US 460 & College Ave
Corridor Improvements Study

Town of Bluefield, Virginia

AUGUST 2020

US 460 & College Avenue Corridor Improvements Study

Town of Bluefield, Virginia

August 2020

Prepared for

VDOT

Prepared by

RK&K

Responsive People | Creative Solutions

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INTRODUCTION

Background

The Virginia Department of Transportation (VDOT) selected US 460 (C. Jefferson Stafford Hwy) and Route 102 (College Avenue) in the Town of Bluefield as a 2019 STARS project because of identified safety and operational concerns along these corridors. This study is entitled the US 460 & College Avenue Corridor Improvements Study and will be referred to as the Study in this report.

Purpose of Study

The purpose of the Study was to identify the existing safety and operational deficiencies in the US 460 study corridor and develop potential projects to improve safety and operations on US 460 and College Avenue in the Town of Bluefield. The goal of the Study was to identify feasible and cost-effective transportation improvements that can be programmed in the VDOT Six-Year Improvement Program (SYIP).

Study Work Group

A study work group (SWG) was formed for the Study to capture input from local stakeholders and to shape the development of improvement concepts. The SWG provided local and institutional knowledge of the corridor; reviewed study methodologies; provided input on key assumptions; and reviewed and approved proposed improvements created through the study process. The SWG included members representing the following organizations:

- VDOT
- Town of Bluefield
- Bluefield College
- Cumberland Plateau Planning District Commission
- RK&K

Study Area

The study area for the US 460 corridor was approximately 1.8 miles long, located in the Town of Bluefield and oriented in an east/west direction. The limits of the Study extended along US 460 from the interchange at Route 720 (Valley Dale St) to the West Virginia / Virginia state line, just east of the intersection at Leatherwood Lane. The study area for the Route 102 (referred to this in report as College Avenue) corridor was approximately 1.2 miles, also located in the Town of Bluefield and oriented in an east/west direction). The limits of the study extended from the Route 720 (Valley Dale St) intersection to the intersection at Leatherwood Lane. The study also included the route 720 (Valley Dale St) between the intersection of Huffard Drive and College Avenue; these limits include the ramps for the US 460 interchange with Route 720. **Figure 1** shows the limits of the study area.

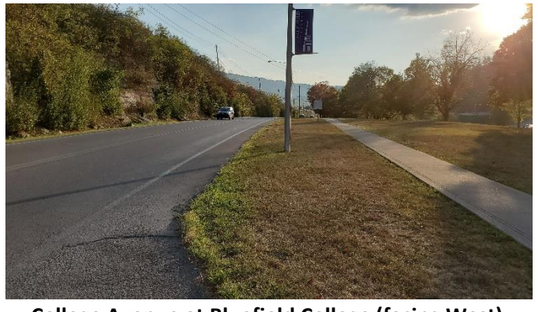
The study area included seventeen intersections. The seventeen intersections are listed below and shown in **Figure 1.**

Study Area Intersections

1. Valley Dale St at Huffard Dr
2. Valley Dale St at US 460 EB Ramp
3. Valley Dale St at US 460 WB Ramps
4. S. College Ave at College Ave
5. College Ave at Sanders Ln
6. College Ave at College Dr
7. College Ave at Ridgeview Plaza
8. College Ave at College Plaza (West Entrance)
9. College Ave at College Plaza (East Entrance)
10. College Ave at Commerce Dr
11. College Ave at Community Dr
12. College Ave at Bluefield College Dr
13. College Ave at Stadium Dr
14. College Ave at Leatherwood Ln
15. Leatherwood Ln at W. Cumberland Dr
16. US 460 at Leatherwood Ln
17. US 460 at Commerce Dr

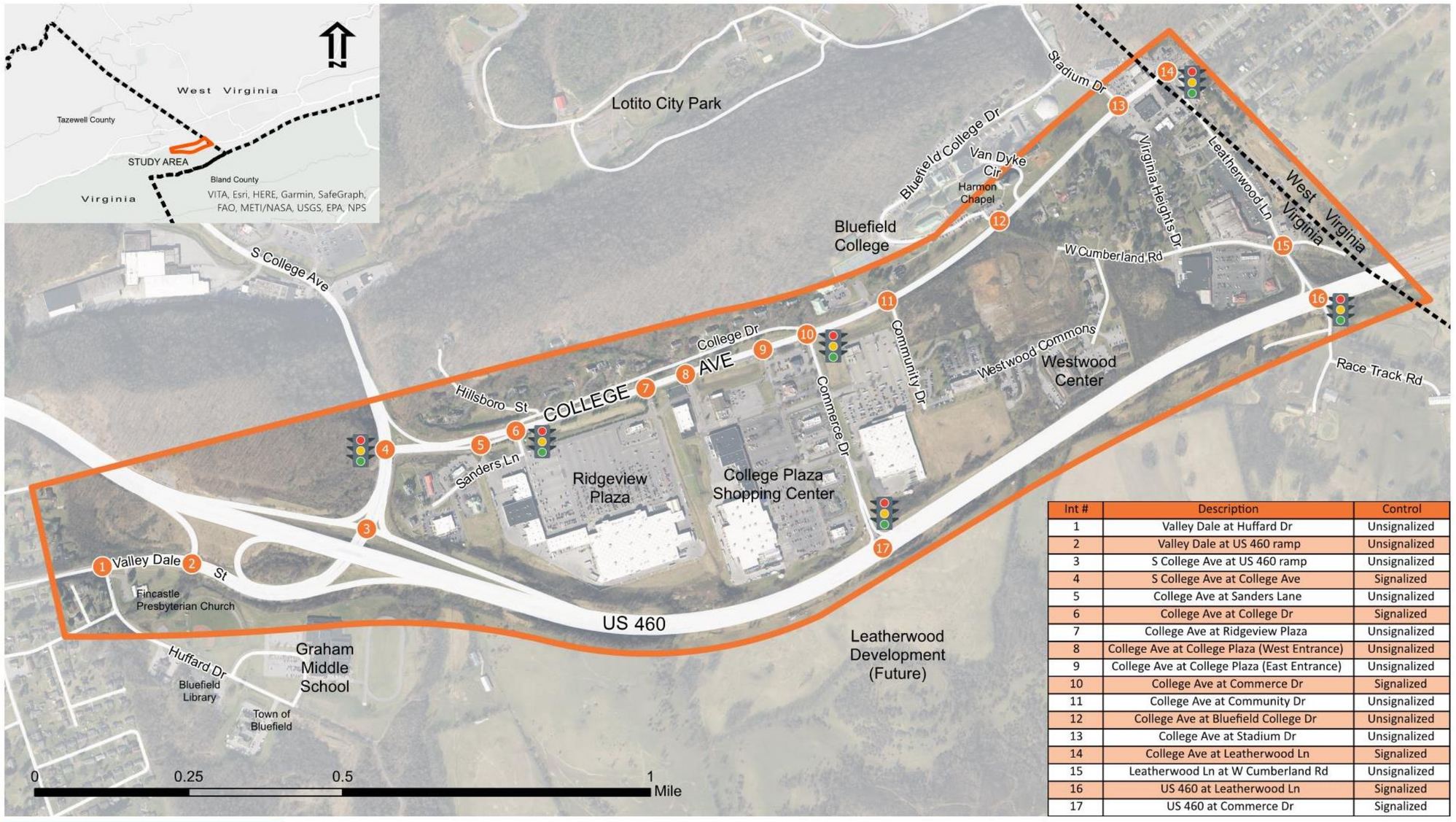
The Study was in a rural setting with rolling terrain. There are areas of commercial development fronting College Avenue and Bluefield College also abuts the study area. The following photos show the nature of the study area. Additional details on the study area are provided in the data collection section of this report.

US 460 at Route 720 interchange (facing east)



College Avenue at Bluefield College (facing West)

Figure 1. Study Area Map



Int #	Description	Control
1	Valley Dale at Huffard Dr	Unsignalized
2	Valley Dale at US 460 ramp	Unsignalized
3	S College Ave at US 460 ramp	Unsignalized
4	S College Ave at College Ave	Signalized
5	College Ave at Sanders Lane	Unsignalized
6	College Ave at College Dr	Signalized
7	College Ave at Ridgeview Plaza	Unsignalized
8	College Ave at College Plaza (West Entrance)	Unsignalized
9	College Ave at College Plaza (East Entrance)	Unsignalized
10	College Ave at Commerce Dr	Signalized
11	College Ave at Community Dr	Unsignalized
12	College Ave at Bluefield College Dr	Unsignalized
13	College Ave at Stadium Dr	Unsignalized
14	College Ave at Leatherwood Ln	Signalized
15	Leatherwood Ln at W Cumberland Rd	Unsignalized
16	US 460 at Leatherwood Ln	Signalized
17	US 460 at Commerce Dr	Signalized

STARS

US 460/COLLEGE AVENUE Corridor Improvements Study
Study Intersections

VDOT

Data Collection and Inventory

A preliminary field review of the study area was conducted on October 2 and 3, 2019 to verify existing conditions and traffic control devices; and observe peak hour traffic conditions and driver behavior. In addition to the field review, existing traffic volume data was collected from a combination of turning movement counts and vehicle classification tube counts. VDOT and the Town of Bluefield provided crash data, existing traffic signal timing plans, and available GIS base mapping data.

The following sections summarize collected data and field review observations.

Description of the Study Area

Field reconnaissance of existing conditions in the study area revealed that the corridor exists within a rural setting with rolling terrain. The following sections provide a summary of US 460 and College Avenue.

US 460

Within the study area, US 460 was a four-lane roadway. The two eastbound travel lanes were separated from the two westbound travel lanes by a variable width grass median. From the West Virginia / Virginia state line to west of Commerce Drive, US 460 was posted with a 55 MPH speed limit and classified as an Other Principal Arterial according to VDOT's 2014 Functional Classification Map. From west of Commerce Drive through the Route 720 interchange and continuing west to US 19, US 460 was posted with a 60 MPH speed limit and it functionally classified as an Other Freeway and Expressway.

College Avenue

Within the study area, College Avenue was a two-lane undivided roadway between Commerce Drive and Leatherwood Lane. Between Route 720 and Commerce Drive, the typical section along College Avenue varied with two-lane, three-lane and four-lane sections observed within this short distance. According to VDOT's 2014 Functional Classification Map, College Avenue between Route 720 and Leatherwood Lane was classified as a Major Collector. The posted speed limit was 35 MPH.

Field Review Observations

During the field review on October 2 and 3, 2019, existing conditions and operations were observed, including the following observations:

- The signalized intersections were not coordinated and vehicles traveling on College Avenue in both directions encountered consecutive red lights
- Vehicles were having difficulty merging and weaving along Route 720 between the ramp from US 460 WB and College Avenue
- Vehicles turning right from northbound Route 720 onto westbound College Avenue were observed not fully stopping
- Unbalanced lane utilization was observed for the northbound through lanes along Route 720 / S. College Avenue at the intersection with College Avenue; the left through lane was more heavily utilized than the right lane.
- Queues were noted throughout the study area, but found to typically clear in one cycle
  - Queues at College Avenue & Commerce Drive were typically 6-10 cars long during peak periods
  - Queues along US 460 at Leatherwood Lane and Commerce Drive were typically 10-15 cars long during peak periods

Eastbound College Ave Queue at Commerce Dr

Westbound US 460 Queue at Leatherwood Ln

- Pedestrians were observed within the Study Area, particularly along College Avenue and Leatherwood Lane, even in segments with no existing sidewalks or other accomodations

Pedestrians along Route 720

Pedestrian crossing Leatherwood Lane

- Sight distance concerns were noted at several the unsignalized intersections/commercial driveways, including:
  - Valley Dale St at Huffard Dr
  - College Ave at College Plaza (east and west entrances)
  - Leatherwood Ln at W. Cumberland Rd

Existing Roadway Geometry

The existing roadway geometry in the study area was observed and documented during the field review. **Figure 2** summarizes the existing lane configurations, including storage and taper lengths, for left- and right-turn storage bays within the study area.

Traffic Volume Data

Collection of turning movement count (TMC) data was conducted at all intersections on May 14, 2019, except for Route 720 (Valley Dale St) at Huffard Drive. Counts for that location were provided by VDOT and collected on March 28, 2018. TMC data was collected between the hours of 7:00 - 7:00 PM at all study area intersections. In addition, 24-hour vehicle classification tube counts were collected at two ramps at the US 460 / Route 720 interchange and the free-flow right-turn from College Avenue westbound to S. College Avenue on May 14, 2019.

Figure 2a. Existing Lane Configurations and Storage Lengths

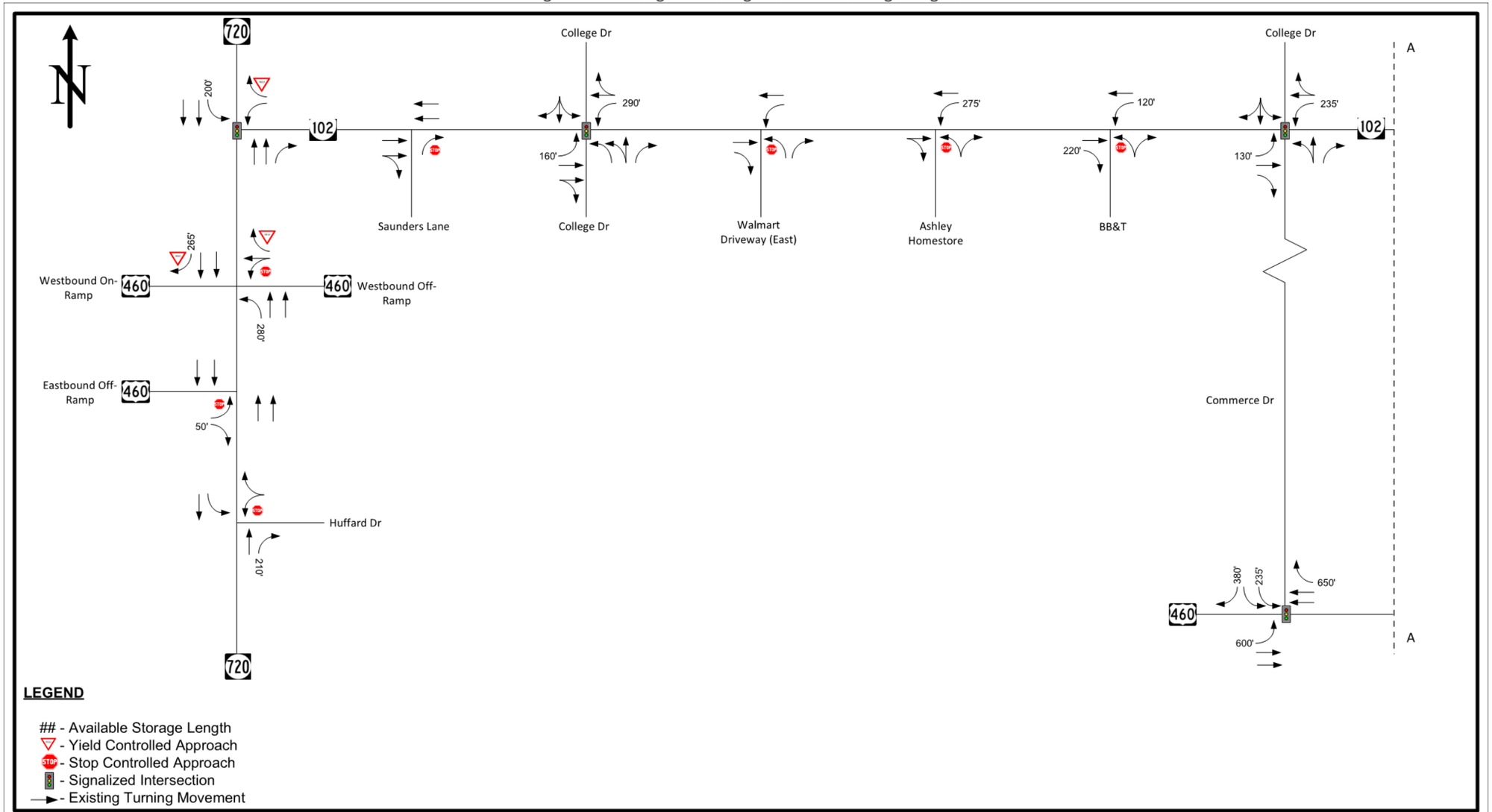
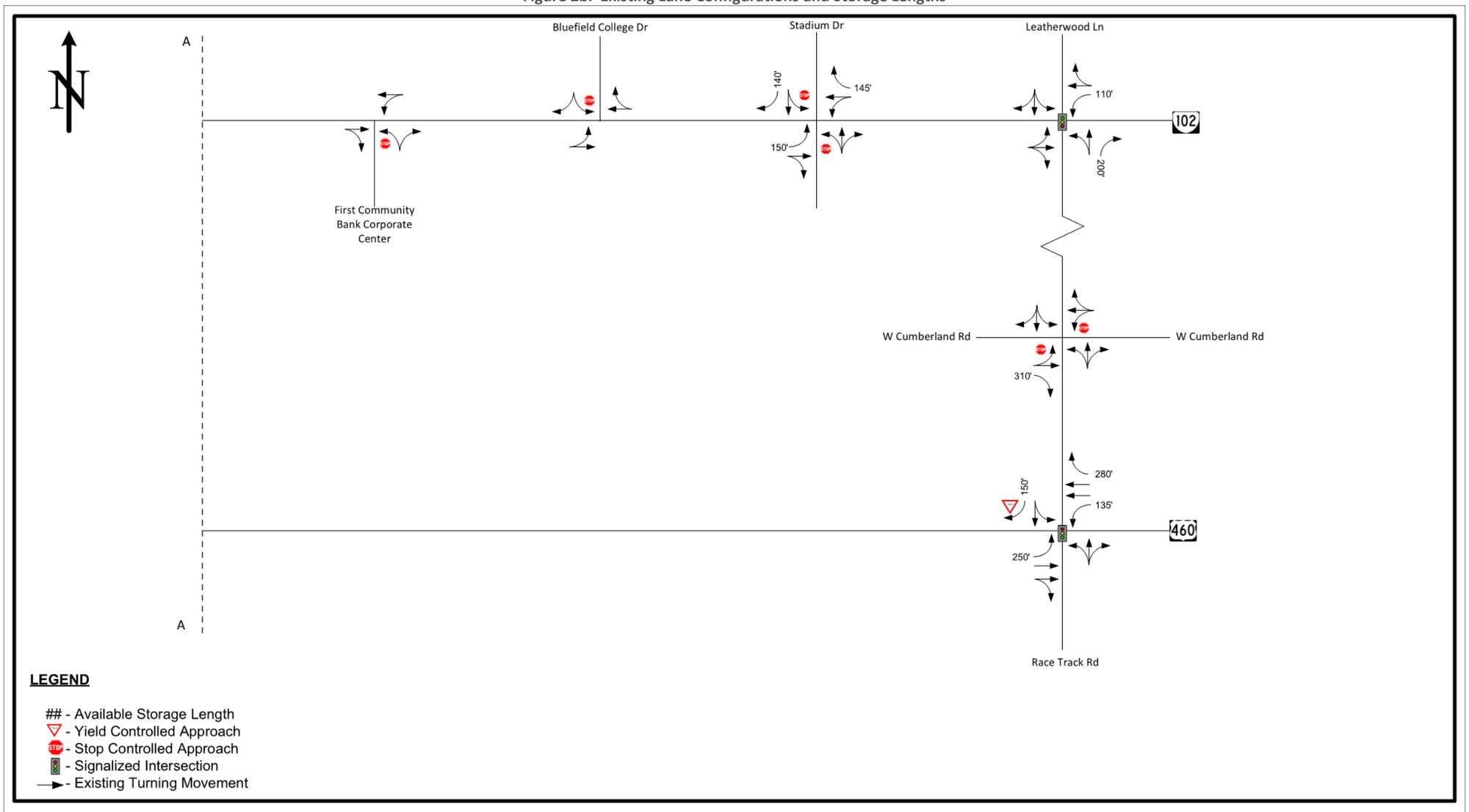


Figure 2b. Existing Lane Configurations and Storage Lengths



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EXISTING (2019) LANE CONFIGURATION & STORAGE LENGTH
US 460 Corridor Improvement Study
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Table 1 summaries the date and source of the count data for each of the 17 study area intersections and three tube count locations. Complete TMC and tube count data is provided in Appendix A.

Table 1 – Study Area Intersection and Ramp Counts

Location	Count Date (Source)
STUDY AREA INTERSECTIONS	
1. Valley Dale St at Huffard Dr	3/28/2018 (TMC)
2. Valley Dale St at US 460 EB Ramp	5/14/2019 (TMC)
3. Valley Dale St at US 460 WB Ramps	5/14/2019 (TMC)
4. S. College Ave at College Ave	5/14/2019 (TMC)
5. College Ave at Sanders Ln	5/14/2019 (TMC)
6. College Ave at College Dr	5/14/2019 (TMC)
7. College Ave at Ridgeview Plaza	5/14/2019 (TMC)
8. College Ave at College Plaza (West Entrance)	5/14/2019 (TMC)
9. College Ave at College Plaza (East Entrance)	5/14/2019 (TMC)
10. College Ave at Commerce Dr	5/14/2019 (TMC)
11. College Ave at Community Dr	5/14/2019 (TMC)
12. College Ave at Bluefield College Dr	5/14/2019 (TMC)
13. College Ave at Stadium Dr	5/14/2019 (TMC)
14. College Ave at Leatherwood Ln	5/14/2019 (TMC)
15. Leatherwood Ln at W. Cumberland Dr	5/14/2019 (TMC)
16. US 460 at Leatherwood Ln	5/14/2019 (TMC)
17. US 460 at Commerce Dr	5/14/2019 (TMC)
RAMPS	
A. SB Route 720 to EB US 460	5/14/2019 (Tube)
B. NB Route 720 to EB US 460	5/14/2019 (Tube)
C. WB College Ave to NB S. College Ave	5/14/2019 (Tube)

VDOT published annual average daily traffic (AADT) volume estimates were also reviewed on US 460 and College Avenue. The 2019 VDOT published AADT volume on US 460 was 16,000 vehicles per day. The 2019 published AADT volume on College Avenue was 12,000 vehicles per day. Historical VDOT AADT volume estimates indicate that traffic volumes have been steady or slightly declining within the study area. Over the five-year period from 2015 to 2019, VDOT AADT volume estimates on US 460 were consistent. Along College Avenue, the published AADT volume estimates declined from 13,000 to 12,000 vehicles per day.

Peak Hour Determination

Based on a preliminary review of the traffic count data and discussions with VDOT and the Study Work Group, it was determined that the appropriate peak periods for analysis would be the Midday and PM peaks. Due to the surrounding commercial land uses and traffic patterns associated with Bluefield College, midday volumes are approximately 30 percent higher than AM peak conditions. PM volumes within the study area are a further 10 percent higher than the Midday peak.

The Midday and PM peak hours of the study area were determined by first reviewing the individual intersection and arterial peak hours. The individual intersection and arterial peak hour volumes were compared to hourly total study area volumes to determine a common peak hour that best represented existing traffic conditions in the study area.

The study team determined that the common peak hour of 12:00 – 1:00 PM best represented the traffic volumes observed during the Midday peak hour in the study corridor. The common peak hour of 4:30 – 5:30 PM was selected for the PM peak period. An intersection peak hour factor (PHF) was calculated for each study area intersection during AM and PM peak hours using the TMC data. The peak hour factors used for the analysis are summarized in **Table 2**.

Table 2 – Peak Hour Factor by Intersection

Intersection	Peak Hour Factor (PHF)	
	Midday Peak Hour	PM Peak Hour
Valley Dale St at Huffard Dr	0.90	0.92
Valley Dale St at US 460 EB Ramp	0.87	0.79
Valley Dale St at US 460 WB Ramps	0.91	0.83
S. College Ave at College Ave	0.89	0.87
College Ave at Sanders Ln	0.98	0.88
College Ave at College Dr	0.93	0.83
College Ave at Ridgeview Plaza	0.96	0.88
College Ave at College Plaza (West Entrance)	0.96	0.90
College Ave at College Plaza (East Entrance)	0.95	0.91
College Ave at Commerce Dr	0.92	0.89
College Ave at Community Dr	0.95	0.84
College Ave at Bluefield College Dr	0.96	0.84
College Ave at Stadium Dr	0.96	0.89
College Ave at Leatherwood Ln	0.92	0.91
Leatherwood Ln at W. Cumberland Dr	0.94	0.96
US 460 at Leatherwood Ln	0.95	0.91
US 460 at Commerce Dr	0.95	0.95

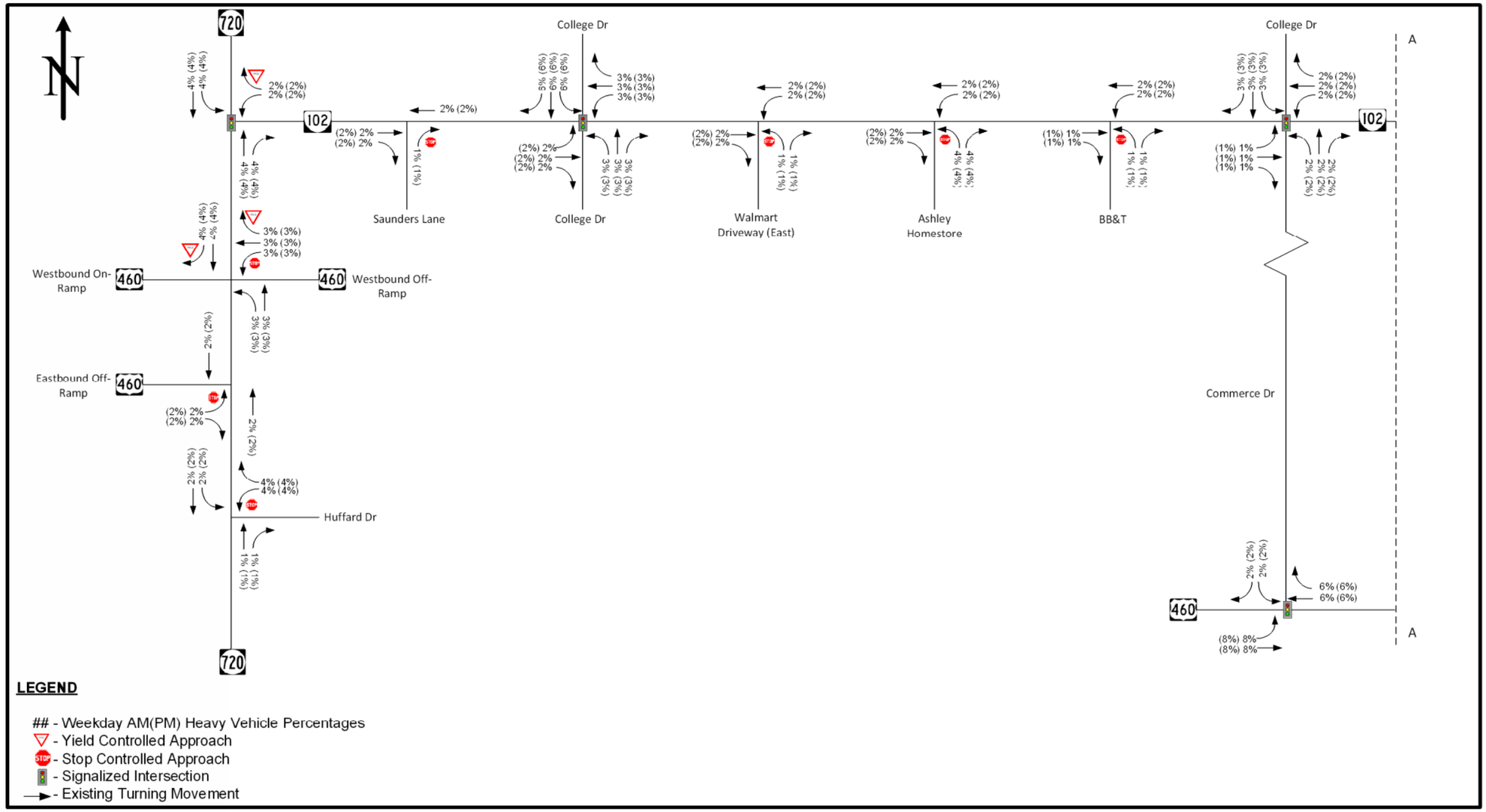
Heavy Vehicle Percentages

Heavy vehicle percentages were calculated for each movement at all study area intersections during the overall study area Midday and PM peak hours. **Figures 3a** and **3b** and **Appendix A** summarize the AM and PM peak hour heavy vehicle percentages for each intersection movement.

Traffic Volume Balancing

Using the available TMC and tube count data, traffic volumes were balanced, where appropriate, throughout the study area. Peak hour traffic volumes were balanced between all study area intersections. For this study, major commercial driveways were included in the detailed data collection, so the typical source of volume imbalances on similar corridors was not present. The existing (2019) balanced AM and PM peak hour traffic volumes in the study area are summarized in **Figures 4a** and **4b**.

Figure 3a. Heavy Vehicle Percentages



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NO BUILD (2019) HEAVY VEHICLE PERCENTAGES
US 460 Corridor Improvement Study
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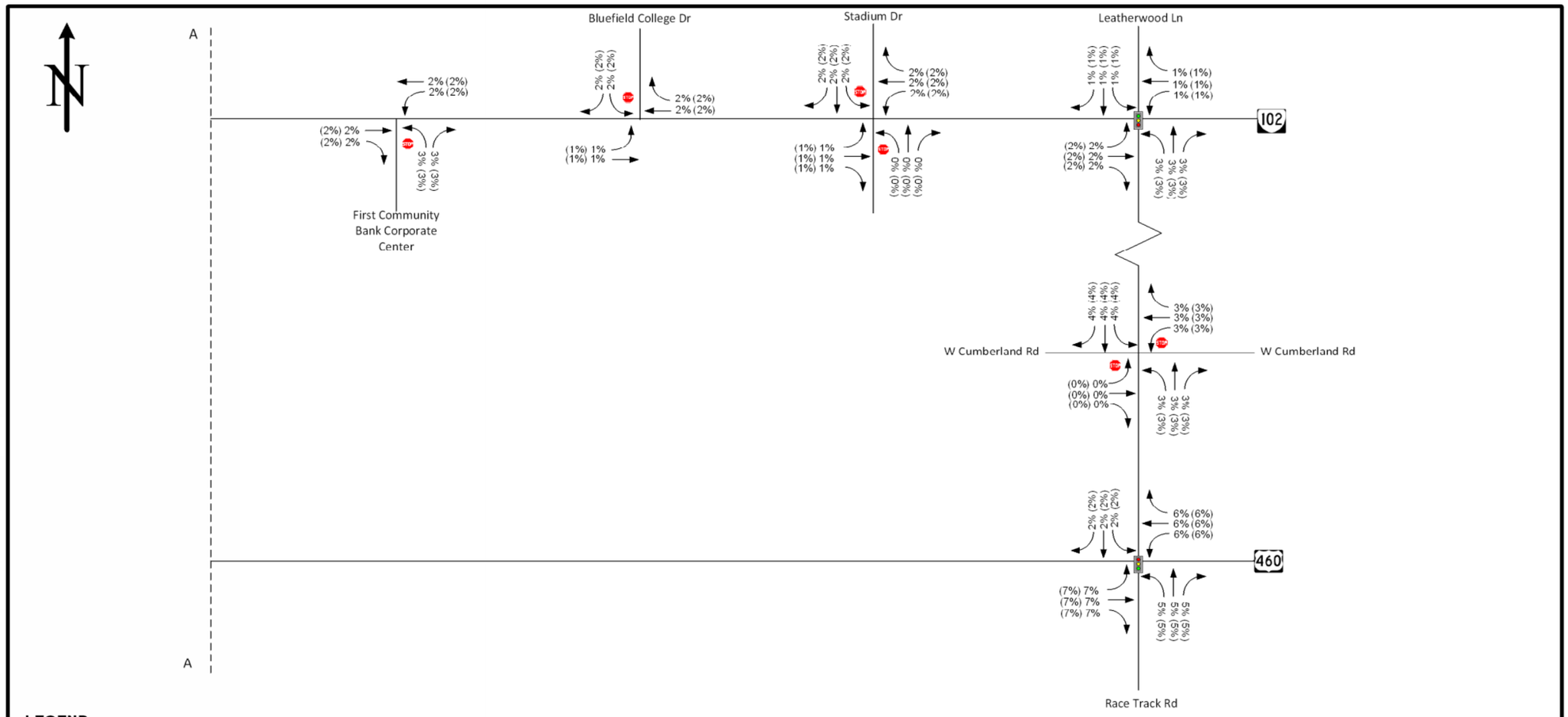
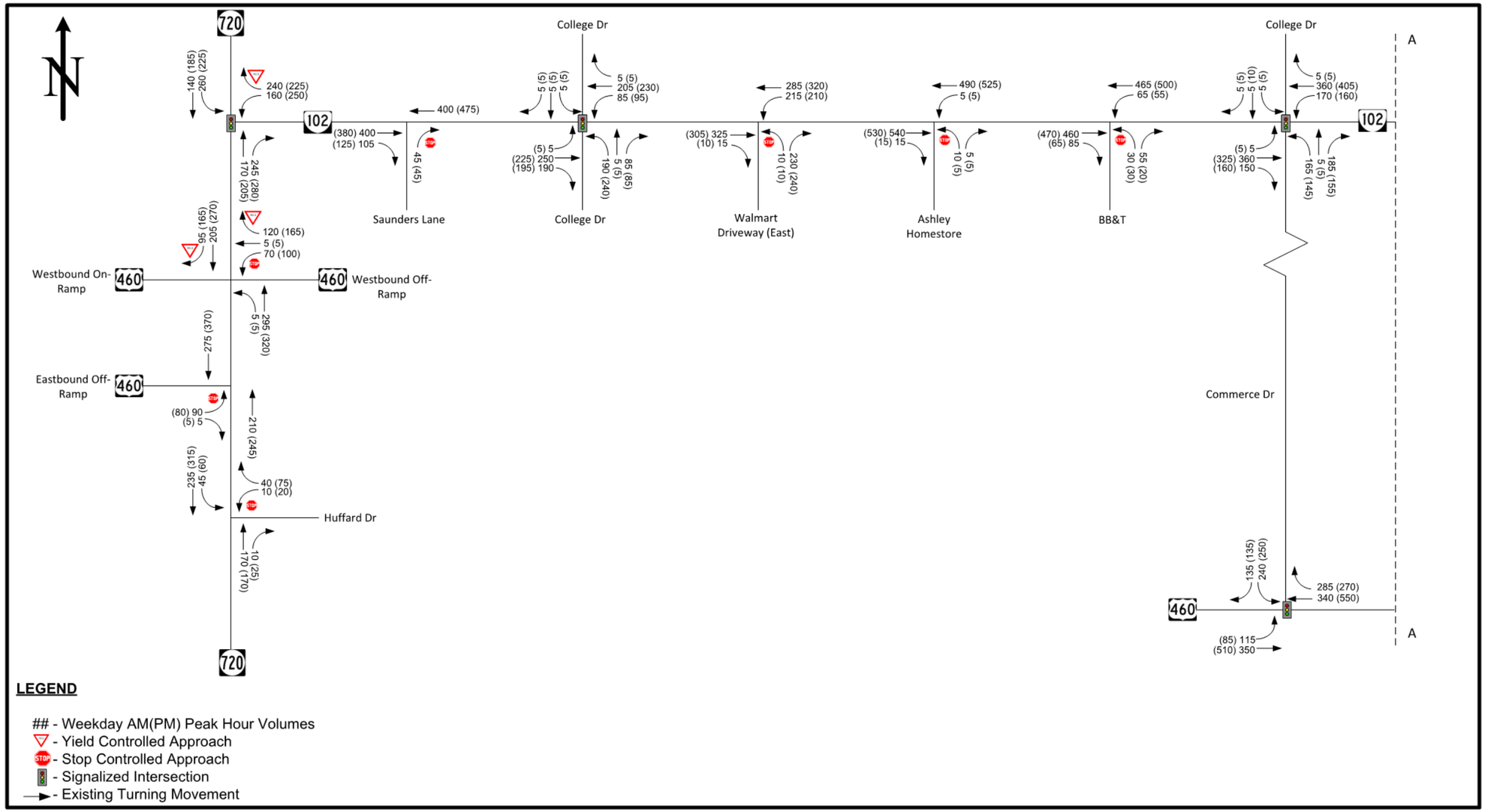
Figure 3b. Heavy Vehicle Percentages (cont.)



VDOT STARS Virginia Department of Transportation	**NO BUILD (2019) HEAVY VEHICLE PERCENTAGES** US 460 Corridor Improvement Study Tazewell County, VA	**SHEET 2**

Figure 4a. Existing 2019 Balanced Traffic Volumes

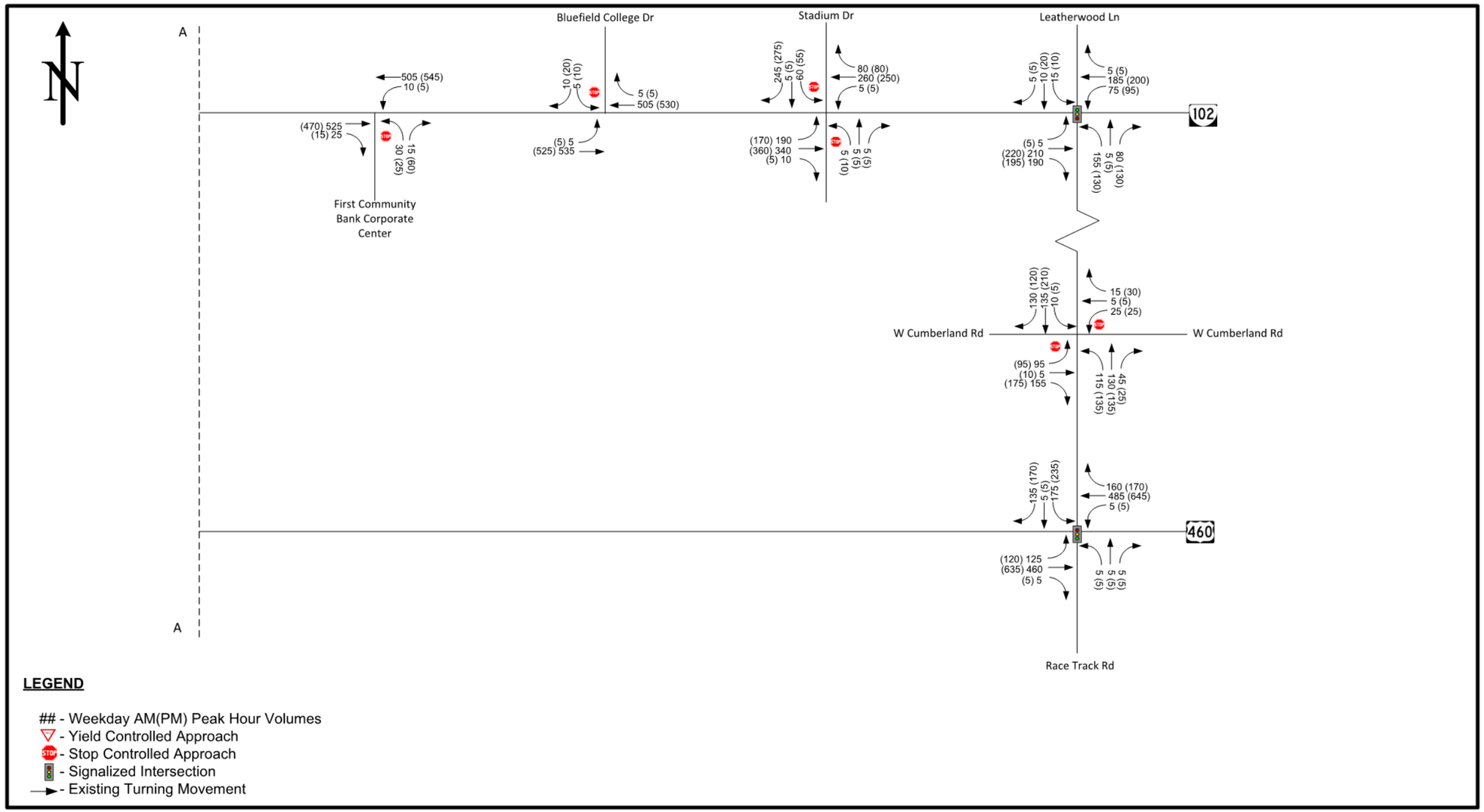


LEGEND

- Weekday AM(PM) Peak Hour Volumes
- Yield Controlled Approach
- Stop Controlled Approach
- Signalized Intersection
- Existing Turning Movement

VDOT STARS Virginia Department of Transportation	**EXISTING (2019) PEAK HOUR VOLUMES** US 460 Corridor Improvement Study Tazewell County, VA	**SHEET 1**

Figure 4b. Existing 2019 Balanced Traffic Volumes



LEGEND

- Weekday AM(PM) Peak Hour Volumes
▽ - Yield Controlled Approach
STOP - Stop Controlled Approach
- Signalized Intersection
→ - Existing Turning Movement

VDOT STARS Virginia Department of Transportation

EXISTING (2019) PEAK HOUR VOLUMES
US 460 Corridor Improvement Study
Tazewell County, VA

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Crash Analysis

Crash data for the study area was used to evaluate corridor safety and identify crash patterns. VDOT's Online Crash Analysis Tool (Tableau Workbook) was used to obtain crash data for the most recent five (5) year period available (May 1, 2014 through April 30, 2019). The crash data were evaluated to identify crash locations and patterns, severity of crashes, and likely causes for crashes. The crash data analysis was used to identify factors that could potentially contribute to crashes and to make recommendations regarding safety improvements that could mitigate future crashes.

A field review was conducted on October 2 and 3, 2019 to observe and document safety concerns along the study corridor. Special focus was given to areas where the crash data indicated a crash pattern or a high crash frequency. The purpose of the field review was to identify factors contributing to the crash patterns as well as identify potential improvements to mitigate crash risks and improve safety along the corridor.

The following sections of the report summarize the crashes that occurred within the study corridor during the five-year crash analysis period and observations made during field reconnaissance.

Summary of Study Area Crashes

A total of 203 crashes occurred within the study area on US Route 460 and VA Route 102 (College Avenue) between May 1, 2014 through April 30, 2019, as shown in **Table 3** and **Figures 5 and 6**. Crashes along major intersecting streets were included in this analysis.

Table 3 – Study Area Crashes

Year	Number of Crashes					
	Fatal	Injury			PDO	Total
		A	B	C		
2014*	0	1	8	1	16	26
2015	0	1	7	5	24	37
2016	0	2	11	4	28	45
2017	1	1	11	8	18	38
2018	0	1	13	10	23	47
2019*	0	0	2	3	4	9
Total	**1**	**6**	**52**	**31**	**113**	**203**
		89				

*Represents partial year data.

Figure 5. Crashes by Location & Severity

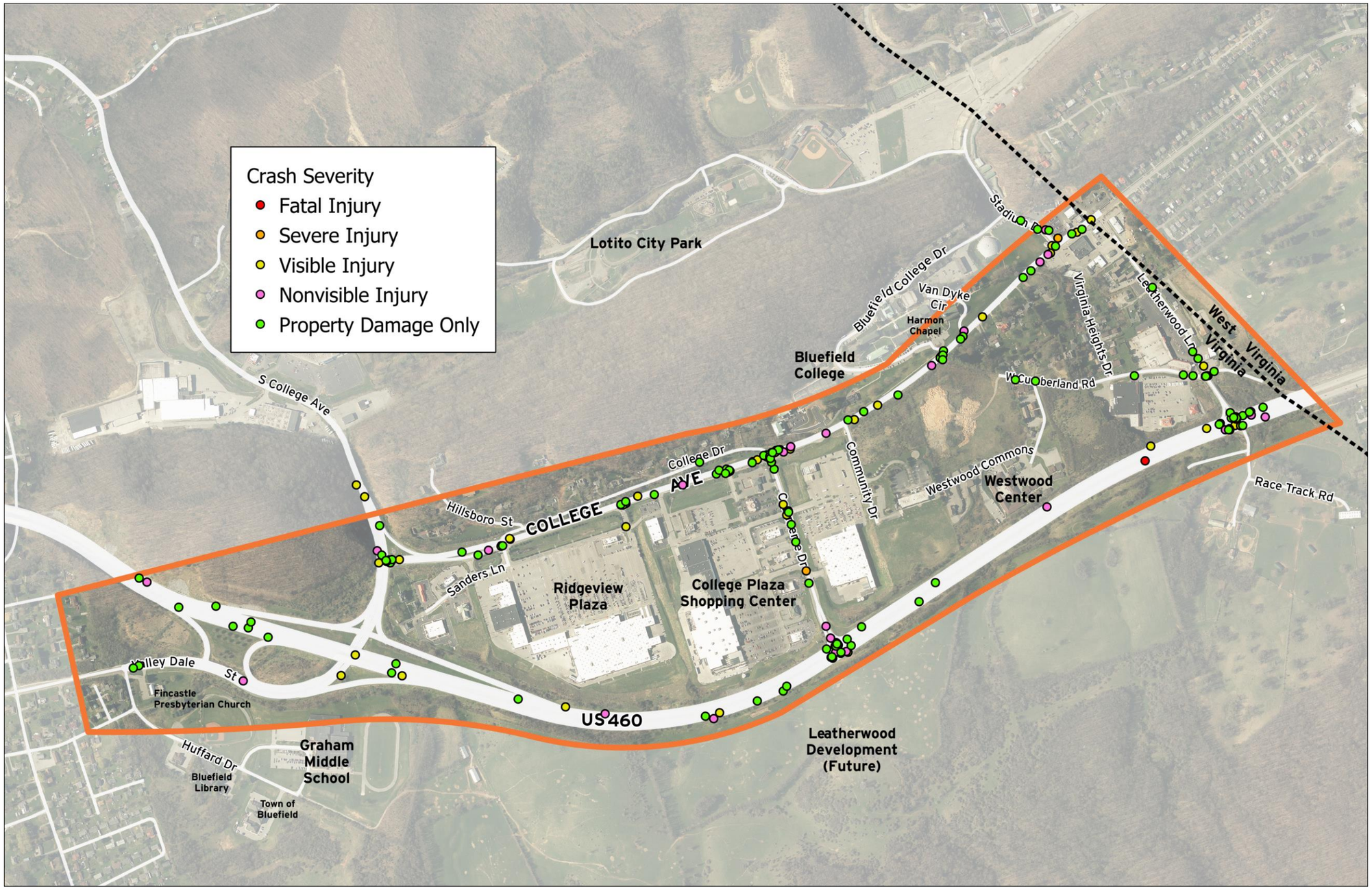


Figure 6. Crash Density Heat Map

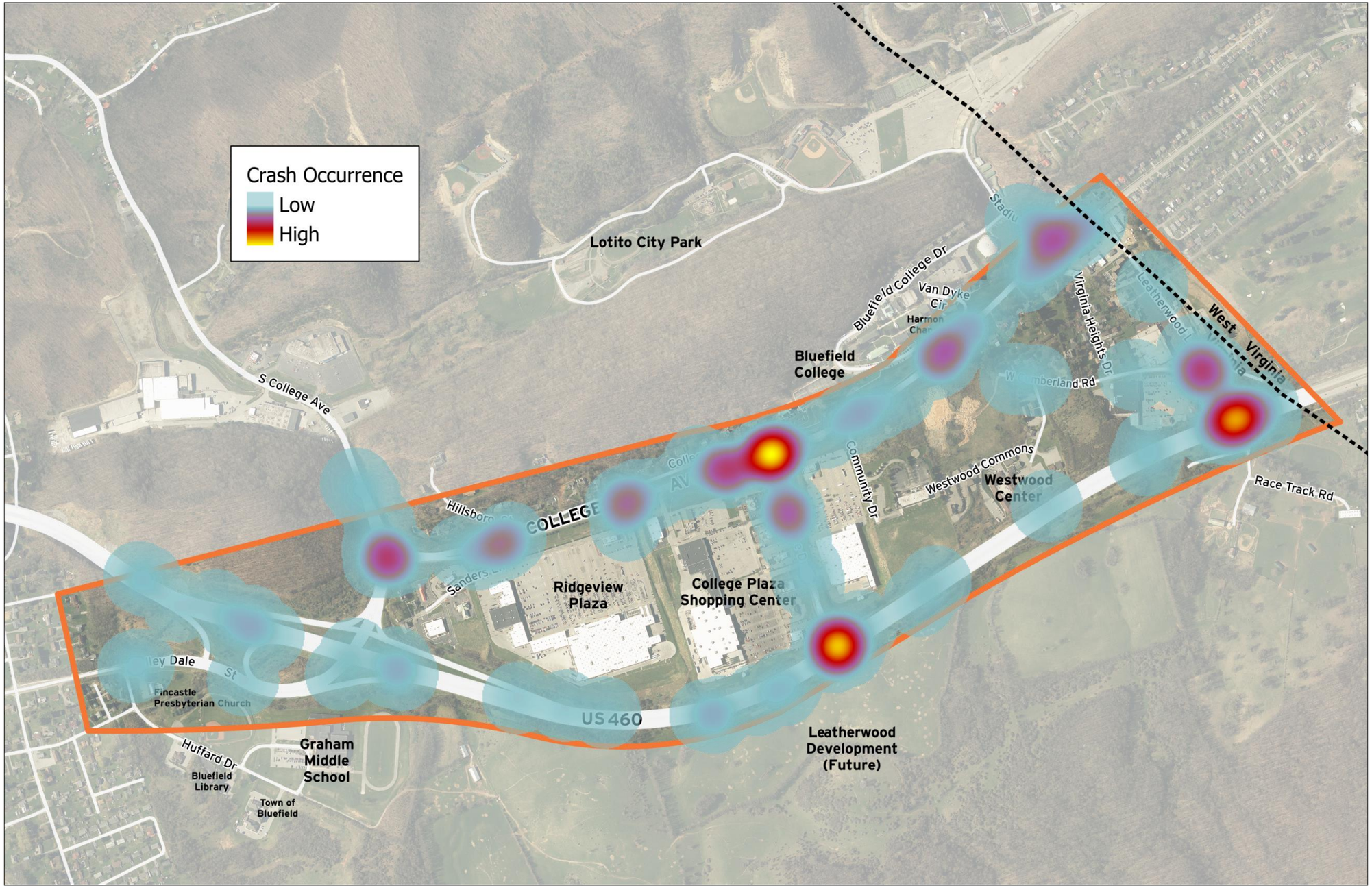
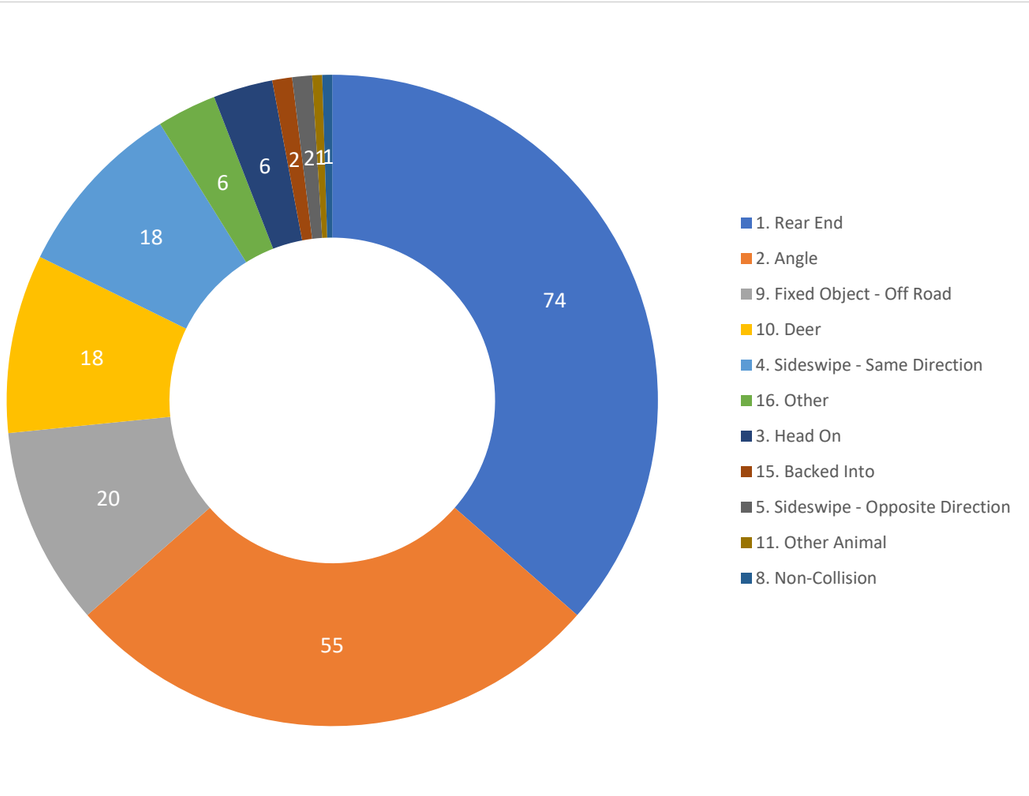


Table 3 shows that 1 fatal crash (0%), 6 severe injury crashes (3%), 52 visible injury crashes (26%), and 31 nonvisible injury crashes (15%) occurred in the study area within the five-year period. The majority of crashes that occurred were property damage only crashes, which accounted for 56% of all crashes. Crashes were also summarized by collision type within the study area and those results are summarized in **Figure 7**.

Figure 7. Crashes by type



The results in **Figure 7** indicate that rear-end crashes were the predominant crash type, representing 36% of all crashes within the study area. Angle crashes were (27%) the next most common crash type, followed by fixed object – off road collisions (10%), deer collisions (9%), and sideswipe – same direction collisions (9%).

Crash Rate Comparison

In addition to the overall summary, crashes were organized by route and crash rates were calculated utilizing the rate calculations described in the *Highway Safety Manual*. **Table 4** compares the calculated total crash, total injury, and Type A (severe) injury rates along US 460 and College Avenue to the statewide averages for similar facilities. The corridor rates which exceed the average for similar facilities are shown in red and those below the corresponding average are shown in green.

Table 4 – Crash Rate Comparison

Route	Crash Rates					
	Corridor – All Crashes	Average	Corridor – Injuries	Average	Corridor – Type A Inj.	Average
US 460	146.25	76.55	68.03	40.23	3.40	8.1
College Ave	676.78	238.02	334.31	122.61	24.46	26.85

The results in **Table 4** indicate that the total crash and injury rates along US 460 and College Avenue both exceed the statewide average rates for similar facilities. Severe injury rates on these two route segments were lower than the corresponding average rates for similar facilities, however.

Intersection Crash Analysis

Based on the crash density mapping and a review of the crash data, 7 of the 17 study area intersections were selected for more detailed crash analysis. These included 5 existing signalized intersections and two stop-controlled intersections. **Table 5** summarizes the crashes by type, severity and year at these 7 intersections and then additional discussion is provided following the table.

Table 5 – Intersection Crash Summary

Total Crashes	Type		Severity			Crash Year					
	Rear-End	Angle	Fatal	Injury	PDO	2014	2015	2016	2017	2018	2019
4. College Ave at S. College Ave											
10	7	3	0	5	5	3	2	1	2	2	0
6. College Ave at College Drive											
8	3	3	0	4	4	2	2	1	2	0	1
10. College Ave at Commerce Dr											
26	17	5	0	14	12	2	6	6	6	1	5
13. College Ave at Stadium Dr											
14	5	5	0	7	7	1	2	5	1	4	1
15. Leatherwood Ln at W. Cumberland Dr											
11	2	6	0	2	9	3	3	3	1	1	0
16. US 460 at Leatherwood Ln											
30	14	9	1	12	17	2	3	4	8	12	1
17. US 460 at Commerce Dr											
24	5	10	0	15	9	1	2	4	8	6	3

College Ave at S. College Ave: A total of 10 crashes occurred at this intersection. The majority of crashes were rear-end (70%) crashes, with half of the crashes resulting in injury. Four (4) of the 7 reported rear-end collisions involved vehicles in the westbound lanes along College Avenue waiting for the light to turn green to make a left-turn.

College Ave at College Dr: A total of 8 crashes occurred at this intersection. Angle (38%) and rear-end (38%) crashes were most common, with half of the crashes resulting in property damage. No notable trends were observed at this location.

College Ave at Commerce Dr: A total of 26 crashes occurred at this intersection. The majority of crashes were rear-end (65%) crashes. Over half (14) of the crashes resulted in injury at this location. Nine (9) of the 17 rear-end crashes involved westbound traffic along College Avenue, with 6 rear-end crashes in the eastbound lanes along College Avenue and 2 crashes along the northbound Commerce Drive approach.

Stadium Dr at College Ave: A total of 14 crashes occurred at this intersection. Rear-end (36%) and angle (36%) crashes were equally represented, with half of the crashes resulting in injury. Several of the angle crashes at this location involved vehicles entering from nearby driveways / commercial entrances. Of the rear-end crashes, 3 occurred in the eastbound direction along College Avenue and 2 occurred along southbound Stadium Drive.

Leatherwood Ln at W Cumberland Rd: A total of 11 crashes occurred at this intersection. The majority of crashes were angle (55%) crashes, with most crashes resulting in property damage. The angle crashes at this location primarily involved vehicles turning left onto Leatherwood Lane from W. Cumberland Drive and being struck by a through vehicle on Leatherwood Lane

Leatherwood Ln at US 460: A total of 30 crashes occurred at this intersection. The majority of crashes were rear-end (47%) and angle (30%) crashes, with most crashes resulting in property damage. There was 1 fatal crash that occurred near this location; the fatality occurred on February 27, 2017 and involved an eastbound vehicle on US 460 running off the road and overcorrecting; the driver was not restrained and was killed as a result of the crash. Crashes at this intersection have increased notably during the study period from 4 crashes in 2015 to 12 crashes in 2018. Eight of the 9 total angle crashes occurred in 2017 and 2018.

Commerce Dr at US 460: A total of 24 crashes occurred at this intersection. Angle (42%) crashes were the most common-type, followed by rear-end (24%) crashes. Eight (8) of the 10 reported angle crashes occurred in 2017 and 2018 at this location as well. Eight of the angle crashes involved eastbound left-turning vehicles from US 460 making a permissive left-turn movement onto Commerce Drive; the remaining two angle collisions involved vehicles disregarding a red signal indication and striking a vehicle proceeding through the intersection.

EXISTING CONDITIONS (2019)

Traffic operational analyses were conducted to evaluate the overall performance of the study corridor under existing (2019) Midday and PM peak hour conditions. The intent of the existing conditions analyses was to provide a general understanding of the baseline traffic conditions as a starting point for developing future improvement strategies. Existing conditions were modeled using Synchro, Version 10. Existing conditions traffic analysis assumptions and results are described in more detail in the following sections.

Traffic Analysis Assumptions

Existing (2019) Synchro models were developed for Midday and PM peak hour conditions based on the existing roadway geometry and collected traffic count data. Synchro inputs and analysis methodologies were consistent with the VDOT Traffic Operations and Safety Analysis Manual (TOSAM).

Traffic Analysis Results

The existing conditions traffic analysis results are summarized in the following section of the report. Two measures of effectiveness were selected to measure the quantitative performance of the study area intersections:

- Average vehicle delay by movement, approach, and intersection – measured in seconds per vehicle
- Maximum queue length – measured in feet

Delay and Level of Service

The Transportation Research Board's (TRB) *Highway Capacity Manual* (HCM) methodologies govern the methodology for evaluating capacity and the quality of service provided to road users traveling through a roadway network. There are six letter grades of Level of Service (LOS), ranging from A to F. LOS A indicates a condition of little or no congestion whereas LOS F indicates a condition of severe congestion, unstable traffic flow, and stop-and-go conditions. Intersection LOS is defined in terms of control delay. **Table 6** summarizes the delay associated with each LOS category for signalized and unsignalized intersections, respectively. If intersection traffic volume exceeds capacity, a LOS F is automatically reported.

Table 6 – Signalized and Unsignalized Intersection Level of Service Criteria

LOS	Volume-to-Capacity Ratio	Control Delay (sec/veh)	
		Signalized Intersection	Unsignalized Intersection
A	≤ 1.0	≤10	≤10
B	≤ 1.0	>10 – 20	>10 – 15
C	≤ 1.0	>20 – 35	>15 – 25
D	≤ 1.0	>35 – 55	>25 – 35
E	≤ 1.0	>55 – 80	>35 – 50
F	> 1.0	>80	>50

Source: Transportation Research Board, Highway Capacity Manual 2010

Synchro was used to calculate the delay and associated LOS at each of the study area intersections under existing conditions. HCM 2010 methodologies were used to analyze all unsignalized intersections and several of the signalized intersections. However, due to the limitations of the HCM 2010 methodologies to analyze intersections with split phasing and turning movements with both shared and exclusive lane configurations, HCM 2000 methodologies were used to analyze the remaining signalized intersections; these locations are noted in the tables.

A table summarizing the existing conditions delay and LOS results by movement, approach, and intersection at each study area intersection is provided in **Appendix B**. The corresponding Synchro output sheets are included in **Appendix B**. Intersection delay and LOS for the six signalized intersections in the study area is summarized in **Table 7**.

Table 7 – Existing (2019) Signalized Intersection Delay and LOS

Signalized Intersection	Midday Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
4. S. College Ave at College Ave	16.7	B	18.8	B
6. College Ave at College Dr	16.1	B	17.8	B
10. College Ave at Commerce Dr*	47.3	D	55.9	E
14. College Ave at Leatherwood Ln*	27.7	C	38.2	D
16. US 460 at Leatherwood Ln*	24.0	C	29.0	C
17. US 460 at Commerce Dr	16.2	B	15.7	B

*Results represent HCM 2000 methodologies.

The results in **Table 7** indicate that 3 of the study intersections operate at LOS B or better in both peak periods. The intersections of US 460 at Leatherwood Lane and College Avenue at Leatherwood Lane both operate at LOS C or LOS D in the Midday and PM peak periods.

The most notable operational issue was found at the College Avenue at Commerce Drive intersection which operates at LOS D during the Midday peak hour and LOS E during the PM peak hour. The northbound Commerce Drive approach was found to operate at LOS F during the PM peak hour. No other movements or approaches at the signalized intersections was found to operate at worse than LOS D under existing conditions. The most notable delay was reported along the northbound Commerce Drive approach, which was consistent with the field observations.

Movement delay and LOS for the worst movement or approach at each of the unsignalized intersections in the study area is summarized in **Table 8**.

Table 8 – Existing (2019) Unsignalized Intersection Delay and LOS (Worst Movement)

Unsignalized Intersection	Movement /Approach	Midday Peak Hour		PM Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
Valley Dale St at Huffard Dr	WB	10.3	B	11.1	B
Valley Dale St at US 460 EB Ramp	EB	13.1	B	16.3	C
Valley Dale St at US 460 WB Ramps	WB	8.1	A	8.6	A
College Ave at Sanders Ln	NB	10.2	B	10.4	B
College Ave at Ridgeview Plaza	NBL	24.4	C	28.1	D
College Ave at College Plaza (West Entrance)	NB	18.3	C	17.9	C
College Ave at College Plaza (East Entrance)	NB	18.0	C	22.0	C
College Ave at Community Dr	NB	20.7	C	19.6	C
College Ave at Bluefield College Dr	SB	14.9	B	18.1	C
College Ave at Stadium Dr	SBL	37.4	E	41.5	E
Leatherwood Ln at W. Cumberland Dr	EBL	20.4	C	25.2	D

LOS E operations were noted for the southbound Stadium Drive approach (stop-controlled) at its intersection with College Avenue. No other stop-controlled movements or approaches were found to operate at worse than LOS D under existing conditions.

Maximum Queue

Queue length is a potential indicator of congestion at both signalized and unsignalized intersections. A maximum back of queue analysis was conducted for the study area intersections for existing Midday and PM peak hour conditions. SimTraffic (average of 10 runs) was used to determine the maximum queue for each lane group. A table summarizing the maximum queues by lane group at each study area intersection is provided in **Appendix B**. The corresponding SimTraffic output sheets are also included in **Appendix B**.

No notable queuing issues were observed in the analysis; the maximum queue lengths were consistent with those observed in the field during the site visit and all queues cleared during one cycle.

TRAFFIC FORECASTING

To understand future traffic conditions in the study area and assess the long-term benefits of proposed improvements, traffic volumes were forecasted for 2040 traffic conditions. The following sections describe the methodology for developing traffic growth rates and projecting future traffic volumes for the study area.

Traffic Growth Rate Development

Both historic traffic growth trends and VDOT's Statewide Planning System (SPS) projected future traffic growth rates were reviewed and used to develop traffic growth rates for the study area.

Historic traffic growth trends were calculated from VDOT published historic AADT traffic volume estimates. VDOT AADT estimates were reviewed from 2001 to 2015 for the 3 separate segments on each the following roadways:

- College Avenue
- US 460

VDOT collected traffic count data varies from roadway to roadway and from year to year. In general, greater amounts of data are collected on a more frequent basis for higher volume roads. Between 2001 to 2018, the VDOT AADT estimates for the roadway segments in the study area were based on either factored short-term traffic count data or factored short-term traffic count data with a growth element. Exponential traffic growth rates were calculated for the three area segments and are summarized in **Table 9.** The calculated historic traffic growth rates showed primarily flat to slightly increasing growth in the study area. A detailed summary of VDOT published AADT traffic volume estimates and calculated historical traffic growth rates for the roadway segments in the study area from 2001 to 2018 is provided in Appendix C.

Table 9 – Historic Traffic Growth Rates

Roadway	Segment	Exponential Growth Rates		
		3-Year (2015-2018)	10-Year (2008-2018)	17-Year (2001-2018)
US 460	WCL Bluefield to Hockman Pike	3.2%	-0.9%	-0.5%
	Hockman Pike to FR-868	0.0%	-0.6%	1.2%
	FR-868 to West VA State Line	0.0%	-1.1%	-0.7%
	Average	**1.1%**	**-0.9%**	**0.0%**
College Avenue	West VA State Line to College Ave	-1.8%	0.1%	0.6%
	Stadium Drive to Valley Dale St	-2.6%	-0.8%	0.5%
	Valley Dale St to Rollins Dr	-5.1%	-1.8%	-0.3%
	Average	**-3.2%**	**-0.8%**	**0.3%**

The Study Team also reviewed SPS projected future traffic growth rates provided by VDOT which indicated growth rates between 0.50 and 0.75 percent per year moving forward. Based on the calculated growth rate data and an understanding of the potential for development in the study area, the SWG agreed upon a **0.5% traffic growth rate for US 460 and 0.75% growth rate for all other roadways** for use in this study.

Potential Future Development

In addition to the background growth rate applied to the existing traffic volumes, this study also accounts for additional site-specific traffic generation anticipated from an approved mixed-use development, referred to as the Leatherwood Development, planned for the south side of US 460 between Huffard Drive and Leatherwood Lane. The Traffic Impact Analysis (TIA) for the proposed Leatherwood development was completed in 2015 and provided by VDOT and reviewed by the study team. The proposed development includes two phases:

- Phase 1 includes two hotels, several restaurants, two convenience markets with 16 gas pumps each, and a home improvement superstore. This phase would generate approximately 14,300 new site trips each day.
- Phase 2 includes additional retail uses, medical and general office space, a supermarket and pharmacy, and approximately 266 residential dwelling units (townhomes and single-family homes). This phase would generate approximately 13,500 new site trips.

The site trip distribution and assignment for these new potential development trips were taken from the TIA and applied to the roadway network within the study area for future 2040 conditions.

Projected Traffic Volumes

The growth rates identified above were applied to the existing traffic volumes for Midday and PM peak hour conditions to generate future background traffic volumes for 2040 conditions. Then the site trips from the Leatherwood development were then added to generate the final set of projected 2040 traffic volumes for the study area. The projected 2040 Midday and PM peak hour volumes are summarized in **Figures 8a and 8b**.

NO-BUILD TRAFFIC CONDITIONS (2040)

No-build traffic conditions were analyzed to evaluate the results of future (2040) traffic demand on the existing roadway network. The intent of no-build conditions analysis was to provide a general understanding of the baseline future traffic conditions to be used to evaluate the effectiveness of potential future improvement strategies.

Synchro modeling assumptions and analysis results for 2040 no-build conditions are described in the following sections.

Traffic Analysis Assumptions

No-Build (2040) Synchro models were developed for Midday and PM peak hour conditions based on the existing roadway geometry and collected traffic count data. Synchro inputs and analysis methodologies were consistent with the VDOT Traffic Operations and Safety Analysis Manual (TOSAM).

The 2040 No-Build analysis does assume two changes from existing conditions. First, there is a funded project (UPC 115482) to provide signal improvements along College Avenue to upgrade signal equipment and provide coordination between signals to improve traffic flow. This study assumed completion of this project. The existing traffic signals along College Avenue were assumed to operate under coordinated signal control and the timings were optimized for the 2040 conditions.

Also, improvements were recommended for the intersection of US 460 at Commerce Drive as part of the proposed Leatherwood development. Those improvements include a new northbound leg at the intersection (dual lefts, one through, and dual rights), dual left-turn lanes along westbound US 460, dual right-turn lanes along US 460, and a new through lane along southbound Commerce Drive. These improvements were assumed as part of the No Build conditions for 2040.

Traffic Analysis Results

The existing conditions traffic analysis results are summarized in the following section of the report. Two measures of effectiveness were selected to measure the quantitative performance of the study area intersections:

- Average vehicle delay by movement, approach, and intersection – measured in seconds per vehicle
- Maximum queue length – measured in feet

Delay and Level of Service

Synchro was used to calculate the delay and associated LOS at each of the study area intersections under no build conditions. HCM 2010 methodologies were used to analyze all unsignalized intersections and several of the signalized intersections. However, due to the limitations of the HCM 2010 methodologies to analyze intersections with split phasing and turning movements with both shared and exclusive lane configurations, HCM 2000 methodologies were used to analyze the remaining signalized intersections; these locations are noted in the tables.

A table summarizing the no build delay and LOS results by movement, approach, and intersection at each study area intersection is provided in **Appendix B**. The corresponding Synchro output sheets are included in **Appendix B**. Intersection delay and LOS for the six signalized intersections in the study area is summarized in **Table 10**.

Table 10 – No Build (2040) Signalized Intersection Delay and LOS

Signalized Intersection	Midday Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
4. S. College Ave at College Ave	16.7	B	21..1	C
6. College Ave at College Dr	21.1	C	22.6	C
10. College Ave at Commerce Dr*	27.7	C	34.9	C
14. College Ave at Leatherwood Ln*	33.3	C	37.1	D
16. US 460 at Leatherwood Ln*	29.1	C	31.9	C
17. US 460 at Commerce Dr	46.8	D	44.0	D

*Results represent HCM 2000 methodologies.

The results in **Table 10** indicate that all intersections would operate at LOS D or better overall under 2040 No Build conditions. This includes improved operations at the College Avenue at Commerce Drive intersection, which operates at LOS E overall during the PM peak under existing conditions. The proposed signalization improvements along College Avenue with coordinated traffic flow and optimized signal timings contribute to the improvement noted at this location.

Movement delay and LOS for the worst movement or approach at each of the unsignalized intersections in the study area is summarized in **Table 11**.

Table 11 – No Build 2040 Unsignalized Intersection Delay and LOS (Worst Movement)

Unsignalized Intersection	Movement /Approach	Midday Peak Hour		PM Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1. Valley Dale St at Huffard Dr	WB	27.0	D	50.5	F
2. Valley Dale St at US 460 EB Ramp	EBL	20.9	C	25.9	D
3. Valley Dale St at US 460 WB Ramps	WBL	27.2	D	56.1	F
5. College Ave at Sanders Ln	NBR	11.1	B	11.0	B
7. College Ave at Ridgeview Plaza	NBL	36.1	E	39.1	E
8. College Ave at College Plaza (West Ent)	NB	27.0	D	24.8	C
9. College Ave at College Plaza (East Entrance)	NB	30.2	D	31.2	D
11. College Ave at Community Dr	NB	54.6	F	59.7	F
12. College Ave at Bluefield College Dr	SB	19.6	C	21.0	C
13. College Ave at Stadium Dr	SBL	248.0	F	158.1	F
15. Leatherwood Ln at W. Cumberland Dr	EBL	36.6	E	67.0	F

A number of operational issues are identified under 2040 No Build conditions for the unsignalized intersections. LOS F operations are projected for the worst movement at 5 of the 11 intersections during at least one of the peak hours analyzed. The most congested operations are anticipated along southbound Stadium Drive, with LOS F with delays exceeding 2.5 minutes for left-turning vehicles during the Midday and PM peak hours.

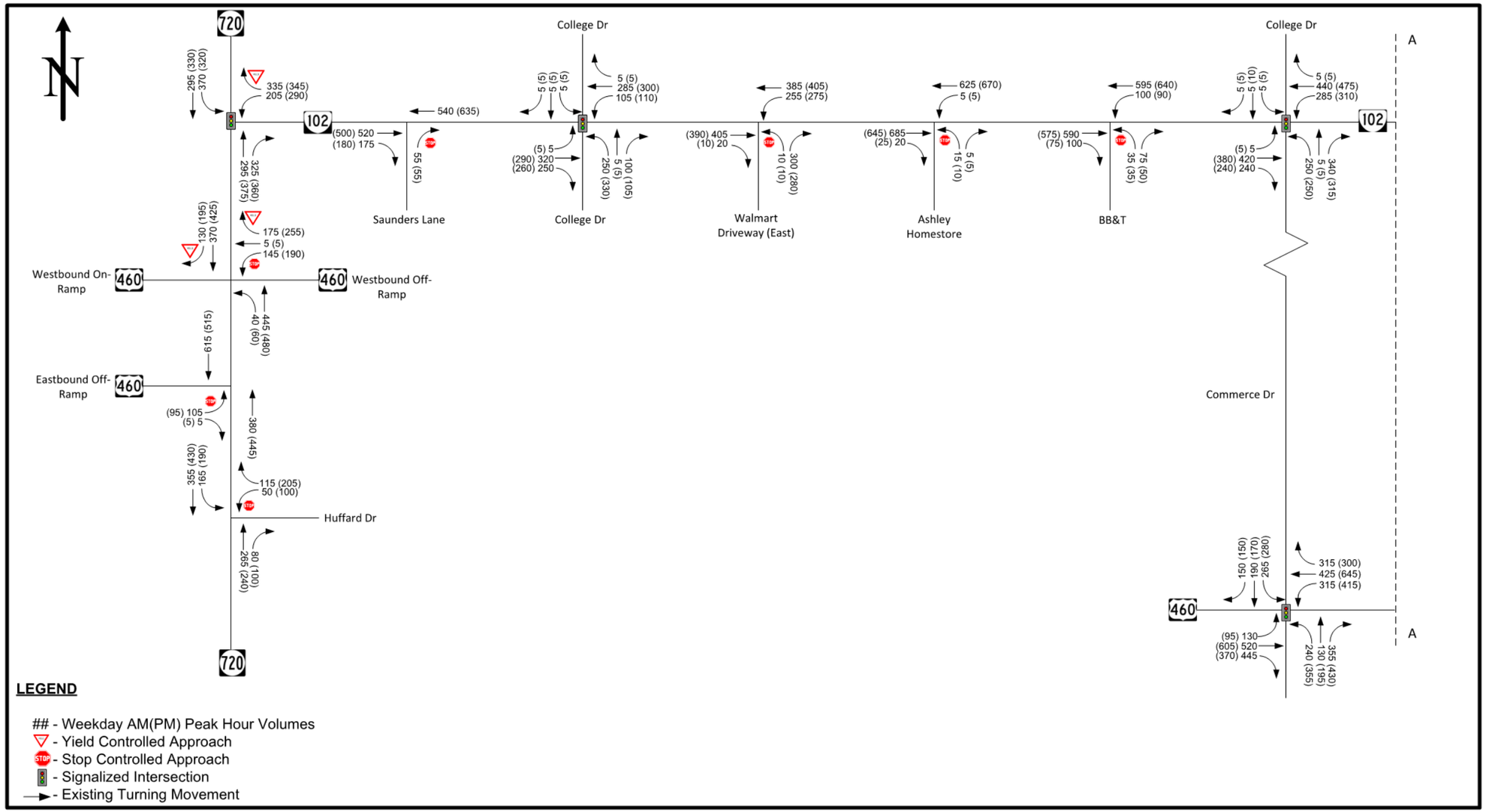
While the volumes are relatively low for many of the movements with poor LOS projected in 2040, one concern is that drivers may begin to accept smaller gaps during peak periods in order to reduce their delay and that may increase the risk or angle crashes at these signalized intersections.

Maximum Queue

Queue length is a potential indicator of congestion at both signalized and unsignalized intersections. A maximum back of queue analysis was conducted for the study area intersections for existing Midday and PM peak hour conditions. SimTraffic (average of 10 runs) was used to determine the maximum queue for each lane group. A table summarizing the maximum queues by lane group at each study area intersection is provided in **Appendix B**. The corresponding SimTraffic output sheets are also included in **Appendix B**.

The results indicate increased queues along the stop-controlled minor street at most locations which is consistent with the projected increase in delay for these movements. Queues were still contained in the available storage at most locations.

Figure 8a. Future (2040) Project Traffic Volumes



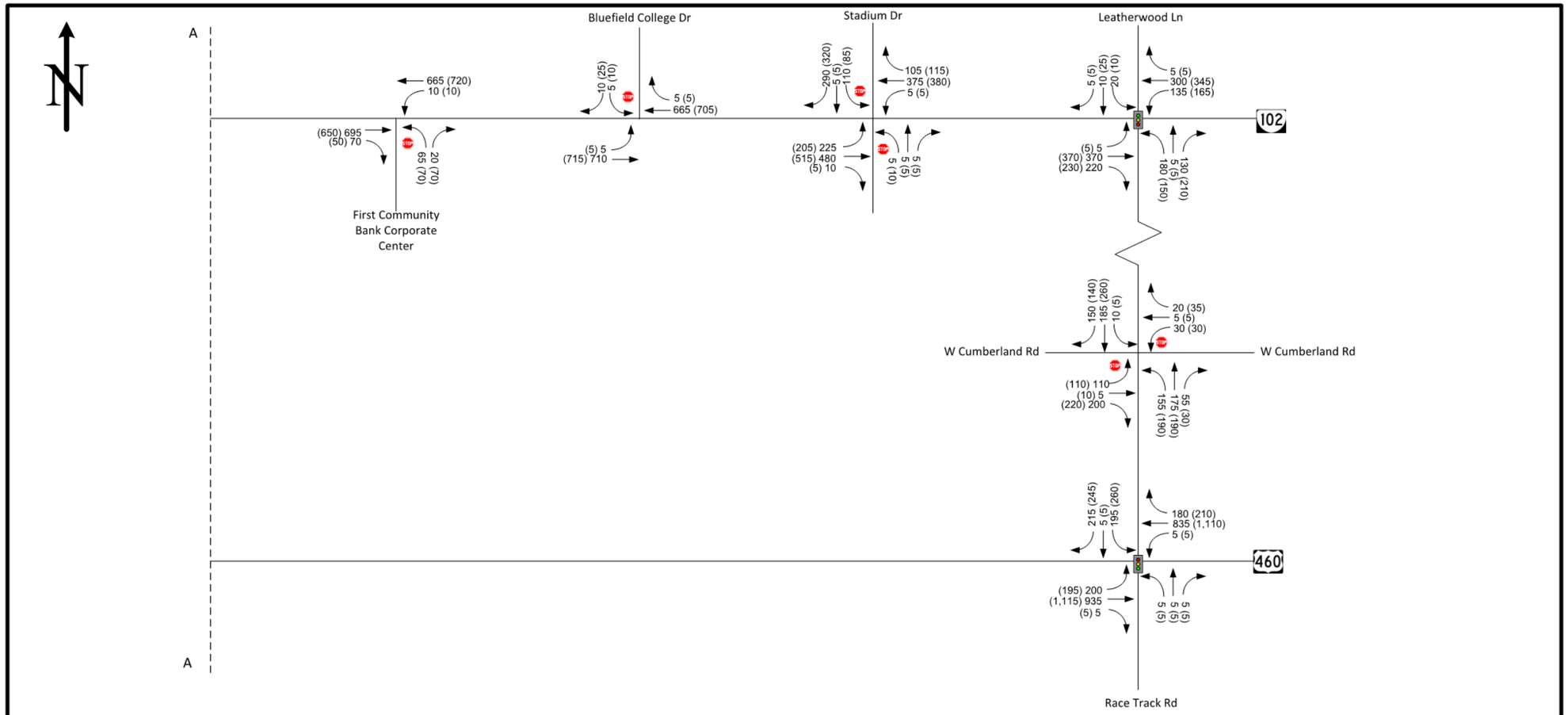
LEGEND

- Weekday AM(PM) Peak Hour Volumes
- Yield Controlled Approach
- Stop Controlled Approach
- Signalized Intersection
- Existing Turning Movement

NO BUILD (2040) PEAK HOUR VOLUMES
US 460 Corridor Improvement Study
Tazewell County, VA

SHEET 1

Figure 8b. Future (2040) Project Traffic Volumes



VDOT STARS Virginia Department of Transportation

NO BUILD (2040) PEAK HOUR VOLUMES
US 460 Corridor Improvement Study
Tazewell County, VA

SHEET 2

Public Engagement – Needs Evaluation Phase

A public engagement opportunity was conducted in October 2019 to review the existing conditions and garner feedback from the public on the transportation needs in the study area. A detailed summary of the public involvement is included in **Appendix C** and a brief summary is provided below.

The public engagement took the form of two main elements. First, a Public Information Meeting was held on October 24, 2020 at the Town of Bluefield Town Hall. There were 16 attendees at the meeting and 6 completed comment forms, with one following up by mail. Also, a web survey was developed and distributed via social media, media releases, flyers, email user groups to garner additional feedback. The survey included 20 questions related to the existing transportation system in the study area and users' experiences with congestion and safety. There were 132 respondents to the survey. Several key results of the survey include:

- 47% of the respondents were either very dissatisfied or somewhat dissatisfied with the driving experience within the study area.
- 54% of the respondents feel either very unsafe or somewhat unsafe while driving, walking, biking or using transit in the study area.
- Only 15% of the respondents were either very satisfied or somewhat satisfied with the overall biking / pedestrian experience within the study area.

Improvement Screening and Analysis

Improvement projects were developed to address safety, geometric, and operational deficiencies along the study corridor identified in the existing and no-build analyses, as well as during the field review. Alternative concepts were developed by the study team and then presented at an alternative development workshop. At the workshop, the SWG was presented information related to the potential operational impacts, potential safety benefits, and preliminary cost ranges for each alternative and then provided their feedback on each project. Based on the screening results, improvement projects were selected for additional study. More detailed design, cost estimates, and schedule estimates were then developed for these selected improvement projects. The following sections describe the concept development, alternative analysis, and improvement project selection.

Concept Development & Alternatives Analysis

Based on the results of the existing conditions operational and safety analyses, the future No Build operations analysis, the feedback received at the public meeting, and preliminary discussions with the Study Work Group and VDOT staff, the study team developed a candidate list of potential improvement concepts to provide improved operations and safety for a variety of users within the study area. These preliminary concepts were reviewed with the Study Work Group on December 16, 2019.

Concepts were grouped into five (5) primary categories with all concepts intended to improve operations and safety for a specific intersection or segment within the study area. The categories considered were:

- Multi-modal improvements (sidewalks, pedestrian signals, etc.)
- Access management improvements
- Intersection control changes (roundabouts, new traffic signals, alternative intersections)
- Turn lane improvements
- New roadway connections

For each alternative, a preliminary operational analysis was conducted, a qualitative safety assessment was performed, and a planning-level cost was assigned. The cost categories for this initial assessment included:

- Very Low (<$2M)
- Low ($2M - $5M)
- Medium ($5M - $10M)
- High ($10M – $15M)
- Very High (>$15M)

The operational analysis focused on confirming that the improvement alternative would improve or at a minimum not negatively impact operations. The following sections provide an overview of the alternatives which were reviewed with the SWG.

Multi-modal Improvements

A number of comments received from the public noted concern with the lack of continuous pedestrian facilities within the study area. This was supported by observations during field visits to the site which noted a moderate level of pedestrian activity along College Avenue, Valley Dale Street, and S. College Avenue. There is an existing sidewalk along the east side of S. College Avenue and Valley Dale Street as well as portions of sidewalk along the south side of College Avenue between the east entrance of Ridgeview Plaza and Bluefield College Drive. To mitigate these concerns, the following alternative was presented:

College Avenue Sidewalk Improvements

This alternative would fill the gaps within the existing sidewalk network along College Avenue between S. College Avenue and Stadium Drive. New sidewalk would be provided along the north side of College Avenue between the S. College Avenue / Valley Dale Street intersection and the College Drive / Ridgeview Plaza (West Entrance). Crosswalks and pedestrian signals would be provided at both intersections. At College Drive / Ridgeview Plaza (West Entrance), the sidewalk would start on the south side of College Avenue and continue east to the tie to the existing sidewalk. Near Bluefield College, sidewalk would be provided along the north side of College Avenue between Bluefield College Drive and Stadium Drive. This alternative would have negligible impacts on traffic operations but would enhance pedestrian mobility and safety compared to the existing conditions. It was classified in the "Low" cost range.

Access Management Improvements

A number of comments received from the public noted concern with the frequency of entrances along College Avenue and the difficulty turning into or out of businesses along that corridor. Between the S. College / Valley Dale Street intersection and Commerce Drive intersection, there are 3 full-access unsignalized commercial entrances, 1 right-in/right-out commercial entrance, and 1 full access signalized intersection (at College Drive / Ridgeview Plaza West Entrance). Three of these entrances serve Ridgeview Plaza and two serve College Plaza.

College Avenue Access Management Improvements

This alternative would modify the existing full access unsignalized commercial entrances at Ridgeview Plaza east entrance and the College Plaza east entrance to right-in/right-out/left-in operation. Left-turns onto College Avenue from Ridgeview Plaza are also served at the signalized Ridgeview Plaza west entrance. Left-turns onto College Avenue from College Plaza are also served at the College Plaza west entrance, which provides better spacing from the existing signal at Commerce Drive. This alternative would reduce conflict points along the corridor and re-route very low volumes to traffic (10 to 15 vehicles during peak hours) to alternate locations, resulting in minimal operational impacts as documented in **Table 12**. This alternative was classified in the "Very Low" cost range.

Table 12 – 2040 Intersection Delay and LOS with Access Management Improvements

Intersection	No Build				W/Access Management			
	Midday Peak Hour		PM Peak Hour		Midday Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
6. College Ave at College Dr	21	C	23	C	22	C	23	C
7. College Ave at Ridgeview Plaza	36	E	39	E	16	C	15	C
8. College Ave at College Plaza West	27	D	25	C	36	E	35	D
9. College Ave at College Plaza East	30	D	31	D	14	B	13	B

Traffic Control Changes

The traffic analysis results revealed several intersections with congested operations under future No Build conditions. Signalized intersections experiencing higher delays may be served more efficiently with a roundabout or other type of alternative intersection. Unsignalized intersections where traffic entering from the side street experiences high delays can lead to angle crashes with drivers accepting smaller gaps to try and complete left-turn movements. In those instances, roundabouts may be good alternatives to reduce delays and improve safety. The following alternatives were evaluated in this category.

Roundabouts

Modern roundabouts are a proven safety countermeasure and provide efficient vehicular flow while reducing speeds and the potential for severe angle crashes which are more common at signalized and stop-controlled intersections. VDOT considers roundabouts the preferred method of intersection control when they are found to be feasible from a geometric, cost, and impacts standpoint. Roundabouts were evaluated at the following intersections:

- Valley Dale Street at Huffard Drive (stop controlled)
- College Avenue at College Drive (signalized)
- College Avenue at Commerce Drive (signalized)
- College Avenue at Stadium Drive (stop controlled)
- Leatherwood Lane at W. Cumberland Road (stop controlled)

Preliminary operational analyses found that each roundabout would result in improved operations compared to the existing signal or stop control; these analysis results are presented in **Table 13**. A high-level geometric review identified concerns with potential impacts to right-of-way, skewed intersection approaches and challenging terrain which would result in design challenges. Additionally, the close proximity between a potential roundabout and nearby traffic signal for the Leatherwood Lane at West Cumberland Road location was also noted. Each roundabout was assigned to the "Low" category for potential costs.

Table 13 – 2040 Intersection Delay and LOS with Roundabouts

Intersection	No Build				Roundabout			
	Midday Peak Hour		PM Peak Hour		Midday Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1. Valley Dale St at Huffard Dr	27.0	D	50.5	F	7.4	A	9.4	A
6. College Ave at College Dr	21.1	C	22.6	C	10.5	B	11.7	B
10. College Ave at Commerce Dr*	27.7	C	34.9	C	22.6	C	26.6	C
13. College Ave at Stadium Dr	248.0	F	158.1	F	13.7	B	13.3	B
15. Leatherwood Ln at W. Cumberland Dr	36.6	E	67.0	F	7.5	A	7.8	A

*Results represent HCM 2000 methodologies.

Innovative Intersections

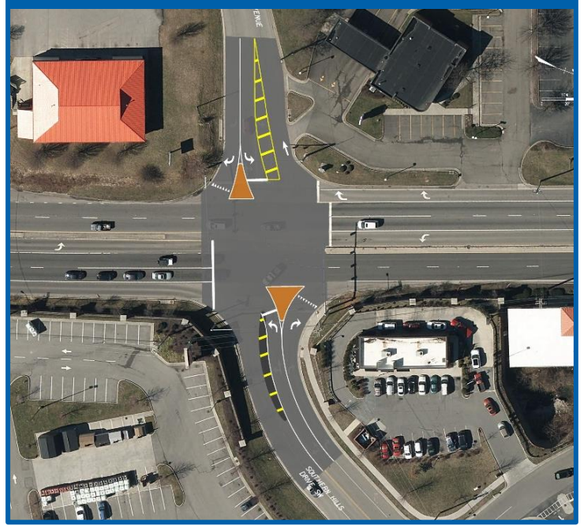
VDOT encourages the use of roundabouts and other innovative intersections to enhance safety and operations compared to traditional intersection configurations. Based on the safety history at the existing signalized intersections along the US 460 corridor at Leatherwood Lane and Commerce Drive, a screening analysis using VDOT's VJuST (Junction Screening Tool) was conducted. This analysis identified the following potential improvement alternatives:

- US 460 at Commerce Drive – Full Displaced Left-Turn
- US 460 at Commerce Drive – Partial Displaced Left-Turn

Both these alternatives were grouped in the "High" to "Very High" category for cost.

For the US 460 at Leatherwood Lane intersection, VJuST indicated relatively minor potential improvement for any of the at-grade intersection alternatives. An alternative concept, called a "Thru Cut," which is being developed for implementation at a number of intersections along the US 220 corridor in the Salem District was identified as a candidate improvement for this intersection. A thru-cut (pictured left) restricts through movements between the minor streets and allows the two side streets to run concurrently, reducing delay for the major street through and left-turn movements.

Thru-Cut Concept



Turn Lane Improvements

A review of the study area identified locations where new turn lanes, or modifications to existing turn lanes would provide enhanced safety and operations within the study area. These locations included:

College Avenue Between Ridgeview Plaza and College Plaza

Additional lanes were considered in the westbound and eastbound directions to provide improved lane continuity along the College Avenue corridor. This improvement was intended to provide increased capacity at the College Avenue / College Drive signalized intersection (#6) by providing an additional westbound through lane feeding the two westbound lanes in the downstream segment. In the eastbound direction, a second lane would be provided between the Ridgeview Plaza East Entrance (#7) and the existing right-turn lane approaching Commerce Drive. This would provide two continuous eastbound lanes along College Avenue between S. College Avenue and Commerce Drive. This was grouped in the "Low" cost category.

Bluefield College Drive Left-Turn Lane

When reviewing the College Avenue corridor, several intersecting streets were identified which are not currently served by a left-turn lane along College Avenue. These included Community Drive, Vandyke Circle, and Bluefield College Drive. Based on the crash data, an eastbound left-turn lane along College Avenue was evaluated at Bluefield College Drive. This would allow traffic turning onto Bluefield College campus to do so from a separate turn lane, allowing through traffic to continue eastbound and reducing the potential for eastbound traffic. This was grouped in the "Low" cost category as well.

Route 720 at US 460 WB Off-Ramp

A review of this area identified a series of weaving conditions and lane drops which resulted in driver confusion and increased risk of sideswipe and rear end crashes. The concept initially presented to the SWG (pictured right) included removal of the existing channelized right-turn lane from the US 460 off-ramp to Route 720. This would be replaced by a more traditional right-turn lane (stop-controlled, with the potential for future signalization if warranted). One of the two northbound through lanes along Route 720 would be striped out and northbound traffic directed into the right-turn lane towards College Avenue. This would reduce weaving in this area and eliminate the downstream lane drop north of College Drive. The operational analysis results showed improved operations for the US 460 WB Ramps intersection and a slight increase in delay for the S. College Ave at College Ave intersection; see **Table 14**. This was grouped in the "Very Low" to "Low" cost category.

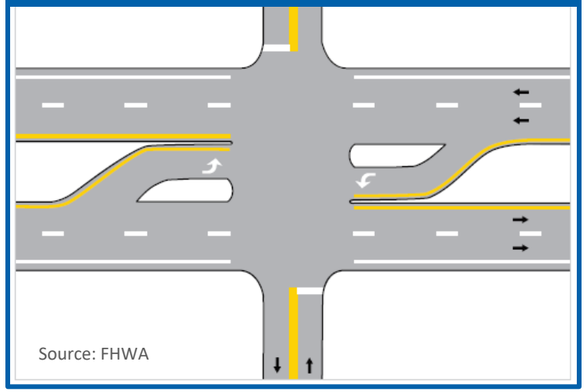
Route 720 & US 460 Off-Ramp - Preliminary Concept

Table 14 – 2040 Intersection Delay and LOS with Route 720/US 460 Ramp Improvements

Intersection	No Build				Modified			
	Midday Peak Hour		PM Peak Hour		Midday Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3. Valley Dale St at US 460 WB Ramps	27	D	51	F	13	B	22	C
4. S. College Ave at College Ave	17	B	21	C	28	C	23	C

US 460 Offset Left-Turn Lanes

Offset Left Turn Lanes - Schematic



During discussions with the SWG, an additional alternative was identified to provide low cost safety improvements at the signalized intersections along US 460 at Commerce Drive and at Leatherwood Lane. Both intersections were identified as crash hotspots during the crash analysis and several comments were received from the public regarding perceived safety issues at these locations. The SWG suggested an alternative to provide positive offset left-turn lanes at both locations. This type of left turn lane (pictured left) provides improved sight distance for left-turning traffic in both directions by shifting the alignment of the opposing turn lanes to the left. This also reduces the total crossing distance for these left-turn maneuvers.

New Roadway Connections

One of the key issues identified during discussions with the SWG was the limited connectivity within Town and the lack of alternate routes, particularly in the area of College Avenue and Leatherwood Lane. Both College Avenue and Leatherwood Lane are one lane per direction in the area of that intersection with multiple closely spaced access points contributing to current congestion and delays.

West Cumberland Road Extension

West Cumberland Road (Rte 746) Extension

The Town of Bluefield had previously identified a potential extension of West Cumberland Road from its current terminus to intersect College Avenue opposite of Bluefield College Drive. This alternative was evaluated and presented to the SWG for consideration. West Cumberland Road would be extended 500 feet and create a new fourth leg at the intersection of College Avenue and Bluefield College Drive. This would provide additional connectivity within the Town but would also direct additional traffic to the challenging intersection of Leatherwood Lane and West Cumberland Road. This alternative could be combined with a traffic signal or roundabout at the intersection with College Avenue. A main benefit would be to reduce traffic along College Avenue at the intersection with Stadium Drive; this would make it easier for Stadium Drive to enter College Avenue compared to the No Build conditions. It was grouped in the "Medium" to "High" cost categories.

Improvement Project Selection

The final step in the screening process was to select the improvements to move forward to the improvement development process, which included development of refined conceptual sketches (using CAD design software) and refined cost estimates. This selection was completed during the December 16, 2019 SWG Meeting. The SWG considered the potential operational and safety improvements, potential cost and impacts, and other local considerations to identify those improvements worthy of more detailed evaluation.

Another key element of the discussion was the selection of two candidate projects for submittal in the 2020 application cycle for potential Smart Scale funding; these two projects would need to address a specific VTRANS need and ideally fall in the "Very Low" to "Low" cost categories. During this discussion, it was noted that the College Avenue sidewalks project would not address a specific VTRANS need, but the College Avenue Access Management improvements would. Therefore, the SWG agreed to combine those improvements into a single alternative.

Table 15 summarizes the improvements selected for detailed evaluation.

Table 15 – Improvement Project Selection Summary

Alternative	Selected Projects	2020 Smart Scale Applications
College Avenue Access Management & Sidewalk Improvements	✓	✓
US 460 Offset Left-Turn Lanes at Commerce Dr & Leatherwood Lane	✓	✓
Valley Dale Street at Huffard Drive Roundabout		
College Avenue at College Drive Roundabout		
College Avenue at Commerce Drive Roundabout	✓	
College Avenue at Stadium Drive Roundabout	✓	
Leatherwood Lane at W. Cumberland Road Roundabout		
US 460 at Commerce Drive – Full Displaced Left-Turn		
US 460 at Commerce Drive – Partial Displaced Left-Turn		
US 460 at Leatherwood Lane Thru-Cut		
College Avenue: Ridgeview Plaza to College Plaza Turn Lanes		
College Avenue at Bluefield College Drive Left-Turn Lane	✓	
Route 720 at US 460 WB Off-Ramp Turn Lanes Improvements	✓	
W. Cumberland Road Extension	✓	

The following provides a brief summary of the projects not selected for recommendations from this study:

- Valley Dale Street at Huffard Drive Roundabout – Challenging terrain presented design constraints as did operational needs for the adjacent high school and church.
- College Avenue at College Drive Roundabout – Operational benefits were relatively small and design challenges were identified due to the surrounding terrain and limited right-of-way.
- Leatherwood Lane at W. Cumberland Road Roundabout – Concerns with the potential property impacts on adjacent parcels and operational concerns with the proximity to the signal at Leatherwood Lane / US 460.
- US 460 at Commerce Drive Displaced Left-Turns – High cost relative to other projects.
- College Avenue: Ridgeview Plaza to College Plaza Turn Lanes – Public concern with unclear lane designation on College Avenue under existing conditions; extended shared turn lanes may increase perceived safety issues.

CONCEPTUAL DESIGN, COSTS, AND SCHEDULES

Conceptual designs and refined planning cost estimates were developed for each selected improvement project and are summarized in the following sections. One-page summary sheets were designed for each improvement project and are included in **Appendix D**. The summary sheets provide a brief project description, conceptual design layout, planning level cost estimate, project schedule and project location map for each improvement project.

Conceptual Design

Conceptual designs were developed for the improvement projects. CAD drawings were developed for improvement projects with geometric components. During the CAD drawing development, the project designs were further refined, and in some cases, modifications were made to the initial concepts developed during the concept development phase. The following sections describe and provide a graphic for each of the selected improvement concepts and discuss any design modifications from the conceptual development phase.

Conceptual design plans were developed in accordance with the following applicable guidelines:

- A Policy on Geometric Design of Highways and Streets (AASHTO 2011)
- VDOT Road Design Manual (Issued January 2005, Revised July 2016)
- VDOT Road and Bridge Standards (VDOT 2016, latest revisions)
- Manual on Uniform Traffic Control Devices (MUTCD 2009)
- 2011 Virginia Supplement to the MUTCD

Design criteria and guidance from these documents were applied to roadways within the project limits based on functional classification and roadway design speeds. The proposed design assumed a WB-67 as the design vehicle to determine the design impacts of the turning radius.

The first two projects were selected for application for funding in the 2020 Smart Scale cycle. They are referred to as Project 1 and Project 2 in this study. The remaining five projects are candidates for future funding submittals and are referenced as Projects A – E.

Project 1: College Avenue Access Management & Sidewalk Improvements

This project improves access management pedestrian mobility along College Avenue between the College Avenue at College Drive intersection (#6) and College Avenue at Stadium Drive intersection (#13). The existing unsignalized full access points along College Avenue at Ridgeview Plaza (East Entrance) and College Plaza (West Entrance) would be modified to right-in/right-out/left-in configurations with the left-turns onto College Plaza re-routed to alternative locations. New sidewalk is proposed along the south side of College Avenue between the College Drive intersection (#6) and the Ridgeview Plaza East Entrance (#7) where existing sidewalk is located. New sidewalk is also proposed along the north side of College Avenue between Bluefield College Drive (#12) and Stadium Drive (#13).

The proposed sidewalk to be included in this alternative was modified based on follow-up discussions with VDOT and the SWG. The initial alternative included sidewalk on the north side of College Avenue between the S. College Avenue intersection and the College Drive intersection, with a crosswalk connecting to the existing sidewalk along the west side of S. College Avenue. However, there was concern expressed with the sidewalk crossing the existing free-flow, channelized right-turn from College Avenue westbound to S. College Avenue northbound. Therefore, this section of sidewalk was removed from the proposed improvements for this alternative, but it was included in a different alternative (see Project E below for more details).

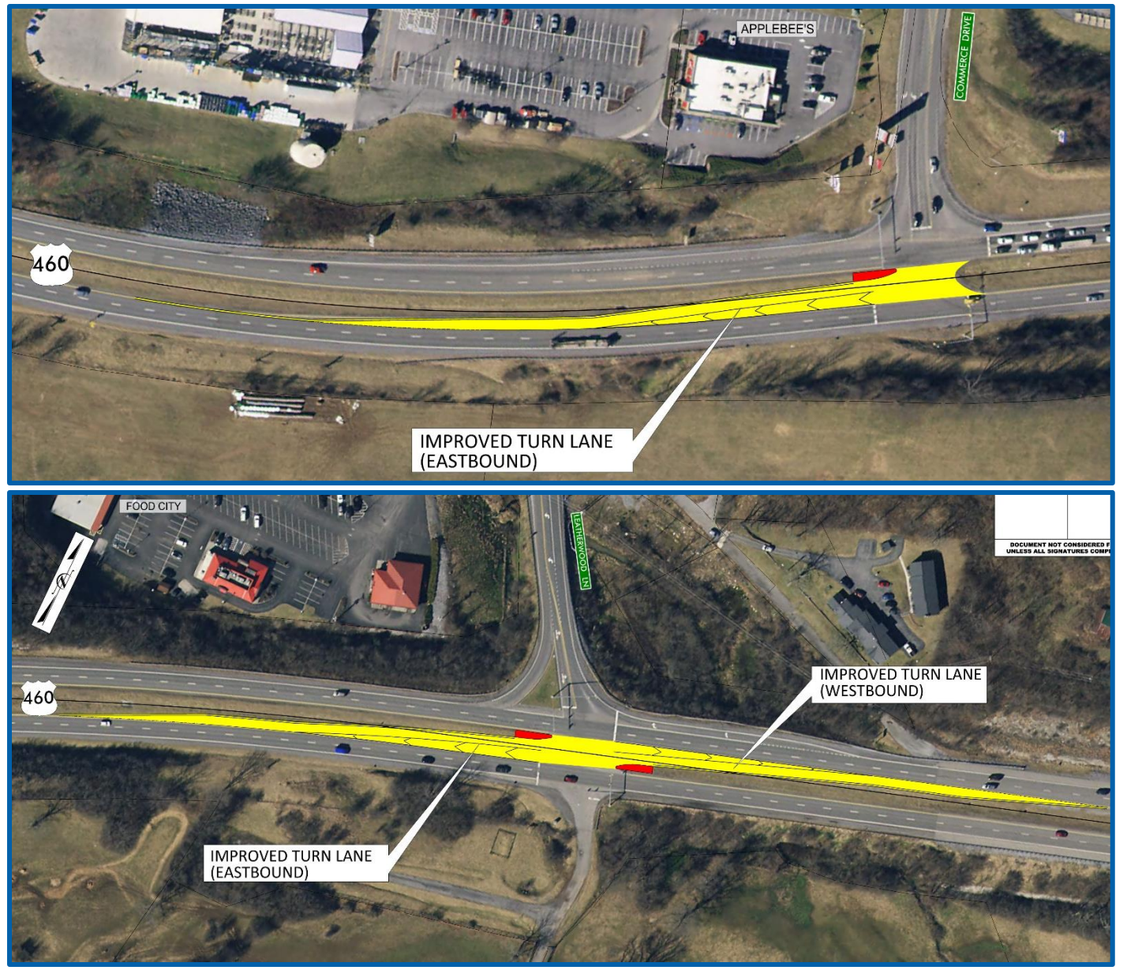
Figure 9 depicts the conceptual design for this project.

Figure 9. College Avenue Access Management & Sidewalk Conceptual Design

Project 2: US 460 Offset Left-Turn Lanes

This project improves safety along the US 460 corridor by providing offset left-turn lanes at both the Leatherwood Lane (#16) and Commerce Drive (#17) intersections. At Leatherwood Lane, both the eastbound and westbound left-turn lanes along US 460 are proposed to be offset. At Commerce Drive, there is an existing eastbound left-turn lane along US 460 and this project would offset that turn lane. In the future, the Leatherwood Development plans to construct dual westbound left-turn lanes along US 460 to access their site at which point the westbound left-turn lane could be addressed.

Figure 10. US 460 Offset Lefts Conceptual Design

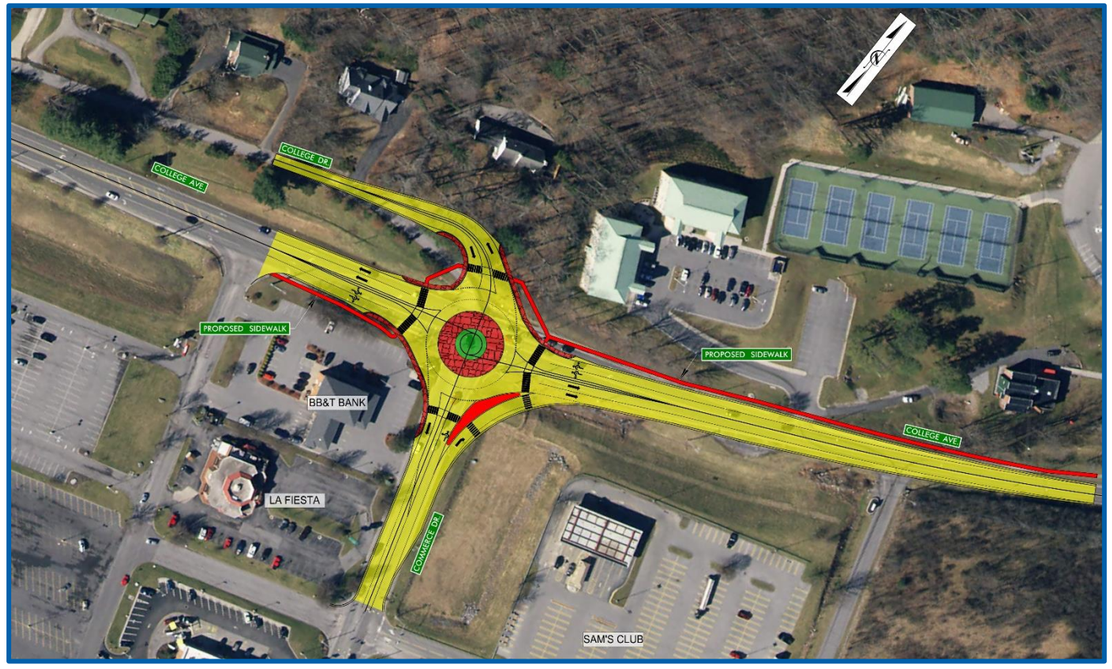


The next group of projects were not identified to be submitted for Smart Scale funding in the 2020 application cycle but are included as recommendations for future projects for the Town of Bluefield to provide additional transportation improvements within the study area.

Project A: College Avenue & Commerce Drive Roundabout

This project improves safety and operations at the College Avenue intersection with Commerce Drive (#10). The existing signalized intersection would be replaced by a hybrid two-lane, one-lane roundabout. Two through lanes would be provided both eastbound and westbound along College Avenue, with a single lane approach along College Drive, and two approach lanes (one shared left-turn / through lane and an exclusive right-turn lane). The project would reconstruct the existing sidewalks within the project limits and provide marked pedestrian crossings of all four legs of the proposed roundabout. Also, while not depicted in **Figure 11**, this alternative would also include modifying the existing full access driveway at Bluefield Commons to a right-in/right-out/left-in configuration. This driveway is located approximately 400 feet east of the main intersection. Left-turns onto College Avenue from that location would be accommodated by a right-turn and a downstream U-turn at the proposed roundabout. Additional potential refinements would be closing the College Drive approach, with College Drive traffic routed to the signalized intersection to the west.

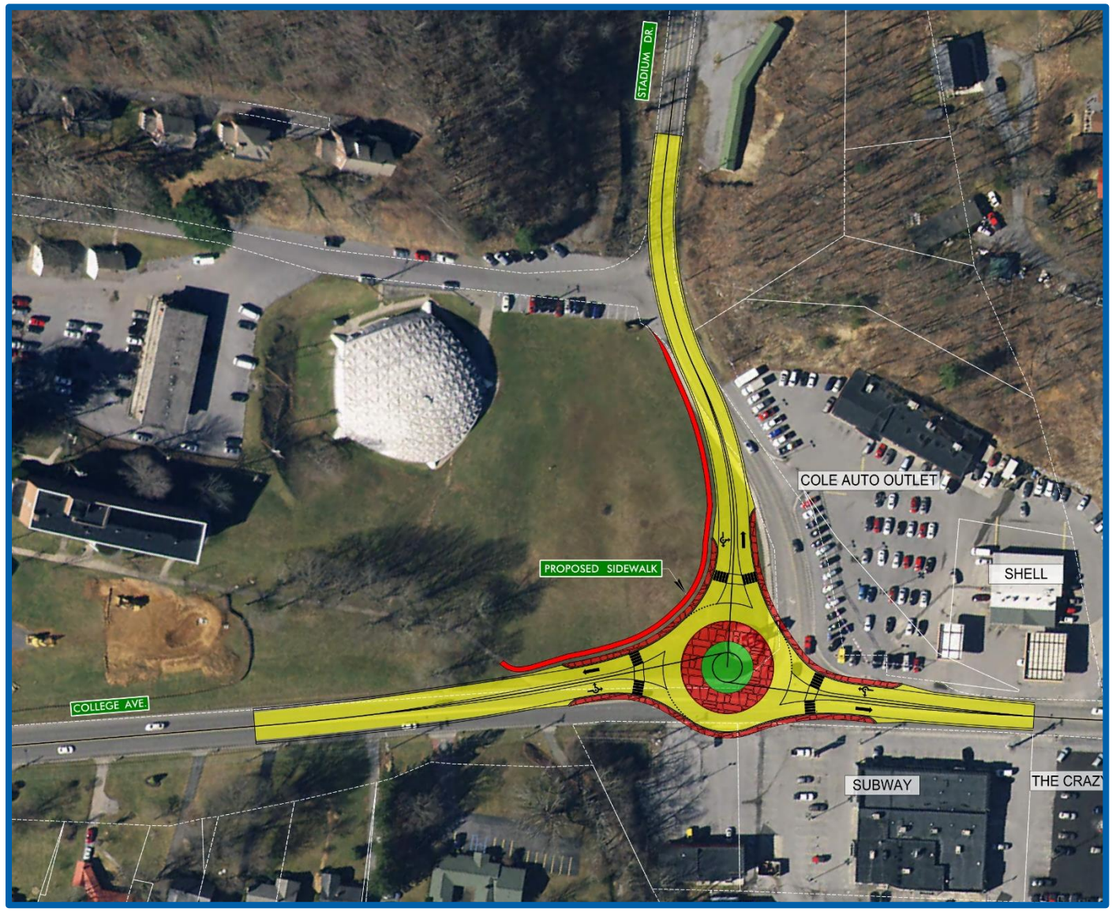
Figure 11. College Avenue at Commerce Drive Roundabout Conceptual Design



Project B: College Avenue & Stadium Drive Roundabout

This project improves safety and operations at the College Avenue intersection with Stadium Drive. A single lane roundabout would be constructed. Access to the adjacent commercial properties would be addressed during more detailed design. The project would reconstruct the sidewalk along the west side of Stadium Drive and north side of College Avenue and provide pedestrian crossings across all the 3 legs of the roundabout.

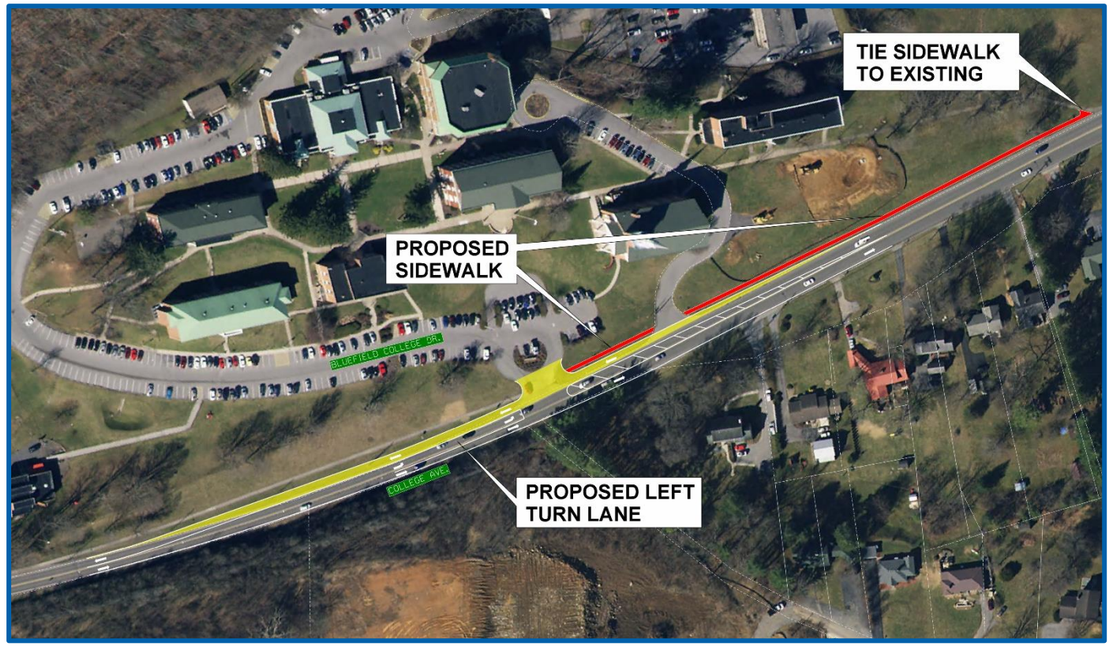
Figure 12. College Avenue at Stadium Drive Roundabout Conceptual Design



Project C: College Avenue Eastbound Left-Turn Lane at Bluefield College Drive

This project improves safety and operations along College Avenue in the vicinity of Bluefield College Drive. The project consists of widening to provide a left-turn lane along eastbound College Avenue to access Bluefield College Drive. The project could also include the proposed sidewalk along the north side of College Avenue, which is part of Project 1. This project could also be combined with **Project D: West Cumberland Road Extension** with the resulting 4-legged intersection signalized.

Figure 13. College Avenue at Bluefield College Drive Left-Turn Lane Conceptual Design



Project D: West Cumberland Road Extension

This project improves safety and operations along College Avenue and Leatherwood Lane. The project includes extending West Cumberland Road (Route 746) approximately 500 feet from its current terminus south of College Avenue. West Cumberland Road would intersect College Avenue as the new fourth leg of the College Avenue / Bluefield College Drive intersection. Additionally, Vandyke Circle would be realigned to intersect Bluefield College Drive; this would eliminate the existing Vandyke Circle intersection with College Avenue. This improvement could be combined with **Project C: College Avenue Eastbound Left-Turn Lane at Bluefield College Drive** and the resulting intersection signalized.

Figure 14. West Cumberland Road Extension Conceptual Design

Project E: College Avenue & Route 720 Intersection Improvements

This project improves safety and operations along College Avenue, S. College Avenue, and Valley Dale Street (Route 720). This project was modified and expanded from the original concept reviewed and selected by the SWG. The original elements of the remain. The project includes removing the existing channelized right-turn lane from the US 460 WB off-ramp to Route 720 and replacing it with a traditional right-turn lane which would be stop-controlled. Additionally, the outside through lane along northbound Route 720 would be striped out and traffic directed into the northbound right-turn lane. This will eliminate the existing weave between the off-ramp and the adjacent signalized intersection and eliminate the existing northbound lane drop just north of the traffic signal.

The project was expanded in order to provide a new sidewalk along the north side of College Avenue between S. College Avenue and College Drive. This segment of sidewalk was removed from **Project 1: College Avenue Access Management and Sidewalk Improvements** due to concern with the safety of pedestrians crossing the channelized right-turn from westbound College Avenue to northbound S. College Avenue. The proposed improvements would eliminate the channelized right-turn and replace it with a new right-turn lane which would be controlled by the existing traffic signal. Sidewalk would be provided along the north side of College Avenue with new crosswalks and pedestrian signals to cross S. College Avenue and to cross College Avenue at the College Drive / Ridgeview Plaza intersection. With both Project 1 and Project E completed, there would be a continuous sidewalk along College Avenue from Stadium Drive to S. College Avenue.

The intersection of Valley Dale Street (Route 720) and the US 460 WB Ramps could be signalized if needed in the future to provide gaps for left and right-turning traffic from the US 460 WB off-ramp to enter Route 720. Signalization would be subject to a review of traffic signal warrants.

Figure 15. College Avenue and Route 720 Intersection Improvements Conceptual Design

Planning-Level Cost Estimates

Refined planning-level cost estimates were developed for all selected improvement projects. The VDOT Project Cost Estimating System (PCES) and the Bristol L&D Estimating Workbook were used as resources for calculation of the project construction and preliminary engineering costs. Quantities were determined based on the conceptual designs. For projects with anticipated right- of-way and/or utility impacts, right-of-way and utility relocation costs were estimated on a project-by-project basis based on the size and complexity of the project, as well as the existing right-of-way limits. In addition, the construction cost included an additional 20% of the base roadway construction cost for construction engineering and inspection (CEI). **Table 16** summarizes the preliminary engineering (PE), right-of-way and utility relocation (RW), construction (CN), and total planning level cost estimates for each improvement project. Costs are reported in 2020 dollars.

Table 16 – Planning-Level Cost Estimates

Project	Cost Estimate (2020 dollars)			
	PE	RW	CN	Total
1) College Avenue Access Management & Sidewalk Improvements	$399,000	357,000	$1,071,000	**$1,827,000**
2) US 460 Offset Left-Turn Lanes	$712,000	-	$2,273,000	**$2,985,000**
A) College Avenue & Commerce Drive Roundabout	$693,000	$604,000	$3,650,000	**$4,947,000**
B) College Avenue & Stadium Drive Roundabout	$500,000	$561,000	$2,370,000	**$3,431,000**
C) Bluefield College Drive Left-Turn Lane	$250,000	$339,000	$1,010,000	**$1,599,000**
D) West Cumberland Road Extension	$687,000	$678,000	$3,600,000	**$4,965,000**
E) Route 720 & College Avenue Intersection Improvements	$250,000	$120,000	$980,000	**$1,350,000**

Project Development Schedules

Estimated project development schedules were also prepared for each of the selected improvement projects. Schedules were based on VDOT's typical project development process and the scope and complexity of the individual projects. **Table 17** summarizes the projected timeframes for the preliminary engineering (PE), right-of-way and utility relocation (RW), and construction phases for each project. Projects on new location (such as **Project D: West Cumberland Road Extension**) include an extended PE period to account for appropriate environmental studies.

Table 17 – Planning-Level Project Development Schedules

Project	Schedule Estimate (Months)			
	PE	RW	CN	Total
1) College Avenue Access Management & Sidewalk Improvements	12	9	3	**24**
2) US 460 Offset Left-Turn Lanes	18	-	4	**23**
A) College Avenue & Commerce Drive Roundabout	24	12	12	**48**
B) College Avenue & Stadium Drive Roundabout	24	12	12	**48**
C) Bluefield College Drive Left-Turn Lane	12	6	6	**24**
D) West Cumberland Road Extension	24	6	6	**36**
E) Route 720 & College Avenue Intersection Improvements	12	6	4	**22**

Proposed Projects – Public Involvement

A virtual public involvement opportunity was available to the public between May 22, 2020 and June 16, 2020. The public involvement opportunity included a short (12 minute) recorded video presentation, available on the study website, which presented the 7 projects identified by the SWG for public consideration. This was supplemented by an online survey, through MetroQuest, which asked that the public rate each of the 7 projects on a scale of 1 to 5 (1 being least favorable and 5 being most favorable). A total of 820 visitors accessed the MetroQuest survey during the public involvement opportunity and 294 responses were received. A detailed summary of the public feedback is included in **Appendix C** and a brief summary is provided below in **Table 18** with the average ranking received by each potential project.

Table 18 – Public Feedback Summary

Project	Average Rank	Number of Rankings
Existing (No Build)	2.5	287
Projects Proposed for 2020 Smart Scale Funding		
Project 1: College Avenue Sidewalk and Access Management Improvements	3.5	234
Project 2: Offset Left Turn Lanes at US 460 / Leatherwood Lane and US 460 / Commerce Drive	4.0	129
Potential Future Improvement Concepts		
Project A: Roundabout - College Avenue & Commerce Drive	2.5	231
Project B: Roundabout - College Avenue & Stadium Drive	3.1	126
Project C: College Avenue Left-Turn Lane at Bluefield College	3.7	123
Project D: West Cumberland Road Extension	3.6	118
Project E: College Avenue and Route 720 Intersection Improvements	3.1	115

The results indicate that all projects were rated equal to or better than the existing conditions. Both Project 1 and Project 2, which are proposed for 2020 Smart Scale funding, received average rankings between 3.5 and 4.0 points and the specific feedback on these alternatives was positive.

Of the remaining five projects, there was some specific concern expressed with the proposed roundabouts along College Avenue. Many comments cited driver unfamiliarity with roundabouts and potential safety concerns. Additional outreach and education regarding the benefits of roundabouts in terms of safety and operations will likely be necessary for Project A and Project B if those projects are funded and progress to design. Project E also received an average rating of 3.1 and several comments indicated some confusion with the proposed project and the expected benefits. Additional outreach will likely be useful for this project to convey the expected benefits to the public.

PROJECT ADVANCEMENT

The study should be used as a planning tool to achieve the next steps of project planning, programming, designing, and constructing the identified safety and operational improvements in the study corridor. To advance these studies, members of the SWG should use the following steps.

Gain Consensus for Projects

Outreach meetings were already conducted to share the seven proposed projects with the public. As noted in the previous section, strong support was found for the projects intended for submittal in the 2020 Smart Scale application cycle. Additional outreach is recommended for those projects for which public feedback was less positive, specifically the proposed roundabouts and the Route 720 & College Avenue intersection improvements.

Prioritize Improvements

The Town of Bluefield has already prioritized two projects from this study for submittal in the 2020 Smart Scale application cycle. Project 1 focuses on safety improvements and pedestrian mobility enhancements along the College Avenue corridor. Project 2 focuses on safety improvements at the signalized intersections along the US 460 corridor. Both projects are anticipated to be constructed within the existing right-of-way.

Each of the additional five projects are anticipated to provide both safety and operational improvements but would require some additional right-of-way or temporary easements and require lengthier project development periods. The Town of Bluefield should identify their priorities among the remaining projects and look to advance those projects as funding opportunities become available.

Prepare Projects for Advancement

Once projects have been prioritized at the local and regional level, the priority projects should be advanced to the following documents in preparation of funding application submissions:

- Local Comprehensive Plan
- Constrained Long-Range Plan (CLRP)
- Transportation Improvement Plan (TIP)
- Statewide Transportation Improvement Plan (STIP)

Apply for Prioritized Funding Programs

The following funding sources should be considered for improvement projects identified in this study.

Smart Scale

SMART SCALE allocates funding from the construction District Grant Program (DGP) and High-Priority Projects Program (HPPP) to transportation projects based on a scoring process. The scoring process evaluates, scores and ranks projects based on congestion mitigation, economic development, accessibility, safety, environmental quality, and land use factors. The location of the project determines the weight of each of these scoring factors in the calculation of the total score. For projects in the Bristol District, the scoring factors with the highest weight are economic development (35%) and safety (30%). As noted above, the Town has selected the following two projects for submittal to the 2020 Smart Scale application cycle:

- Project 1: College Avenue Access Management & Sidewalk Improvements
- Project 2: US 460 Offset Left-Turn Lanes

For future rounds of Smart Scale, Projects A through E could be submitted independently, or two or more projects could potentially be packaged together and submitted as a single application to recognize potential cost savings with completing the projects concurrently and maximizing the project benefit score in the Smart Scale rating system. For the proposed projects identified, the following projects are logical candidates to be combined in a single Smart Scale application:

- Project C: Bluefield College Drive Left-Turn Lane
- Project D: West Cumberland Road Extension

Revenue Sharing

Revenue sharing is a program that provides a dollar for dollar state match to local funds for transportation projects. Projects eligible for Revenue Sharing funds include construction, reconstruction, improvement, and maintenance projects. All identified improvement projects are candidate projects for Revenue Sharing.

Advance Selected Projects to VDOT SYIP

Once project applications are approved for funding through one or more of the aforementioned funding sources, the project should be incorporated in the VDOT SYIP, so it can enter the project development process.