB-C)	B (WB-B)	B (WB-C)	B (WB-C)	B (WB-B)	B (WB-C)	B (WB-C)
2	Maple Street & US 601 (South State Street)	Signalized	(WB-C)	(WB-C)	(WB-D)	(WB-C)	(WB-C)	(WB-D)	(WB-C)	(WB-C)	(WB-D)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	Unsignalized	(WB-C)	(EB-D)	(EB-D)	(EB-C)	(EB-F)	(EB-F)	(EB-D)	(EB-F)	(EB-F)
4	US 421 NB Ramp & US 601 (South State Street)	Unsignalized	C (NWB-D)	C (NWB-D)	C (NWB-D)	C (NWB-D)	C (NWB-D)	D (NWB-E)	C (NWB-D)	C (NWB-E)	D (NWB-E)
5	US 421 SB Ramp & US 601 (South State Street)	Signalized	B (EB-E)	A (EB-E)	A (EB-E)	C (EB-D)	B (EB-D)	C (EB-D)	C (EB-D)	C (EB-D)	B (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Unsignalized	A (EB-D)	C (EB-E)	C (EB-E)	B (EB-D)	C (EB-E)	C (EB-E)	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-A)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(NB-A)	(NB-A)	(NB-A)	(WB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

Corridor Plan Development

To develop a plan for the corridor, both safety aspects and capacity needs were considered. As the No-Build analysis results show, all of the signalized intersections operate at acceptable levels and several intersections even have excess capacity. As a result, VHB considered a road diet (three-lane section) along the full length of this corridor. Road diets are proven safety countermeasures that improve vehicular and pedestrian safety by reducing conflicts, reducing speeds, and reducing multi-threat collisions. Capacity analysis indicated that four lanes were, however required immediately north of the interchange. As a result, maintaining a four through lanes and using a raised median was studied through this section, which helps minimize overall conflict points and makes left-turn movements more predictable to drivers. Roundabouts were also studied due to their safety and capacity benefits as well as accommodation for U-turning vehicles.

One improvement option, referred to as Build 1 in this document, proposes installing a median along US 601 that results in a continuous median section from the US 421 NB Ramps to Maple Avenue and from US 421 SB Ramps to Sharon Road which would restrict Beroth Drive and the commercial driveways along US 601 to right-in/right-out movements only. In addition, this scenario assumed the installation of roundabouts at the US 601 intersections with Maple Avenue, US 421 NB Ramps, US 421 SB Ramps and Sharon Road. Left-turning traffic at properties along the median section may either use interconnected driveways to access adjacent full access intersections, or they may make downstream U-turns at the new roundabouts. The

roundabouts should be designed in a manner to accommodate heavy vehicle maneuvers. The section of US 601 between Maple Avenue and Lee Avenue would be converted into a three-lane roadway with a single lane each in northbound and southbound directions and a center two-way left-turn lane. The three lane section may continue to the north to connect to the existing three-lane section at Hemlock Street. The excess width may be converted to a bike lane, or perhaps on-street parking near the downtown. Figure ES-1 shows the recommended improvements associated with Build 1.

Build 2 was developed to address the most pressing safety concerns, and therefore includes shorter-term recommendations along the corridor aimed at providing low-cost improvements that enhance safety in the vicinity of intersections with the highest crash frequency. This option proposes a median from the US 421 NB Ramps to Beroth Drive and from the US 421 SB Ramps to Sharon Road. The median would be constructed such that the US 601 and Beroth Drive intersection would operate as a left-in, right-in/right-out intersection. Figure ES-2 shows the recommended improvements associated with Build 2.

Each option proposes the installation of a median along portions of the corridor, within the study limits. Medians have the effect of consolidating left-turn movements along the section, which minimizes overall conflict points along the corridor and makes the left-turn movements more predictable to drivers along US 601. Research has proven that medians substantially reduce the number of angle, left-turn, and head-on collisions, which are usually the most severe types of accidents. In lieu of turning left onto US 601 from the various driveways, drivers will instead turn right before making downstream U-turns. The inclusion of roundabouts as part of Build 1 allows improves the ability to U-turn at downstream intersections. The implementation of any of these options is projected to improve safety within the study area, however; delay may increase slightly at some of the intersections as a result of increased left-turn and U-turn volumes. In addition to any widening associated with the medians, the Build 1 option would require widening at the intersections for the construction of the roundabouts.

Build Capacity Analysis

Build 1

Based on Build 1 analysis, all the intersections in the study area are expected to operate at better levels of service when compared to No-Build scenarios with the exception of US 601 and Lee Avenue intersection. As a result of the road diet, this intersection is projected to drop from overall LOS B to LOS C during the PM peak hour under Build 1 (2023) conditions and during both AM and PM peak hours under Build 1 (2033) conditions. However, despite the reduction in through lanes, the intersection operates well within acceptable levels.

Although single lane roundabouts are preferred, capacity analyses indicated multilane configurations were required during the long-term peak periods. With the installation of roundabouts, the US 601 and US 421 NB Ramps/Pine Street intersection, the US 601 and US 421 SB Ramps intersection and the US 601 and Sharon Road intersection are projected to operate at LOS B or better during all three peak periods in 2023 and 2033 Build 1 scenarios. The roundabout controlled US 601 and Maple Street intersection is projected to operate at LOS A during the AM peak and LOS B during the Midday and PM peak.

With the installation of a median along the US 601 corridor, the US 601 and Beroth Drive intersection will be restricted to right-in/right-out only movements. The stop-controlled eastbound Beroth Drive is projected to operate at LOS C or better during all three peak periods under both 2023 and 2033 Build 1 conditions.

Build 2

Based on Build 2 analysis, all the intersections in the study area are expected to continue operating at acceptable levels of service. The US 601 and Lee Avenue intersection is projected to drop from overall LOS B to LOS C during the Midday and PM peak hours as a result of the road diet.

With the installation of a median along the US 601 corridor, the US 601 and Beroth Drive intersection will be restricted to left-in, right-in/right-out only movements. The stop-controlled eastbound Beroth Drive is projected to operate at LOS C or better during all three peak periods under both 2023 and 2033 Build 2 conditions.

Table ES-2 summarizes the level of service results across all the Build scenarios under both 2023 and 2033 conditions.

Table ES - 2 Build (2023 and 2033) Intersection Level of Service Results

ID	Intersection Name	Build 1 2023			Build 1 2033			Build 2 2023			Build 2 2033		
		AM	Midday	PM	AM	Midday	PM	AM	Midday	PM	AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	B (WB-C)	C (WB-C)	C (WB-D)	B (WB-C)	C (WB-D)	C (WB-D)	B (WB-C)	C (WB-C)	C (WB-D)	B (WB-C)	C (WB-D)	C (WB-D)
2	Maple Street & US 601 (South State Street)	A (NB-A)	B (NB-B)	B (NB-B)	A (NB-A)	B (NB-B)	B (NB-C)	(EB-B)	(EB-C)	(WB-C)	(WB-B)	(EB-C)	(WB-C)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	(EB-B)	(EB-B)	(EB-B)	(EB-B)	(EB-C)	(EB-C)	(EB-B)	(EB-B)	(EB-B)	(EB-B)	(EB-B)	(EB-C)
4	US 421 NB Ramp & US 601 (South State Street)	A (NB-A)	A (SB-B)	B (SB-C)	A (NB-B)	B (SB-B)	C (SB-C)	C (NWB-E)	C (NWB-E)	D (WB-E)	C (NWB-E)	C (NWB-E)	D (NWB-E)
5	US 421 SB Ramp & US 601 (South State Street)	A (EB-A)	A (EB-A)	B (EB-B)	A (EB-B)	A (EB-B)	B (EB-B)	C (EB-D)	B (EB-D)	C (EB-D)	C (EB-D)	C (EB-D)	C (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	A (NB-A)	A (SB-B)	B (SB-B)	A (NB-A)	B (SB-B)	B (SB-C)	B (EB-D)	C (EB-E)	C (EB-E)	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	(NB-A)	(NB-A)	(NB-A)	(WB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)

LEGEND: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

Roadway Improvement Recommendations

The following roadway improvements recommended for the Build 1 and Build 2 scenarios:

Build 1

US 601 (South State Street)

- Construct a median along US 601 between US 421 NB Ramps and Maple Street.
- Construct a median along US 601 between US 421 SB Ramps and Sharon Road.
- Restripe US 601 north of Maple Street to provide one travel lane in both the northbound and southbound directions and a center two-way left-turn lane.

US 601 (South State Street) and Lee Avenue

- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Maple Street

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides and one circulating lane on the north and south sides.
- Restripe the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Restripe the southbound US 601 approach to provide a shared left/through lane and a shared through/right-turn lane. The inside shared left/through lane on US 601 can transition to a center two-way left-turn lane north of Maple Street.

US 601 (South State Street) and Beroth Drive

- Restripe the Beroth Drive approach to provide a right-turn lane only movement.
- Modify the northbound US 601 approach to provide an exclusive through lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 NB Ramps

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides and one circulating lane on the north and south sides.
- Modify the westbound Pine Street approach to provide a shared left/through/right-turn lane.
- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

- Modify the southbound US 601 approach to provide a shared left/through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 SB Ramps

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides.
- Modify the US 421 SB Off-Ramp to provide a shared left/through/right-turn lane.
- Modify the northbound US 601 approach to provide a through lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a through lane.

US 601 (South State Street) and Sharon Road/Shopping Center Driveway

- Construct a single-lane roundabout at this intersection with a single entry and exit lane on all approaches.

Build 2

US 601 (South State Street)

- Construct a median along US 601 between US 421 NB Ramps and Beroth Drive.
- Construct a median along US 601 between US 421 SB Ramps and Sharon Road.
- Restripe US 601 north of Maple Street to provide one travel lane in both the northbound and southbound directions and a center two-way left-turn lane.

US 601 (South State Street) and Lee Avenue

- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Maple Street

- Restripe the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Restripe the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Beroth Drive

- Restripe the Beroth Drive approach to provide a right-turn lane only movement.
- Modify the northbound US 601 approach to provide an exclusive left-turn lane, a through lane, a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide a through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 NB Ramps

- Restripe the US 421 NB Off-Ramp approach to provide a shared left/through/right-turn lane and an exclusive right-turn lane.
- Construct a U-turn bulb in the northeast quadrant of the intersection to accommodate southbound U-turning maneuvers.

In addition to the above improvements, numerous low-cost safety improvements were identified along the corridor based on the Road Safety Assessment. These improvements include clearing obstructions in sight distance triangles, installing new signs, replacing old/missing signs, relocating stop-bars, optimizing signal timings, installing delineators, crosswalks and sidewalks, etc. If NCDOT chooses to implement any of these suggested improvements, they can be installed prior to or in conjunction with either Build 1 or Build 2.

Figure ES-1 and Figure ES-2 show the roadway improvements associated with Build 1 and Build 2. The recommended safety improvements are shown in Figure ES-3.

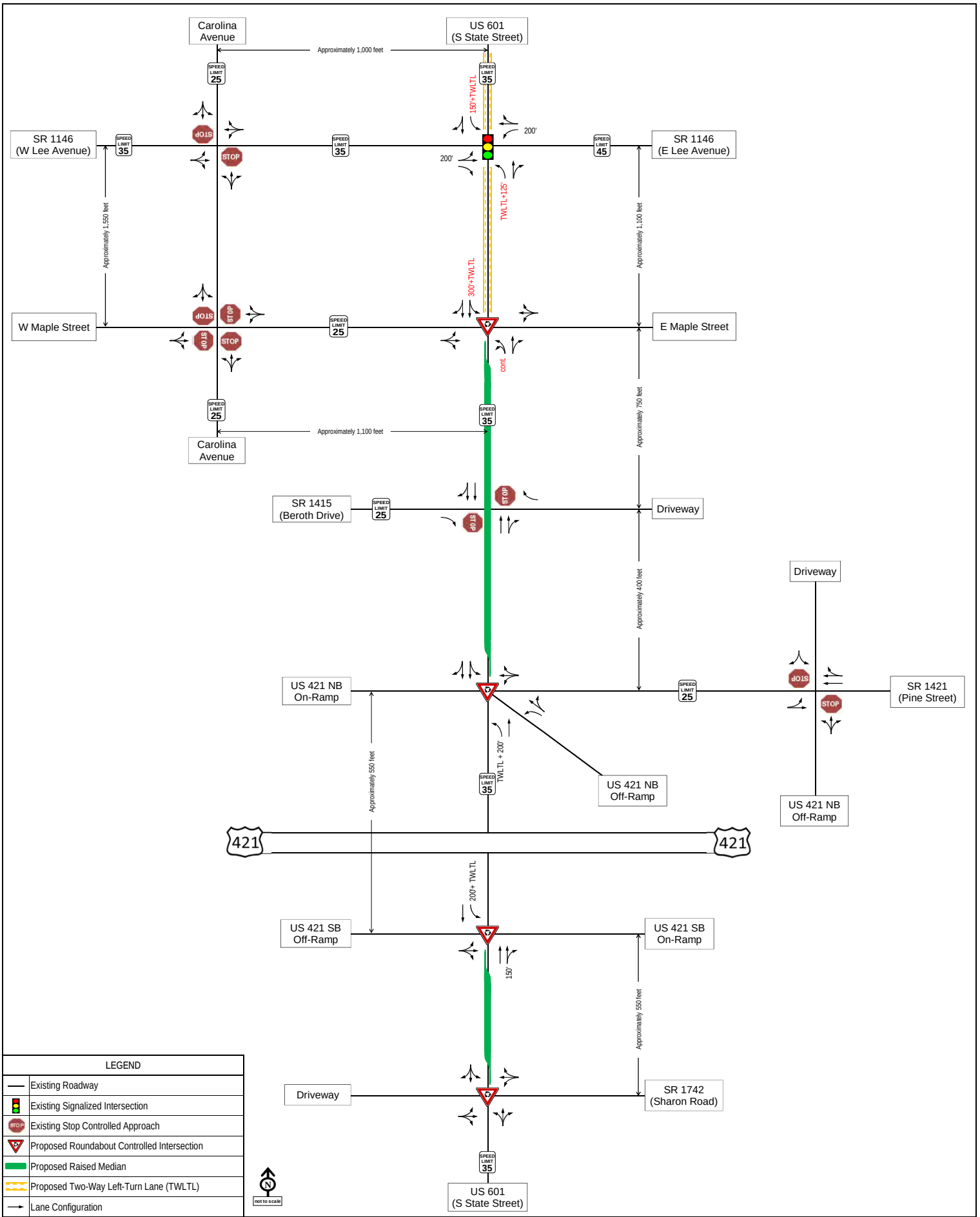

Figure ES-1
Build 1 Lane Geometrics and Traffic Control

US 601 Corridor Study
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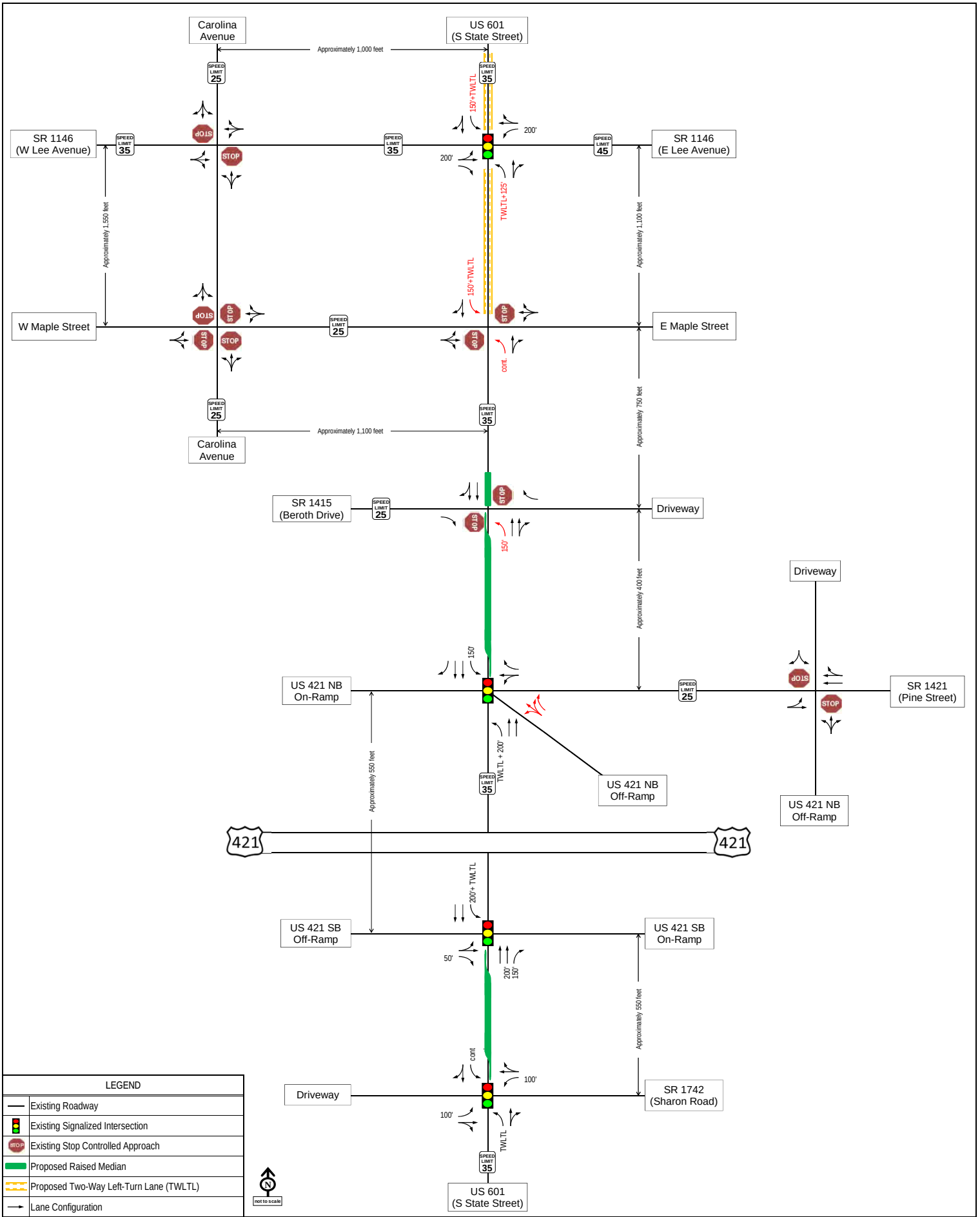

Figure ES-2
Build 2 Lane Geometrics and Traffic Control

US 601 Corridor Study
Yadkinville, NC

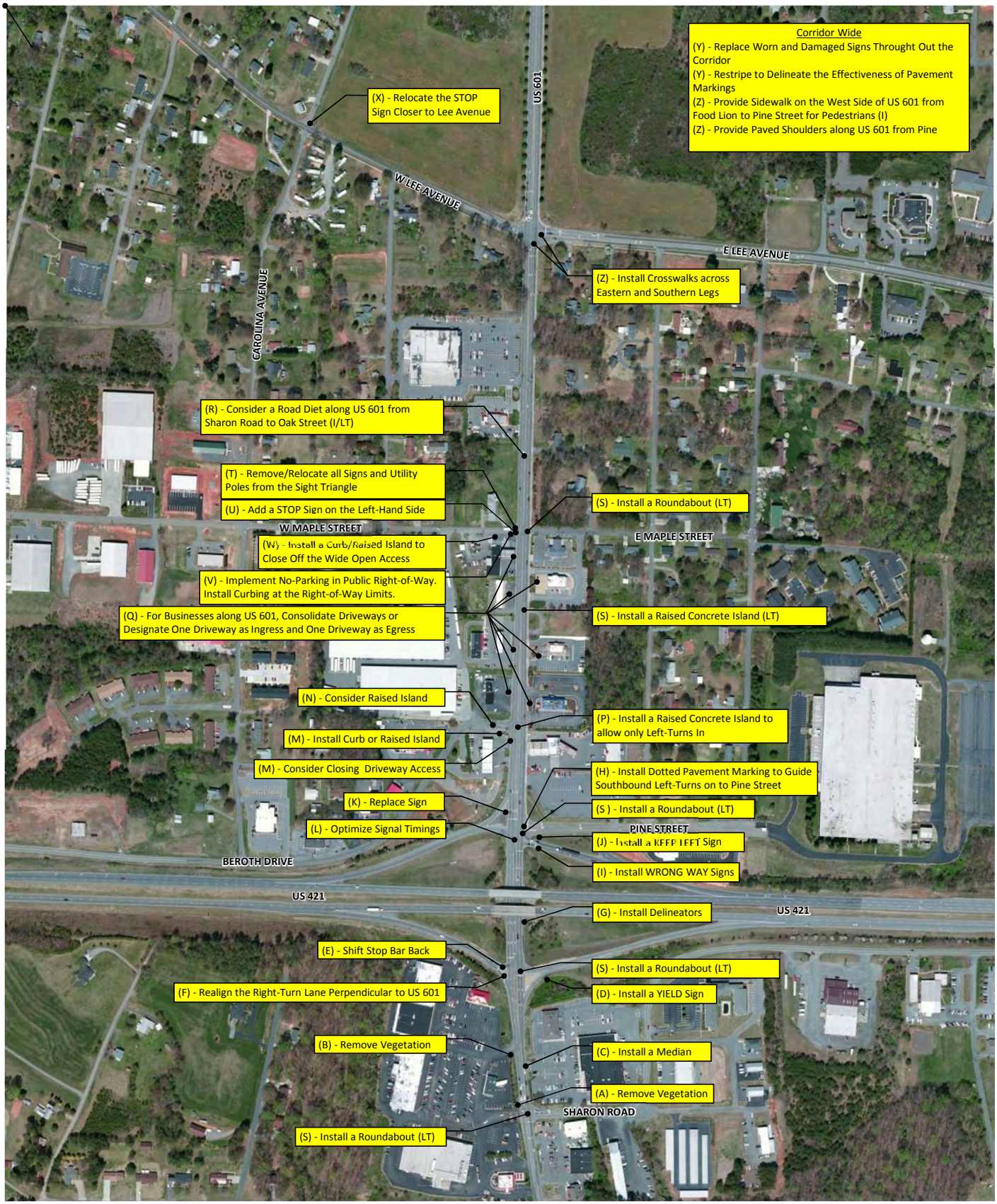

Figure ES-3
Improvements Recommended for Safety Issues

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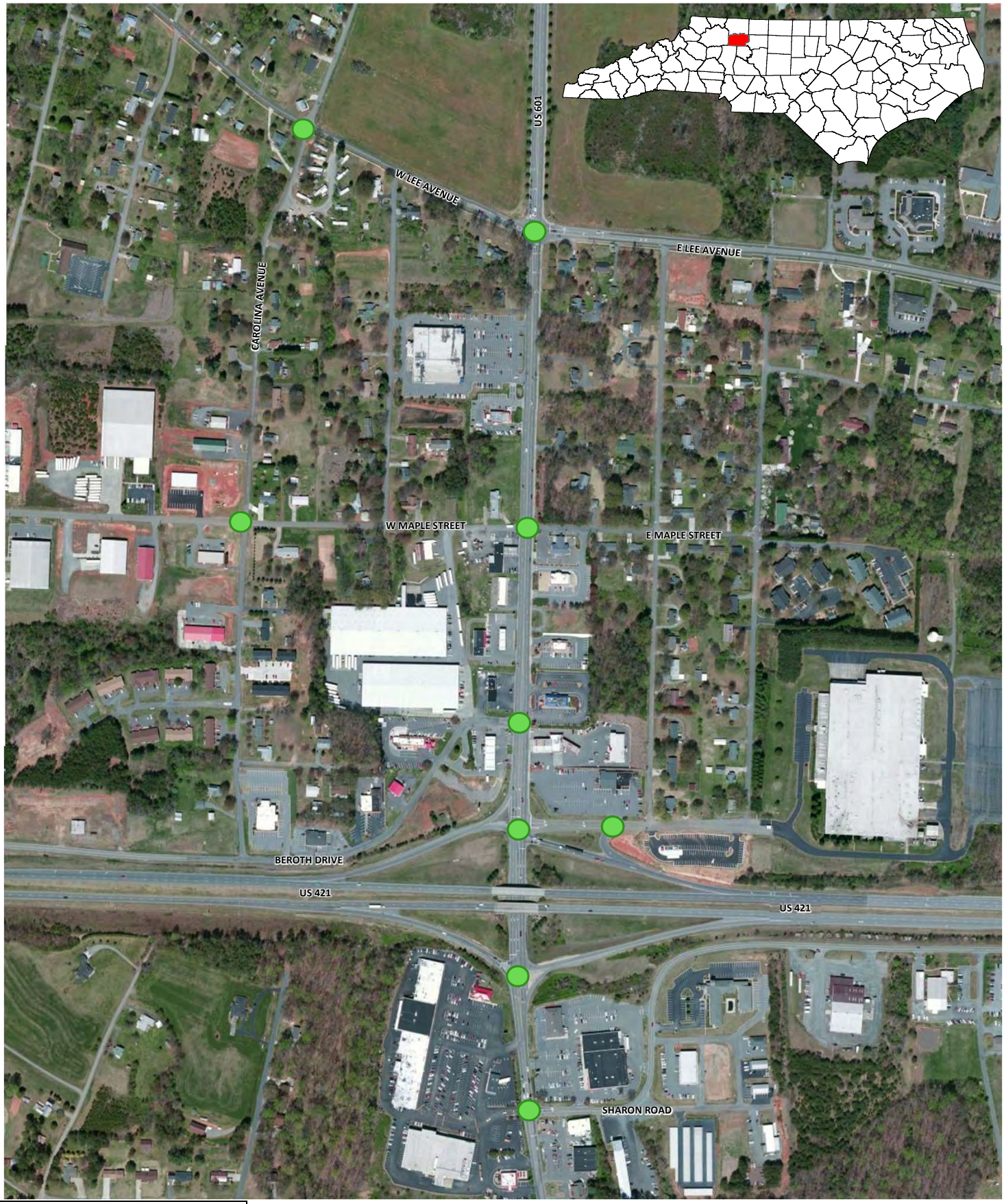
Introduction

This report provides capacity and safety analyses for a portion of US 601 corridor in Yadkin County, NC. The overall objective of this transportation analysis effort is to identify the safety and operational deficiencies of this area and present the North Carolina Department of Transportation (NCDOT) with alternative measures that address the deficiencies.

The study will focus primarily on US 601 from SR 1146 (Lee Avenue) north of US 421 to SR 1742 (Sharon Road) south of US 421. Additionally, Carolina Avenue from Lee Avenue to Maple Street will also be analyzed as part of this study.

VHB Engineering NC, P.C. (VHB) was retained by the North Carolina Department of Transportation to analyze the area and identify potential intersection improvement alternatives that would improve functionality along the US 601 with special emphasis on the US 421 interchange area. This report summarizes the analysis and presents options to improve operations in the study area.



LEGEND
Study Area Intersections

VHB

Figure 1
Vicinity Map

US 601 Corridor Study
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2

Existing (2013) Conditions

This section describes the study area and analyzes the existing conditions at the intersections. Intersection level of service analysis was undertaken for existing conditions (2013) for the AM, Midday and PM peak hours. In addition, a crash analysis was also performed to determine the crash rates and patterns.

Study Area

The following intersections were included in the study area and were analyzed for existing and future conditions:

- US 601 (South State Street) and SR 1146 (Lee Avenue) (*signalized*)
- US 601 (South State Street) and Maple Street (*unsignalized*)
- US 601 (South State Street) and SR 1415 (Beroth Drive) (*unsignalized*)
- US 601 (South State Street) and US 421 NB Ramps/SR 1421 (Pine Street) (*signalized*)
- US 601 (South State Street) and US 421 SB Ramps (*signalized*)
- US 601 (South State Street) and SR 1742 (Sharon Road)/Shopping Center Driveway (*signalized*)
- SR 1146 (West Lee Avenue) and Carolina Avenue (*unsignalized*)
- West Maple Street and Carolina Avenue (*unsignalized*)
- SR 1421 (Pine Street) and US 421 NB Exit Slip Ramp (*unsignalized*)

Existing Roadway Conditions

This section describes the existing major roadways in the study area. Annual Average Daily Traffic (AADT) data for the surround network of roads was obtained from the NCDOT. The most recent AADT counts from the NCDOT are for 2012 on the study area roadways.

US 601 (South State Street)

US 601 is a north-south minor arterial connecting Tarboro, SC to Mt. Airy, NC and provides a parallel route to I-77, a north-south interstate to the west. The posted speed limit along US 601 within the study area is 35 miles per hour (mph).

The typical cross-section along US 601 varies within the study area. North of Beroth Drive, the cross-section is a four-lane, undivided roadway. Between Beroth Drive and the US 421 EB Ramps, the cross-section is a five-lane, undivided roadway, and south of the US 421 EB Ramps, the cross-section transitions to a three-lane roadway at Sharon Road.

The land uses along US 601 within the study area are primarily commercial and retail south of Maple Street. North of Maple Street, the land use is primarily residential with the exception of a Food Lion and Bojangles located on the west side of US 601.

The AADT volumes along US 601 (South State Street) for 2012 are reported by the NCDOT as follows:

Location	NCDOT AADT (vpd)
North of Lee Avenue	9,400
North of Beroth Drive	17,000
South of Sharon Road	7,900

Looking north along US 601 towards the Sharon Road intersection

Looking north along US 601 towards the Beroth Drive intersection

US 421

US 421 is an east-west four-lane principal arterial that runs from Michigan City, IN to Fort Fisher, NC. There is no posted speed limit within the study area.

Location	NCDOT AADT (vpd)
West of US 601	16,000
East of US 601	17,000

Looking west towards US 421 SB Off-Ramp at the US 601 intersection

Looking west along US 421 NB Off-Ramp at the US 601 intersection

SR 1146 (Lee Avenue)

Lee Avenue is an east-west minor collector east of US 601 and an east-west local street west of US 601. The posted speed limit is 45 mph to the east of US 601 and 35 mph to its west.

The typical cross-section along Lee Avenue varies within the study area. West of US 601, the cross-section is a two-lane, undivided roadway and east of US 601, the cross-section is a three-lane, undivided cross-section.

Within the study area, the land use along Lee Avenue is primarily residential on the south side of Lee Avenue and open space on the north side.

Location	NCDOT AADT (vpd)
West of US 601	4,200*
East of US 601	4,100

**2011 AADT*

Looking east along Lee Avenue at the US 601 intersection

Looking east towards Lee Avenue from the US 601 intersection

Maple Street

Maple Street is an east-west, two-lane, local street with a posted speed limit of 25 mph within the study area. The land uses along Maple Street are a mix of retail, commercial and residential along the length of the road.

Looking east along Maple Street at the US 601 intersection

Looking west along Maple Street at the US 601 intersection

SR 1415 (Beroth Drive)

Beroth Drive is an east-west, two-lane, local street with a posted speed limit of 25 mph within the study area. Beroth Drive serves as a service road for US 421, serving the retail/commercial development in the northwestern corner of the US 601 and US 421 interchange, in addition to the residential uses west of Carolina Avenue (where Beroth Drive changes to Beamer Road).

Location	NCDOT AADT (vpd)
West of US 601	410*

**2011 AADT*

Looking east along Beroth Drive at the US 601 intersection

Looking west along Beroth Drive at the US 601 intersection

SR 1421 (Pine Street)

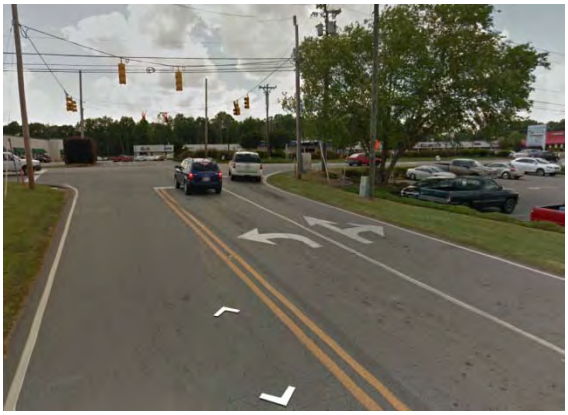
Pine Street is an east-west, two-lane, local street with a posted speed limit of 25 mph within the study area. Pine Street serves the retail/industrial development in the northeastern corner of the US 601 and US 421 interchange, in addition to the residential uses along Eisenhower Street and Coolidge Street.

Looking west along Pine Street at the US 601 intersection

Looking east along Pine Street from the US 601 intersection

SR 1742 (Sharon Road)

Sharon Road is an east-west, two-lane, local street with no posted speed limit within the study area. Sharon Road acts as a service road for US 421, serving the retail/industrial development in the southeast corner of the US 601 and US 421 interchange and some residential uses along Sharon Road.



Looking west along Sharon Road towards the US 601 intersection

Looking east along Shopping Center driveway towards the US 601 intersection

Carolina Avenue

Carolina Avenue is a north-south, two-lane, local street with a posted speed limit of 25 mph within the study area. The land uses along Carolina Avenue is mostly residential with some commercial/industrial use near Beroth Drive.

	
Looking south along Carolina Avenue at the US 601 intersection	*Looking north towards Carolina Avenue from the US 601 intersection*

Figure 2 provides a schematic diagram of the roadways near the proposed development including the existing intersection geometrics.

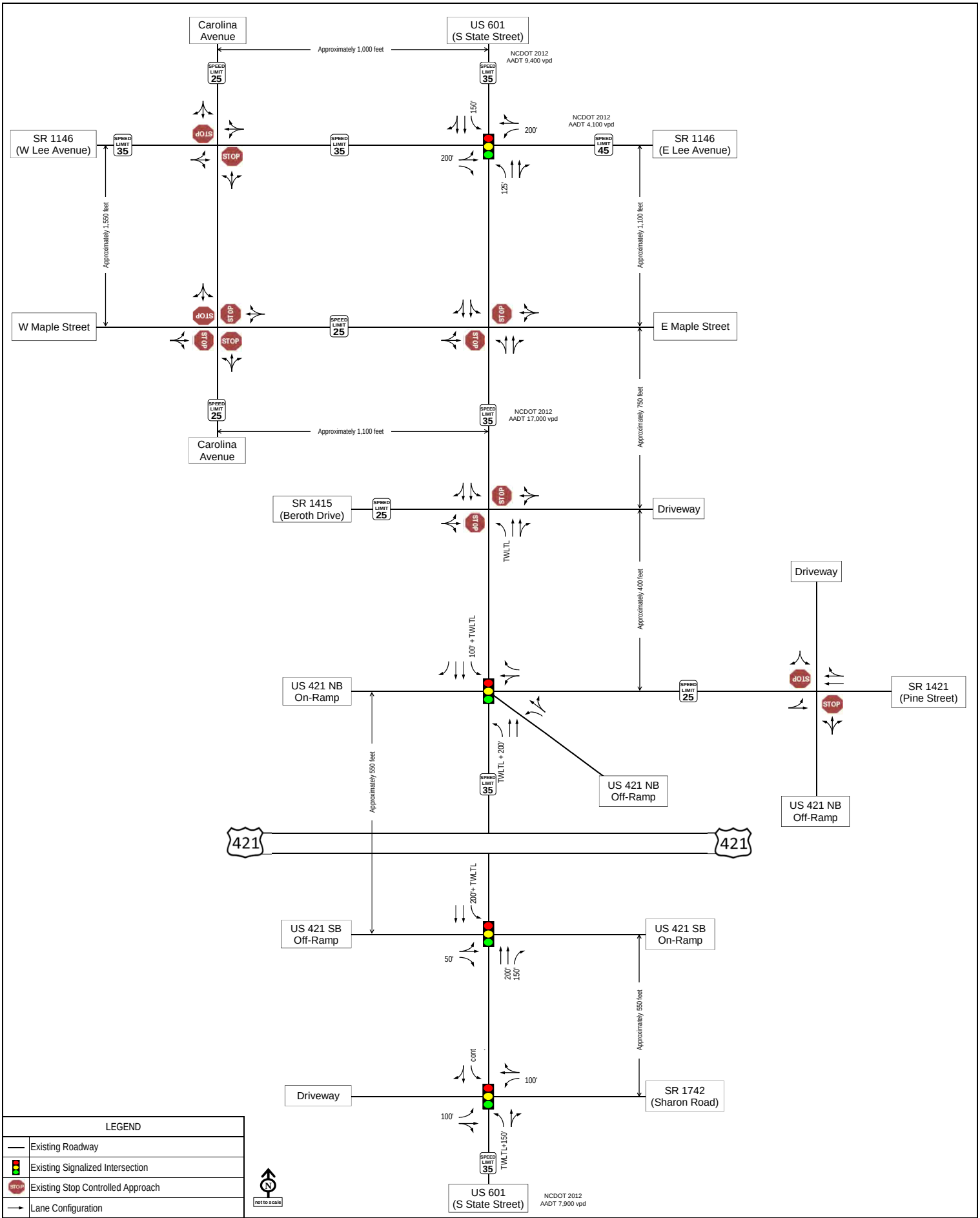


Figure 2
Existing (2013) Lane Geometrics and Traffic Control

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Yadkinville, NC

Turning Movement Count Data

VHB collected the AM, Midday and PM peak hour intersection turning movements analyzed in this study. Table 1 summarizes the schedule used to obtain the turning movement data. A detailed summary of the traffic counts can be found in Appendix A.

Table 1 Weekday Peak Hour Turning Movement Count Schedule

Intersection	Time Period	Data Collection Date
US 601 (South State Street) and SR 1146 (Lee Avenue)	6:00 AM – 7:00 PM	Tuesday July 16, 2013
US 601 (South State Street) and Maple Street	6:00 AM – 7:00 PM	Tuesday July 16, 2013
US 601 (South State Street) and SR 1415 (Beroth Drive)	6:00 AM – 7:00 PM	Tuesday July 16, 2013
US 601 (South State Street) and US 421 NB Ramps/SR 1421 (Pine Street)	6:00 AM – 7:00 PM	Tuesday July 16, 2013
US 601 (South State Street) and US 421 SB Ramps	6:00 AM – 7:00 PM	Tuesday July 16, 2013
US 601 (South State Street) and SR 1742 (Sharon Road)/Shopping Center	6:00 AM – 7:00 PM	Tuesday July 16, 2013
SR 1146 (West Lee Avenue) and Carolina Avenue	6:00 AM – 7:00 PM	Tuesday July 16, 2013
West Maple Street and Carolina Avenue	6:00 AM – 7:00 PM	Tuesday July 16, 2013
SR 1421 (Pine Street) and US 421 NB Exit Slip Ramp	6:00 AM – 7:00 PM	Tuesday July 16, 2013

Some slight volume balancing adjustments were manually applied to a couple of intersection turning movement counts in order to reduce volume discrepancies between adjacent intersections along US 601 within the study area. If any of the allowed movements had no counted volume, it was assumed that there is a minimum of four vehicles making that movement in order to determine the level of service. No seasonal adjustment factors were applied to the intersection volumes. The resulting AM, Midday and PM peak hour turning movement volumes are shown in Figure 3.

Signal Timing/Phasing Data

Signal design plans were obtained from the NCDOT. Existing signal phasing and timing variables (yellow and all red intervals, etc.) were used for the Existing (2013) conditions, while cycle lengths and splits were optimized using *Synchro's* automatic optimization feature for all of the scenarios. Future year analyses reflects the Congestion Management Capacity Guidelines (Yellow= 5 sec, All Red = 2 sec, etc.). Appendix B contains the signal design plans as provided by the NCDOT.

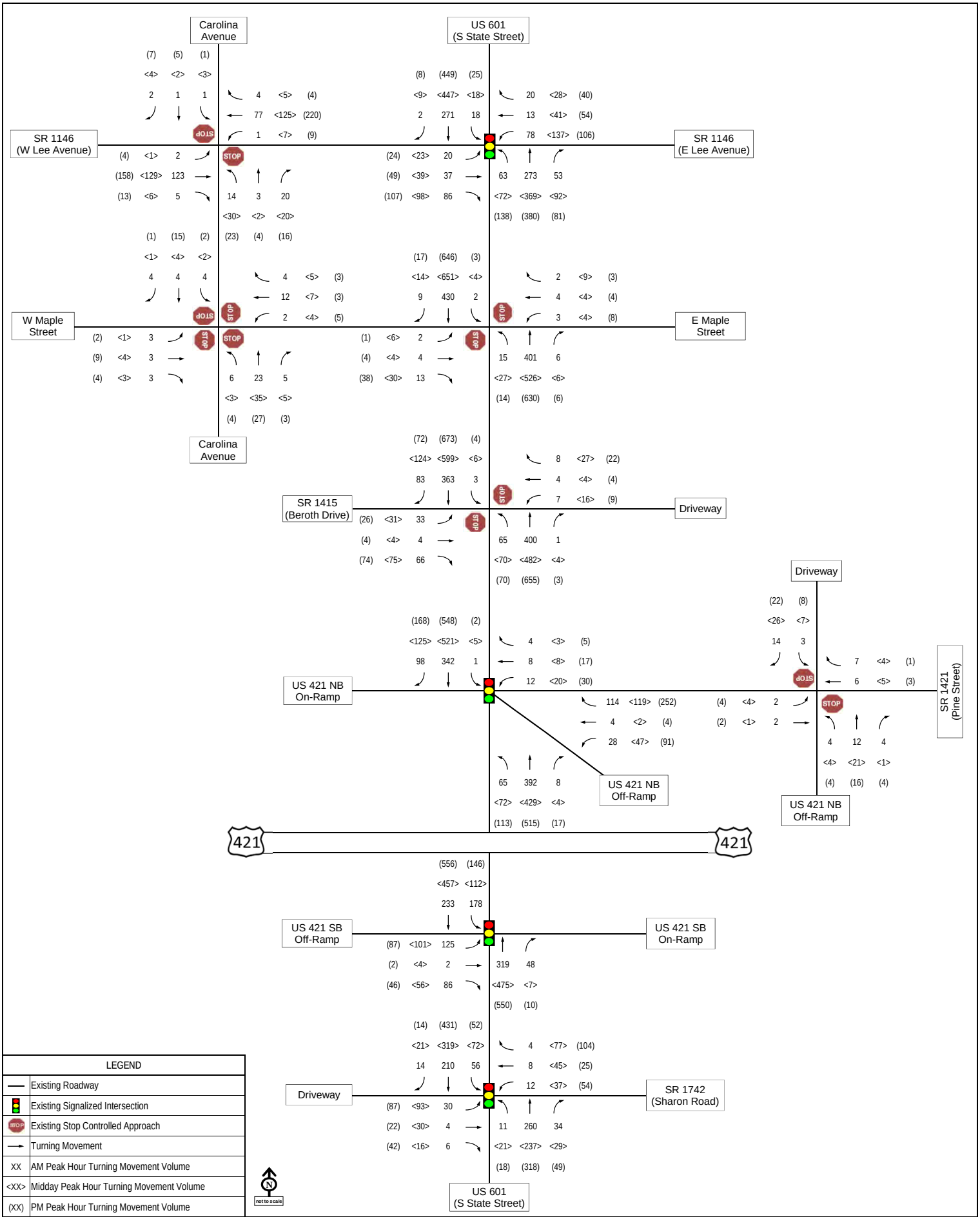


Figure 3
Existing (2013) AM, Midday and PM Peak Hour Turning Movement Volumes

US 601 Corridor Study
Yadkinville, NC

Level of Service Criteria

Peak hour level of service (LOS) measures the adequacy of the intersection geometrics and traffic controls of an intersection or approach for the given turning volumes. Levels of service range from A through F, based on the average control delay experienced by vehicles traveling through the intersection during the peak hour. Control delay represents the portion of total delay attributed to traffic control devices (e.g., signals or stop signs). Table 2 provides a general description of various levels of service categories and delay ranges.

Table 2 Level of Service Description for Intersections

LOS	Description	Signalized Intersection	Unsignalized Intersection
A	Little or no delay	<= 10 sec.	<= 10 sec.
B	Short traffic delay	10-20 sec.	10-15 sec.
C	Average traffic delay	20-35 sec.	15-25 sec.
D	Long traffic delay	35-55 sec	25-35 sec
E	Very long traffic delay	55-80 sec.	35-50 sec.
F	Unacceptable delay	> 80 sec.	> 50 sec.

LOS is based on an analysis of the average peak hour (as defined by the Institute of Transportation Engineers) with LOS D considered acceptable for both signalized intersections and unsignalized, stop-controlled approaches. For unsignalized intersections, where the stop controlled approach is below LOS D, operations may still be considered acceptable if the delays and queuing on that approach are not extreme, safety is not an issues, and/or side street volumes do not warrant improved traffic control to aid in the movement of side street traffic.

Level of Service Analysis

Intersection capacity analysis for the existing roadway geometrics and traffic volumes was performed for the AM, Midday and PM peak hour conditions using *Synchro/SimTraffic Professional Version 7*. All the intersections in the study area currently operate at acceptable LOS (LOS D or better) during all three peak hours.

Table 3 summarizes the existing intersection levels of service, with the full *Synchro* capacity analysis output included in Appendix C. When reporting the LOS results for signalized intersections, an overall intersection LOS is reported, as well as the worst-operating approach and subsequent LOS. For an unsignalized intersection, the worst-operating approach and subsequent LOS is reported.

Table 3 Existing (2013) Level of Service Results

ID	Intersection Name	Control	Existing 2013		
			AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	A (WB-B)	B (WB-B)	B (WB-C)
2	Maple Street & US 601 (South State Street)	Unsignalized	(WB-C)	(WB-C)	(WB-D)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	Unsignalized	(WB-C)	(EB-D)	(EB-D)
4	US 421 NB Ramps & US 601 (South State Street)	Signalized	C (NWB-D)	C (NWB-D)	C (NWB-D)
5	US 421 SB Ramps & US 601 (South State Street)	Signalized	B (EB-E)	A (EB-E)	A (EB-E)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Signalized	A (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-A)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

Crash Analysis

Collision data was provided by NCDOT for the five-year period from July 1, 2008 to June 30, 2013 along the US 601 corridor within the study area limits.

Corridor Crash Summary

During the study period, there were 219 crashes reported along US 601 from SR 1742 (Sharon Road) to SR 1146 (Lee Avenue) within the analysis period. One fatality occurred along northbound US 601 under the US 421 bridge, between the southbound and northbound ramps. There were 71 (approximately 32%) non-fatal injury collisions and 147 (approximately 67%) collisions resulting in property damage only. The total crash rate along the corridor was 1,189.33 crashes per 100 million miles travelled which is more than double the statewide average for similar urban United States Routes (452.52). The most prevalent collision type within the study area was rear end crashes (33%), followed by left turn crashes (29%) and angle crashes (16%).

The collision trends along US 601 from SR 1146 (Lee Avenue) to SR 1742 (Sharon Road) are compared to statewide averages in Table 4. The full NCDOT crash reports are included in Appendix D. The total crash rate for the US 601 corridor is higher than the statewide average for similar urban US routes with at least four lanes of travel undivided, with total crash rates of 1189.33 and 452.52, respectively. Rear-end collisions are typically associated with intersection locations, while left-turn crashes are associated with turning movements at unsignalized intersections or mid-block along undivided corridors.

Table 4 Crash Rate Comparison to Statewide Averages

Roadway/Type	Total Crash Rate[1]	Fatal Crash Rate[1]	Non-Fatal Injury Crash Rate[1]	Night Crash Rate[1]	Wet Crash Rate[1]
US 601 (S State Street) (Lee Avenue to Sharon Road)	1189.33	5.43	385.58	195.51	266.11
Urban United States Routes, 4 or more lanes undivided[2]	452.52	1.11	152.77	80.23	73.41

[1] *Crashes per 100 million miles travelled*

[2] *NCDOT Statewide Three Year Crash Rates (2008-2010)*

Collision Diagrams

A collision diagram was developed for the project study area to further assess collision trends at intersections and mid-block locations along the corridor. Individual crashes were collected from corridor and intersection crash reports obtained from the NCDOT. The original police report was obtained and reviewed for cases in which there were inconsistencies in the data reported. The collision diagrams for US 601 from Sharon Road to Lee Avenue are included in Appendix E.

Several trends can be noted from these diagrams. First, at the unsignalized intersections along the corridor, the majority of crashes are left-turn crashes followed by rear-end and angle crashes. Majority of the left-turn crashes occurred at the US 601 and Beroth Drive intersection which can be attributed to the turns in and out of Beroth Drive crossing two through lanes in each direction on US 601.

Second, at the signalized intersections along the corridor, the majority of crashes are rear end crashes followed by left-turn crashes. The most frequent crash location is at the US 601 and Lee Avenue intersection followed by the US 601 and US 421 Southbound Ramps intersection.

In addition to the crashes at the signalized and unsignalized intersections along the corridor, there are also rear-end crashes at mid-block locations near certain businesses due to the vehicles waiting in the inside through lane of US 601 to make left-turns into the business driveways. Table 5 shows the breakdown of crashes by intersection.

Table 5 Summary of Crashes, by Study Intersection

Intersection	Traffic Control	Rear End	Angle	Left Turn	Ran Off Road	Right Turn	Sideswipe	Other	Total
Lee Avenue	Signalized	9	7	9	1	2	2	1	*31*
Maple Street	Unsignalized	10	5	3	1	0	1	1	*21*
Beroth Drive	Unsignalized	11	9	34	0	2	10	1	*67*
US 421 NB Ramps	Signalized	10	0	1	2	0	4	2	*19*
US 421 SB Ramps	Signalized	9	0	7	0	1	0	0	*17*
Sharon Drive	Signalized	3	7	2	0	1	2	0	*15*

3

No-Build (2022 and 2023) Conditions

Although this study focuses on identifying possible safety countermeasures along the corridor, assessing future operations allow for proper planning and timing of the improvements. A 10-year (2023) and 20-year (2033) horizon were deemed to be appropriate future evaluation years for analysis. This ensures that any roadway improvements that are recommended at the completion of this study would be adequate in the long term. The following sections detail the traffic forecast process and provide results of the future conditions analysis.

Background Growth and Development

Historic trends in this area, as shown in Table 6, indicate that there is no significant annual growth along the corridor and even negative growth in some areas. However, to be conservative, an annual one percent (1%) growth rate was applied to the Existing (2013) turning movement volumes to obtain No-Build (2023) and No-Build (2033) turning movement volumes at the intersections along the corridor.

Based on discussions with the NCDOT and Town staff, trips expected to be generated from any planned developments were included in addition to the background growth. The specific developments included are:

- 2,200 square-foot Waffle House along Beroth Drive
- 2,825 square-foot Future Retail Development (Old Dry Cleaner along US 601 north of Beroth Drive)
- 19,000 square-foot General Retail (southwest corner of US 601 and Lee Avenue)
- 220,000 square-foot of Manufacturing (Old Sara Lee Manufacturing Plant along Pint Street)

The trips for the planned developments and the vacant parcels were estimated based on methodologies published in *ITE Trip Generation Manual, 9th Edition*. If any of the allowed movements at an intersection had no volumes, it was assumed that there is a minimum of four vehicles in order to determine the LOS. Appendix F contains the individual trips for each of these developments.

Figure 4 illustrates the No-Build (2023) intersection turning movement volumes and Figure 5 illustrates the No-Build (2033) intersection turning movement volumes.

Table 6 Annual Daily Traffic by Location

Route	Location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SR 1146 (Lee Ave)	East of US 601	4,900		4,800		5,200		5,000		4,700		4,100
SR 1146 (Lee Ave)	West of US 601		4,700		4,400		4,500		4,600		4,200	
SR 1415 (Beroth Drive)	West of US 601		150		270		310		360		410	
US 421	East of US 601									18,000	18,000	17,000
US 421	West of US 601	18,000	16,000	17,000	16,000	18,000	18,000	19,000	17,000	18,000	18,000	16,000
US 601	North of SR 1415		17,000	17,000	17,000	18,000	16,000	18,000	17,000	18,000	17,000	17,000
US 601	South of SR 1314	9,600	9,900	10,000	11,000	12,000	10,000	11,000	10,000	11,000	10,000	10,000
US 601	South of SR 1742	8,700	9,500	8,700	8,400	8,600	7,700	8,500	8,500	8,600	7,800	7,900

Level of Service Analysis

Intersection levels of service analyses were performed for the AM, Midday and PM peak hours using *Synchro/SimTraffic Professional, Version 7*. Signal cycle lengths and splits were optimized within *Synchro* as part of the future year analysis.

The 2023 and 2033 No-Build scenarios project the traffic conditions along the study corridor with forecasted volumes along the roadway and the Existing (2013) geometric and traffic control conditions.

No-Build (2023) Operations

The results of the No-Build (2023) intersection capacity analysis indicate that the all the signalized intersections are expected to continue operating at acceptable levels of service. The US 601 and US 421 NB Ramps/Pine Street intersection is projected to drop from an overall LOS C to D during the PM peak hour. The stop-controlled eastbound Beroth Drive approach is projected to operate at LOS C during the AM peak and LOS F during the Midday and PM peaks. The projected queues are expected to be relatively minor. Table 7 summarizes the levels of service for the No-Build (2023) conditions and the full *Synchro* output can be found in Appendix C.

Table 7 No-Build (2023) Level of Service Results

ID	Intersection Name	Control	No-Build 2023		
			AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	B (WB-B)	B (WB-C)	B (WB-C)
2	Maple Street & US 601 (South State Street)	Unsignalized	(WB-C)	(WB-C)	(WB-D)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	Unsignalized	(EB-C)	(EB-F)	(EB-F)
4	US 421 NB Ramp & US 601 (South State Street)	Signalized	C (NWB-D)	C (NWB-D)	D (NWB-E)
5	US 421 SB Ramp & US 601 (South State Street)	Signalized	C (EB-D)	B (EB-D)	C (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Signalized	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(WB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

No-Build (2033) Operations

The results of the No-Build (2033) intersection capacity analysis indicate that the all the signalized intersections are expected to continue operating at acceptable levels of service. The stop-controlled eastbound Beroth Drive approach is projected to operate at LOS D during the AM peak and LOS F during the Midday and PM peaks. The projected queues are expected to be relatively minor. Table 8 summarizes the levels of service for the No-Build (2033) conditions and the full *Synchro* output can be found in Appendix C.

Table 8 No-Build (2033) Level of Service Results

ID	Intersection Name	Control	No-Build 2033		
			AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	B (WB-B)	B (WB-C)	B (WB-C)
2	Maple Street & US 601 (South State Street)	Unsignalized	(WB-C)	(WB-C)	(WB-D)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	Unsignalized	(EB-D)	(EB-F)	(EB-F)
4	US 421 NB Ramp & US 601 (South State Street)	Signalized	C (NWB-D)	C (NWB-E)	D (NWB-E)
5	US 421 SB Ramp & US 601 (South State Street)	Signalized	C (EB-D)	C (EB-D)	B (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Signalized	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

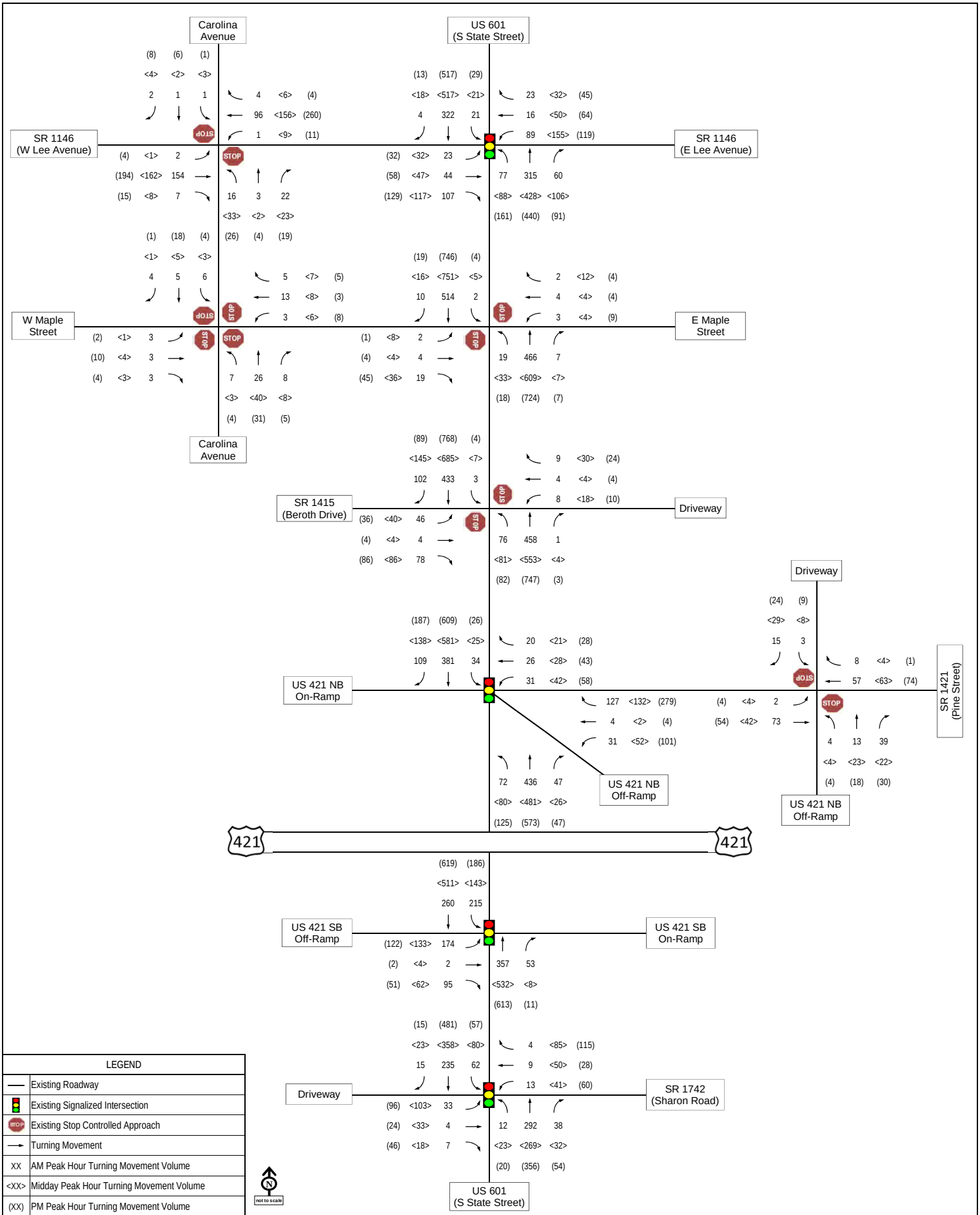


Figure 4
No-Build (2023) AM, Midday and PM Peak Hour Turning Movement Volumes

US 601 Corridor Study
Yadkinville, NC

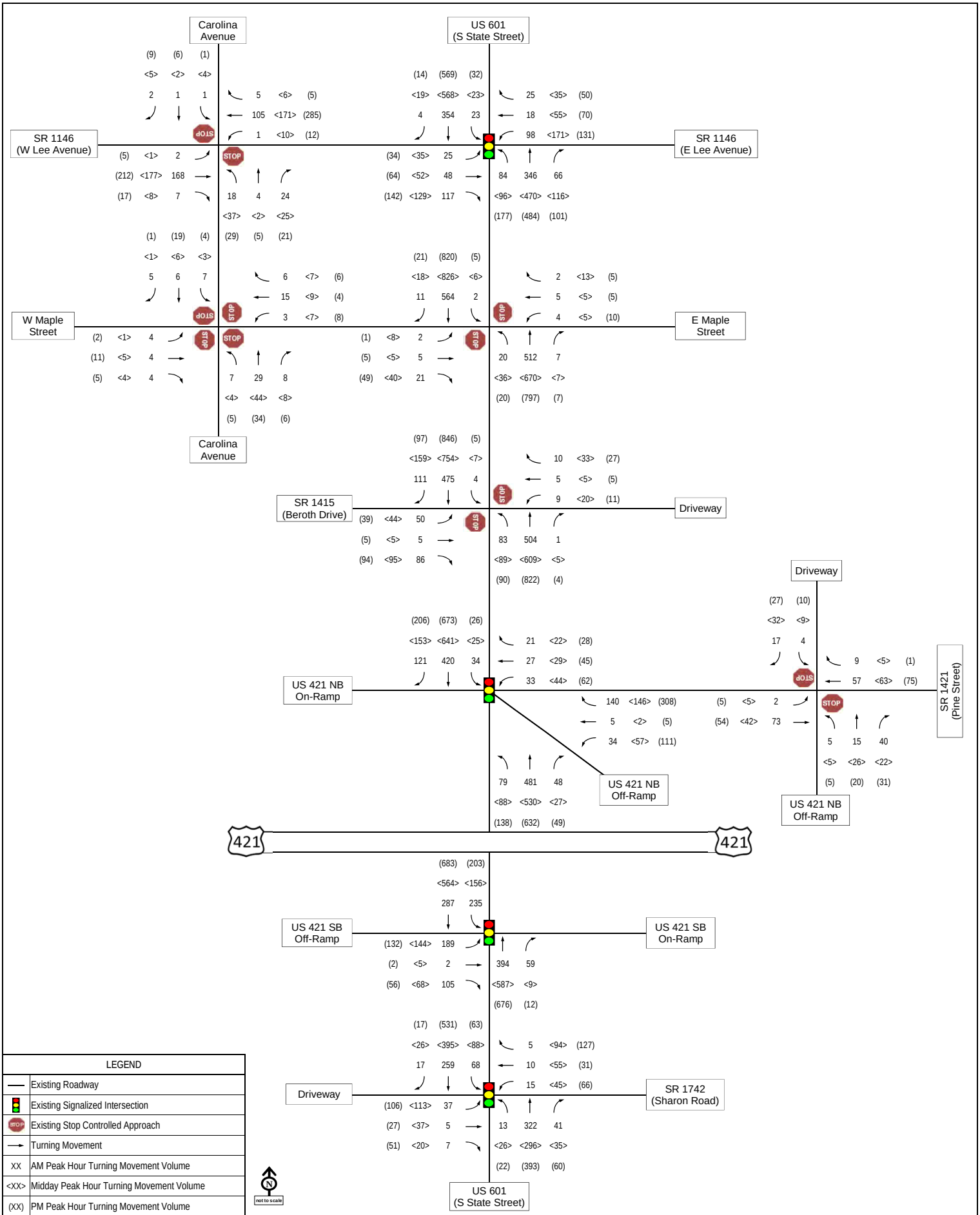


Figure 5
No-Build (2033) AM, Midday and PM Peak Hour Turning Movement Volumes

US 601 Corridor Study
Yadkinville, NC

3

Road Safety Assessment

Once the crash data was obtained from NCDOT and was evaluated, an on-site field assessment was conducted by VHB project team on August 27 and 28, 2013 in a similar manner as a Federal Highway Administration (FHWA) Road Safety Audit (RSA), where the team specifically identifies roadway characteristics or deficiencies that may be contributing to the collision activity reported in the data. With each issue identified, a suggested improvement was developed to address the potential deficiency. The list of possible countermeasures was further refined into feasible recommendations that were also categorized as near-term, intermediate and long-term improvements.

The NCDOT Regional Traffic Engineer (Jimmy Hamrick) and Division Traffic Engineer (Daniel Adams), joined and assisted the VHB team in identifying issues and developing recommendations. The project team also met with Yadkinville Town Manager (Christopher Ong), Chief of Police (Tim Parks) and NCDOT Division 11 Senior Planning Engineer (Dean Ledbetter), to gain local perspectives on the safety and operations within the study area. Table 9 provides the results of the field assessment in terms of identified safety issues and recommended improvements. The recommended improvements, indexed by the alphabets in the table, are shown in Figure 10.

Table 9 Summary of Safety Issues and Suggested Improvements

US 601 (State Street) at SR 1742 (Sharon Drive) / Signalized Colonial Shoppes Driveway	
Safety Issue	**Suggested Improvement**
Roadside obstructions to sight distance—Drivers seeking to turn right on a red signal from the signalized Colonial Shoppes driveway onto southbound US 601 are faced with sight distance obstructions in the form of roadside vegetation and trailblazer signs.	*Near-term* – Remove the vegetation and relocate the trailblazer signs to remove them from the sight triangle (A).

Photo shows vantage of driver looking left from behind the stop line of right-turn lane of signalized Colonial Shoppes driveway at US 601/Sharon Drive.

Photo shows vantage of driver looking left from atop the stop line of right-turn lane of signalized Colonial Shoppes driveway at US 601/Sharon Drive.

US 601 (State Street) at CVS Pharmacy Driveway/Unsignalized Colonial Shoppes Driveway	
Safety Issue	**Suggested Improvement**
Roadside obstructions to sight distance—Drivers seeking to turn left from the unsignalized Colonial Shoppes driveway onto northbound US 601 are faced with sight distance obstructions in the form of roadside vegetation. This vegetation forces drivers to creep out to within a few feet of the southbound US 601 through lane.	*Near-term* – Remove the vegetation from the sight triangle (B).

Photo shows vantage of driver looking right from the unsignalized Colonial Shoppes driveway at US 601.

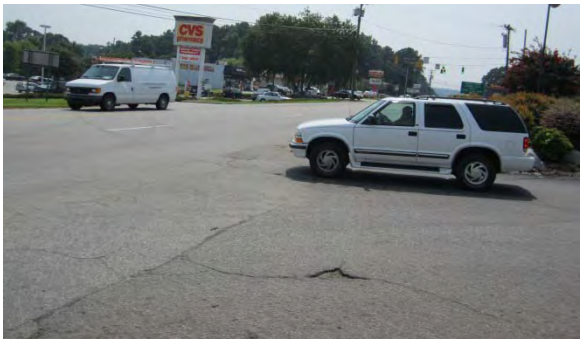


Photo shows driver at unsignalized Colonial Shoppes driveway pulling to within a few feet of near SB US 601 through lane to see past vegetation.

Offset between opposing driveways—The centerlines of the driveways of the CVS Pharmacy plaza (on the east side of US 601) and the Lowes Foods plaza (on the west side) are offset by approximately 60 ft. Multiple vehicles were observed turning right from the CVS parking lot onto northbound US 601 and stopping in the southbound US 601 turn lane to wait for a gap to turn left into the Pizza Hut driveway. Additionally, drivers simultaneously attempting to turn onto northbound US 601 from both driveways were competing for the same gap in northbound traffic.	*Intermediate* – Consider installing a narrow raised median island along US 601 to prohibit left turns into and out of the CVS and unsignalized Colonial Shoppes driveways (C).

Aerial image from Google Earth showing offset between CVS and unsignalized Colonial Shoppes driveways along US 601.

Photo shows vehicles simultaneously seeking to turn onto northbound US 601 from CVS driveway (on left) and unsignalized Colonial Shoppes driveway (on right).

US 601 (State Street) at Southbound US 421 Ramps

Safety Issue	Suggested Improvement
Missing intersection traffic control—There is only a single YIELD sign for the right-turn movement from northbound US 601 onto the southbound US 421 entrance ramp, and it is on the left side of the travel lane. This has the potential to confuse drivers on which movement is required to yield, as some may mistakenly assume that the YIELD sign applies to the left-turning movement from southbound US 601.	*Near-term* – Install an additional YIELD sign on the right-hand side of the approach from northbound US 601 onto the SB US 421 On-Ramp, as required by the MUTCD (Section 2B.10) (D).

US 601 (State Street) at Southbound US 421 Ramps	
Safety Issue	Suggested Improvement
 *Photo shows single YIELD sign for right-turn movement from NB US 601 onto US 421 SB On-Ramp; sign is on left side of applicable travel lane.*	 *Photo shows single YIELD sign for right-turn movement from NB US 601 onto US 421 SB On-Ramp; sign is on left side of applicable travel lane.*
Striping configuration— ▪ The geometric characteristics of the US 421 SB Off-Ramp (i.e., sweeping curve to the right) are such that drivers intending to turn right onto southbound US 601 may expect to have a yield or free-flowing condition, which may help explain the observed rear-end collisions here. This expectation is reinforced by the current striping along the ramp, which includes a large radius that promotes greater speed and creates an acute angle with US 601 for right turns. ▪ The stop lines at the US 421 SB Off-Ramp for the left-turn and right-turn movements are at the same offset from US 601, which puts the left-turning vehicles in the sight line of right-turning vehicles looking left to turn right on a red signal indication onto southbound US 601.	*Near-term* – Consider removing the existing stop line for the left-turn movement of the US 421 SB Off-Ramp and installing a new stop line 10 feet back to improve the line of sight for drivers seeking to turn right on a red signal indication (E). *Near-term/Intermediate* – Consider restriping the ramp such that the gore striping between the left- and right-turn lanes is eliminated and the right-turn lane approaches US 601 at an angle that is closer to perpendicular. This should serve to encourage slower speeds among right-turning vehicles and insinuate that the impending right-turn maneuver is not yield-controlled or free-flowing (F).

US 601 (State Street) at Southbound US 421 Ramps	
Safety Issue	Suggested Improvement

Image from Google Street View showing curvature in US 421 SB Off-Ramp. Red line has been used to highlight how the white edgeline curves to the right and disappears from view.

Image from Google Earth shows gore striping, stop line placment, and sweeping curve for right turns at US 421 Off-Ramp.

Photo showing driver's vantage from right-turn lane at US 421 SB Off-Ramp looking north from the stop line.

Photo showing right-turning driver looking over her shoulder in light of the sharp angle between the US 421 SB Off-Ramp right-turn movement and US 601.

US 601 (State Street) Underpass at US 421	
Safety Issue	Suggested Improvement
Lack of roadside delineation—There are no delineators on the concrete barrier beneath the US 421 overpass, an area that lacks street lighting. This was the location of a fatal crash during non-daylight hours in 2008.	*Near-term* – Consider installing delineators on the concrete barrier to provide consistent delineation of the roadside features and improve nighttime visibility (G).

Photo shows nighttime vantage of driver on northbound US 601 approaching the overpass at US 421.

Photo shows lack of delineators on the concrete barrier along northbound US 601 beneath the US 421 overpass.

US 601 (State Street) at US 421 NB Ramps / SR 1421 (Pine Street)	
Safety Issue	Suggested Improvement
Unique intersection geometry—The fact that Pine Street intersects US 601 at the terminus of the US 421 NB ramps creates a unique five-legged junction with the potential for driver confusion and wrong way maneuvers. The existing pair of WRONG WAY signs at the ramp is located approximately 400 feet from the stop line (in advance of the direct connection between the ramp and Pine Street) and, therefore, may not be immediately visible to a wrong way driver. In contrast, the pair of WRONG WAY signs on the US 421 SB Off-Ramp is placed only 110 feet or so from the stop line at US 601.	*Near-term* – Consider installing yellow and white dotted line pavement markings and white straight-arrow pavement marking symbol to better delineate the intended vehicle path from southbound US 601 to eastbound Pine Street (H). (See the following rendering on right.) *Near-term* – Consider installing an additional pair of WRONG WAY signs on the US 421 NB Off-Ramp closer to the ramp terminus to provide earlier notice to wrong way drivers incorrectly entering the ramp from US 601 (I). *Near-term* – Consider the installation of a KEEP LEFT (R4-8) sign in the space between Pine Street and the US 421 NB Off-Ramp to better indicate the proper vehicle path there (J).

Aerial image from Google Earth showing existing pavement marking configuration at the US 601 and US 421 NB Ramps/Pine Street intersection.

Rendering showing application of (1) white and yellow dotted line pavement markings to delineate movement from southbound US 601 onto Pine Street and (2) through arrow on Pine Street departure leg.

Photo illustrates distance from US 421 NB Off-Ramp terminus at US 601 to existing WRONG WAY (R5-1a) signs.

Missing traffic control sign—There is a bent sign post and a missing sign at the nose of the raised channelizing island at the US 421 NB On-Ramp.	*Near-term* – It is presumed that it is a Double Arrow (W12-1) sign that is missing from this location. Check installation records to confirm what sign had been installed at this location and determine whether it should be replaced. If no sign is to be replaced, remove the damaged sign post from the raised island (K).

Photo showing bent sign post and missing sign at raised channelizing island at US 421 NB On Ramp.

Photo showing bent sign post and missing sign at raised channelizing island at US 421 NB On-Ramp.

US 601 (State Street) at SR 1415 (Beroth Drive)	
Safety Issue	Suggested Improvement
Excessive number of vehicle conflicts—There were 36 crashes reported at the US 601 and Beroth Drive intersection during the five-year analysis period. The confluence of several factors here yields a number of safety issues: ▪ Significant queuing of vehicles in the right lane of southbound US 601 from the US 421 NB Ramps/Pine Street in advance of the Beroth Drive intersection. Drivers in the right lane sometimes leave courtesy gaps (as shown on the following page) for drivers from Beroth Drive to turn left or turn right into the left southbound through lane. However, the Beroth drivers may not be able to see vehicles approaching along US 601 from the left or the right due to the vehicle queue. (Collisions resulting from this condition are sometimes called "multiple-threat.") ▪ A number of tractor trailer trucks and other heavy vehicles were observed turning into and out of Beroth Drive. At times, the turning trucks were unable to complete their maneuvers because of vehicles waiting to turn onto US 601 and blocked both southbound lanes on US 601 (forcing vehicles in both to come to a complete stop). This gridlock situation was not alleviated until one or more vehicles on Beroth Drive altered their travel paths to allow the trucks to complete their intended maneuvers. ▪ Beroth Drive is approximately 40 feet wide at US 601, and it was observed that some vehicles desiring to turn right and left from Beroth Drive pulled alongside one another, with each inhibiting the sight lines of the other. ▪ The BP station at the southwest corner of US 601 and Beroth Drive intersection has two access points along US 601 and two driveway access points and a 125-foot-long continuous access opening along Beroth Drive. The northern access to the BP station along US 601 is less than 30 feet from the Beroth Drive intersection.	*Near-term* – Check the existing signal timing at the US 601 and US 421 NB Ramps/Pine Street intersection to ensure it is optimized for current traffic volumes. Efficiency may be increased such that the southbound US 601 queue up to and beyond Beroth Drive may be reduced or eliminated (L). *Near-term/Intermediate* – Consider closing the northern BP access along US 601. Also consider installing curbing or a raised island to close off the wide open access to the BP along Beroth Drive—perhaps the first 80 feet or so nearest to US 601—to better control vehicular movements there (M). *Near-term/Intermediate* – Consider the installation of a raised concrete island along Beroth Drive at US 601 to narrow the Beroth Drive egress and eliminate side-by-side placement of left- and right-turning vehicles. This island will also channelize queued vehicles along Beroth toward its south edge of pavement, which will provide more room for left-turning tractor trailers coming from northbound US 601 to complete their maneuvers onto Beroth Drive (N). *Intermediate* – Consider installing a raised concrete island on US 601 to allow and channelize left turns from northbound US 601 onto Beroth Drive but prohibit left turns from Beroth Drive onto northbound US 601 (P).

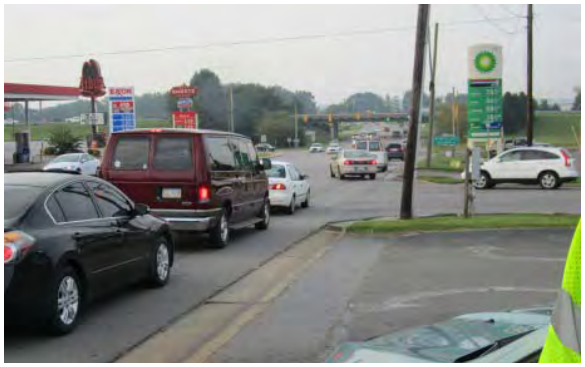


Photo showing a driver giving a courtesty gap at Beroth Drive in light of the queue along southbound US 601 across Beroth Drive; this condition can lead to "multiple-threat" collisions.

Photo showing the right-lane queue along southbound US 601 from the US 421 NB ramps across Beroth Drive.

Photo showing uninhibited access for the BP station along Beroth Drive.

Photo showing a vehicle on southbound US 601 braking in advance of the left-turning tractor trailer from Beroth Drive that pulled out in front of it.

Photos showing the difficulty faced by a left-turning tractor trailer in completing its maneuver from northbound US 601 onto Beroth Drive. A number of other vehicles were also impacted; e.g., the SB vehicles whose path was blocked were forced to come to a complete stop, and the pickup truck desiring to turn left from Beroth Drive ultimately turned right to give the truck the space it needed.

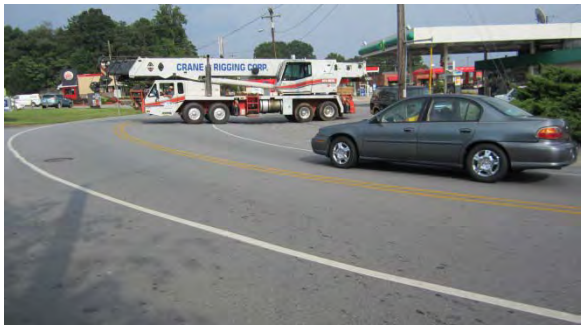


Photo showing large vehicle exiting BP station onto Beroth Drive across the wide unrestricted access.

Image from Google Earth showing left-turning and right-turning vehicles side-by-side on Beroth Drive at US 601.

Consider closing northern BP driveway along US 601 and installing a raised curb/island to better control vehicular movements.

US 601 (State Street) between SR 1421 (Pine Street) and Maple Street

Safety Issue	Suggested Improvement
Numerous closely-spaced full-access intersections—The large number of closely-spaced full-access intersections—including Beroth Drive and a series of commercial driveways—along US 601 between Pine Street and Maple Street enables countless conflicting movements within the corridor. The crash history shows a large number of rear-end and angle collisions throughout the corridor. Safety issues are further compounded by the fact that many of the businesses there have multiple driveways at which both ingress and egress movements are permitted, leading to uncertainty among drivers over which particular driveway a vehicle will utilize to enter or exit a site and many instances when vehicles at adjacent driveways attempt to utilize the same gap in mainline traffic to enter US 601.	*Near-term* – Consider requiring the businesses with two accesses along US 601 to consolidate driveways, designate one driveway as an ingress and one as an egress, which could be done using signing (e.g., DO NOT ENTER, ONE WAY) and pavement marking symbols. Such action could maximize the distance between egress movements from adjacent parcels, as well as serve to assign certain movements to certain driveways, thereby clarifying where a vehicle can be expected to enter and exit the property (Q). *Intermediate / Long-term* – Consider the implementation of a road diet along US 601 from Sharon Drive to Oak Street (north of downtown Yadkinville), which would constitute a three-lane cross-section—a single through lane in each direction and a center two-way left-turn lane. This configuration would remove left-turning vehicles from the inside through lanes (R). *Long-term* – Consider the implementation of a narrow concrete median and a series of roundabouts along US 601 (at Sharon Drive, the US 421 SB Ramps, the US 421 NB Ramps, and Maple Avenue). The concrete median would prohibit left turns into and out of all commercial properties in

	this area. Roundabouts could be installed at Sharon Drive, the southbound US 421 ramps, the US 421 NB Ramps, and Maple Avenue to safely and effectively accommodate the U-turn maneuvers that would be necessary in light of the imposed right-in/right-out configurations (S).

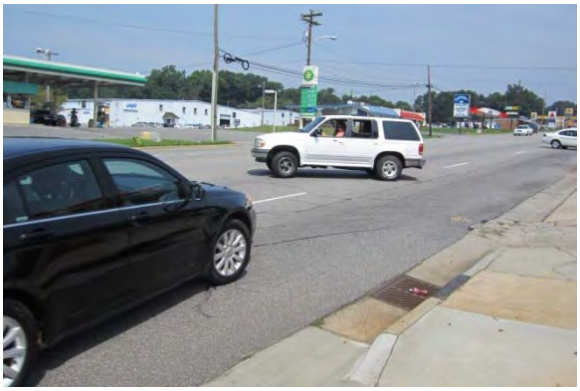


Photo showing vehicles simultaneously exiting the adjacent driveways and crossing one another's path.

Photo showing conflicting northbound and southbound left turns from the US 601 two-way left-turn lane just south of Beroth Drive.

Rendering showing application of pavement marking arrows to convert commercial driveways to exclusive ingresses or egresses.

Photo showing one example of the many commercial establishments having multiple bidirectional driveway accesses along US 601.

<table>
<tr><th colspan="2">Maple Street at US 601 (State Street)</th></tr>
<tr><th>Safety Issue</th><th>Suggested Improvement</th></tr>
<tr><td>Roadside obstructions to sight distance—Drivers seeking to enter or cross US 601 from W Maple Street are faced with sight distance obstructions looking left and right, such as utility poles, private nonstandard signs, and, at times, vehicles entering or exiting the adjacent Shell gas station.</td><td>Near-term – Consider the removal/relocation of all signs from within the sight triangle (T).

Intermediate – Consider the removal/relocation of utility poles and other sight distance obstructions that are more permanent in nature (T).</td></tr>
<tr><td> 
Photo showing driver's vantage looking left (i.e., north) from eastbound Maple Street approach at US 601.</td><td> 
Photo showing driver's vantage looking right (i.e., south) from eastbound Maple Street approach at US 601.</td></tr>
<tr><td>Partial obstruction of intersection traffic control—The STOP sign for the eastbound Maple Street approach along US 601 is prone to be partially or fully blocked by parked vehicles at the Shell station, making it difficult to detect for approaching drivers.</td><td>Near-term – Consider adding a supplemental STOP sign for eastbound Maple Street (either on the left-hand side of Maple Street or overhead) to emphasize the stop condition to approaching drivers. If a left-hand-side STOP sign is installed, ensure that it is placed such that it does not become a sight distance obstruction to eastbound drivers on Maple Street (U).
Near-term/Intermediate – Confirm the right-of-way limits at the southwest corner of the US 601 and Maple Street intersection to ensure vehicles at the Shell station are not permitted to park within the public right-of-way along Maple Street. If it becomes apparent that vehicles are parking within the right-of-way, consider installing concrete curbing at the right-of-way limits to prohibit this activity and provide better visibility of the existing STOP sign (V).</td></tr>
</table>

Image from Google Streetview showing the partial obstruction of the STOP sign on eastbound Maple Street at US 601 by several parked vehicles.

Photo showing partial obstruction of the STOP sign on eastbound Maple Street at US 601 by parked towtruck.

Wide uncontrolled access—The Shell station at the southwest corner of US 601 and Maple Street has two access points along US 601 and an unrestricted continuous access opening along Maple Street that is over 100 feet long.	*Near-term/Intermediate* – Consider installing curbing or a raised island to close off the wide open access to the Shell station along Maple Street to channelize vehicular movements there (W).

Photo showing uninhibited access for the Shell station along Maple Street.

Photo showing uninhibited access for the Shell station along Maple Street.

Carolina Avenue at Lee Avenue	
Safety Issue	**Suggested Improvement**
Oddly-placed traffic control—The STOP sign for the southbound approach of Carolina Avenue is located approximately 80 feet from the edge of the nearest Lee Avenue through lane, creating a potentially confusing situation for approaching drivers.	*Near-term* – Relocate the STOP sign to a position closer to the Lee Avenue intersection in accordance with Section 2B.10 of the MUTCD (X).

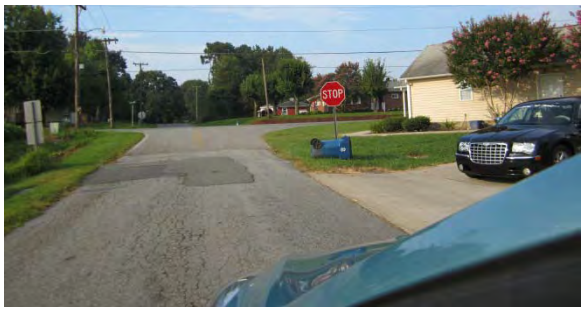


Photo showing STOP sign as seen from southbound approach of Carlina Avenue at Lee Avenue.

Photo showing how far back a vehicle is from Lee Avenue when it stops at the location of the STOP sign there.

Throughout Study Area	
Safety Issue	**Suggested Improvement**
Degraded signing and delineation—The condition of signs, pavement markings, and raised pavement markers in several areas of the study corridor was noted to be poor, which may render them less effective in conveying their intended messages to drivers.	*Near-term* – Replace worn and damaged signs throughout the study corridor (Y). *Near-term/Intermediate* – If (1) no major restriping operations are already planned and (2) no major restriping operations are planned associated with this safety review, then consider restriping the study corridor to maximize the delineating effectiveness of the pavement markings (Y).

Photo showing worn pavement markings along US 601 near Beroth Drive.

Photo showing worn pavement markings along Pine Street at US 601.

Photo showing worn pavement markings along US 601

Photo showing worn pavement markings along US 601 near the NB US 421 ramps.

Photo showing vandalized sign along US 601.

north of Beroth Drive.

Photo showing worn YIELD sign at SB US 421 entrance

ramp.

Photo showing worn pavement markings along US 601 north of Sharon Drive.

Lack of continuity and accommodations for non-motorized users—

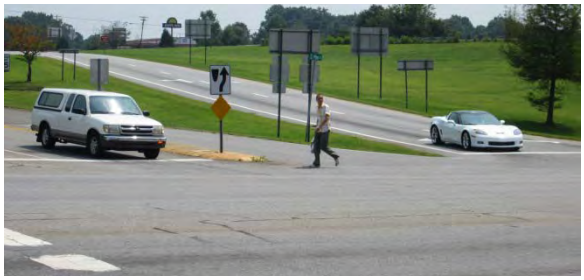
- There is sidewalk along the east side of US 601 from downtown Yadkinville to Pine Street and along the south side of Lee Avenue both east and west of US 601, but there are no marked crosswalks at the signalized US 601and Lee Avenue intersection.
- The sidewalk segment along the west side of US 601 begins at Lee Avenue and ends at the north Food Lion driveway.
- Several pedestrians were seen walking along US 601 from one side of US 421 to the other, and there are numerous apartments and mobile homes just south of the Colonial Shoppes plaza. There is a lack of paved shoulders or other suitable space for non-motorized users south of Pine Street.

Near-term – Consider the installation of a marked crosswalk across the eastern and southern legs of the US 601 and Lee Avenue intersection to provide continuity between sidewalk sections (Z).

Intermediate/Long-term – Consider the installation of sidewalk on the west side of US 601 from the Food Lion to Pine Street to facilitate pedestrian movements on that side of US 601 (Z).

Intermediate/Long-term – Consider providing paved shoulders along US 601 from Pine Street southward towards Oakwood Road or Walnut Street (where the three-lane section of US 601 ends), which will provide more suitable space for pedestrian and bicycle travel between the north and south sides of US 421 (Z).

Photo showing a pedestrian crossing Lee Avenue on the east side of the US 601 intersection.



Photos showing pedestrian crossing the NB US 421 exit ramp and Pine Street.

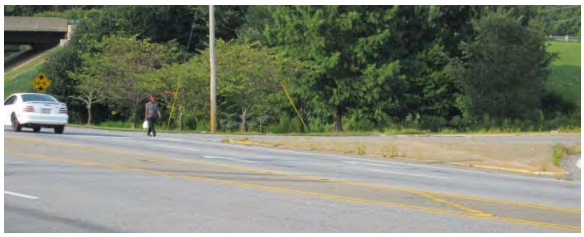


Photo showing pedestrian coming from underpass and crossing SB US 421 entrance ramp.

Photo showing bicyclist riding north along US 601 approach US 421 overpass.

Photo showing the end of the sidewalk along the west side of US 601 at the northern Food Lion access.

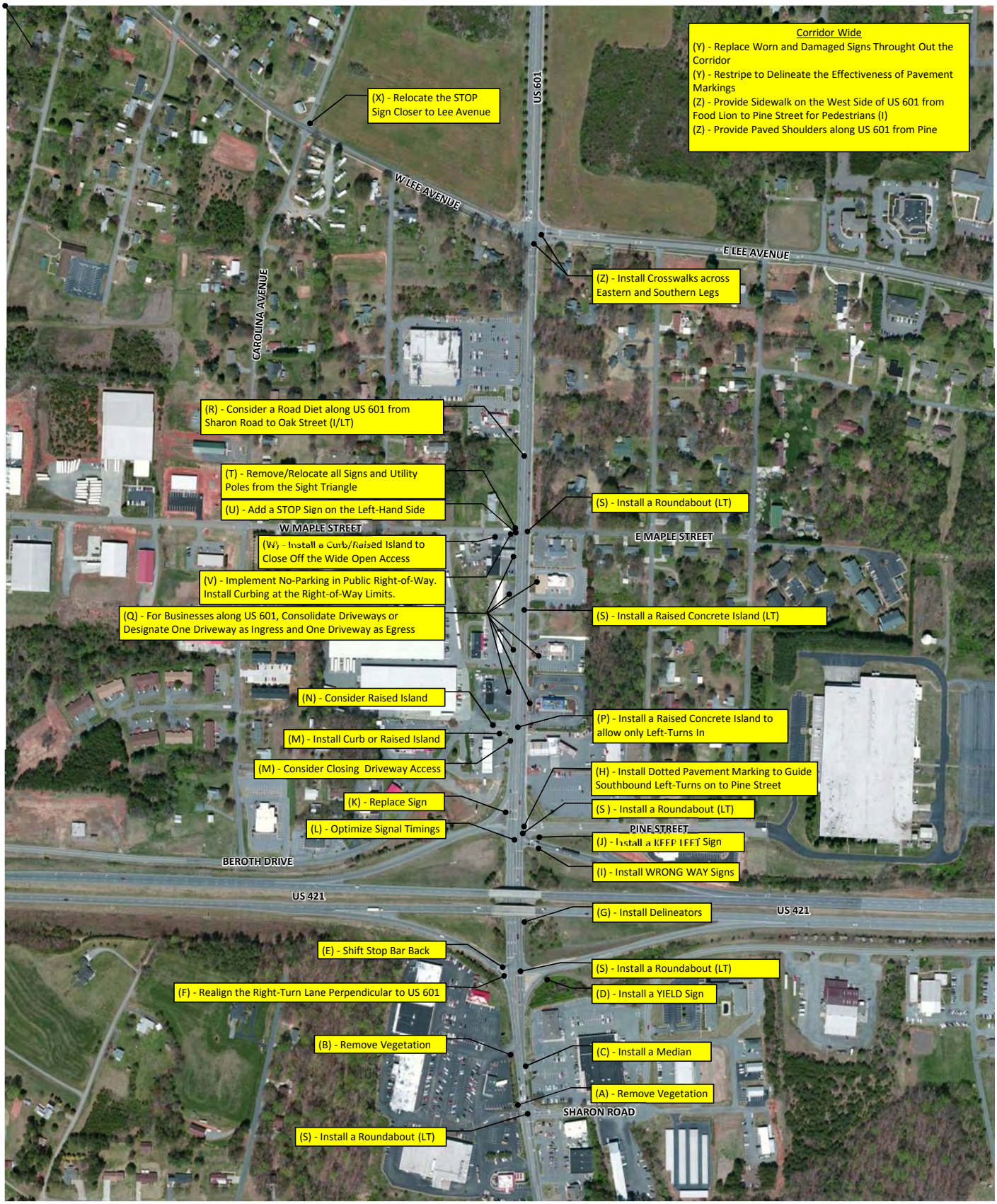


Figure 6
Improvements Recommended for Safety Issues

US 601 Corridor Study
Yadkinville, NC

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Build 1

To develop a plan for the US 601 corridor, both safety aspects and capacity needs were considered. Two alternatives, referred to as Build 1 and Build 2, were developed and analyzed.

Description

Build 1 option was originally considered by NCDOT and proposes installation of roundabouts at the US 601 and Maple Avenue intersection, US 601 and US 421 NB Ramps intersection, US 601 and US 421 SB Ramps intersection and US 601 and Sharon Road intersection. In addition, the Build 1 option assumes installation of new median along US 601 that results in a continuous median section between US 421 northbound ramps and Maple Avenue and between US 421 southbound ramps and Sharon Road. The section of US 601 between Maple Avenue and Lee Avenue would be converted into a three-lane roadway with a single lane in northbound and southbound directions and a two-way left-turn lane. The following improvements are recommended as part of this scenario:

US 601 (South State Street)

- Construct a median along US 601 between US 421 NB Ramps and Maple Street.
- Construct a median along US 601 between US 421 SB Ramps and Sharon Road.
- Restripe US 601 north of Maple Street to provide one travel lane in both the northbound and southbound directions and a center two-way left-turn lane.

US 601 (South State Street) and Lee Avenue

- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Maple Street

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides and one circulating lane on the north and south sides.
- Restripe the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Restripe the southbound US 601 approach to provide a shared left/through lane and a shared through/right-turn lane. The inside shared left/through lane on US 601 can transition to a center two-way left-turn lane north of Maple Street.

US 601 (South State Street) and Beroth Drive

- Restripe the Beroth Drive approach to provide a right-turn lane only movement.
- Modify the northbound US 601 approach to provide an exclusive through lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 NB Ramps

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides and one circulating lane on the north and south sides.
- Modify the westbound Pine Street approach to provide a shared left/through/right-turn lane.
- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide a shared left/through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 SB Ramps

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides.
- Modify the US 421 SB Off-Ramp to provide a shared left/through/right-turn lane.
- Modify the northbound US 601 approach to provide a through lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a through lane.

US 601 (South State Street) and Sharon Road/Shopping Center Driveway

- Construct a single-lane roundabout at this intersection with a single entry and exit lane on all approaches.

Figure 7 illustrates the lane configurations and traffic control along the corridor for Build 1 (2023 and 2023) scenarios.

Level of Service Analysis

Volumes for the Build 1 (2022 and 2023) scenarios were derived using the No-Build (2023 and 2033) as a base and the rerouting the left-turns as appropriate to account for left-turn restrictions at the unsignalized approaches and driveways as a result of the recommended median treatments. In locations where left-turns are restricted, the movements would be accounted for by rerouting vehicles to turn right onto US 601 and then making a downstream left-turn or U-turn. As the turning movement counts at individual driveways were not available, the turning movement volumes were estimated based on the existing lane-uses and driveway connectivity to adjacent streets. Figure 8 and Figure 9 show the future intersection turning movement volumes for Build 1 (2023) and Build 1 (2033) conditions.

Intersection capacity analysis was performed for the AM, Midday and PM peak hour conditions using *Synchro/SimTraffic Professional Version 7*. For roundabout analysis, *SIDRA Intersection Version 5.1* was used.

Build 1 (2023)

The results of the Build 1 (2023) intersection capacity analysis indicate that the all the intersections are expected to continue operating at acceptable levels of service. The stop-controlled eastbound Beroth Drive approach is projected to operate at LOS B during the AM peak and LOS C during the Midday and PM peaks.

Table 10 Build 1 (2023) Level of Service Results

ID	Intersection Name	Control	Build 1 (2023)		
			AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	B (WB-C)	C (WB-C)	C (WB-D)
2	Maple Street & US 601 (South State Street)	Roundabout	A (NB-A)	B (NB-B)	B (NB-B)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	RIRO	(EB-B)	(EB-B)	(EB-B)
4	US 421 NB Ramp & US 601 (South State Street)	Roundabout	A (NB-A)	A (SB-B)	B (SB-C)
5	US 421 SB Ramp & US 601 (South State Street)	Roundabout	A (EB-A)	A (EB-A)	B (EB-B)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Roundabout	A (NB-A)	A (SB-B)	B (SB-B)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

Build 1 (2033)

The results of the Build 1 (2033) intersection capacity analysis indicate that the all the signalized intersections are expected to continue operating at acceptable levels of service. The stop-controlled eastbound Beroth Drive approach is projected to operate at LOS B during the AM peak and at LOS C during Midday and PM peaks.

Table 11 Build 1 (2033) Level of Service Results

ID	Intersection Name	Control	Build 1 (2033)		
			AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	B (WB-C)	C (WB-D)	C (WB-D)
2	Maple Street & US 601 (South State Street)	Roundabout	A (NB-A)	B (NB-B)	B (NB-C)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	RIRO	(EB-B)	(EB-C)	(EB-C)
4	US 421 NB Ramp & US 601 (South State Street)	Roundabout	A (NB-B)	B (SB-B)	C (SB-C)
5	US 421 SB Ramp & US 601 (South State Street)	Roundabout	A (EB-B)	A (EB-B)	B (EB-B)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Roundabout	A (NB-A)	B (SB-B)	B (SB-C)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(WB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

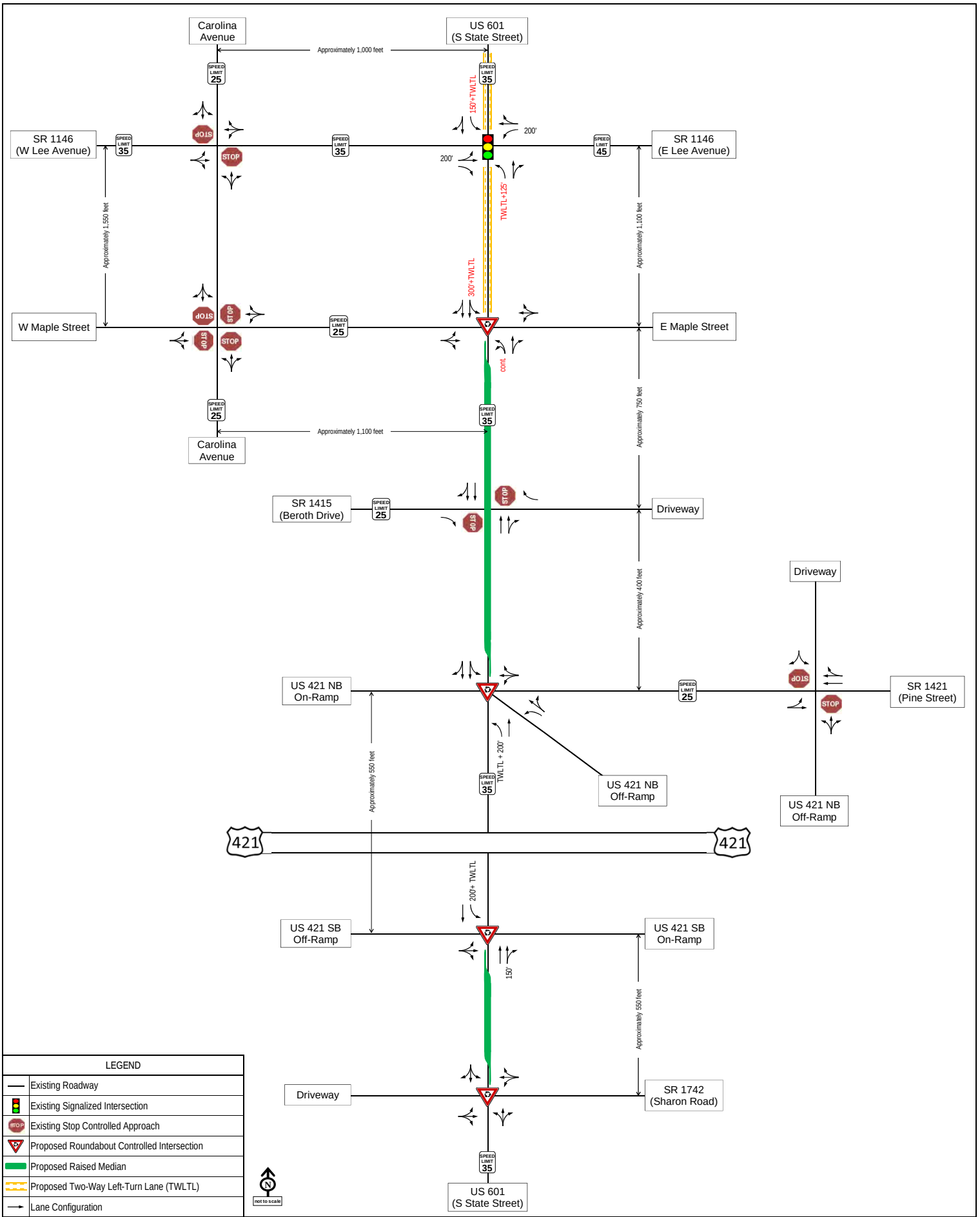

Figure 7
Build 1 Lane Geometrics and Traffic Control

US 601 Corridor Study
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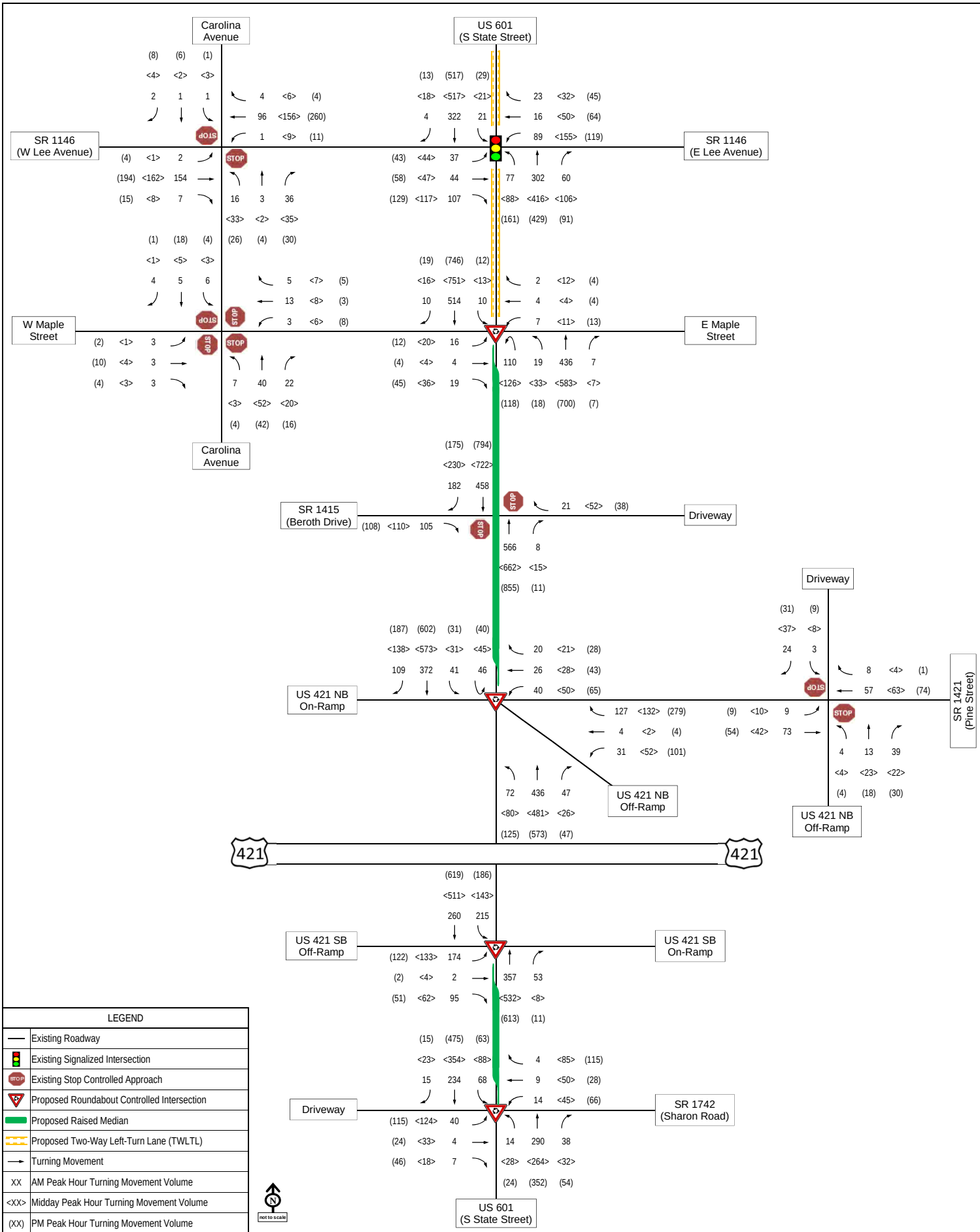

LEGEND	
	Existing Roadway
	Existing Signalized Intersection
STOP	Existing Stop Controlled Approach
	Proposed Roundabout Controlled Intersection
	Proposed Raised Median
	Proposed Two-Way Left-Turn Lane (TWLTL)
	Turning Movement
XX	AM Peak Hour Turning Movement Volume
<XX>	Midday Peak Hour Turning Movement Volume
(XX)	PM Peak Hour Turning Movement Volume

Figure 8
Build 1 (2023) AM, Midday and PM Peak Hour Turning Movement Volumes

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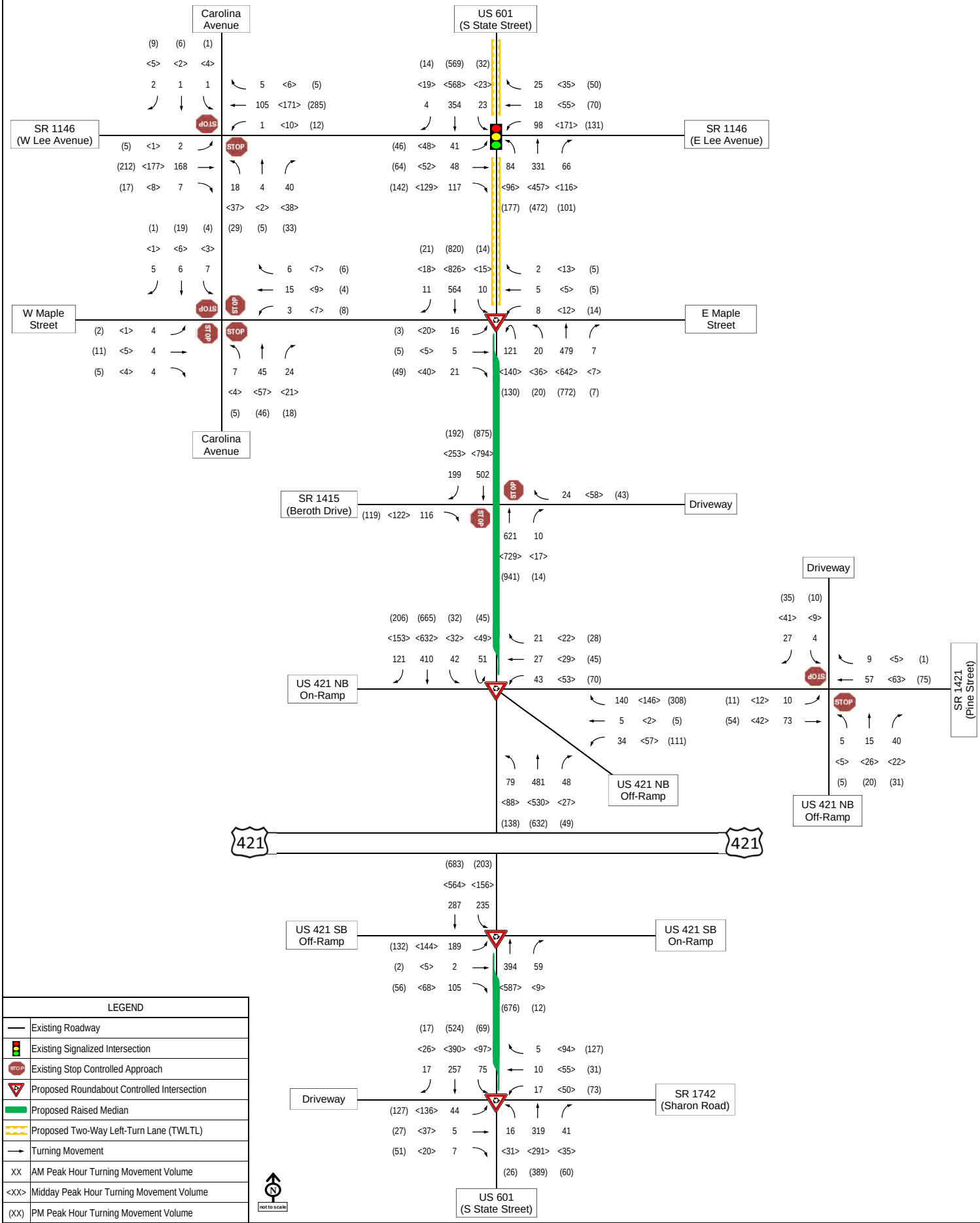

LEGEND	
—	Existing Roadway
	Existing Signalized Intersection
STOP	Existing Stop Controlled Approach
	Proposed Roundabout Controlled Intersection
	Proposed Raised Median
	Proposed Two-Way Left-Turn Lane (TWLTL)
→	Turning Movement
XX	AM Peak Hour Turning Movement Volume
<XX>	Midday Peak Hour Turning Movement Volume
(XX)	PM Peak Hour Turning Movement Volume

Figure 9
Build 1 (2033) AM, Midday and PM Peak Hour Turning Movement Volumes

US 601 Corridor Study
Yadkinville, NC

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Build 2

Description

Build 2 was developed to address the most pressing safety concerns, and therefore includes shorter-term recommendations along the corridor aimed at providing low-cost improvements that enhance safety in the vicinity of intersections with the highest crash frequency. This option proposes a median from the US 421 NB Ramps to Beroth Drive and from the US 421 SB Ramps to Sharon Road. The median would be constructed such that the US 601 and Beroth Drive intersection would operate as a left-in, right-in/right-out intersection. The following improvements are recommended as part of this scenario:

US 601 (South State Street)

- Construct a median along US 601 between US 421 NB Ramps and Beroth Drive.
- Construct a median along US 601 between US 421 SB Ramps and Sharon Road.
- Restripe US 601 north of Maple Street to provide one travel lane in both the northbound and southbound directions and a center two-way left-turn lane.

US 601 (South State Street) and Lee Avenue

- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Maple Street

- Restripe the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Restripe the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Beroth Drive

- Restripe the Beroth Drive approach to provide a right-turn lane only movement.

- Modify the northbound US 601 approach to provide an exclusive left-turn lane, a through lane, a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide a through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 NB Ramps

- Restripe the US 421 NB Off-Ramp approach to provide a shared left/through/right-turn lane and an exclusive right-turn lane.
- Construct a U-turn bulb in the northeast quadrant of the intersection to accommodate southbound U-turning maneuvers.

Figure 10 illustrates the lane configurations and traffic control along the corridor for Build 2 (2023 and 2033) scenarios.

Level of Service Analysis

Volumes for the Build 2 (2022 and 2023) scenarios were derived using the No-Build (2023 and 2033) as a base and the rerouting the left-turns as appropriate to account for left-turn restrictions at the unsignalized approaches and driveways as a result of the new median. In locations where left-turns are restricted, the movements would be accounted for by rerouting vehicles to turn right onto US 601 and then making a downstream left-turn or U-turn or rerouting them to an interconnected signalized intersection. As the turning movement counts at individual driveways were not available, the turning movement volumes were estimated based on the existing lane-uses and driveway connectivity to adjacent streets. Appendix G contains the step by step adjustment factors applied. Figure 11 and Figure 12 show the future intersection turning movement volumes for Build 2 (2023) and Build 2 (2033) conditions.

Intersection capacity analysis was performed for the AM, Midday and PM peak hour conditions using *Synchro/SimTraffic Professional Version 7*.

Build 2 (2023)

The results of the Build 2 (2023) intersection capacity analysis indicate that the all the signalized intersections are expected to continue operating at acceptable levels of service. The stop-controlled eastbound Beroth Drive approach is projected to operate at LOS B during all three peaks.

Table 12 Build 2 (2023) Level of Service Results

ID	Intersection Name	Control	Build 2 (2023)		
			AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	B (WB-C)	C (WB-C)	C (WB-D)
2	Maple Street & US 601 (South State Street)	Unsignalized	(EB-B)	(EB-C)	(WB-C)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	Unsignalized	(EB-B)	(EB-B)	(EB-B)
4	US 421 NB Ramp & US 601 (South State Street)	Signalized	C (NWB-E)	C (NWB-E)	D (WB-E)
5	US 421 SB Ramp & US 601 (South State Street)	Signalized	C (EB-D)	B (EB-D)	C (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Signalized	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

Build 2 (2033)

The results of the Build 2 (2023) intersection capacity analysis indicate that the all the signalized intersections are expected to continue operating at acceptable levels of service. The stop-controlled eastbound Beroth Drive approach is projected to operate at LOS B during the AM and Midday peak and LOS C during the PM peak hour.

Table 13 Build 2 (2033) Level of Service Results

ID	Intersection Name	Control	Build 2 (2033)		
			AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	B (WB-C)	C (WB-D)	C (WB-D)
2	Maple Street & US 601 (South State Street)	Unsignalized	(WB-B)	(EB-C)	(WB-C)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	Unsignalized	(EB-B)	(EB-B)	(EB-C)
4	US 421 NB Ramp & US 601 (South State Street)	Signalized	C (NWB-E)	C (NWB-E)	D (NWB-E)
5	US 421 SB Ramp & US 601 (South State Street)	Signalized	C (EB-D)	C (EB-D)	C (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Signalized	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

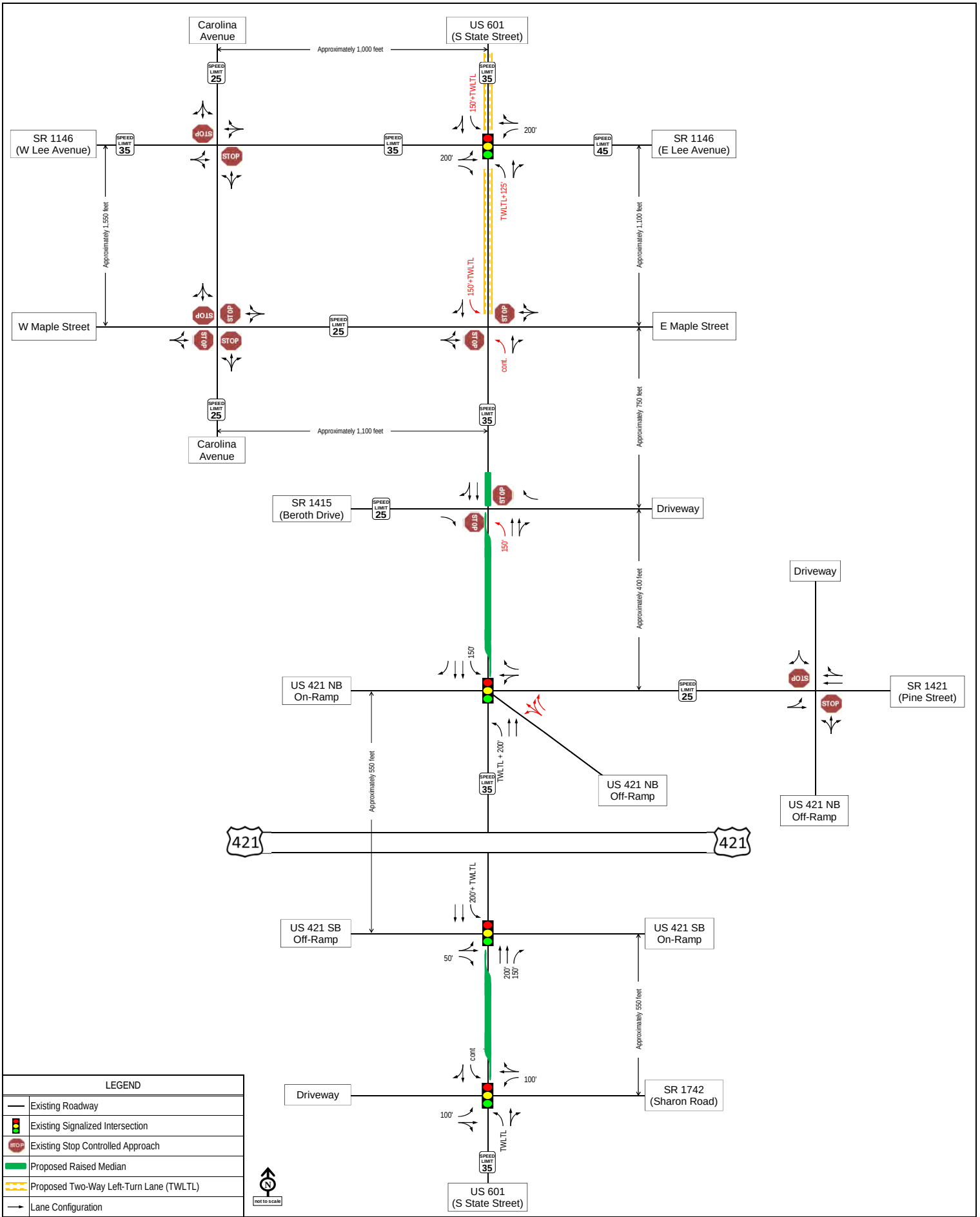

Figure 10
Build 2 Lane Geometrics and Traffic Control

US 601 Corridor Study
Yadkinville, NC

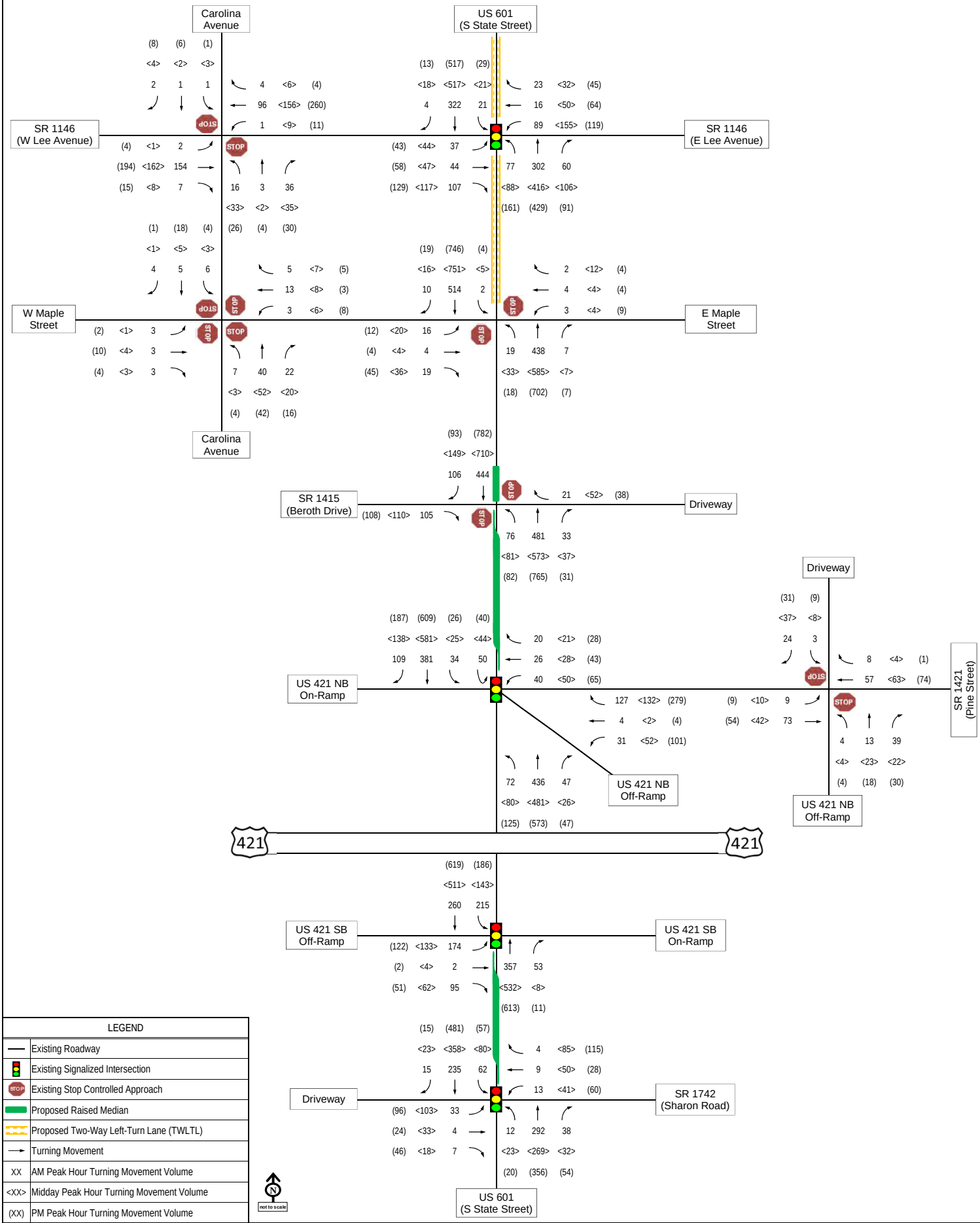

Figure 11
Build 2 (2023) AM, Midday and PM Peak Hour Turning Movement Volumes

US 601 Corridor Study
Yadkinville, NC

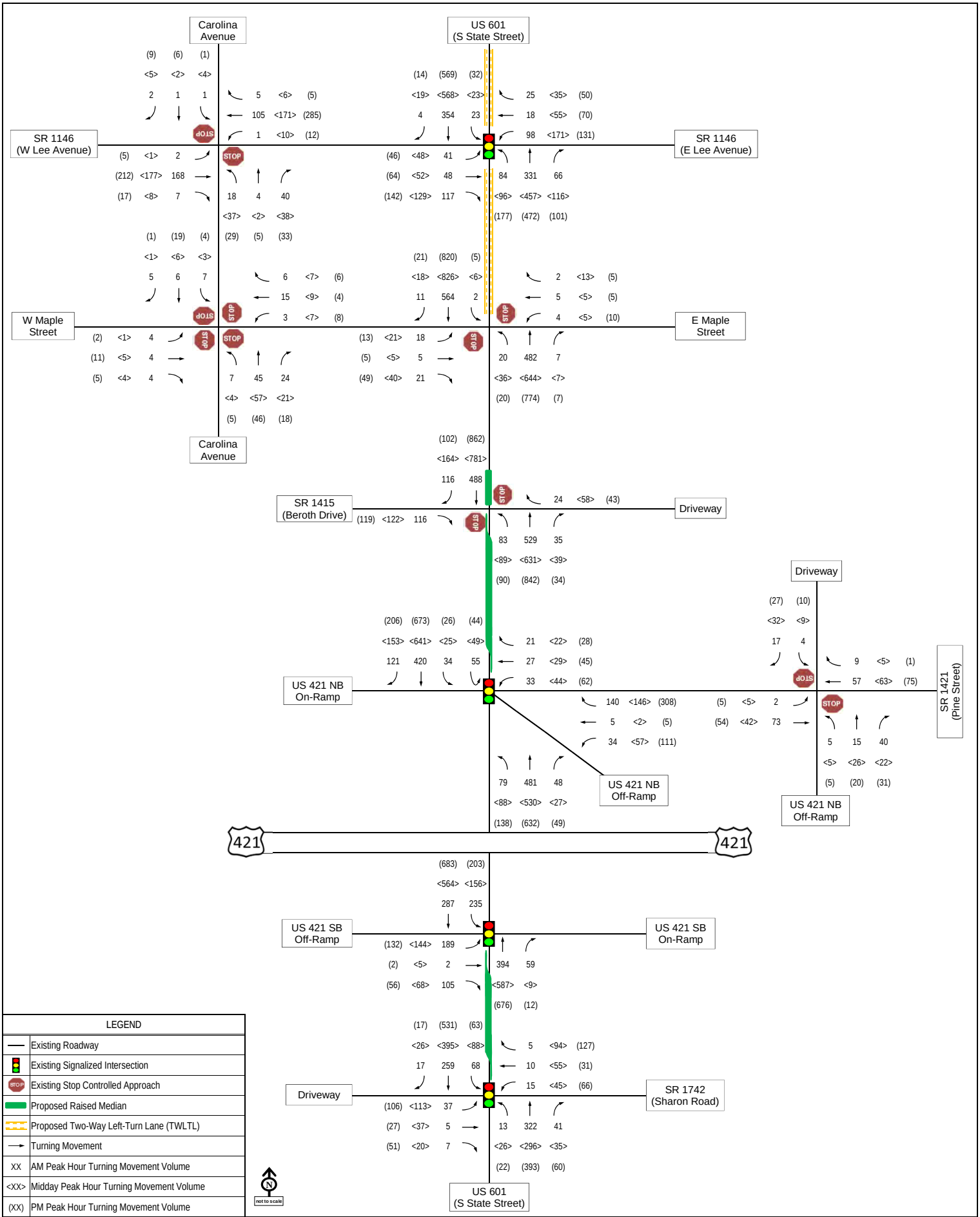

Figure 12
Build 2 (2033) AM, Midday and PM Peak Hour Turning Movement Volumes

US 601 Corridor Study
Yadkinville, NC

6

Signal Warrants

Based on the scope of this project, a peak hour signal warrant analyses was requested and therefore performed at following intersections in the study area:

- US 601 (South State Street) and Maple Street (*unsignalized*)
- SR 1146 (West Lee Avenue) and Carolina Avenue (*unsignalized*)
- West Maple Street and Carolina Avenue (*unsignalized*)

Initially, a peak hour signal warrants analyses was performed to identify the intersections that meet the warrants during the AM, Midday and PM peak hours under the No-Build (2033) conditions. The analysis was performed using *HCS 2010 Warrants* software. Based on the analysis, none of the above intersections meet the peak hour warrants to install a traffic signal.

Based on high peak hour turning movement volumes, a peak hour signal warrant analysis was also performed for the US 601 and Beroth Drive intersection. This intersection meets the peak hour volume warrants under No-Build (2023) conditions and peak hour volume and delay warrants under No-Build (2033) conditions. This intersection is located less than 400 feet from the US 601 and US 421 NB Ramps/Pine Street intersection, well less than the 1,000 – 1,200 feet minimum signal spacing that is desired. As a result of this close spacing and the desire to preserve the interchange operations, a signal is not recommended at this location.

The full *HCS 2010 Warrants* reports are included in Appendix H.

7

Recommended Improvements

The following roadway improvements recommended for the Build 1 and Build 2 scenarios:

Build 1

US 601 (South State Street)

- Construct a median along US 601 between US 421 NB Ramps and Maple Street.
- Construct a median along US 601 between US 421 SB Ramps and Sharon Road.
- Restripe US 601 north of Maple Street to provide one travel lane in both the northbound and southbound directions and a center two-way left-turn lane.

US 601 (South State Street) and Lee Avenue

- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Maple Street

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides and one circulating lane on the north and south sides.
- Restripe the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Restripe the southbound US 601 approach to provide a shared left/through lane and a shared through/right-turn lane. The inside shared left/through lane on US 601 can transition to a center two-way left-turn lane north of Maple Street.

US 601 (South State Street) and Beroth Drive

- Restripe the Beroth Drive approach to provide a right-turn lane only movement.

- Modify the northbound US 601 approach to provide an exclusive through lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 NB Ramps

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides and one circulating lane on the north and south sides.
- Modify the westbound Pine Street approach to provide a shared left/through/right-turn lane.
- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide a shared left/through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 SB Ramps

- Construct a multi-lane roundabout with two circulating lanes on the east and west sides.
- Modify the US 421 SB Off-Ramp to provide a shared left/through/right-turn lane.
- Modify the northbound US 601 approach to provide a through lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a through lane.

US 601 (South State Street) and Sharon Road/Shopping Center Driveway

- Construct a single-lane roundabout at this intersection with a single entry and exit lane on all approaches.

Build 2

US 601 (South State Street)

- Construct a median along US 601 between US 421 NB Ramps and Beroth Drive.
- Construct a median along US 601 between US 421 SB Ramps and Sharon Road.
- Restripe US 601 north of Maple Street to provide one travel lane in both the northbound and southbound directions and a center two-way left-turn lane.

US 601 (South State Street) and Lee Avenue

- Modify the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Maple Street

- Restripe the northbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.
- Restripe the southbound US 601 approach to provide an exclusive left-turn lane and a shared through/right-turn lane.

US 601 (South State Street) and Beroth Drive

- Restripe the Beroth Drive approach to provide a right-turn lane only movement.
- Modify the northbound US 601 approach to provide an exclusive left-turn lane, a through lane, a shared through/right-turn lane.
- Modify the southbound US 601 approach to provide a through lane and a shared through/right-turn lane.

US 601 (South State Street) and US 421 NB Ramps

- Restripe the US 421 NB Off-Ramp approach to provide a shared left/through/right-turn lane and an exclusive right-turn lane.
- Construct a U-turn bulb in the northeast quadrant of the intersection to accommodate southbound U-turning maneuvers.

In addition to the above improvements, numerous low-cost safety improvements were identified along the corridor based on the Road Safety Assessment. These improvements include clearing obstructions in sight distance triangles, installing new signs, replacing old/missing signs, relocating stop-bars, optimizing signal timings, installing delineators, crosswalks and sidewalks, etc. If NCDOT chooses to implement any of these suggested improvements, they can be installed prior to or in conjunction with either Build 1 or Build 2.

Table 14 Existing (2013) and No-Build (2023 and 2033) Level of Service Results

ID	Intersection Name	Control	Existing 2013			No-Build 2023			No-Build 2033		
			AM	Midday	PM	AM	Midday	PM	AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	Signalized	A (WB-B)	B (WB-B)	B (WB-C)	B (WB-B)	B (WB-C)	B (WB-C)	B (WB-B)	B (WB-C)	B (WB-C)
2	Maple Street & US 601 (South State Street)	Signalized	(WB-C)	(WB-C)	(WB-D)	(WB-C)	(WB-C)	(WB-D)	(WB-C)	(WB-C)	(WB-D)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	Unsignalized	(WB-C)	(EB-D)	(EB-D)	(EB-C)	(EB-F)	(EB-F)	(EB-D)	(EB-F)	(EB-F)
4	US 421 NB Ramp & US 601 (South State Street)	Unsignalized	C (NWB-D)	C (NWB-D)	C (NWB-D)	C (NWB-D)	C (NWB-D)	D (NWB-E)	C (NWB-D)	C (NWB-E)	D (NWB-E)
5	US 421 SB Ramp & US 601 (South State Street)	Signalized	B (EB-E)	A (EB-E)	A (EB-E)	C (EB-D)	B (EB-D)	C (EB-D)	C (EB-D)	C (EB-D)	B (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	Unsignalized	A (EB-D)	C (EB-E)	C (EB-E)	B (EB-D)	C (EB-E)	C (EB-E)	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	Unsignalized	(NB-A)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	Unsignalized	(NB-A)	(NB-A)	(NB-A)	(WB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	Unsignalized	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)

Legend: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS

Table 15 Build (2023 and 2033) Intersection Level of Service Results

ID	Intersection Name	Build 1 2023			Build 1 2033			Build 2 2023			Build 2 2033		
		AM	Midday	PM	AM	Midday	PM	AM	Midday	PM	AM	Midday	PM
1	SR 1146 (Lee Avenue) & US 601 (South State Street)	B (WB-C)	C (WB-C)	C (WB-D)	B (WB-C)	C (WB-D)	C (WB-D)	B (WB-C)	C (WB-C)	C (WB-D)	B (WB-C)	C (WB-D)	C (WB-D)
2	Maple Street & US 601 (South State Street)	A (NB-A)	B (NB-B)	B (NB-B)	A (NB-A)	B (NB-B)	B (NB-C)	(EB-B)	(EB-C)	(WB-C)	(WB-B)	(EB-C)	(WB-C)
3	SR 1415 (Beroth Drive) & US 601 (South State Street)	(EB-B)	(EB-B)	(EB-B)	(EB-B)	(EB-C)	(EB-C)	(EB-B)	(EB-B)	(EB-B)	(EB-B)	(EB-B)	(EB-C)
4	US 421 NB Ramp & US 601 (South State Street)	A (NB-A)	A (SB-B)	B (SB-C)	A (NB-B)	B (SB-B)	C (SB-C)	C (NWB-E)	C (NWB-E)	D (WB-E)	C (NWB-E)	C (NWB-E)	D (NWB-E)
5	US 421 SB Ramp & US 601 (South State Street)	A (EB-A)	A (EB-A)	B (EB-B)	A (EB-B)	A (EB-B)	B (EB-B)	C (EB-D)	B (EB-D)	C (EB-D)	C (EB-D)	C (EB-D)	C (EB-D)
6	SR 1742 (Sharon Road)/Driveway & US 601 (South State Street)	A (NB-A)	A (SB-B)	B (SB-B)	A (NB-A)	B (SB-B)	B (SB-C)	B (EB-D)	C (EB-E)	C (EB-E)	B (EB-D)	C (EB-E)	C (EB-E)
7	SR 1146 (Lee Avenue) & Carolina Avenue	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)	(NB-B)
8	Maple Street & Carolina Avenue	(NB-A)	(NB-A)	(NB-A)	(WB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)
9	Pine Street & Driveway	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)	(NB-A)

LEGEND: X = Overall Intersection LOS; (XX-X) = Worst Approach-Worst Approach LOS