

Appendix A: Traffic Analysis Report

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Traffic Analysis

**Woodruff Road
Congestion Relief Project
Greenville, SC**

Prepared for:
South Carolina Department of Transportation

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**Woodruff Road Congestion Relief Project
Traffic Analysis
Greenville, SC**

**Prepared for:
South Carolina Department of Transportation**

**Prepared by:
Bihl Engineering, LLC
304 Meeting Street, Suite F
Charleston, SC 29401
Mail:
P.O. Box 31318
Charleston, SC 29417
(843) 637-9187**



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TABLE OF CONTENTS

	<u>Page No.</u>
1.0 EXECUTIVE SUMMARY	1
2.0 INTRODUCTION	3
3.0 INVENTORY	3
3.1 STUDY AREA.....	3
3.2 EXISTING ROADWAY CONDITIONS	6
3.2.1 Interstate Roadways	6
3.2.2 SCDOT Roadways	6
3.2.3 Greenville County Roadways	10
3.2.4 City of Greenville Roadways.....	11
3.3 AREA ROADWAY CONSTRUCTION PROJECTS	12
3.3.1 I-85/I-385 Gateway Project	12
3.3.2 Woodruff Road Sidewalk Project	12
3.3.3 I-85 (US 25 to SC 129) - US 29 and SC 146/296 Signal Improvement & Cameras	12
3.3.4 Piedmont Natural Gas Connector Road	12
3.4 TRANSIT FACILITIES	12
4.0 DATA COLLECTION.....	15
4.1 ROADWAY VOLUME DATA.....	15
4.2 TURNING MOVEMENT COUNTS	22
4.3 SIGNAL PLANS AND TIMINGS	23
5.0 ACCIDENT DATA SUMMARY	25
6.0 BACKGROUND GROWTH DEVELOPMENT.....	26
6.1 HISTORIC TRAFFIC VOLUMES.....	26
7.0 ALTERNATIVES DEVELOPMENT	28
7.1 GREENVILLE-PICKENS AREA TRANSPORTATION STUDY MODEL VOLUMES	28
7.2 PRELIMINARY ALTERNATIVES DEVELOPMENT	28
7.2.1 Alternatives for Study.....	29
7.2.2 No Build Alternative.....	29
7.2.3 Alternative 1.....	29
7.2.4 Alternative 2C.....	29
7.2.5 Alternative 3C.....	29

7.2.6	<i>Alternative 6C</i>	30
7.2.7	<i>Alternative 6D</i>	30
7.3	ROADWAY GROWTH RATES	36
7.4	METHODOLOGY FOR DEVELOPING FUTURE YEAR TRAFFIC VOLUMES	36
7.5	PEAK HOUR TRAFFIC VOLUMES BY ALTERNATIVE	41
8.0	INTERSECTION CAPACITY ANALYSIS	66
8.1	EXISTING CONDITIONS	69
8.2	2045 NO BUILD CONDITIONS.....	73
8.3	2045 ALTERNATIVE 1 CONDITIONS	76
8.4	2045 ALTERNATIVE 2C CONDITIONS	79
8.5	2045 ALTERNATIVE 3C CONDITIONS	82
8.6	2045 ALTERNATIVE 6C CONDITIONS	86
8.7	2045 ALTERNATIVE 6D CONDITIONS	89
8.8	INTERSECTION ANALYSIS SUMMARY	93
8.9	ARTERIAL ANALYSIS	93
8.10	PERFORMANCE INDEX BY ALTERNATIVE	95
8.11	CORRIDOR SUMMARIES BY ALTERNATIVE.....	96
8.11.1	<i>Existing Conditions</i>	96
8.11.2	<i>2045 No Build Alternative</i>	96
8.11.3	<i>2045 Alternative 1</i>	97
8.11.4	<i>2045 Alternative 2C</i>	97
8.11.5	<i>2045 Alternative 3C</i>	98
8.11.6	<i>2045 Alternative 6C</i>	98
8.11.7	<i>2045 Alternative 6D</i>	98
9.0	OTHER CORRIDOR IMPROVEMENT CONSIDERATIONS.....	99
9.1	TRAFFIC SIGNAL UPGRADES	99
9.2	RESULTS OF 2017 ROAD SAFETY ASSESSMENT	99
9.3	ACCESS MANAGEMENT	100
9.4	SIGHT DISTANCE, PAVEMENT MARKINGS AND SIGNAGE	101
10.0	SUMMARY.....	101

LIST OF TABLES

Table No.	Title	Page No.
Table 1:	SCDOT Annual Average Daily Traffic (AADT) Counts by Year	7
Table 2:	Circulator A: CU-ICAR/University Center/Haywood Mall	14
Table 3:	Circulator B: CU-ICAR/University Center/Haywood Mall	14
Table 4:	Projected Daily Traffic Volumes and Growth Rates by Alternative	37
Table 5:	Signalized Intersection Level of Service Criteria	66
Table 6:	Unsignalized Intersection Level of Service Criteria	67
Table 7:	Intersections Analyzed by Alternative.....	68
Table 8:	Level of Service and delay - Existing Conditions	69
Table 9:	Level of Service and delay - No Build Conditions	75
Table 10:	Level of Service and delay - Alternative 1 Conditions.....	78
Table 11:	Level of Service and delay - Alternative 2C Conditions	81
Table 12:	Level of Service and delay - Alternative 3C Conditions	84
Table 13:	Level of Service and delay - Alternative 6C Conditions	88
Table 14:	Level of Service and delay - Alternative 6D Conditions.....	91
Table 15:	Comparison of Level of Service Grades to 2045 No Build Level of Service.....	93
Table 16:	Arterial Level of Service Criteria - Class II Urban Street.....	94
Table 17:	Arterial Level of Service - Woodruff Road - Level of Service	94
Table 18:	Performance Index - Woodruff Road	95

LIST OF FIGURES

Figure No.	Title	Page No.
Figure 1:	Study Area	4
Figure 2:	Existing Laneage	8
Figure 3:	Greenlink #16 Route	13
Figure 4:	Woodruff Road Traffic Volumes by Location	16
Figure 5:	Woodruff Road Average Daily Traffic Volumes	18
Figure 6:	Woodruff Road Daily Directional Traffic Volumes.....	19
Figure 7:	Woodruff Road Average Weekday Hourly Traffic Volumes.....	20
Figure 8:	Other Study Area Roadways - Average Weekday Daily Traffic Volumes	21
Figure 9:	Existing Traffic Volumes	24
Figure 10:	Accident Overview	27
Figure 11:	Alternative 1 Concept.....	31
Figure 12:	Alternative 2C Concept	32
Figure 13:	Alternative 3C Concept	33
Figure 14:	Alternative 6C Concept	34
Figure 15:	Alternative 6D Concept.....	35
Figure 16:	2045 No Build Woodruff Road Traffic Volumes.....	42
Figure 17:	2045 No Build New Roadway Traffic Volumes	43
Figure 18:	2045 No Build Woodruff Road Saturday Traffic Volumes.....	44
Figure 19:	2045 No Build New Roadway Saturday Traffic Volumes	45
Figure 20:	Alternative 1 Woodruff Road Traffic Volumes	46
Figure 21:	Alternative 1 New Roadway Traffic Volumes	47
Figure 22:	Alternative 1 Woodruff Road Saturday Traffic Volumes	48
Figure 23:	Alternative 1 New Roadway Saturday Traffic Volumes.....	49

LIST OF FIGURES (CONTINUED)

Figure No.	Title	Page No.
Figure 24:	Alternative 2C Woodruff Road Traffic Volumes.....	50
Figure 25:	Alternative 2C New Roadway Traffic Volumes	51
Figure 26:	Alternative 2C Woodruff Road Saturday Traffic Volumes.....	52
Figure 27:	Alternative 2C New Roadway Saturday Traffic Volumes	53
Figure 28:	Alternative 3C Woodruff Road Traffic Volumes.....	54
Figure 29:	Alternative 3C New Roadway Traffic Volumes	55
Figure 30:	Alternative 3C Woodruff Road Saturday Traffic Volumes.....	56
Figure 31:	Alternative 3C New Roadway Saturday Traffic Volumes	57
Figure 32:	Alternative 6C Woodruff Road Traffic Volumes.....	58
Figure 33:	Alternative 6C New Roadway Traffic Volumes	59
Figure 34:	Alternative 6C Woodruff Road Saturday Traffic Volumes.....	60
Figure 35:	Alternative 6C New Roadway Saturday Traffic Volumes	61
Figure 36:	Alternative 6D Woodruff Road Traffic Volumes.....	62
Figure 37:	Alternative 6D New Roadway Traffic Volumes	63
Figure 38:	Alternative 6D Woodruff Road Saturday Traffic Volumes	64
Figure 39:	Alternative 6D New Roadway Saturday Traffic Volumes.....	65
Figure 40:	Existing Level of Service	71
Figure 41:	2045 No Build Level of Service.....	74
Figure 42:	Alternative 1 Level of Service.....	77
Figure 43:	Alternative 2C Level of Service	80
Figure 44:	Alternative 3C Level of Service	83
Figure 45:	Alternative 6C Level of Service	87
Figure 46:	Alternative 6D Level of Service.....	90

1.0 Executive Summary

The proposed Woodruff Road Congestion Relief project is located in Greenville County, South Carolina. The project extends along Woodruff Road from Verdae Boulevard/Roper Mountain Road to Smith Hines Road. The Woodruff Road Congestion Relief Project will consist of a two- or four-lane, limited access new location roadway with a multi-use path. The study area for the Existing conditions also includes Woodruff Road from Mall Connector Road to Verdae Boulevard/Roper Mountain Road.

The study reviews the Existing conditions, the future 2045 No Build conditions, and the future 2045 Build Alternatives conditions.

There are several projects in the design phase or underway in the study area; these include the I-85/I-385 Gateway Project, the Salters Road improvements, the Woodruff Road sidewalk improvements, the Piedmont Natural Gas (PNG) Connector and conversion of the Woodruff Road signalized intersections to adaptive control. The City of Greenville has also completed a new connector road between Carolina Point Parkway and Market Point Drive.

Roadways in the study area are a combination of SCDOT, Greenville County and City of Greenville roadways. The Greenlink transit service provides service along a portion of the study area.

The Woodruff Road corridor is a highly travelled corridor which currently experiences high levels of congestion during peak times. Peak travel times occur during the AM peak hour, lunchtime – Midday peak hour, and PM peak hour as well as the Saturday peak hour. Due to the high level of commercial activity along the corridor, the Midday peak hour is sometimes higher than the PM peak hour and Saturdays also experience peak times. During peaks there are sometimes queuing issues throughout the corridor where the demand for the turn lanes exceeds the available storage. This causes intermittent queuing, which further affects the traffic flow and operations of the corridor. At some locations during peak periods, travel demand at an intersection exceeds the available queuing distance between intersections, resulting in queue spillback to the adjacent intersection. This causes the traffic to be metered through the project intersections as vehicles travel through the corridor.

A review of the recent crash history shows that intersections, as well as driveways along the side streets play a large role in crash location. Vehicles turning either onto or from the main corridor of Woodruff Road are shown as high crash location areas, most commonly rear end and angle collision types which suggest this is due to congestion on the road. Additionally, during the period analyzed there were three fatalities in the study area. Based on the detailed summaries of these

incidents, it was noted that these incidents were not due to geometric or design issues. It is likely that the low number of fatalities are a result of high traffic congestion leading to a decrease in average speed resulting in a less severe impact when collision occurs.

The Build Alternatives for the project include the following:

- Alternative 1 - This alternative widens Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road with a Diverging Diamond Intersection (DDI) at I-85.
- Alternative 2C - This alternative widens Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road with a DDI at I-85. This alternative includes a new roadway beginning south of Woodruff Road that utilizes the existing roadway network from Verdae Boulevard to Market Point Drive and continues to Smith Hines Road via new alignment.
- Alternative 3C - This alternative widens Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road with a DDI at I-85. This alternative includes a three-lane new roadway connecting Woodruff Industrial Lane to Carolina Point Parkway and continuing to Smith Hines Road via new alignment.
- Alternative 6C - This alternative includes a five-lane new roadway connecting Woodruff Industrial Lane to Carolina Point Parkway and continuing to Smith Hines Road via new alignment.
- Alternative 6D - This alternative includes a five-lane new roadway connecting Woodruff Industrial Lane to Carolina Point Parkway and continuing to Smith Hines Road via new alignment. This alternative also includes the installation of a DDI at I-85.

The projected level of service for the 2045 No Build conditions study area intersections degrades from the Existing conditions. All the 2045 Build Alternatives improve conditions beyond the 2045 No Build conditions. The 2045 Build Alternatives results generally improve study area intersection conditions from the 2045 No Build conditions with Alternative 6C showing the greatest number of improved intersections and the fewest number of degraded intersections when compared to the 2045 No Build conditions. Alternative 6D operates similarly to Alternative 6C with three fewer improved intersections and two more degraded locations.

The Woodruff Road arterial analysis shows that Alternative 6D had the highest projected average travel speed during the AM peak hour while Alternative 1 had the lowest projected average travel

speed. Alternative 6C results in the smallest range of projected average speeds with operations of LOS D and LOS E.

The Woodruff Road performance index (an operations metric calculated using the total delay (control and queue delay) and the vehicle stops per hour) results in Alternative 6C operating best with the lowest performance index while Alternative 1 has the highest performance index.

In summary, all 2045 Build Alternatives result in better operations for the No Build with Alternatives 3C, 6C and 6D performing the best based on projected intersection operations, Woodruff Road arterial analysis and Woodruff Road performance index.

2.0 Introduction

The proposed Woodruff Road Congestion Relief project is located in Greenville County, South Carolina. The project extends along Woodruff Road from Verdae Boulevard/Roper Mountain Road to Smith Hines Road. The Woodruff Road Congestion Relief Project will consist of a two- or four-lane, limited access new location roadway with a multi-use path. The study area for the Existing conditions also includes Woodruff Road from Mall Connector Road to Verdae Boulevard/Roper Mountain Road.

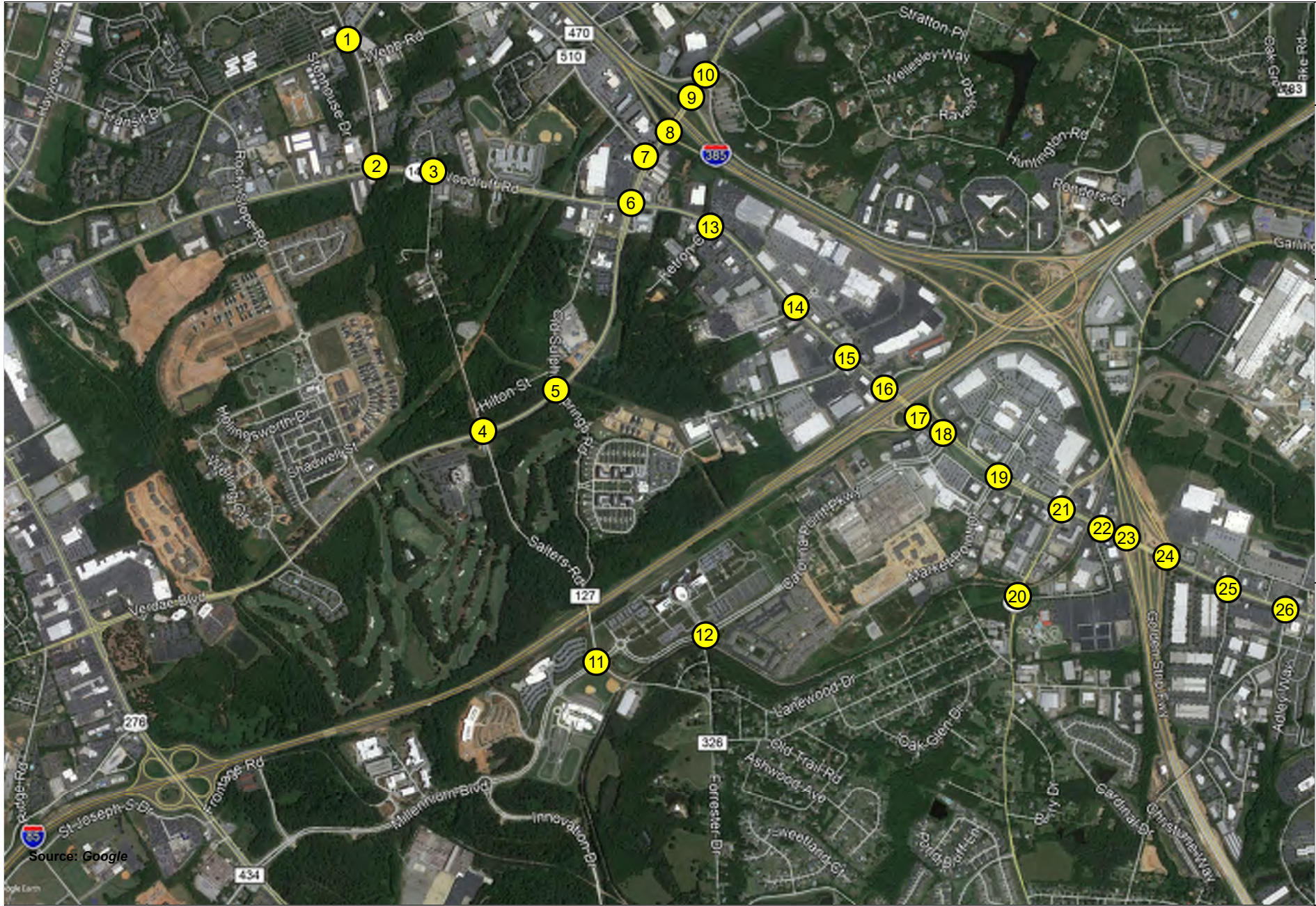
The study reviews the Existing conditions, the future 2045 No Build conditions, and the future 2045 Build Alternatives conditions.

3.0 Inventory

The following section discusses the Existing conditions study area, including the existing roadway conditions, area roadway construction projects, and transit facilities. **Figure 1** shows the overall study area for the project.

3.1 Study Area

The Existing conditions traffic analysis study area for the project includes the following existing intersections and reviews their operations during the AM, Midday, and PM peak hour conditions. Saturday peak hour conditions were also studied for the Woodruff Road intersections as noted in the list below.



Source: Google

Figure 1

Study Area

Woodruff Road Parallel



- Mall Connector Road at Halton Road
- Woodruff Road at Mall Connector Road (Saturday)
- Woodruff Road at Salters Road
- Verdae Boulevard at Salters Road
- Verdae Boulevard at Old Sulphur Springs Road
- Woodruff Road at Verdae Boulevard/Roper Mountain Road (Saturday)
- Roper Mountain Road at Congaree Road
- Roper Mountain Road at I-385 SB
- Roper Mountain Road at I-385 NB
- Roper Mountain Road at Independence Boulevard/Frontage Road
- Millennium Boulevard at Sulphur Springs Road
- Carolina Point Parkway roundabout at Avana and Corporate Campus
- Woodruff Road at Ketron Court (Saturday)
- Woodruff Road at Green Heron Road (Saturday)
- Woodruff Road at Woodruff Industrial Lane (Saturday)
- Woodruff Road at I-85 SB
- Woodruff Road at I-85 NB (Saturday)
- Woodruff Road at Carolina Point Parkway (Saturday)
- Woodruff Road at Market Point Drive (Saturday)
- Miller Road at Park Woodruff Drive
- Woodruff Road at Miller Road (Saturday)
- Woodruff Road at Park Woodruff Drive (Saturday)
- Woodruff Road at I-385 SB
- Woodruff Road at I-385 NB
- Woodruff Road at Merovan Driveway
- Woodruff Road at Smith Hines Road

The Existing conditions traffic analysis study area also includes the following roadways:

- Woodruff Road (SC 146) from 500 feet west of Mall Connector Road to 500 feet east of I-385
- Roper Mountain Road (S-183) from Woodruff Road (SC 146) to 500 feet north of I-385
- Salters Road from Millennium Drive to Woodruff Road (SC 146)
- Verdae Road from 500 feet south of Salters Road to Woodruff Road (SC 146)
- Mall Connector Road from Woodruff Road (SC 146) to 500 feet north of Halton Road (S-311)

- Old Sulfur Springs Road (SC 326 section and non-state section)
- Miller Road (S-564) from 500 feet south of Thousand Oaks Drive to Woodruff Road (SC 146)
- Ketron Court
- Green Heron Road
- Woodruff Industrial Lane
- Carolina Point Parkway
- Market Point Drive
- Millennium Boulevard
- Smith Hines Road

3.2 Existing Roadway Conditions

The study area consists of interstate, state, Greenville County, and City of Greenville roadways. **Table 1** shows the Annual Average Daily Traffic (AADT) volumes for year 2006 and years 2010 - 2016. The existing roadway laneage for the study area intersections and roadways is shown on **Figure 2**.

3.2.1 Interstate Roadways

Two interstates traverse the study area: I-85 and I-385.

I-385 – I-385 is an eight-lane interstate highway with a posted speed limit of 55 miles per hour (mph) in the study area. Per South Carolina Department of Transportation (SCDOT) 2016 AADT counts, I-385 has approximately 105,500 vehicles per day (vpd) from Roper Mountain Road to I-85 and approximately 100,400 vpd from I-85 to Woodruff Road. Since 2010 I-385 has experienced an increase in traffic of approximately 2% per year in the vicinity of the project.

I-85 – I-85 is a six-lane interstate highway with a posted speed limit of 60 mph in the study area. Per SCDOT 2016 AADT counts, I-85 has approximately 108,000 vpd from Laurens Road to Woodruff Road and approximately 107,600 vpd from Woodruff Road to I-385. Since 2010 I-85 has experienced an increase in traffic of approximately 2% to 3% per year in the sections from Laurens Road to Woodruff Road and from Woodruff Road to I-385, respectively.

3.2.2 SCDOT Roadways

Woodruff Road, Roper Mountain Road, Halton Road, Congaree Road, Independence Boulevard, Frontage Road, Miller Road and Garlington Road are SCDOT roadways.

Table 1: SCDOT Annual Average Daily Traffic (AADT) Counts by Year										
Roadway	Road Section		Year							
	Start	End	2016	2015	2014	2013	2012	2011	2010	2006
I-85	Laurens Rd.	Woodruff Rd.	108,000	107,000	101,100	94,000	93,100	92,700	92,700	98,000
I-85	Woodruff Rd.	I-385	107,600	105,800	100,600	91,500	90,200	90,800	91,000	94,400
I-385	I-85	Roper Mtn. Rd.	105,500	99,600	96,600	95,700	93,200	95,000	92,000	87,000
I-385	Woodruff Rd.	I-85	100,400	91,600	89,500	70,600	88,900	87,300	87,000	84,500
Miller Rd.	Corn Rd.	Woodruff Rd.	7,700	7,200	6,900	6,000	-	-	-	-
Woodruff Rd.	Laurens Rd.	I-85	12,900	13,000	12,600	11,900	12,600	11,500	12,100	11,800
Woodruff Rd.	I-85	SC 14	35,500	34,400	35,400	34,600	34,100	33,500	32,200	30,800
Mall Connector Rd.	Woods Crossing Rd.	Congaree Rd.	6,600	6,200	5,300	5,100	5,600	5,200	5,100	5,800
Verdae Blvd.	Rocky Slope Rd.	Verdae Blvd.	17,300	15,500	12,200	12,800	13,400	13,200	13,900	-
Roper Mountain Rd.	I-385	Woodruff Rd.	33,300	31,600	32,100	22,200	17,700	18,300	19,600	-
Roper Mountain Rd.	Roper Mountain Rd. Ext.	I-385	22,200	22,200	17,700	18,300	19,600	20,600	18,800	21,100
Halton Rd.	Woodruff Rd.	Congaree Rd.	8,900	8,900	7,400	7,600	8,100	9,000	8,600	11,800
Congaree Rd.	Roper Mountain Rd.	Patewood Dr.	15,400	13,900	13,400	13,300	14,700	14,600	13,900	16,200
Salters Rd.	Verdae Blvd.	Woodruff Rd.	1,100	1,100	750	700	850	750	900	1,050
Salters Rd.	I-85	Verdae Blvd.	5,300	5,300	4,100	4,300	4,400	4,900	4,600	4,000
Old Sulphur Springs Rd.	Hamby Dr.	I-85	4,000	6,100	5,000	4,200	5,100	5,000	4,900	-

Source: SCDOT count data

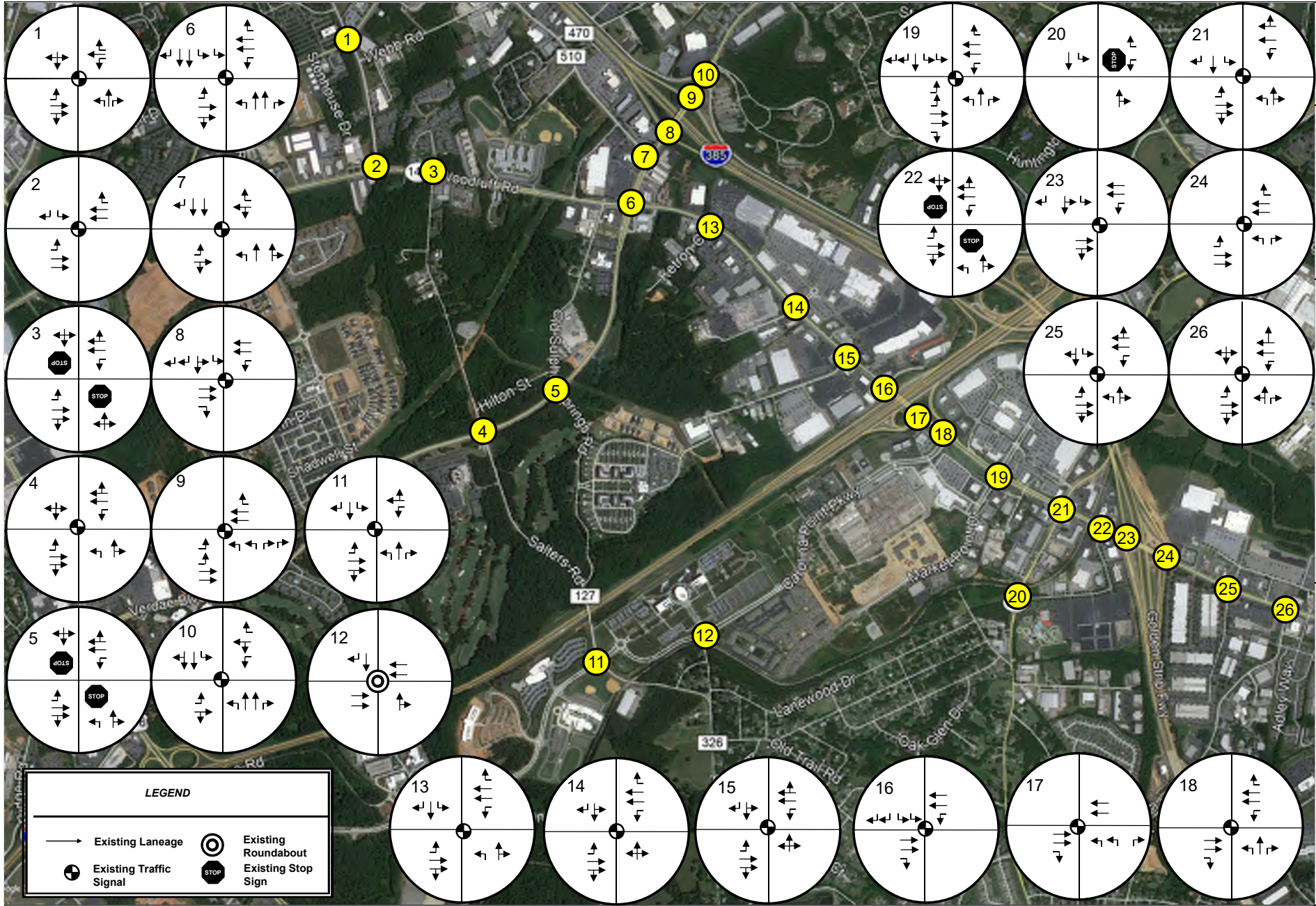


Figure 2

Existing Laneage

Woodruff Road Parallel

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Woodruff Road (S-146) – Woodruff Road is a five-lane minor arterial roadway with a two-way left-turn lane. Woodruff Road has a posted speed limit of 45 mph from Mall Connector Road to Verdae Boulevard and a posted speed limit of 35 mph east of Verdae Boulevard. Per SCDOT 2016 AADT counts, Woodruff Road has approximately 35,500 vpd from I-85 to SC 14, representing the eastern segment of Woodruff Road, and 12,900 vpd from Laurens Road to I-85, representing the western segment of Woodruff Road west of Roper Mountain Road. Since 2010, Woodruff Road has experienced an increase in traffic of approximately 1% and 2% per year in the sections from Laurens Road to I-85 and I-85 to SC 14, respectively.

During peak times, extensive queuing occurs on Woodruff Road especially during the December shopping season where traffic is significantly impacted by access to commercial parcels along the corridor. This is documented in the *Magnolia Park – Final Traffic Analysis* prepared by AECOM in January 2017. This study documents the congestion issues on Woodruff Road and within Magnolia Park. It specifically notes that due to the overall congestion on Woodruff Road, vehicles exiting the development commonly do not have room to successfully pass through an intersection without blocking it, essentially metering the flow along the corridor. This study also found that on Saturday, 50% of the vehicles using Woodruff Road between Roper Mountain Road/Verdae Boulevard and I-85 were accessing the Magnolia Park Development.

Roper Mountain Road (S-183) – Roper Mountain Road is a four-lane minor arterial roadway with a posted speed limit of 40 mph in the vicinity of the study area. Per SCDOT 2016 AADT counts, Roper Mountain Road has approximately 33,300 vpd from I-385 to Woodruff Road and approximately 22,200 vpd from Roper Mountain Road Extension to I-385. Since 2010, Roper Mountain Road has experienced an increase in traffic of approximately 7% and 3% per year in the sections from I-385 to Woodruff Road and Roper Mountain Road Extension to I-385 respectively. Roper Mountain Road provides access between Woodruff Road and I-385.

Halton Road (S-311) – Halton Road is a four-lane major collector roadway with two-way left-turn lane and a posted speed limit of 40 mph. Per SCDOT 2016 AADT counts, Halton Road has approximately 8,900 vpd and has seen an increase in traffic of approximately 1% per year since 2010.

Congaree Road (S-509) – Congaree Road is a three-lane major collector roadway with a two-way left-turn lane and a posted speed limit of 35 mph. Per SCDOT 2016 AADT counts, Congaree Road has approximately 15,400 vpd and has seen an increase in traffic of approximately 2% per year since 2010. Congaree Road provides access to the Haywood Mall from Roper Mountain Road.

Independence Boulevard (S-1102) – Independence Boulevard is a two-lane roadway that runs parallel to I-385 south of Roper Mountain Road.

Frontage Road (S-1103) – Frontage Road is a two-lane roadway with a posted speed limit of 35 mph. Frontage Road runs parallel to I-385 north of Roper Mountain Road.

Miller Road (S-564) – Miller Road is a two-lane major collector roadway with a posted speed limit of 45 mph. Per SCDOT 2015 AADT counts, Miller Road has approximately 7,200 vpd.

Garlington Road (S-564) – Garlington Road is a two-lane roadway connecting Woodruff Road to Pelham Road with a posted speed limit of 45 mph.

Salters Road – Salters Road is a two-lane major collector roadway with a posted speed limit of 25 mph north of Verdae Boulevard and a five-lane roadway with bike pedestrian facilities and a posted speed limit of 35 mph south of Verdae Boulevard. At the time of the traffic counts, Salters Road was closed north of Verdae Boulevard as part of the Salters Road widening project. Per SCDOT 2016 AADT counts, Salters Road has approximately 1,100 vpd from Woodruff Road to Verdae Boulevard and approximately 5,300 vpd from Verdae Boulevard to I-85. Since 2010, Salters Road has experienced an increase in traffic of approximately 3% and 2% per year in the sections from Woodruff Road to Verdae Boulevard and Verdae Boulevard to I-85, respectively. A portion of Salter Road is owned and maintained by the County.

3.2.3 Greenville County Roadways

Ketron Court, Green Heron Road and Woodruff Industrial Lane are owned and maintained by Greenville County.

Ketron Court – Ketron Court is a minor two-lane roadway. Ketron Court is currently a dead-end street south of Woodruff Road.

Green Heron Road – Green Heron Road is a minor two-lane roadway. Green Heron Road is currently a dead-end street south of Woodruff Road.

Woodruff Industrial Lane – Woodruff Industrial Lane is a minor two-lane roadway with a two-way left-turn lane for approximately 800 feet. Woodruff Industrial Lane has a posted speed limit of 25 mph.

North of Woodruff Road, the roadways opposite Ketron Court, Green Heron Road, and Woodruff Industrial Lane provide access to private development.

Smith Hines Road – Smith Hines Road is a two-lane roadway with a posted speed limit of 30 mph from Woodruff Road to Miller Road.

3.2.4 City of Greenville Roadways

Verdae Boulevard, Mall Connector Road, Salters Road, Old Sulfur Springs Road, Millennium Boulevard, Carolina Point Parkway, Market Point Drive and Park Woodruff Drive are owned and maintained by the City of Greenville.

Verdae Boulevard – Verdae Boulevard is a five-lane minor arterial roadway with a two-way left-turn lane and a posted speed limit of 45 mph. Verdae Boulevard. Per SCDOT 2016 AADT counts, Verdae Boulevard has approximately 17,300 vpd. Since 2010, Verdae Boulevard has experienced an average increase in traffic of approximately 3% per year. Verdae Boulevard connects Salters Road to Woodruff Road.

Mall Connector Road – Mall Connector Road is a three-lane roadway with a two-way left-turn lane and a posted speed limit of 35 mph. Per SCDOT 2016 AADT counts, Mall Connector Road has approximately 6,600 vpd and has seen an increase in traffic of approximately 4% per year since 2010. Mall Connector Road provides access to the Haywood Mall from Woodruff Road.

Old Sulphur Springs Road – Old Sulphur Springs Road is a two-lane roadway with a posted speed limit of 25 mph. Per SCDOT 2016 AADT counts, Old Sulphur Springs Road has approximately 4,000 vpd. Old Sulphur Springs Road saw a rise in traffic from 2010 to 2015 with an increase of approximately 4% per year however there was a decrease in traffic of approximately 50% from 2015 to 2016. Old Sulphur Springs Road was closed at the time of the traffic counts for road construction from just north of Verdae Boulevard to Millennium Boulevard/Carolina Point Parkway, which is the probable cause of the significant decrease in traffic.

Millennium Boulevard – Millennium Boulevard is a four-lane divided roadway. East of Old Sulphur Springs Road, Millennium Boulevard becomes Carolina Point Parkway.

Carolina Point Parkway – Carolina Point Parkway is a four-lane divided roadway with a posted speed limit of 30 mph. Carolina Point Parkway extends from Millennium Boulevard to Woodruff Road. Since the collection of the traffic counts, the City has recently completed a two-lane roadway connection between Carolina Point Parkway and Market Point Drive.

Market Point Drive – Market Point Drive is a four-lane divided major collector roadway. Market Point Drive has a posted speed limit of 25 mph.

Park Woodruff Drive – Park Woodruff Drive is a two-lane roadway with a two-way left-turn lane. Park Woodruff Drive connects Woodruff Road and Miller Road.

3.3 Area Roadway Construction Projects

There are several SCDOT and City projects underway in the study area. These are summarized below.

3.3.1 I-85/I-385 Gateway Project

The I-85/I-385 Gateway Project is an ongoing SCDOT design build project to construct the new interchange at I-85 and I-385. Along with the construction of a new interchange, the project also includes improvements to I-385, Roper Mountain Road, Woodruff Road, Garlington Road, Miller Road, and Chrome Drive. The project is expected to be completed in 2019. The improvements associated with this project will be incorporated in the future conditions analysis.

3.3.2 Woodruff Road Sidewalk Project

The Woodruff Road Sidewalk Project is currently in design and development. The project will construct a new sidewalk on the northern side of Woodruff Road between Roper Mountain Road to Old Country Road (just west of I-85).

3.3.3 I-85 (US 25 to SC 129) - US 29 and SC 146/296 Signal Improvement & Cameras

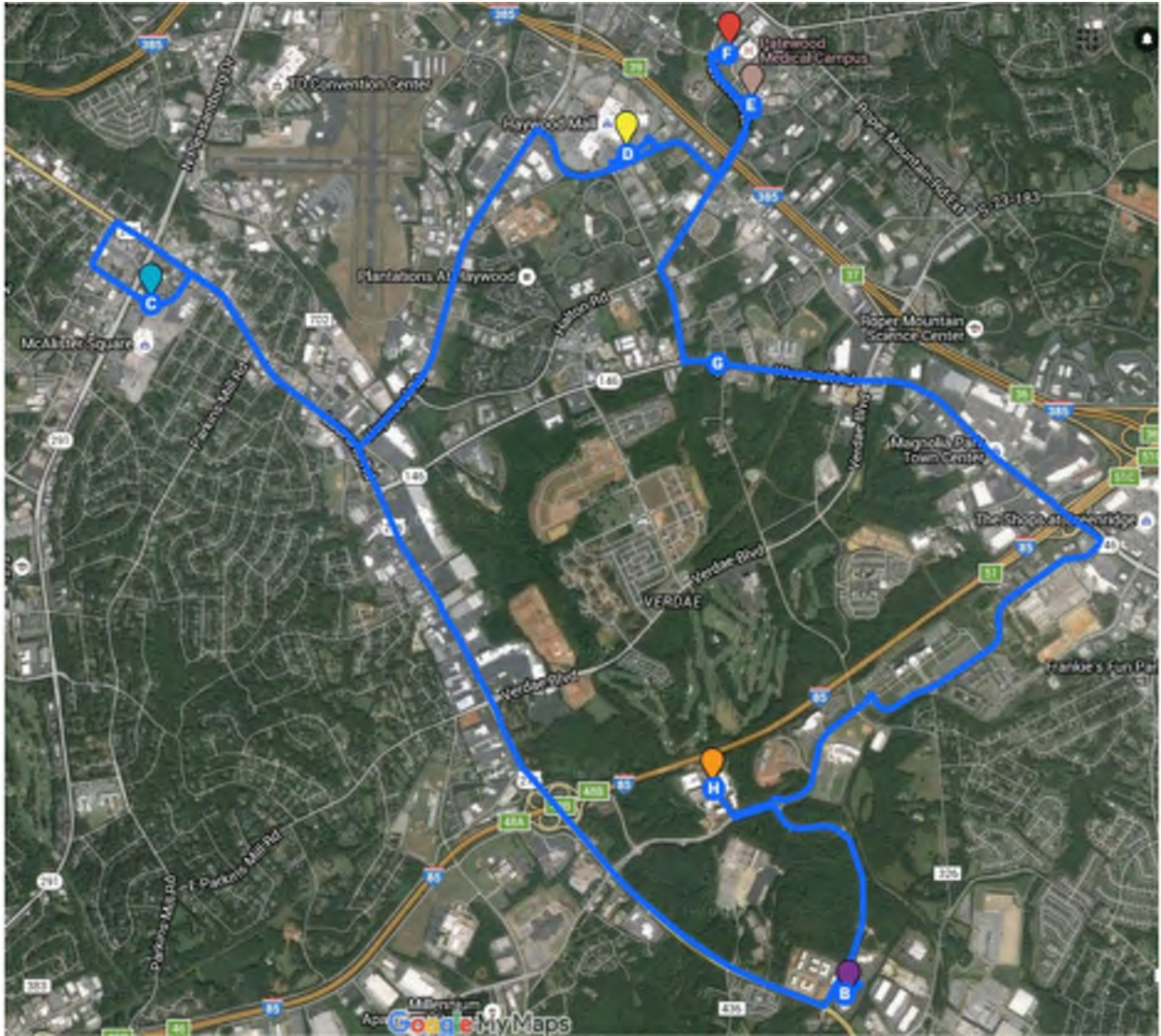
This project will implement advanced traffic signal systems along the Woodruff Road Corridor along with US 29, SC 296 and other connecting routes. The project will coordinate with I-85 operations for corridor management purposes.

3.3.4 Piedmont Natural Gas Connector Road

This project will connect Woodruff Industrial Lane to Verdae Boulevard with connections planned with Green Heron Road and Ketron Court. The Ketron Court and Green Heron Road access points are planned to be roundabouts. The facility is planned to be controlled access and will have a traffic signal at its connection to Verdae Boulevard. This project is currently under construction. The improvements associated with this project will be incorporated in the future conditions analysis.

3.4 Transit Facilities

The Greenville area is served by Greenlink Transit. The study area is partially served by Route 16, the University Center CU-ICAR circulator route. This route serves Woodruff Road from Carolina Point Parkway to Mall Connector Road. The route connects Woodruff Road to the Haygood Mall area and to Laurens Road as shown in **Figure 3**.



Source: Greenlink

Figure 3: Greenlink #16 Route

On Monday through Friday, the route runs every half hour from 5:30 AM to 9:00 PM and on Saturday, it runs hourly from 8:30 AM to 6:30 PM. **Tables 2 and 3** show the route schedules for the circulators.

Table 2: Circulator A: CU-ICAR / University Center / Haywood Mall¹	
Stop	Time
CU-ICAR	:30
St. Francis Millennium	:34
University Center	:46
Haywood Mall	:55
St. Francis Eastside	:00
Patewood Medical Campus	:02
Waterside Greene Apartments	:07
CU-ICAR	:22

Source: <http://www.ridegreenlink.com/1204/Schedules>

Table 3: Circulator B (Monday-Friday ONLY): CU-ICAR / University Center / Haywood Mall¹	
Stop	Time
CU-ICAR	:00
St. Francis Millennium	:04
University Center	:16
Haywood Mall	:25
St. Francis Eastside	:30
Patewood Medical Campus	:32
Waterside Greene Apartments	:37
CU-ICAR	:52

Source: <http://www.ridegreenlink.com/1204/Schedules>

4.0 Data Collection

The following data collection activities were performed for the study area.

4.1 Roadway Volume Data

In addition to the SCDOT daily traffic volume data presented in **Table 1**, pneumatic tube count data was collected at the following locations in April, May, and October 2017. Tube counts were collected for 48 hours or seven days depending on the location.

- Woodruff Road (SC 146)
 - Between Miller Road and Market Point Drive
 - Between Carolina Point Parkway and I-85
 - Between Woodruff Industrial Lane and Green Heron Road
 - Between Ketron Court and Roper Mountain Road/Verdae Boulevard
 - Between Roper Mountain Road and Salters Road
 - Between I-385 and Smith Hines Road
- Verdae Boulevard south of Woodruff Road (SC 146)
- Salters Road between Verdae Boulevard and Woodruff Road (SC 146)
- Verdae Boulevard between Salters Road and Woodruff Road (SC 146)
- Mall Connector Road between Woodruff Road (SC 146) and Halton Road (S-311)
- Miller Road (S-564) south of Woodruff Road (SC 146)
- Carolina Point Parkway between Millennium Drive and Woodruff Road (SC 146)

All count data is included in the **Appendix**.

Capacity of a roadway is based on the area type, speed limit, number of lanes, the presence of a median and turn lanes. The Florida Department of Transportation (FDOT) Level of Service (LOS) generalized tables use these roadway characteristics to determine roadway capacity. For Woodruff Road, LOS D capacity is approximately 40,000 vpd. **Figure 4** shows a comparison of the volumes on Woodruff Road by section and by day of week with the LOS D capacity of 40,000 vpd.

Along the Woodruff Road corridor, Sunday has the lowest traffic volumes. At all locations, traffic volumes rise steadily through the week with Friday seeing the highest traffic volumes. The highest traffic volumes on Woodruff Road in the study area are seen in the vicinity of Smith Hines Road where the corridor sees over 45,000 vpd on average weekdays and Fridays (greater than the roadway's capacity) and approximately 35,000 vpd on an average weekend day. There was a significant drop in traffic volumes in the vicinity of Mall Connector Road where the corridor has between 15,000 and 20,000 vpd on average weekdays and Fridays and approximately 12,000 vpd on an average weekend day.

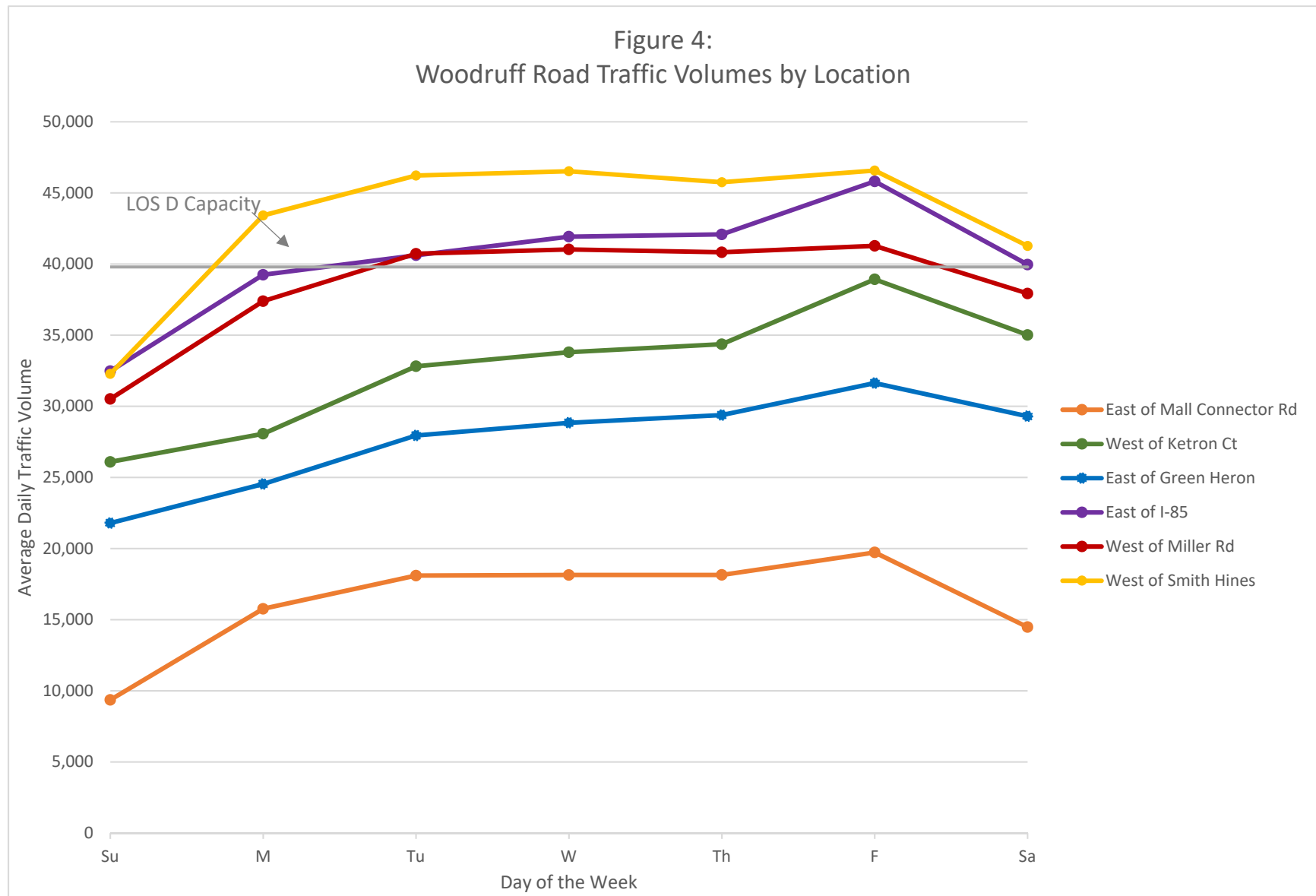


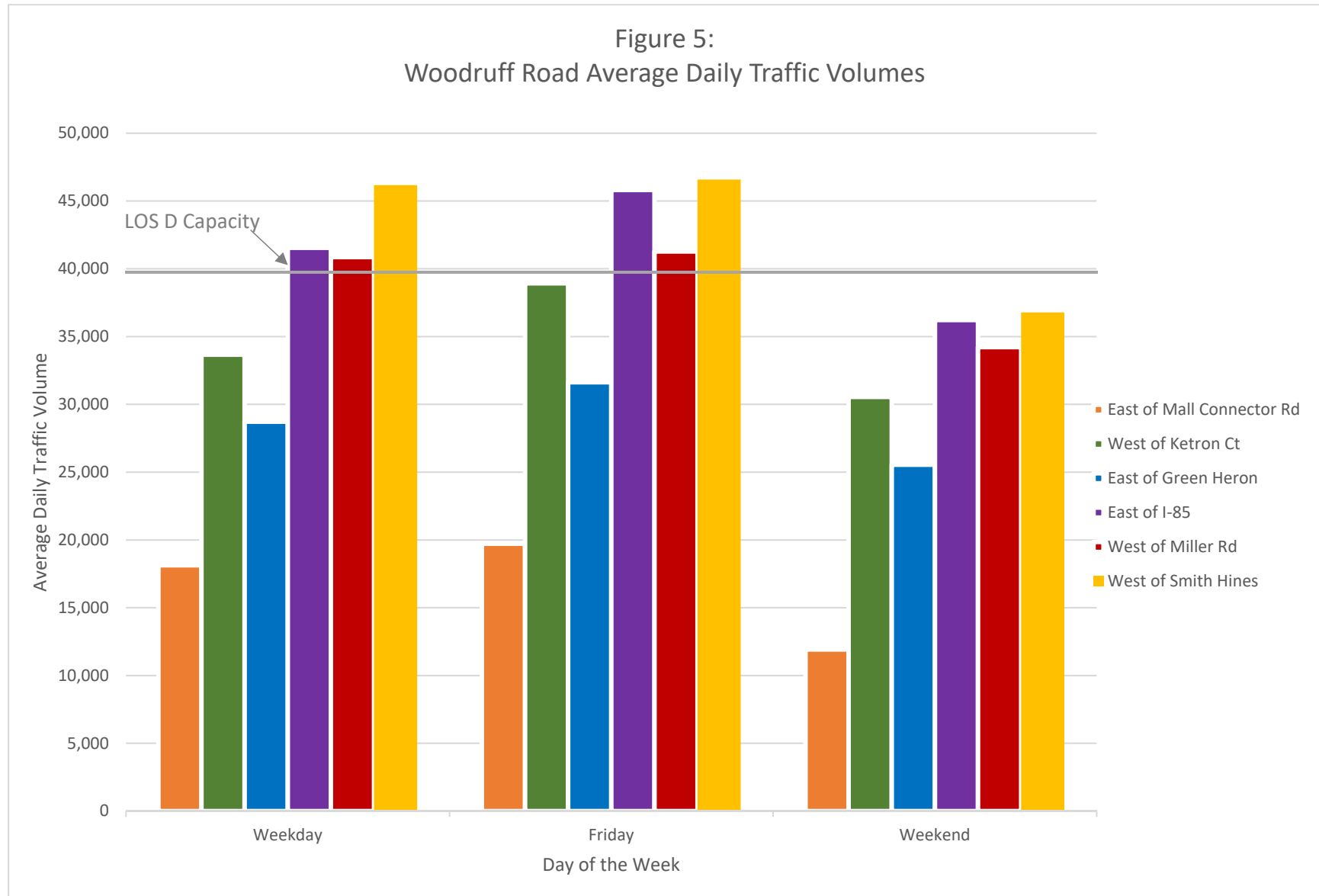
Figure 5 shows a comparison of the average weekday, Friday, and Saturday volumes on Woodruff Road by section. Across the Woodruff Road corridor, the areas between Roper Mountain Road and Ketron Court, between I-85 and Miller Road, and between I-385 and Smith Hines Road consistently see higher traffic volumes than the other areas of the corridor. These segments are over LOS D capacity on an average weekday and Friday.

Figure 6 shows a comparison of the total daily volumes on Woodruff Road by section, direction of travel, and day of week. At Mall Connector Road and Green Heron Road the directionality of the traffic volumes on Woodruff Road are generally evenly split between eastbound and westbound traffic. The section of Woodruff Road east of I-85 has the most variability with a greater amount of traffic traveling eastbound away from the interstate. West of Miller Road and west of Ketron Court, the traffic travels more predominately westbound on the corridor. West of Smith Hines Road, the traffic travels more predominately eastbound on the corridor. Based on the FDOT generalized LOS tables, the LOS D daily directional capacity is approximately 20,000 vpd.

Figure 7 shows a comparison of the Woodruff Road traffic over the time of day and the hourly two-way capacity of the roadway of approximately 3,600 vehicles (based on the FDOT generalized LOS tables). Peaks occur across the corridor at 8 AM, noon and 5 PM. There is a decrease in traffic volume after each peak, with a more pronounced drop at 9 AM in the vicinity of I-85, Miller Road, and Smith Hines Road. At these locations, there is a large amount of commercial square footage where some businesses open later in the morning outside of the AM peak hour. Except for the Miller Road and Smith Hines Road locations, the corridor experiences a small drop after lunch which then builds to the PM peak hour. On the average weekday, the traffic begins to drop along the corridor around 7 PM. Woodruff Road, east of Green Heron, a more sustained PM peak hour but then drops off similar to the rest of the corridor. **Figure 7** shows all segments of Woodruff Road to be operating at LOS D or better on an hourly weekday basis.

Figure 8 shows a comparison of the other study area roadway average weekday traffic volumes and their respective LOS D capacities. Capacities for the individual roadways were determined based on the roadway characteristics. Verdae Boulevard had the highest average weekday daily traffic volume of approximately 20,000 vehicles, most similar to the traffic volumes on Woodruff Road by Mall Connector Road, east of Roper Mountain Road. Miller Road has approximately 12,000 vehicles per day on an average weekday and Carolina Point Parkway and Mall Connector Road have approximately 8,000 vehicles per day. Salters Road was collected but is not shown in **Figure 8** as a portion of Salters Road is currently under construction, widening it from a two-lane roadway to a five-lane road with bicycle and pedestrian facilities from Verdae Boulevard to Millennium Boulevard/Carolina Point Parkway. **Figure 8** shows all roadways have weekday volumes lower than the LOS D capacity for the roadway.

Figure 5:
Woodruff Road Average Daily Traffic Volumes



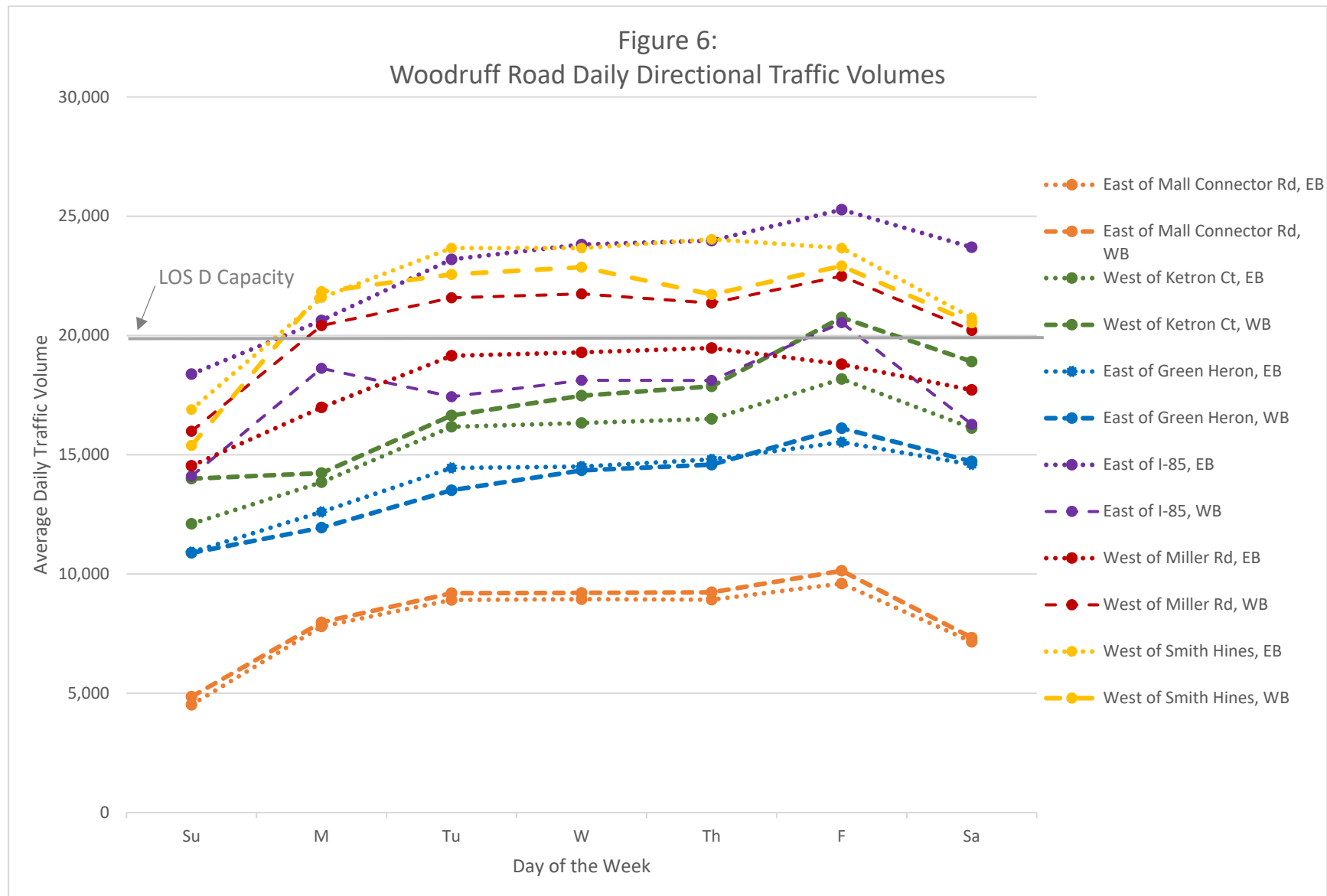
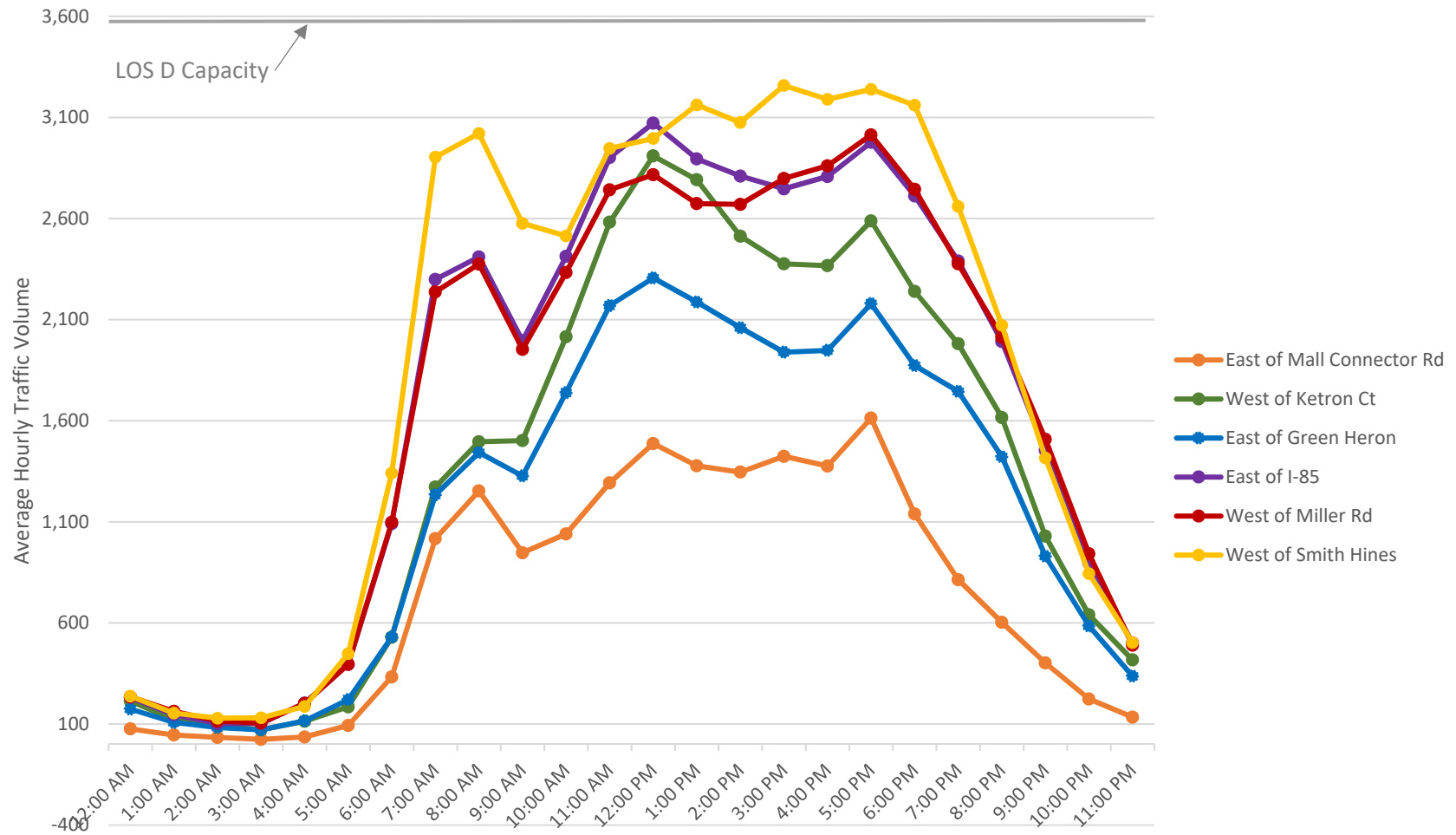


Figure 7:
Woodruff Road Average Weekday Hourly Traffic Volumes





4.2 Turning Movement Counts

Turning movement traffic count data was collected in April 2017 from 7:00 AM to 9:00 AM, 11:00 AM to 1:00 PM, and 4:00 PM to 6:00 PM for weekday counts and 11:00 AM to 3:00 PM for Saturday counts at the following intersections:

- Mall Connector Road at Halton Road
- Woodruff Road at Mall Connector Road
- Woodruff Road at Salters Road
- Verdae Boulevard at Salters Road
- Verdae Boulevard at Old Sulphur Springs Road
- Woodruff Road at Verdae Boulevard/Roper Mountain Road
- Roper Mountain Road at Congaree Road
- Roper Mountain Road at I-385 SB
- Roper Mountain Road at I-385 NB
- Roper Mountain Road at Independence Boulevard/Frontage Road
- Carolina Point Parkway roundabout at Avana and Corporate Campus
- Woodruff Road at Ketron Court
- Woodruff Road at Green Heron Road
- Woodruff Road at Woodruff Industrial Lane
- Woodruff Road at I-85 SB
- Woodruff Road at I-85 NB
- Woodruff Road at Carolina Point Parkway
- Woodruff Road at Market Point Drive
- Miller Road at Park Woodruff Drive
- Woodruff Road at Miller Road
- Woodruff Road at Park Woodruff Drive
- Woodruff Road at I-385 SB
- Woodruff Road at I-385 NB

Turning movement traffic count data was collected in September 2017 from 7:00 AM to 9:00 AM, 11:00 AM to 1:00 PM, and 2:00 PM to 6:00 PM at the following intersection:

- Millennium Boulevard at Sulphur Springs Road

Turning movement traffic count data was collected in October 2017 from 7:00 AM to 9:00 AM, 11:00 AM to 1:00 PM, and 2:00 PM to 6:00 PM at the following intersections:

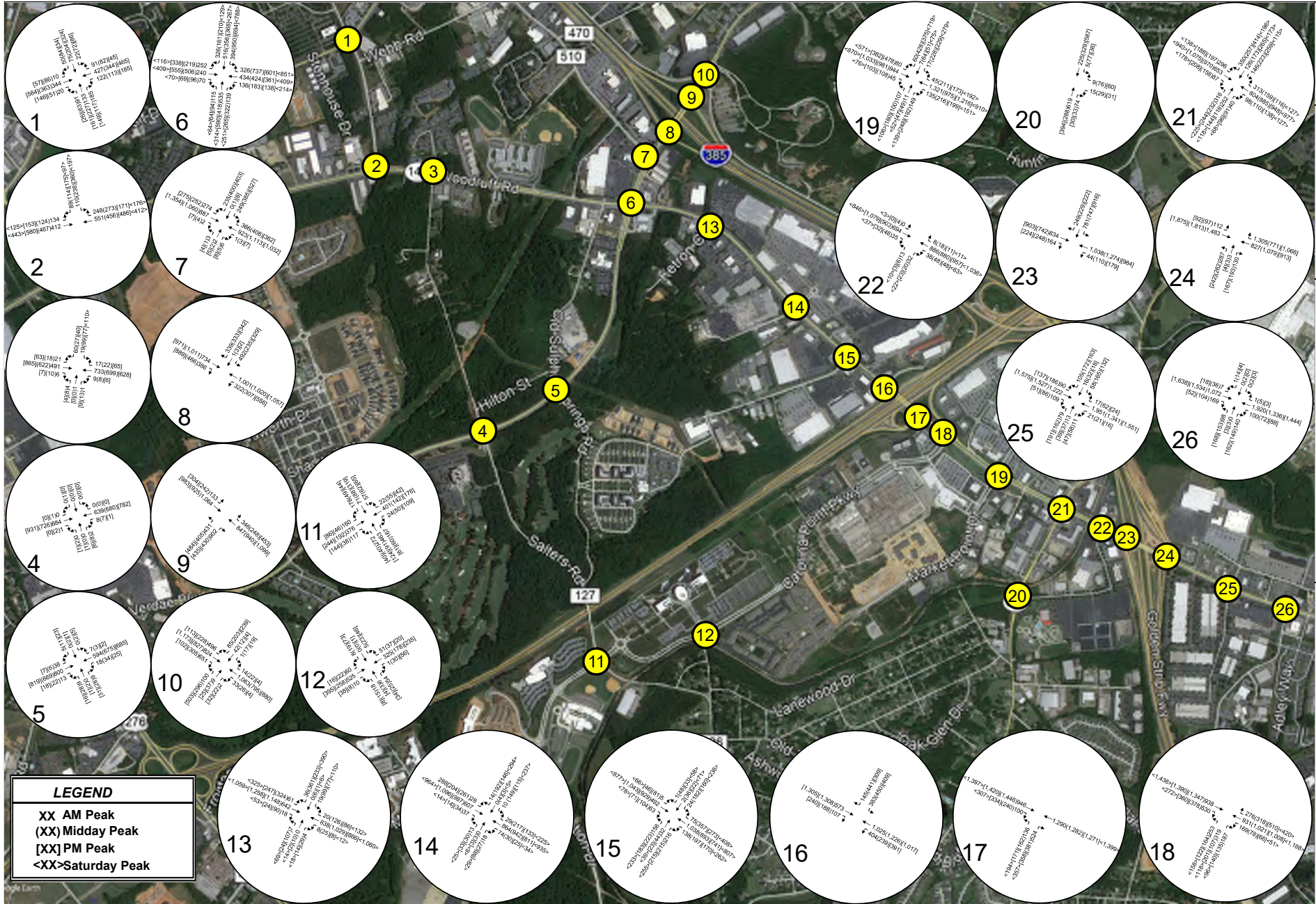
- Woodruff Road at Merovan Access
- Woodruff Road at Smith Hines Road

Turning movement count data can be found in the **Appendix** and the AM, Midday, PM, and Saturday peak hour existing traffic volumes are shown in **Figure 9**.

4.3 Signal Plans and Timings

There are 18 existing traffic signals located at intersections in the study area. Traffic signal plans were obtained from the City of Greenville and SCDOT for the existing signal installations at the following locations:

- Mall Connector Road at Halton Road
- Woodruff Road at Mall Connector Road
- Verdae Boulevard at Salters Road
- Woodruff Road at Verdae Boulevard/Roper Mountain Road
- Roper Mountain Road at Congaree Road
- Roper Mountain Road at I-385 SB
- Roper Mountain Road at I-385 NB
- Roper Mountain Road at Independence Boulevard/Frontage Road
- Millennium Boulevard at Sulphur Springs Road
- Woodruff Road at Ketron Court
- Woodruff Road at Green Heron Road
- Woodruff Road at Woodruff Industrial Lane
- Woodruff Road at I-85 SB
- Woodruff Road at I-85 NB
- Woodruff Road at Carolina Point Parkway
- Woodruff Road at Market Point Drive
- Woodruff Road at Miller Road
- Woodruff Road at I-385 SB
- Woodruff Road at I-385 NB
- Woodruff Road at Merovan Access
- Woodruff Road at Smith Hines Road



LEGEND	
XX	AM Peak
(XX)	Middy Peak
[XX]	PM Peak
<XX>	Saturday Peak

Figure 9

Existing Traffic Volumes

Woodruff Road Parallel



Existing signal timings were applied to the signalized intersections for the intersection analysis.

Traffic signal timings are being updated as part of the I-85/I-385 Gateway Project. These were incorporated in the analysis as appropriate.

5.0 Accident Data Summary

The accident analysis is summarized in the *Accident Analysis Summary (Bihl Engineering 2018)* for the project. For the study, historic crash data from January 2015 – December 2016 were reviewed for the entirety of the study area including the following roadways:

- Woodruff Road (Mall Connector Road [mile point (MPT) 1.167] to I-385 [MPT 3.820])
- Mall Connector Road (Woodruff Road to 500 feet north of Halton Road)
- Salters Road (Old Sulphur Springs Road [MPT 1.260] to Woodruff Road [MPT 2.490])
- Roper Mountain Road (Roper Mountain Road Extension [MPT 2.510] to Woodruff Road [MPT 2.990])
- Verdae Boulevard (Rocky Slope Road [MPT 1.100] to Geer Highway [MPT 1.980])
- Ketron Court
- Green Heron Road
- Old Sulphur Springs Road (Woodruff Road to Forrester Drive [MPT 1.100])
- Woodruff Industrial Lane
- Carolina Point Parkway (Old Sulphur Springs Road to Woodruff Road)
- Market Point Drive
- Miller Road (Berry Drive [MPT 3.644] to Woodruff Road [MPT 4.25])

The 1,185 crashes (814 crashes on Woodruff Road and 371 crashes on the surrounding study area roadways) were reviewed allowing for the identification of hotspot locations and trends within the study area.

Many of the accidents were classified as property damage only; however, 11% were classified as possible injuries, 4% as non-incapacitating injuries, less than 1% as incapacitating injuries, and less than 0.5% as fatalities. Crashes involving fatalities were the result of both fixed object and angle collisions on Woodruff Road and Verdae Boulevard.

Crash rates were calculated for the roadway segments in the study area. Woodruff Road experiences a crash rate of 20.19 crashes per 1,000,000 vehicle miles travelled for the 2.653-mile segment in the study area. Of the remaining study area roadways experiencing higher crash rates and more than five crashes in a two-year period, Roper Mountain Road has a crash rate of 25.80

crashes per 1,000,000 vehicle miles travelled and Woodruff Industrial Lane has a crash rate of 21.22 crashes per 1,000,000 vehicle miles travelled. These latter two roadway segments are shorter than a half mile, so these crash rates are specific to the length of the roadway in the study area. Other study area roadway crash rates ranged from 3 – 9 crashes per 1,000,000 vehicle miles traveled.

Based on the review of the crash locations and trends, the study area hot spots were identified and are listed below:

- Woodruff Road MPT 1.80- MPT 2.00
(Intersection of Woodruff Road and Roper Mountain Road)
- Woodruff Road MPT 2.70- MPT 2.90
(From Woodruff Industrial Lane to Carolina Point Parkway)
- Woodruff Road MPT 3.15- MPT 3.55
(From Market Point Drive to I-385 northbound ramp)
- Roper Mountain Road MPT 2.40- MPT 3.00
(I-385 on/off-ramps to Frontage Road/Independence Boulevard)

In general, the number of accidents along Woodruff Road and Roper Mountain Road in the study area are considered high. Many of these accidents are rear end and the congestion on the corridor contributes to the number of incidents. **Figure 10** shows collision data along the corridor.

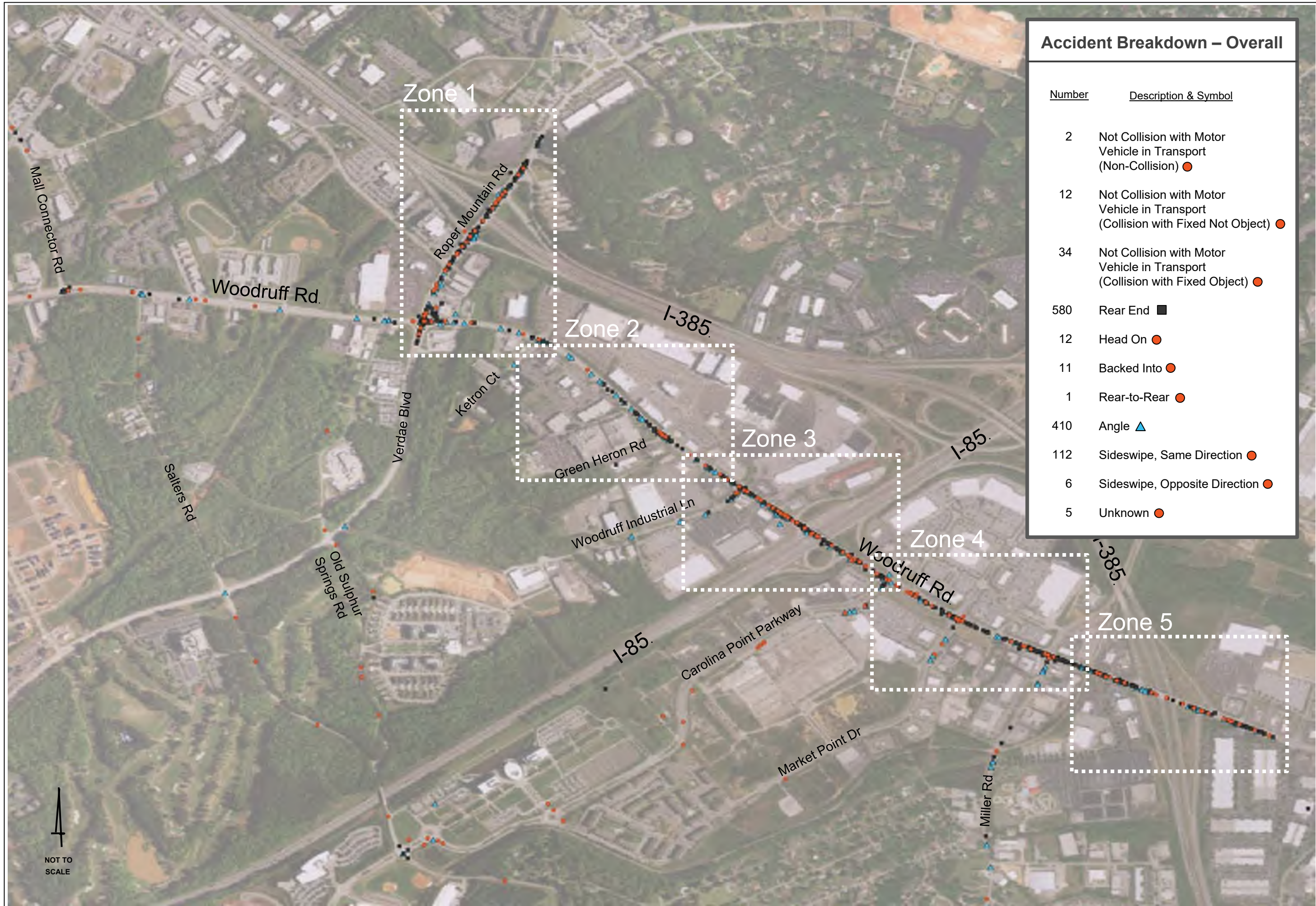
A review of the crash history shows that intersections, as well as the driveways along the side streets to play a large role in crash location. Vehicles turning either onto or from the main corridor of Woodruff Road are shown as high crash location areas, most commonly rear end and angle collision types which suggest this is due to the congestion of the road. Additionally, during the period analyzed there were three fatalities in the study area. Based on the detailed summaries of these incidents, it was noted that these incidents were not due to geometric or design issues. It is likely that the low number of fatalities are a result of high traffic congestion leading to a decrease in average speed resulting in a less severe impact when collision occurs.

6.0 Background Growth Development

Background traffic volumes were developed by reviewing historic and projected traffic data. The following section discusses the methodology used to develop future year traffic volumes.

6.1 Historic Traffic Volumes

To determine the historic growth rate, previously collected data was compared to existing data to determine a percent growth per year that has been realized over the past ten years. Based on historic



Accident Breakdown – Overall

Number	Description & Symbol
2	Not Collision with Motor Vehicle in Transport (Non-Collision) ●
12	Not Collision with Motor Vehicle in Transport (Collision with Fixed Not Object) ●
34	Not Collision with Motor Vehicle in Transport (Collision with Fixed Object) ●
580	Rear End ■
12	Head On ●
11	Backed Into ●
1	Rear-to-Rear ●
410	Angle ▲
112	Sideswipe, Same Direction ●
6	Sideswipe, Opposite Direction ●
5	Unknown ●

Figure 10

Accident Overview

Woodruff Road Congestion Relief Project



NOT TO SCALE

Annual Average Daily Traffic (AADT) data collected by the South Carolina Department of Transportation (SCDOT), the study area experienced an overall growth rate of approximately 3% per year from 2006 to 2016. Woodruff Road saw an increase of 1.5% per year growth rate from 2006 to 2016 (ten years). Miller Road, Verdae Boulevard, Roper Mountain Road, and Salters Road were also reviewed due to their location in the study area. Roper Mountain Road had the highest increase of traffic at 11% growth rate per year from I-385 to Woodruff Road from 2010 to 2016 (six years).

7.0 Alternatives Development

The details of the alternatives were developed using Greenville-Pickens Area Transportation Study Long-Range transportation model information and project team input. This section describes the process used to develop the project alternatives for study.

7.1 Greenville-Pickens Area Transportation Study Model Volumes

The Greenville-Pickens Area Transportation Study (GPATS) publishes a Long-Range Transportation Plan (LRTP) every ten years with updates every five years. The latest publicly available model included projections for the 2040 conditions.

The 2015 and baseline 2040 GPATS LRTP model runs for the study area are shown in the **Appendix**.

7.2 Preliminary Alternatives Development

The alternatives development included a review of various concepts that reviewed the project limits along Woodruff Road, along with variations on the locations of the parallel roadway and the number of lanes on Woodruff Road.

As part of the alternative model development, the 2040 GPATS LRTP model network was adjusted to reflect the preliminary project concepts and the projected daily traffic volumes by model segment and the projected segment level of service based on the projected volume to capacity ratios. All model runs showed lower traffic volumes on the Woodruff Road segments from Mall Connector Road to Roper Mountain Road with projected levels of service of LOS D or better.

This transportation related information was presented to the project team and along with other environmental, utility, roadway constructability, and other information four segments were selected for further study. All of the alternatives do not include improvements to Woodruff Road from Mall Connector Road to Roper Mountain Road.

The model runs for all preliminary concepts and summary table of the projected daily traffic volumes are shown in the **Appendix**.

7.2.1 Alternatives for Study

The following alternatives were included for study in the traffic analysis. The details of each alternative are described below. In addition, for the concepts referenced below, the laneage of the intersection of Woodruff Road and Miller Road/Garlington Road includes the I-85/I-385 Gateway project laneage improvements at that intersection.

7.2.2 No Build Alternative

The PNG Connector and the I-85/I-385 Gateway Project are included in the No Build and all additional scenarios as they will be constructed prior to the 2045 design year. This alternative has no additional improvements to the corridor.

7.2.3 Alternative 1

Alternative 1 widens Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road. It also includes the installation of a DDI at I-85. The PNG Connector and the I-85/I-385 Gateway project are included in this alternative. In addition, a north leg of Woodruff Road at Carolina Point Parkway is constructed. **Figure 11** shows a conceptual alignment of the alternative.

7.2.4 Alternative 2C

Alternative 2C widens Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road. It also includes the installation of a DDI at I-85. In addition to the widening, this alternative includes construction of a new roadway south of Woodruff Road, utilizing the existing roadway network from Verdae Boulevard to Carolina Point Parkway, then continuing to Smith Hines Road via new alignment. The PNG Connector and the I-85/I-385 Gateway Project are included in this alternative. Also, in this alternative, a north leg of Woodruff Road at Carolina Point Parkway is constructed and the north leg of the intersection of Woodruff Road at Smith Hines Road (existing McAlister's Deli driveway) is proposed to be closed. **Figure 12** shows a conceptual alignment of the alternative.

7.2.5 Alternative 3C

Alternative 3C widens Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road. It also includes the installation of a DDI at I-85. This alternative includes construction of a new three-lane roadway connecting Woodruff Industrial Lane to Carolina Point Parkway and continuing to Smith Hines Road. The PNG Connector and the I-85/I-385 Gateway

Project are included in this alternative. Also, in this alternative, a north leg of Woodruff Road at Carolina Point Parkway is constructed and the north leg of the intersection of Woodruff Road at Smith Hines Road (existing McAlister’s Deli driveway) is proposed to be closed. **Figure 13** shows a conceptual alignment of the alternative.

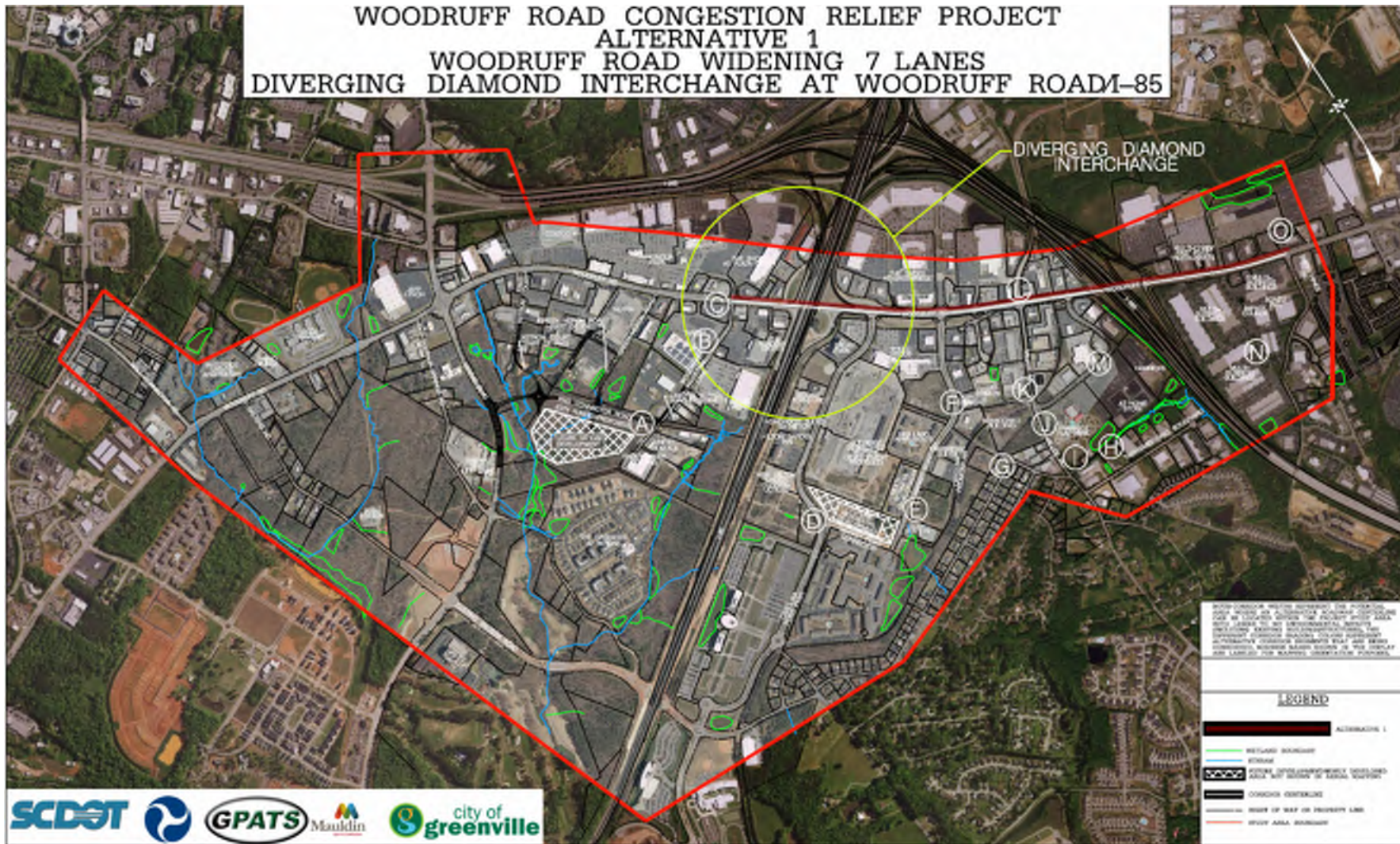
7.2.6 *Alternative 6C*

Alternative 6C includes construction of a new five-lane roadway connecting Woodruff Industrial Lane to Carolina Point Parkway and continuing to Smith Hines Road. The PNG Connector and the I-85/I-385 Gateway Project are included in this alternative. Also, in this alternative, the north leg of the intersection of Woodruff Road at Smith Hines Road (existing McAlister’s Deli driveway) is proposed to be closed. **Figure 14** shows a conceptual alignment of the alternative.

7.2.7 *Alternative 6D*

Alternative 6D includes construction of a new five-lane roadway connecting Woodruff Industrial Lane to Carolina Point Parkway and continuing to Smith Hines Road. This alternative also includes the installation of a DDI at I-85. The PNG Connector and the I-85/I-385 Gateway Project are included in this alternative. Also, in this alternative the north leg of the intersection of Woodruff Road at Smith Hines Road (existing McAlister’s Deli driveway) is proposed to be closed. **Figure 15** shows a conceptual alignment of the alternative.

WOODRUFF ROAD CONGESTION RELIEF PROJECT
 ALTERNATIVE 1
 WOODRUFF ROAD WIDENING 7 LANES
 DIVERGING DIAMOND INTERCHANGE AT WOODRUFF ROAD-85



Source: Infrastructure Consulting & Engineering

Figure 11

Alternative 1 Concept

Woodruff Road Congestion Relief Project

**WOODRUFF ROAD CONGESTION RELIEF PROJECT
 ALTERNATIVE 2C - NEW 3 LANE ROUTE
 WOODRUFF ROAD WIDENING 7 LANES
 DIVERGING DIAMOND INTERCHANGE AT WOODRUFF ROAD-85**



Source: Infrastructure Consulting & Engineering

Figure 12

Alternative 2C Concept

Woodruff Road Congestion Relief Project

**WOODRUFF ROAD CONGESTION RELIEF PROJECT
 ALTERNATIVE 3C - NEW 3 LANE ROUTE
 WOODRUFF ROAD WIDENING 7 LANES
 DIVERGING DIAMOND INTERCHANGE AT WOODRUFF ROAD-85**



Source: Infrastructure Consulting & Engineering

Figure 13

Alternative 3C Concept

Woodruff Road Congestion Relief Project

WOODRUFF ROAD CONGESTION RELIEF PROJECT
 ALTERNATIVE 6C – NEW 5 LANE ROUTE
 MILLER ROAD WIDENING 5 LANES



Source: Infrastructure Consulting & Engineering

Figure 14

Alternative 6C Concept

Woodruff Road Congestion Relief Project

**WOODRUFF ROAD CONGESTION RELIEF PROJECT
 ALTERNATIVE 6D – NEW 5 LANE ROUTE
 DIVERGING DIAMOND INTERCHANGE AT WOODRUFF ROAD/85
 MILLER ROAD WIDENING 5 LANES**



Source: Infrastructure Consulting & Engineering

Figure 15

Alternative 6D Concept

Woodruff Road Congestion Relief Project

7.3 Roadway Growth Rates

Table 4 summarizes the calculated growth rates in the study area, based on the model projections, which included data from study area roadways for the No Build and Build Alternatives. Alternative 6C and Alternative 6D are shown together as the roadway network does not change except for the DDI installation in Alternative 6D.

7.4 Methodology for Developing Future Year Traffic Volumes

As stated previously, traffic volumes for the future year conditions were developed using the 2040 GPATS LRTP model traffic trends combined with historical AADT data provided by SCDOT, applied to the existing conditions traffic volumes.

For roadways in the study area where the 2040 GPATS LRTP model specifically projects the 2040 traffic volumes, model scenarios were developed to reflect the improvements for each Build Alternative. Yearly growth rates, based on the model volumes in the 2015 baseline and 2040 Build Alternative models, were calculated for each roadway section under each Build Alternative. Existing year turning movement baseline counts were grown by the yearly growth rates for their respective roadway section for 28 years, from the 2017 Existing conditions traffic volumes to develop the projected 2045 conditions for the No Build Alternative and each Build Alternative. Projected daily traffic volumes and growth rates are shown in **Table 4**.

For roadways not specifically included in the 2040 GPATS LRTP, the 2045 traffic volumes were developed using the growth rates associated with adjacent roadways or traffic analysis zones in the vicinity (**Table 4**).

Table 4: Projected Daily Traffic Volumes and Growth Rates by Alternative													
Roadway	Start	End	Model Projected Daily Traffic Volumes						Yearly Growth Rate by Section (2015 to 2040)				
			Alternative						No Build	1	2C	3C	6C/6D
			2015	No Build	1	2C	3C	6C/6D					
Woodruff Rd	Rocky Slope Rd	Mall Connector Rd	-	15,209	15,283	15,080	15,302	15,695	1.19%	1.24%	1.21%	1.19%	1.27%
Woodruff Rd	Salters Rd	Brook Dr	13,199	15,938	16,024	15,916	16,375	17,150					
Woodruff Rd	Brook Dr	Verdae Blvd	15,681	21,516	21,832	21,718	21,110	20,919	0.24%	0.49%	0.60%	0.47%	0.19%
Woodruff Rd	Verdae Blvd	Green Heron Rd	22,764	24,146	25,553	26,186	25,458	23,853					
Woodruff Rd	Green Heron Rd	Mall Driveway	22,764	28,837	30,690	30,213	28,233	25,234	0.65%	0.96%	0.88%	0.59%	0.12%
Woodruff Rd	Mall Driveway	Woodruff Industrial Ln	29,360	31,788	33,892	33,440	31,608	28,457	1.13%	1.43%	1.34%	0.46%	0.02%
Woodruff Rd	Woodruff Industrial Ln	I-85 SB Ramp	32,606	41,815	44,234	43,498	36,369	32,730					
Woodruff Rd	I-85 SB Ramp	I-85 NB Ramp	-	48,242	54,855	54,038	47,407	40,062	0.53%	1.30%	1.16%	0.53%	-0.30%
Woodruff Rd	I-85 NB Ramp	Carolina Point Pkwy	45,788	51,806	60,702	59,078	51,847	42,391					
Woodruff Rd	Carolina Point Pkwy	Market Point Dr	49,848	57,748	66,725	62,006	57,748	47,882	0.63%	1.35%	0.98%	0.63%	-0.16%
Woodruff Rd	Market Point Dr	Miller Road	39,140	46,054	55,022	48,781	46,574	38,078	0.71%	1.62%	0.99%	0.76%	-0.11%
Woodruff Rd	Miller Road	I-385 SB Ramp	36,694	40,348	48,067	41,700	39,799	32,890	0.40%	1.24%	0.55%	0.34%	-0.41%
Woodruff Rd	I-385 SB Ramp	I-385 NB Ramp	44,223	50,655	59,492	53,044	50,965	43,155	0.58%	1.38%	0.80%	0.61%	-0.10%

Table 4 (cont.): Projected Daily Traffic Volumes and Growth Rates by Alternative													
Roadway	Start	End	Model Projected Daily Traffic Volumes						Yearly Growth Rate by Section (2015 to 2040)				
			Alternative										
			2015	No Build	1	2C	3C	6C/6D	No Build	1	2C	3C	6C/6D
Woodruff Rd	I-385 NB Ramp	Smith Hines Rd	57,430	62,551	70,338	63,613	61,495	53,558	0.36%	0.90%	0.43%	0.28%	-0.27%
Woodruff Rd	Smith Hines Rd	Prado Way	57,430	62,551	70,338	74,091	74,488	71,046	0.36%	0.90%	1.16%	1.19%	0.95%
Verdae Blvd	Woodruff Rd	PNG Connector	13,121	17,280	17,525	17,256	18,079	19,501	1.83%	1.96%	1.68%	1.98%	2.07%
Roper Mtn Rd	Woodruff Rd	Congaree Rd	28,580	36,327	35,901	35,621	35,913	36,244	1.08%	1.02%	0.99%	1.03%	1.07%
PNG Connector	Verdae Blvd	Woodruff Industrial Ln	-	14,002	14,164	13,092	17,688	20,188	-	-	-	-	-
Green Heron Rd	PNG Connector	Woodruff Rd	2,209	4,691	5,136	4,026	2,774	1,384	4.49%	5.30%	3.29%	1.02%	-1.49%
Woodruff Industrial Ln	PNG Connector	Woodruff Rd	4,445	10,027	10,342	10,058	5,258	4,837	5.02%	5.31%	5.05%	0.73%	0.35%
Carolina Point Pkwy	Old Sulphur Springs Rd	New Roadway Connection	1,542	4,914	5,205	10,476	6,166	7,162	8.75%	9.50%	23.1%	11.9%	14.5%
Carolina Point Pkwy	New Roadway Connection	Woodruff Rd	1,542	4,914	5,205	2,122	4,856	4,534	8.75%	9.50%	1.50%	8.60%	7.76%
Miller Rd	Thousand Oaks Blvd	Woodruff Rd	6,827	7,071	7,456	6,962	5,370	5,185	0.14%	0.37%	0.08%	-0.85%	-0.96%
New Roadway Connection	Woodruff Rd	Miller Rd	-	-	-	10,476	12,992	17,487	-	-	-	-	-
New Roadway Connection	Miller Rd	Midpoint	-	-	-	8,742	10,568	17,375	-	-	-	-	-

Table 4 (cont.): Projected Daily Traffic Volumes and Growth Rates by Alternative													
Roadway	Start	End	Model Projected Daily Traffic Volumes						Yearly Growth Rate by Section (2015 to 2040)				
			Alternative						No Build	1	2C	3C	6C/6D
			2015	No Build	1	2C	3C	6C/6D					
New Roadway Connection	Midpoint	Carolina Point Pkwy	-	-	-	8,354	14,246	20,800	0.99%	1.46%	1.19%	0.88%	0.41%
New Roadway Connection	Carolina Point Pkwy	PNG Connector	-	-	-	-	13,433	18,729	-	-	-	-	-
Connection to Mall (Woodruff)	Verdae Blvd	I-85	14,744	14,442	14,454	14,455	14,462	14,452	-0.08%	-0.08%	-0.08%	-0.08%	-0.08%
Connection to Mall (Woodruff)	I-85	Miller Rd	5,486	5,186	5,270	5,275	5,329	5,289					
Garlington Road	Woodruff Rd	Chrome Dr	13,667	16,416	17,184	17,288	17,432	16,338	0.80%	1.03%	1.06%	1.10%	0.78%
I-85 SB Offramp	-	-	7,646	11,043	10,253	10,441	10,799	10,036	1.78%	1.36%	1.46%	1.65%	1.25%
I-85 SB Onramp	-	-	15,281	18,024	18,653	18,526	19,526	18,112	0.72%	0.88%	0.85%	1.11%	0.74%
I-85 NB Offramp	-	-	11,817	13,500	14,045	13,670	14,550	13,740	0.57%	0.75%	0.63%	0.93%	0.65%
I-85 NB Onramp	-	-	3,552	5,067	4,253	4,236	4,283	4,451	1.71%	0.79%	0.77%	0.82%	1.01%
I-85 NB Onramp	-	-	3,651	4,893	4,714	4,584	4,444	4,441	1.36%	1.16%	1.02%	0.87%	0.87%

Table 4 (cont.): Projected Daily Traffic Volumes and Growth Rates by Alternative													
Roadway	Start	End	Model Projected Daily Traffic Volumes						Yearly Growth Rate by Section (2015 to 2040)				
			Alternative						NB	1	2C	3C	6C/6D
			2015	No Build	1	2C	3C	6C/6D					
Market Point Drive	Woodruff Rd	Market Point Conn	16,238	19,446	19,602	14,482	12,403	10,854	0.79%	0.83%	-0.43%	-0.94%	-1.33%
I-385 SB Offramp	-	-	14,428	14,800	14,826	14,870	14,497	14,351	0.10%	0.11%	0.12%	0.02%	-0.02%
I-385 SB Onramp	-	-	4,882	5,585	6,716	7,032	7,252	6,587	0.58%	1.50%	1.76%	1.94%	1.40%
I-385 NB Offramp	-	-	5,310	5,341	7328	7,605	7,693	7,263	0.02%	1.52%	1.73%	1.80%	1.47%
I-385 NB Onramp	-	-	14,312	14,507	15243	15,289	15,288	14,693	0.05%	0.26%	0.27%	0.27%	0.11%
Smith Hines Road TAZ	-	-	22,665	25,985	25959	25,984	25,975	25,894	0.59%	0.58%	0.59%	0.58%	0.57%
Market Point TAZ	-	-	5,486	5,186	5,270	5,275	5,329	5,299	-0.22%	-0.16%	-0.15%	-0.11%	-0.14%
Smith Hines new + TAZ	-	-	22,665	25,985	25,959	36,460	38,967	43,381	0.59%	0.58%	2.43%	2.88%	3.66%

Source: GPATS model runs

Carolina Point Parkway locations were adjusted from the 2040 GPATS LRTP model volumes due to the 2015 base year model not accurately reflecting the 2017 conditions. Carolina Point Parkway growth rates were determined to be 8% – 30% per year. The 2015 model traffic volumes were found to be much lower than the 2017 measured traffic volumes. Therefore, the 2017 traffic volumes were used to develop the growth rates for the Carolina Point Parkway intersections.

The PNG Connector was not present in the 2015 model or Existing conditions but is included in the future year models. To reflect the traffic volumes on the PNG Connector, the relationship between the Woodruff Road and PNG Connector model volumes was used to develop the PNG Connector traffic volumes, along with the traffic volumes at the intersections on Woodruff Road in the vicinity. In addition, the PNG Connector traffic study performed by AECOM was used to assist in the development of the reassigned traffic volumes.

A similar methodology was completed for the new Parallel Roadway sections; the relationship between the Woodruff Road and new roadway model volumes was used to develop the new Parallel Roadway traffic volumes, along with the traffic volumes at the intersections on Woodruff Road in the vicinity. For Alternatives 3C, 6C, and 6D, the traffic volumes between the PNG Connector and the new roadway were balanced along the roadway as the Parallel Roadway is continued to the PNG Connector.

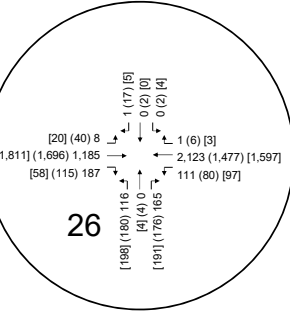
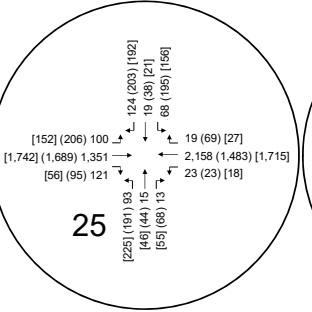
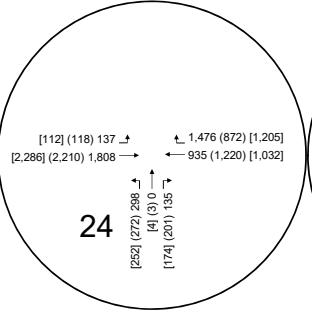
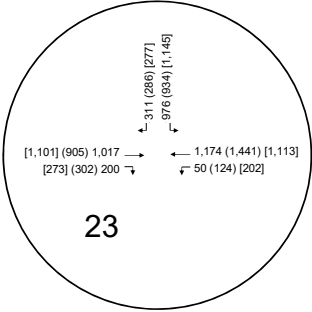
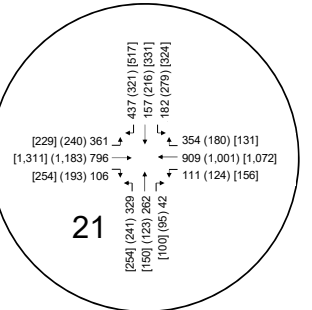
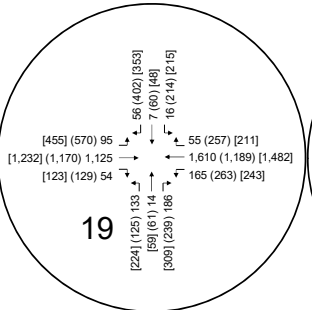
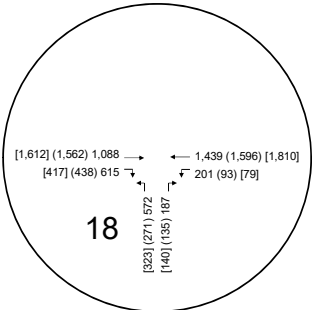
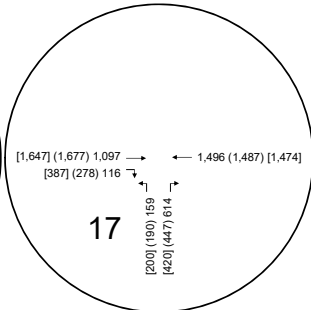
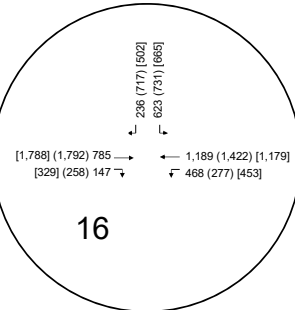
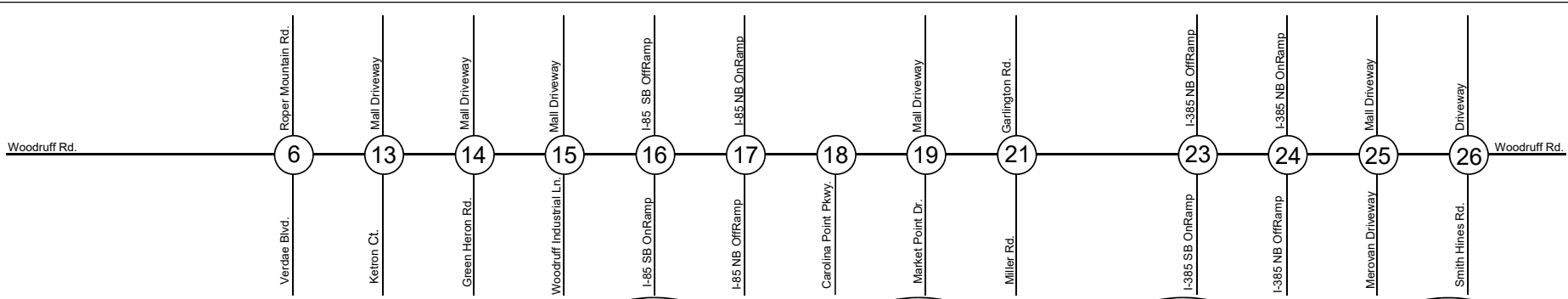
To further assist with the future traffic assignment, several select link model runs were performed for areas not specifically included in the model. These select link model runs are included in the **Appendix** and include segment distribution information for segments along Woodruff Industrial Lane, Woodruff Road, and the Parallel Roadway to assist with traffic assignment.

In Alternative 1, 2C, and 3C where a DDI is planned and a new north leg was constructed at the intersection of Woodruff Road at Carolina Point Parkway, the traffic volumes at Market Point Drive were adjusted and 1/3 of the north leg traffic was reassigned to the new Carolina Point Parkway north leg. In Alternative 6D, Woodruff Road at Parkway is a three leg intersection.

7.5 Peak Hour Traffic Volumes by Alternative

Based on this methodology, AM, Midday, PM and Saturday (where applicable) peak hour traffic volumes were developed for each alternative. **Figures 16 – 39** show the traffic volumes for each scenario used in the capacity analysis for the alternative.

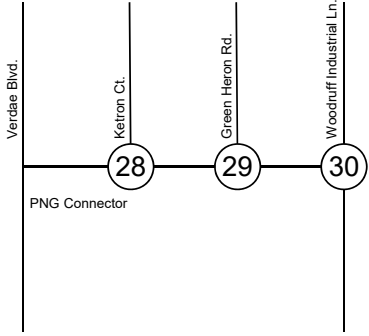
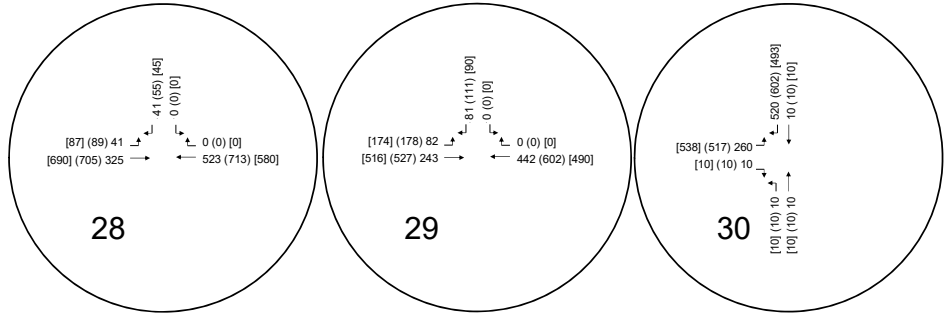
Intersection volume development worksheets are included in the Appendix.



LEGEND

XX AM Peak
 (XX) Midday Peak
 [XX] PM Peak

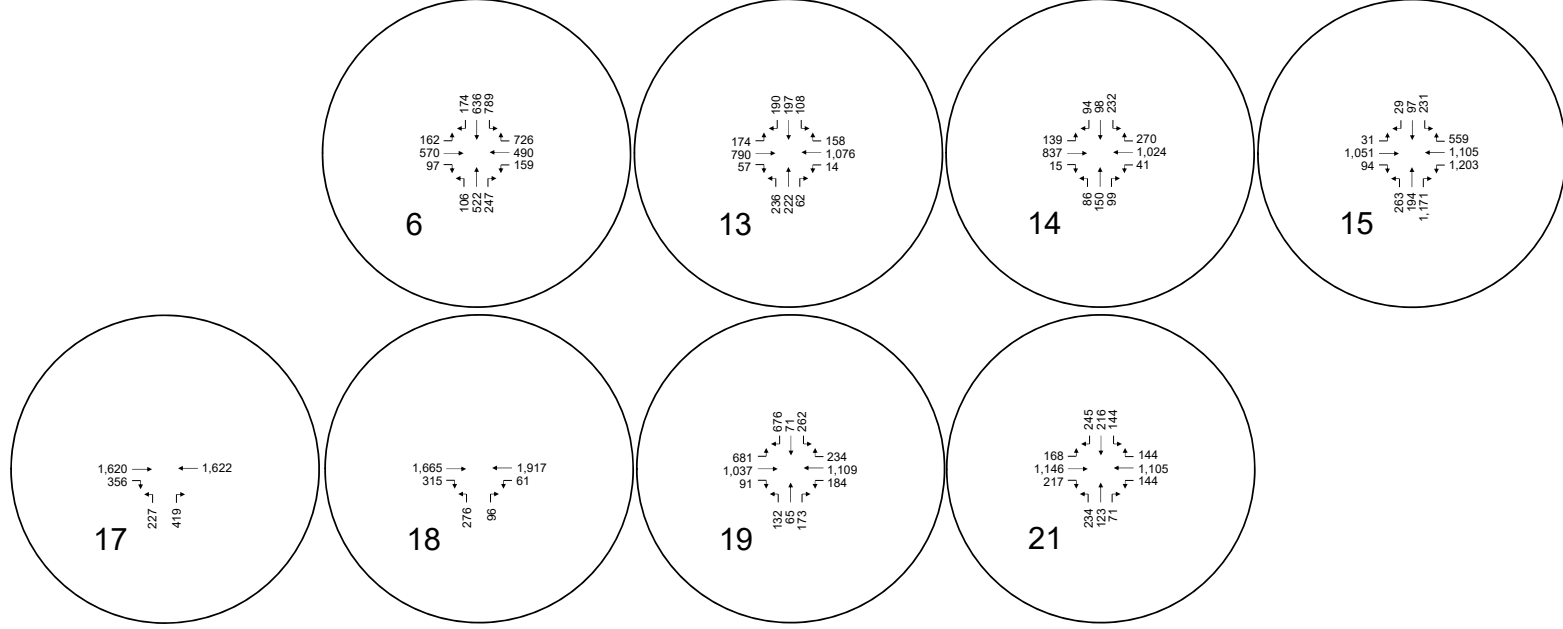
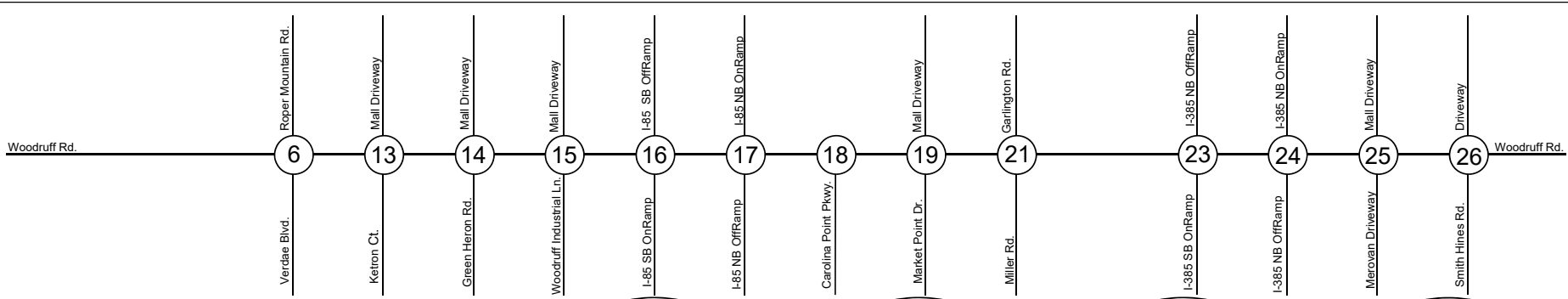
LEGEND
XX AM Peak
(XX) Midday Peak
[XX] PM Peak



Woodruff Road Congestion Relief Project

2045 No Build New Roadway Traffic Volumes

Figure 17



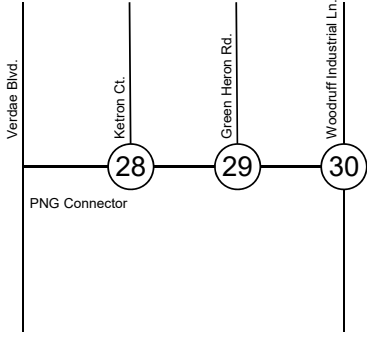
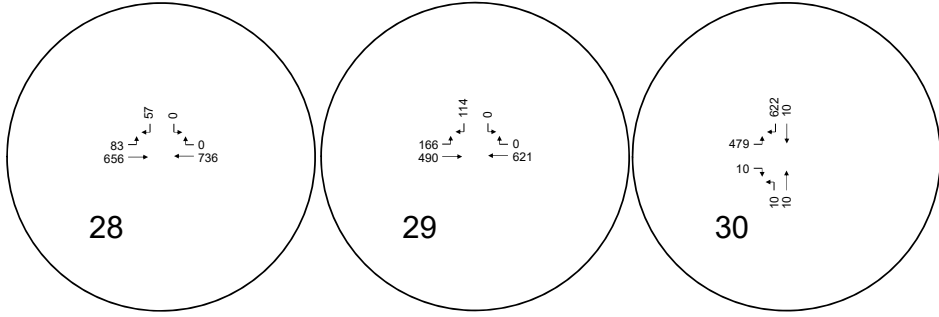
LEGEND
XX Saturday Peak

**2045 No Build
Woodruff Road
Saturday Traffic
Volumes**

**Woodruff Road Congestion
Relief Project**



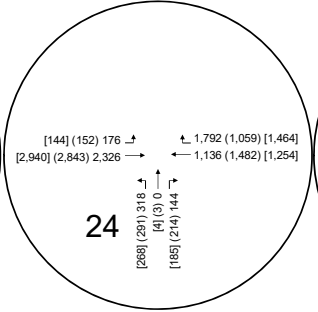
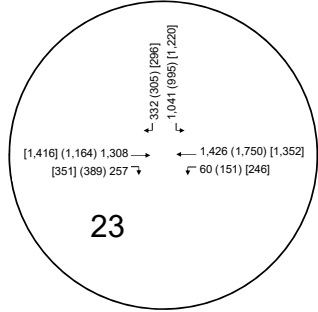
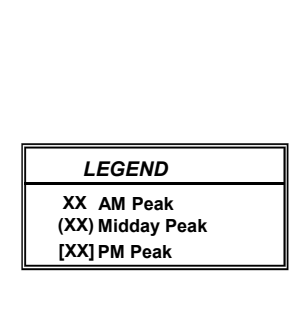
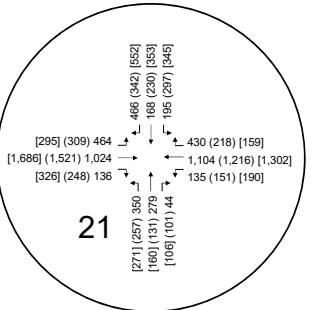
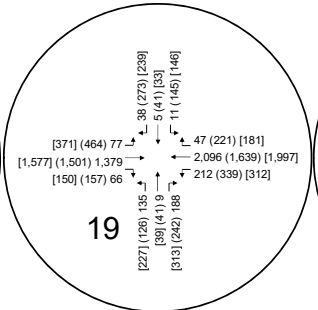
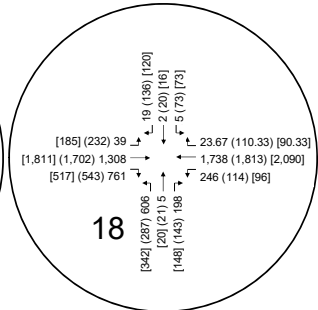
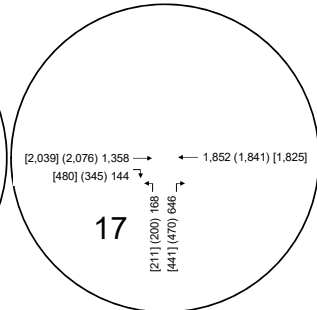
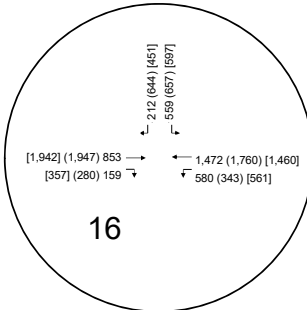
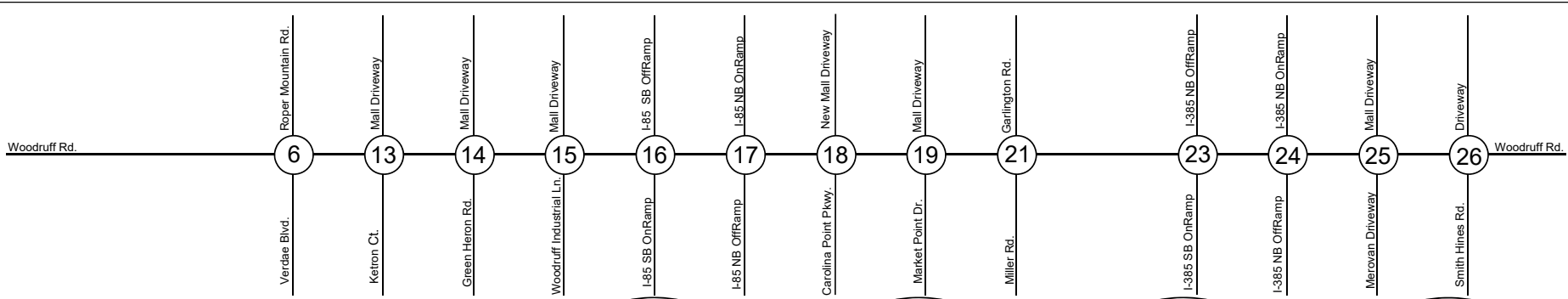
LEGEND
XX Saturday Peak



Woodruff Road Congestion Relief Project

2045 No Build New Roadway Saturday Traffic Volumes

Figure 19



LEGEND
 XX AM Peak
 (XX) Midday Peak
 [XX] PM Peak

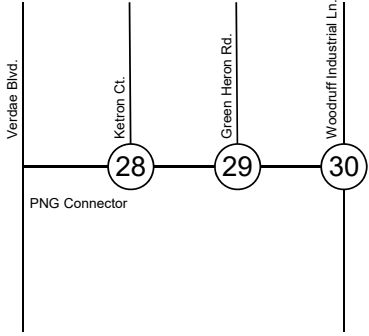
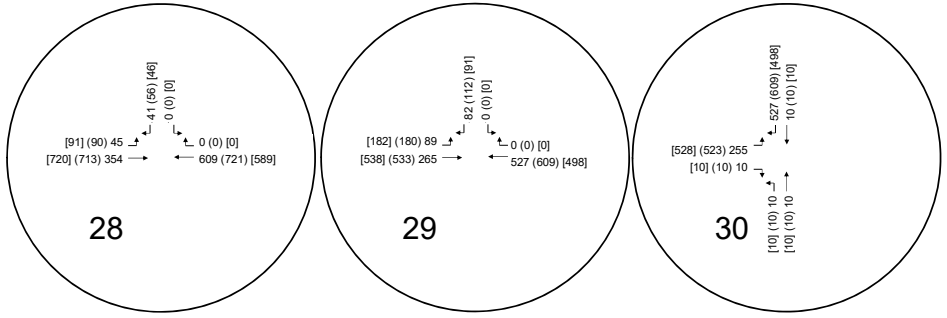
Figure 20

Alternative 1
 Woodruff Road
 Traffic Volumes

Woodruff Road Congestion
 Relief Project



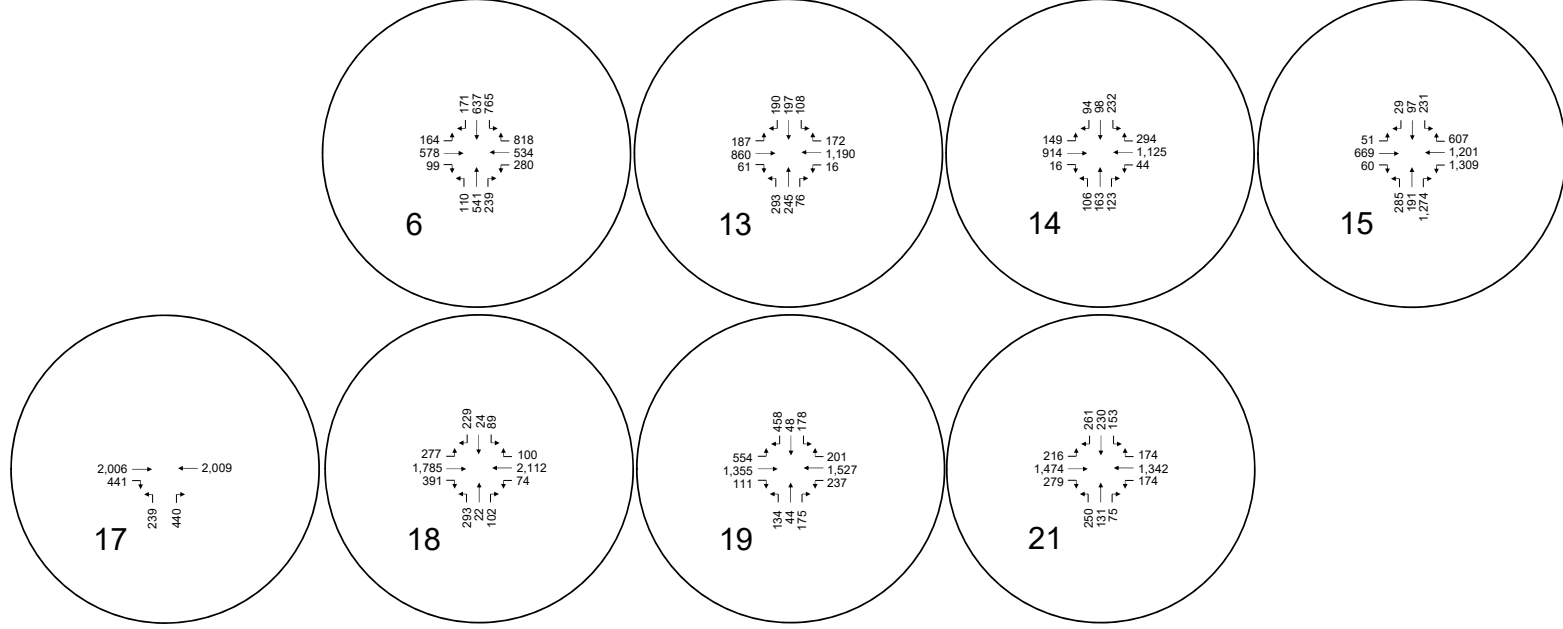
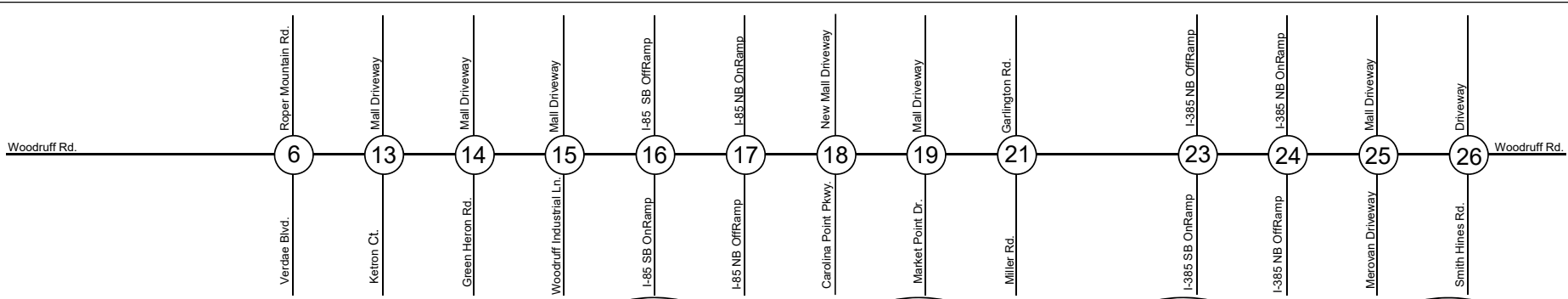
LEGEND
XX AM Peak
(XX) Midday Peak
[XX] PM Peak



Woodruff Road Congestion Relief Project

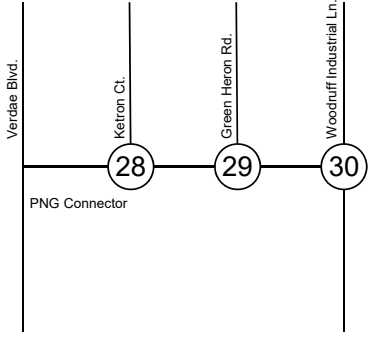
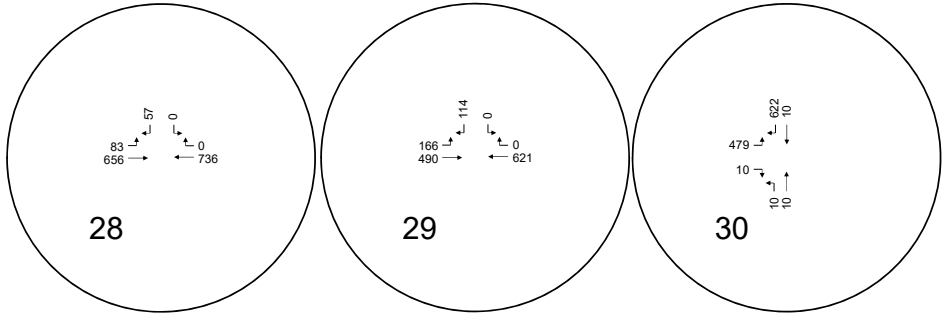
Alternative 1
New Roadway
Traffic Volumes

Figure
21



LEGEND	
XX	Saturday Peak

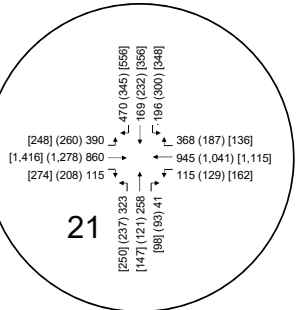
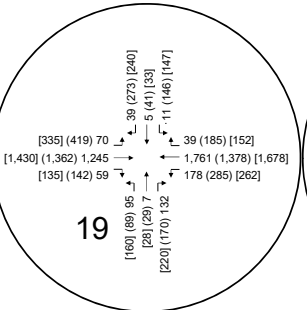
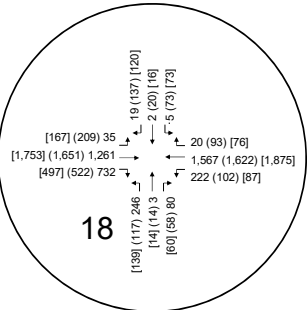
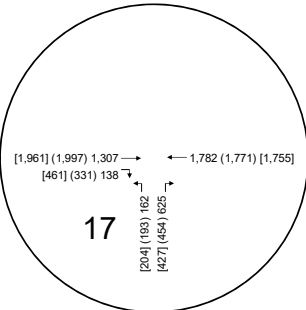
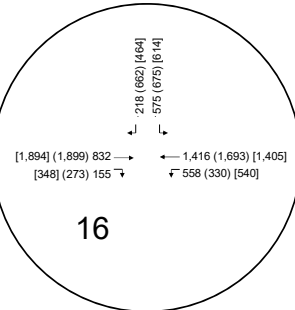
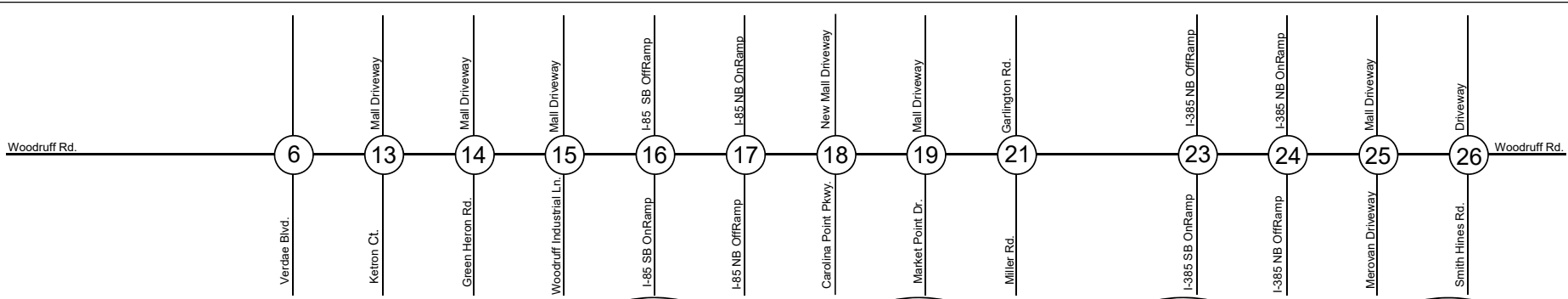
LEGEND
XX Saturday Peak



Woodruff Road Congestion Relief Project

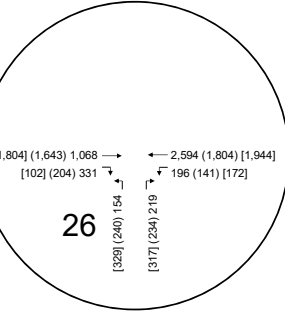
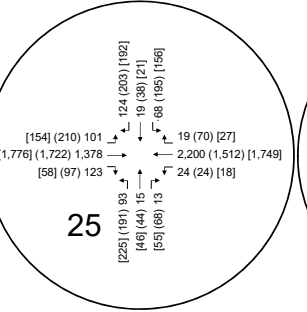
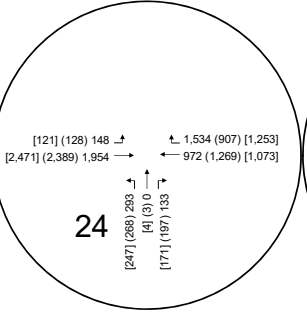
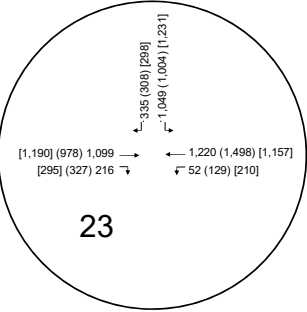
**Alternative 1
New Roadway
Saturday Traffic
Volumes**

Figure 23

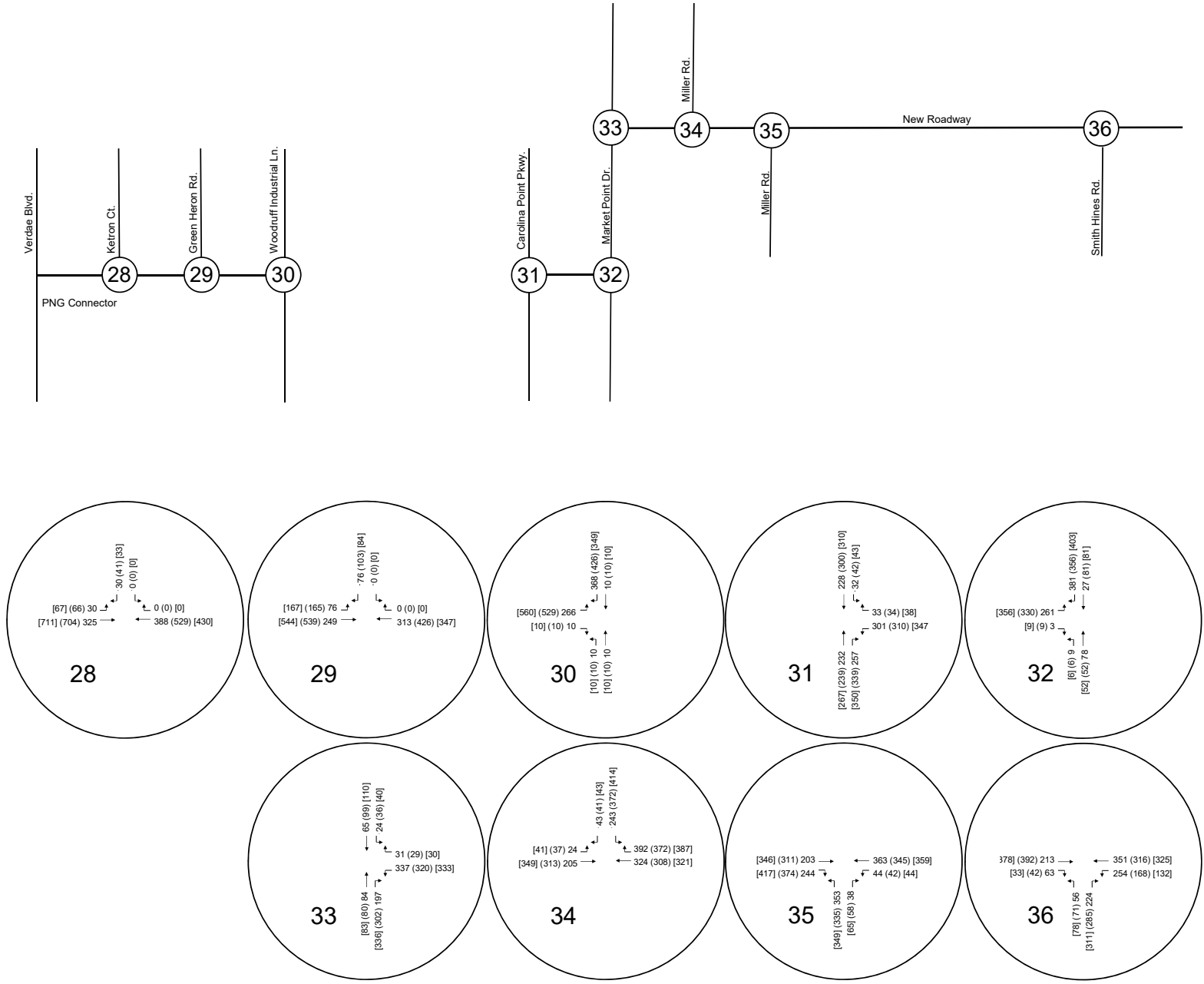


LEGEND

XX AM Peak
(XX) Middy Peak
[XX] PM Peak



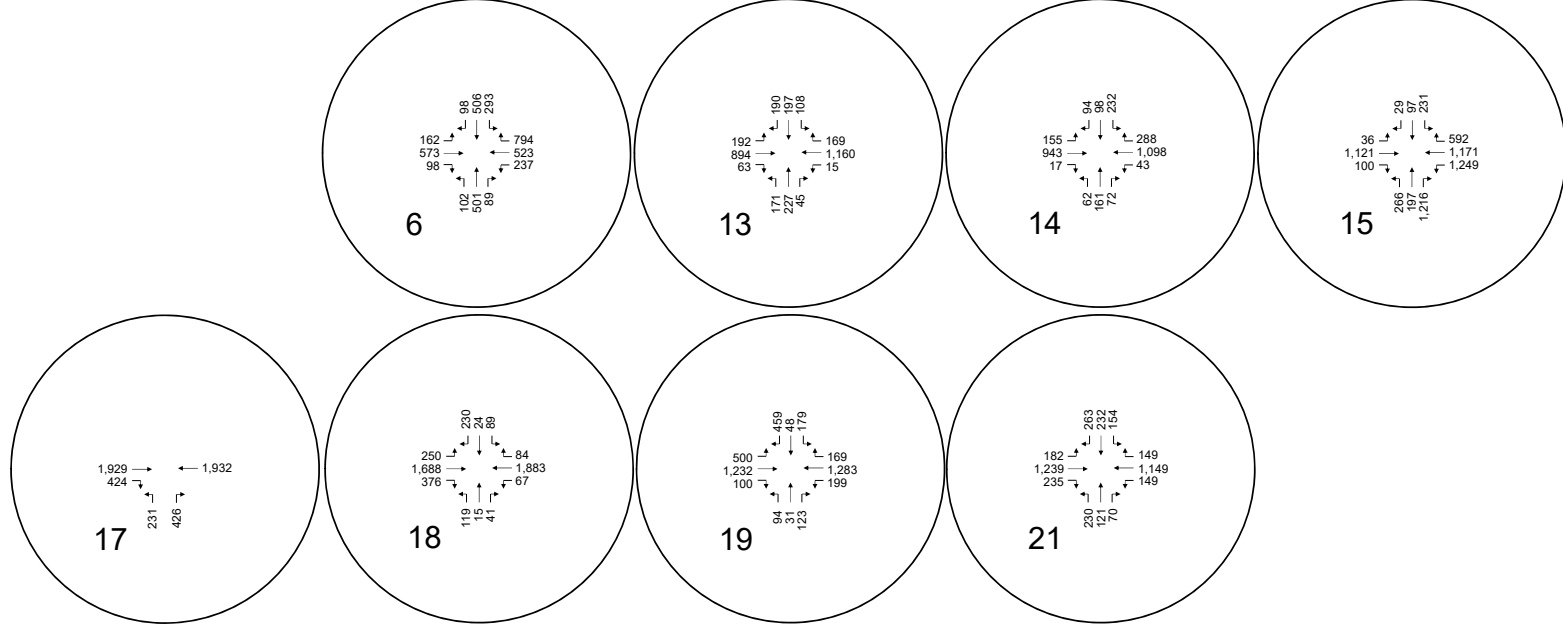
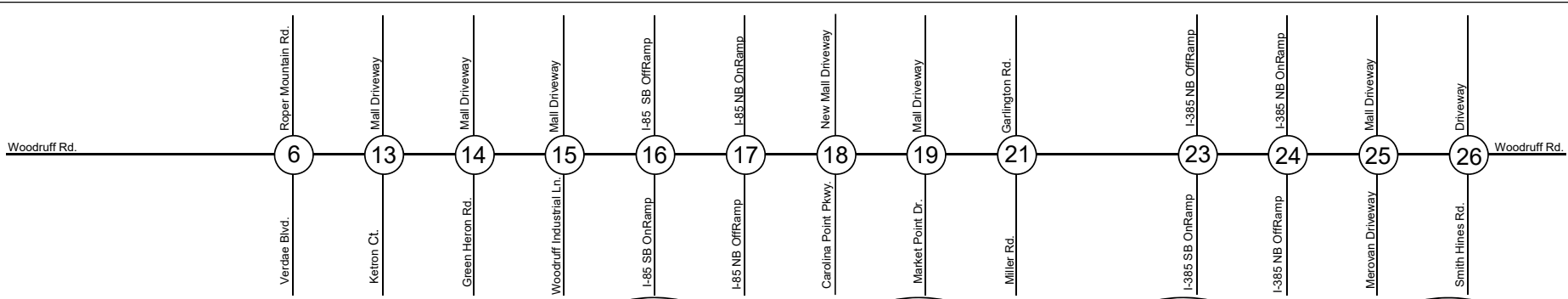
LEGEND	
XX	AM Peak
(XX)	Midday Peak
[XX]	PM Peak



Woodruff Road Congestion Relief Project

Alternative 2C
New Roadway
Traffic Volumes

Figure
25



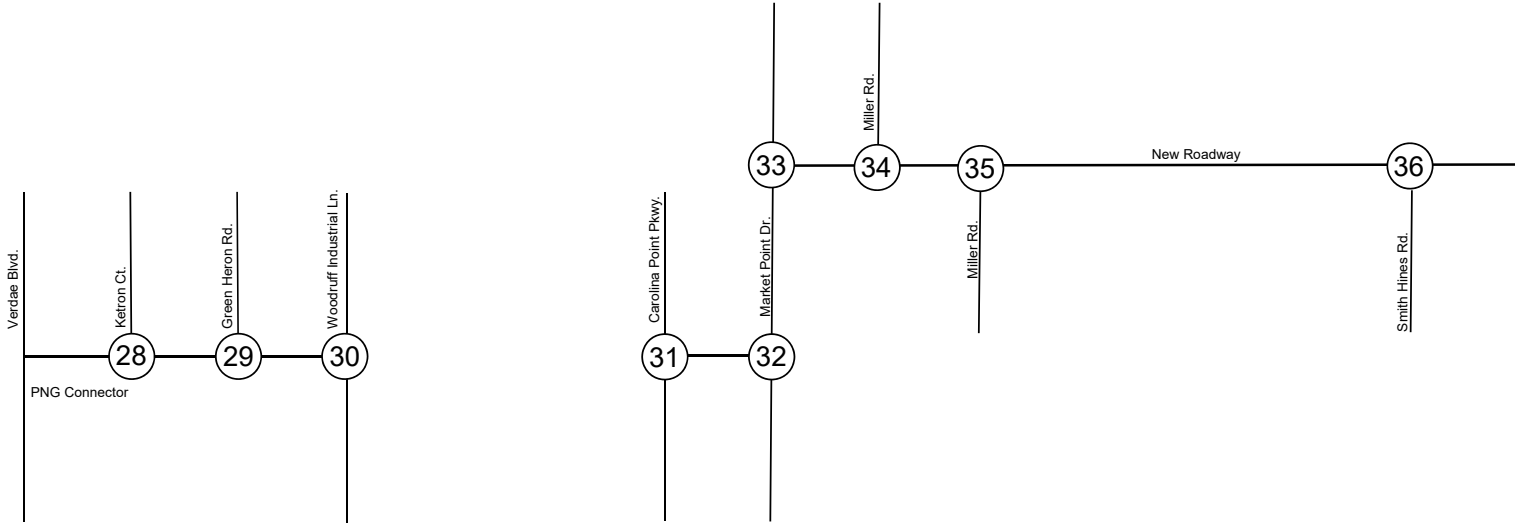
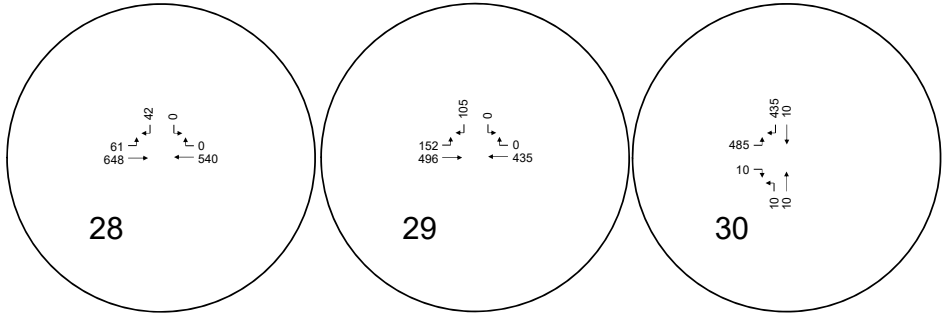
LEGEND
XX Saturday Peak

Alternative 2C
Woodruff Road
Saturday Traffic
Volumes

Woodruff Road Congestion
Relief Project



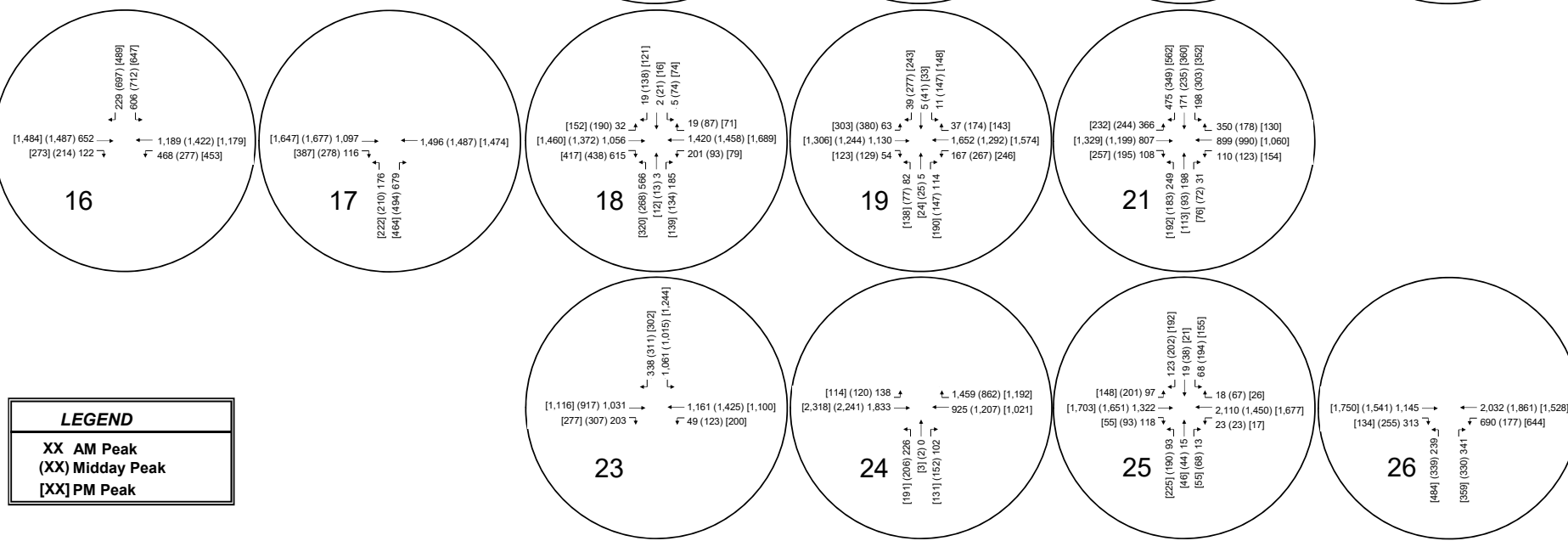
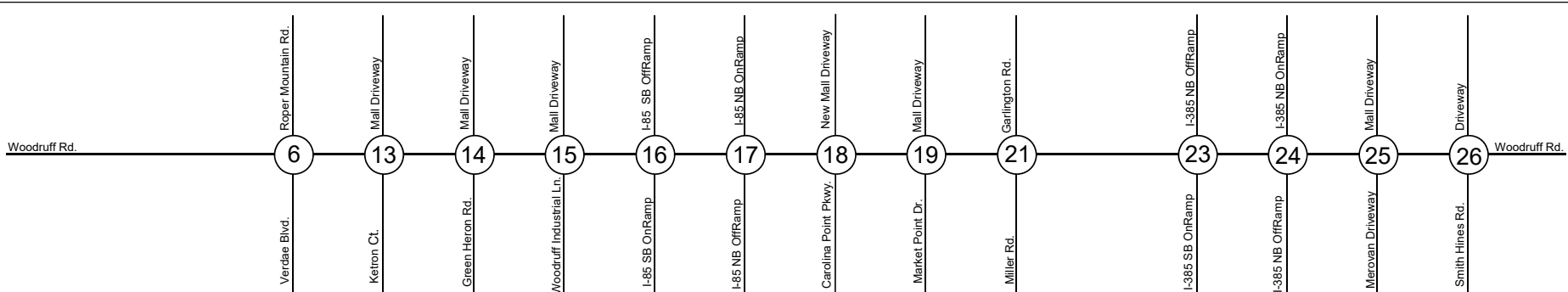
LEGEND
XX Saturday Peak



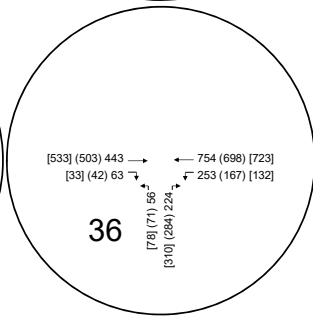
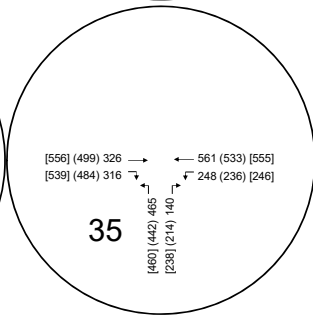
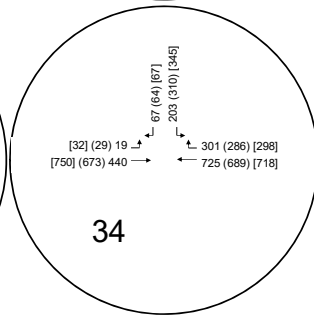
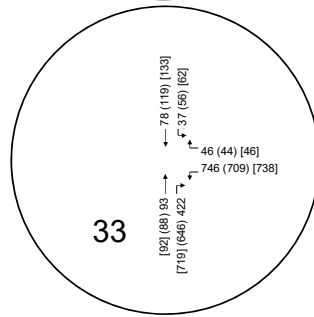
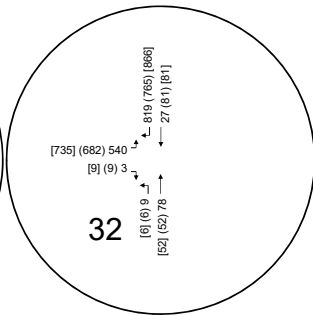
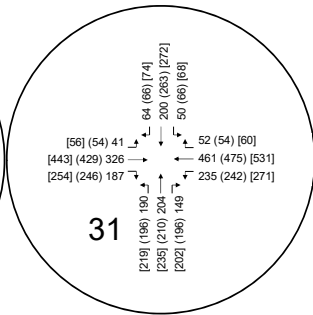
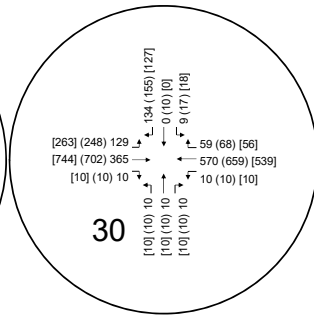
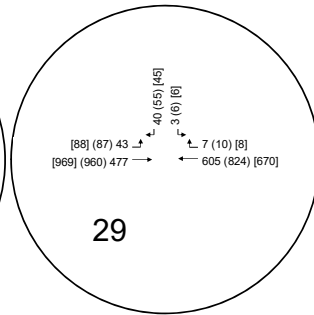
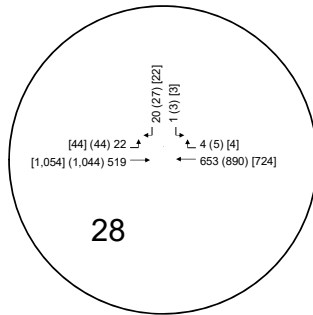
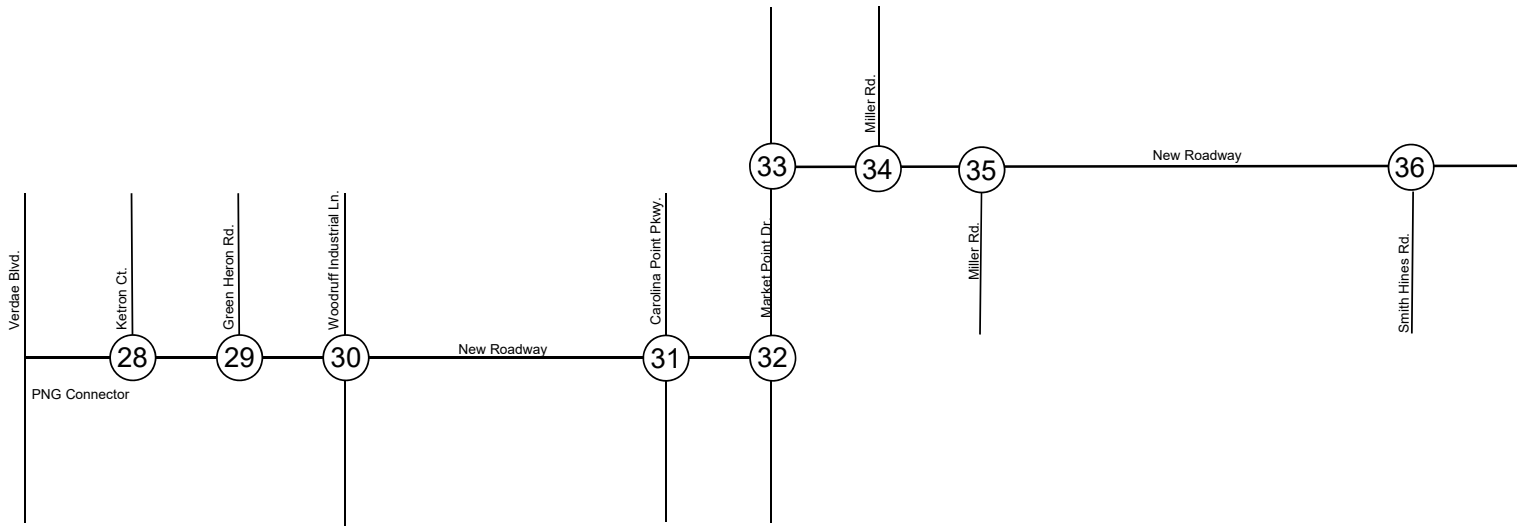
Woodruff Road Congestion Relief Project

**Alternative 2C
New Roadway
Saturday Traffic
Volumes**

Figure 27



LEGEND	
XX	AM Peak
(XX)	Middy Peak
[XX]	PM Peak



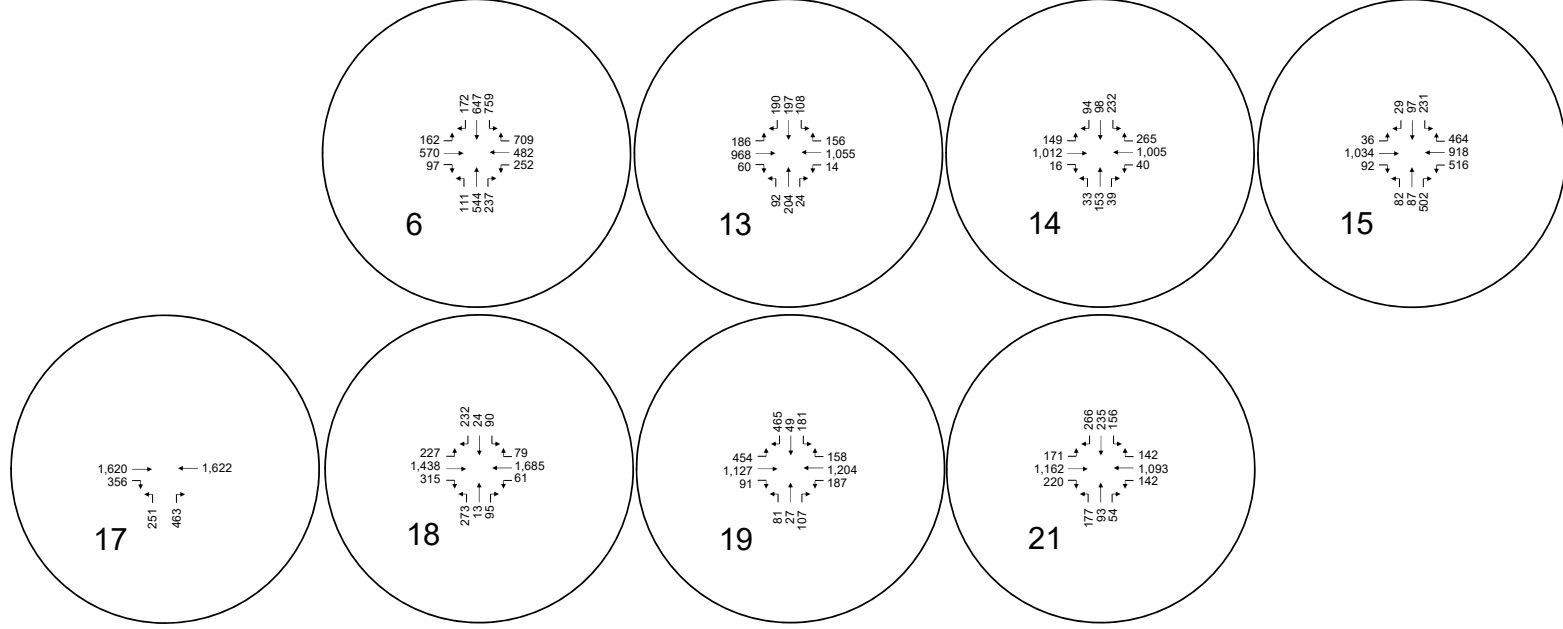
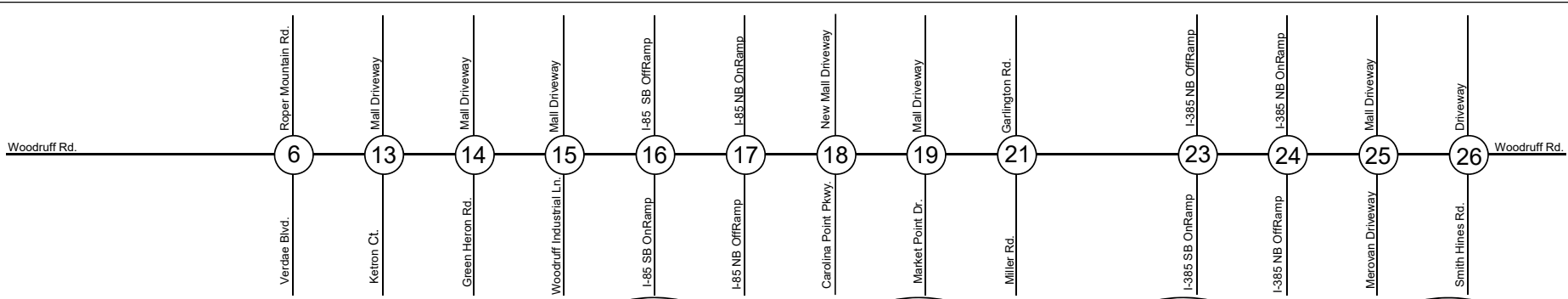
LEGEND	
XX	AM Peak
(XX)	Midday Peak
[XX]	PM Peak



Woodruff Road Congestion Relief Project

Alternative 3C
New Roadway
Traffic Volumes

Figure
29



LEGEND

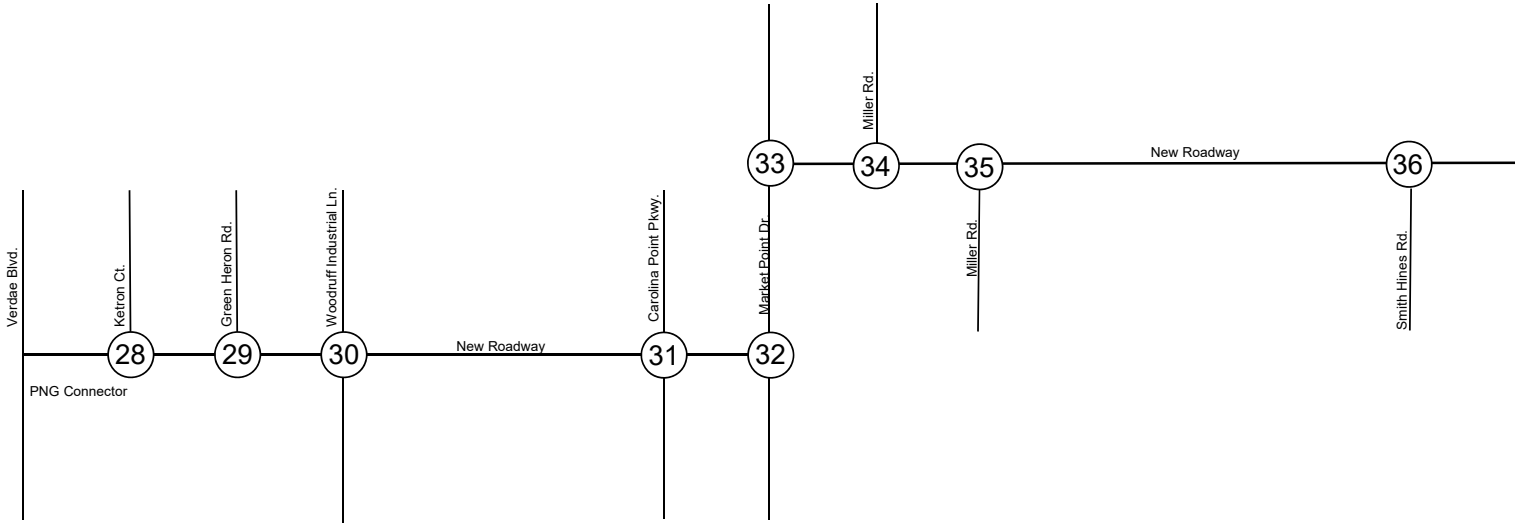
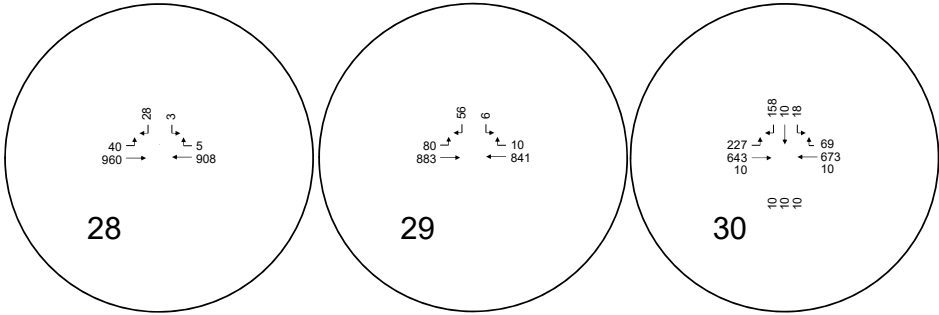
XX Saturday Peak

Alternative 3C
Woodruff Road
Saturday Traffic
Volumes

Woodruff Road Congestion
Relief Project



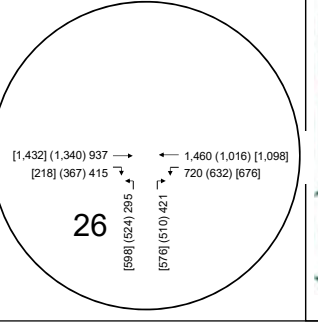
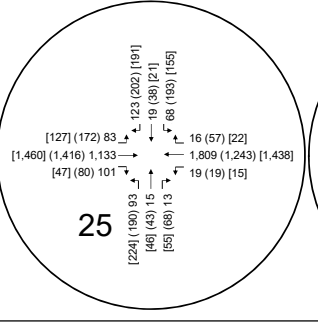
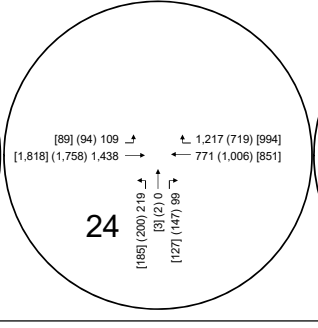
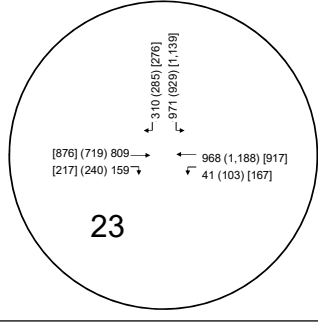
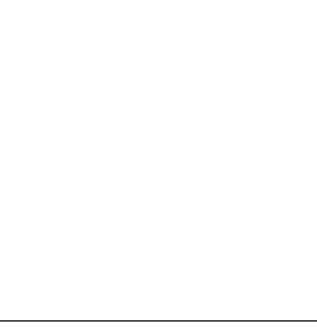
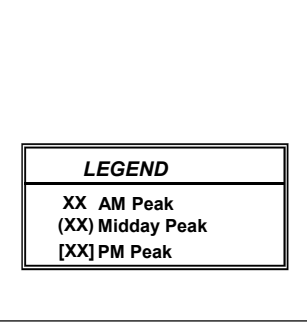
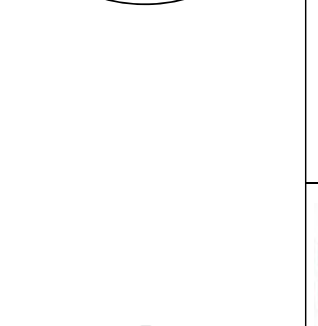
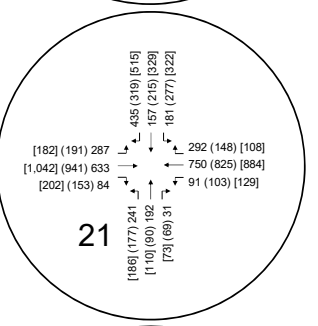
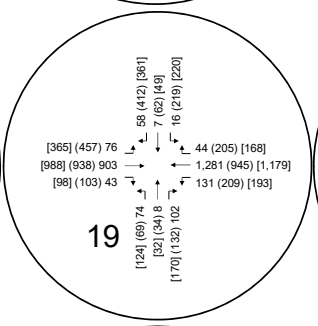
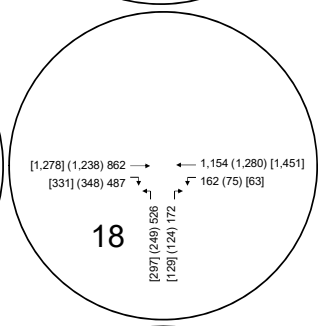
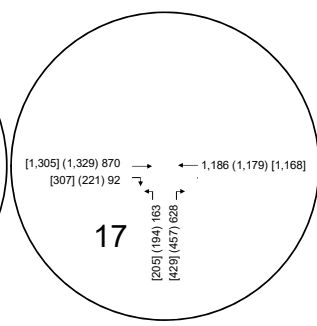
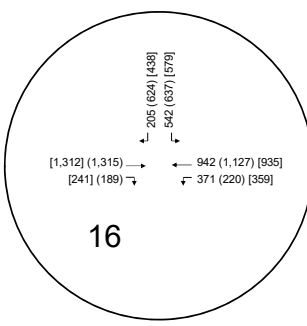
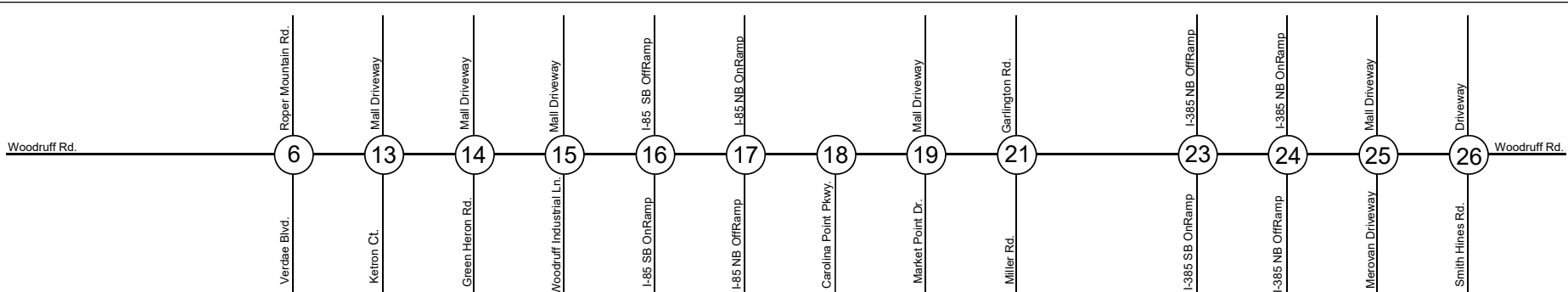
LEGEND
XX Saturday Peak



Woodruff Road Congestion Relief Project

**Alternative 3C
New Roadway
Saturday Traffic
Volumes**

Figure 31



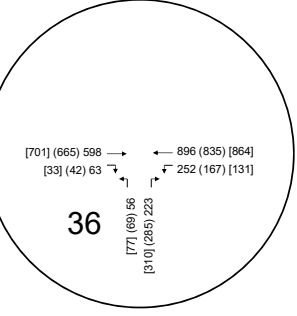
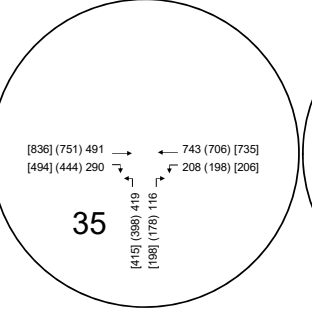
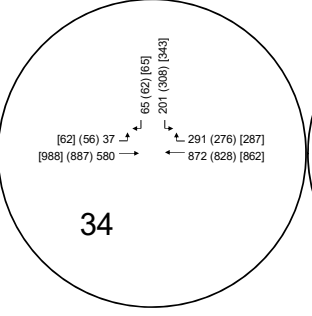
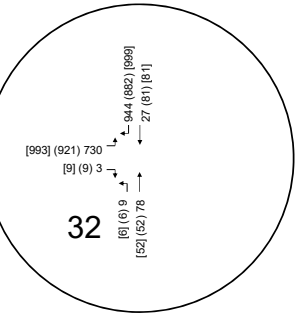
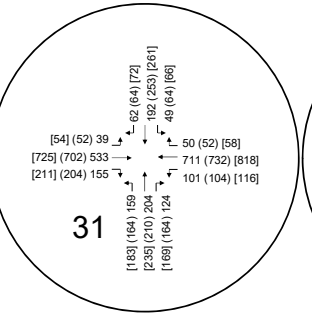
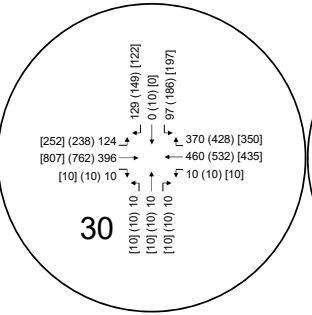
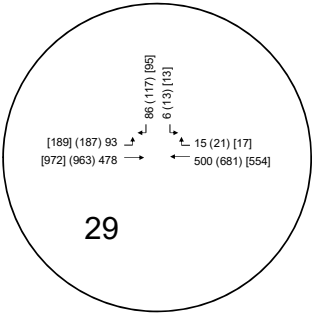
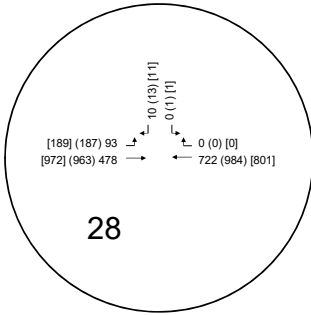
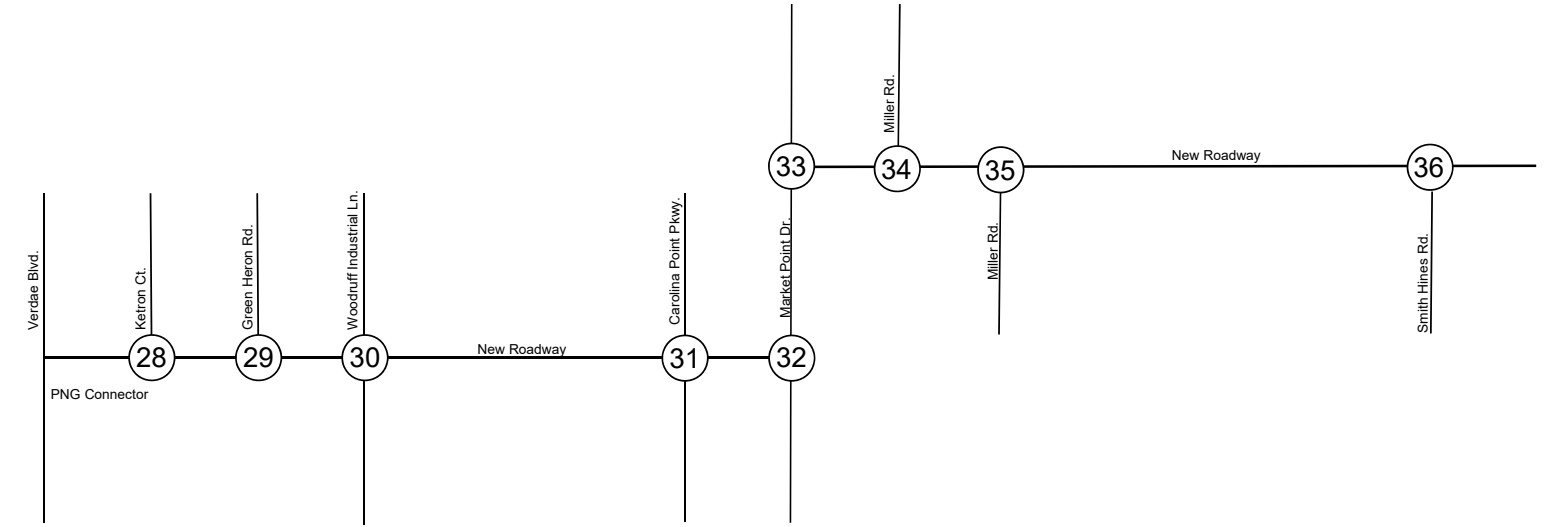
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 XX AM Peak
 (XX) Midday Peak
 [XX] PM Peak

**Alternative 6C
 Woodruff Road
 Traffic Volumes**

**Woodruff Road Congestion
 Relief Project**



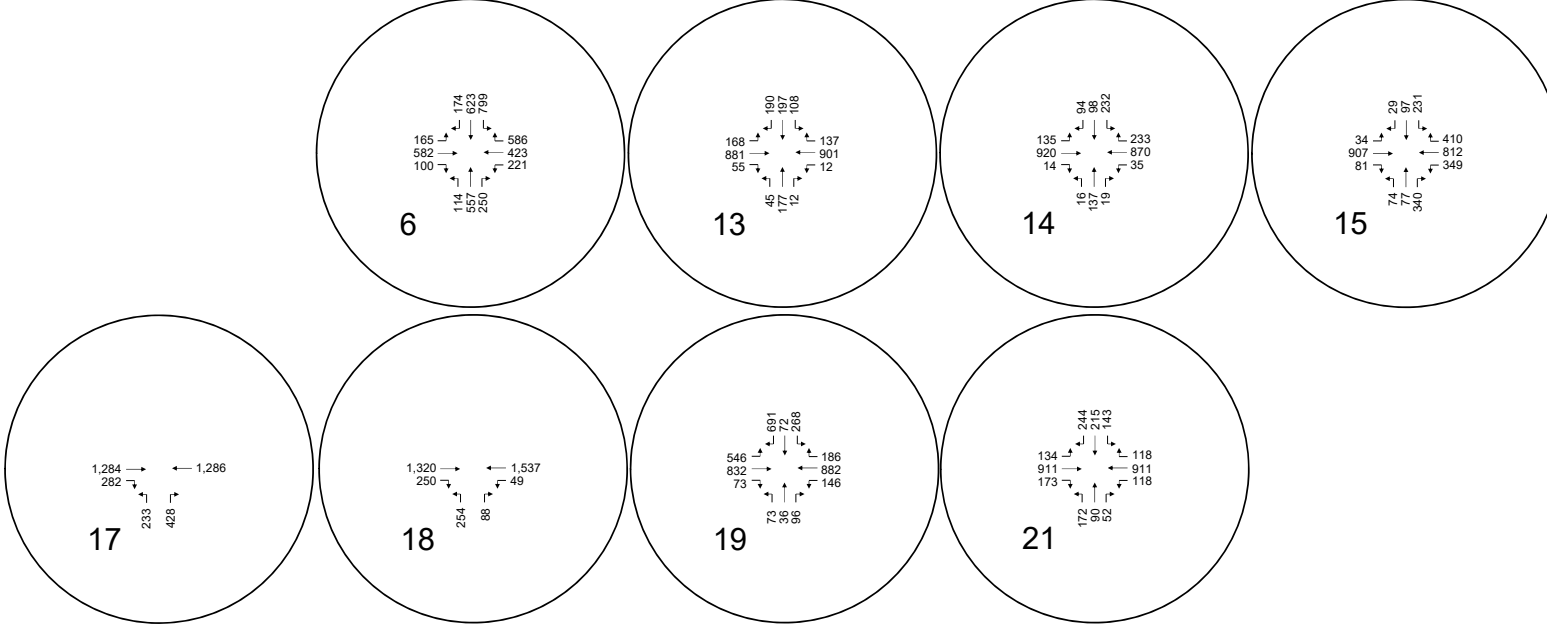
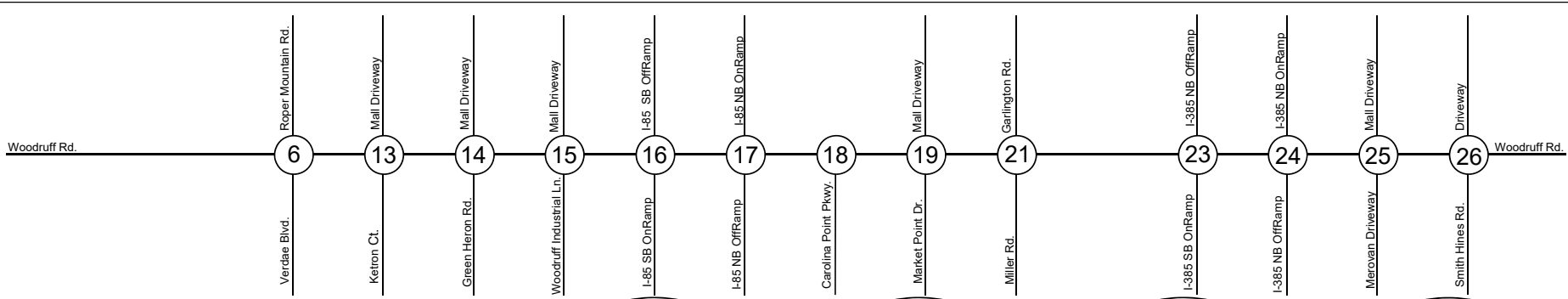
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XX	AM Peak
(XX)	Midday Peak
[XX]	PM Peak



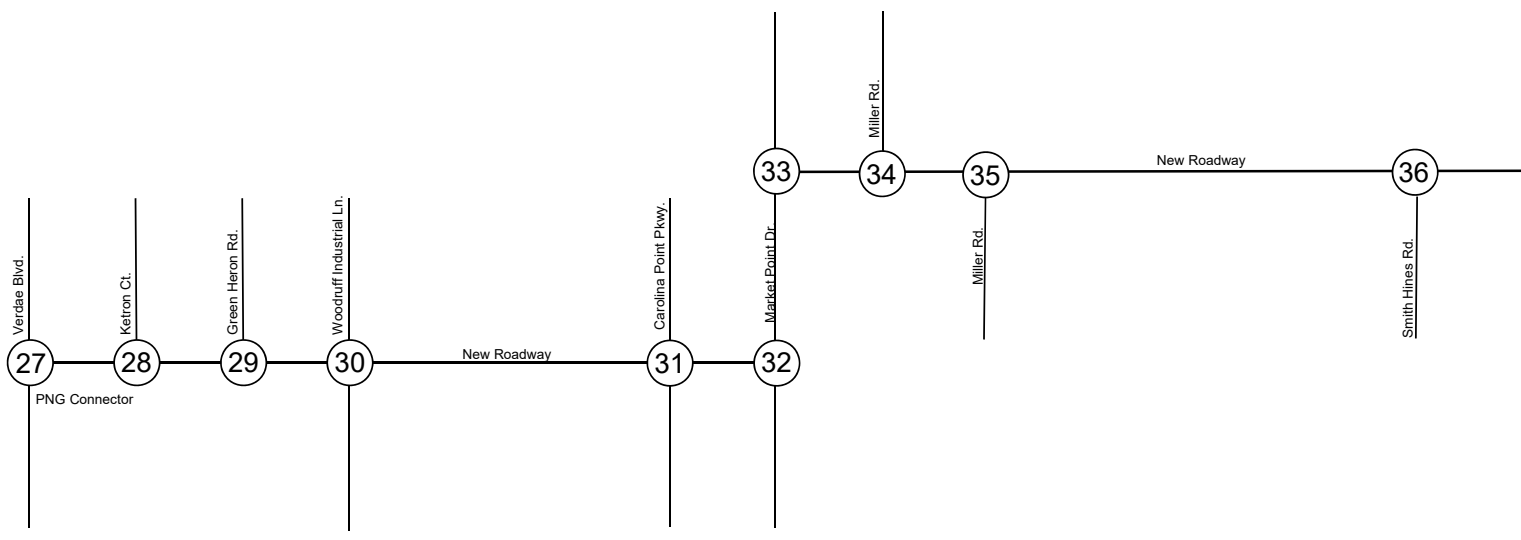
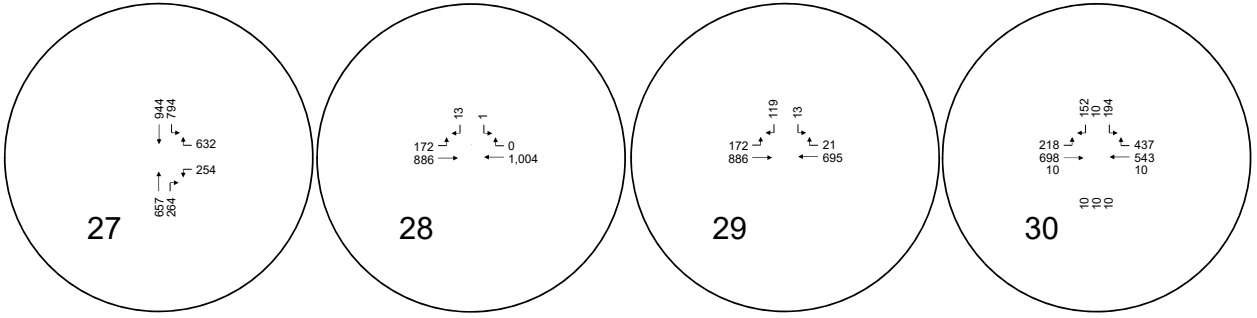
Woodruff Road Congestion Relief Project

Alternative 6C New Roadway Traffic Volumes

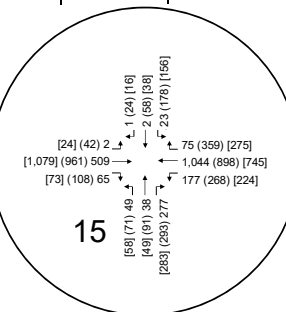
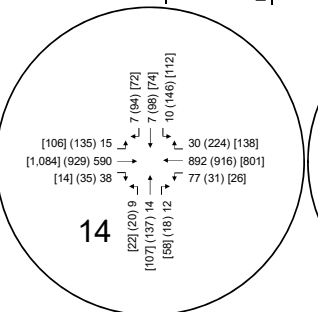
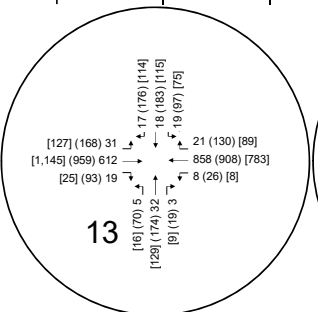
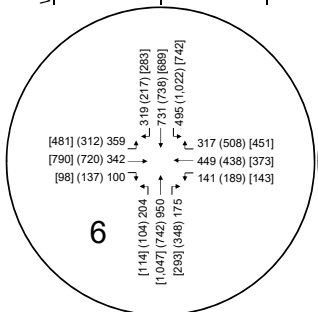
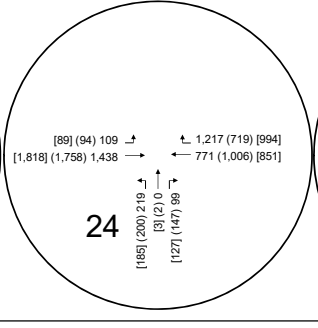
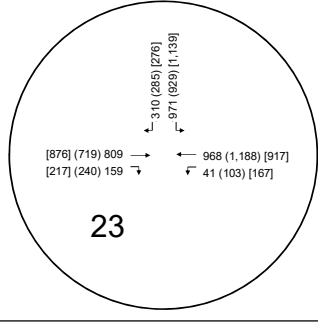
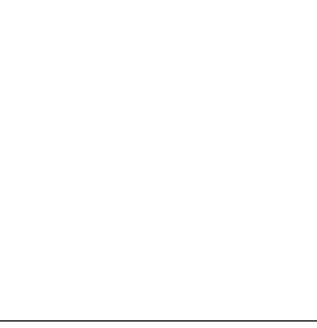
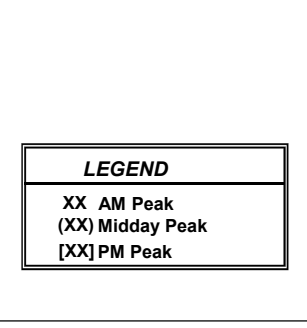
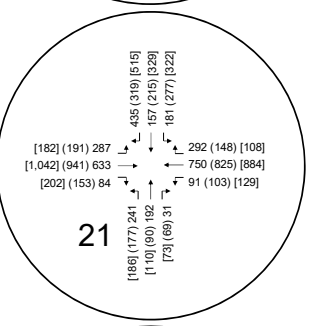
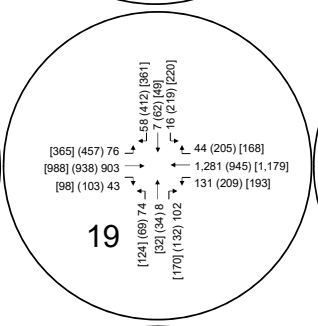
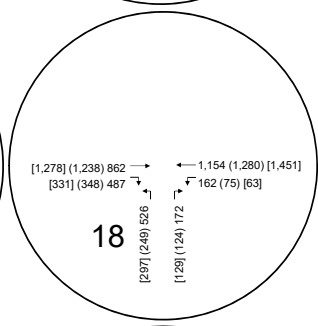
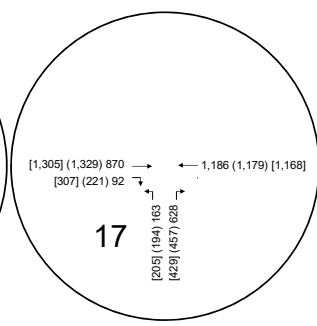
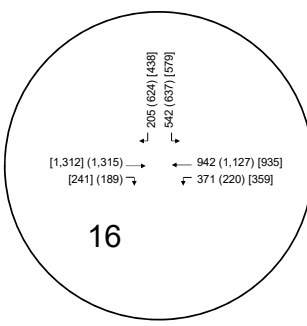
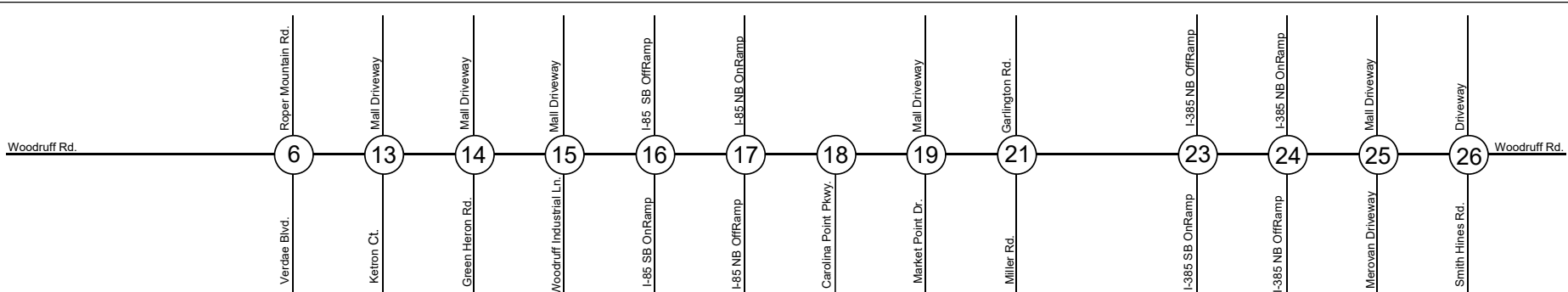
Figure 33



LEGEND
XX Saturday Peak

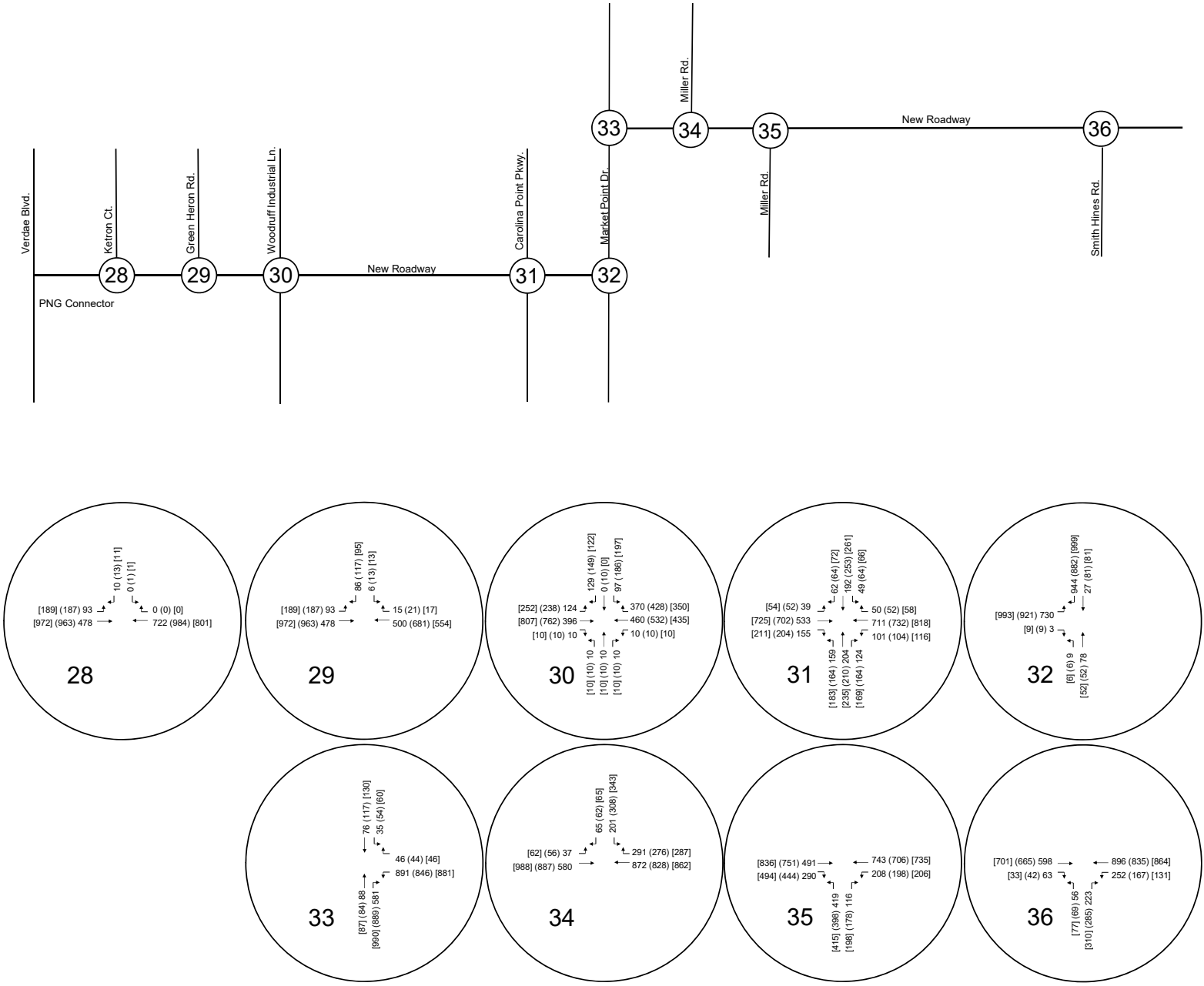


LEGEND
XX Saturday Peak



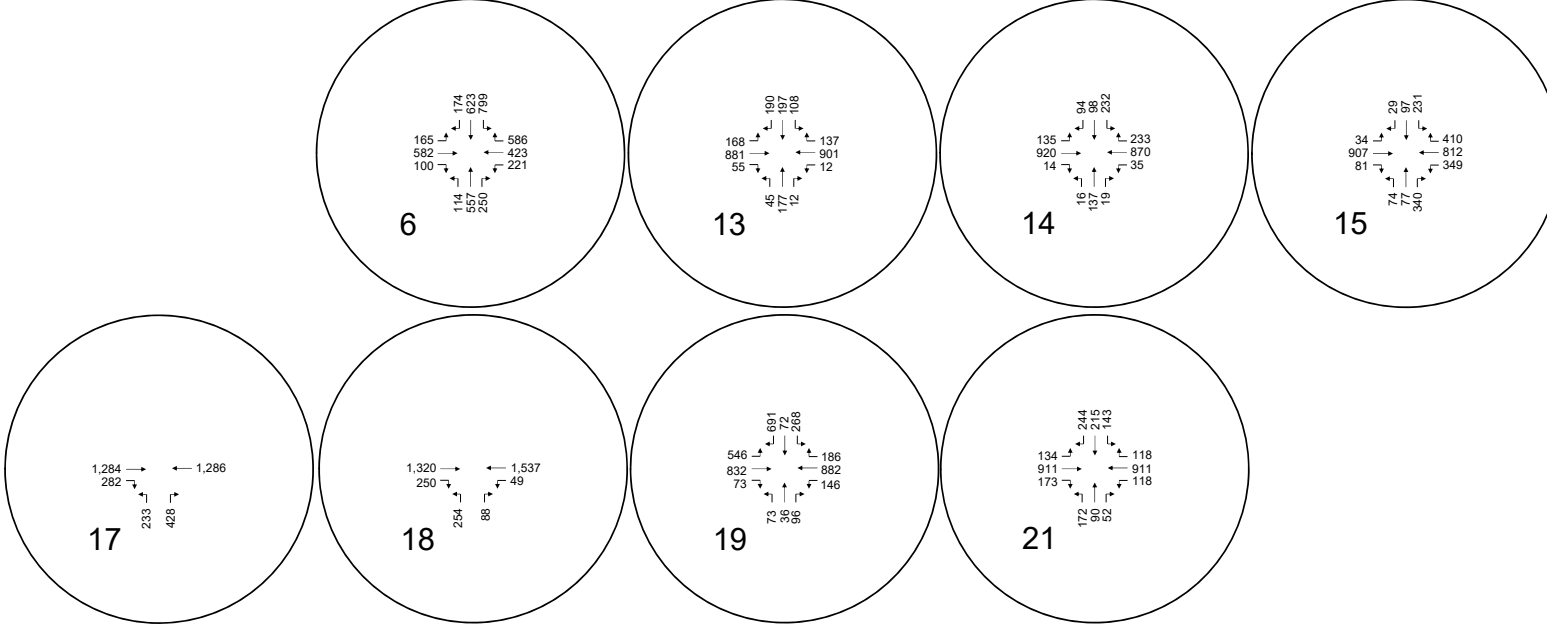
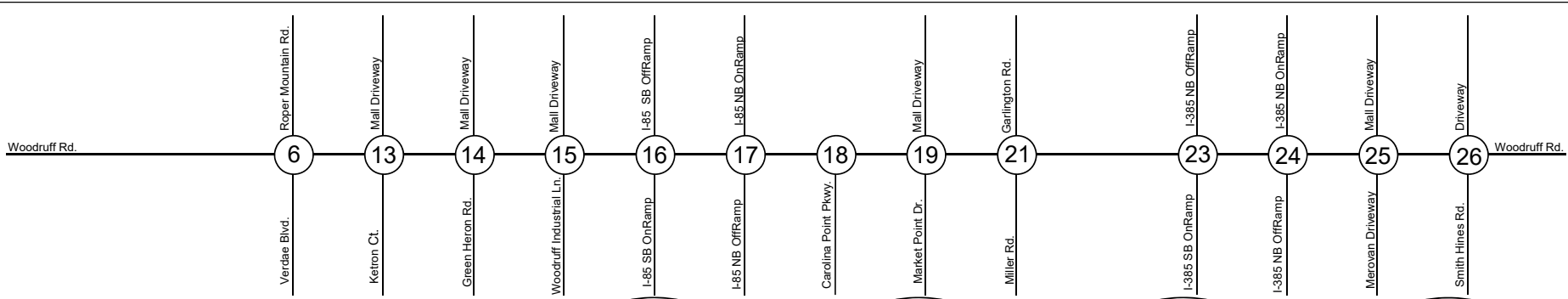
LEGEND	
XX	AM Peak
(XX)	Middy Peak
[XX]	PM Peak

LEGEND	
XX	AM Peak
(XX)	Midday Peak
[XX]	PM Peak



Woodruff Road Congestion Relief Project

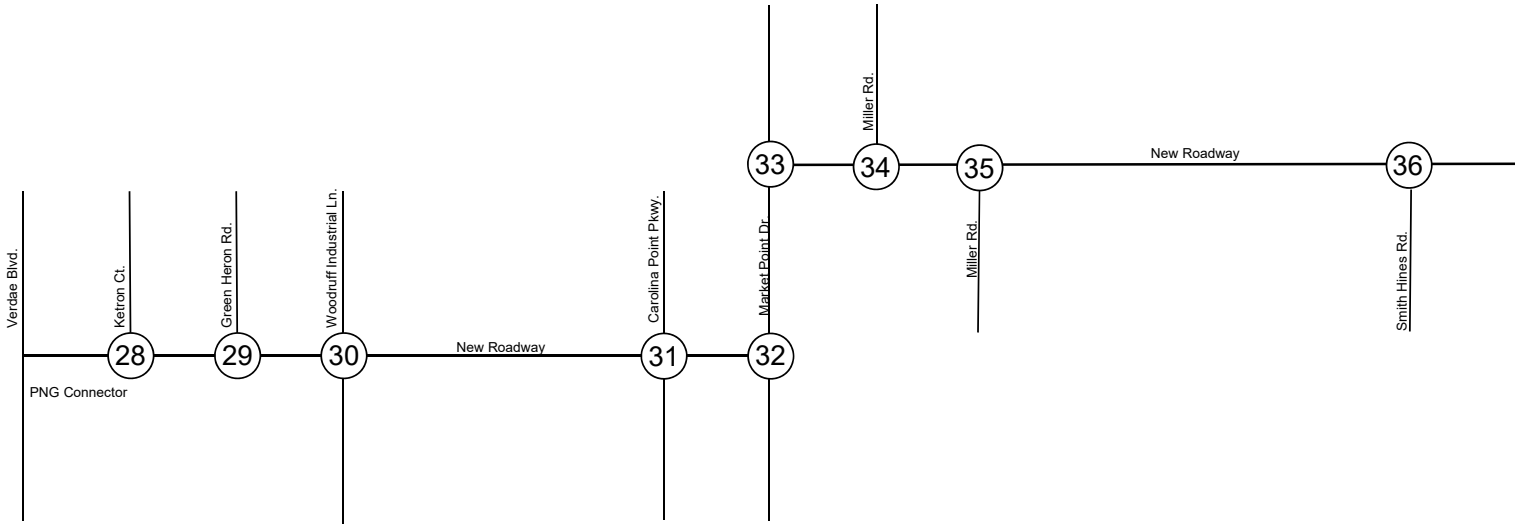
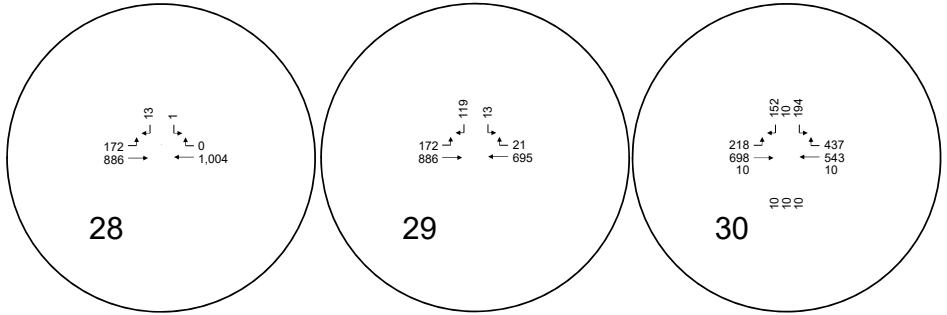
Alternative 6D New Roadway Traffic Volumes



LEGEND

XX Saturday Peak

LEGEND
XX Saturday Peak



Woodruff Road Congestion Relief Project

Alternative 6D New Roadway Saturday Traffic Volumes

Figure 39

8.0 Intersection Capacity Analysis

Capacity analyses were performed for the AM, Midday, PM, and Saturday (where applicable) peak hour traffic conditions using the Synchro Version 10 software to determine the operating characteristics of the roadway network for the Existing, 2045 No Build and 2045 Build conditions. The analyses were conducted with methodologies contained in the *2010 Highway Capacity Manual* (Transportation Research Board, December 2010). In cases where the 2010 Highway Capacity Manual procedures could not be applied, due to the clustering of intersections at I-85/Carolina Point Parkway, the Synchro level of service was reported. SIDRA 8.0 was used to analyze the roundabouts in the study area.

Capacity of an intersection is defined as the maximum number of vehicles that can pass through an intersection during a specified time, typically an hour. Capacity is described by LOS for the operating characteristics of an intersection. LOS is a qualitative measure that describes operational conditions and motorist perceptions within a traffic stream. The *Highway Capacity Manual* defines six levels of service, LOS A through LOS F, with A being the best and F being the worst.

LOS for signalized intersections is determined by the overall intersection operations and is reflected in average delay per vehicle. LOS D or better is typically considered acceptable for signalized intersections. **Table 5** shows the level of service control delay criteria for a signalized intersection. Existing signal timings were applied to the signalized intersections for the intersection analysis.

Table 5: Signalized Intersection Level of Service Criteria	
Level of Service	Average Overall Control Delay (seconds/vehicle)
LOS A	≤ 10
LOS B	> 10 and ≤ 20
LOS C	> 20 and ≤ 35
LOS D	> 35 and ≤ 55
LOS E	> 55 and ≤ 80
LOS F	> 80

Source: 2010 HCM, Transportation Research Board, 2010

LOS for a two-way stop-controlled (TWSC) intersection is determined by the delay of the poorest performing minor approach, as LOS is not defined for TWSC intersections as a whole. It is typical for minor stop-controlled side streets and driveways on major streets to experience longer delays at LOS E and LOS F during peak hours while the majority of the traffic moving through the corridor typically experiences little or no delay. **Table 6** shows the level of service control delay criteria for an unsignalized intersection.

Table 6: Unsignalized Intersection Level of Service Criteria	
Level of Service	Average Minor Street Control Delay (seconds/vehicle)
LOS A	≤ 10
LOS B	>10 and ≤ 15
LOS C	>15 and ≤ 25
LOS D	>25 and ≤ 35
LOS E	>35 and ≤ 50
LOS F	>50

Source: 2010 HCM, Transportation Research Board, 2010

Table 7 shows each intersection and the scenarios for which it was studied for the AM, Midday, PM, and Saturday (where applicable) peak hour traffic conditions. Based on the results of the preliminary modeling and alternative review, the study area for the 2045 future conditions analysis focused on the Woodruff Road and Parallel Roadway corridors.

For the future year analyses, a peak hour factor of 0.9 and a two percent heavy vehicle factor was used for all study area intersections. Corridor signal cycle lengths along Woodruff Road were optimized from Ketron Court to Smith Hines Road. The intersection of Woodruff Road at Verdae Boulevard/Roper Mountain Road is on a separate coordinated signal system, so it was not coordinated with the other Woodruff Road intersections.

The intersections along Woodruff Road were optimized along the corridor for the 2045 future No Build and Build Alternatives. If an intersection was recommended in the modeling optimization to be uncoordinated, the cycles were reviewed, and all intersections were set to the same cycle lengths and intersection offsets were optimized.

Intersection	Existing	No Build	Alt 1	Alt 2C	Alt 3C	Alt 6C	Alt 6D
Mall Connector Rd. at Halton Rd.	✓	✗	✗	✗	✗	✗	✗
Woodruff Rd. at Mall Connector Rd.	✓	✗	✗	✗	✗	✗	✗
Woodruff Rd. at Salters Rd.	✓	✗	✗	✗	✗	✗	✗
Verdae Blvd. at Salters Rd.	✓	✗	✗	✗	✗	✗	✗
Verdae Blvd. at Old Sulphur Springs Rd.	✓	✗	✗	✗	✗	✗	✗
Woodruff Rd. at Verdae Blvd./Roper Mountain Rd.	✓	✓	✓	✓	✓	✓	✓
Roper Mountain Rd. at Congaree Rd.	✓	✗	✗	✗	✗	✗	✗
Roper Mountain Rd. at I-385 SB	✓	✗	✗	✗	✗	✗	✗
Roper Mountain Rd. at I-385 NB	✓	✗	✗	✗	✗	✗	✗
Roper Mountain Rd. at Independence Blvd./Frontage Rd.	✓	✗	✗	✗	✗	✗	✗
Millennium Blvd. at Sulphur Springs Rd.	✓	✗	✗	✗	✗	✗	✗
Carolina Point Pkwy. at Avana and Corporate Campus	✓	✗	✗	✗	✗	✗	✗
Woodruff Rd. at Ketron Ct.	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at Green Heron Rd.	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at Woodruff Industrial Lane	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at I-85 SB	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at I-85 NB	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at Carolina Point Pkwy.	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at Market Point Dr.	✓	✓	✓	✓	✓	✓	✓
Miller Rd. at Park Woodruff Dr.	✓	✗	✗	✗	✗	✗	✗
Woodruff Rd. at Miller Rd.	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at Park Woodruff Dr.	✓	✗	✗	✗	✗	✗	✗
Woodruff Rd. at I-385 SB	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at I-385 NB	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at Merovan Access	✓	✓	✓	✓	✓	✓	✓
Woodruff Rd. at Smith Hines Rd.	✓	✓	✓	✗	✗	✗	✗
PNG Connector at Ketron Ct.	✗	✓	✓	✓	✓	✓	✓
PNG Connector at Green Heron Rd.	✗	✓	✓	✓	✓	✓	✓
PNG Conn./Parallel Rd. at Woodruff Industrial Ln.	✗	✓	✓	✓	✓	✓	✓
Parallel Rd. at Carolina Point Pkwy. (West)	✗	✗	✗	✗	✓	✓	✓
Parallel Rd. at Carolina Point Pkwy. (East)	✗	✗	✗	✓	✓	✓	✓
Parallel Rd. at Market Point Dr. (South)	✗	✗	✗	✓	✓	✓	✓
Parallel Rd. at Market Point Dr. (North)	✗	✗	✗	✓	✓	✓	✓
Parallel Rd. at Miller Rd. (North)	✗	✗	✗	✓	✓	✓	✓
Parallel Rd. at Miller Rd. (South)	✗	✗	✗	✓	✓	✓	✓
Parallel Rd. at Smith Hines Rd.	✗	✗	✗	✓	✓	✓	✓
Woodruff Rd. at Parallel Rd.	✗	✗	✗	✓	✓	✓	✓

8.1 Existing Conditions

Table 8 summarizes LOS and control delay (average seconds of delay per vehicle) for the projected Existing AM, Midday, PM, and Saturday (where applicable) peak hour conditions at the study area intersections. The detailed Synchro output reports are shown in the **Appendix**.

Table 8: Level of Service and delay (average seconds per vehicle) Existing Conditions					
Intersection	Traffic Control¹	Existing Conditions			
		AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Mall Connector Road at Halton Road	S	A (9.7)	C (21.1)	C (24.8)	N/A
Woodruff Road at Mall Connector Road	S	B (12.7)	B (14.0)	B (19.4)	B (17.1)
Woodruff Road at Salters Road	U	F (84.6) – SB	D (28.3) – SB	D (30.9) – SB	N/A
Verdae Boulevard at Salters Road	S	B (13.6)	B (12.5)	B (13.3)	N/A
Verdae Boulevard at Old Sulphur Springs Road	U	D (27.7) – NB	D (29.6) – NB	C (24.5) – NB	N/A
Woodruff Road at Verdae Boulevard/Roper Mountain Road	S	C (30.2)	E (69.4)	D (53.9)	D (47.6)
Roper Mountain Road at Congaree Road	S	B (18.6)	F (409.7)	F (223.2)	N/A
Roper Mountain Road at I-385 SB	S	B (17.0)	C (24.7)	C (25.4)	N/A
Roper Mountain Road at I-385 NB	S	C (28.6)	B (17.3)	C (20.8)	N/A
Roper Mountain Road at Frontage Road/ Independence Boulevard	S	E (76.0)	F (86.9)	D (39.9)	N/A
Millennium Boulevard at Sulphur Springs Road	S	C (21.3)	B (12.0)	B (18.7)	N/A
Carolina Point Parkway at Avana and Corporate Campus	U	A (5.8)	A (4.8)	A (5.8)	N/A
Woodruff Road at Ketrone Court	S	B (11.2)	B (14.6)	B (18.8)	C (20.2)
Woodruff Road at Green Heron Road	S	B (17.0)	B (11.6)	A (6.6)	B (16.1)

Table 8 (cont.): Level of Service and delay (average seconds per vehicle) Existing Conditions					
Intersection	Traffic Control¹	Existing Conditions			
		AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Woodruff Road at Woodruff Industrial Lane	S	D (44.5)	C (27.1)	C (26.8)	D (54.5)
Woodruff Road at I-85 SB	S	C (21.6)	B (17.5)	D (40.2)	N/A
Woodruff Road at I-85 NB	S	B (11.0)	D (41.0)	D (47.3)	C (25.2)
Woodruff Road at Carolina Point Parkway	S	C (22.2)	B (12.3)	C (25.2)	B (13.8)
Woodruff Road at Market Point Drive	S	C (32.1)	C (31.4)	C (30.3)	D (44.0)
Miller Road at Park Woodruff Drive	U	C (19.5) – WB	B (12.9) – WB	C (16.8) – WB	N/A
Woodruff Road at Miller Road	S	E (55.3)	C (33.8)	D (38.1)	D (41.2)
Woodruff Road at Park Woodruff Drive	U	C (22.0) – NB	D (32.0) – NB	D (32.7) – SB	D (34.2) – NB
Woodruff Road at I-385 SB	S	C (33.9)	B (14.0)	C (29.7)	N/A
Woodruff Road at I-385 NB	S	B (10.7)	B (11.1)	C (24.4)	N/A
Woodruff Road at Merovan Access	S	D (50.2)	C (30.0)	C (32.4)	N/A
Woodruff Road at Smith Hines Road	S	B (11.7)	B (19.2)	B (11.0)	N/A

1. S = Signalized, U = Unsignalized, R = Roundabout
2. N/A = not studied in this scenario

Figure 40 summarizes the LOS by intersection in the Existing conditions.

Woodruff Road at Mall Connector Road is currently operating at LOS B for all conditions. This section of roadway is one of the areas of Woodruff Road with the lowest traffic volumes and does not experience the congestion in the denser commercial area of the corridor.

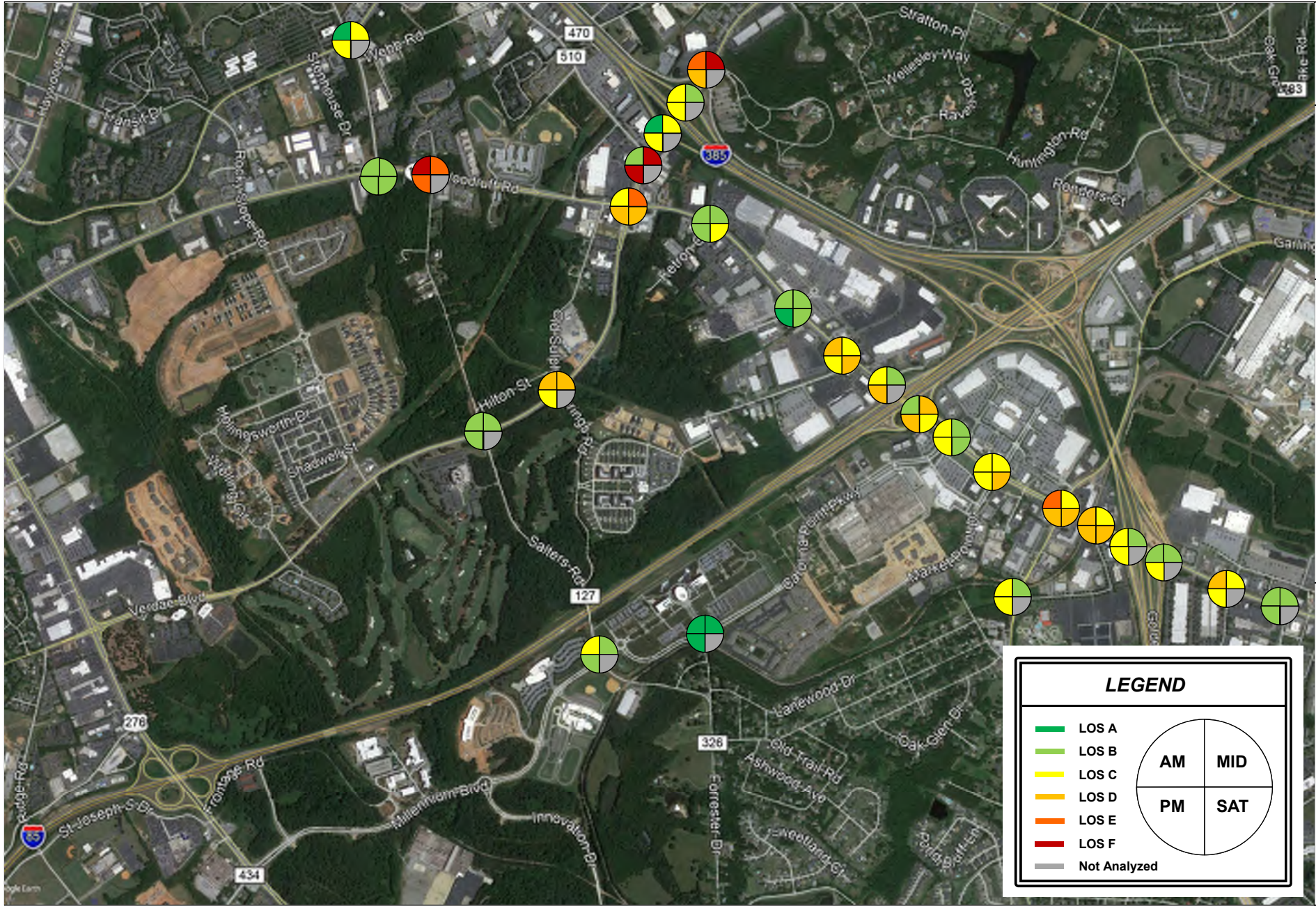


Figure 40

Existing Level of Service

Woodruff Road Congestion Relief Project



At Salters Road, an unsignalized intersection, the Salters Road approach experiences elevated delays during the AM peak hour conditions. This is not uncommon for side streets on major corridors during the peak conditions where the side street experiences elevated delays while the mainline traffic experiences little to no delay. The operations of this intersection along with the other intersections along Salters Road will change with the improvements to the corridor currently in progress.

The remaining intersections along the corridor are operating at LOS D or better with few exceptions; however, the analysis primarily looks at the traffic volume traveling through the intersections and does not fully address additional operational issues due to queueing. The side streets of these intersections are often operating at elevated levels of service while the heavier mainline volumes flow through the corridor. An identified issue along the corridor has been the side street traffic volumes blocking the intersections during peak times as queueing along the corridor prevents them from traveling completely through the intersection to join the flow of traffic along the Woodruff Road corridor.

The intersections along Mall Connector Road are currently operating at LOS C or better. There are some queueing issues at the intersection of Woodruff Road at Mall Connector Road during peak times.

The Roper Mountain Road corridor experiences delays during peak times. Several of the turn movements have elevated traffic volumes where queueing and delays occur, affecting the rest of the corridor. The intersections with the interstate ramps currently operate at LOS C or better for the AM, Midday, and PM peak hour conditions; however, the intersections with Congaree Road and Frontage Road/Independence Boulevard experience elevated delays during the peaks primarily during the Midday and PM peak hours, where the side streets are experiencing heavy delays.

The intersection of Verdae Boulevard at Salters Road is currently under transition due to the construction project. At the intersection of Verdae Boulevard at Old Sulfur Springs Road, the intersection currently operates at LOS D or better during the AM, Midday, and PM peak hour conditions.

The Woodruff Road at Carolina Point Parkway intersection is currently clustered with the I-85 off-ramp sharing a traffic signal cabinet. This intersection is planned to have its own controller in the future and the phasing will be updated to include a protected movement for the westbound left-turn onto Carolina Point Parkway. The northbound approach experiences queueing issues during the peak hours. As noted previously, the City has recently built a connector roadway between

Carolina Point Parkway and Market Point Drive to provide connectivity and additional options to access Woodruff Road from the south.

The intersection of Miller Road at Park Woodruff Drive operates at LOS D or better in the existing conditions. The intersection of Miller Road at Woodruff Road is experiencing delays and the northbound approach is subject to significant queueing during peak times.

8.2 2045 No Build Conditions

The 2045 No Build conditions analysis included the following improvements:

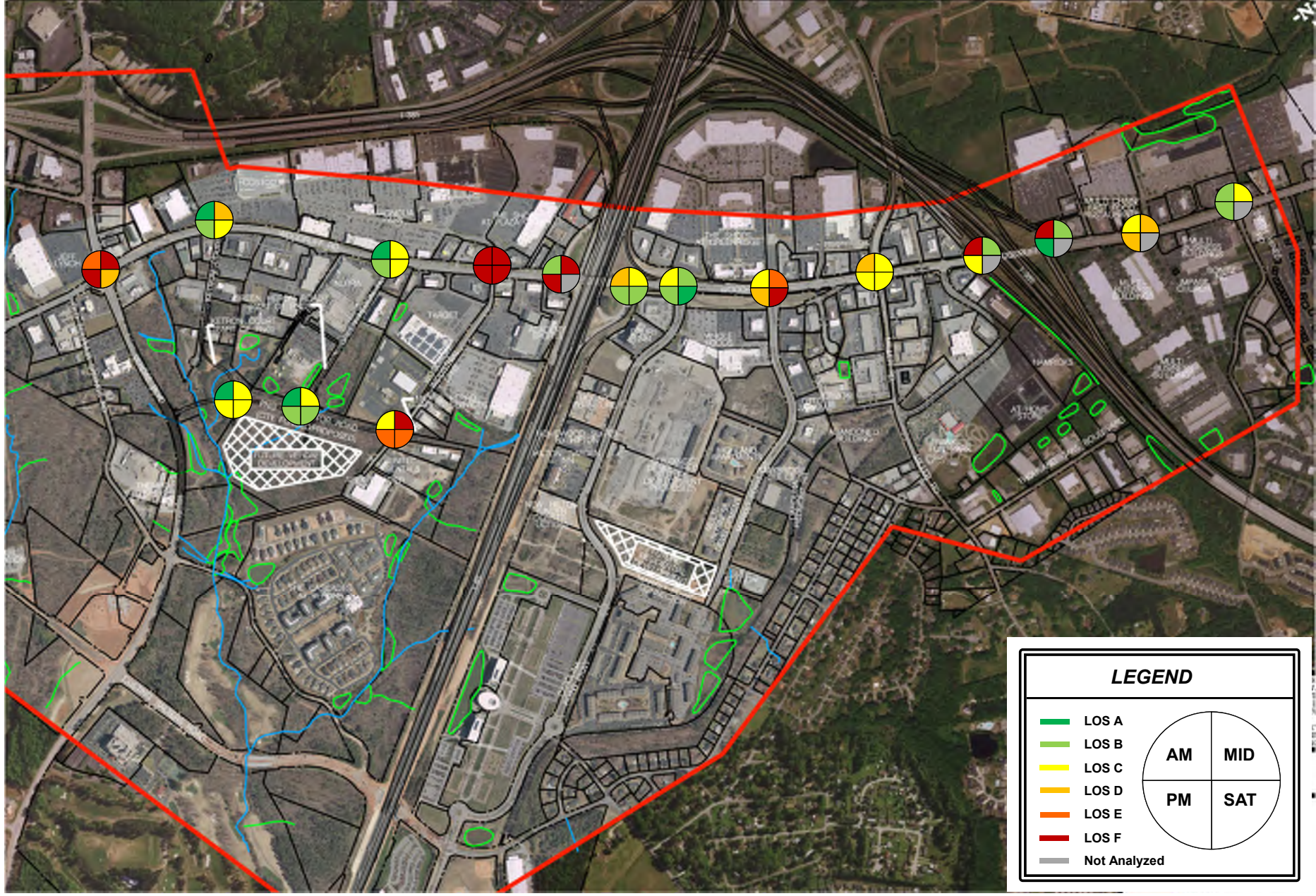
- PNG Connector extending from Verdae Boulevard to Woodruff Industrial Lane
- I-85/I-385 Gateway Project
- Traffic signal timing optimization at study area signalized intersections

Figure 41 summarizes the LOS by intersection in the 2045 No Build conditions.

Table 9 summarizes LOS and control delay (average seconds of delay per vehicle) for the projected No Build AM, Midday, PM, and Saturday (where applicable) peak hour conditions at the study area intersections. The detailed Synchro output reports are shown in the **Appendix**.

Intersections along the Woodruff Road corridor are projected to operate at LOS A – LOS F in the 2045 No Build conditions. The majority of intersections along the corridor are projected to operate at LOS D or better with the exceptions of Woodruff Road at Verdae Boulevard/Roper Mountain Road during the AM, Midday, and PM peak hour conditions, Woodruff Road at Woodruff Industrial Lane during all time periods, Woodruff Road at I-85 SB Ramps during the Midday and PM peak hour conditions, Woodruff Road at Market Point Drive during the Saturday peak hour conditions, and Woodruff Road at the I-385 NB and SB Ramps during the AM peak hour conditions which operate at LOS E or F. Overall traffic operations in the 2045 No Build conditions are generally projected to be worse than the Existing conditions during the AM, Midday PM and Saturday peak hour conditions.

Intersections on the PNG Connector are projected to operate at LOS A – LOS F. The intersection of the PNG at Woodruff Industrial Lane is also projected to operate at LOS E or LOS F during the Midday or PM peak hour conditions.



LEGEND

AM	MID
PM	SAT

Table 9: Level of Service and delay (average seconds per vehicle) No Build Conditions					
Intersection	Traffic Control¹	AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Woodruff Rd. at Verdae Blvd./Roper Mountain Rd.	S	E (56.6)	F (175.4)	F (90.7)	D (47.4)
Woodruff Rd. at Ketron Ct.	S	A (6.0)	D (45.2)	B (11.1)	C (22.9)
Woodruff Rd. at Green Heron Rd.	S	A (5.4)	C (25.1)	B (16.3)	C (28.5)
Woodruff Rd. at Woodruff Industrial Lane	S	F (221.4)	F (409.1)	F (325.2)	F (500.2)
Woodruff Rd. at I-85 SB	S	B (19.7)	F (84.4)	F (81.7)	N/A
Woodruff Rd. at I-85 NB	S	D (35.0)	C (23.3)	B (10.5)	B (11.1)
Woodruff Rd. at Carolina Point Pkwy.	S	C (24.1)	B (10.8)	B (10.5)	A (8.3)
Woodruff Rd. at Market Point Dr.	S	C (28.1)	E (57.2)	D (53.0)	F (86.2)
Woodruff Rd, at Miller Rd.	S	D (50.7)	C (24.1)	C (28.2)	C (25.5)
Woodruff Rd. at I-385 SB	S	F (272.4)	B (18.7)	C (30.9)	N/A
Woodruff Rd. at I-385 NB	S	F (321.0)	B (12.8)	A (9.7)	N/A
Woodruff Rd. at Merovan Access	S	C (22.2)	D (39.6)	D (36.2)	N/A
Woodruff Rd. at Smith Hines Rd.	S	B (17.7)	C (32.2)	B (16.4)	N/A
PNG Connector at Ketron Ct.	R	A (8.8)	C (18.8)	C (15.4)	C (17.4)
PNG Connector at Green Heron Rd.	R	A (8.0)	C (15.5)	B (12.9)	B (12.9)
PNG Connector/Parallel Rd. at Woodruff Industrial Lane	U	C (15.0) – EB	F (50.6) – EB	E (41.3) – EB	E (39.3) – EB

1. S = Signalized, U = Unsignalized, R = Roundabout
2. N/A = not studied in this scenario

8.3 2045 Alternative 1 Conditions

The 2045 Alternative 1 conditions analysis included the following improvements:

- Improvements as listed in the No Build conditions
- Widening of Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road
- Installation of a DDI at I-85
- Installation of a north leg of Carolina Point Parkway
- Traffic signal timing optimization at study area signalized intersections

Figure 42 shows the LOS by intersection in the 2045 Alternative 1 conditions.

Table 10 summarizes LOS and control delay (average seconds of delay per vehicle) for the projected Alternative 1 AM, Midday, PM, and Saturday (where applicable) peak hour conditions at the study area intersections. The detailed Synchro output reports are shown in the **Appendix**.

In the 2045 Alternative 1 conditions, the overall traffic operations are expected to improve from the 2045 No Build conditions. Intersections on the Woodruff Road corridor are projected to operate at LOS A – LOS F. The majority of intersections along the corridor are projected to operate at LOS D or better with the exceptions of Woodruff Road at Verdae Boulevard/Roper Mountain Road during the AM, Midday, and PM peak hour conditions, Woodruff Road at Woodruff Industrial Lane during the Midday and Saturday peak hour conditions, Woodruff Road at Market Point Drive during the Midday and PM peak hour conditions, Woodruff Road at Miller Road during the AM peak hour conditions, and Woodruff Road at Smith Hines Road during the Midday and PM peak hour conditions. Installation of the DDI at the I-85 interchange is projected to improve traffic operations at the intersections of Woodruff Road at I-85 SB Ramps and Woodruff Road at I-85 NB Ramps.

Intersections along the PNG Connector are projected to operate at LOS A – LOS C.

Overall, traffic operations in the 2045 Alternative 1 conditions (AM, Midday and PM peak hour conditions) are projected to improve conditions in 16 cases, have similar results in 20 cases and degrade conditions in 12 cases when compared to the No Build conditions. In cases where intersections are projected to degrade, in four instances, the LOS is projected to be at LOS E or LOS F. Otherwise, the intersections are projected to be operating at LOS D or better.

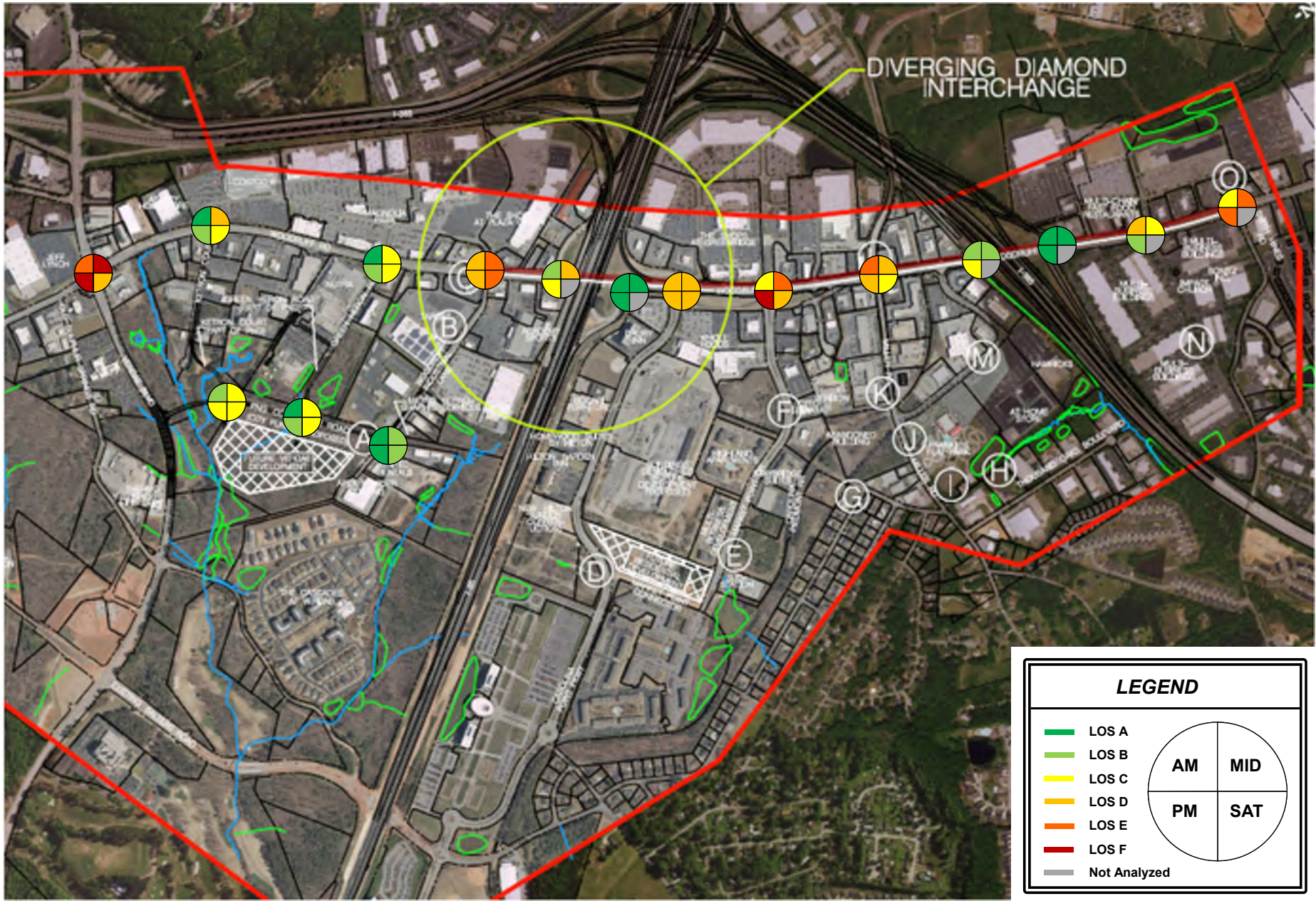


Figure 42

Alternative 1
Level of Service

Woodruff Road Congestion
Relief Project

Table 10: Level of Service and delay (average seconds per vehicle) Alternative 1 Conditions					
Intersection	Traffic Control¹	AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Woodruff Rd. at Verdae Blvd./Roper Mountain Rd.	S	E (57.3)	F (80.5)	F (97.5)	D (47.4)
Woodruff Rd. at Ketron Ct.	S	A (6.5)	D (53.2)	B (11.0)	C (27.0)
Woodruff Rd. at Green Heron Rd.	S	A (4.9)	C (22.7)	B (14.1)	C (23.0)
Woodruff Rd. at Woodruff Industrial Lane	S	D (49.4)	E (57.3)	D (52.6)	E (67.6)
Woodruff Rd. at I-85 SB	S	B (18.9)	D (40.0)	C (25.2)	N/A
Woodruff Rd. at I-85 NB	S	A (0.5)	A (0.5)	A (0.5)	N/A
Woodruff Rd. at Carolina Point Pkwy.	S	D (49.5)	D (39.9)	D (39.0)	D (46.5)
Woodruff Rd. at Market Point Dr.	S	C (32.7)	E (68.3)	F (80.7)	D (39.8)
Woodruff Rd at Miller Rd.	S	E (56.6)	D (47.2)	D (52.7)	C (26.2)
Woodruff Rd. at I-385 SB	S	B (19.3)	B (12.3)	C (28.3)	N/A
Woodruff Rd. at I-385 NB	S	A (9.4)	A (8.8)	A (8.8)	N/A
Woodruff Rd. at Merovan Access	S	D (47.4)	C (21.9)	B (19.8)	N/A
Woodruff Rd. at Smith Hines Rd.	S	C (22.7)	E (62.5)	E (63.0)	N/A
PNG Connector at Ketron Ct.	R	B (10.4)	C (19.4)	C (16.8)	C (18.0)
PNG Connector at Green Heron Rd.	R	A (9.4)	C (15.9)	B (13.7)	C (15.0)
PNG Connector/Parallel Rd. at Woodruff Industrial Lane	R	A (8.4)	B (10.6)	A (9.4)	B (10.6)

1. S = Signalized, U = Unsignalized, R = Roundabout
2. N/A = not studied in this scenario

8.4 2045 Alternative 2C Conditions

The 2045 Alternative 2C conditions analysis included the following improvements:

- Improvements as listed in the No Build conditions
- Widening of Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road
- Installation of a DDI at I-85
- Installation of a north leg of Carolina Point Parkway
- Installation of a new three-lane roadway (Parallel Road) from Carolina Point Parkway to Smith Hines Road via a new alignment
- Traffic signal timing optimization at study area signalized intersections

Figure 43 shows the LOS by intersection in the 2045 Alternative 2C conditions.

Table 11 summarizes LOS and control delay (average seconds of delay per vehicle) for the projected Alternative 2C AM, Midday, PM, and Saturday (where applicable) peak hour conditions at the study area intersections. The detailed Synchro output reports are shown in the **Appendix**.

In the 2045 Alternative 2C conditions, the overall traffic operations are expected to improve from the 2045 No Build conditions. Intersections on the Woodruff Road corridor are projected to operate at LOS A – LOS F. Most intersections along the corridor are projected to operate at LOS D or better with the exceptions of Woodruff Road at Verdae Boulevard/Roper Mountain Road during the PM peak hour conditions, Woodruff Road at Woodruff Industrial Lane during the Midday, PM, and Saturday peak hour conditions, and Woodruff Road at Miller Road during the PM peak hour conditions. Installation of the DDI at the I-85 interchange is projected to improve traffic operations at the intersections of Woodruff Road at I-85 SB Ramps and Woodruff Road at I-85 NB Ramps.

Intersections along the PNG Connector and Parallel Roadway corridor are projected to operate at LOS A – LOS C.

Overall, traffic operations in the 2045 Alternative 2C conditions (AM, Midday and PM peak hour conditions) are projected to improve conditions in 22 cases, have similar results in 15 cases and degrade conditions in 11 cases when compared to the No Build conditions. In cases where intersections are projected to degrade, in one instance the LOS is expected to be operating at LOS E or LOS F, otherwise the intersections are projected to operate at LOS D or better.

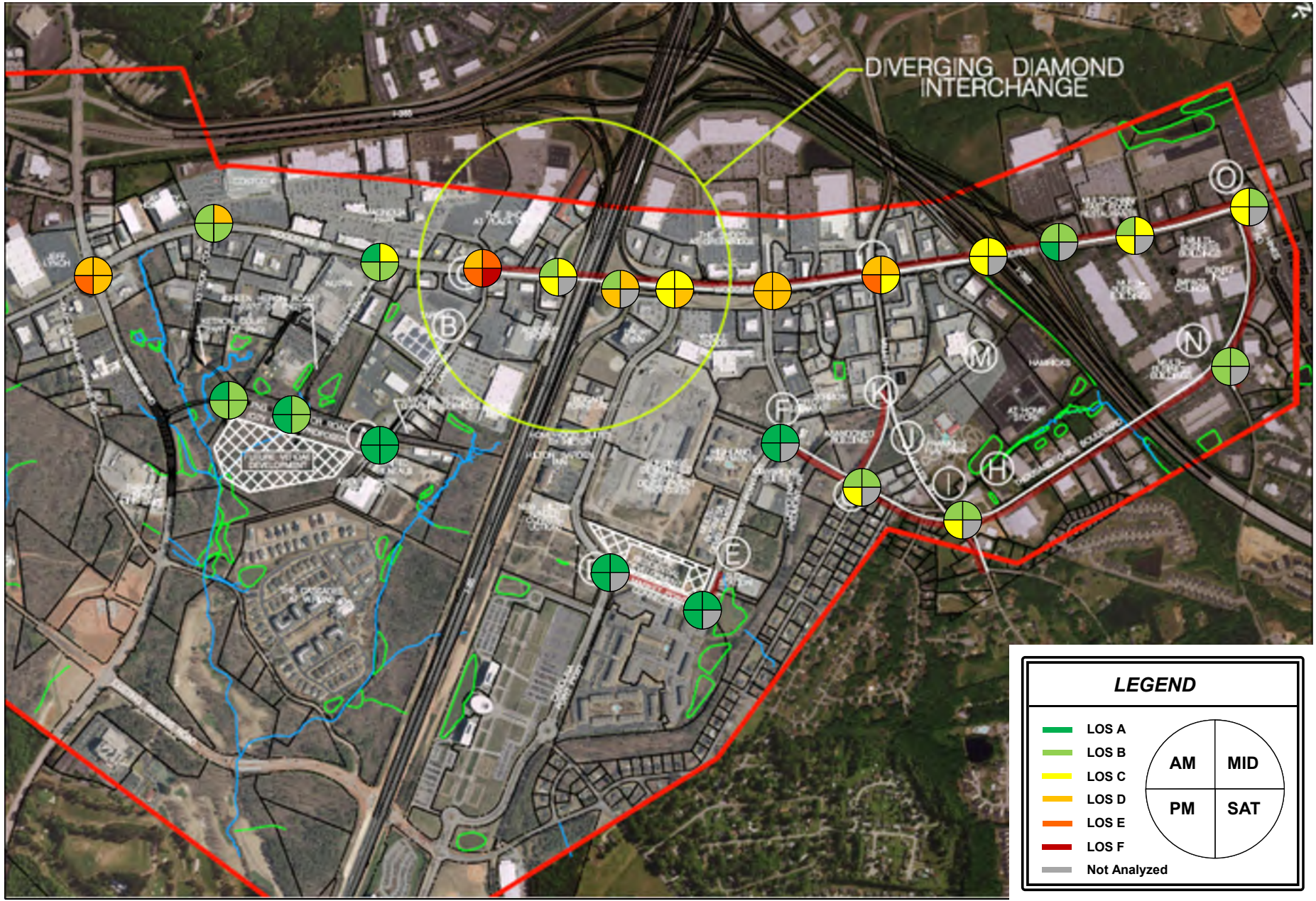


Figure 43

Alternative 2C
Level of Service

Woodruff Road Congestion
Relief Project



Table 11: Level of Service and delay (average seconds per vehicle) Alternative 2C Conditions					
Intersection	Traffic Control¹	AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Woodruff Rd. at Verdae Blvd./Roper Mountain Rd.	S	D (39.7)	D (42.7)	E (63.6)	D (36.6)
Woodruff Rd. at Ketron Ct.	S	B (14.4)	D (37.9)	B (13.7)	B (19.3)
Woodruff Rd. at Green Heron Rd.	S	A (3.2)	C (20.6)	B (11.3)	B (18.4)
Woodruff Rd. at Woodruff Industrial Lane	S	D (42.5)	E (79.7)	E (58.3)	F (92.1)
Woodruff Rd. at I-85 SB	S	B (16.7)	D (35.2)	C (22.3)	N/A
Woodruff Rd. at I-85 NB	S	B (20.0)	D (38.0)	D (39.1)	N/A
Woodruff Rd. at Carolina Point Pkwy.	S	C (23.1)	C (25.8)	C (25.1)	D (37.1)
Woodruff Rd. at Market Point Dr.	S	D (36.4)	D (46.3)	D (50.4)	D (36.3)
Woodruff Rd. at Miller Rd.	S	D (48.0)	D (43.4)	E (57.4)	C (25.8)
Woodruff Rd. at I-385 SB	S	C (27.7)	C (28.8)	C (23.3)	N/A
Woodruff Rd. at I-385 NB	S	B (16.9)	B (12.3)	A (6.9)	N/A
Woodruff Rd. at Merovan Access	S	B (14.6)	C (27.2)	C (20.3)	N/A
PNG Connector at Ketron Ct.	R	A (7.4)	B (14.4)	B (14.3)	B (12.8)
PNG Connector at Green Heron Rd.	R	A (6.8)	B (12.4)	B (12.2)	B (11.2)
PNG Connector/Parallel Rd. at Woodruff Industrial Lane	R	A (6.6)	A (8.9)	A (8.9)	A (8.5)
Parallel Rd. at Carolina Point Pkwy.	R	A (6.0)	A (6.4)	A (6.8)	N/A
Parallel Rd. at Market Point Dr. (South)	R	A (5.9)	A (3.5)	A (5.4)	N/A

Table 11 (cont.): Level of Service and delay (average seconds per vehicle) Alternative 2C Conditions					
Parallel Rd. at Market Point Dr. (North)	R	A (6.0)	A (6.2)	A (6.5)	N/A
Parallel Rd. at Miller Rd. (North)	R	B (13.0)	B (14.3)	C (16.6)	N/A
Parallel Rd. at Miller Rd. (South)	R	B (11.4)	B (14.3)	C (17.3)	N/A
Parallel Rd. at Smith Hines Rd.	R	B (10.4)	B (10.9)	B (10.9)	N/A
Woodruff Rd. at Parallel Rd.	S	C (32.3)	B (16.7)	C (21.3)	N/A

1. S = Signalized, U = Unsignalized, R = Roundabout
2. N/A = not studied in this scenario

8.5 2045 Alternative 3C Conditions

The 2045 Alternative 3C conditions analysis included the following improvements:

- Improvements as listed in the No Build conditions
- Widening of Woodruff Road to a seven-lane section between Woodruff Industrial Lane and Smith Hines Road
- Installation of a DDI at I-85
- Installation of a north leg of Carolina Point Parkway
- Installation of a new three-lane roadway (Parallel Road) from Woodruff Industrial Lane to Smith Hines Road via a new alignment with closure of the north leg of the Woodruff Road at Smith Hines intersection
- Traffic signal timing optimization at study area signalized intersections

Figure 44 shows the LOS by intersection in the 2045 Alternative 3C conditions.

Table 12 summarizes the LOS and control delay (average seconds of delay per vehicle) for the projected Alternative 3C AM, Midday, PM, and Saturday (where applicable) peak hour conditions at the study area intersections. The detailed Synchro output reports are shown in the **Appendix**.

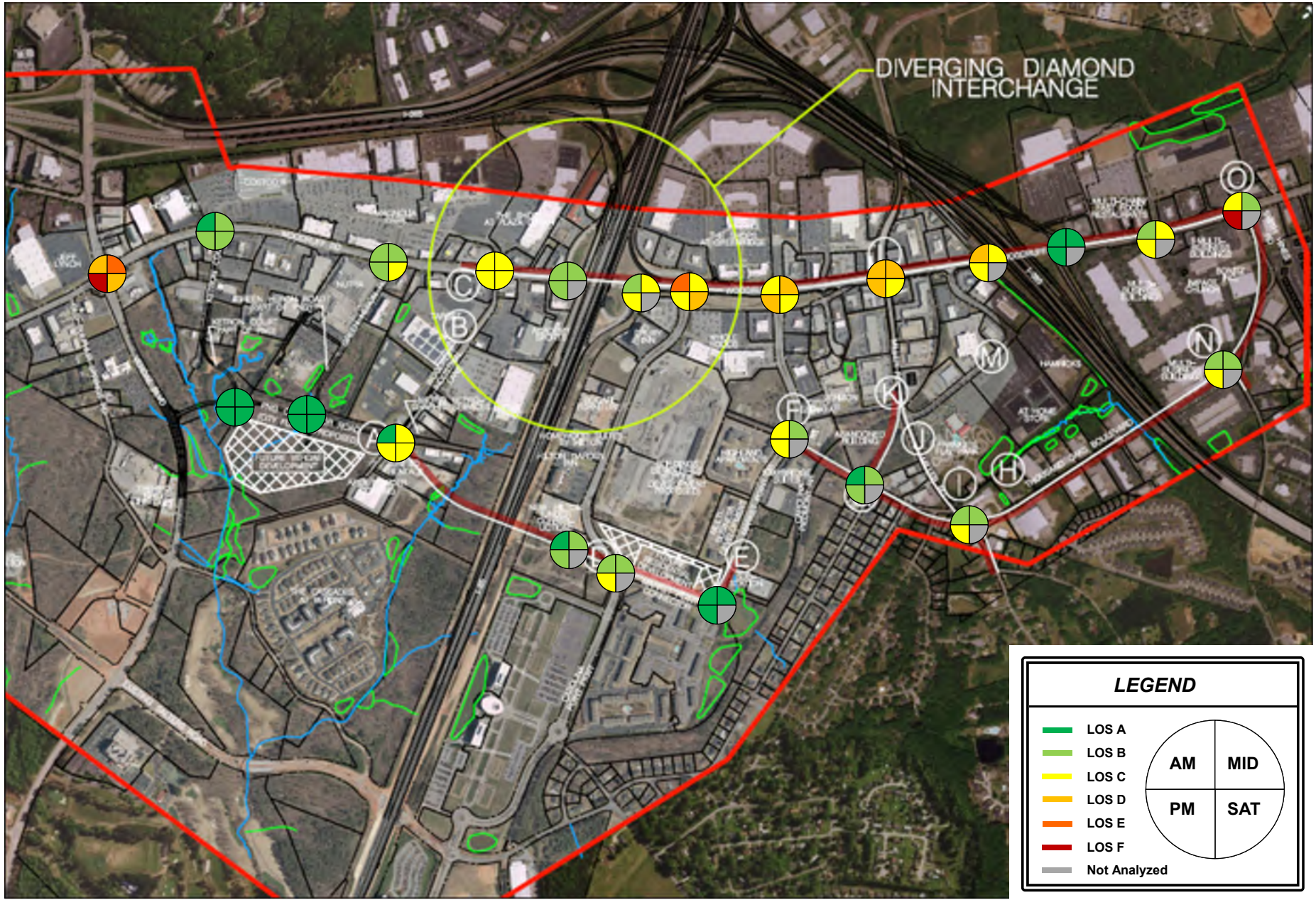


Figure 44

Alternative 3C
Level of Service

Woodruff Road Congestion
Relief Project

**Table 12:
Level of Service and delay (average seconds per vehicle)
Alternative 3C Conditions**

Intersection	Traffic Control¹	AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Woodruff Rd. at Verdae Blvd./Roper Mountain Rd.	S	D (52.8)	E (75.5)	F (90.2)	D (49.3)
Woodruff Rd. at Ketron Ct.	S	A (7.8)	B (15.7)	B (13.1)	B (15.7)
Woodruff Rd. at Green Heron Rd.	S	B (15.7)	B (18.6)	B (15.3)	C (27.2)
Woodruff Rd. at Woodruff Industrial Lane	S	C (30.2)	C (30.0)	C (28.1)	C (34.6)
Woodruff Rd. at I-85 SB	S	B (18.7)	B (18.9)	B (18.1)	N/A
Woodruff Rd. at I-85 NB	S	B (18.3)	C (31.5)	C (21.3)	N/A
Woodruff Rd. at Carolina Point Pkwy.	S	E (74.1)	C (29.3)	C (32.4)	D (39.4)
Woodruff Rd. at Market Point Dr.	S	C (29.3)	D (49.4)	D (47.0)	C (30.7)
Woodruff Rd. at Miller Rd.	S	D (47.5)	D (41.4)	D (54.8)	C (30.4)
Woodruff Rd. at I-385 SB	S	D (44.3)	C (28.5)	C (33.6)	N/A
Woodruff Rd. at I-385 NB	S	A (7.4)	A (9.8)	A (9.8)	N/A
Woodruff Rd. at Merovan Access	S	B (11.8)	C (23.7)	C (26.7)	N/A
PNG Connector at Ketron Ct.	R	A (6.4)	A (9.5)	A (9.0)	A (9.1)
PNG Connector at Green Heron Rd.	R	A (6.2)	A (9.2)	A (8.8)	A (8.8)
PNG Connector/Parallel Rd. at Woodruff Industrial Lane	R	A (5.2)	C (24.4)	C (16.3)	C (23.8)
Parallel Rd. at Carolina Point Pkwy. (West)	R	A (9.6)	B (11.4)	B (13.6)	N/A
Parallel Rd. at Carolina Point Pkwy. (East)	R	B (11.8)	B (14.3)	C (15.6)	N/A

Table 12 (cont.): Level of Service and delay (average seconds per vehicle) Alternative 3C Conditions					
Parallel Rd. at Market Point Dr. (South)	R	A (7.1)	A (7.7)	A (8.3)	N/A
Parallel Rd. at Market Point Dr. (North)	R	C (15.6)	B (14.5)	C (16.9)	N/A
Parallel Rd. at Miller Rd. (North)	R	A (9.0)	B (10.9)	B (12.5)	N/A
Parallel Rd. at Miller Rd. (South)	R	B (12.1)	B (14.1)	C (16.7)	N/A
Parallel Rd. at Smith Hines Rd.	R	B (14.2)	B (14.4)	C (16.6)	N/A
Woodruff Rd. at Parallel Rd.	S	C (33.1)	B (17.3)	F (94.8)	N/A

1. S = Signalized, U = Unsignalized, R = Roundabout
2. N/A = not studied in this scenario

In the 2045 Alternative 3C conditions the overall traffic operations are expected to improve from the 2045 No Build conditions. Intersections along the Woodruff Road Corridor are projected to operate at LOS A – LOS F. Intersections along the corridor are projected to operate at LOS D or better with the exception of Woodruff Road at Verdae Boulevard/Roper Mountain Road during the Midday and PM peak hours and Woodruff Road at Carolina Point Parkway during the AM peak hour. Installation of the DDI at the I-85 interchange is projected to improve traffic operations at the intersections of Woodruff Road at I-85 SB and Woodruff Road at I-85.

The PNG Connector and Parallel Roadway corridor are projected to operate at LOS A – LOS C.

Overall, traffic operations in the 2045 Alternative 3C conditions (AM, Midday and PM peak hour conditions) are projected to improve conditions in 25 cases, have similar results in 13 cases and degrade conditions in 10 cases when compared to the No Build conditions. In cases where intersections are projected to degrade, in one instance the LOS is projected to be LOS E or LOS F, otherwise the intersections are projected to operate at LOS D or better.

8.6 2045 Alternative 6C Conditions

The 2045 Alternative 6C conditions analysis included the following improvements:

- Improvements as listed in the No Build conditions
- Installation of a new five-lane roadway (Parallel Road) from Woodruff Industrial Lane to Smith Hines Road via a new alignment with the closure of the north leg of the intersection of Woodruff Road at Smith Hines Road
- Traffic signal timing optimization at study area signalized intersections

Figure 45 shows the LOS by intersection in the 2045 Alternative 6C conditions.

Table 13 summarizes the LOS and control delay (average seconds of delay per vehicle) for the projected Existing AM, Midday, PM, and Saturday (where applicable) peak hour conditions at the study area intersections. The detailed Synchro output reports are shown in the **Appendix**.

In the 2045 Alternative 6C conditions, the overall traffic operations are expected to improve from the 2045 No Build conditions. Intersections along the Woodruff Road Corridor are projected to operate at LOS A – LOS F. Most intersections along the corridor are projected to operate at LOS D or better with the exceptions of Woodruff Road at Verdae Boulevard/Roper Mountain Road during the Midday and PM peak hour conditions, Woodruff Road at Woodruff Industrial Lane during the Saturday peak hour conditions, Woodruff Road at Market Point Drive during the Saturday peak hour conditions, and Woodruff Road at the Parallel Road during the PM peak hour conditions.

Intersections along the PNG Connector and Parallel Roadway are projected to operate at LOS A – LOS D with the exception of Woodruff Road at the Parallel Road during the PM peak hour as previously mentioned.

Overall, traffic operations in the 2045 Alternative 6C conditions (AM, Midday and PM peak hour conditions) are projected to improve conditions in 25 cases, have similar results in 16 cases and degrade conditions in 7 cases when compared to the No Build conditions. In cases where intersections are projected to degrade, in one instance the LOS is projected to be LOS E or LOS F, otherwise, the intersections are projected to be operating at LOS D or better.

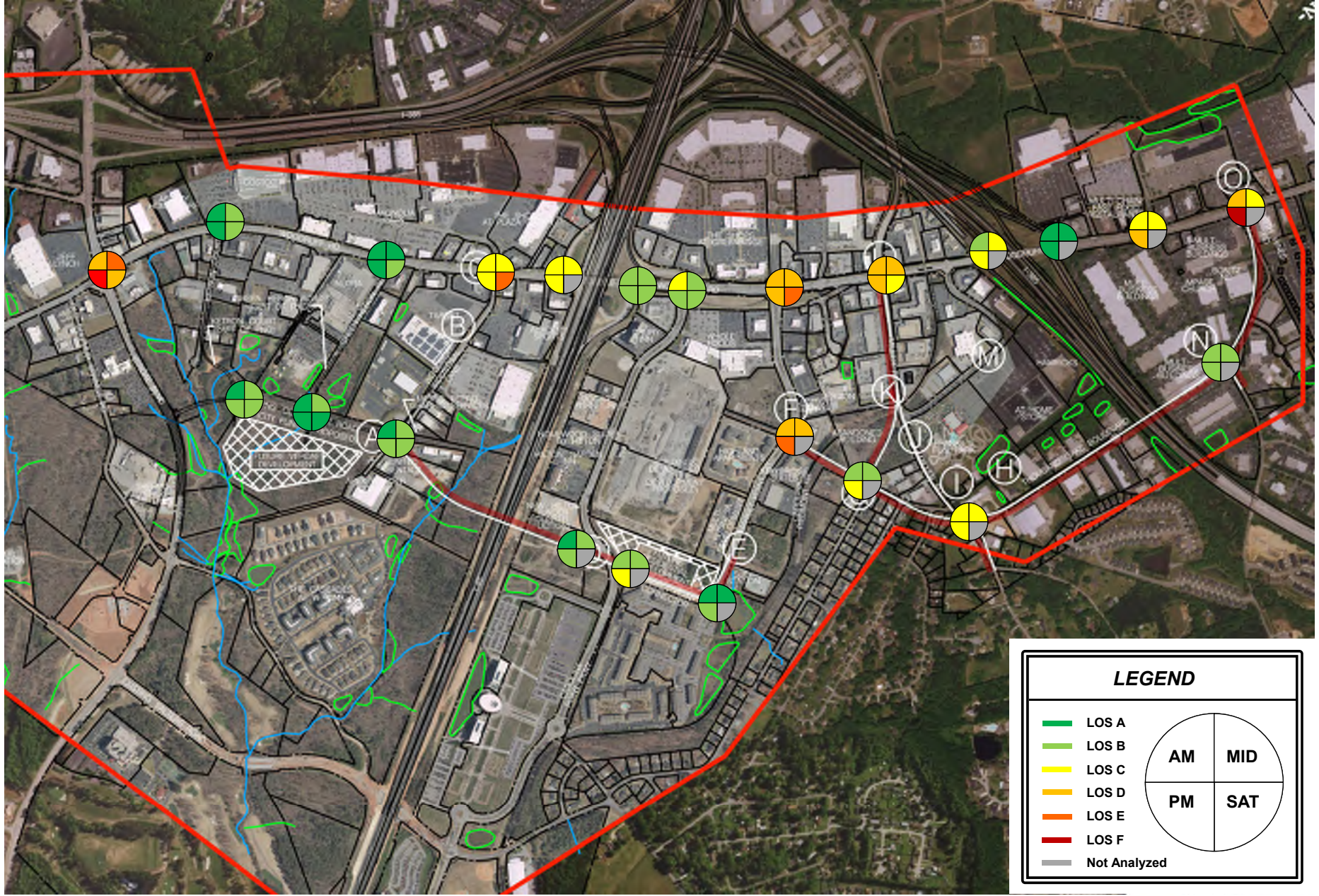


Figure 45

Alternative 6C
Level of Service

Woodruff Road Congestion
Relief Project

Table 13: Level of Service and delay (average seconds per vehicle) Alternative 6C Conditions					
Intersection	Traffic Control¹	AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Woodruff Rd. at Verdae Blvd./Roper Mountain Rd.	S	D (51.5)	E (78.4)	F (91.6)	D (44.7)
Woodruff Rd. at Ketron Ct.	S	A (4.4)	B (14.7)	A (9.9)	B (15.5)
Woodruff Rd. at Green Heron Rd.	S	A (2.0)	A (8.3)	A (8.1)	B (14.6)
Woodruff Rd. at Woodruff Industrial Lane	S	C (23.0)	C (33.4)	C (27.3)	E (56.8)
Woodruff Rd. at I-85 SB	S	C (21.9)	C (28.3)	C (24.5)	N/A
Woodruff Rd. at I-85 NB	S	B (18.0)	B (13.3)	B (17.8)	B (17.0)
Woodruff Rd. at Carolina Point Pkwy.	S	C (23.9)	B (14.3)	B (16.0)	B (13.0)
Woodruff Rd. at Market Point Dr.	S	D (41.6)	D (51.1)	D (40.0)	E (75.9)
Woodruff Rd. at Miller Rd.	S	D (40.9)	D (40.1)	D (39.9)	C (30.0)
Woodruff Rd. at I-385 SB	S	B (15.8)	C (25.5)	C (22.4)	N/A
Woodruff Rd. at I-385 NB	S	A (6.6)	A (6.6)	A (6.6)	N/A
Woodruff Rd. at Merovan Access	S	C (26.5)	C (24.6)	D (39.8)	N/A
PNG Connector at Ketron Ct.	R	A (7.1)	B (11.7)	B (10.5)	B (11.2)
PNG Connector at Green Heron Rd.	R	A (6.3)	B (10.1)	A (9.8)	A (9.4)
PNG Connector/Parallel Rd. at Woodruff Industrial Lane	R	A (8.4)	B (13.7)	B (13.1)	B (13.2)
Parallel Rd. at Carolina Point Pkwy. (West)	R	A (8.9)	B (12.9)	B (14.5)	N/A
Parallel Rd. at Carolina Point Pkwy. (East)	R	B (11.7)	B (14.3)	C (20.0)	N/A

Table 13 (cont.): Level of Service and delay (average seconds per vehicle) Alternative 6C Conditions					
Parallel Rd. at Market Point Dr. (South)	R	A (8.2)	A (9.2)	B (11.1)	N/A
Parallel Rd. at Market Point Dr. (North)	R	D (25.3)	D (30.1)	E (46.2)	N/A
Parallel Rd. at Miller Rd. (North)	R	B (12.3)	B (14.3)	C (17.4)	N/A
Parallel Rd. at Miller Rd. (South)	R	C (16.9)	C (16.4)	C (21.2)	N/A
Parallel Rd. at Smith Hines Rd.	R	B (10.9)	B (10.5)	B (10.8)	N/A
Woodruff Rd. at Parallel Rd.	S	D (37.1)	C (33.3)	F (109.0)	N/A

1. S = Signalized, U = Unsignalized, R = Roundabout
2. N/A = not studied in this scenario

8.7 2045 Alternative 6D Conditions

The 2045 Alternative 6D conditions analysis included the following improvements:

- Improvements as listed in the No Build conditions
- Installation of a DDI at I-85
- Installation of a new five-lane roadway (Parallel Road) from Woodruff Industrial Lane to Smith Hines Road via a new alignment with the closure of the north leg of the intersection of Woodruff Road at Smith Hines Road
- Traffic signal timing optimization at study area signalized intersections

Figure 46 shows the LOS by intersection in the 2045 Alternative 6D conditions.

Table 14 summarizes the LOS and control delay (average seconds of delay per vehicle) for the projected Existing AM, Midday, PM, and Saturday (where applicable) peak hour conditions at the study area intersections. The detailed Synchro output reports are shown in the **Appendix**.

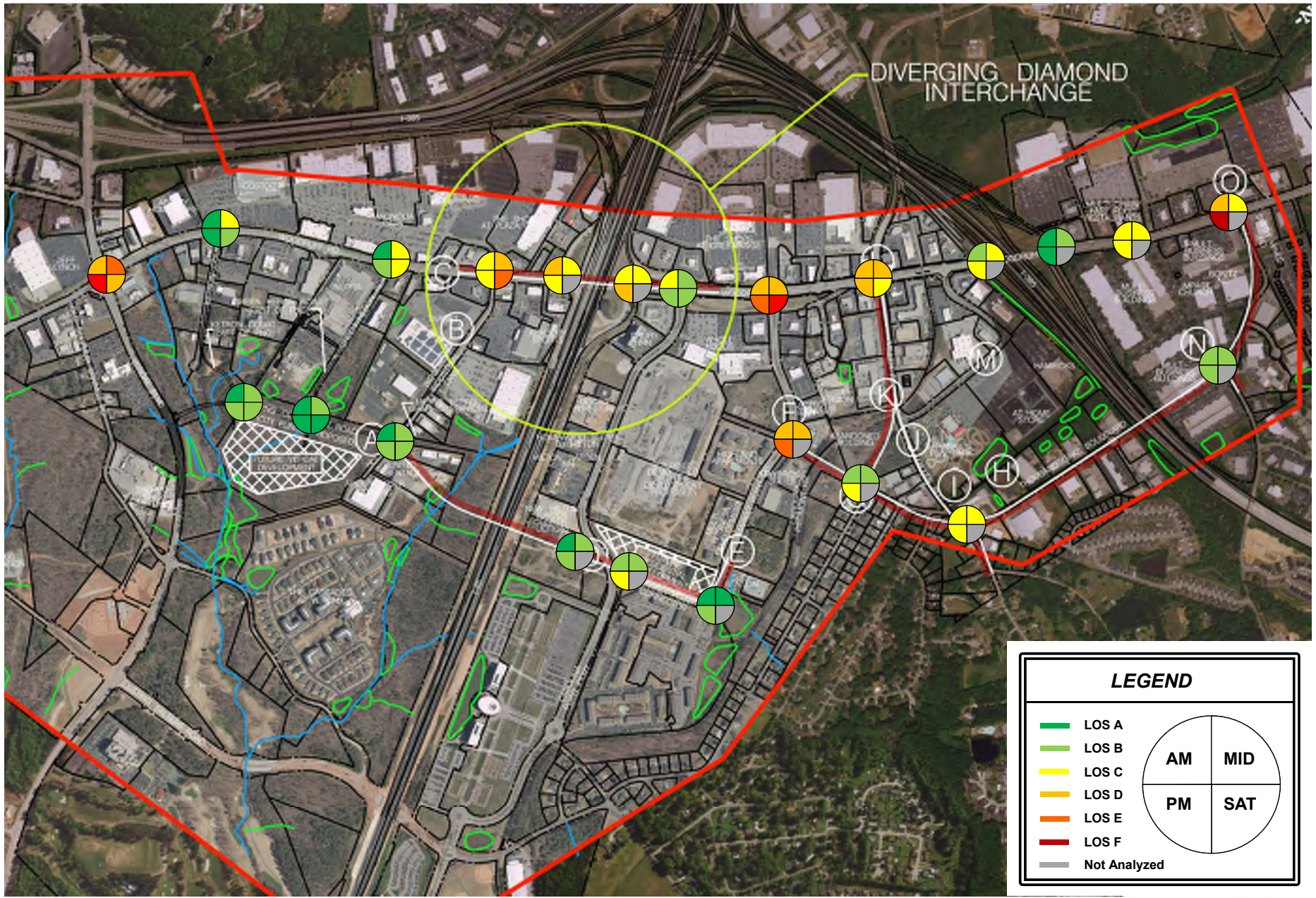


Figure 46

Alternative 6D
Level of Service

Woodruff Road Congestion
Relief Project

**Table 14:
Level of Service and delay (average seconds per vehicle)
Alternative 6D Conditions**

Intersection	Traffic Control¹	AM Peak Hour	Midday Peak Hour	PM Peak Hour	Saturday Peak Hour
Woodruff Rd. at Verdae Blvd./Roper Mountain Rd.	S	D (52.0)	E (78.4)	F (91.7)	D (44.8)
Woodruff Rd. at Ketron Ct.	S	A (4.4)	C (20.4)	A (9.9)	B (15.5)
Woodruff Rd. at Green Heron Rd.	S	A (6.8)	C (20.6)	B (19.9)	C (23.2)
Woodruff Rd. at Woodruff Industrial Lane	S	C (22.5)	D (46.2)	C (33.3)	E (57.0)
Woodruff Rd. at I-85 SB	S	D (36.4)	C (31.3)	C (34.3)	N/A
Woodruff Rd. at I-85 NB	S	C (30.9)	C (28.4)	D (39.8)	N/A
Woodruff Rd. at Carolina Point Pkwy.	S	C (22.0)	B (13.9)	B (15.3)	B (12.2)
Woodruff Rd. at Market Point Dr.	S	D (38.8)	D (54.5)	E (61.2)	F (80.7)
Woodruff Rd. at Miller Rd.	S	D (40.9)	D (40.5)	D (53.3)	C (30.0)
Woodruff Rd. at I-385 SB	S	B (15.8)	C (29.5)	C (25.2)	N/A
Woodruff Rd. at I-385 NB	S	A (6.6)	B (11.3)	A (6.6)	N/A
Woodruff Rd. at Merovan Access	S	C (26.6)	C (24.6)	C (27.7)	N/A
PNG Connector at Ketron Ct.	R	A (7.1)	B (11.7)	B (10.5)	B (11.2)
PNG Connector at Green Heron Rd.	R	A (6.3)	B (10.1)	A (9.8)	A (9.4)
PNG Connector/Parallel Rd. at Woodruff Industrial Lane	R	A (8.4)	B (13.7)	B (13.1)	B (13.2)
Parallel Rd. at Carolina Point Pkwy. (West)	R	A (8.9)	B (12.9)	B (14.5)	N/A
Parallel Rd. at Carolina Point Pkwy. (East)	R	B (11.7)	B (14.3)	C (20.0)	N/A

<p align="center">Table 14 (cont.): Level of Service and delay (average seconds per vehicle) Alternative 6D Conditions</p>					
Parallel Rd. at Market Point Dr. (South)	R	A (8.2)	A (9.2)	B (11.1)	N/A
Parallel Rd. at Market Point Dr. (North)	R	D (25.3)	D (30.1)	E (46.2)	N/A
Parallel Rd. at Miller Rd. (North)	R	B (12.3)	B (14.3)	C (17.4)	N/A
Parallel Rd. at Miller Rd. (South)	R	C (16.9)	C (16.4)	C (21.2)	N/A
Parallel Rd. at Smith Hines Rd.	R	B (10.9)	B (10.5)	B (10.8)	N/A
Woodruff Rd. at Parallel Rd.	S	D (40.4)	C (33.3)	F (122.3)	N/A

1. S = Signalized, U = Unsignalized, R = Roundabout
2. N/A = not studied in this scenario

In the 2045 Alternative 6D conditions, the overall traffic operations are expected to improve from the 2045 No Build conditions. Most intersections along the corridor are projected to operate at LOS D or better with the exceptions of Woodruff Road at Verdae Boulevard/Roper Mountain Road during the Midday and PM peak hour conditions, Woodruff Road at Market Point Drive during the PM and Saturday peak hour conditions, Woodruff Road at Woodruff Industrial Lane during the Saturday peak hour conditions, and Woodruff Road at the Parallel Road during the PM peak hour conditions. Installation of the DDI at the I-85 interchange is projected to improve traffic operations at the intersections of Woodruff Road at I-85 SB during the Midday and PM peak hours and at Woodruff Road at I-85 NB during the Am and Midday peak hours.

Intersections along the PNG Connector and Parallel Roadway are projected to operate at LOS A – LOS D with the exception of the Parallel Road at Market Point Drive (North) during the PM peak hour.

Overall traffic operations in the 2045 Alternative 6D conditions (AM, Midday and PM peak hour conditions) are projected to improve conditions in 22 cases, have similar results in 17 cases and degrade conditions in 9 cases when compared to the No Build conditions. In cases where intersections are projected to degrade, in two instances, the intersection is projected to operate at LOS E or LOS F. Otherwise, the intersections are operating at LOS D or better.

8.8 Intersection Analysis Summary

Table 15 shows a summary comparison of the alternatives. There are 16 intersections along Woodruff Road studied for each alternative. The AM, Midday and PM peak hour results were reviewed for each alternative for a review of 48 total intersections. A detailed comparison is included in the **Appendix**.

Alternative	Improve	Similar	Degrade	Total
2045 Alternative 1	16 (33%)	20 (42%)	12 (25%)	48 (100%)
2045 Alternative 2C	22 (46%)	15 (31%)	11 (23%)	48 (100%)
2045 Alternative 3C	25 (52%)	13 (27%)	10 (21%)	48 (100%)
2045 Alternative 6C	25 (52%)	16 (33%)	7 (15%)	48 (100%)
2045 Alternative 6D	22 (46%)	17 (35%)	9 (19%)	48 (100%)

In general, the projected intersection levels of service for the 2045 No Build conditions degrade from the Existing conditions. The 2045 Build Alternatives results generally improve study area intersection conditions from the 2045 No Build conditions, with Alternative 6C having the greatest number of improved intersections (52%) and the fewest number of degraded intersections (15%) when compared to the 2045 No Build conditions. Alternative 6D has similar results to Alternative 6C with three fewer improved locations and two more degraded locations.

8.9 Arterial Analysis

Arterial analysis was performed for the Woodruff Road corridor for the AM, Midday, and PM peak hour conditions for the Existing, 2045 No Build, and Build Alternatives. Saturday was not included because a limited number of intersection counts were collected. The arterial analysis level of service describes the average travel speed on a corridor. Travel speed along the corridor considers intersection delay and travel time vehicles experience when traveling on Woodruff Road. The Woodruff Road corridor from Ketron Court to Smith Hines Road was reviewed. The intersections of Woodruff Road at I-85 Southbound On-Ramp/Off-Ramp and Woodruff Road at I-85 Northbound On-Ramp/Off-Ramp were not included in the arterial analysis; therefore, Woodruff Road was broken into two sections, east and west of the I-85 DDI. Overall corridor speeds were calculated using the projected speed and distance to develop eastbound and westbound

estimated roadway speeds by alternative. **Table 16** shows the level of service ranges by corridor speed.

Level of Service	Average Travel Speed (miles per hour)
LOS A	> 35
LOS B	>28 – 35
LOS C	>22 – 28
LOS D	>17 – 22
LOS E	>13 – 17
LOS F	≤13

Source: 2000 HCM, Transportation Research Board, 2000

Table 17 shows the projected Woodruff Road corridor speeds and a comparison of the arterial travel speeds for the Existing, 2045 No Build, and the 2045 Build Alternatives conditions during the AM, Midday, and PM peak hours.

Peak Hour	2017 Existing Conditions	2045 No Build Conditions	2045 Alt 1 Conditions	2045 Alt 2C Conditions	2045 Alt 3C Conditions	2045 Alt 6C Conditions	2045 Alt 6D Conditions
EB Woodruff Road							
AM Peak Hour	D (18.1)	F (10.5)	E (16.3)	D (17.3)	D (18.6)	D (18.6)	D (18.4)
Midday Peak Hour	D (17.6)	F (11.9)	F (12.9)	F (12.9)	E (16.1)	E (16.1)	E (16.6)
PM Peak Hour	E (16.6)	F (9.5)	E (14.2)	E (13.3)	E (13.8)	E (15.4)	E (15.4)
WB Woodruff Road							
AM Peak Hour	E (15.4)	E (13.1)	E (15.9)	E (15.1)	D (18.1)	D (19.2)	D (19.5)
Midday Peak Hour	E (14.2)	F (11.5)	F (11.4)	E (13.5)	E (14.0)	E (16.3)	D (17.3)
PM Peak Hour	E (15.5)	E (13.1)	F (12.2)	E (15.2)	E (16.0)	E (16.7)	E (16.5)

The average speeds on Woodruff Road in the Existing conditions ranged from 14 – 18 mph with levels of service of LOS D and E. In the 2045 No Build conditions, the average speeds decrease to 9 – 13 mph at LOS E and F. All of the alternatives improve average speed from the 2045 No Build conditions, with the improvements for Alternative 1 increasing average speeds to 11 – 16 mph at LOS E and F, the improvements for Alternative 2C increasing average speeds to 13 – 17 mph at LOS D – F, the improvements for Alternative 3C increasing average speeds to 13 – 19 at LOS D and E, the improvements for Alternative 6C increasing average speeds to 15 – 19 at LOS D and E, and the improvements for Alternative 6D increasing average speeds to 15 – 19 mph at LOS D and E.

In summary, Alternative 6D had the highest projected average travel speed during the AM peak hour while Alternative 1 had the lowest projected average travel speed. Alternative 6C results in the smallest range of projected average speeds with operations of LOS D and LOS E.

8.10 Performance Index by Alternative

Performance index is an operations metric calculated using the total delay (control and queue delay) in seconds and the vehicle stops in vehicles per hour using the following equation. A lower performance index indicates better corridor operations. **Table 18** shows the performance index by alternative.

$$\text{Performance Index} = [Total Delay * 1 + Number of Vehicle Stops * 10]/3600$$

Table 18: Performance Index – Woodruff Road							
Peak Hour	2017 Existing Conditions	2045 No Build Conditions	2045 Alt 1 Conditions	2045 Alt 2C Conditions	2045 Alt 3C Conditions	2045 Alt 6C Conditions	2045 Alt 6D Conditions
AM Peak Hour	294.2	837.5	471.1	373.6	348.9	262.7	287.0
Midday Peak Hour	386.0	1,041.2	768.1	609.2	414.4	383.9	330.3
PM Peak Hour	445.2	931.9	763.8	580.4	545.4	488.3	478.0

The performance index is projected to increase from the Existing conditions (approximately 300 – 450) to the 2045 No Build conditions (approximately 850 – 1,050). The performance index improves for all 2045 Build Alternatives compared to the No Build conditions; the Alternative 1 performance index ranges from approximately 475 – 775, the Alternative 2C performance index ranges from approximately 375 – 600, the Alternative 3C performance index ranges from approximately 350 – 550, the Alternative 6C performance index ranges from approximately 250 – 500, and the Alternative 6D performance index ranges from approximately 275 – 475.

In summary, Alternative 6C has the lowest overall performance index while Alternative 1 has the highest performance index.

8.11 Corridor Summaries by Alternative

The following sections summarize the Woodruff Road and PNG Connector/Parallel Roadway corridor analysis results for each alternative.

8.11.1 Existing Conditions

Woodruff Road Corridor from Mall Connector Road to Smith Hines Road

As stated previously, the Woodruff Road corridor is currently heavily congested during peak conditions. Queuing occurs at intersection turn lanes and through lanes along the corridor causing spillback issues impacting the overall flow of Woodruff Road. In addition, this congestion is causing a metering effect of the traffic along the corridor and therefore the operations shown in **Table 8** are better than what is experienced in everyday traffic.

Some of the unsignalized intersections operate at LOS E or LOS F, this is not uncommon for minor intersections on major intersections such as Woodruff Road to experience higher levels of delay when the major corridor experiences little to no delay.

The arterial analysis shows Woodruff Road operating at LOS D and LOS E with a performance index of 300 – 450.

8.11.2 2045 No Build Alternative

Woodruff Road Corridor from Verdae Boulevard/Roper Mountain Road to Smith Hines Road

As shown in **Table 9**, the Woodruff Road corridor is expected to continue to experience congestion during peak conditions in the 2045 No Build conditions. It is expected that queueing will continue to cause spillback issues along the corridor, impacting the overall flow of Woodruff Road. Congestion along the corridor is expected to continue to cause a metering effect of the traffic along the corridor and therefore operations in **Table 9** could be showing better operations than what would be experienced in everyday traffic.

In general, the 2045 No Build conditions most of the signalized intersections along the corridor are projected to operate worse than in the Existing conditions.

The arterial analysis shows Woodruff Road operating at LOS E and LOS F with a performance index of 850 – 1,050.

PNG Connector Corridor from Verdae Boulevard to Woodruff Industrial Lane

The roundabouts located at PNG Connector at Ketron Court and PNG Connector at Green Heron Road are projected to operate at LOS C or better during all peak hours.

8.11.3 2045 Alternative 1

Woodruff Road Corridor from Verdae Boulevard/Roper Mountain Road to Smith Hines Road

As shown in **Table 10**, the Woodruff Road corridor is expected to continue to experience some congestion during peak conditions in the 2045 Alternative 1 conditions. Although the corridor is expected to experience elevated delay at some intersections along the corridor at some peak hours, the overall operations of the corridor are projected to be better than traffic operations during the 2045 No Build conditions. The arterial analysis shows Woodruff Road operating at LOS E and LOS F with a performance index of approximately 475 – 775.

PNG Connector Corridor from Verdae Boulevard to Woodruff Industrial Lane

The roundabouts located at PNG Connector at Ketron Court and PNG Connector at Green Heron Road are projected to operate acceptably during all peak hours. Improvement of the intersection of PNG Connector at Woodruff Industrial Lane into a roundabout is projected to improve the traffic operations with the roundabout.

8.11.4 2045 Alternative 2C

Woodruff Road Corridor from Verdae Boulevard/Roper Mountain Road to Smith Hines Road

As shown in **Table 11**, the Woodruff Road corridor is expected to continue to experience some congestion during peak conditions in the 2045 Alternative 2C conditions. Although the corridor is expected to experience elevated delay at some intersections along the corridor at some peak hours, the overall operations of the corridor are projected to be better traffic operations than during the 2045 No Build conditions. The arterial analysis shows Woodruff Road operating at LOS D – LOS F with a performance index or approximately 375 – 600.

PNG Connector/Parallel Road Corridor from Verdae Boulevard to Woodruff Industrial Lane

As shown in **Table 11**, the roundabouts along the PNG Connector/Parallel Road Corridor are projected to operate acceptably during all peak hours in the 2045 Alternative 2C conditions.

8.11.5 2045 Alternative 3C

Woodruff Road Corridor from Verdae Boulevard/Roper Mountain Road to Smith Hines Road

As shown in **Table 12**, the Woodruff Road corridor is expected to continue to experience some congestion during peak conditions in the 2045 Alternative 2C conditions. Although the corridor is expected to experience elevated delay at some intersections along the corridor at some peak hours, the overall operations of the corridor are projected to be higher than traffic operation during the 2045 No Build conditions. The arterial analysis shows Woodruff Road operating at LOS D and LOS E with a performance index of approximately 350 – 550.

PNG Connector/Parallel Road Corridor from Verdae Boulevard to Woodruff Industrial Lane

As shown in **Table 12**, the roundabouts along the PNG Connector/Parallel Road Corridor are projected to operate acceptably during all peak hours in the 2045 Alternative 3C conditions.

8.11.6 2045 Alternative 6C

Woodruff Road Corridor from Verdae Boulevard/Roper Mountain Road to Smith Hines Road

As shown in **Table 13**, the Woodruff Road corridor is expected to continue to experience some congestion during peak conditions in the 2045 Alternative 6C conditions. Although the corridor is expected to experience elevated delay at some intersections along the corridor at some peak hours, the overall operations of the corridor are projected to be better than traffic operation during the 2045 No Build conditions. The arterial analysis shows Woodruff Road operating at LOS D and LOS E with a performance index of 250 – 500.

PNG Connector/Parallel Road Corridor from Verdae Boulevard to Woodruff Industrial Lane

As shown in **Table 13**, the roundabouts along the PNG Connector/Parallel Road Corridor are projected to operate acceptably during all peak hours in the 2045 Alternative 6C conditions with the exception of the intersection of the Parallel Road at Market Point Drive(North) during the PM peak hour conditions.

8.11.7 2045 Alternative 6D

Woodruff Road Corridor from Verdae Boulevard/Roper Mountain Road to Smith Hines Road

As shown in **Table 14**, the Woodruff Road corridor is expected to continue to experience some congestion during peak conditions in the 2045 Alternative 6D conditions. Although the corridor is

expected to experience elevated delay at some intersections along the corridor at some peak hours, the overall operations of the corridor are projected to be better than traffic operations during the 2045 No Build conditions. The arterial analysis shows Woodruff Road operating at LOS D and LOS E with a performance index of 275 – 475.

PNG Connector/Parallel Road Corridor from Verdae Boulevard to Woodruff Industrial Lane

As shown in **Table 14**, the roundabouts along the PNG Connector/Parallel Road Corridor are projected to operate acceptably during all peak hours in the 2045 Alternative 6D conditions with the exception of the Parallel Road at Market Point Drive (North) during the PM peak hour conditions.

9.0 Other Corridor Improvement Considerations

In addition to the geometric improvements for the study area intersections as part of the Build Alternatives, other corridor improvements should be considered to further improve corridor operations. These may include but are not limited to additional signal improvements and access management along the corridor. A number of these items were documented in the August 2017 *Greenville County Road Safety Assessment: SC 146 (Woodruff Road) from MP 1.9 – 5.0* by AECOM which encompasses the project study area.

9.1 Traffic Signal Upgrades

As stated previously, adaptive signal timing is being installed along the corridor. This will allow the traffic signal system to respond and adapt to current conditions rather than rely on a set signal timing plan, thereby improving the efficiency of the traffic signal system.

In addition, where appropriate, flashing yellow arrow signal heads should be considered per SCDOT and Federal Highway Administration (FHWA) standards. This will also preserve consistency along the corridor as any traffic signals that are upgraded as part of the Build Alternatives will be required to use flashing yellow arrows.

In addition, where appropriate, pedestrian facilities should be upgraded to the current standards.

9.2 Results of 2017 Road Safety Assessment

The following improvements were recommended as part of the Road Safety Assessment (AECOM, 2017) to improve corridor conditions:

- Install a concrete median on Woodruff Road that forces vehicles exiting the Shoppes at Greenridge (the new right-in / right-out unsignalized driveway) to the I-85 NB On Ramp

- Install overhead lane assignment signs on the Carolina Point Parkway approach to Woodruff Road
- Install a concrete median on Woodruff Road that extends from Market Point Drive to Miller Road/Garlington Road
- Install a concrete median on Woodruff Road that extends to Miller Road/Garlington Road to I-385 Off Ramp

Other recommended improvements included the installation of backplates at all traffic signals, installation of a flashing yellow arrow at Woodruff Road at Merovan Access, installation of countdown pedestrian heads and crosswalks on the corridor where they are missing and improvement of pedestrian components at the intersections to be Americans with Disabilities Act compliant.

9.3 Access Management

Access management is the control of access points along the corridor to limit the traffic movements and improve traffic flow, primarily by reducing conflict points along the corridor. Access management can be in the form of driveway and access spacing, median treatments to manage traffic coupled with the development of improved turn lanes with accessible areas for U-turns, or similar.

SCDOT provides access management guidelines in the Access and Roadside Management Standards (ARMS) manual. The minimum driveway spacing guideline of 220 feet is given for 35 mph roadways with an AADT greater than 2,000 vehicles.

Installation of medians is also considered a safety measure. Reducing conflict points and confining turning movements to signalized intersections typically results in a reduction of crash rates along corridors where access management is implemented. Where feasible, median installation in the commercial areas of Woodruff Road are recommended.

Many businesses are concerned that access management will make it more difficult for customers to access their businesses. However, FHWA notes that ““Before and after” studies of businesses in Florida, Iowa, Minnesota, and Texas along highways where access has been managed found that the vast majority of businesses do as well or better after the access management projects are completed.”

9.4 Sight Distance, Pavement Markings and Signage

As the 2045 Build Alternatives are further developed in the design phase, the intersection sight distance, pavement markings and signage should be reviewed and designed to the SCDOT and Manual on Uniform Traffic Control Devices (MUTCD) standards.

10.0 Summary

The proposed Woodruff Road Congestion Relief project is located in Greenville County, South Carolina. The project extends along Woodruff Road from Verdae Boulevard/Roper Mountain Road to Smith Hines Road. The Woodruff Road Congestion Relief Project will consist of a two- or four-lane, limited access new location roadway with a multi-use path. The study area for the Existing conditions also includes Woodruff Road from Mall Connector Road to Verdae Boulevard/Roper Mountain Road.

The study reviews the Existing conditions, the future 2045 No Build conditions, and the future 2045 Build Alternatives conditions.

The Woodruff Road corridor is a highly travelled corridor which currently experiences high levels of congestion during peak times. Peak travel times occur during the AM peak hour, lunchtime – Midday peak hour, and PM peak hour as well as the Saturday peak hour. Due to the high level of commercial activity along the corridor, the Midday peak hour is sometimes higher than the PM peak hour and Saturdays also experience peak times. During peaks there are sometimes queuing issues throughout the corridor where the demand for the turn lanes exceeds the available storage. This causes intermittent queuing, which further affects the traffic flow and operations of the corridor. At some locations during peak periods, travel demand at an intersection exceeds the available queuing distance between intersections causing queue spillback to the adjacent intersection. This causes the traffic to be metered through the project intersections as vehicles travel through the corridor.

A review of the 2045 Build Alternatives results in improvements beyond the 2045 No Build conditions. Alternative 6C has the greatest number of improved intersections and the fewest number of degraded intersections when compared to the 2045 No Build conditions. Alternative 6D operates similarly to Alternative 6C with three fewer improved intersections and two more degraded locations.

Alternative 6D had the highest projected average travel speed during the AM peak hour while Alternative 1 had the lowest projected average travel speed. Alternative 6C results in the smallest range of projected average speeds with operations of LOS D and LOS E.

The Woodruff Road performance index (an operations metric calculated using the total delay (control and queue delay) and the vehicle stops per hour) resulting in Alternative 6C operating better with the lowest performance index while Alternative 1 has the highest performance index.

In summary, all 2045 Build Alternatives result in better operations for the No Build with Alternatives 3C, 6C and 6D performing the best based on projected intersection operations, Woodruff Road arterial analysis and Woodruff Road performance index.