

Interchange Justification Report

I-77 and Panthers Development

I-77 Exit 81

Rock Hill, York County, South Carolina

Prepared for:



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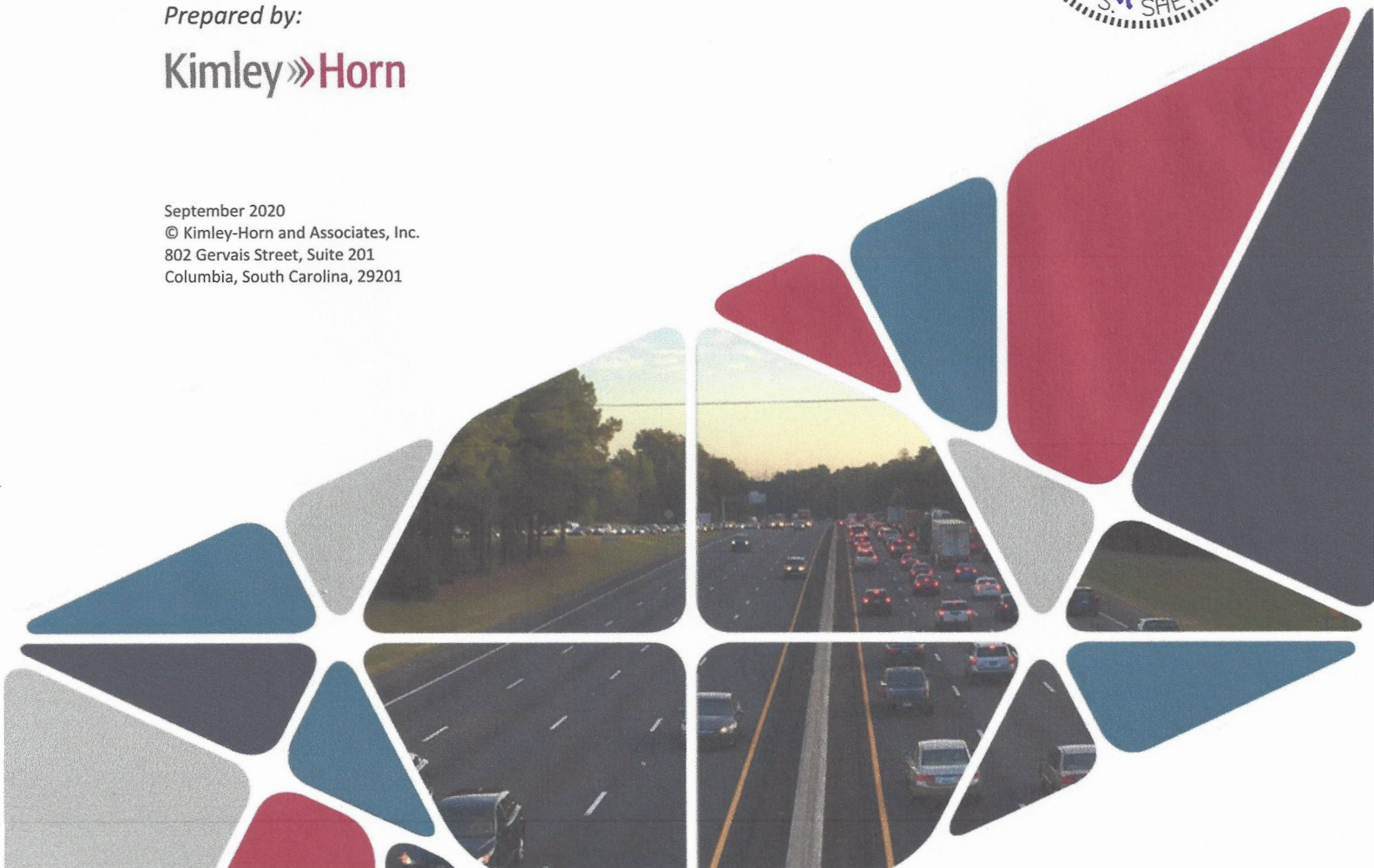


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1 Introduction

The purpose of this report is to document an Interchange Justification Report (IJR) for the proposed I-77 and One Carolina Drive interchange in York County, South Carolina in accordance with Federal Highway Administration (FHWA) and South Carolina Department of Transportation (SCDOT) guidelines. This IJR analysis evaluates the impacts of a new interchange near mile marker 81 on I-77 to serve the traffic associated with the new development, as well as to serve existing and future traffic within the study area via a new interstate access point. This report summarizes the procedures and findings of the selection of the study area, analysis hours, traffic volume development for the design years, capacity analysis results, and responses to the FHWA policy requirements for access to the interstate system.

1.1 Project Background

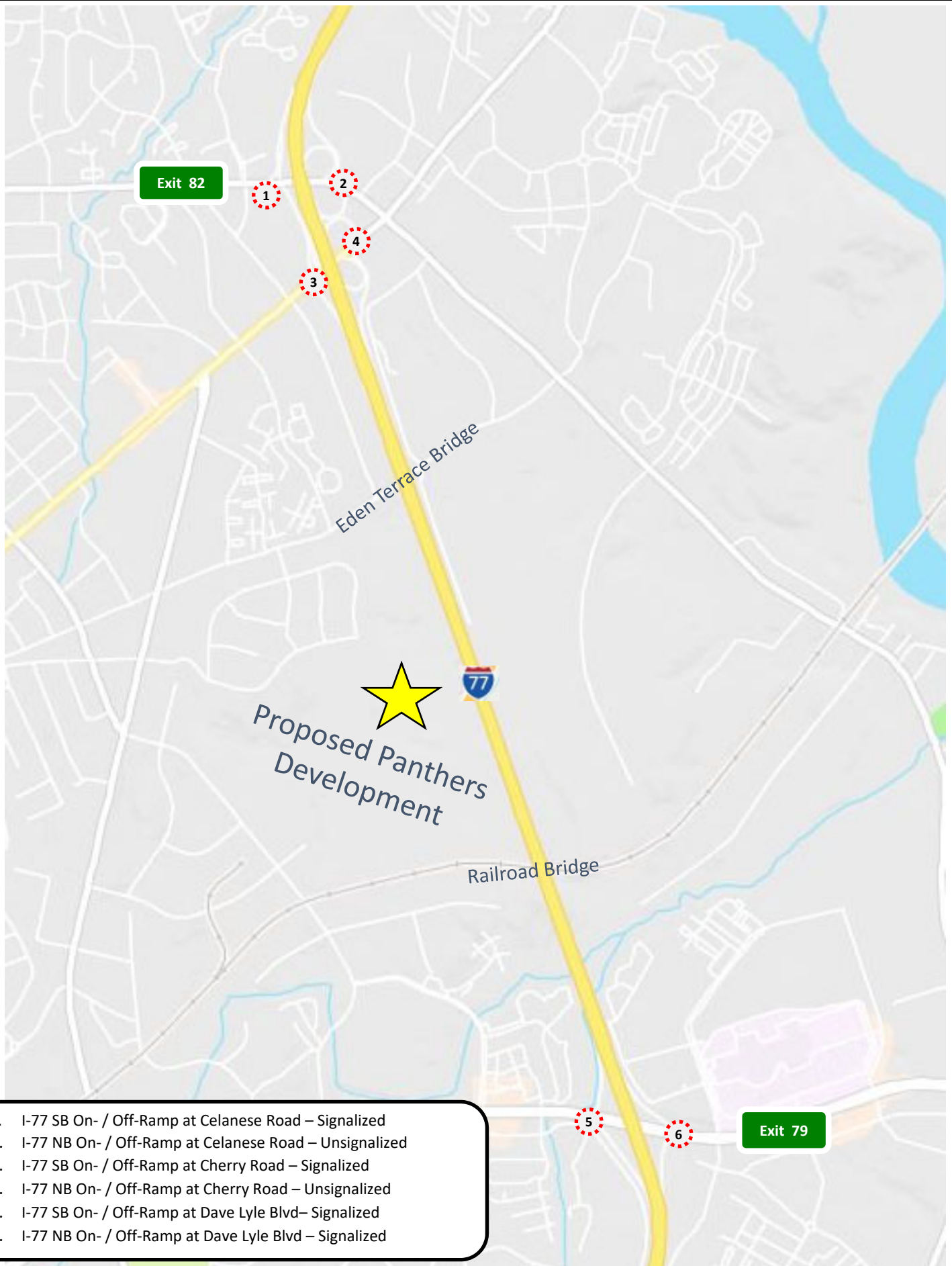
The Carolina Panthers have recently selected a site on which to locate their practice facility and team headquarters in the City of Rock Hill, York County, South Carolina. Furthermore, the site will consist of commercial mixed-use land uses including residential, retail, dining, lodging, and office space. The proposed development is located on an undeveloped property on the west side of I-77 near mile marker 81, between Exit 82 US 21 (Cherry Road)/US 161 (Celanese Road) on the north end and Exit 79 SC 122 (Dave Lyle Boulevard) on the south end.

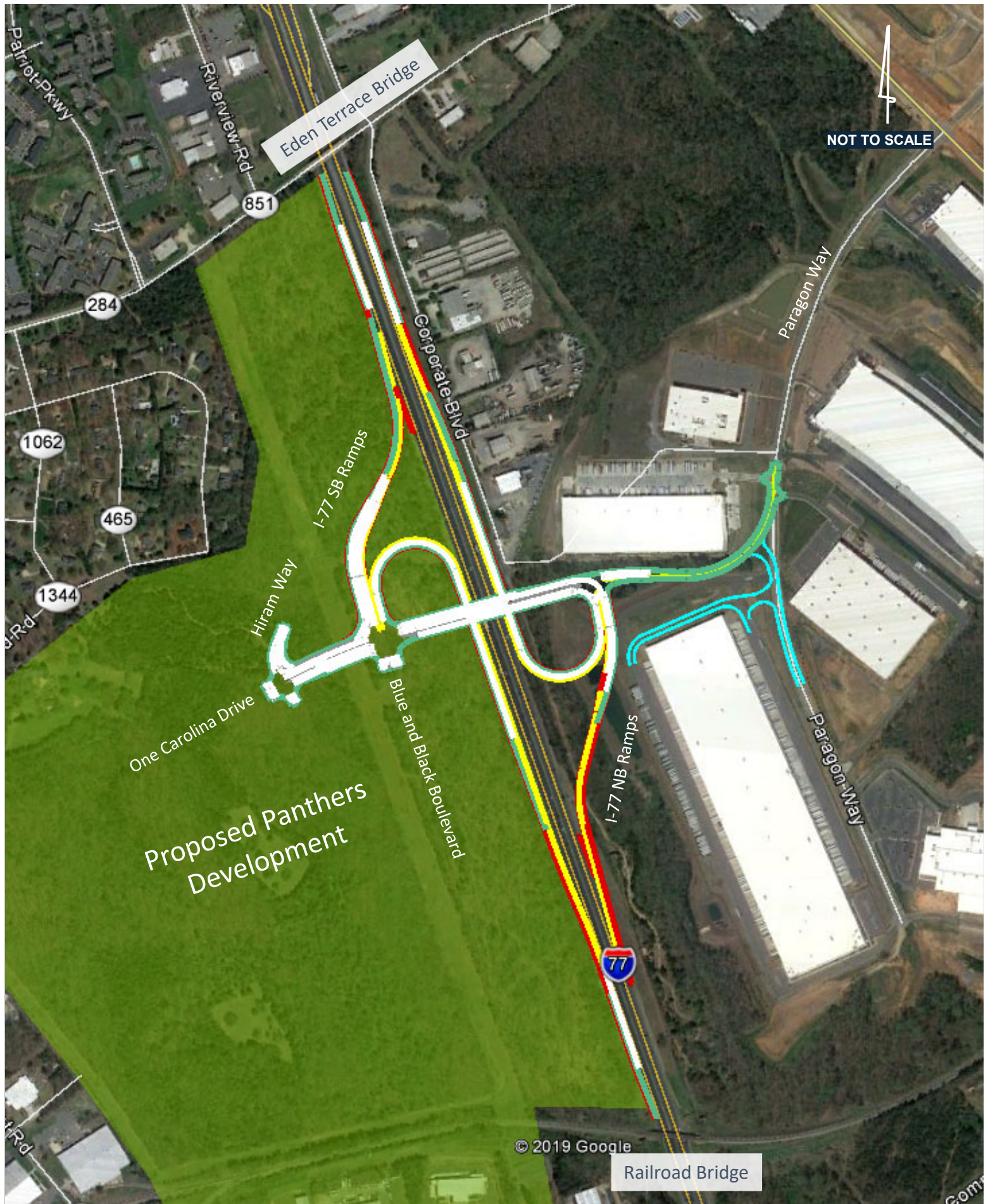
As part of this development, a new east/west crossing route (One Carolina Drive) will be constructed to connect the Panthers development to I-77, as well as to Paragon Way and Mt. Gallant Road on the east and west sides of the interstate, respectively. The new roadway will be functionally classified as an Urban Major Collector.

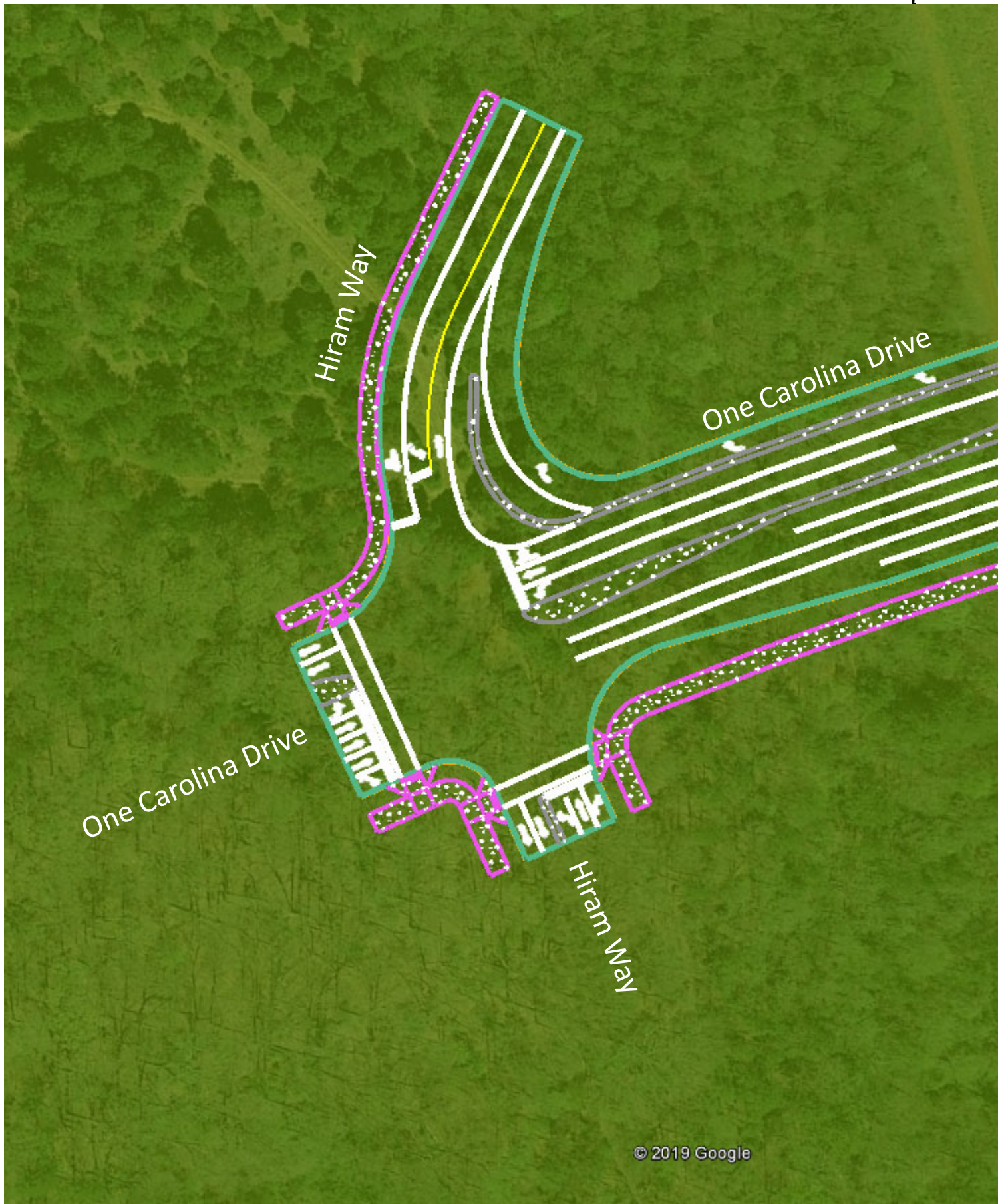
The proposed I-77 and One Carolina Drive interchange location is approximately 1 mile south of the I-77 Exit 82 US 21 (Cherry Road)/US 161 (Celanese Road) interchange, and approximately 1.3 miles north of the I-77 Exit 79 SC 122 (Dave Lyle Boulevard) interchange. The proposed I-77 and One Carolina Drive interchange configuration is a Partial Cloverleaf E, which has two quadrants (southeast and northwest) that include off-ramps and dual-lane loop on-ramps providing for all interchange movements.

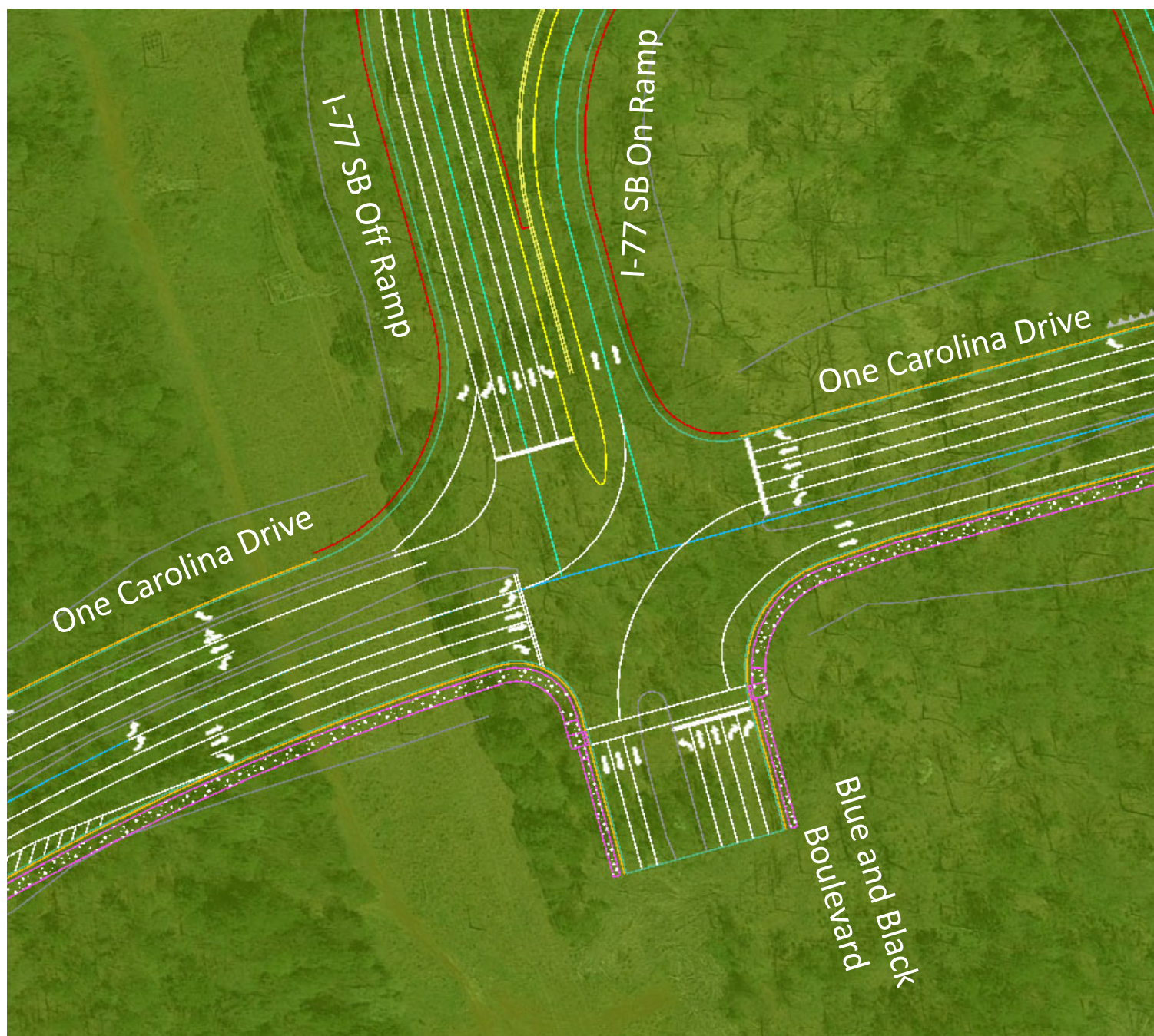
Within York County, I-77 serves as the primary north-south corridor providing access to the Charlotte Metropolitan Service Area (MSA), which is the largest MSA within the State of North Carolina that also encompasses portions of York County and Lancaster County in South Carolina. Due to the close proximity of York County to the employment and service area of Charlotte, the Town of Fort Mill and the City of Tega Cay, along with the urbanized areas of York County, have experienced sustained growth for more than 20 years. Between the 2000 and 2010 census, York County experienced a 37.4% increase in population from 164,641 to 226,073 residents. Based on U.S. Census estimates, from 2010 to 2018, the Town of Fort Mill has grown by 71.5%, the City of Tega Cay by 39.6%, and York County by 21.3%.

The location of the One Carolina Drive interchange and spacing to adjacent interchanges is provided in Figure 1 and a figure illustrating a conceptual plan for the proposed interchange is shown in Figure 2A, with more detailed intersection laneage shown in Figure 2B through D. Figure 3A through F provide the conceptual signing plan for the proposed interchange.









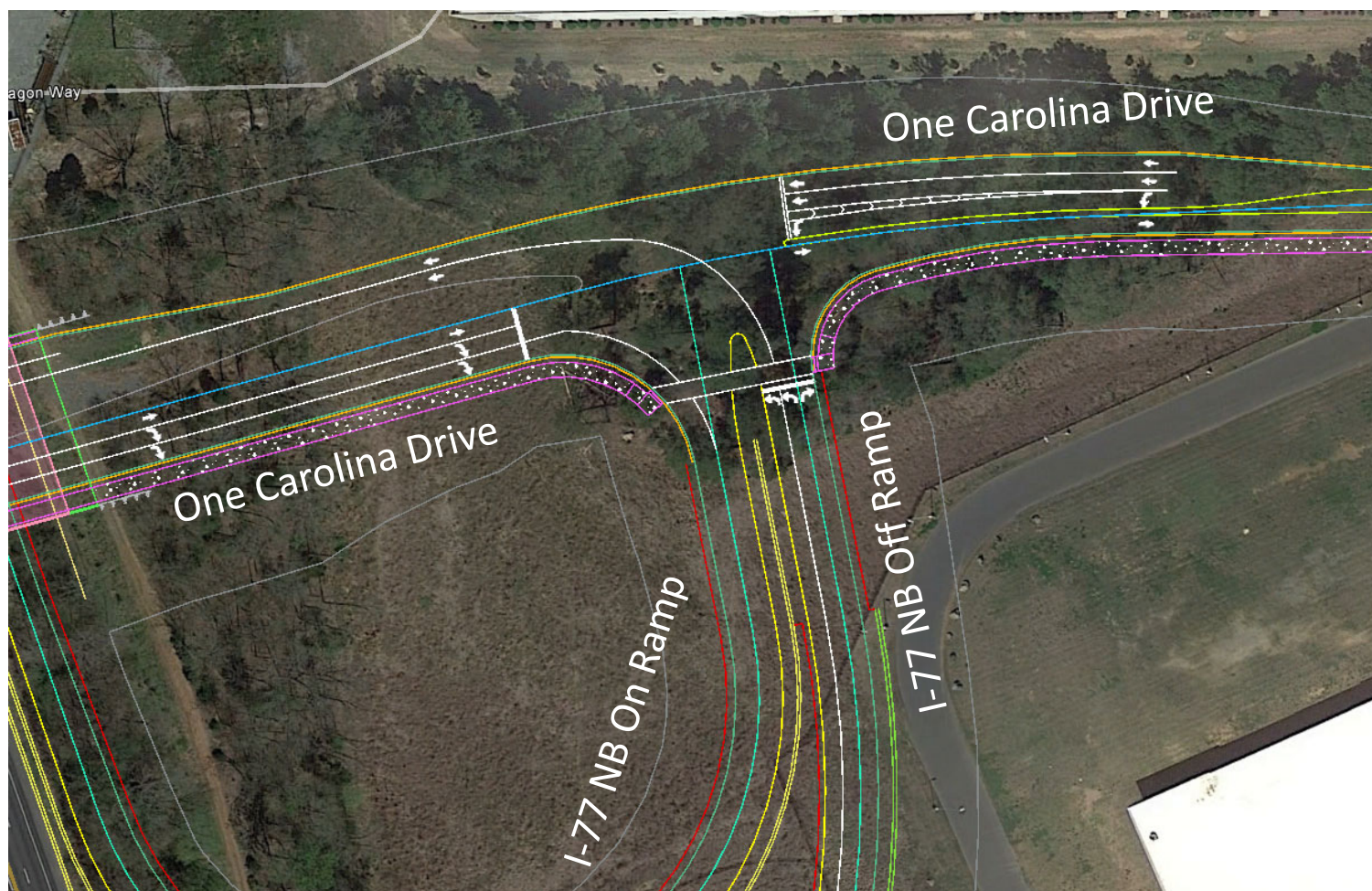
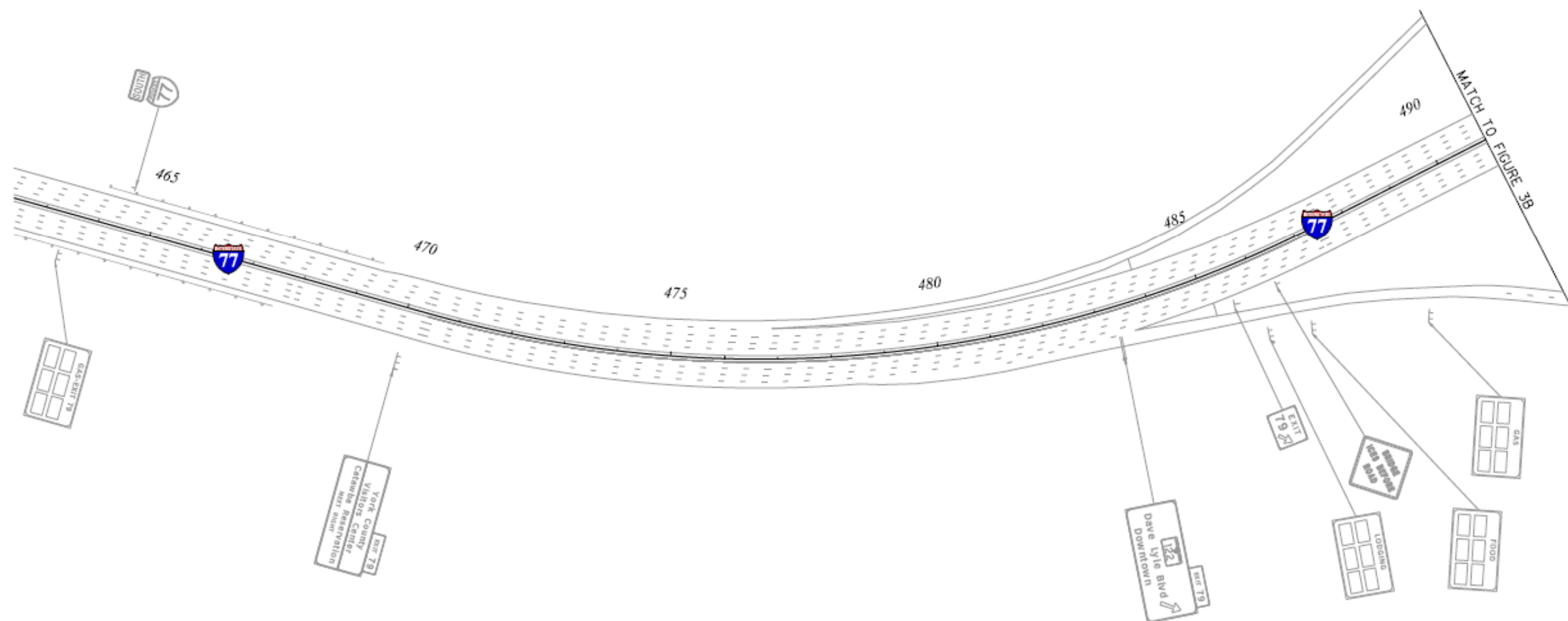


FIGURE 3A



SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
COLUMBIA, S.C.

CONCEPTUAL
SIGNING PLAN

SCALE 1" = 200'

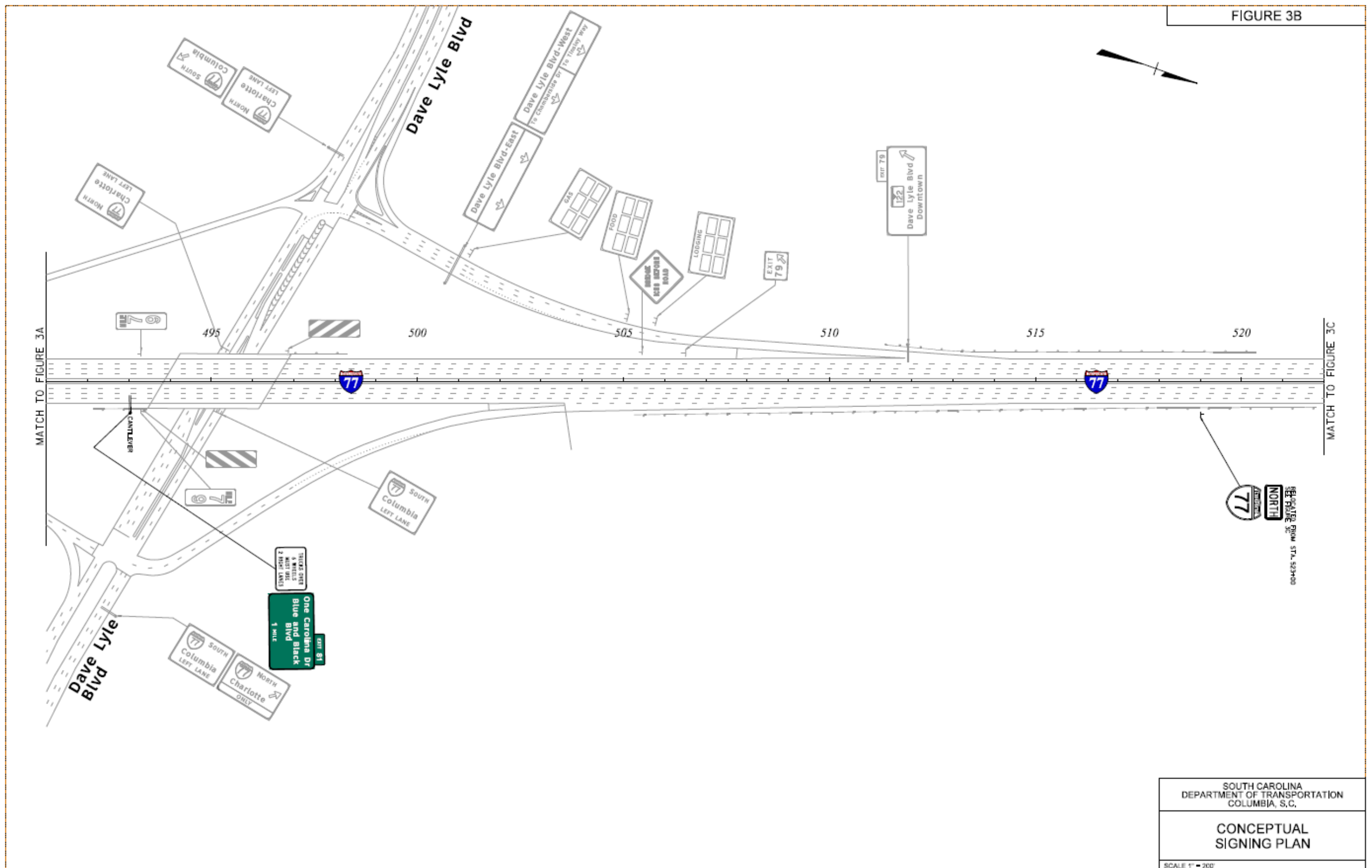
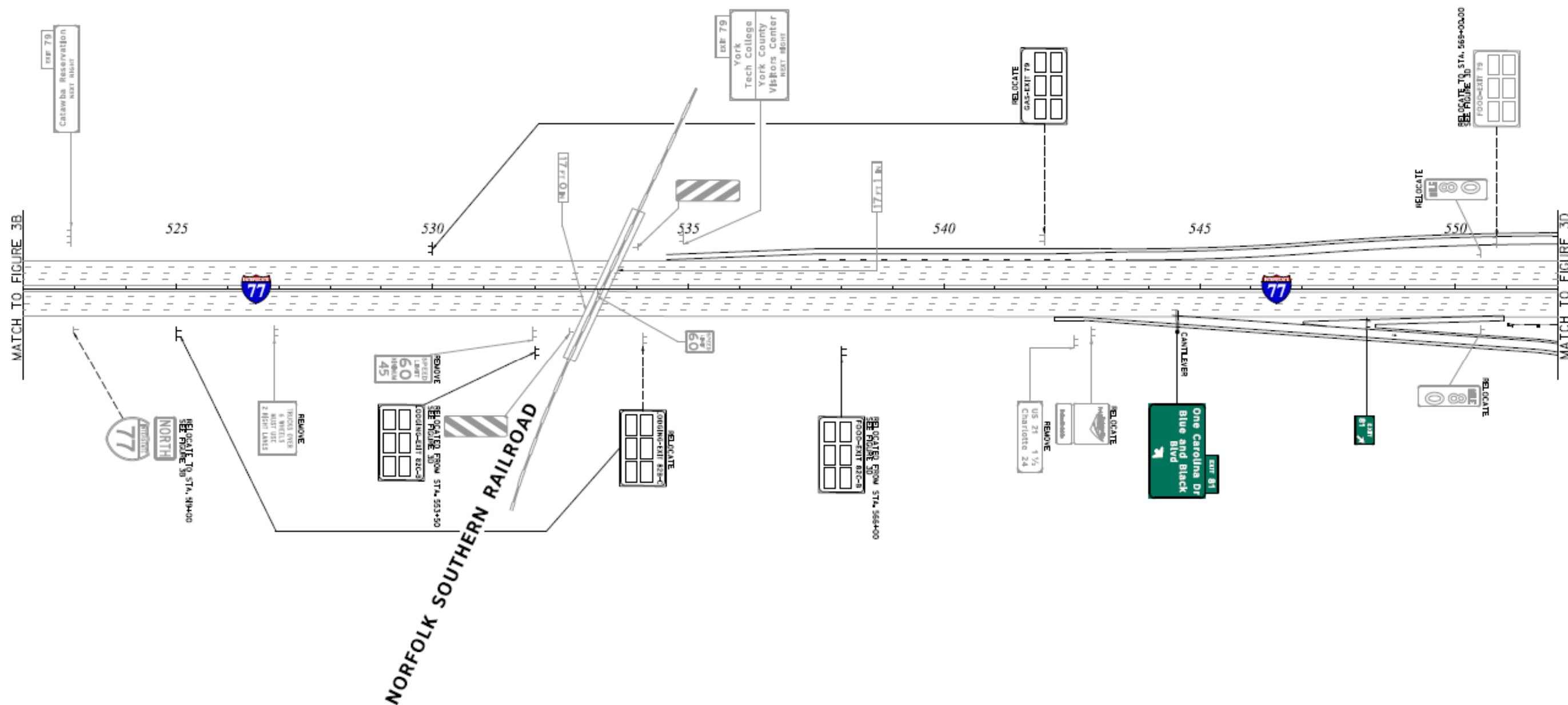


FIGURE 3C



SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
COLUMBIA, S.C.

CONCEPTUAL
SIGNING PLAN

SCALE 1" = 200'

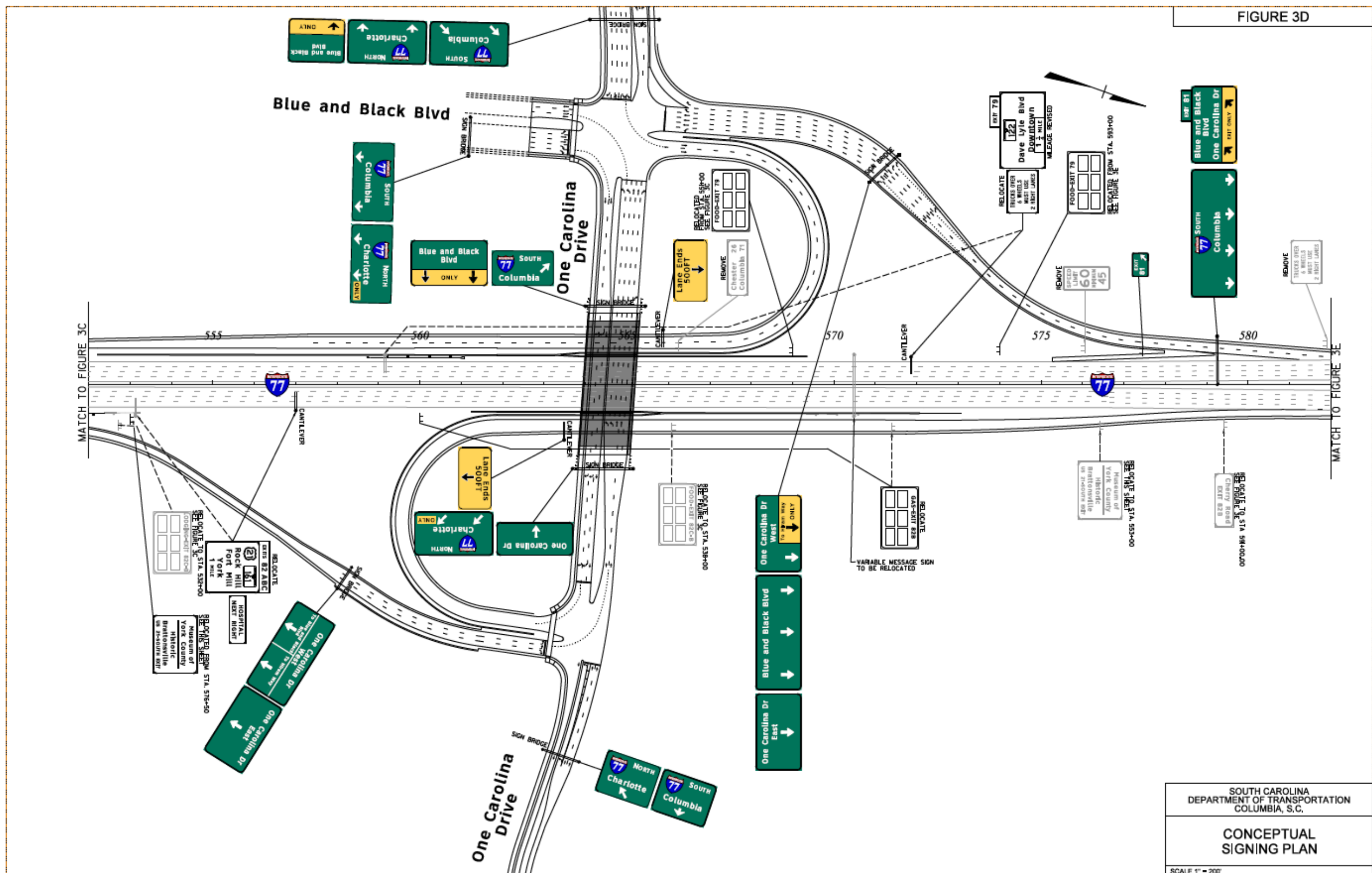
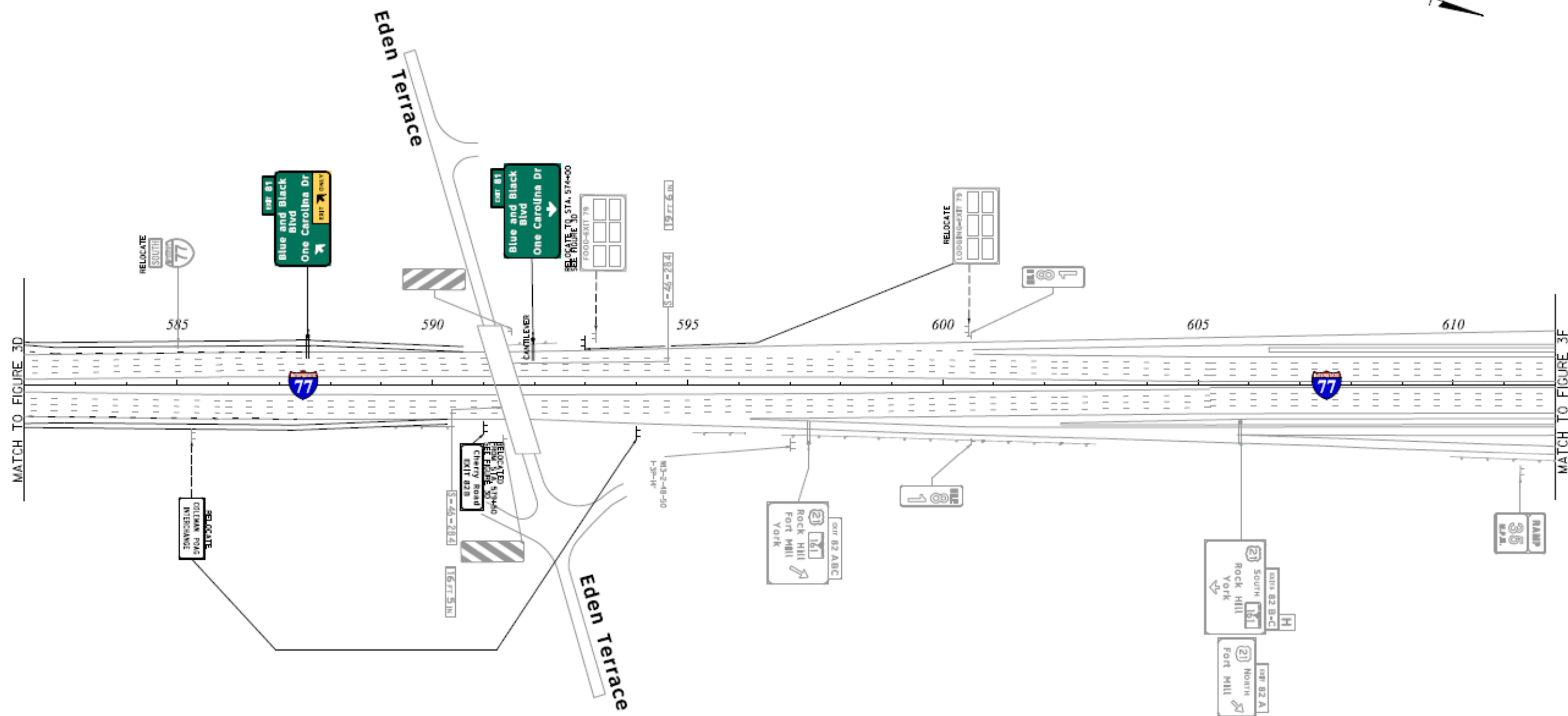


FIGURE 3E



SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION COLUMBIA, S.C.	
CONCEPTUAL SIGNING PLAN	
SCALE 1" = 200'	

1.2 Existing Roadway Conditions

I-77 is an eight (8) lane interstate freeway in the vicinity of the study area that connects the midlands of South Carolina with North Carolina and the Charlotte area. In the area of the proposed interchange, I-77 is divided by a concrete barrier wall median.

1.3 Future Roadway Improvements

Within the study area there are several projects that are currently in the planning phase.

Exit 82 ABC / I-77 Interchange Reconfiguration

The Rock Hill-Fort Mill Area Transportation Study (RFATS) in the 2045 Long Range Transportation Plan (LRTP) identified the need to improve the existing interchange between Celanese Road and I-77 as well as between Cherry Road and I-77. At the time of development of this IJR, specific interchange improvements were yet to be developed. The project is planned to be completed by 2025.

1.4 Purpose and Need

The purpose of this IJR near South Carolina mile marker 81 on I-77 is to:

1. Justify the proposed interchange to accommodate the traffic demand associated with the proposed Panthers development to and from I-77
2. Reduce the congestion at the adjacent upstream and downstream interchanges along I-77 through the addition of a new interchange to provide access to I-77 for the surrounding area

The proposed Panthers development is anticipated to be commercial mixed-use and include athletic training facilities and associated land uses, residential, retail, dining, and office space. The development will be phased, and upon full buildout, will generate nearly 50,000 daily trips—the majority of which will access the development via I-77.

Based on data obtained from the U.S. Census Bureau, York County had a population of 131,497 in the 1990 census, which grew to 164,614 in the 2000 census, and to 226,073 in the 2010 census. The population of York County was estimated to be 274,118 in July 2018. From 1990 to 2010, the population in York County has grown by 94,576 people. The majority of this population growth has occurred in the northeast portion of York County, in the Town of Fort Mill and the City of Tega Cay. As compared to the State of South Carolina, from 2010 to 2018, York County experienced a population growth of approximately 21%, whereas the State of South Carolina experienced a population growth of approximately 10%.

1.5 IJR Analysis Methodology

Numerous coordination meetings were held to discuss and agree to the IJR analysis methodology and assumptions. The meetings' attendees have included FHWA, SCDOT, SC Department of Commerce, the Carolina Panthers' development team, and project consultant staff. The following documents a summary of assumptions agreed to and used in the analyses. The analyses were conducted in accordance with FHWA's *Policy on Access to the Interstate System (May 2017)* and *Interstate System Access Informational Guide (August 2010)*.

The development will include the team headquarters, practice facility, and associated land uses, as well as commercial mixed-use land uses including residential, retail, dining, lodging, and office space. Development phasing and trip generation information for use in this IJR analysis were provided by the

Carolina Panthers' development team (included in Appendix A). Overall, the full buildout of the development is expected to generate nearly 50,000 daily trips based on the development team's trip generation analysis.

The proposed I-77 and One Carolina Drive interchange is planned to be opened in year 2023; therefore, the analysis years of the IJR analyses are Opening Year 2023 conditions and Horizon Year 2043 conditions. For the IJR analyses, Build and No Build conditions of the proposed interchange for the respective analysis years have been considered.

1.6 IJR Traffic Analysis Study Area

The adjacent interchanges of I-77 at Exit 82 ABC – US 21/SC 161 (Celanese Road/Cherry Road) and Exit 79 – SC 122 (Dave Lyle Boulevard) were considered in the project study area. The study area intersections in this IJR analysis include the following:

Existing Intersections

- I-77 SB Ramps at Celanese Road - Signalized
- I-77 NB Ramps at Celanese Road - Unsignalized
- I-77 SB Ramps at Cherry Road - Signalized
- I-77 NB Ramps at Cherry Road - Unsignalized
- I-77 SB Ramps at Dave Lyle Boulevard - Signalized
- I-77 NB Ramps at Dave Lyle Boulevard – Signalized

Proposed New Intersections

- I-77 NB Ramps at One Carolina Drive – Signalized
- I-77 SB Ramps/Blue and Black Boulevard at One Carolina Drive – Signalized
- One Carolina Drive at Hiram Way – Signalized
- One Carolina Drive at Paragon Way - Unsignalized

The intersection of One Carolina Drive at Paragon Way will be an unsignalized T-intersection to provide access to the commercial development east of the interchange. This intersection is not included in this IJR analysis.

To develop an annual background growth rate for traffic in the study area, two sources of data were reviewed: SCDOT historical traffic count data along I-77 and the interchange crossing routes, and model volumes obtained from the Metrolina Regional Travel Demand Model (MRM). Additional information related to the estimation of traffic growth is included in Section 3.2 Background Growth Rate.

2 Selection of Analysis Hours

To determine the most appropriate analysis hours for the IJR, traffic count data were collected within the study area. Peak-hour intersection turning movement and heavy vehicle counts were performed by DADN Associates Highway Performance Engineers from 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM on Thursday, March 21, 2019 for the following intersections:

- I-77 SB Ramps at Celanese Road – Signalized
- I-77 NB Ramps at Celanese Road – Unsignalized
- I-77 SB Ramps at Cherry Road – Signalized
- I-77 NB Ramps at Cherry Road – Unsignalized

Peak-hour intersection turning movement and heavy vehicle counts were performed by All Traffic Data Services, Inc. on Thursday, May 9, 2019 from 6:30 AM to 9:00AM and 4:00PM to 6:00 PM for the following intersections:

- I-77 SB Ramps at Dave Lyle Boulevard – Signalized
- I-77 NB Ramps at Dave Lyle Boulevard – Signalized

Additional information regarding the turning movement counts is available in the Traffic Volume Development section. Appendix B includes the raw turning movement counts.

Based on the collected turning movement counts, the observed peak hours for each study area intersection were identified and are summarized in Table 1.

Table 1: Study Area Intersection Peak Hours

Intersection Peak Hours			
Intersection #	Intersection	AM Peak Hour	PM Peak Hour
1	I-77 SB Ramps at Celanese Road	7:15 AM - 8:15 AM	4:45 PM - 5:45 PM
2	I-77 NB Ramps at Celanese Road	7:15 AM - 8:15 AM	4:30 PM - 5:30 PM
3	I-77 SB Ramps at Cherry Road	7:15 AM - 8:15 AM	5:00 PM - 6:00 PM
4	I-77 NB Ramps at Cherry Road	7:15 AM - 8:15 AM	5:00 PM - 6:00 PM
5	I-77 SB Ramps at Dave Lyle Boulevard	7:15 AM - 8:15 AM	4:45 PM - 5:45 PM
6	I-77 NB Ramps at Dave Lyle Boulevard	7:15 AM - 8:15 AM	4:45 PM - 5:45 PM

As shown in Table 1, the peak hour of the intersections of Celanese Road, Cherry Road at the I-77 SB Ramps and I-77 NB Ramps varied at most by 30-minutes with adjacent study intersections at Celanese Road and Dave Lyle Boulevard, which is typical of a congested network, such as I-77.

A 7-day traffic classification count was performed by All Traffic Data Services, Inc. on the I-77 mainline at a point located between the Eden Terrace Road bridge to the north and the railroad bridge to the south from Thursday, May 9 to Wednesday May 15, 2019. Based on the count data, it was determined that the observed two-way average daily traffic (ADT) is approximately 96,500 vehicles per day on weekdays, and 83,700 vehicles per day on weekend days. Appendix B includes the raw mainline classification count data.

To assess typical weekday traffic conditions, the mainline classification count was used to estimate the design-hour factor (K-factor) and directional distribution factor (D-factor) along I-77 between Dave Lyle and Cherry Road. The AM peak hour for the I-77 mainline was observed to be from 7:00 AM to 8:00 AM and the PM peak hour from 4:15 PM to 5:15 PM.

As compared to the peak hours observed at the intersections of the I-77 ramp termini at Dave Lyle, the AM peak hour along the I-77 mainline begins 15-minutes prior to the start of the peak hour at the I-77 SB and NB Ramps.

The PM peak hour observed along I-77 occurs 30-minutes prior to that observed at the I-77 ramp termini intersections at Dave Lyle, which is consistent with observations made along Cherry Road and Dave Lyle Boulevard and Celanese Road during the PM study period.

The K-factor is an indicator of the percentage of overall daily traffic that occurs during the peak hour, or design hour. The K-factor observed along I-77 between Cherry Road and Dave Lyle Boulevard at the Eden Terrace Bridge was estimated to be 0.07.

The D-factor is an indicator of directionality of traffic during the peak hours or the percentage of the hourly traffic traveling in the peak direction. The D-factor observed along I-77 between Cherry Road and Dave Lyle Boulevard at Eden Terrace Bridge was estimated to be 0.58 in the AM peak hour (northbound direction) and 0.58 in the PM peak hour (southbound direction).

The weekday hourly distribution of northbound, southbound, and total traffic volumes along I-77, in addition to the K-factor, and AM and PM peak hour D-factors are shown in Figure 4.

Furthermore, due to the high amount of anticipated commuting traffic traveling to/from the employment centers to be located within the Panthers development, it is expected that the peak hours of the development trip generation will occur during the AM and PM peak hours of the adjacent street.

As a result, the 7:15 AM to 8:15 AM and 5:00 PM to 6:00 PM peak hours were selected as the analysis hours for the IJR traffic analysis.

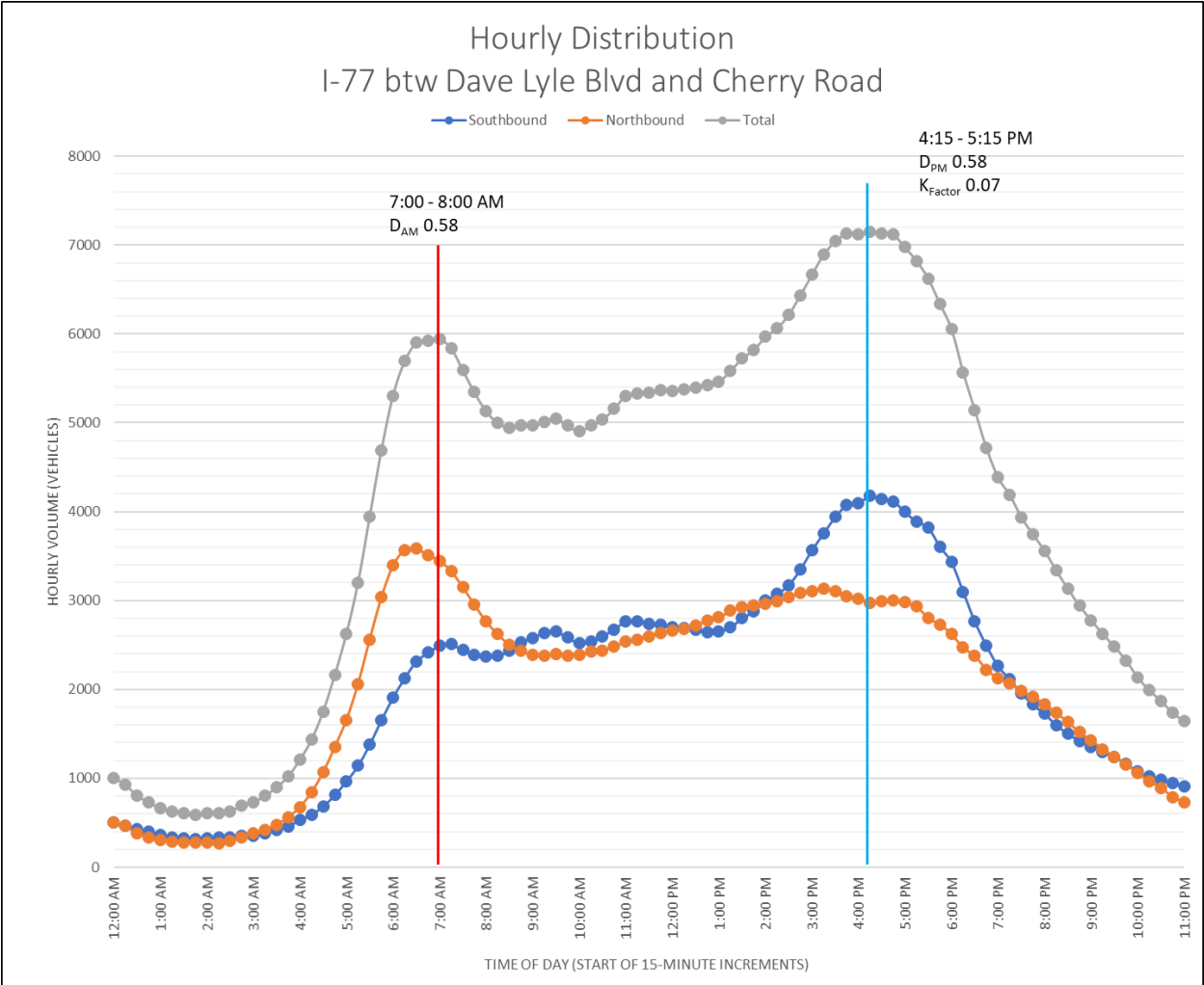


Figure 4: I-77 Mainline Hourly Distribution

3 Traffic Volume Development

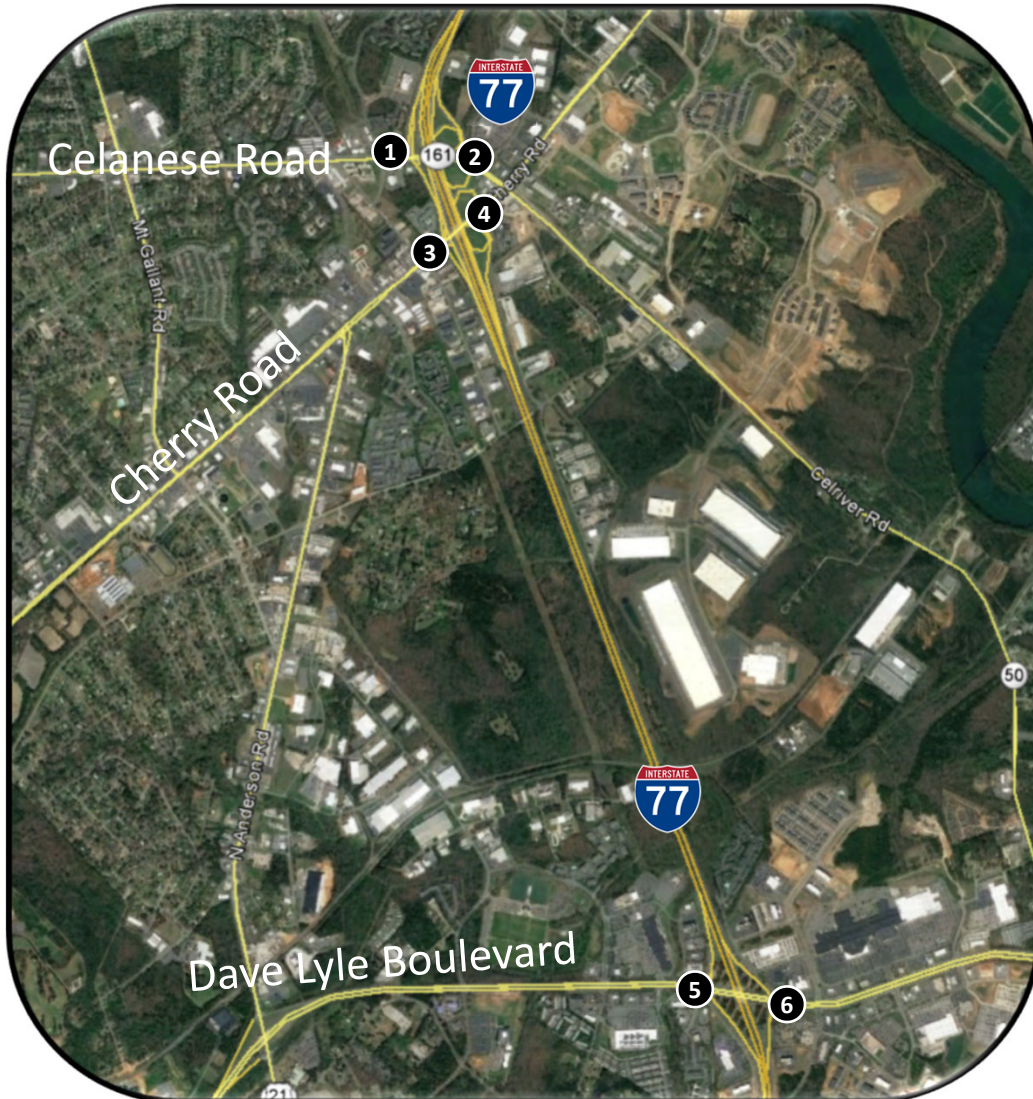
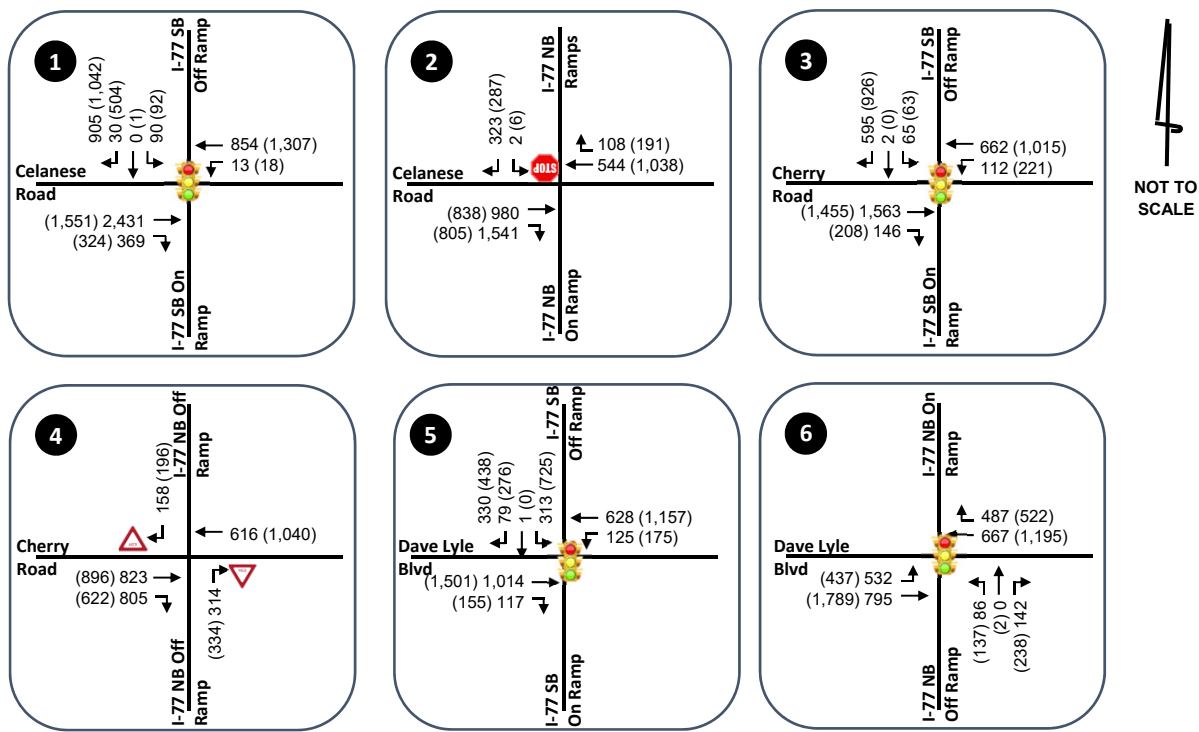
For the IJR analyses, opening year 2023 and horizon year 2043 conditions were considered. For both of the respective study years, Build and No Build conditions of the proposed interchange were evaluated. Existing 2019 traffic volumes were collected at the study area intersections; the development of the I-77 analysis hours was discussed in the previous section. The existing turning movement volumes within the study area are shown in Figure 5.

3.1 New Interchange Traffic Redistribution

It is assumed that the addition of a new interchange will result in some existing traffic diverting from the adjacent interchanges to the north and south to the new interchange. To determine the extent of this traffic rerouting, Bluetooth origin-destination data collection was performed at ten locations within the project study area to determine the interactions between locations. The origin-destination data were collected for the full 24-hour period for 15-minute increments which permitted breaking out the AM peak period (7:00AM to 9:00AM), Midday peak period (11:00AM to 1:00PM), and PM peak period (4:00PM to 6:00PM) Figure 6 shows the Bluetooth data collection locations. The Bluetooth Reader locations are:

- A. South of Dave Lyle Boulevard
- B. SB Ramp at Dave Lyle Boulevard
- C. NB Ramp at Dave Lyle Boulevard
- D. Red River Road at Dave Lyle Boulevard
- E. Paragon Way at Cel-River Road
- F. Cel-River Road/Celanese Road at Cherry Road
- G. North of Celanese Road
- H. S Anderson Road at Dave Lyle Boulevard
- I. N Anderson Road at Mt Gallant Road
- J. N Anderson Road at Cherry Road

The origin destination data collected was summarized by AM and PM peak periods. The origin-destination data summary during AM and PM peak periods are shown in Table 2 through Table 5. These tables show the interaction of trips between origins and destinations—the percentages in the tables represent the distribution of trips from a given origin to all other destinations within the Bluetooth study area network.



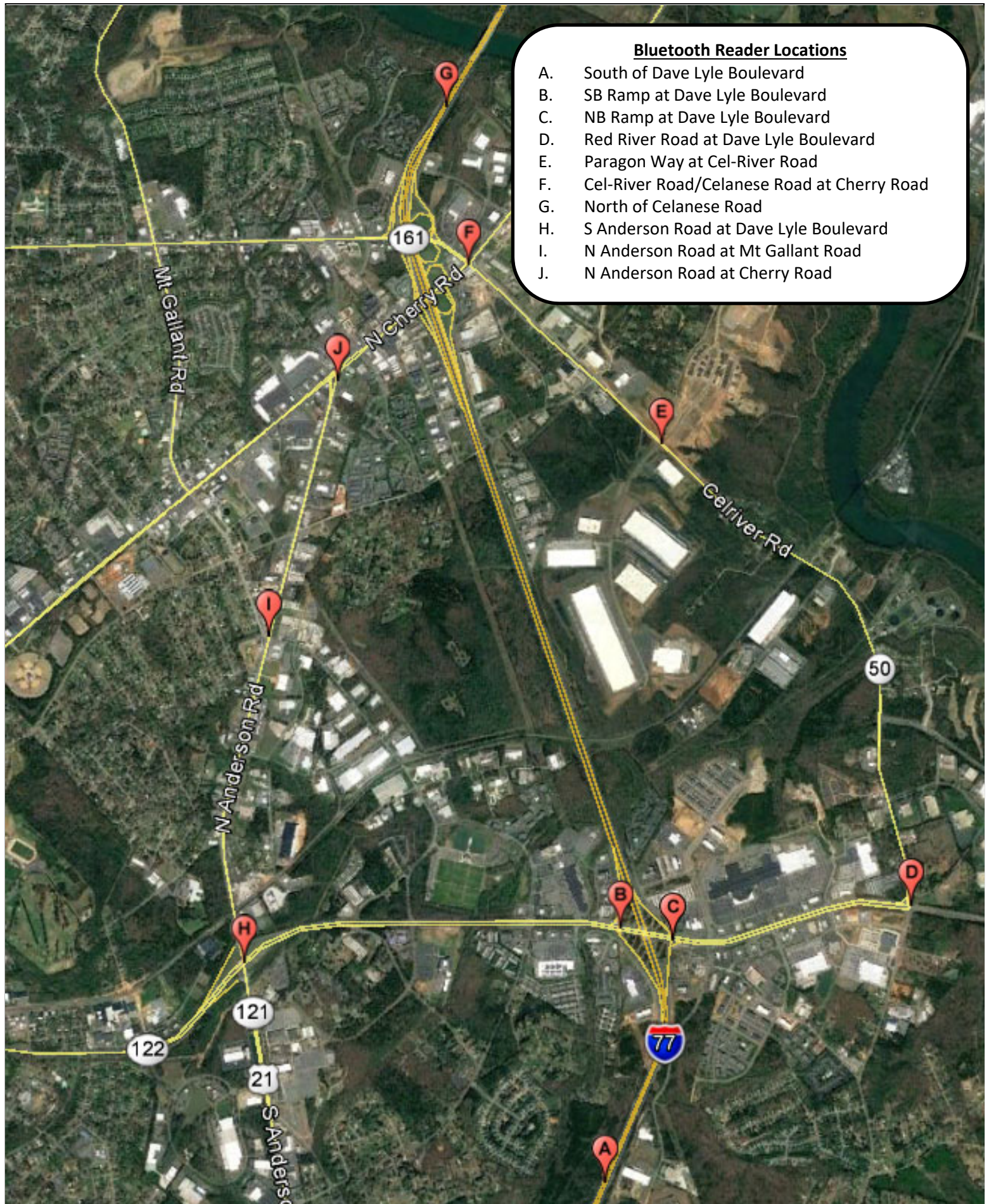


Table 2: AM Peak Period Bluetooth O-D Data (Origins to Destinations)

AM Peak Period - From Origins to Destinations												
O/D		Destinations										Grand Total
		A	B	C	D	E	F	G	H	I	J	
Origins	A	0.00%	1.62%	21.06%	2.08%	1.39%	6.25%	66.90%	0.46%	0.00%	0.23%	100%
	B	57.25%	0.00%	13.47%	3.11%	1.30%	2.07%	15.03%	6.74%	0.26%	0.78%	100%
	C	4.17%	9.62%	0.00%	5.13%	1.60%	7.05%	68.91%	2.56%	0.00%	0.96%	100%
	D	2.94%	18.63%	17.65%	0.00%	26.47%	20.59%	7.84%	5.88%	0.00%	0.00%	100%
	E	2.70%	1.35%	1.35%	27.03%	0.00%	51.35%	14.86%	0.00%	0.00%	1.35%	100%
	F	12.02%	4.72%	1.29%	9.87%	27.90%	0.00%	32.62%	4.29%	3.00%	4.29%	100%
	G	51.69%	26.84%	4.77%	1.99%	2.98%	3.38%	0.00%	2.78%	0.80%	4.77%	100%
	H	1.15%	29.89%	25.29%	4.60%	2.30%	3.45%	16.09%	0.00%	2.30%	14.94%	100%
	I	0.00%	0.00%	2.70%	2.70%	5.41%	16.22%	16.22%	0.00%	0.00%	56.76%	100%
	J	2.34%	1.75%	1.17%	0.00%	1.17%	36.26%	41.52%	6.43%	9.36%	0.00%	100%

Table 3: AM Peak Period Bluetooth O-D Data (Destinations to Origins)

AM Peak Period - From Destinations to Origins												
O/D		Destinations										Grand Total
		A	B	C	D	E	F	G	H	I	J	
Origins	A	0.00%	3.02%	42.52%	9.47%	4.65%	13.24%	38.64%	2.60%	0.00%	1.32%	
	B	41.54%	0.00%	24.30%	12.63%	3.88%	3.92%	7.75%	33.77%	3.33%	3.95%	
	C	2.44%	12.93%	0.00%	16.84%	3.88%	10.78%	28.74%	10.39%	0.00%	3.95%	
	D	0.56%	8.19%	8.41%	0.00%	20.93%	10.29%	1.07%	7.79%	0.00%	0.00%	
	E	0.38%	0.43%	0.47%	21.05%	0.00%	18.63%	1.47%	0.00%	0.00%	1.32%	
	F	5.26%	4.74%	1.40%	24.21%	50.39%	0.00%	10.16%	12.99%	23.33%	13.16%	
	G	48.87%	58.19%	11.21%	10.53%	11.63%	8.33%	0.00%	18.18%	13.33%	31.58%	
	H	0.19%	11.21%	10.28%	4.21%	1.55%	1.47%	1.87%	0.00%	6.67%	17.11%	
	I	0.00%	0.00%	0.47%	1.05%	1.55%	2.94%	0.80%	0.00%	0.00%	27.63%	
	J	0.75%	1.29%	0.93%	0.00%	1.55%	30.39%	9.49%	14.29%	53.33%	0.00%	
Grand Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	

Table 4: PM Peak Period Bluetooth O-D Data (Origins to Destinations)

PM Peak Period - From Origins to Destinations												
O/D		Destinations										Grand Total
		A	B	C	D	E	F	G	H	I	J	
Origins	A	0.00%	4.06%	21.10%	1.22%	0.20%	5.68%	66.13%	0.20%	0.00%	1.42%	100%
	B	47.38%	0.00%	21.88%	5.79%	0.18%	1.08%	11.39%	10.13%	0.90%	1.27%	100%
	C	5.90%	27.52%	0.00%	6.14%	0.74%	5.65%	45.95%	6.63%	0.49%	0.98%	100%
	D	3.36%	10.08%	21.01%	0.00%	30.25%	23.53%	6.72%	4.20%	0.84%	0.00%	100%
	E	1.52%	2.27%	2.27%	36.36%	0.00%	46.21%	7.58%	2.27%	0.76%	0.76%	100%
	F	12.78%	5.26%	1.50%	9.40%	27.44%	0.00%	23.68%	5.26%	2.63%	12.03%	100%
	G	41.22%	32.84%	6.34%	1.59%	1.13%	1.81%	0.00%	2.27%	0.34%	12.46%	100%
	H	0.00%	31.82%	29.87%	1.30%	0.65%	9.74%	13.64%	0.00%	1.95%	11.04%	100%
	I	0.00%	4.44%	6.67%	0.00%	0.00%	20.00%	15.56%	8.89%	0.00%	44.44%	100%
	J	4.46%	6.44%	2.97%	1.49%	1.98%	37.13%	30.20%	7.43%	7.92%	0.00%	100%

Table 5: PM Peak Period Bluetooth O-D Data (Destinations to Origins)

PM Peak Period- From Destinations to Origins											
O/D		Destinations									
		A	B	C	D	E	F	G	H	I	J
Origins	A	0.00%	3.88%	28.26%	3.87%	0.78%	10.73%	43.70%	0.69%	0.00%	3.54%
	B	37.48%	0.00%	32.88%	20.65%	0.78%	2.30%	8.45%	38.62%	13.16%	3.54%
	C	3.43%	21.75%	0.00%	16.13%	2.33%	8.81%	25.07%	18.62%	5.26%	2.02%
	D	0.57%	2.33%	6.79%	0.00%	27.91%	10.73%	1.07%	3.45%	2.63%	0.00%
	E	0.29%	0.58%	0.82%	30.97%	0.00%	23.37%	1.34%	2.07%	2.63%	0.51%
	F	4.86%	2.72%	1.09%	16.13%	56.59%	0.00%	8.45%	9.66%	18.42%	16.16%
	G	52.07%	56.31%	15.22%	9.03%	7.75%	6.13%	0.00%	13.79%	7.89%	55.56%
	H	0.00%	9.51%	12.50%	1.29%	0.78%	5.75%	2.82%	0.00%	7.89%	8.59%
	I	0.00%	0.39%	0.82%	0.00%	0.00%	3.45%	0.94%	2.76%	0.00%	10.10%
	J	1.29%	2.52%	1.63%	1.94%	3.10%	28.74%	8.18%	10.34%	42.11%	0.00%
Grand Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Five Bluetooth locations were identified for use in estimating the traffic redistribution for the new interchange:

- A: I-77 South of Dave Lyle Boulevard
- B: SB Ramp at Dave Lyle Boulevard
- E: Paragon Way at Cel-River Road
- G: I-77 North of Celanese Road
- I: N Anderson Road at Mt Gallant Road

From the Bluetooth O-D data matrices, the highest interaction percentages of the origin to destination and destination to origin were chosen to calculate the traffic redistribution for both AM and PM peak periods.

Based on the Bluetooth O-D Data percentages, the following interaction percentages were determined and shown in Table 6.

Table 6: Origin-Destination Percentages to Calculate Traffic redistribution

Study Area Origin/Destination Percentages		
Interaction Between	AM Peak Percentage	PM Peak Percentage
I and G	13%	8%
E and G	3%	1%
E and A	5%	1%
B and I	3%	13%
I and E	5%	1%

These percentages provided in Table 6 were applied to the turning movement volumes of the following intersections to estimate the traffic redistribution to be applied to the background turning movement volumes:

- N Anderson Road at Mt. Gallant Road (at Bluetooth location I)
- Cel-River Road at Paragon Way (at Bluetooth location E)
- I-77 SB Ramps at Dave Lyle Boulevard (at Bluetooth location B)

The traffic redistribution turning movement volumes are included the Build scenarios for years 2023 and 2043. Detailed information related to the Bluetooth O-D analysis and traffic redistribution estimation is included in Appendix C.

3.2 Background Growth Rate

To forecast future traffic analysis volumes, the regional travel demand model and historical SCDOT daily traffic data were used. The Metrolina Regional Travel Demand Model (MRM) was used to obtain year 2015, year 2025, and year 2045 model volumes to establish model growth rates.

Additionally, twenty (20) years – 1999 to 2018 – of SCDOT historic traffic data were used to estimate historical growth in the study area.

Study Area Growth Rate Selection:

Upon review of the growth rates established from the regional travel demand model and SCDOT historic traffic data, exponential annual growth rates were selected and applied to 2019 existing traffic volumes within the study area. Table 7 shows the study area growth rates selected for use in the analysis.

Table 7: Study Area Growth Rates

Study Area Growth Rates		
Study Area Roadway	Opening Year 2023	Horizon Year 2043
Dave Lyle Boulevard West of Interchange - SB Ramps	2.00%	0.50%
Dave Lyle Boulevard East of Interchange - NB Ramps	2.50%	3.75%
Cherry Road	2.00%	2.00%
Celanese Road	2.00%	2.00%
Mainline (I-77)	2.00%	1.50%

3.3 Opening Year 2023 Traffic Volumes

The opening year 2023 traffic volumes were developed for projected 2023 conditions by applying an annual growth rate to the existing traffic volumes and adding the estimated traffic redistribution from the adjacent interchanges, as well as the projected trip generation volumes of the proposed Panthers development.

3.3.1 New Interchange Traffic Redistribution (2023)

As mentioned in a previous section, it is anticipated that the new interchange will attract traffic from the adjacent interchanges located to the north (Cherry Road and Celanese Road) and south (Dave Lyle Boulevard). The traffic redistribution estimations were performed for existing conditions year 2019, and included in the background traffic growth calculations to reflect redistributed traffic in year 2023.

Additional information related to the new interchange traffic redistribution analysis are included in Appendix D.

3.3.2 Panthers Development Trip Generation (2023)

The new development trip generation used in this IJR analysis for Opening Year 2023 was provided by the Carolina Panthers' development team. The growth rate was not applied to the supplied trip generation. It is assumed that 2023 volumes are only generated from General Office, Medical Office, and NFL Training Facility based on information provided by the developer's traffic engineering team.

The new development trip generation analysis is included in Appendix A.

3.3.3 Trip Distribution (2023)

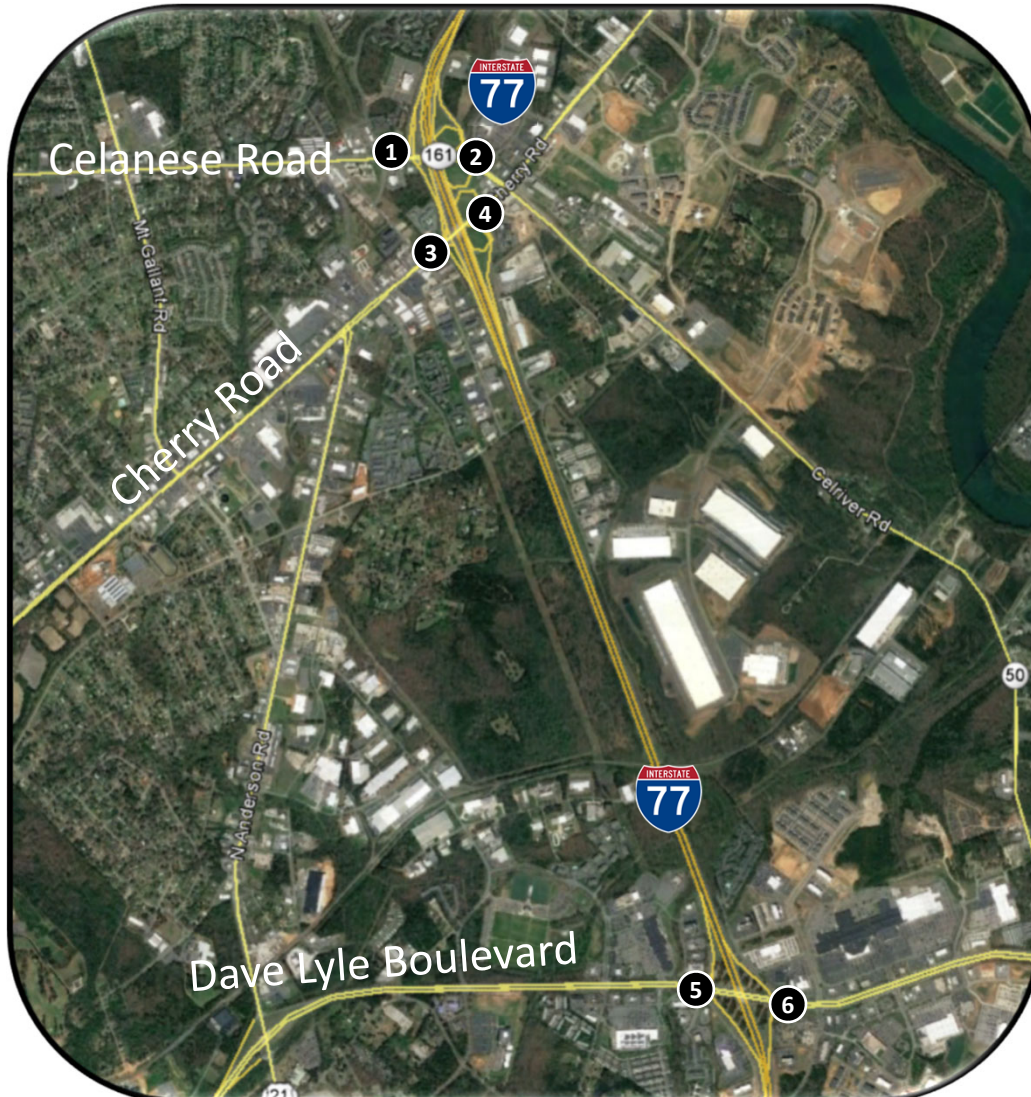
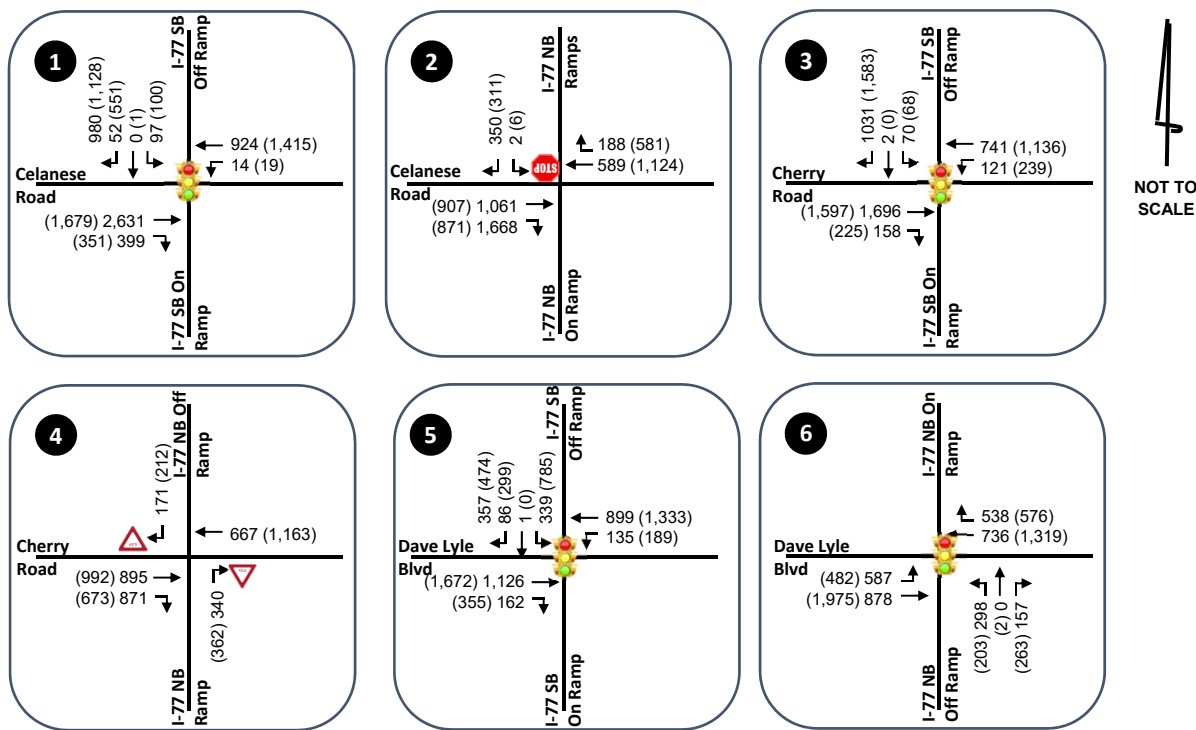
Distribution of the site development traffic was also provided by the developer's traffic engineering team. The distribution associated with the proposed Panthers development was as follows:

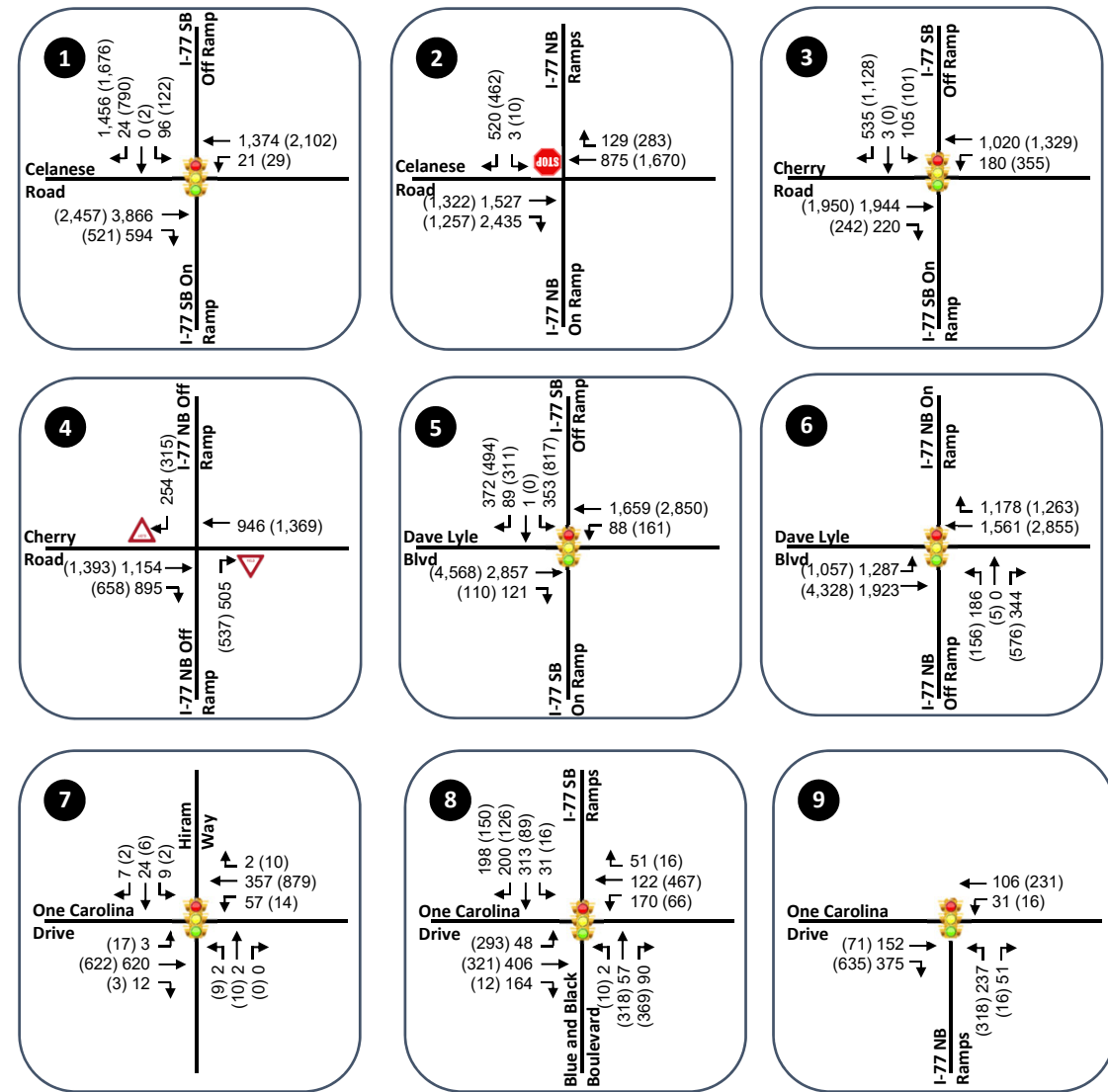
- 50% to and from the North along I-77
- 25% to and from the South along I-77
- 3% to and from the East across the new interchange
- 22% to and from surface streets west of I-77

Additional information related to the developer provided trip distribution is included in Appendix A.

3.3.4 Opening Year 2023 Traffic Volume Development Summary

Based upon the estimated trip generation of the Panthers development and considering the annual growth rate selected for year 2023, Opening Year 2023 AM and PM peak hour traffic volumes were developed for the No Build and Build interchange scenarios. Volume development used in estimating future traffic are included in Appendix D. Figures illustrating the proposed Opening Year AM and PM peak hour traffic volumes for the No Build and Build scenarios are shown in Figure 7 and Figure 8, respectively.





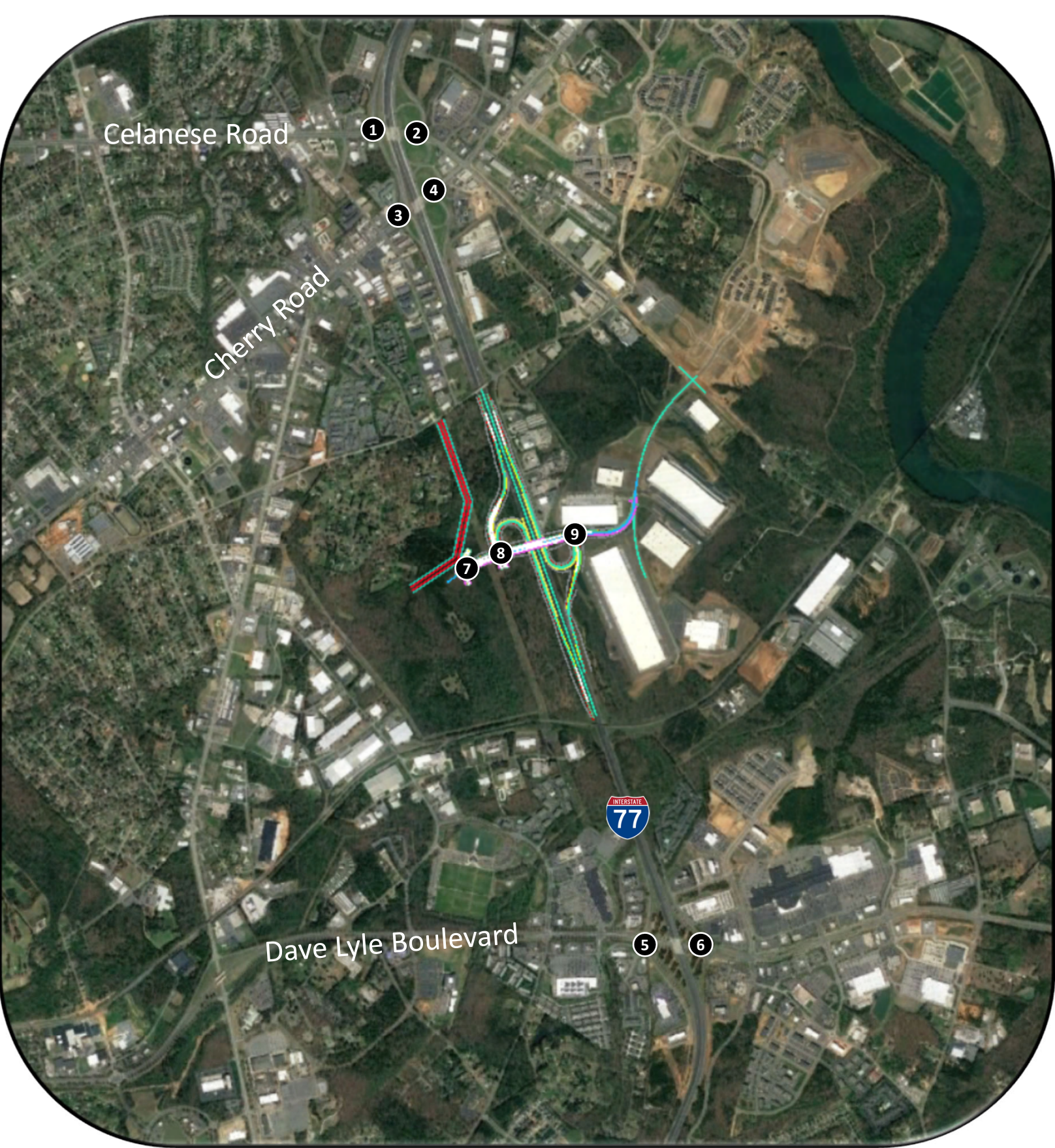
LEGEND

→ Existing Laneage

xx (xx) AM (PM) Turning Movement

🚦 Existing Signal

🛑 Stop Control



3.4 Horizon Year 2043 Traffic Volumes

The Horizon Year 2043 traffic volumes were developed for projected 2043 conditions by applying an annual growth rate to the existing traffic volumes and adding the projected trip generation volumes provided by the developer's traffic engineering team.

3.4.1 New Interchange Traffic Redistribution (2043)

As mentioned in a previous section, it is anticipated that the new interchange will attract traffic from the adjacent interchanges located to the north (Cherry Road and Celanese Road) and south (Dave Lyle Boulevard). The traffic redistribution estimations were performed for existing conditions year 2019, and included in the background traffic growth calculations to reflect redistributed traffic in year 2043.

Additional information related to the new interchange traffic redistribution analysis are included in Appendix D.

3.4.2 Panthers Development Trip Generation (2043)

The new development trip generation used in this IJR analysis for Horizon Year 2043 was provided by the Carolina Panthers' development team. It is assumed that 2043 volumes include all development phases, based on information provided by the developer's traffic engineering team. These developments include Multi Family Housing, Hotel, Research and Development Center, Retail, High Turnover Restaurant, and Quality Restaurant.

The new development trip generation analysis is included in Appendix A.

3.4.3 Trip Distribution (2043)

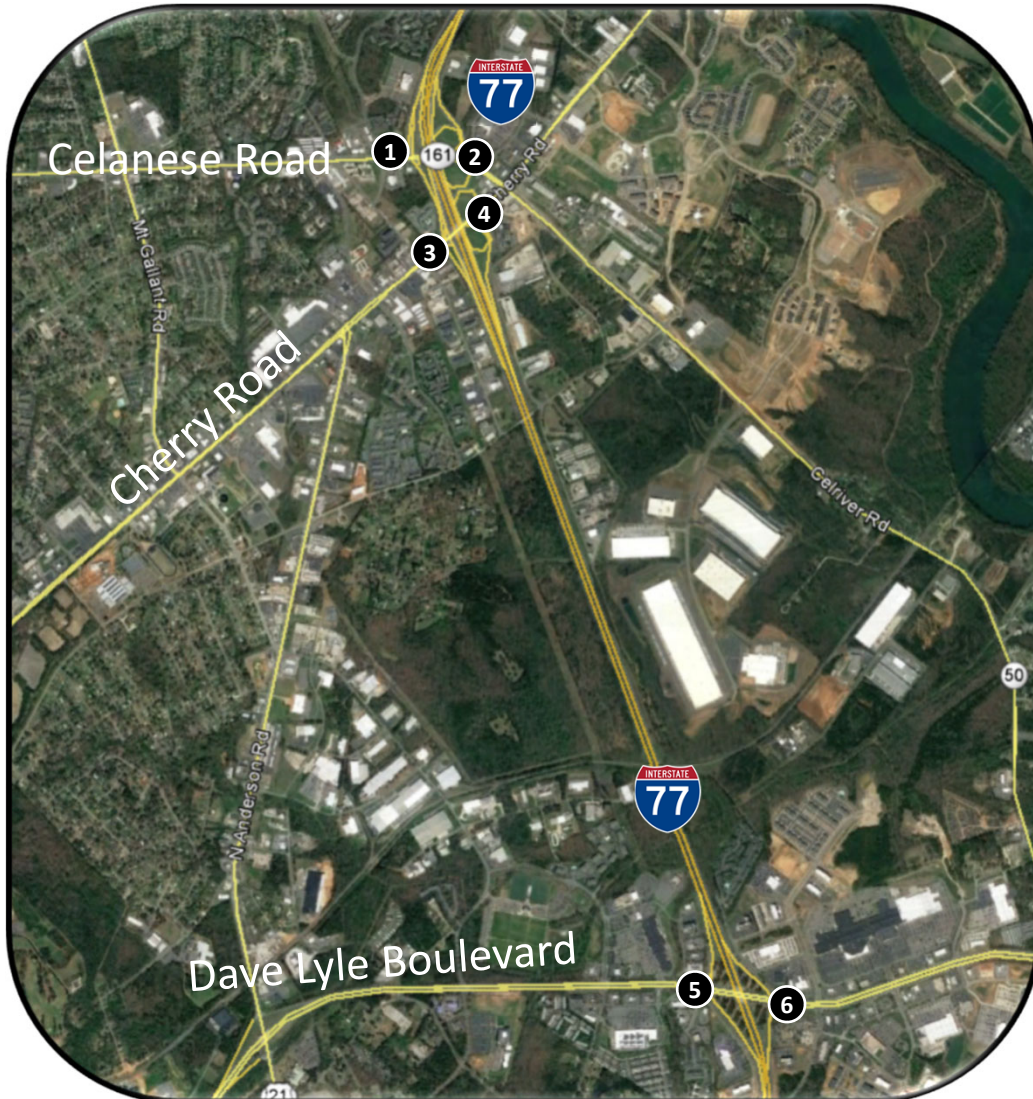
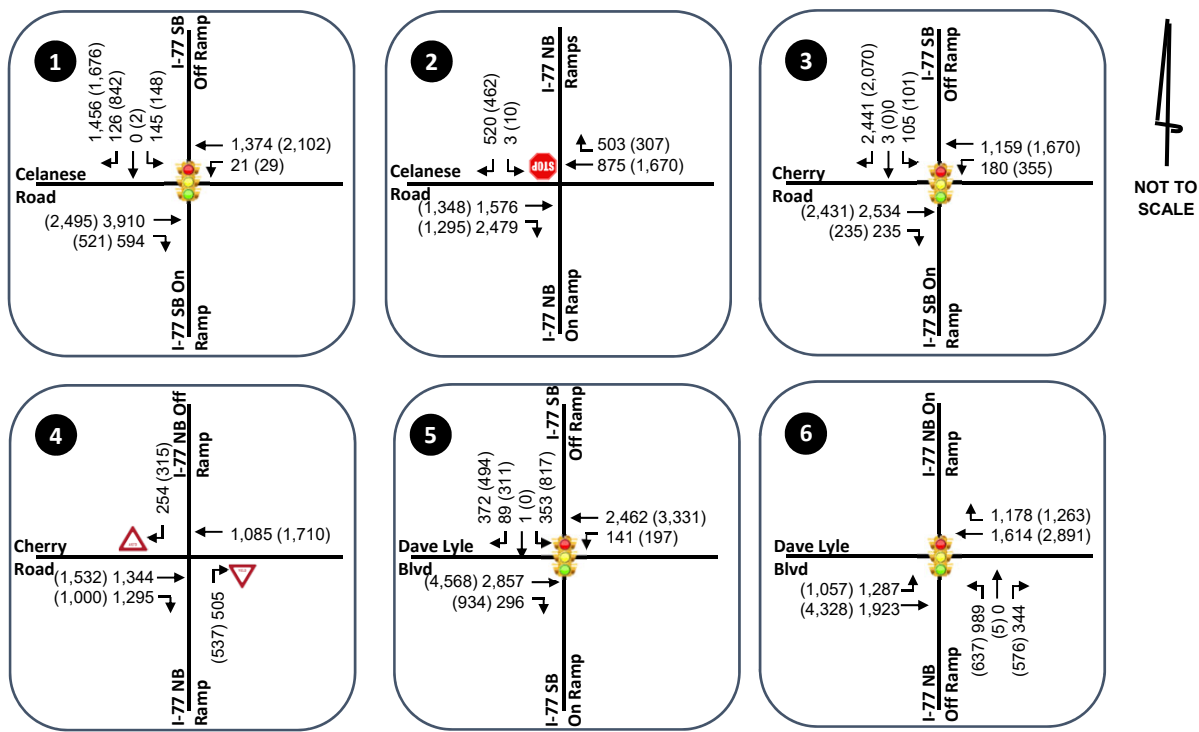
Distribution of the site development traffic for Horizon Year 2043 was also provided by the developer's traffic engineering team, and is consistent with the trip distribution used for the Opening Year 2023 scenario. The distribution associated with the proposed Panthers development was as follows:

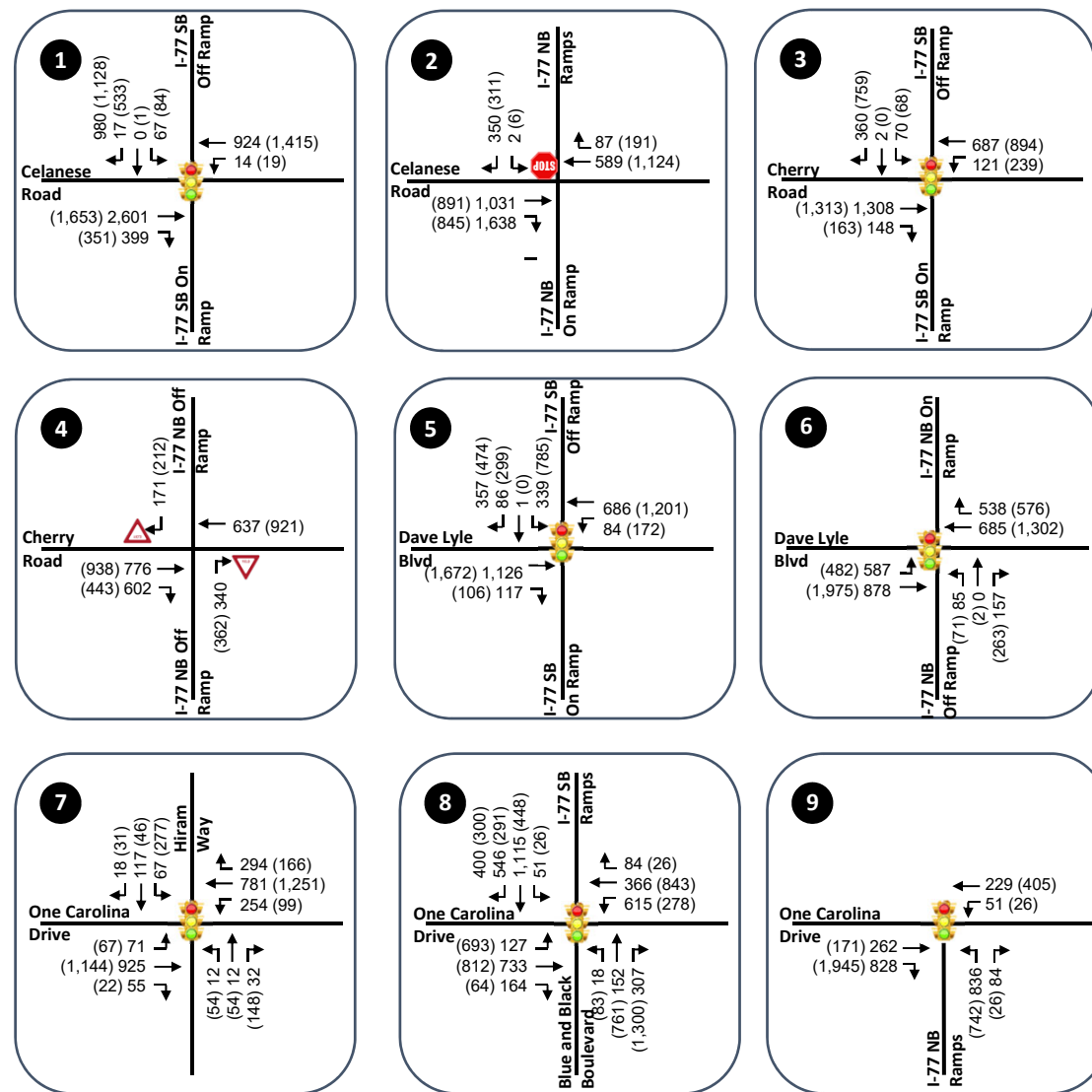
- 50% to and from the North along I-77
- 25% to and from the South along I-77
- 3% to and from the East across the new interchange
- 22% to and from surface streets west of I-77

Additional information related to the developer provided trip-distribution is included in Appendix A.

3.4.4 Horizon Year 2043 Traffic Volume Development Summary

Based upon the estimated trip generation of the Panthers development and considering the annual growth rate selected for year 2043, Horizon Year 2043 AM and PM peak hour traffic volumes were developed for the No Build and Build interchange scenarios. Volume development used in estimating future traffic are included in Appendix D. Figures illustrating the proposed Horizon Year AM and PM peak hour traffic volumes for the No Build and Build scenarios are shown in Figure 9 and Figure 10, respectively.





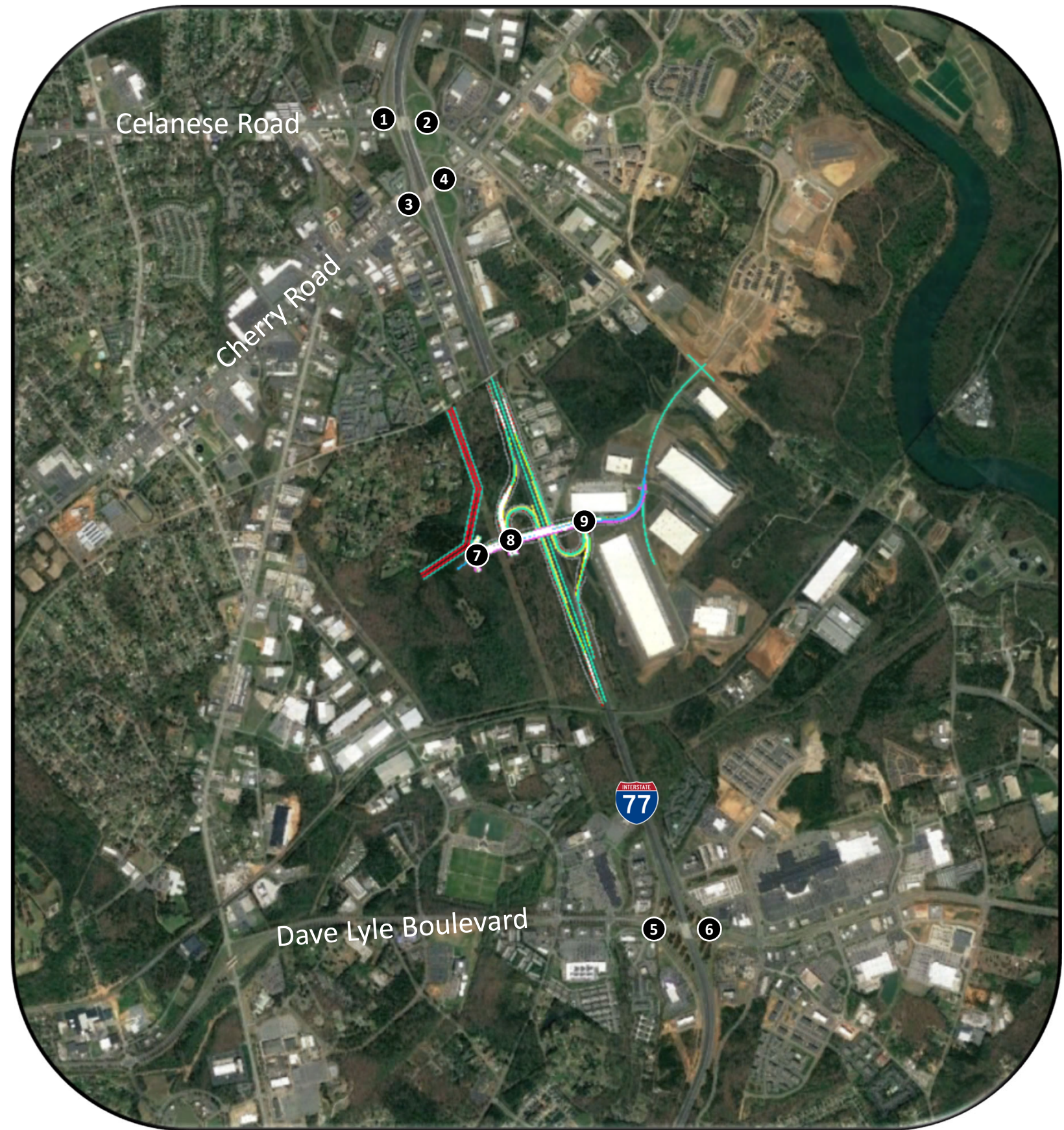
LEGEND

→ Existing Laneage

xx (xx) AM (PM) Turning Movement

🚦 Existing Signal

🛑 Stop Control



4 Capacity Analysis

Using the projected Opening Year 2023 and Horizon Year 2045 traffic volumes for No Build and Build conditions of the proposed I-77 and Panthers interchange, capacity analyses were conducted for the study area freeway facilities and intersections using McTrans *Highway Capacity Software (HCS)* and Trafficware's *Synchro 10* software. The *Synchro* analyses were conducted at a planning level and exact signal timings and phases will be determined during the design phase in accordance with the SCDOT *Signal Design Guidelines*.

Interstate Freeway Analysis Methodology

Based on HCM 2010, capacity analyses were performed, and levels of service were defined for each freeway segment and ramp merge or diverge in the study area. The LOS of freeway segments is based on the density of vehicles, expressed in passenger cars per mile per lane. Six levels of services are defined for each type of facility, from A (the best) to F (the worst). These grades represent the perspective of drivers and are an indication of the comfort and convenience associated with driving.

For basic freeway segments, LOS A represents free-flow operations where vehicles can easily maneuver within the traffic stream. LOS B represents reasonably free flow, and free-flow speeds are maintained. LOS C provides flow with speeds at or near the free-flow speed of the freeway. LOS D is the level at which speeds begin to decline slightly with flows increasing and density beginning to increase more quickly. LOS E, at its highest density value, describes operation at capacity. Operations at this level are volatile, because there are virtually no usable gaps in the traffic stream. LOS F occurs when queues begin to form on the freeway as a result of a breakdown or bottleneck at a downstream point.

For merging and diverging segments, LOS A represents unrestricted operation. LOS B shows minimal levels of turbulence and noticeable merging and diverging maneuvers. LOS C shows reduced average speed within the ramp influence area. LOS D represents intrusive turbulence levels where virtually all vehicles slow down to accommodate merging or diverging maneuvers. LOS E represents condition near or at capacity. LOS F represents saturated conditions.

HCS 2010 software, which emulates HCM 2010 methodology, was used to analyze the freeway ramp facilities, both merge and diverge, and the freeway mainline segments within the study area. The following existing merge, diverge, and mainline segments are analyzed under AM and PM peak conditions for the existing and future scenarios as previously described. Additionally, weaving segment analyses were performed for the CD road that connects the Cherry Road/Celanese Road interchanges.

The LOS criteria for basic freeway segments, merge and diverge areas, and weaving segments are presented in Table 8.

Table 8: Level-of-Service Control Delay Thresholds for Basic Freeway Segments, Merge and Diverge Areas, and Weaving Segments

Level-of-Service Control Delay Thresholds for Basic Freeway Segments, Merge and Diverge Areas, and Weaving Segments			
Level-of-Service	Basic Freeway Segment Density (pc/mi/ln)	Merge and Diverge Areas Density (pc/mi/ln)	Weaving Segment Density on C-D Roadways (pc/mi/ln)
A	≤ 11	≤ 10	≤ 12
B	> 11 - 18	> 10 - 20	> 12 - 24
C	> 18 - 26	> 20 - 28	> 24 - 32
D	> 26 - 35	> 28 - 35	> 32 - 36
E	> 35 - 45	> 35	> 36
F	> 45 or Demand Exceeds Capacity	Demand Exceeds Capacity	Demand Exceeds Capacity

Interchange Intersection Analysis Methodology

Capacity analyses at the signalized intersections within the study area were performed for the AM and PM peak hours using the Synchro Version 10. The program uses methodologies contained in the 2000 and 2010 editions of the Highway Capacity Manual (HCM) to determine the operating characteristics of an intersection. Capacity is defined as the maximum number of vehicles that can pass over a particular road segment, or through a particular intersection, within a specified period of time under prevailing roadway, traffic, and control conditions.

For signalized intersections, LOS is defined for the overall intersection operation, based on control delay, which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.

Table 9 lists the LOS control delay thresholds published in the Highway Capacity Manual (HCM) for signalized intersections. It should be noted that HCM 2000 results output from this version of Synchro were used since HCM 2010 methodology only reports results for signalized intersections with strict NEMA phasing and HCM 6th methodology does not support particular roadway geometrics used in the alternatives analyzed. Therefore, to remain consistent in our results, HCM 2000 results were used at all signalized intersections. HCM 2010 results were used at unsignalized intersections.

Table 9: Level-of-Service Delay Thresholds for Signalized and Unsignalized Intersections

Level-of-Service Control Delay Thresholds for Signalized and Unsignalized Intersections		
Level-of-Service	Signalized Intersections (sec/veh)	Unsignalized Intersections (sec/veh)
A	≤ 10	≤ 10
B	> 10 - 20	> 10 - 15
C	> 20 - 35	> 15 - 25
D	> 35 - 55	> 25 - 35
E	> 55 - 80	> 35 - 50
F	> 80 or Demand Exceeds Capacity	> 50 or Demand Exceeds Capacity

Intersection capacity analysis reports generated by *Synchro 10* software are included in Appendix F and are briefly summarized later in this report.

Signal timing plans provided by SCDOT for the existing signalized intersections are included in Appendix E. The existing cycle lengths, splits, and offsets used in the existing conditions analysis provide a true representation of the current traffic conditions. With growth in traffic through the design years modeled, the timings will most likely be modified. Therefore, to provide a better representation of true comparison expected by the proposed interchange, these timings were optimized under all future year conditions.

As part of the analyses, a peak hour factor of 0.90 was assumed for all future scenarios. The heavy vehicle percentages used were based on those collected during data collection.

4.1 Existing Year Analysis

In an effort to establish the baseline conditions for the study area, an existing conditions (year 2019) evaluation was performed for the study area to include the I-77 freeway and interchange intersection capacity analyses through the interchanges at Celanese Road/Cherry Road and Dave Lyle Boulevard.

4.1.1 Existing Freeway Facility Analysis

The results of the freeway facility analyses considering the 2019 Existing conditions for the AM and PM peak hours are summarized in Table 10.

Table 10: Freeway Facility LOS Analysis Summary (2019 Existing)

Freeway Facility LOS Analysis Summary (2019 Existing)														
I-77 Section	Southbound AM (PM)							Northbound AM (PM)						
	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS		Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS	
	North of Celanese Road	-	3,536 (6,037)	65.0 (64.5)	14.8 (24.6)	FS		B (C)	-	5,108 (3,773)	65.0 (65.0)	21.3 (15.6)	FS	C (B)
	On/Off North of Celanese Road/Cherry Road	1,687 (2,628)	3,536 (6,037)	60.9 (59.5)	8.7 (20.3)	D		A (C)	2,454 (1,618)	2,654 (2,155)	62.3 (64.5)	9.1 (0.4)	M	A (A)
	At Celanese Road/Cherry Road	-	1,849 (3,409)	65.0 (65.0)	7.7 (13.8)	FS		A (B)	-	2,654 (2,155)	65.0 (65.0)	11.0 (8.9)	FS	B (A)
	On/Off South of Celanese Road/Cherry Road	642 (772)	1,849 (3,409)	61.3 (60.5)	11.8 (17.6)	M		B (B)	797 (823)	3,451 (2,978)	59.8 (59.4)	19.8 (17.8)	D	B (B)
	At Eden Terrace	-	2,491 (4,181)	65.0 (65.0)	10.4 (16.9)	FS		A (B)	-	3,451 (2,978)	65.0 (65.0)	14.4 (12.3)	FS	B (B)
	On/Off North of Dave Lyle Boulevard	723 (1,439)	2,491 (4,181)	61.6 (60.0)	16.5 (26.4)	D		B (C)	1,019 (961)	2,432 (2,017)	61.3 (61.5)	14.0 (11.9)	M	B (B)
	At Dave Lyle Boulevard Road	-	1,768 (2,742)	65.0 (65.0)	7.4 (11.1)	FS		A (B)	-	2,432 (2,017)	65.0 (65.0)	10.1 (8.3)	FS	A (A)
	On/Off South of Dave Lyle Boulevard	243 (330)	1,768 (2,742)	61.7 (61.1)	9.7 (13.3)	M		A (B)	228 (377)	2,660 (2,394)	63.9 (63.2)	12.0 (11.5)	D	B (B)
South of Dave Lyle Boulevard	-	2,011 (3,072)	65.0 (65.0)	8.4 (12.4)	FS	A (B)	-	2,660 (2,394)	65.0 (65.0)	11.1 (9.9)	FS	B (A)		
Note: ¹ FS = Basic Freeway Segment; D = Diverge Area; M = Merge Area														

Note: ¹FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area

As shown in Table 10, the freeway analysis found that all sections of I-77 within the study area operate at LOS C or better during the AM and PM peak hours under year 2019 existing conditions.

A weaving segment capacity analysis was performed for the weaving segments on the northbound CD road connecting the Cherry Road and Celanese Road interchanges. The results of the weaving analysis are shown in Table 11.

Table 11: Weaving Segment LOS Analysis Summary (2019 Existing)

Weaving Segment LOS Analysis Summary (2019 Existing)		
Segment	LOS (Density [pc/mi/ln])	
	AM	PM
I-77 NB CD road, between Cherry Road NB On-Loop and Cherry Road NB Off- Loop	B (19.9)	B (16.3)
I-77 NB CD road, between Celanese Road NB On-Loop and Celanese Road NB Off-Loop	E (39.8)	C (24.4)

As shown in Table 11, the weaving segment on the CD road between the Celanese Road loop ramps was found to operate at LOS E during the AM peak hour in year 2019. The study area weaving sections were found to operate at LOS C or better during all other year 2019 Existing conditions scenarios.

4.1.2 Existing Intersection Analysis

As part of the existing conditions intersection analyses, the existing turn lane geometry at the adjacent interchange ramp termini were used. Additionally, the existing peak hour factors and heavy vehicle percentages were used where available.

The results of the intersection analyses considering existing conditions are summarized in Table 12.

Table 12: AM and PM Peak Hour Intersection LOS Analysis Summary (2019)

AM and PM Peak Hour Intersection LOS Analysis Summary (2019)			
Intersection	Control Type	Level of Service/Delay (seconds)	
		AM	PM
I-77 NB & Celanese Road	Stop Controlled	C/15.2	C/24.2
I-77 SB & Celanese Road	Signalized	A/9.6	C/32.1
I-77 SB & Cherry Road	Signalized	D/41.6	F/132.9
I-77 NB & Dave Lyle Boulevard	Signalized	C/23.1	C/24.1
I-77 SB & Dave Lyle Boulevard	Signalized	B/16.9	B/18.2

As shown in Table 12, the stop-controlled intersection of the I-77 SB ramps at Cherry Road was found to operate at LOS D in the AM peak hour, and LOS F in the PM peak hour. All other intersections within the study area were found to operate at LOS C or better during the AM and PM peak hours.

4.2 Opening Year 2023 Analyses

For 2023 Build conditions, the proposed I-77 and Panthers interchange configuration is a Partial Cloverleaf E, which has two quadrants (southeast and northwest) that include off-ramps and dual-lane loop on-ramps providing for all interchange movements.

4.2.1 Freeway Facility Analyses – 2023 No Build

The results of the freeway facility analyses considering 2023 No Build conditions for the AM and PM peak hours are summarized in Table 13 and indicate that the study area freeway facilities are anticipated to operate at LOS D or better during the AM and PM peak hours. The HCS analysis results reports for the freeway facility analyses for 2023 No Build conditions are included in Appendix G.

Table 13: Freeway Facility LOS Analysis Summary (2023 No Build)

Freeway Facility LOS Analysis Summary (2023 No Build)												
I-77 Section	Southbound AM (PM)						Northbound AM (PM)					
	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS
North of Celanese Road	-	4,234 (6,639)	65.0 (61.5)	19.1 (30.9)	FS	C (D)	-	5,616 (4,470)	64.2 (65.0)	25.5 (20.1)	FS	C (C)
On/Off North of Celanese Road/Cherry Road	2,233 (2,949)	4,234 (6,639)	54.3 (52.6)	15.9 (26.8)	D	B (C)	2,727 (2,125)	2,889 (2,345)	58.1 (63.0)	13.8 (6.4)	M	B (A)
At Celanese Road/Cherry Road	-	2,001 (3,690)	65.0 (65.0)	9.0 (16.2)	FS	A(B)	-	2,889 (2,354)	65.0 (65.0)	13.0 (10.5)	FS	B (A)
On/Off South of Celanese Road/Cherry Road	695 (836)	2,001 (3,690)	58.8 (58.0)	13.6 (20.5)	M	B (C)	863 (891)	3,752 (3,236)	53.1 (53.1)	22.8 (20.6)	D	C (C)
At Eden Terrace	-	2,696 (4,526)	65.0 (65.0)	12.2 (19.9)	FS	B (C)	-	3,752 (3,236)	65.0 (65.0)	16.8 (14.5)	FS	B (B)
On/Off North of Dave Lyle Boulevard	783 (1,558)	2,696 (4,526)	56.3 (54.5)	18.6 (30.4)	D	B (D)	1,125 (1,061)	2,627 (2,175)	59.1 (59.4)	16.5 (14.3)	M	B (B)
At Dave Lyle Boulevard	-	1,913 (2,968)	65.0 (65.0)	8.6 (13.1)	FS	A(B)	-	2,627 (2,175)	65.0 (65.0)	11.8 (9.8)	FS	B (A)
On/Off South of Dave Lyle Boulevard	298 (544)	1,913 (2,968)	58.6 (58.2)	11.2 (16.8)	M	B (B)	455 (468)	3,082 (2,643)	57.1 (57.1)	16.0 (14.1)	D	B (B)
South of Dave Lyle Boulevard	-	2,211 (3,512)	65.0 (65.0)	10.0 (15.5)	FS	A(B)	-	3,082 (2,643)	65.0 (65.0)	13.8 (11.9)	FS	B (B)
Note: ¹ FS = Basic Freeway Segment D = Diverge Area M = Merge Area												

Note: ¹FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area

A weaving segment capacity analysis was performed for the weaving segments on the northbound CD road connecting the Cherry Road and Celanese Road interchanges. The results of the weaving analysis for the 2023 No Build conditions are shown in Table 14.

Table 14: Weaving Segment LOS Analysis Summary (2023 No Build)

Weaving Segment LOS Analysis Summary (2023 No Build)		
Segment	LOS (Density [pc/mi/ln])	
	AM	PM
I-77 NB CD road, between Cherry Road NB On-Loop and Cherry Road NB Off-Loop	C (24.4)	C (25.2)
I-77 NB CD road, between Celanese Road NB On-Loop and Celanese Road NB Off-Loop	F ¹	D (34.8)

Note: ¹ v/c ratio greater than 1.0

As shown in Table 14, the weaving segment on the CD road between the Celanese Road loop ramps is anticipated to operate at LOS F during the AM peak hour under the 2023 No Build conditions, due to the volume to capacity (V/C) ratio being greater than 1.0. The study area weaving sections are anticipated to operate at LOS D or better during all other year 2023 No Build conditions scenarios.

4.2.2 Freeway Facility Analyses – 2023 Build

The results of the freeway facility analyses considering 2023 Build conditions for the AM and PM peak hours are summarized in Table 15 and indicate that the study area freeway facilities are anticipated to operate at LOS D or better during the AM and PM peak hours under the year 2023 Build conditions. The HCS analysis results reports for the freeway facility analyses for 2023 Build conditions are included in Appendix G.

Table 15: Freeway Facility LOS Analysis Summary (2023 Build)

Freeway Facility LOS Analysis Summary (2023 Build)												
I-77 Section	Southbound AM (PM)						Northbound AM (PM)					
	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS
North of Celanese Road	-	4,234 (6,639)	65.0 (61.5)	19.1 (30.9)	FS	C (D)	-	5,616 (4,470)	64.2 (65.0)	25.5 (20.1)	FS	C (C)
On/Off North of Celanese Road/Cherry Road	1,491 (2,568)	4,234 (6,639)	56.1 (53.5)	10.4 (24.1)	D	B (C)	2,321 (1,474)	3,295 (2,996)	60.0 (64.0)	11.9 (3.4)	M	B (A)
At Celanese Road/Cherry Road	-	2,743 (4,071)	65.0 (65.0)	12.4 (17.9)	FS	B (B)	-	3,295 (2,996)	65.0 (65.0)	14.8 (13.4)	FS	B (B)
On/Off South of Celanese Road/Cherry Road	695 (616)	2,743 (4,071)	58.6 (58.1)	16.3 (20.1)	M	B (C)	863 (891)	4,158 (3,887)	53.1 (53.1)	24.6 (23.4)	D	C (C)
Between On/Off South of Celanese Road/Cherry Road and On/Off North of One Carolina Drive	-	3,438 (4,687)	65.0 (65.0)	15.5 (20.6)	FS	B (C)	-	4,158 (3,887)	65.0 (65.0)	18.7 (17.4)	FS	C (B)
On/Off North of One Carolina Drive	742 (381)	3,438 (4,687)	56.4 (57.3)	9.1 (13.2)	D	A (B)	406 (651)	3,752 (3,236)	57.8 (57.8)	16.8 (17.0)	M	B (B)
At One Carolina Drive	-	2,696 (4,306)	65.0 (65.0)	12.2 (19.0)	FS	B (C)	-	3,752 (3,236)	65.0 (65.0)	16.8 (14.5)	FS	B (B)
On/Off South of One Carolina Drive	156 (627)	2,696 (4,306)	58.3 (57.4)	11.0 (20.4)	M	B (C)	288 (334)	4,040 (3,570)	57.5 (57.4)	19.9 (18.1)	D	B (B)
Between On/Off South of One Carolina Drive and On/Off North of Dave Lyle Boulevard	-	2,852 (4,933)	65.0 (65.0)	12.9 (21.7)	FS	B (C)	-	4,040 (3,570)	65.0 (65.0)	18.1 (16.0)	FS	C (B)
On/Off North of Dave Lyle Boulevard	783 (1,558)	2,852 (4,933)	56.3 (54.5)	19.2 (32.1)	D	B (D)	1,125 (1,061)	2,915 (2,509)	59.0 (59.3)	17.6 (15.5)	M	B (B)
At Dave Lyle Boulevard	-	2,069 (3,375)	65.0 (65.0)	9.3 (14.9)	FS	A (B)	-	2,915 (2,509)	65.0 (65.0)	13.1 (11.3)	FS	B (B)
On/Off South of Dave Lyle Boulevard	142 (137)	2,069 (3,375)	58.6 (58.4)	10.4 (14.9)	M	B (B)	167 (134)	3,082 (2,643)	57.8 (57.8)	14.4 (12.3)	D	B (B)
South of Dave Lyle Boulevard	-	2,211 (3,512)	65.0 (65.0)	10.0 (15.5)	FS	A (B)	-	3,082 (2,643)	65.0 (65.0)	13.8 (11.9)	FS	B (B)
Note: ¹ FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area												

Note: ¹FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area

A weaving segment capacity analysis was performed for the weaving segments on the northbound CD road connecting the Cherry Road and Celanese Road interchanges. The results of the weaving analysis for the 2023 No Build conditions are shown in Table 16.

Table 16: Weaving Segment LOS Analysis Summary (2023 Build)

Weaving Segment LOS Analysis Summary (2023 Build)		
Segment	LOS (Density [pc/mi/ln])	
	AM	PM
I-77 NB CD road, between Cherry Road NB On-Loop and Cherry Road NB Off-Loop	B (20.3)	B (16.4)
I-77 NB CD road, between Celanese Road NB On-Loop and Celanese Road NB Off-Loop	F ¹	C (28.6)

Note: ¹ v/c ratio greater than 1.0

As shown in Table 16, the weaving segment on the CD road between the Celanese Road loop ramps is anticipated to operate at LOS F during the AM peak hour under the 2023 Build conditions, due to the volume to capacity (V/C) ratio being greater than 1.0. The study area weaving sections are anticipated to operate at LOS C or better during all other year 2023 Build conditions scenarios. The LOS improvement versus the 2023 No Build scenario can likely be attributed to the traffic redistribution volume reduction within the weaving section associated with the proposed new interchange, as well as a new access point for Panthers development traffic.

To more easily compare the results between scenarios, Table 17 shows the comparison of 2023 No Build and Build scenarios for the freeway facility analysis.

Table 17: 2023 Opening Year Freeway Facility LOS Summary Comparison

2023 Freeway Facility LOS Analysis Summary Comparison												
I-77 Section	2023 No Build Southbound AM(PM)			2023 Build Southbound AM(PM)			2023 No Build Northbound AM(PM)			2023 Build Northbound AM(PM)		
	Density [pc/mi/ln]	Type ¹	LOS	Density [pc/mi/ln]	Type ¹	LOS	Density [pc/mi/ln]	Type ¹	LOS	Density [pc/mi/ln]	Type ¹	LOS
North of Celanese Road	19.1 (30.9)	FS	C (D)	19.1 (30.9)	FS	C (D)	25.5 (20.1)	FS	C (C)	25.5 (20.1)	FS	C (C)
On/Off North of Celanese Road/Cherry Road	15.9 (26.8)	D	B (C)	10.4 (24.1)	D	B (C)	13.8 (6.4)	M	B (A)	11.9 (3.4)	M	B (A)
At Celanese Road/Cherry Road	9.0 (16.2)	FS	A (B)	12.4 (17.9)	FS	B (B)	13.0 (10.5)	FS	B (A)	14.8 (13.4)	FS	B (B)
On/Off South of Celanese Road/Cherry Road	13.6 (20.5)	M	B (C)	16.3 (20.1)	M	B (C)	22.8 (20.6)	D	C (C)	24.6 (23.4)	D	C (C)
Between On/Off South of Celanese Road/Cherry Road and On/Off North of One Carolina Drive	-	-	-	15.5 (20.6)	FS	B (C)	-	-	-	18.7 (17.4)	FS	C (B)
On/Off North of One Carolina Drive	-	-	-	9.1 (13.2)	D	A (B)	-	-	-	16.8 (17.0)	M	B (B)
At One Carolina Drive	12.2 (19.9)	FS	B (C)	12.2 (19.0)	FS	B (C)	16.8 (14.5)	FS	B (B)	16.8 (14.5)	FS	B (B)
On/Off South of One Carolina Drive	-	-	-	11.0 (20.4)	M	B (C)	-	-	-	19.9 (18.1)	D	B (B)
Between On/Off South of One Carolina Drive and On/Off North of Dave Lyle Boulevard	-	-	-	12.9 (21.7)	FS	B (C)	-	-	-	18.1 (16.0)	FS	C (B)
On/Off North of Dave Lyle Boulevard	18.6 (30.4)	D	B (D)	19.2 (32.1)	D	B (D)	16.5 (14.3)	M	B (B)	17.6 (15.5)	M	B (B)
At Dave Lyle Boulevard	8.6 (13.1)	FS	A (B)	9.3 (14.9)	FS	A (B)	11.8 (9.8)	FS	B (A)	13.1 (11.3)	FS	B (B)
On/Off South of Dave Lyle Boulevard	11.2 (16.8)	M	B (B)	10.4 (14.9)	M	B (B)	16.0 (14.1)	D	B (B)	14.4 (12.3)	D	B (B)
South of Dave Lyle Boulevard	10.0 (15.5)	FS	A (B)	10.0 (15.5)	FS	A (B)	13.8 (11.9)	FS	B (B)	13.8 (11.9)	FS	B (B)

Note: ¹FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area

4.2.3 Intersection Analyses – 2023 No Build and Build

As part of the 2023 No Build and Build analyses, the existing geometry at the adjacent interchanges were used. Additionally, a peak hour factor of 0.90 and the existing heavy vehicle percentages were used where available. For the proposed new interchange intersections, a heavy vehicle percentage of 2.0% was assumed.

The results of the intersection analyses considering 2023 No Build and 2023 Build conditions are summarized in Table 18.

Table 18: AM and PM Peak Hour Intersection LOS Analysis Summary (2023)

AM and PM Peak Hour Intersection LOS Analysis Summary (2023)					
Intersection	Control Type	Level of Service/Delay (seconds)			
		AM		PM	
		2023 No Build	2023 Build	2023 No Build	2023 Build
I-77 NB & Celanese Road	Stop Controlled	C/18.3	C/18.3	E/40.3	E/40.0
I-77 SB & Celanese Road	Signalized	B/17.6	B/13.1	D/43.2	D/42.2
I-77 SB & Cherry Road	Signalized	F/138.2	E/68.4	F/157.9	E/63.2
I-77 NB & One Carolina Drive	Signalized	-	B/11.8	-	B/10.3
I-77 SB/Blue and Black Boulevard & One Carolina Drive	Signalized	-	C/34.7	-	C/22.1
One Carolina Drive & Hiram Way	Signalized	-	B/11.2	-	A/7.5
I-77 NB & Dave Lyle Boulevard	Signalized	C/20.5	B/15.9	C/26.8	C/25.1
I-77 SB & Dave Lyle Boulevard	Signalized	B/15.2	B/16.4	D/49.4	D/49.7

As shown in Table 18, the intersection of the I-77 SB ramps at Cherry Road is anticipated to operate at LOS F during the AM and PM peak hours for the year 2023 No Build scenario, and LOS E in the 2023 Build scenario. This improvement can likely be attributed to the reduction in traffic at this interchange as a result of the new interchange access point being implemented. In the Build scenario, the proposed interchange intersections are anticipated to operate at LOS C or better during the peak hours, and all other intersections are anticipated to operate similarly or at an improved LOS as compared to the No Build scenario.

4.3 Horizon Year 2043 Analyses

For 2023 Build conditions, the proposed I-77 and Panthers interchange configuration is a Partial Cloverleaf E, which has two quadrants (southeast and northwest) that include off-ramps and dual-lane loop on-ramps providing for all interchange movements.

4.3.1 Freeway Facility Analyses – 2043 No Build

The results of the freeway facility analyses considering 2043 No Build conditions for the AM and PM peak hours are summarized in Table 19. The HCS analysis results reports for the freeway facility analyses for 2043 No Build conditions are included in Appendix G.

Table 19: Freeway Facility LOS Analysis Summary (2043 No Build)

Freeway Facility LOS Analysis Summary (2043 No Build)												
I-77 Section	Southbound AM (PM)						Northbound AM (PM)					
	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS
North of Celanese Road	-	6,617 (9,242)	60.9 (43.1)	31.8 (61.4)	FS	D (F)	-	8,709 (7,630)	46.6 (55.3)	54.5 (40.2)	FS	F (E)
On/Off North of Celanese Road/Cherry Road	4,275 (4,839)	6,617 (9,242)	49.4 (48.1)	37.2 (47.3)	D	F (F)	4,276 (4,119)	4,433 (3,511)	Error (19.0)	32.4 (27.1)	M	F (C)
At Celanese Road/Cherry Road	-	2,342 (4,403)	65.0 (65.0)	10.6 (19.4)	FS	A (C)	-	4,433 (3,511)	65.0 (65.0)	19.9 (15.8)	FS	C (B)
On/Off South of Celanese Road/Cherry Road	1,033 (1,242)	2,342 (4,403)	58.4 (56.6)	17.6 (26.4)	M	B (C)	1,282 (1,324)	5,715 (4,835)	52.1 (52.1)	33.7 (29.9)	D	D (D)
At Eden Terrace	-	3,375 (5,645)	65.0 (64.3)	15.2 (25.1)	FS	B (C)	-	5,715 (4,835)	64.0 (65.0)	26.1 (21.7)	FS	D (C)
On/Off North of Dave Lyle Boulevard	815 (1,622)	3,375 (5,645)	56.3 (54.4)	21.7 (35.5)	D	C (E)	2,465 (2,325)	3,250 (2,510)	53.6 (56.3)	29.9 (25.9)	M	D (C)
At Dave Lyle Boulevard	-	2,560 (4,023)	65.0 (65.0)	11.5 (17.7)	FS	B (B)	-	3,250 (2,510)	65.0 (65.0)	14.6 (11.3)	FS	B (B)
On/Off South of Dave Lyle Boulevard	438 (1,131)	2,560 (4,023)	58.4 (56.8)	14.7 (25.4)	M	B (C)	1,333 (1,218)	4,583 (3,728)	55.0 (55.3)	27.4 (22.9)	D	C (C)
South of Dave Lyle Boulevard	-	2,998 (5,154)	65.0 (64.9)	13.5 (22.7)	FS	B (C)	-	4,583 (3,728)	65.0 (65.0)	20.6 (16.7)	FS	C (B)

Note: ¹FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area

As shown in Table 19, the southbound basic freeway segment and diverge segment north of Celanese Road are anticipated to operate at LOS F for the year 2043 No Build conditions. Additionally, the northbound basic freeway segment and merge segment north of Celanese Road are anticipated to operate at LOS F during the AM peak hour—it should be noted that the average speed in this merge area could not be calculated in the HCS software, likely due to the excessive traffic volume in this segment. The southbound diverge segment at Dave Lyle Boulevard is anticipated to operate at LOS E in the PM peak hour for the year 2043 No Build conditions. The increases in density and degraded LOS at these locations are likely attributed to the high growth rates expected in the area used to develop the year 2043 No Build volumes, as well as the addition of Panthers development traffic on existing interchanges.

A weaving segment capacity analysis was performed for the weaving segments on the northbound CD road connecting the Cherry Road and Celanese Road interchanges. The results of the weaving analysis for the 2043 No Build conditions are shown in Table 20.

Table 20: Weaving Segment LOS Analysis Summary (2043 No Build)

Weaving Segment LOS Analysis Summary (2043 No Build)		
Segment	LOS (Density [pc/mi/ln])	
	AM	PM
I-77 NB CD road, between Cherry Road NB On-Loop and Cherry Road NB Off- Loop	F (46.0)	F ¹
I-77 NB CD road, between Celanese Road NB On-Loop and Celanese Road NB Off-Loop	F ¹	F ¹
Note: ¹ v/c ratio greater than 1.0		

As shown in Table 20, the weaving segments on the CD road between the Cherry Road and Celanese Road loop ramps are anticipated to operate at LOS F during the AM and PM peak hours under the 2043 No Build conditions, due to the high growth rates expected in the area and the addition of Panthers development traffic onto the existing interchanges.

4.3.2 Freeway Facility Analyses – 2043 Build

The results of the freeway facility analyses considering 2043 Build conditions for the AM and PM peak hours are summarized in Table 21. The HCS analysis results reports for the freeway facility analyses for 2043 Build conditions are included in Appendix G.

Table 21: Freeway Facility LOS Analysis Summary (2043 Build)

Freeway Facility LOS Analysis Summary (2043 Build)												
I-77 Section	Southbound AM (PM)						Northbound AM (PM)					
	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS	Ramp Volume [veh/hr]	Mainline Volume [veh/hr]	Average Speed [mph]	Density [pc/mi/ln]	Type ¹	LOS
North of Celanese Road	-	6,617 (9,242)	60.9 (43.1)	31.8 (61.4)	FS	D (F)	-	8,709 (7,630)	46.6 (55.3)	54.5 (40.2)	FS	F (E)
On/Off North of Celanese Road/Cherry Road	2,163 (3,773)	6,617 (9,242)	54.4 (50.7)	21.6 (39.5)	D	C (F)	3,397 (2,148)	5,312 (5,482)	13.7 (53.0)	28.3 (18.0)	M	F (B)
At Celanese Road/Cherry Road	-	4,454 (5,469)	65.0 (64.6)	20.1 (24.2)	FS	C (C)	-	5,312 (5,482)	64.7 (64.4)	23.9 (24.8)	FS	C (C)
On/Off South of Celanese Road/Cherry Road	1,033 (761)	4,454 (5,469)	56.9 (56.7)	25.3 (26.3)	M	C (C)	1,282 (1,324)	6,594 (6,806)	52.1 (52.1)	37.5 (38.5)	D	E (E)
Between On/Off South of Celanese Road/Cherry Road and On/Off North of One Carolina Drive	-	5,487 (6,230)	64.4 (62.9)	25.0 (28.3)	FS	C (D)	-	6,594 (6,806)	61.1 (60.1)	31.5 (33.0)	FS	D (D)
On/Off North of One Carolina Drive	2,112 (1,066)	5,487 (6,230)	53.2 (55.7)	24.3 (19.3)	D	C (B)	879 (1,971)	5,715 (4,835)	55.2 (50.8)	27.9 (33.7)	M	C (D)
At One Carolina Drive	-	3,375 (5,164)	65.0 (64.9)	15.2 (22.8)	FS	B (C)	-	5,715 (4,835)	64.0 (65.0)	26.1 (21.7)	FS	D (C)
On/Off South of One Carolina Drive	363 (1,480)	3,375 (5,164)	58.0 (53.6)	15.2 (30.5)	M	B (D)	920 (768)	6,635 (5,603)	56.0 (56.4)	34.7 (29.3)	D	D (D)
Between On/Off South of One Carolina Drive and On/Off North of Dave Lyle Boulevard	-	3,738 (6,644)	65.0 (61.4)	16.8 (30.9)	FS	B (D)	-	6,635 (5,603)	60.9 (64.2)	31.8 (25.4)	FS	D (C)
On/Off North of Dave Lyle Boulevard	815 (1,622)	3,738 (6,644)	56.3 (54.4)	23.3 (39.8)	D	C (E)	2,465 (2,325)	4,170 (3,278)	50.1 (54.6)	33.2 (28.7)	M	D (D)
At Dave Lyle Boulevard	-	2,923 (5,022)	65.0 (65.0)	13.2 (22.1)	FS	B (C)	-	4,170 (3,278)	65.0 (65.0)	18.7 (14.7)	FS	C (B)
On/Off South of Dave Lyle Boulevard	75 (132)	2,923 (5,022)	58.5 (57.8)	13.0 (20.7)	M	B (C)	413 (450)	4,583 (3,728)	57.2 (57.1)	22.3 (18.7)	D	C (B)
South of Dave Lyle Boulevard	-	2,998 (5,154)	65.0 (64.9)	13.5 (22.7)	FS	B (C)	-	4,583 (3,728)	65.0 (65.0)	20.6 (16.7)	FS	C (B)

Note: ¹ FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area

As shown in Table 21, the southbound basic freeway segment and diverge segment north of Celanese Road are anticipated to operate at LOS F in the PM peak hour for the year 2043 Build conditions. It should be noted that both of these locations are also anticipated to operate at LOS F under 2043 No Build conditions.

The southbound Dave Lyle Boulevard diverge segment is anticipated to operate at LOS E in the PM peak hour for the year 2043 Build conditions, which is consistent with the year 2043 No Build scenario and is likely attributed to the increased traffic on the I-77 mainline.

Additionally, the northbound basic freeway segment and merge segment north of Celanese Road are anticipated to operate at LOS F during the AM and PM peak hours.

All merge and diverge segments associated with the proposed One Carolina Drive interchange are anticipated to operate at LOS D or better under year 2043 Build conditions.

A weaving segment capacity analysis was performed for the weaving segments on the northbound CD road connecting the Cherry Road and Celanese Road interchanges. The results of the weaving analysis for the 2043 Build conditions are shown in Table 22.

Table 22: Weaving Segment LOS Analysis Summary (2043 Build)

Weaving Segment LOS Analysis Summary (2043 Build)		
Segment	LOS (Density [pc/mi/ln])	
	AM	PM
I-77 NB CD road, between Cherry Road NB On-Loop and Cherry Road NB Off-Loop	D (32.6)	C (26.0)
I-77 NB CD road, between Celanese Road NB On-Loop and Celanese Road NB Off-Loop	F ¹	F (40.5)
Note: ¹ v/c ratio greater than 1.0		

As shown in Table 22, the weaving segment on the CD road between the Celanese Road loop ramps is anticipated to operate at LOS F during the AM and PM peak hours 2043 Build conditions. The weaving section at the Cherry Road Northbound CD is anticipated to operate at LOS D or better during the peak hours under year 2043 Build conditions. As compared to the year 2043 No Build conditions, the operations at these weaving locations are improved as a result of the traffic redistribution reduction associated with the new interchange.

To more easily compare the results between scenarios, Table 23 shows the comparison of 2043 No Build and Build scenarios for the freeway facility analysis.

Table 23: 2043 Horizon Year Freeway Facility LOS Summary Comparison

2043 Freeway Facility LOS Analysis Summary Comparison												
I-77 Section	2043 No Build Southbound AM(PM)			2043 Build Southbound AM(PM)			2043 No Build Northbound AM(PM)			2043 Build Northbound AM(PM)		
	Density [pc/mi/ln]	Type¹	LOS	Density [pc/mi/ln]	Type¹	LOS	Density [pc/mi/ln]	Type¹	LOS	Density [pc/mi/ln]	Type¹	LOS
North of Celanese Road	31.8 (61.4)	FS	D (F)	31.8 (61.4)	FS	D (F)	54.5 (40.2)	FS	F (E)	54.5 (40.2)	FS	F (E)
On/Off North of Celanese Road/Cherry Road	37.2 (47.3)	D	F (F)	21.6 (39.5)	D	C (F)	32.4 (27.1)	M	F (C)	28.3 (18.0)	M	F (B)
At Celanese Road/Cherry Road	10.6 (19.4)	FS	A (C)	20.1 (24.2)	FS	C (C)	19.9 (15.8)	FS	C (B)	23.9 (24.8)	FS	C (C)
On/Off South of Celanese Road/Cherry Road	17.6 (26.4)	M	B (C)	25.3 (26.3)	M	C (C)	33.7 (29.9)	D	D (D)	37.5 (38.5)	D	E (E)
Between On/Off South of Celanese Road/Cherry Road and On/Off North of One Carolina Drive	-	-	-	25.0 (28.3)	FS	C (D)	-	-	-	31.5 (33.0)	FS	D (D)
On/Off North of One Carolina Drive	-	-	-	24.3 (19.3)	D	C (B)	-	-	-	27.9 (33.7)	M	C (D)
At One Carolina Drive	15.2 (25.1)	FS	B (C)	15.2 (22.8)	FS	B (C)	26.1 (21.7)	FS	D (C)	26.1 (21.7)	FS	D (C)
On/Off South of One Carolina Drive	-	-	-	15.2 (30.5)	M	B (D)	-	-	-	36.3 (30.9)	D	D (D)
Between On/Off South of One Carolina Drive and On/Off North of Dave Lyle Boulevard	-	-	-	16.8 (30.9)	FS	B (D)	-	-	-	31.8 (25.4)	FS	D (C)
On/Off North of Dave Lyle Boulevard	21.7 (35.5)	D	C (E)	23.3 (39.8)	D	C (E)	29.9 (25.9)	M	D (C)	33.2 (28.7)	M	D (D)
At Dave Lyle Boulevard	11.5 (17.7)	FS	B (B)	13.2 (22.1)	FS	B (C)	14.6 (11.3)	FS	B (B)	18.7 (14.7)	FS	C (B)
On/Off South of Dave Lyle Boulevard	14.7 (25.4)	M	B (C)	13.0 (20.7)	M	B (C)	27.4 (22.9)	D	C (C)	22.3 (18.7)	D	C (B)
South of Dave Lyle Boulevard	13.5 (22.7)	FS	B (C)	13.5 (22.7)	FS	B (C)	20.6 (16.7)	FS	C (B)	20.6 (16.7)	FS	C (B)
Note: ¹FS = Basic Freeway Segment, D = Diversion Area, M = Merge Area												

Note: ¹FS = Basic Freeway Segment, D = Diverge Area, M = Merge Area

As shown in Table 23, the freeway facilities are anticipated to operate at similar or improved Levels of Service in the Build analyses—with the exception of the northbound diverge at the Celanese Road/Cherry Road off ramp. The increase in density at this location is likely attributed to the redistribution of traffic to the mainline by utilizing the One Carolina Drive northbound on ramp instead of the Cherry Road/Celanese Road northbound on ramp. In order to maintain LOS D at this location in the 2043 Build scenario, the northbound off ramp at the Celanese Road/Cherry Road interchange would require lengthening the existing 300 foot deceleration length to a minimum of 600 feet. However, the deceleration length at this diverge area is constrained by the Eden Terrace overpass bridge which is located approximately 450 feet from the existing marked gore and does not have sufficient lateral width to accept an additional northbound auxiliary lane under the bridge structure. Due to these constraints, a full replacement of the Eden Terrace overpass bridge would be required to implement the above mentioned improvements.

4.3.3 Intersection Analyses – 2043 No Build and Build

As part of the 2043 No Build and Build analyses, the existing geometry at the adjacent interchanges were used. Additionally, a peak hour factor of 0.90 and the existing truck percentages were used where heavy vehicle data were available. For the proposed new interchange intersections, a heavy vehicle percentage of 2.0% was assumed.

The results of the intersection analyses considering 2043 No Build and 2043 Build conditions are summarized in Table 24.

Table 24: AM and PM Peak Hour Intersection LOS Analysis Summary (2043)

AM and PM Peak Hour Intersection LOS Analysis Summary (2043)					
Intersection	Control Type	Level of Service/Delay (seconds)			
		AM		PM	
		2043 No Build	2043 Build	2043 No Build	2043 Build
I-77 NB & Celanese Road	Stop Controlled	F/105.7	F/105.3	F/450.3	F/441.9
I-77 SB & Celanese Road	Signalized	F/101.7	F/80.5	F/194.4	F/179.0
I-77 SB & Cherry Road	Signalized	F/607.6	D/49.9	F/469.8	F/195.1
I-77 NB & One Carolina Drive	Signalized	-	C/24.6	-	B/17.3
I-77 SB/Blue and Black Boulevard & One Carolina Drive	Signalized	-	D/40.7	-	D/52.6
One Carolina Drive & Hiram Way	Signalized	-	C/21.6	-	C/23.6
I-77 NB & Dave Lyle Boulevard	Signalized	F/256.1	F/158.5	F/454.2	F/438.6
I-77 SB & Dave Lyle Boulevard	Signalized	F/87.3	F/91.4	F/363.1	F/372.2

As shown in Table 24, the intersection of the I-77 SB ramps at Cherry Road and Celanese Road are anticipated to operate at LOS F during the AM and PM peak hours for the year 2043 No Build scenarios. For the 2043 Build scenario, these locations are anticipated to have improved operations likely as a result of traffic redistribution reduction and the addition of the new interchange for Panthers development traffic. In the Build scenario, the proposed interchange intersections are anticipated to operate at LOS D or better during the peak hours, and all other intersections are anticipated to operate similarly or at an improved LOS as compared to the No Build scenario.

In an effort to assess if there are any expected queue spillbacks onto I-77 as a result of the new interchange and associated development, SimTraffic 95th percentile queues were reviewed and are provided for horizon year 2043 in Table 25.

Table 25: AM and PM Peak Hour Intersection 95th Percentile Queueing Summary (2043)

SimTraffic 95 th Percentile Queue At One Carolina Drive Signal System													
Intersection	Condition	EB			WB			NB			SB		
		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
AM Peak Hour													
One Carolina Drive at I-77 NB Ramps	2043 Build	-	138'	24'	90'	123'	-	267'	-	0'	-	-	-
One Carolina Drive at I-77 SB Ramps		90	317'	117'	260'	119'	0'	42'	103'	68'	69'	196'	143'
PM Peak Hour													
One Carolina Drive at I-77 NB Ramps	2043 Build	-	206'	83'	61'	218'	-	248'	-	0'	-	-	-
One Carolina Drive at I-77 SB Ramps		315	309'	71'	401'	717'	157'	262'	392'	349'	51'	321'	197'

As shown in Table 25, no queues spillback onto the interstate during the AM and PM peak hours. As no spillbacks were found in the year 2043 results, the results for year 2023 are not specifically mentioned here, but are included in the Appendix. The 95th percentile queueing analysis was not performed for the adjacent interchanges as it is expected that the traffic redistribution associated with the addition of the One Carolina Drive interchange will reduce queuing at those locations.

5 Interstate Crash History Analysis

A crash history analysis was performed as part of the proposed One Carolina Drive IJR. Historic crash data were obtained for the segment of I-77 from mile marker 78.0 to mile marker 82.0. For this analysis, the extents of the crash data were reduced to cover from mile marker 79.0 (I-77 at Dave Lyle Boulevard interchange) to mile marker 81.5 (I-77 at Cherry Road interchange). The mainline interstate crashes are summarized as part of the IJR development. In this section, I-77 is an 8-lane divided interstate system with a posted speed limit of 60 mph.

For this analysis, three and a half (3.5) years (1/1/2016 to 6/30/2019) of crash data were provided by SCDOT. These crash data were reviewed with an intent to quantify the types and severity of crashes and identify trends and potential safety issues.

Overall, a total of 291 crashes were recorded during the 3.5 year analysis period. Crashes were reviewed based on temporal trends, severity, surface condition, lighting condition, and manner of collision. Most crashes occurred during year 2016 accounting for 126 crashes (43%). Upon further review, it was discovered that the I-77 bridge crossing the Catawba River (north of the study area) was undergoing emergency deck improvements in year 2016, which likely contributed to the increase in crashes during that year.

Crashes were analyzed by Day of the Week which found that crashes are fairly evenly distributed amongst days, with Monday and Friday being only slightly higher than other days. Monthly trends were also evaluated, which found that crashes are fairly evenly distributed amongst months of the year, with January, June, and December being only slightly higher than other months, and September being the month with the least amount of crashes.

Among the 291 crashes there were 5 fatal crashes (2%) with a total of 6 fatalities, 65 injury crashes (22%) among them 46 Possible injury crashes, 16 Non-Incapacitating Injury crashes, and 3 Incapacitating Injury crashes. The most frequent crash severity was Property Damage Only (PDO) with 221 crashes (76%).

Additionally, crashes were analyzed based on lighting condition and pavement condition. The analysis found that 194 crashes (67%) occurred during daylight conditions and 97 crashes (33%) occurred during nighttime conditions. Based on pavement conditions, 249 of the total crashes (86%) occurred on dry pavement conditions and 42 crashes (14%) occurred on wet pavement conditions.

Crashes were also analyzed by manner of collision. The most common crash type reported was Rear End with a total of 138 crashes (47%). The second most common manner of collision was Sideswipe which accounted for 60 of the total crashes (21%).

When analyzed by Probable Cause, the analysis found that 118 crashes (41%) occurred due to driving too fast for conditions. The second most frequent probable cause was improper lane change which accounted for 60 of the total crashes (21%).

The summary tables for the crashes by Year, Day of the Week, Month of the Year, Severity, Lighting Condition, Surface Condition, Manner of Collision and Probable Cause are shown in Table 26 through Table 33.

Table 26: I-77 Study Area Crashes by Year

I-77 Study Area Crashes by Year					
	2016	2017	2018	2019*	Total
Crashes per Year	126	67	65	33	291
Percentage	43%	23%	22%	11%	100%

* 2019 Crashes represent 1/1/2019 to 6/30/2019

Table 27: I-77 Study Area Crashes by Day of the Week

I-77 Study Area Crashes by Day of the Week		
Day of the Week	Total	Percentage
Sunday	38	13%
Monday	52	18%
Tuesday	35	12%
Wednesday	29	10%
Thursday	42	14%
Friday	54	19%
Saturday	41	14%
Grand Total	291	100%

Table 28: I-77 Study Area Crashes by Month of the Year

I-77 Study Area Crashes by Month of the Year		
Month of the Year	Total	Percentage
January	32	11%
February	19	7%
March	30	10%
April	25	9%
May	23	8%
June	33	11%
July	26	9%
August	17	6%
September	9	3%
October	20	7%
November	24	8%
December	33	11%
Grand Total	291	100%

Table 29: I-77 Study Area Crashes by Severity

I-77 Study Area Crashes by Severity		
Injury Type	Total	Percentage
Fatality Crashes	5	2%
Possible Injury Crashes	46	16%
Non-Incapacitating Injury Crashes	16	5%
Incapacitating Injury Crashes	3	1%
PDO	221	76%
Grand Total	291	100%

Table 30: I-77 Study Area Crashes by Lighting Condition

I-77 Study Area Crashes by Lighting Condition		
Lighting Condition	Total	Percentage
Day	194	67%
Night	97	33%
Grand Total	291	100%

Table 31: I-77 Study Area Crashes by Surface Condition

I-77 Study Area Crashes by Surface Condition		
Surface Condition	Total	Percentage
Dry	249	86%
Wet	42	14%
Grand Total	291	100%

Table 32: I-77 Study Area Crashes by Manner of Collision

I-77 Study Area Crashes by Manner of Collision		
Manner of Collision	Total	Percentage
Rear End	138	47%
Sideswipe	60	21%
Angle	17	6%
Run Off Road	44	15%
Animal	2	1%
Pedestrian	1	0%
Head On	1	0%
Bicycle	0	0%
Other	28	10%
Grand Total	291	100%

Table 33: I-77 Study Area Crashes by Probable Cause

I-77 Study Area Crashes by Probable Cause		
Probable Cause	Total	Percentage
Driving Too Fast for Conditions	118	41%
Improper Lane Usage/Change	60	21%
Distracted/Inattention	24	8%
Followed Too Closely	18	6%
Under The Influence	17	6%
Debris	11	4%
Cargo	9	3%
Fail To Yield Right of Way	8	3%
Other Improper Act	5	2%
Aggressive Operation of Vehicle	3	1%
Tires/Wheel	3	1%
Animal in Road	2	1%
Disregarded Signs, Signals, Etc.	2	1%
Improper Crossing	1	0%
Made an Improper Turn	1	0%
Medical Related	1	0%
Obstruction in Roadway	1	0%
Overcorrecting/Oversteering	1	0%
Rut, Holes, Bumps	1	0%
Vision Obscured (within Unit)	1	0%
Unknown	4	1%
Grand Total	291	100%

There were five (5) fatal crashes on this section of I-77 during the 3.5 year analysis period. The fatal crashes are summarized by condition as follows:

- **Lighting Condition** - Three (3) of the fatal crashes occurred during Daytime and two (2) during Nighttime conditions
- **Pavement Condition** – Four (4) of the fatal crashes occurred under Dry pavement conditions and one (1) occurred under Wet pavement conditions
- **Manner of Collision** – Three (3) of the crashes were Rear End, one (1) Pedestrian, and one (1) Other Moveable Object.
- **Probable Cause** – Two (2) of the crashes were due to Driving Too Fast for Conditions, one (1) Driving Under Influence, one (1) Improper Crossing, and one (1) Debris

To gain a better understanding of the fatal crashes within the study area, the Traffic Collision Report Form (TR 310) reports for the fatal crashes (provided by SCDOT) were reviewed. This review found that the five (5) fatal crashes resulted in six (6) total fatalities. A brief description of each fatal crash is below:

Crash 1: Occurred at mile marker 79.2 north of Dave Lyle Boulevard during nighttime, dry pavement conditions. An unknown object (debris) struck the windshield of a northbound vehicle causing it to lose power and become disabled. The disabled vehicle was struck in the rear (possible injury) by another vehicle that was driving too fast for conditions due to inattention (possible injury). A third vehicle that was also driving too fast for conditions due to inattention struck the left rear end of the second vehicle. The driver of the third vehicle was killed. The crash occurred on June 18, 2018.

Crash 2: Occurred at mile marker 79.7 north of Dave Lyle Boulevard during nighttime, dry pavement conditions. A pedestrian under influence of drugs was crossing the southbound direction of the interstate. A vehicle traveling southbound struck the pedestrian and then struck the median wall. A second vehicle traveling southbound also struck the pedestrian. The pedestrian was killed and there were no injuries for the occupants of the vehicles. The crash occurred on October 22, 2017.

Crash 3: Occurred at mile marker 80.1 south of Eden Terrace Bridge during daytime, dry pavement conditions. A vehicle was traveling northbound and was rear ended by a second vehicle driving too fast for conditions with the driver under the influence. Both vehicles ran off the right side of the road, down an embankment, and struck trees—the first vehicle overturned. The front seat passenger in the first vehicle was killed, the driver of the first vehicle suffered an incapacitating injury. The driver of the second vehicle had a possible injury. The crash occurred on June 9, 2016.

Crash 4: Occurred at mile marker 80.3 south of Eden Terrace Bridge during daytime, wet pavement conditions. A vehicle on southbound I-77 slowed down to pull onto the shoulder, a second vehicle slowed down and was rear ended by a third vehicle. The third vehicle then hit the first vehicle, then ran off the road to the right and struck a tree. The driver of the third vehicle was killed. All other occupants involved had no apparent injuries. The crash occurred on November 6, 2018.

Crash 5: Occurred at mile marker 81.10 south of Cherry Road during daytime, dry pavement conditions. A northbound vehicle was stopped in a travel lane due running out of gas and had its hazard lights on—the report states that this driver was under the influence of drugs. A second vehicle that was traveling too fast for conditions due to inattention made a lane change and struck the first vehicle in the rear. The driver and backseat (driver's side) passenger of the first vehicle were both killed. Two passengers-

side passengers in the first vehicle suffered injuries. The driver of the second vehicle suffered non-incapacitating injuries. The crash occurred on November 17, 2019.

Based on this review of the crashes within the study area, no unusual trends or crash types susceptible to correction in the design of the new interchange were identified. As the probable causes contributing to the most crashes were found to be Driving Too Fast for Conditions and Improper Lane Change, it is possible that increased enforcement in the area could potentially reduce crashes.

6 FHWA Policy Requirements

The Federal Law Section 111 of Title 23, United States Code (23 USC 111) requires that proposed new or revised access points to the Interstate System must be approved by the FHWA before such modifications can be made. **The FHWA policy states:** *It is in the national interest to preserve and enhance the Interstate System to meet the needs of the 21st Century by assuring that it provides the highest level of service in terms of safety and mobility. Full control of access along the Interstate mainline and ramps, along with control of access on the crossroad at interchanges, is critical to providing such service.*

FHWA policy states that all requests for new or revised access points to the Interstate System must include sufficient supporting information to allow FHWA to independently evaluate the request and ensure that all pertinent factors and alternatives have been appropriately considered. The Interchange Justification Report needs to address the following policy requirements as listed in the Federal Register.

- 1. An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C 109(d) and 23 CFR 655.603(d)).***

The analysis of the Interstate System within the identified study area includes:

- Exit 82 ABC (Celanese Road / Cherry Road)
- Exit 81 Proposed One Carolina Drive Interchange
- Exit 79 Dave Lyle Boulevard

The analysis, which was developed using methodologies and practices contained in the 2000 and 2010 editions of the Transportation Research Board *Highway Capacity Manual (HCM)*, indicates that the proposed interchange will serve the anticipated traffic associated with the Panthers development, as well as reduce congestion at the adjacent interchanges at Celanese Road/Cherry Road and Dave Lyle Boulevard.

Conceptual plans of the proposed design alternative and signing plans can be found earlier in this report.

Based on the findings of this IJR analysis, the I-77 freeway facilities are anticipated to operate at similar or improved Levels of Service in the 2043 Build scenario —with the exception of the northbound diverge at the Celanese Road/Cherry Road off ramp. The increase in density at this location is likely attributed to the redistribution of traffic to the mainline by utilizing the One Carolina Drive northbound on ramp instead of the Cherry Road/Celanese Road northbound on ramp. In order to maintain LOS D at this location in the 2043 Build scenario, the northbound off ramp at the Celanese Road/Cherry Road interchange would require lengthening the existing 300 foot deceleration length to a minimum of 600 feet. However, the deceleration length at this diverge area is constrained by the Eden Terrace overpass bridge which is located approximately 450 feet from the existing marked gore and does not have sufficient lateral width to accept an additional northbound auxiliary lane under the bridge structure. Due to these constraints, a full replacement of the Eden Terrace overpass bridge would be required to implement the above mentioned improvements.

The proposed interchange design will meet all current applicable design standards for interstate interchange designs, therefore implementing any safety related elements integrated into the standards.

2. ***The proposed access connects to a public road only and will provide for all traffic movements. Less than “full interchanges” may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.***

As illustrated in Figure 2, the proposed concept provides access for entering and exiting movements of I-77 northbound and southbound, which provides a connection to the proposed Panthers development, cross access to Mt Gallant Road west of the interstate, and cross access to Cel-River Road east of the interstate.