



City of Staunton 10 PSI Intersections Improvement Study

Staunton, Virginia

FINAL REPORT

February 2022





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10 PSI Intersections
Improvement Study

Final Report

February 2022

Prepared for



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1. INTRODUCTION

1.1. Purpose / Background

The Virginia Department of Transportation (VDOT) Staunton District, VDOT Transportation Mobility and Planning Division (TMPD), and The City of Staunton, Virginia, identified the need to evaluate the safety, multimodal, and traffic operations conditions for ten intersections at different locations throughout the City. VDOT has identified the study intersections as those with Potential for Safety Improvement (PSI), which is based on Virginia Specific Highway Safety Performance Functions (SPF). These data sets have been developed by VDOT using the latest Highway Safety Manual (HSM) methods. Virginia’s SPFs, based on major and minor road traffic volumes, were developed for both VDOT and Locally maintained intersections with different traffic control and the number of roadway approaches. Locations that have more crashes than expected based on the related SPF have a PSI value greater than zero. These PSI values indicate that engineering review is recommended for possible mitigating countermeasures.

The purpose of this study is to analyze the traffic, safety, pedestrian and bicyclist, and geometric conditions for the ten intersections identified as having Potential for Safety Improvement (PSI) within the City of Staunton. This project falls under the Strategically Targeted and Affordable Roadway Solutions (STARS) program. This study identifies and assesses safety-focused improvement options for the short term, the intermediate-term, and the long term for these intersections. The City of Staunton adopted a comprehensive plan in July 2019 and a Bicycle and Pedestrian Plan in May 2018 that forms a basis for improvements that were considered in this intersection study.

The study develops and evaluates potential alternatives to improve safety and operations at the study intersections. The recommended improvements can be advanced for funding consideration through one of the State’s transportation grant programs, such as Smart Scale, Revenue Sharing, or Transportation Alternatives for inclusion in VDOT’s Six-Year Improvement Program (SYIP).

A stakeholder working group was developed to solicit input and feedback throughout the course of the study. Responsibilities of the stakeholders included providing input in:

1. Traffic engineering and traffic signal operations
2. Pedestrian and bicycle facilities
3. Land development
4. Access management
5. Transportation planning
6. Transit operations
7. Highway safety
8. Preliminary design and cost estimating
9. Local familiarity with the City of Staunton

The stakeholder group for the study included representatives from:

1. VDOT Staunton District and Central Office
2. City of Staunton
3. BRITE Bus Transit Service
4. Staunton-Augusta-Waynesboro Metropolitan Planning Organization (SAWMPO)
5. ATCS Team (consultants to VDOT for the Study)

1.2. Study Area

The study area consists of ten intersections, seven of which are in downtown Staunton. Six of the seven downtown intersections are signalized, while the seventh intersection is unsignalized with stop control. The downtown study intersections provide access to a multitude of developments such as restaurants, small businesses, banks, municipal buildings, a hotel, parking garages and lots, and the Staunton Amtrak Station. Due to this high-density development, downtown Staunton invites high pedestrian activity. There is existing pedestrian infrastructure consisting of sidewalks and crosswalks at all seven study intersections. Additionally, there are several one-way streets and streets with parallel street parking. The City of Staunton’s Comprehensive Plan aims to create walkable neighborhoods and reduce the number of short vehicle trips through a high-quality pedestrian network. For more detail on the proposed pedestrian network, please see Page 24 of the Staunton Capital Improvement Plan. The existing pedestrian network of Downtown Staunton, while useful, presents a notable lack of pedestrian signals at intersections. Additionally, there are no designated bicycle facilities within the study area. **Figure 1** shows a map of the

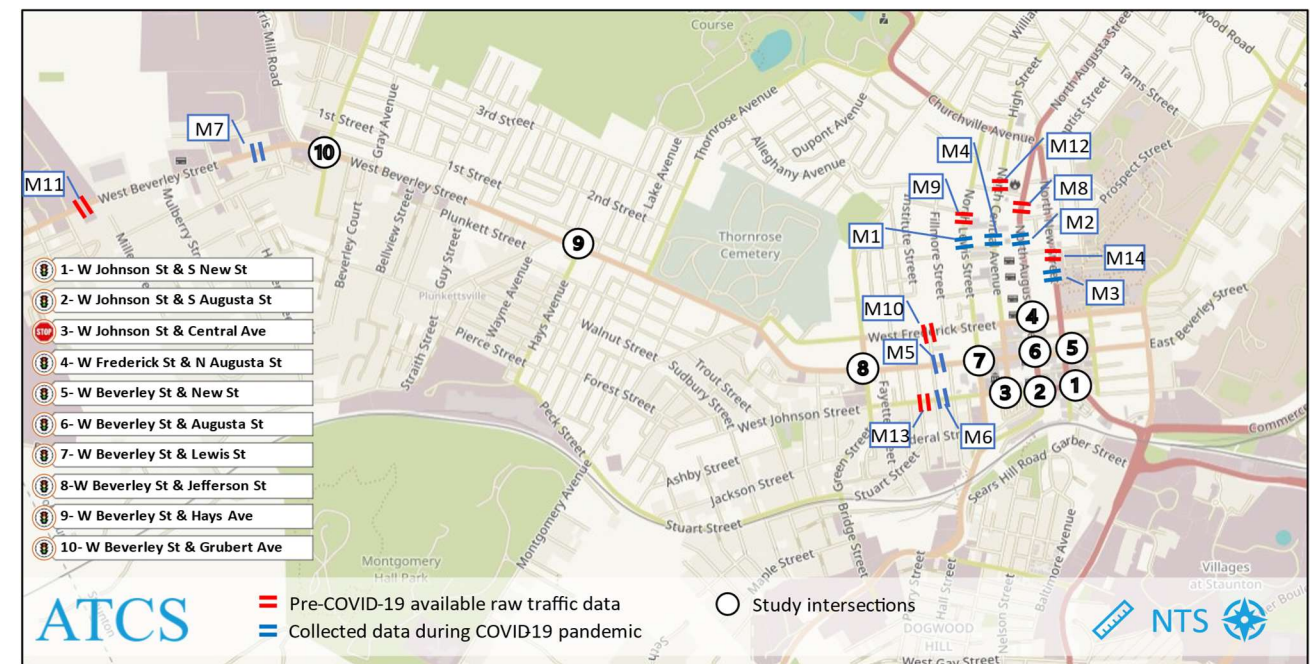


Figure 1. Study Area and Available Mid-Block Traffic Volume Counts

study area.

The study area includes the following intersections:

1. West Johnson Street & South New Street (signalized)
2. West Johnson Street & Augusta Street (signalized)
3. West Johnson Street & Central Avenue (unsignalized)
4. West Frederick Street & Augusta Street (signalized)
5. West Beverley Street & New Street (signalized)
6. West Beverley Street & Augusta Street (signalized)
7. West Beverley Street & Lewis Street (signalized)
8. West Beverley Street & Jefferson Street (signalized)
9. West Beverley Street & Hays Avenue (signalized)
10. West Beverley Street & Grubert Avenue (signalized)

2. EXISTING CONDITIONS

2.1. Traffic Data

This study was conducted during the COVID-19 pandemic, which significantly affected traffic volumes throughout the 2020 calendar year as a result of travel restrictions put in place by state and local governments to control the spread of COVID-19. Although many restrictions were lifted by the time traffic data collection efforts were conducted in November 2020, overall traffic volumes remained below typical levels. In order to ensure the collected data represents as close to normal conditions as possible, the collected data was compared to pre-pandemic data provided by VDOT, with proper adjustment rates applied when necessary.

The Virginia Department of Transportation (VDOT) publishes annual summaries of traffic volume data collected from various count stations. The data is aggregated to annual average daily traffic (AADT) and Average Annual Weekday Traffic (AAWDT), in which AADT is the estimate of typical daily traffic on a road segment for all days of the week, Sunday through Saturday, over the period of one year. AAWDT is the estimate of typical traffic over the period of one year for the days between Monday through Thursday inclusive. Additionally, a K factor is calculated and provided, which is an estimate of the portion of the traffic volume traveling during the peak hour or design hour. These data points are available for 2019 (pre-pandemic) per segment along the streets where many study intersections are located. In addition to published traffic volumes, VDOT provided raw data collected in 2019 at four locations. The during pandemic data from 2020 was collected at seven mid-block locations for 48 hours and two hours during the Midday and PM peak periods at all ten study intersections.

The volume data comparison was completed utilizing street segments defined by VDOT's count program, the 2019 segment AAWDT or ADT from the raw data, and ADT from the mid-block counts collected during the pandemic to determine the overall difference in volume. Additionally, pre-pandemic design peak hours are calculated from multiplying the AAWDT by the K factors or directly calculated from raw data where available. These calculated design peak hour volumes are then compared to during pandemic peak hour data from the mid-block counts and the highest intersection peak hours.

See **Appendix B** for the full COVID-19 adjustment technical memo. A map of the final turning movements counts is shown below in **Figure 2**.

2.2. Analysis Peak Period and Tools

Based on the review of available traffic volume data and local knowledge, the earlier peak period occurs around noon time instead of a typical early morning peak. Therefore, the traffic data was collected for the Midday and PM peak periods. As the intersections are located on different corridors, an individual peak hour period was determined for each intersection. The operational analysis was performed for the 2020 existing year and 2035 design year.

The intersections' traffic operations analyses were conducted using Synchro 10, VJust 1.0, and SIDRA 9 analysis tools. The operational analysis was based on guidance provided in the VDOT Traffic Operations and Safety Analysis Manual (TOSAM), Version 1.0, November 2015 (Update February 2020). Synchro analyses

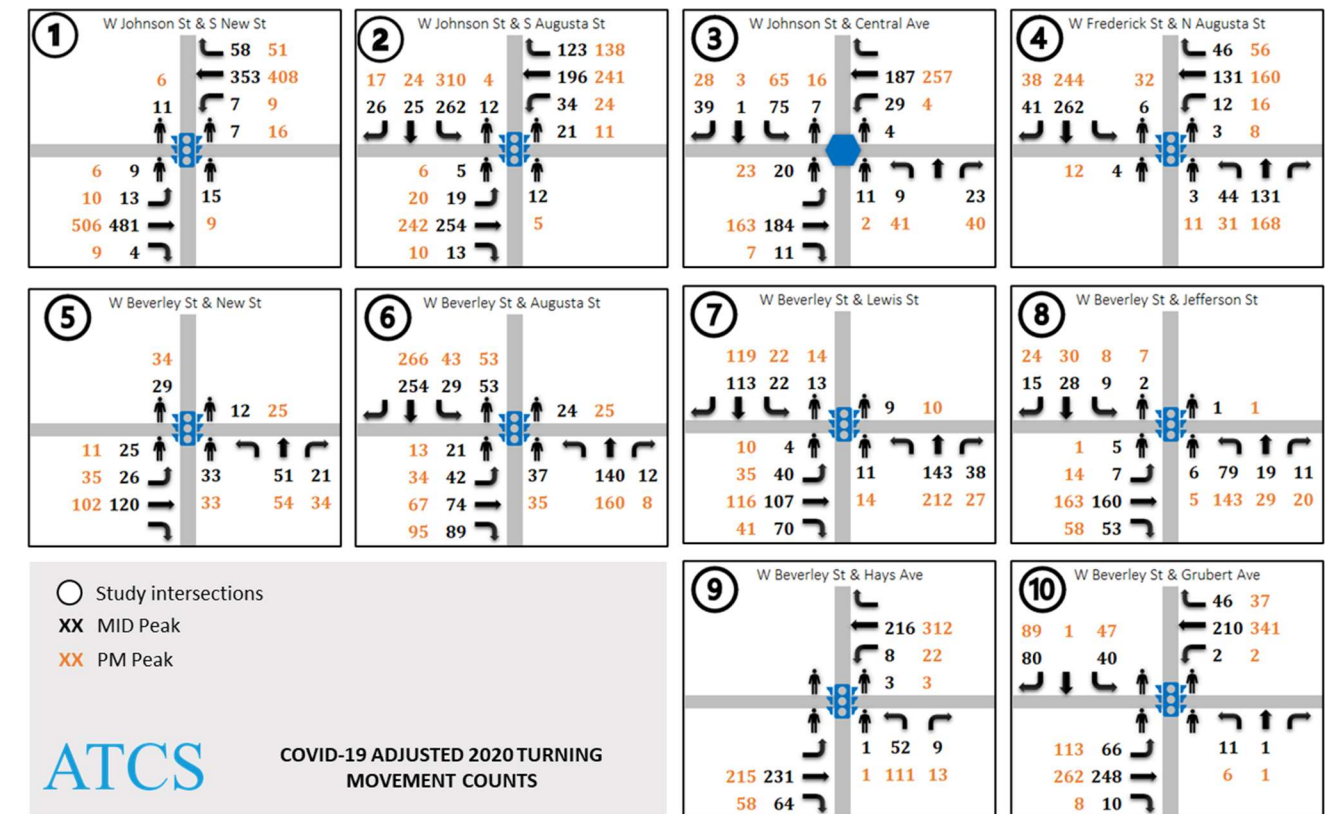


Figure 2. 2020 COVID-19 Adjusted Turning Movement Counts

are based on methodologies presented in the Highway Capacity Manual (HCM) 6th edition where applicable. Otherwise, HCM 2000 methodology was used.

2.3. Measures of Effectiveness

There are many measures of effectiveness (MOE) in traffic operations analysis to quantify operational and safety objectives and provide a basis for evaluating the performance of a transportation network. Several MOEs for intersection analysis can be reported from Synchro, VJuST, and SIDRA. For the purposes of this study, guidance for reporting MOEs for signalized and unsignalized intersections were obtained from Chapter 4 of the VDOT TOSAM. A summary of the MOEs evaluated for the study intersections are presented below:

- Control Delay (measured in seconds per vehicle – sec/veh)
- Level of service (LOS)
- 95th Percentile Queue Length (measured in feet – ft)
- Volume-to-Capacity (v/c) Ratio

2.4. Future Traffic Volumes

The existing turning movement counts were forecasted to the 2035 future Year, which was determined by the study team as the design year for the improvements. Projecting the turning movement counts at the study intersections to the design year with an appropriate growth rate was the first step in developing the future conditions analysis.

During the kick-off meeting held on October 28, 2020, the study team members suggested that the potential for growth around the study intersections is very limited, as these areas are developed with no significant redevelopments planned. Therefore, a linear annual growth rate of 0.5% was deemed suitable for all study intersections.

2.5. Study Intersections and Traffic Operation Conditions (2020)

2.5.1. West Johnson Street & South New Street – Signalized Intersection

As shown in **Figure 3**, West Johnson Street at South New Street consists of one left turn lane and one shared through/right turn lane along eastbound and westbound Johnson Street. South New Street is a one-way street northbound, north of the intersection, and southbound, south of the intersection. There are crosswalks across all four approaches of the intersection with ramps at all corners of the intersection. Sidewalks are present along both sides of West Johnson Street and South New Street.



Figure 3. Aerial of West Johnson St & South New St

The intersection level of service (LOS), delays, and queue lengths are shown in **Table 1**

Table 1. Delay, LOS and 95th Queue for West Johnson St and South New St

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
W Johnson St & S New St	W Johnson St	EBL	1.2	A	1	1.2	A	1
		EBT	0.9	A	0	4.4	A	0
		EBR						
	W Johnson St	WBL	9.1	A	6	12.9	B	7
		WBT	12.4	B	241	28.6	C	313
		WBR						
Overall			6.0	A		15.2	B	

2.5.2. West Johnson Street & Augusta Street – Signalized Intersection

As shown in **Figure 4**, West Johnson Street at Augusta Street consists of one left turn lane and one shared through/right turn lane along eastbound and westbound Johnson Street. Augusta Street is a one-way street southbound and consists of one left turn lane and one shared through/right turn lane. There are crosswalks across all four approaches of the intersection with ramps at all corners of the intersection. Sidewalks are present along both sides of West Johnson Street and Augusta Street.



Figure 4. Aerial of West Johnson St and Augusta St

The intersection level of service (LOS), delays, and queue lengths are shown in **Table 2**.

Table 2. Delay, LOS and 95th Queue for West Johnson St and Augusta St

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Johnson Street & South Augusta Street	South Augusta Street	SBL	16.9	B	194	20.7	C	248
		SBT	6.5	A	14	7.8	A	15
		SBR						
	West Johnson Street	EBL	8.7	A	11	9.2	A	12
		EBT	33.0	C	157	28.2	C	150
		EBR						
	West Johnson Street	WBL	12.4	B	17	7.4	A	8
		WBT	33.6	C	213	33.6	C	224
WBR								
Overall			26.2	C		26.2	C	

2.5.3. West Johnson Street & Central Avenue – Unsignalized Intersection

As shown in **Figure 5**, West Johnson Street at Central Avenue consists of one left turn lane and one shared through/right turn lane along westbound Johnson Street with one shared left turn/through/right turn lane along eastbound Johnson Street. Southbound Central Avenue consists of one left turn lane and one right turn lane. The entrance to the Wharf parking lot is located to the southeast of this intersection. There are crosswalks across the north and west approaches of the intersection with ramps at the northeast, northwest, and southwest corners of the intersection. Sidewalks are present along both sides of West Johnson Street and Central Avenue.



Figure 5. Aerial of West Johnson St and Central Ave

The intersection level of service (LOS), delays, and queue lengths are shown in **Table 3**.

Table 3. Delay, LOS and 95th Queue for W Johnson St and Central Ave

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Johnson Street & Central Avenue	Central Avenue	SBL	11.2	B	12	10.7	B	8
		SBT						
		SBR						
	West Johnson Street	EBL	0.0	A	0	0.0	A	0
		EBT						
		EBR						
	West Johnson Street	WBL	0.0	A	0	0.0	A	0
		WBT						
		WBR						
	Overall		2.6	A		1.9	A	

2.5.4. West Frederick Street & Augusta Street – Signalized Intersection

As shown in **Figure 6**, Frederick Street is a two-lane one-way westbound street that consists of one shared left turn/through lane and one through/right turn lane. Northbound Augusta Street consists of one left turn lane and one shared through/right turn lane, with one through lane and one right turn lane southbound Augusta Street. Frederick Street has parallel street parking on the north side, east of the intersection and has angled parking along on the north side, west of the intersection. Augusta Street has street parking on the northbound approach in both directions. Augusta Street's southbound approach has a raised median divider separating the southbound through and right turn lanes. There are crosswalks across all four approaches of the intersection with ramps at all corners of the intersection. Sidewalks are present along both sides of West Frederick Street and Augusta Street.



Figure 6. Aerial of West Frederick St and North Augusta St

The intersection level of service (LOS), delays, and queue lengths are shown in **Table 4**.

Table 4. Delay, LOS and 95th Queue for Frederik St and N Augusta St

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Frederick Street & North Augusta Street	North Augusta Street	NBL	7.8	A	18	7.4	A	14
		NBT						
		NBR						
	North Augusta Street	SBL	24.6	C	157	22.5	C	129
		SBT						
		SBR						
	West Frederick Street	WBL	11.5	B	37	12.1	B	44
		WBT						
		WBR						
	Overall		14.4	B		13.5	B	

2.5.5. Downtown Beverley Street Intersection

Beverley Street has three study intersections within Downtown Staunton (Figure 7). Beverley Street intersects the following: New Street (5), Augusta Street (6), and N Lewis Street (7). Beverley Street is a two-lane, one-way eastbound road. At each intersection, the turn lanes are shared with the through lanes. All three study intersections are signalized with pedestrian crossings on all four approaches. Although the pedestrian crossings do not have painted markings on the pavement, they do have a brick overlay to help differentiate them from the regular pavement. Beverley Street also has street parking along the north side. This stretch of Beverley Street provides access to Staunton City Hall, restaurants, and local retail businesses. During the site visit, delivery vehicles were parked in one of the two lanes along Beverley Street, causing bottlenecks. Additionally, Beverley Street has high pedestrian activity.



Figure 7. Study Intersections along Beverley Street

The intersection level of service (LOS), delays, and queue lengths are shown in Table 5, Table 6, and Table 7.

Table 5. Delay, LOS and 95th Queue for West Beverley St and South New St

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & New Street	New Street	NBL	20.6	C	45	11.5	B	18
		NBT						
		NBR	20.1	C	22	11.7	B	9
	West Beverley Street	EBL						
		EBT	7.8	A	28	12.5	B	30
		EBR						
Overall			12.0	B		12.2	B	

Table 6. Delay, LOS and 95th Queue for West Beverley St and Augusta St

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Augusta Street	Augusta Street	NBL						
		NBT	23.6	C	115	24.3	C	126
		NBR						
	Augusta Street	SBL	9.4	A	16	9.5	A	21
		SBT	12.1	B	112	11.9	B	116
	West Beverley Street	EBL						
EBT		18.0	B	60	18.9	B	61	
EBR								
Overall			17.0	B		17.3	B	

Table 7. Delay, LOS and 95th Queue for West Beverley St and Lewis St

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Lewis Street	Lewis Street	NBL						
		NBT	18.8	B	99	23.4	C	141
		NBR						
	Lewis Street	SBL	5.3	A	9	7.9	A	12
		SBT	5.6	A	35	8.5	A	49
	West Beverley Street	EBL						
EBT		18.9	B	55	16.2	B	51	
EBR								
Overall			15.6	B		17.3	B	

2.5.6. West Beverley Street & Jefferson Street – Signalized Intersection

As shown in **Figure 8**, West Beverley Street at Jefferson Street consists of one shared left-turn/through/right turn lane along eastbound West Beverley Street and both approaches of Jefferson Street. There are crosswalks across all four approaches of the intersection with ramps at all corners of the intersection. Sidewalks are present along both sides of West Beverley Street and Jefferson Street.



Figure 8. Aerial of West Beverley St and Jefferson St

This intersection is located approximately 0.2 miles west of Lewis Street in Downtown Staunton. At this intersection, Beverley Street's eastbound approach has two-way traffic, whereas Beverley Street's eastbound receiving lane is a two-lane, one-way eastbound street. This two-lane, one-way configuration starts at Jefferson Street and continues through Downtown Staunton, ending at South Coalter Street. The area surrounding this intersection is mostly residential, with a few local businesses. There is street parking on all four approaches, but not within about 100 feet of the intersection. There are no signs indicating where street parking begins or ends in some locations.

The intersection level of service (LOS), delays, and queue lengths are shown in **Table 8**

Table 8. Delay, LOS and 95th Queue for West Beverley St and Jefferson St

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Jefferson Street	Jefferson Street	NBL	18.2	B	72	23.9	C	126
		NBT						
		NBR						
	Jefferson Street	SBL	13.3	B	34	12.2	B	37
		SBT						
		SBR						
	West Beverley Street	EBL	7.6	A	74	7.8	A	79
		EBT						
		EBR						
Overall			11.4	B		14.7	B	

2.5.7. West Beverley Street & Hays Avenue – Signalized Intersection

As shown in **Figure 9**, West Beverley Street at Hays Avenue consists of one shared left-turn/through/right turn lane along eastbound West Beverley Street and northbound Hays Avenue, and one left turn lane and one through lane along westbound West Beverley Street. There is a crosswalk with ramps on the east approach of the intersection. Sidewalks are present along both sides of West Beverley Street and Hays Avenue.

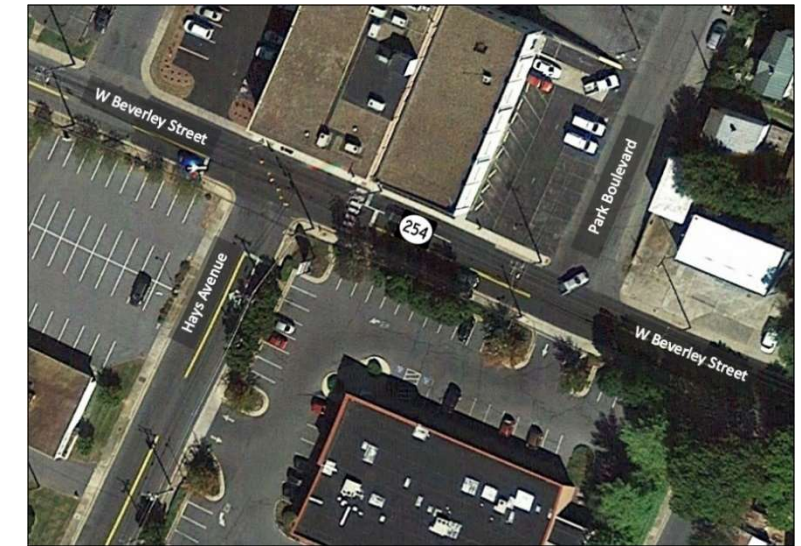


Figure 9. Aerial of West Beverley St and Hays Ave

The intersection level of service (LOS), delays, and queue lengths are shown in **Table 9**.

Table 9. Delay, LOS and 95th Queue for West Beverley St and Hays Avenue

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Hays Avenue	Hays Avenue	NBL	50.6	D	87	55.4	E	164
		NBR	22.8	C	17	20.5	C	21
	West Beverley Street	EBT	15.9	B	201	15.5	B	185
		EBR						
	West Beverley Street	WBL	52.0	D	6	53.1	D	48
		WBT	5.3	A	80	5.9	A	119
	Overall			15.7	B		18.7	B

2.5.8. West Beverley Street & Grubert Avenue – Signalized Intersection

As shown in **Figure 10**, West Beverley Street at Grubert Avenue consists of one left turn, one through, and one right turn lane along eastbound Beverley Street with one left turn lane and one shared through/right turn lane along westbound Beverley Street. Northbound and southbound Grubert Avenue consists of one shared left turn/through/right turn lane. There is a crosswalk across the north approach of the intersection. Sidewalks are present along the east side of Grubert Avenue north of the intersection and along the north side of West Beverley Street east of the intersection.

The intersection level of service (LOS), delays, and queue lengths are shown in **Table 10**

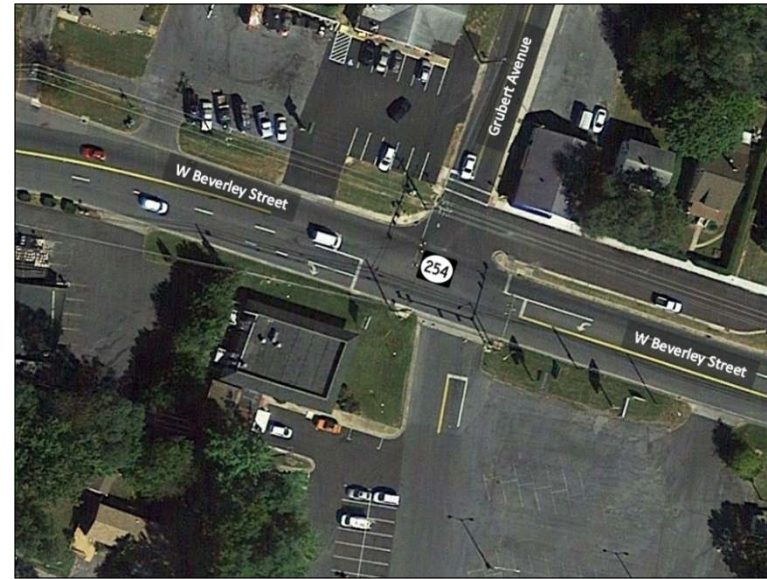


Figure 10. Aerial of West Beverley St and Grubert Ave

Table 10. Delay, LOS and 95th Queue for West Beverley St and Grubert Ave

2020 Existing - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	MID			PM		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Grubert Avenue	Grubert Avenue	NBL	33.8	C	25	37.4	D	19
		NBT						
		NBR						
	Grubert Avenue	SBL	12.1	B	48	26.3	C	100
		SBT						
		SBR						
	West Beverley Street	EBL	34.3	C	80	40.2	D	132
		EBT						
		EBR						
	West Beverley Street	WBL	35.0	C	8	38.0	D	8
WBT								
WBR								
Overall			14.3	B		24.1	C	

3. SAFETY ANALYSIS

Safety analyses were performed for each study intersection, which included a review of crash data and existing field conditions. The analysis was conducted to evaluate the potential areas of improvement for safety at the study intersections, determine the likely factors contributing to crashes, and propose potential mitigation activities.

3.1. Methodology

Crash data was obtained from the VDOT Crash Database Tableau Tool at each of the ten study intersections. The analysis was performed for crashes within a 250 feet radius of each intersection, for a period spanning from January 2013 to the end of October 2020. Additionally, FR-300 crash reports were obtained and reviewed for all crashes at each intersection.

The crash data was evaluated to identify crash locations and patterns, crash severity, and likely causes. As part of the crash analysis, collision diagrams illustrating all crashes by year were developed and are included in **Appendix C**. The crash data and collision diagrams were examined to identify crash locations on which to focus during field reviews. The crash data analysis and field review data were used to identify factors that could contribute to crashes and make recommendations regarding safety improvements that could mitigate future crashes.

3.2. Field Review

The study team representatives conducted a site visit of the study intersections on January 12, 2020, during the Midday period to assess traffic operations, roadway geometrics, safety, vehicle interaction conflicts, and existing signage. In the observation of these conditions, various engineering manuals (e.g. Manual on Uniform Traffic Control Devices (MUTCD), Virginia Supplement to MUTCD, VDOT Traffic Engineering Design Manual (TEDM), 2010 ADA Standards for Accessible Design (ADA)) were considered. The study team used collision diagrams to determine crash patterns and areas of focus. However, the recommendations and/or observations noted may not be directly related to crash patterns, but may reduce the risk of crashes.

3.3. Study Intersection Safety Analysis

3.3.1. West Johnson Street at South New Street Crash Summary (Intersection 1)

The intersection of West Johnson Street and South New Street had a total of 28 crashes from January 2013 to the end of October 2020. As shown in **Figure 12**, 22 of these crashes have occurred between 2015 and 2019.

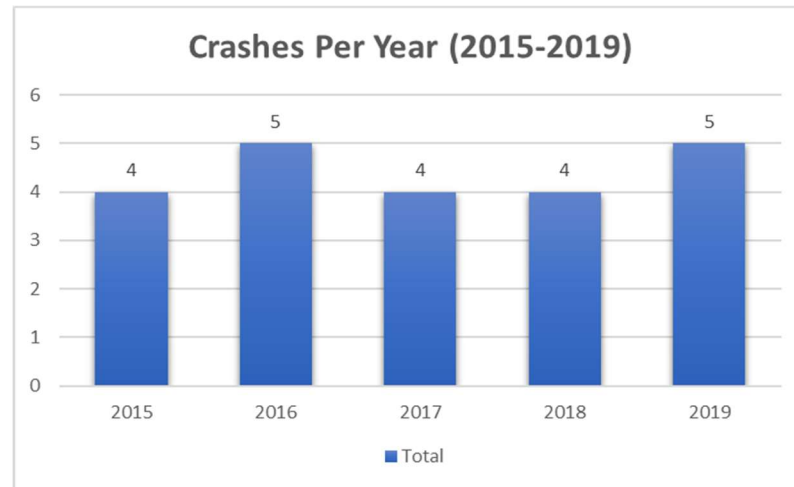


Figure 12. Number of Crashes Per Year for W Johnson St at S New St

Figure 13 summarizes crash severity for crashes between the years 2015 and 2019. As shown in the figure, 68% of crashes between 2015 and 2019 resulted in an injury.

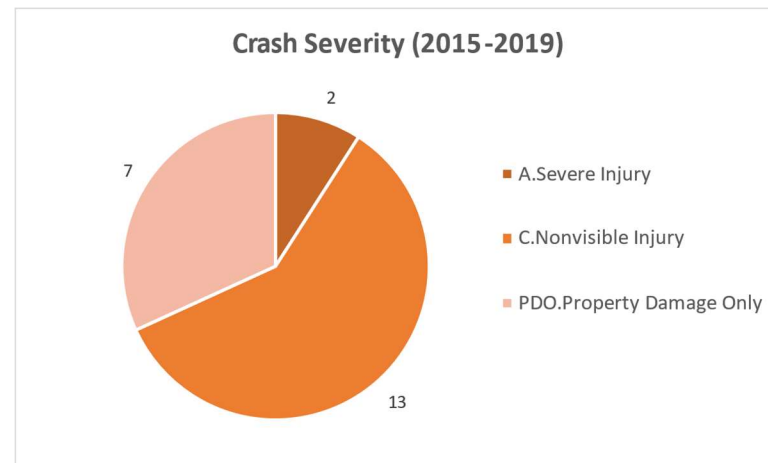


Figure 13 Crash Severity for W Johnson St at S New St

Figure 11 shows the crash types by the time of the day with traffic volume distribution, in which rear-end crashes have been the most prevalent (11 crashes) type of crash at this intersection. The highest number of crashes occurred during the midday timeframe, which was mostly rear-end crashes that generally correlated to congestion and queuing issues. However, at this location mid-day peak volumes are lower than the PM peak. The review of the crash reports revealed that eight of the 11 rear-end crashes occurred on the eastbound approach.

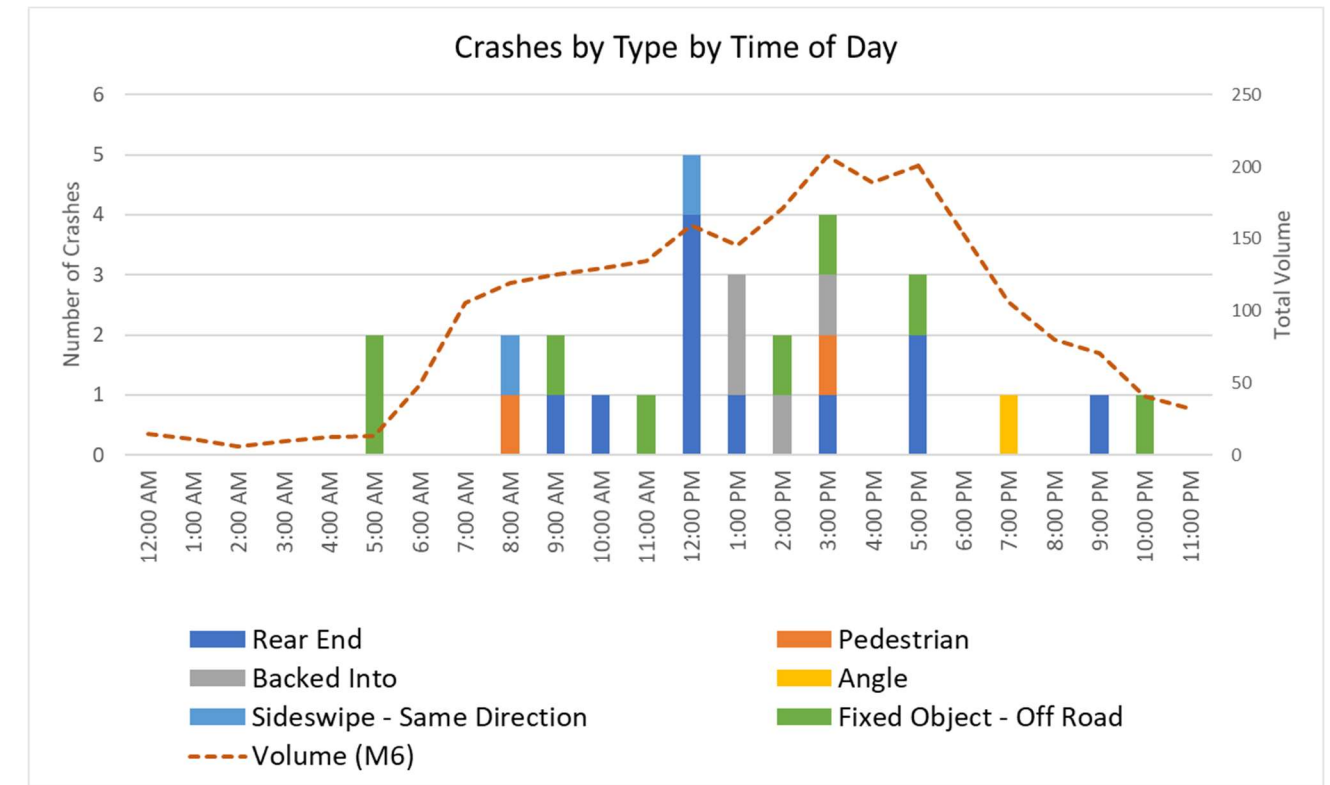


Figure 11 Crash Type Per Time of The Day for W Johnson St at S New St

Based on the review of FR-300 crash reports, most of the rear end collisions resulted from driver error in following too closely. Four fixed object – off road crashes occurred at the westbound approach to the intersection. All four of these crashes involved drivers colliding with a light pole or sign post. Similarly, the fixed object - off road crashes in the intersection's northwest quadrant resulted from vehicles traveling westbound and hitting a light pole. Three crashes occurred along the northern approach of New Street, where vehicles backed into one another. There are two pedestrian crashes that occurred at the intersection where the FR-300 crash reports revealed that the pedestrian did not have the right of way in the collision. One of the two pedestrian crashes occurred at the western crosswalk.

3.3.1.1. Field Review

On the north side of the intersection, New Street is a one-way street northbound with on-street parking on both sides and one-way southbound on the south side. During the study team site visit, the following points were noted:

- The pedestrian ramps are not up to ADA standards
- There are pedestrian signals at all four sides of the intersection. Currently, they are not programmed to reservice modes, but it is recommended to change it to reservice mode to reduce pedestrian crossing delays.
- There are no bike facilities.
- The parking space on the northwest corner of the intersection creates a safety hazard area
- Lane marking and signing improvements are needed



Figure 14 Site Visit Photo at W Johnson St & S New St

3.3.2. West Johnson Street at Augusta Street Crash Summary (Intersection 2)

The intersection of West Johnson Street and Augusta Street had 28 total crashes from 2013 to 2020. Looking at the total crashes per year, the number of crashes went up from two in 2015 to five in 2019, as shown in Figure 15.

As shown in Figure 16, nine out of the 17 crashes that occurred between 2015 and 2019 have resulted in an injury, including one severe injury.

Rear-end crashes were the most frequent crash type at this intersection (10 crashes). Half of all rear-end crashes occurred at the intersection's eastbound and westbound approaches. The other rear-end crashes occurred at the eastbound and westbound receiving lanes.

The majority of the crashes (82%) occurred between the 6:00 am to 4:00 pm window. See Figure 17 for the total crashes per time of the day and traffic volume distribution.

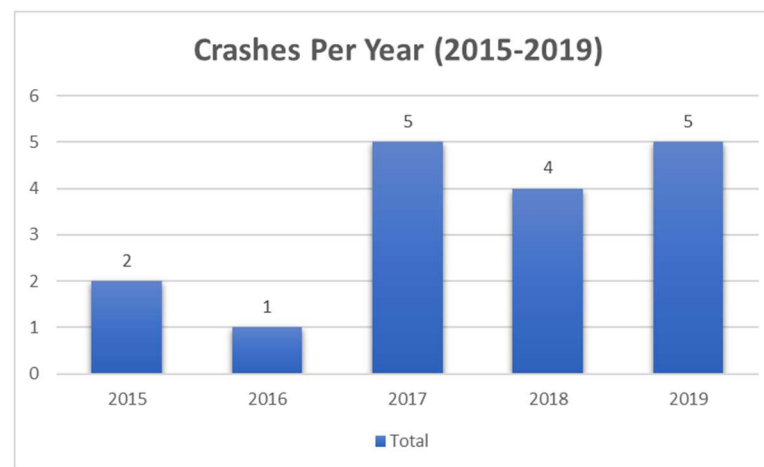


Figure 15 Total Crashes Per Year for W Johnson St at Augusta St

Data from the FR-300 reports revealed that eight of these collisions arose from drivers following too closely. Drivers losing control of their vehicles led to two rear end crashes. There was a total of six angle crashes at this intersection. Three angle crashes happened between vehicles traveling southbound and westbound through the intersection. All three of these crashes happened at night. In one these crashes, the driver waiting at the southbound approach was stopped past the stop bar and was hit by a vehicle traveling west through the intersection. Failure to stop at the red light resulted in other two crashes for this movement. Another angle crash involved a southbound vehicle running the red light and colliding with a vehicle traveling eastbound. The remaining two-angle crashes occurred at the Augusta Street and Barristers Row/Central Avenue intersection. For both crashes, vehicles making a northbound left turn failed to yield to vehicles traveling southbound.

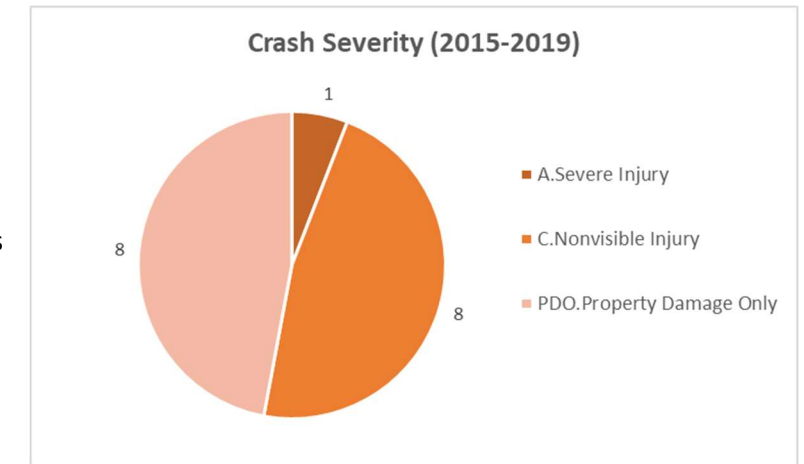


Figure 16 Crash Severity for W Johnson St at Augusta St

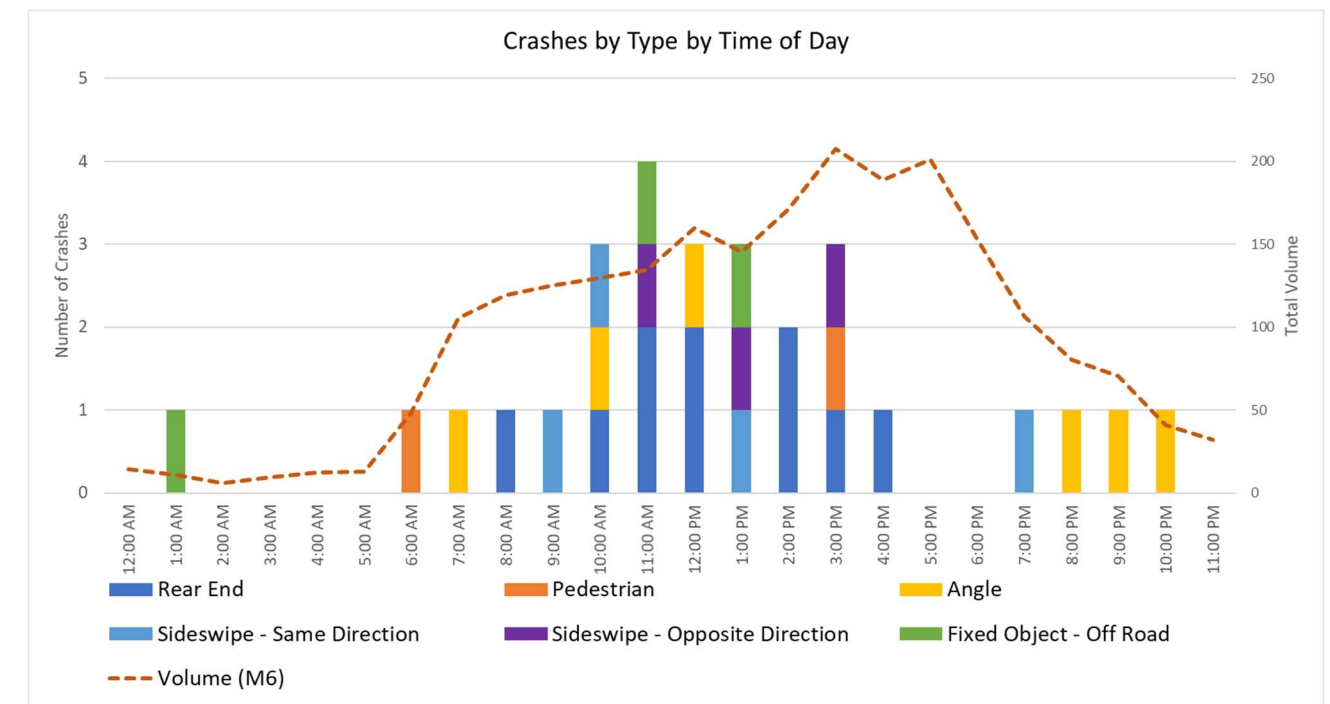


Figure 17 Crash Type Per Time of The Day for W Johnson St at Augusta St

There was a total of two pedestrian crashes. In one crash, a vehicle turned left from the southbound approach and hit two pedestrians within the eastern crosswalk on Johnson Street. In the other pedestrian crash, a vehicle turning left from the westbound approach hit a pedestrian using the southern crosswalk. The drivers had a green light in both instances, but failed to yield to the pedestrians.

3.3.2.1. Field Review

The following observations were noted from the field review:

- The western leg of the intersection has a very closely spaced parking (25 feet away from the stop bar) entrance within the intersection functional area.
- Pedestrian curb ramps are not up to ADA requirements.
- There are no pedestrian signals.
- There are no bike facilities.
- There are no crosswalk markings. Instead, the crosswalk area is separated by brick pavers surface.
- Both eastbound and westbound left-turn movements have a five-section signal head that operate as protected/permissive phases.

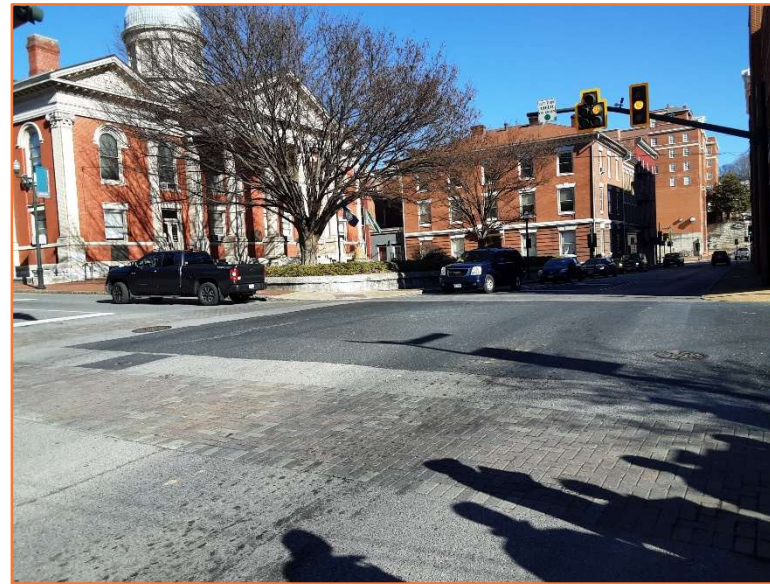


Figure 18 Site Visit Photo of W Johnson St at Augusta St

3.3.3. West Johnson Street at Central Avenue Crash Summary (Intersection 3)

The intersection of West Johnson Street and Central Avenue had only one crash between 2013 and 2020. This crash was classified as an angle crash and resulted in a non-visible injury (C). The FR-300 states that a driver leaving the parking lot in the northwest quadrant of the intersection failed to yield to a westbound vehicle. The vehicle leaving the parking lot was trying to turn right onto southbound West Johnson Street.

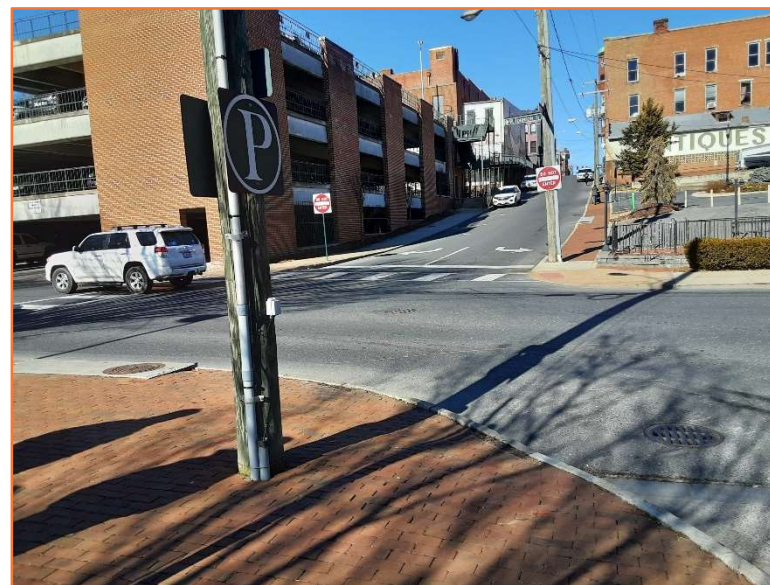


Figure 19 Site Visit Photo of W Johnson St at Central Ave

During the site visit, it was observed that there is crosswalk on two sides of the intersection. However, the curb ramps are not ADA compliant. During the field review, the need for a crosswalk on the eastern approach of the intersection (crossing W Johnson Street) was noted as this intersection provides an important connection between parking and local retail.

3.3.4. West Frederick Street at Augusta Street Crash Summary (Intersection 4)

The intersection of West Frederick Street and Augusta Street had 20 crashes from January 2013 to the end of October 2020. As shown in Figure 20, the average number of crashes between 2015 to 2019 is less than four crashes per year.

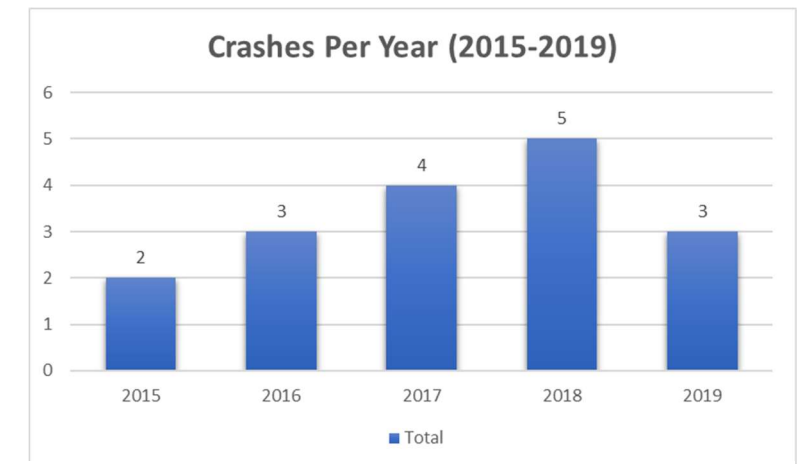


Figure 20 Total Crashes Per Year for W Frederick St at Augusta

As shown in Figure 21, most of the crashes that have occurred between 2015 and 2019 fall into the injury crash severity group (65%), including one severe injury.

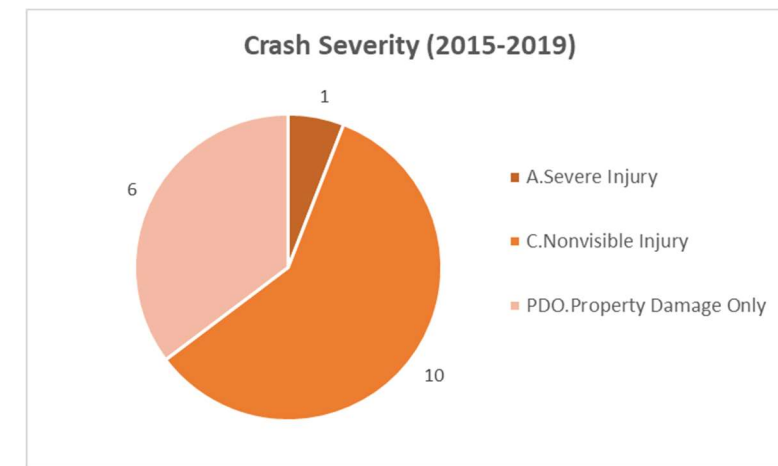


Figure 21 Crash Severity for W Frederick St at Augusta St

Figure 22, which summarizes the crash types by time of day, shows that five crashes occurred during the 2 pm period and three crashes at 5 pm and 9 pm, and the other crashes occurred throughout the day. The 2 pm crashes were mixed of different collision types that no trends can be observed. However, the 9 pm crashes are only angle crashes that are related to running on red per review of FR300 reports during low traffic volume. Angle crashes are the most common type of crash with a total of 8 such crashes that occurred during the study period. Three angle crashes occurred between the southbound and westbound movements through the intersection. In two of these crashes, drivers failed to stop at the red light and proceeded through the intersection. In the other crash, the driver braked hard, but their vehicle slid through the intersection due to snow on the road. Two angle crashes occurred between the northbound through and westbound through movements. One of the crashes was due to the northbound through driver disregarding the traffic signal, and the other was due to the westbound driver disregarding the traffic signal. Another two angle crashes occurred between vehicles southbound through and northbound and westbound left-turning vehicles. In both crashes, the FR-300 report stated that the left-turning vehicles failed to yield to

the vehicles traveling southbound. The remaining angle crash happened within the northern leg of the intersection. In an attempt to find street parking, a vehicle made an illegal U-turn within the southbound lane and collided with another vehicle traveling north on Augusta Street.

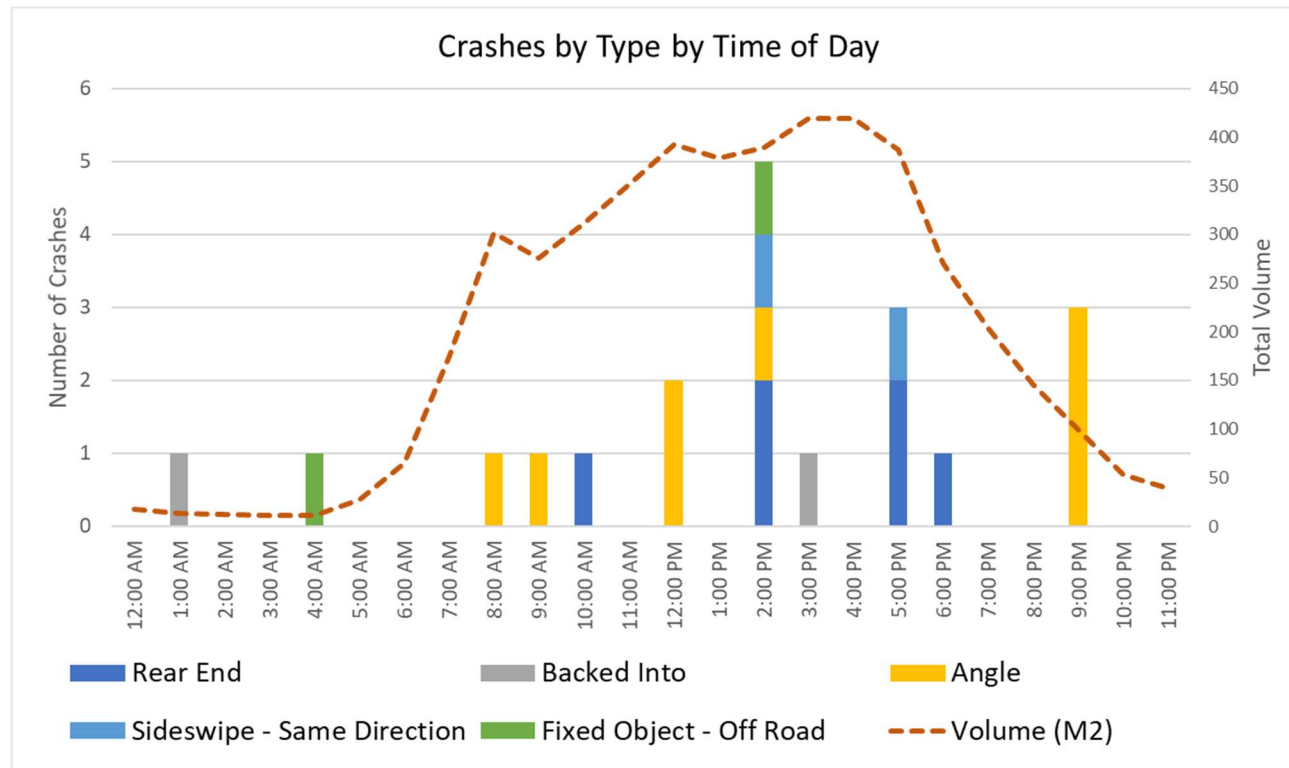


Figure 22 Crash Type Per Time of The Day for W Frederick St at Augusta St

Additionally, six rear-end crashes also took place at this intersection. Three of the six rear-end crashes occurred at the intersection's southbound approach. In all three crashes, drivers failed to stop in time, and rear-ended vehicles already stopped for the southbound red light. The remaining three rear-end crashes took place within the westbound approach. Crashes within this approach were either due to vehicles flowing too closely (2 crashes) or a vehicle rear-ending an already standing vehicle (1 crash). On the northern approach, there were two crashes where vehicles backed into another vehicle, one of which involved a vehicle trying to back into a parking spot, while the other involved a vehicle that was leaving and backed into another vehicle.

3.3.4.1. Field Review

The site visit highlighted the following needs to be evaluated:

- Pedestrian curb ramps do not meet ADA requirements.
- There are no pedestrian signals.
- There are no crosswalk markings. Instead, the crosswalk area is separated by brick pavers surface.
- There are no bike facilities.
- Review location of the crosswalks
- Evaluate the need for the traffic signal.
- The need for geometrical improvement of the southbound right-turn lane.

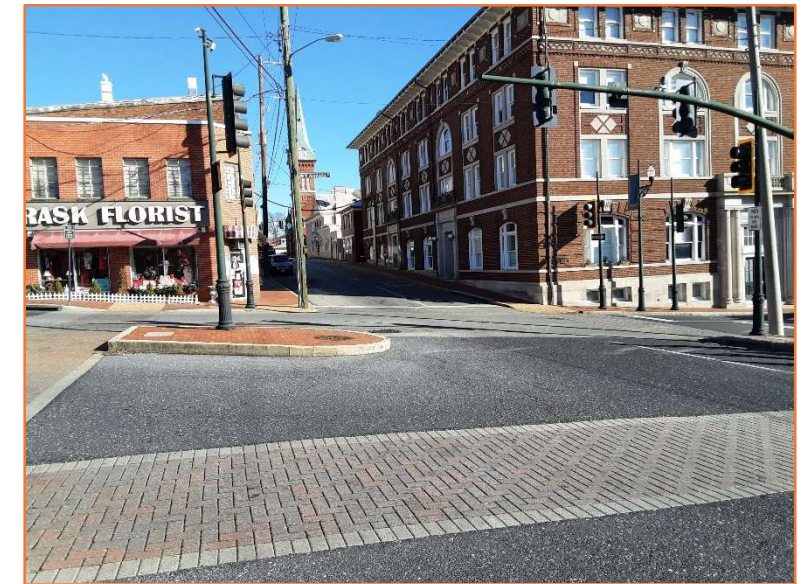


Figure 23 Site Visit Photo of W Frederick St at Augusta St

3.3.5. West Beverley Street at New Street Crash Summary (Intersection 5)

The intersection of Beverley Street and New Street had 19 crashes between 2013 and 2020. Figure 24, which summarizes the total number of crashes per year between 2015 and 2019, shows only one crash occurred in 2015 and 2016. However, after 2016, the number of crashes increased to over three crashes per year in 2017 through 2019.

Figure 26, which summarizes crash severity between 2015 and 2019, shows that more than half of the crashes that happened between 2015 and 2019 resulted in an injury.

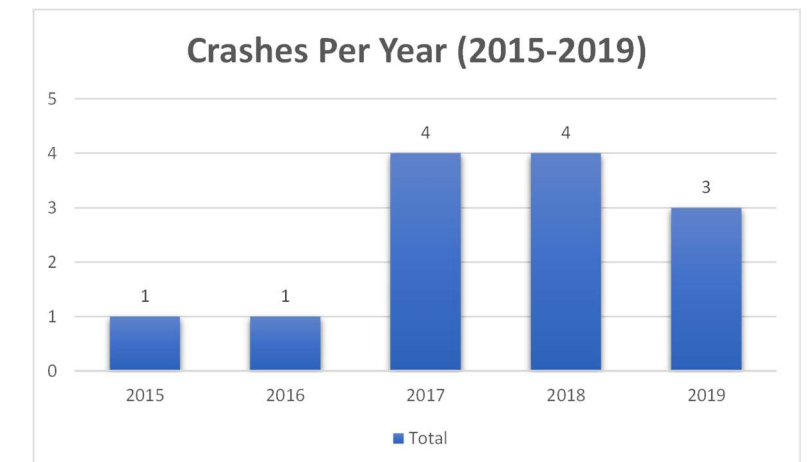


Figure 24 Total Crashes Per Year for W Beverley St at New St

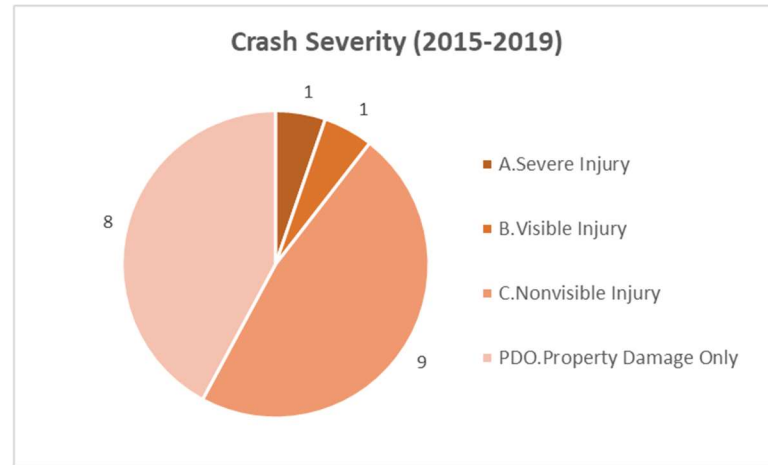


Figure 26 Crash Severity for W Beverley St at New St

As shown in Figure 26, angle crashes were the most predominant type of crash at this intersection with a total of nine such crashes. Eight of the nine angle crashes occurred between eastbound and northbound through movements. An analysis of the FR-300 reports showed that failure to stop at the red light from the northbound approach accounted for five crashes. The remaining three crashes arose from vehicles failing to stop at the red light on the eastbound approach. One angle crash occurred between the southbound left and eastbound through movement.

In this crash, the driver of the eastbound vehicle stated that they saw a yellow light and proceeded through the intersection. As shown in Figure 25 below, most of the angle crashes occurred during non-peak hours, with a total of six crashes occurring during nighttime hours, five of which were angle crashes.

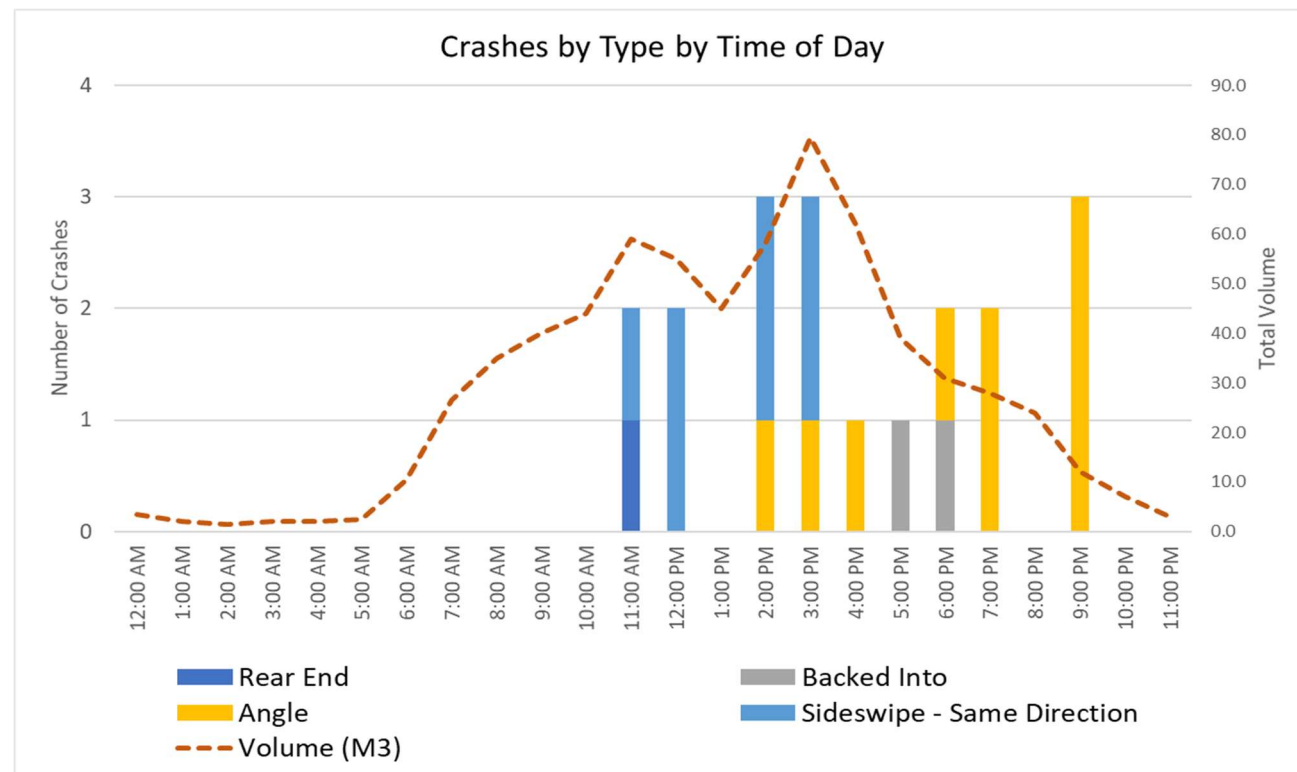


Figure 25 Crash Type Per Time of The Day for W Beverley St at New St

This intersection also had seven same-direction sideswipe crashes. Three of these crashes occurred on the northbound approach. The FR-300 report stated that vehicles turning right hit a legally parked vehicle on the left side of New Street for two of the crashes. The two crashes involved large vehicles needing a wide right

turn and striking the parked vehicle on the left. The remaining crash at this approach can be attributed to a vehicle in the through lane and a vehicle in the right turn lane being too close together.

3.3.5.1. Field Review

This intersection has the second-highest pedestrian traffic among study intersections. However, the site visit observation determined that:

- The pedestrian curb ramps do not meet ADA requirements, and the pedestrian waiting area for crossing is very tight. It was observed that the sidewalk was blocked due to pedestrians trying to cross the street.
- There are no crosswalk markings. Instead, the crosswalk area is separated by brick pavers surface.
- There are no pedestrian signals.
- There are no bike facilities.
- A parking spot is located at the northbound stop bar, which creates unsafe conflict points within the intersection area.



Figure 27 Site Visit Photo of W Beverley St at New St

3.3.6. West Beverley Street at Augusta Street Crash Summary (Intersection 6)

The Beverley Street and Augusta Street intersection had a total of 34 crashes, the second-highest number of crashes out of all ten intersections. As shown in **Figure 29**, the total crashes per year distribution between 2015 and 2019 shows that 2017 had the highest number of crashes with nine crashes.

As shown in **Figure 30**, of the 26 total crashes that occurred between 2015 and 2019, 21 crashes (81%) resulted in injuries.

As shown in **Figure 28**, which summarizes collision type by time of the day and traffic volume distribution at the M2 counting location, angle crashes were the most common crash type at this intersection. Nine of the 17 angle crashes occurred between the southbound through and eastbound through movement. FR-300 reports for these crashes stated that drivers disregarded the traffic signal and ran the red light. The split of vehicles running the red light from the southern and eastern approaches was about 50/50. Five of the 17 angle crashes occurred between the southbound left and northbound through movement. In all five crashes, vehicles turning left from the southbound approach had a green light but failed to yield to the northbound through traffic. A "Left Turn Yield on Green" sign was visible from the southbound approach during the site visit. However, based on the FR-300 reports, this sign was only added recently in 2019.

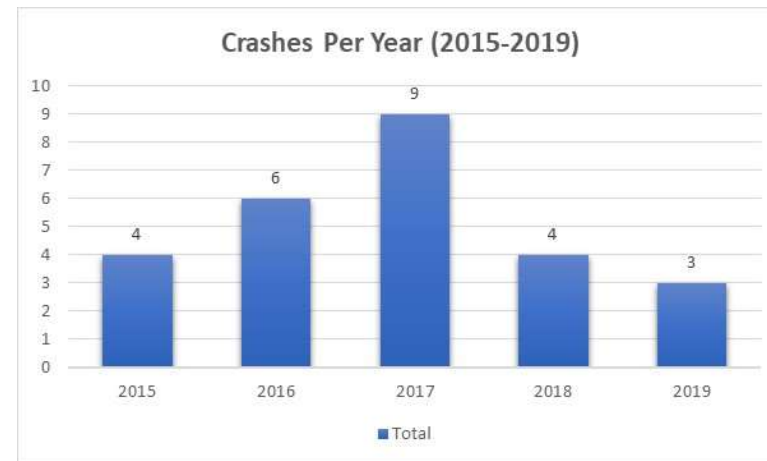


Figure 29 Total Crashes Per Year for W Beverley St at Augusta St

There was one pedestrian crash in which the driver failed to see the pedestrian within the Augusta Street crosswalk. The vehicle was turning left from W Beverley Street onto N Augusta Street.

This intersection also saw six same-direction sideswipe crashes. Four of the six crashes happened along with W Beverley Street's eastbound approach. The FR-300 reports stated that vehicles traveling eastbound sideswiped parked vehicles in all four crashes. Three of the crashes were with vehicles parked on the left side, and one crash was with a vehicle parked on the right side. The other two sideswipe crashes happened along Augusta Street's southbound approach. There was one opposite-direction sideswipe crash in which a tour bus turning eastbound left from Beverley Street struck a standing car in the southbound approach. A total of six fixed object off-road crashes

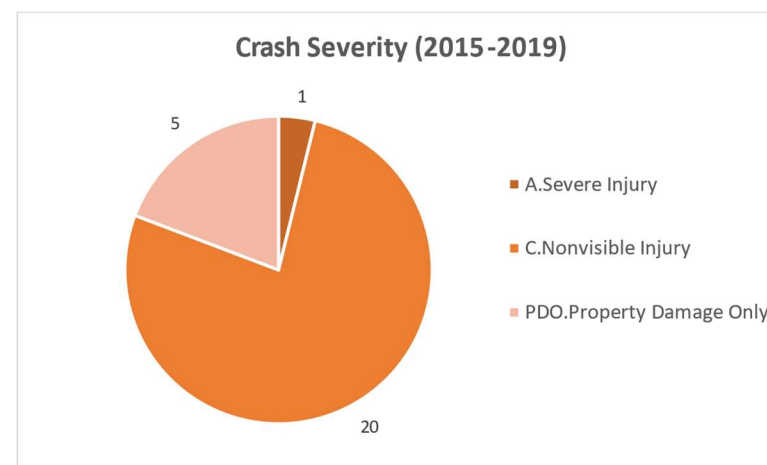


Figure 30 Crash Severity for W Beverley St at Augusta St

occurred at this intersection. For five of the fixed object crashes, trucks turning right from Augusta Street onto Beverley Street struck the traffic light on the corner. Finally, crashes occurred throughout the day and night, showing no clear trend by the time of the day or traffic volume peaks.

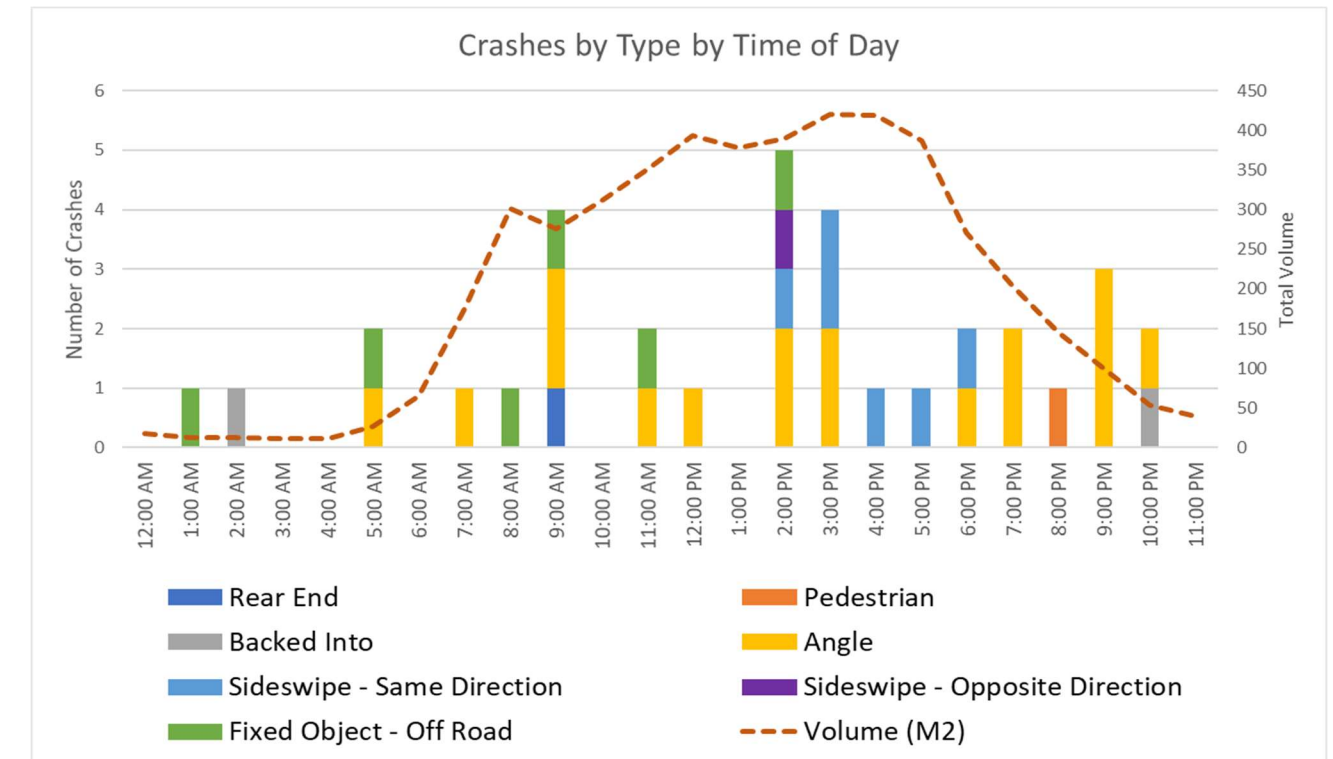


Figure 28 Crash Type Per Time of The Day for W Beverley St at Augusta St

3.3.6.1. Field Review

During the site visit, the study team noticed that the northbound approach lane width was narrow, whereas the adjacent receiving lane was much wider than it needed to be. There is no street parking on this approach. Although there are "No Turn on Red" signs posted for the Augusta Street approaches, the current signs are not MUTCD compliant.

As far as the pedestrian accommodation, the following points were noted:

- The pedestrian curb ramps do not meet ADA requirements.
- There are no crosswalk markings. Instead, the crosswalk area is separated by brick pavers surface.
- There are no pedestrian signals.



Figure 31 Site Visit Photo of W Beverley St at Augusta St

- There are no bike facilities.

3.3.7. West Beverley Street at Lewis Street Crash Summary (Intersection 7)

The intersection of West Beverley Street and Lewis Street had 42 crashes from January 2013 to October 2020. Looking at the recent five years crash history, crashes are trending down from nine crashes in 2015 to one in 2019. **Figure 32** shows the total crashes per year from 2015 to 2019.

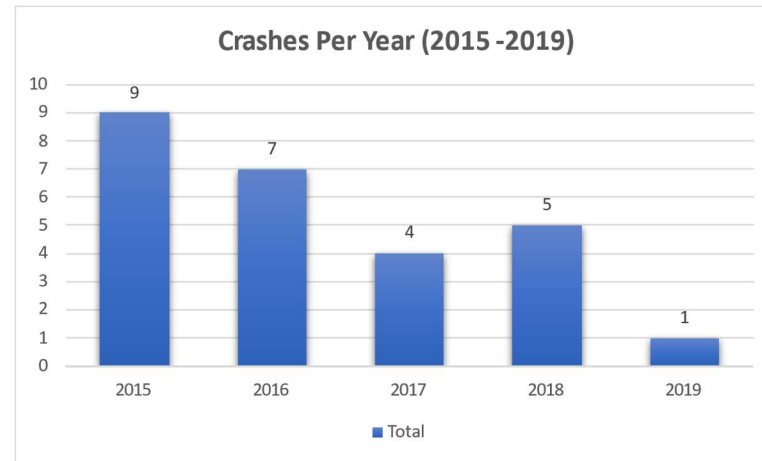


Figure 32 Total Crashes Per Year for W Beverley St at Lewis St

As shown in **Figure 33**, which summarizes crash severity for the total crashes between 2015 and 2019, the majority of the crashes resulted in injury crashes. There were two severe injury crashes. One of them was an angle crash between southbound and eastbound through movements in which the southbound approach disregarded the traffic light. The other one was a pedestrian crash on the southern crosswalk in which the driver failed to yield while making an eastbound right turn.

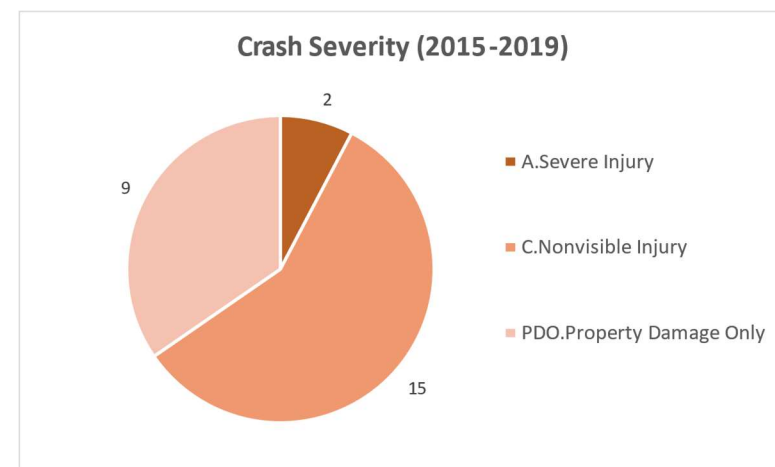


Figure 33 Crash Severity for W Beverley St at Lewis St

Even though the PM traffic volume peak is higher, the crash frequency during the PM peak is lower than the AM peak.

Out of the 37 angle crashes, 17 crashes occurred between the northbound and eastbound through movements. FR-300 reports stated that of the 17 crashes, seven vehicles ran the red light from the eastbound approach, and ten vehicles ran the red signal from the northbound approach. 19 of the 37 angle crashes occurred between the southbound and eastbound through movements. Of the 19 angle crashes, six happened in wet weather, and one happened in snowy conditions. FR-300 reports for the angle crashes stated that in eight of the 19 crashes, the vehicle from the southbound approach ran the red light, while the vehicle from the eastbound approach ran the red light in the other 11 angle crashes. The remaining angle

crash occurred when a vehicle leaving the Johnson Street Parking Garage in the southeast quadrant failed to yield to the southbound vehicle.

Additionally, two pedestrian crashes occurred within the study area. The first pedestrian crash involved a vehicle striking a pedestrian while backing into a parking spot on Beverley Street. The second pedestrian crash involved a van making an eastbound right turn and failing to yield to the pedestrian in the southern

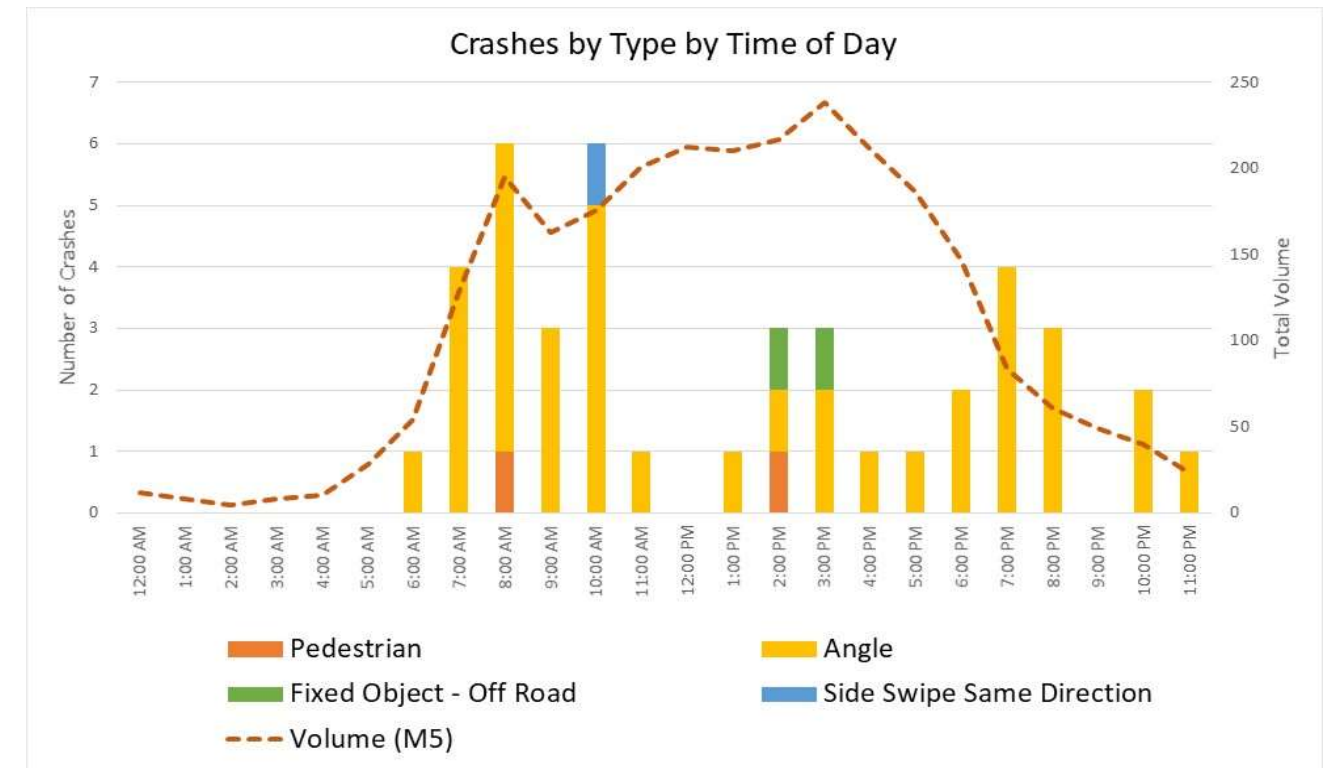


Figure 34 Crash Type Per Time of The Day for W Beverley St at Lewis St

crosswalk.

3.3.7.1. Field Review

The total number of crashes at this intersection is trending down. One of the improvements that have been implemented in recent years was adding retroreflective borders to all signal heads, which improves signal head visibility. In addition to that, the study team noted the following items during the site visit:

- There are no pedestrian signals.
- Curb ramps do not meet ADA standards.
- The No Turn on Red regulatory sign is not MUTCD compliant.

- There are marked crosswalk on three sides of the intersection (North, South, West) and the eastside has pavers instead of crosswalk markings.
- Evaluate the need for the southbound left-turn lane.

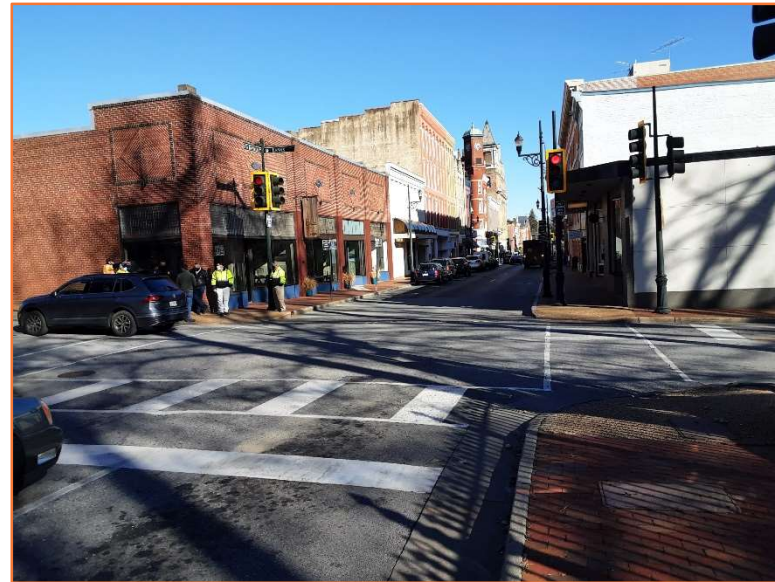


Figure 35 Site Visit Photo of W Beverley St at Lewis St

3.3.8. West Beverley Street at Jefferson Street Crash Summary (Intersection 8)

The intersection of Beverley Street and Jefferson Street had a total of 17 crashes during the study period. As shown in **Figure 37**, which summarizes the total number of crashes per year from 2015 to 2019., the number of crashes goes down from four crashes in 2016 to zero crashes in 2019.

Figure 38, which summarizes crash severity during the 2015 to 2019 time period, shows that five injury crashes have occurred with one of them including a severe injury. This severe injury resulted from an angle crash between an eastbound through and northbound left-turn movement.

Figure 38 summarizes the total number of crashes by collision type and time of the day with traffic volume at the M5 counting location. Generally, the crashes have occurred throughout the day, with the highest crash frequency period occurring at 9:00 am, in which three crashes have occurred. Additionally, the graph shows no clear relations between traffic volume peak hour and crash frequency.

At this intersection, angle crashes (eight crashes) were the most prevalent crash type. Four out of the eight angle crashes occurred between the northbound left and southbound through movements. In all four

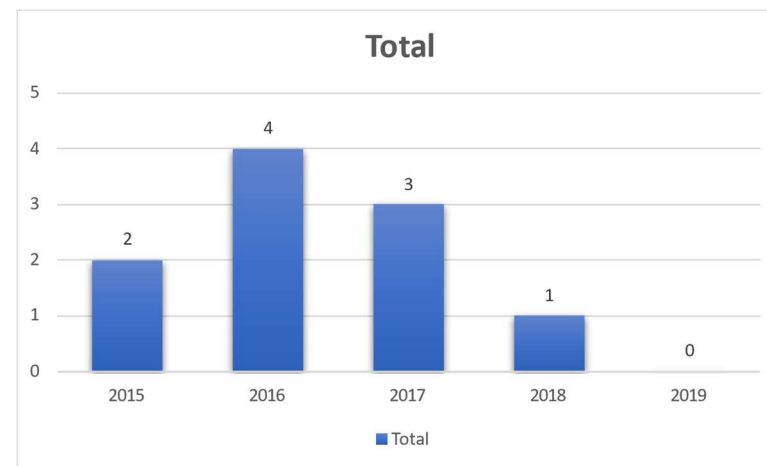


Figure 37 Total Crashes Per Year for W Beverley St at Jefferson St

crashes, northbound left-turning vehicles had a permissive green light and failed to yield to the southbound through vehicles.

In a similar scenario, one crash involved a southbound left-turning vehicle failing to yield to the northbound through vehicle. In another angle crash, a vehicle traveling eastbound on Beverley Street ran a red light and struck a northbound left turning vehicle. The remaining two angle crashes occurred between the northbound through and eastbound through movements. In one crash, the eastbound vehicle disregarded the traffic signal and ran the red light. In the other angle crash, the police officer was unable to determine which vehicle failed to obey

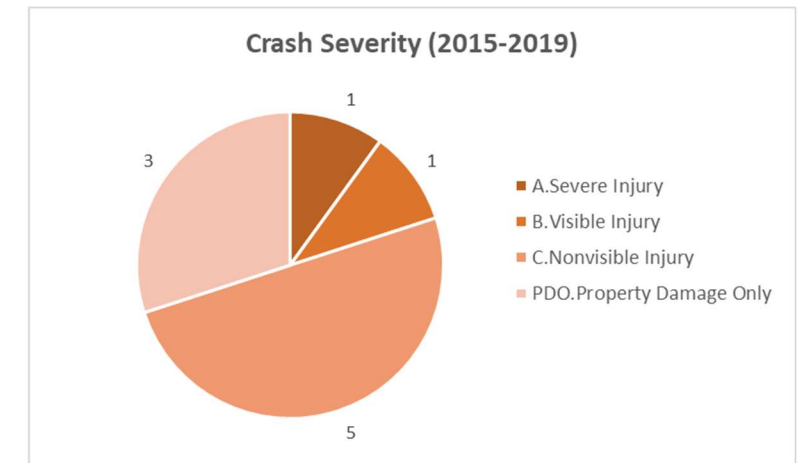


Figure 38 Crash Severity for W Beverley St at Jefferson St

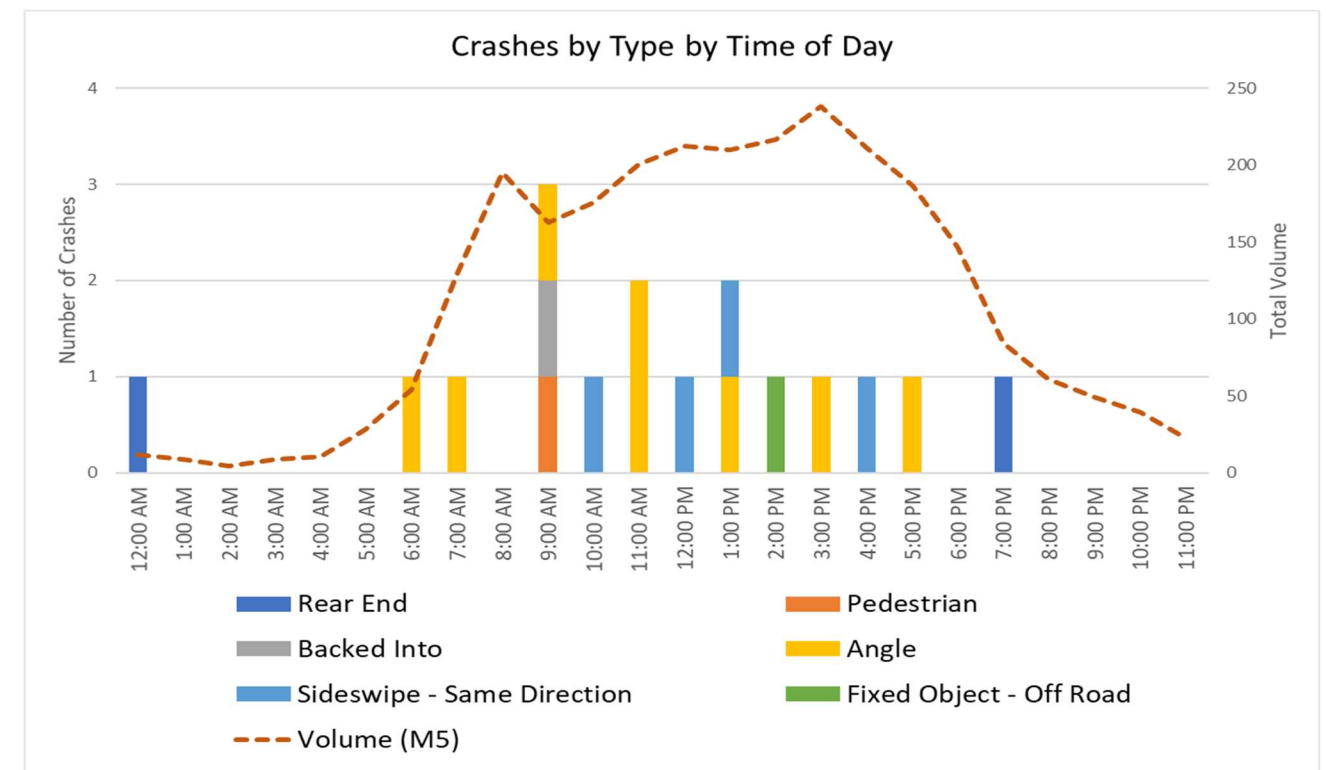


Figure 36 Crash Type Per Time of The Day for W Beverley St at Jefferson St

the traffic signal. There were also two rear-end crashes and four same-direction sideswipe crashes, which occurred randomly throughout the day, with no time of the day related trends observed from the data analysis.

Additionally, one pedestrian crash occurred. In this crash, the driver turned left from Jefferson Street's southbound approach, was looking at oncoming traffic, and failed to see the pedestrian crossing the eastern crosswalk.

3.3.8.1. Field Review

The intersection is a gateway into Downtown Staunton, where West Beverley Street becomes one-way eastbound. During the site visit, the study team discussed the desire for a design that considers the intersection's location that includes a gateway feature to the downtown. Additionally, the following points were noted:

- Curb ramps do not meet ADA standards.
- There are no pedestrian signals.
- There are marked crosswalk at each side of the intersection.
- Evaluation of traffic signal need.

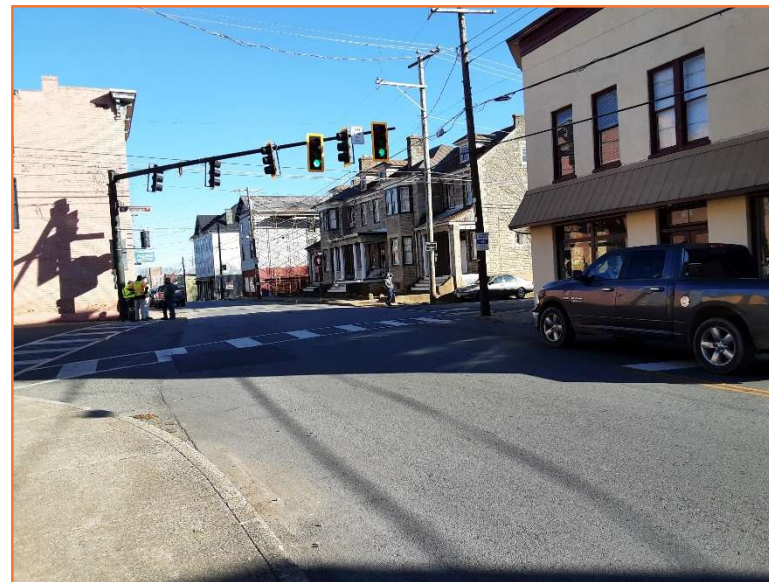


Figure 39 Site Visit Photo of W Beverley St at Jefferson St

- Geometrical improvements to shortening pedestrian crossing distance.

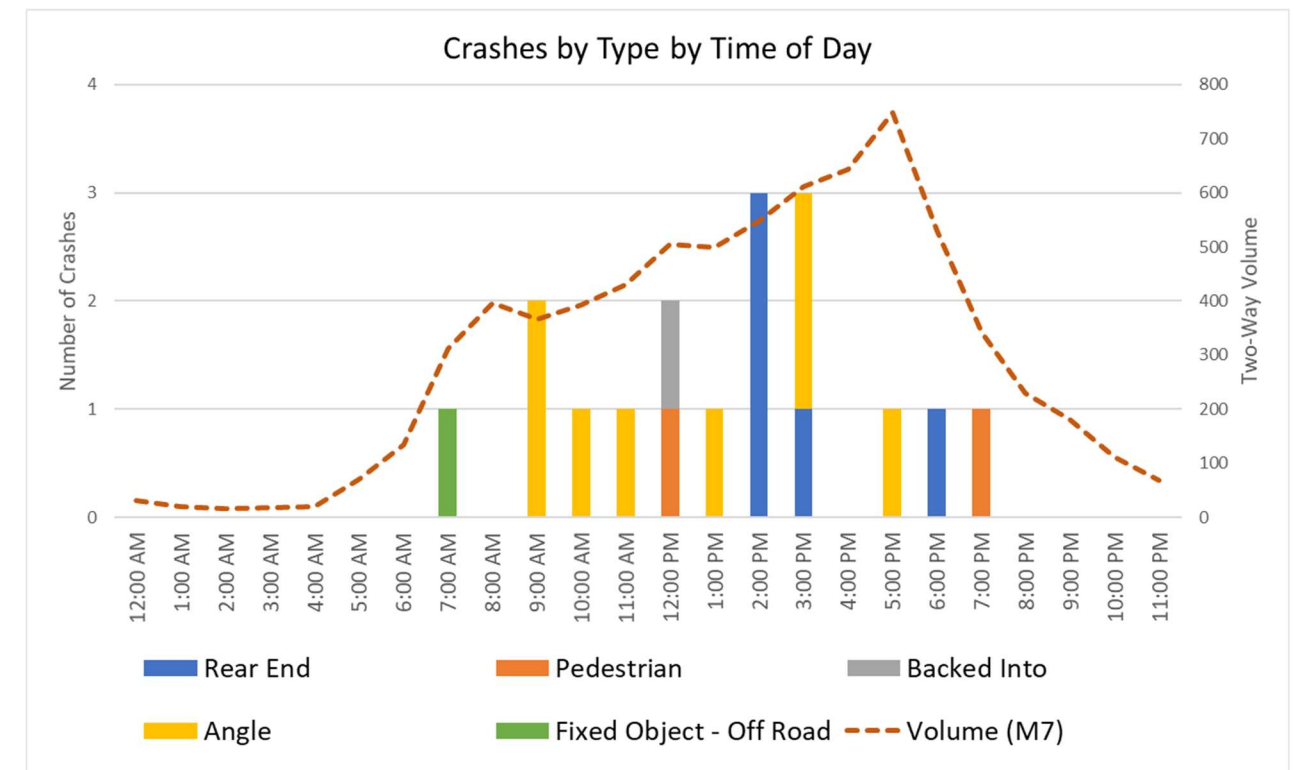


Figure 40 Crash Type Per Time of The Day for W Beverley St at Hays Ave

3.3.9. West Beverley Street at Hays Avenue Crash Summary (Intersection 9)

The intersections of West Beverley Street at Hays Avenue had a total of 17 crashes during the study period. As shown in **Figure 41**, which summarizes the total number of crashes per year between 2015 and 2019, the total number of crashes in a year peaked at four crashes in 2017 and 2018 and went down to one crash in 2019.

Figure 42 shows the crash severity categories for crashes that occurred between 2015 and 2019. Available crash data shows that ten out of the 12 (83%) crashes have resulted in a nonvisible injury.

Figure 40 shows the total number of crashes by collision type and time of the day with traffic volume at the M7 counting station. All crashes occurred between 7:00 am and 7:00 pm, with no defined patterns. Furthermore, the crash frequencies show no direct connection to traffic volume peak hours.

The most frequent type of crash at this location was an angle crash (8 crashes). The angle crashes were scattered throughout the study area as there was no single movement where multiple angle crashes

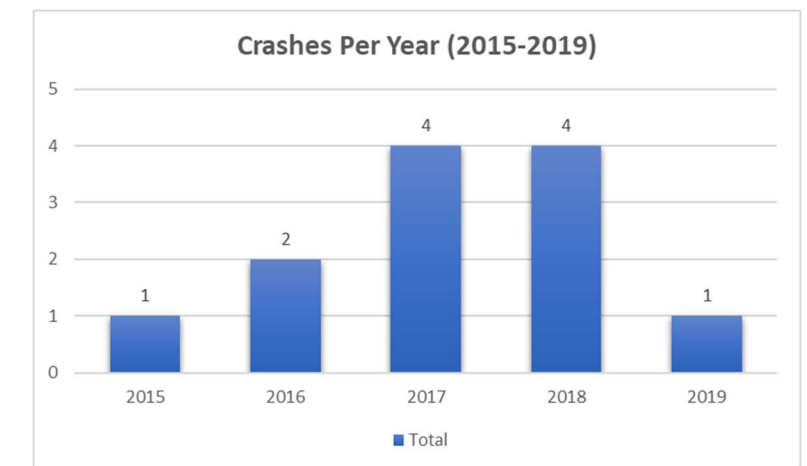


Figure 41 Total Crashes Per Year for W Beverley St at Hays Ave

occurred. Four of the eight angle crashes were at the Park Boulevard intersection, which was included in the crash data analysis due to its proximity to the Hays Avenue intersection. In two of these crashes, drivers turning out of Park Boulevard failed to see oncoming traffic. In one crash, the driver failed to see an oncoming motorcycle, and in the other crash, a work zone impeded the driver's view.

In the other two angle crashes at Park Boulevard, vehicles turning eastbound left into Park Boulevard struck vehicles in the southbound approach. In one crash, the left turning vehicle could not see due to direct sunlight, and in the other crash, the vehicle misjudged the left turn and struck the vehicle in the southbound approach.

Hays Avenue had three angle crashes at its intersection. In all three crashes, the vehicles on Beverley Street failed to stop for their red light as the vehicles turning from Hays Avenue onto Beverley Street had green lights.

Four of the five total rear-end crashes occurred on Beverley Street eastbound approaching Park Boulevard. In all four crashes, vehicles stopped to turn left onto Park Boulevard and got rear-ended. There were two pedestrian crashes at this intersection. One occurred at the Hays Avenue crosswalk across Beverley Street. In this collision, the car ran the red light and fled the scene (hit and run). In the second pedestrian-related crash, a moped driver collided with a pedestrian at night at the Park Boulevard intersection.

3.3.9.1. Field Review

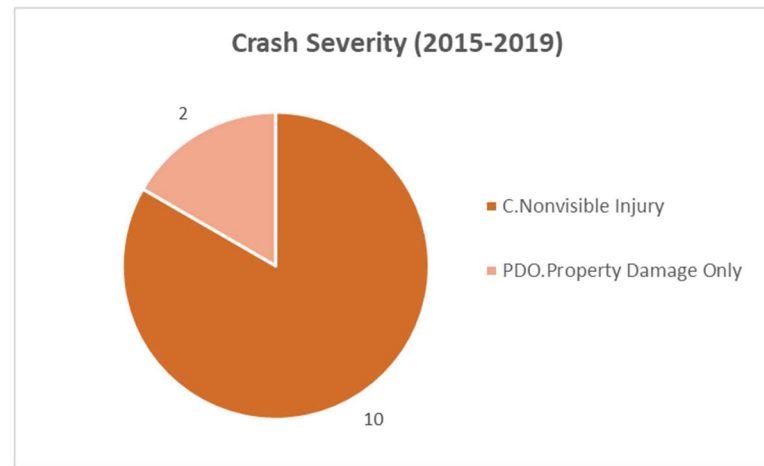


Figure 42 Crash Severity for W Beverley St at Hays Ave

The site visit observations were noted as follows:

- There is no pedestrian signal and no pedestrian crossing on the Hays Avenue approach.
- Curb ramps do not meet ADA requirements.
- Hays Avenue stop bar is far back from the intersection.
- The westbound left turn movement operates in a protected-only phase, which can be operated as a protected/permissive phase
- The traffic signal cabinet and controller are over 30 years old and has limitations to add APS and FYA systems.

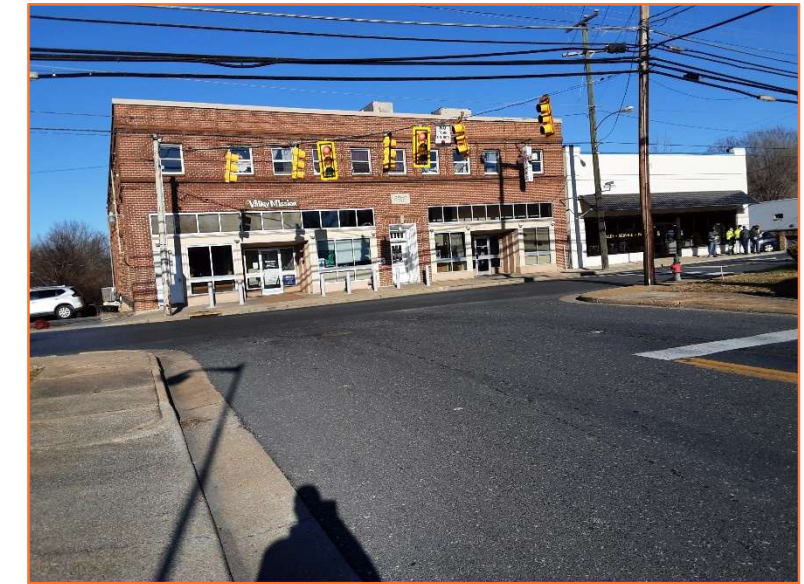


Figure 43 Site Visit Photo of W Beverley St at Hays Ave

3.3.10. West Beverley Street at Grubert Avenue Crash Summary (Intersection 10)

The intersection of West Beverley Street and Grubert Avenue had a total of 20 crashes from January 2013 to October 2020. The number of crashes per year have increased in the past five years from two crashes in 2015 to four crashes in 2019 as shown in Figure 44.

Figure 45 shows the severity categories for crashes that occurred between 2015 to 2019. Most of the crashes resulted in injury crashes, including one severe injury.

Figure 46 shows the total number of crashes by collision type and time of the day with traffic volumes at the M7 counting location. The most prevalent type of crash at this intersection were rear-end crashes (14). Six of the 14 rear-end crashes occurred at the Beverley Street westbound approach. All rear-end crashes, according to the FR-300 reports, were attributed to vehicles following too closely and failing to stop in time.

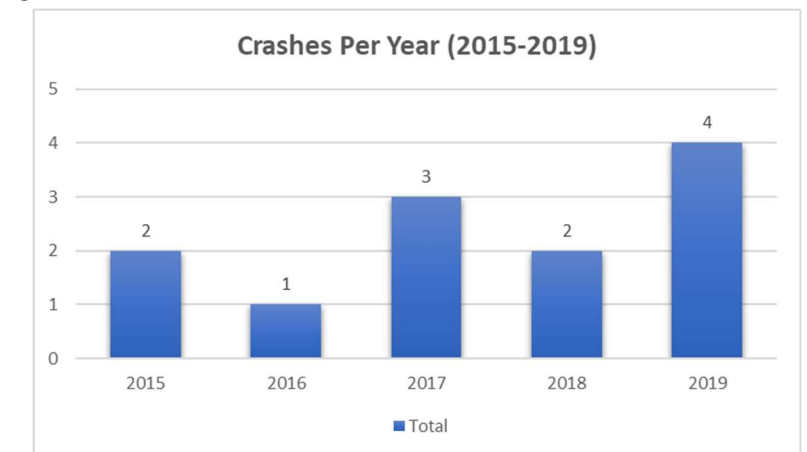


Figure 44 Total Crashes Per Year for W Beverley St at Grubert Ave

The two fixed object-off road crashes in the northeast quadrant of the intersection can be attributed to drivers losing control, due to either brake failure or wet surface conditions. In both collisions, the drivers hit a pole structure.

There was also one pedestrian crash at this intersection. In this crash, a vehicle made an eastbound left turn from Beverley Street and hit a pedestrian using the crosswalk across Grubert Street. The driver had a green light, and there were no pedestrian signals at this intersection.

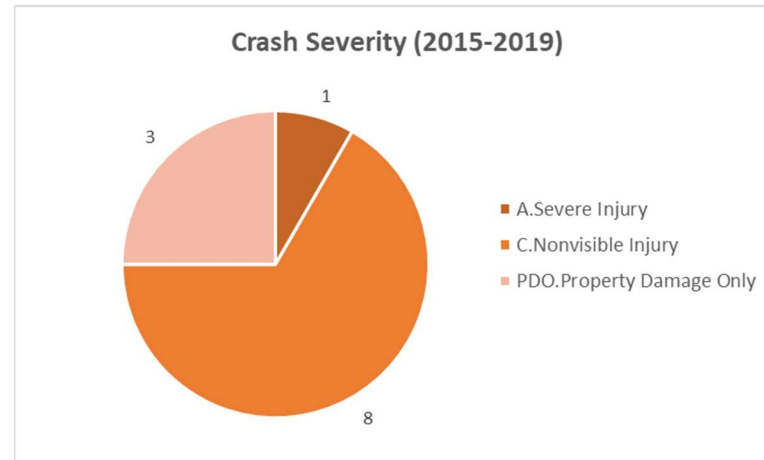


Figure 45 Crash Severity for W Beverley St at Grubert Ave

Review of the crash frequency shows that the 12:00 pm period has the highest crash frequency with six crashes (five rear-end crashes and one angle crash). Although this period is not the highest traffic volume peak, the recurrence of rear-end crashes might be related to clearance interval timing. The study will take a closer look at the midday signal timing and clearance intervals to determine if any adjustments can be made.

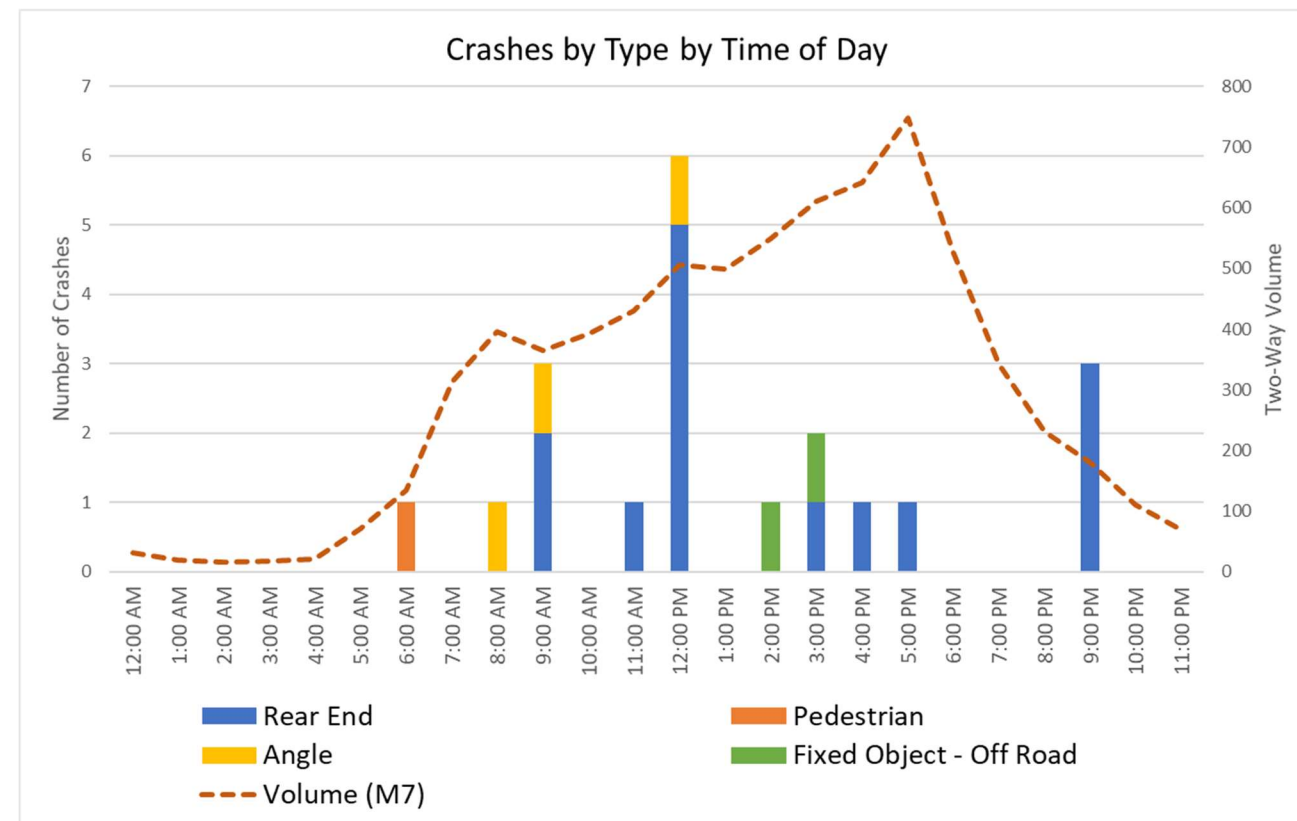


Figure 46 Crash Type Per Time of The Day for W Beverley St at Grubert Ave

3.3.10.1. Field Review

The site visit observations noted the following points:

- The crosswalk across Grubert Street ends in a grass area with no pedestrian refuge.
- There is no crosswalk across Beverley Street.
- Lack of proper road marking to delineate service road movements at the east side of the intersection.
- A full access commercial entrance within a few feet of the eastbound approach stop bar
- Opportunity to operate eastbound and westbound left-turn movements in a permissive phase



Figure 47 Site Visit Photo of W Beverley St at Grubert Ave

4. IMPROVEMENT ALTERNATIVES

This section summarizes the improvement alternatives considered for each study intersection. The proposed improvements are primarily driven by a need to address existing and future safety, multimodal, and operational concerns. The alternatives were developed based upon the results of the Existing Conditions and No-Build Conditions analyses, field observations, review of prior studies/recommendations, and coordination with VDOT Staunton District and the City of Staunton.

4.1. Build Conditions

The quantitative and qualitative analysis was performed on the proposed improvements for operational and safety conditions, multimodal impact, and travel route impacts. The quantitative analysis was performed for improvements such as proposing a new intersection control system, adding/reconfiguring turn lanes, and signal phasing operation changes. Qualitative assessments were performed for the improvements where quantitative analysis was not applicable, which included improvements such as curb bump-outs, signing and marking, and bike and pedestrian improvements.

4.2. Planning Level Cost Estimates

The proposed improvements are grouped into two groups depending on the funding strategy. Group One is low-cost, short-term improvements that can be funded by the City, and Group Two is long-term/high-cost improvements that need state/federal funding programs.

The planning level cost estimates for the year 2022 were developed differently for each group. Since each group's implementation strategy varies, different cost estimating methodologies were used. Group One estimates were developed using quantity take-off and industry knowledge using 2022 costs, assuming the city forces will implement the improvements. Group Two estimates were developed using the VDOT Project Cost Estimating System. The cost estimates included Construction (CN), Right-of-Way and Utilities Relocation (ROW), and Preliminary Engineering (PE) costs.

The following intersections fall under Group One cost estimates:

- 1 – W Johnson St at S New St
- 2 – W Johnson St at Augusta St
- 3 – W Johnson St at Central Ave
- 5 – W Beverley St at New St
- 6 – W Beverley St at Augusta St
- 7 – W Beverley St at Lewis St
- 10 – W Beverley St at Grubert Ave

The recommended funding strategies for these intersections include Revenue Sharing and the Capital Improvement Program.

The following intersections fall under Group Two cost estimates:

- 4 – W Frederick St at Augusta St
- 8 – W Beverley St at Jefferson St
- 9 – W Beverley St at Hays Ave

The recommended funding strategies for these intersections include the Highway Safety Improvement Program (FY23), Revenue Sharing, and Smart Scale.

4.3. Planning Level Schedule Estimate

Planning level schedules were developed for all improvement alternatives. Schedule estimates were based on funding and implementation strategy, familiarity with the complexity of projects within the Staunton District, as well as discussions with the study team.

4.4. Alternative Evaluation

The proposed alternatives were evaluated based on traffic operations, safety, multimodal accommodations, and costs. Within these criteria, the alternatives were scored with the scale shown in **Figure 48** below.

Scale	Description
	Significant improvement
	Noticeable improvement
	No or minimum improvement
	Minimum
	Noticeable
	Significant

Figure 48. Alternative Evaluation Scale

4.5. Traffic Operations

The traffic operations Measures of Effectiveness (MOEs) and VJuST outcomes were compared for the year 2035 no-build and build conditions for each of the proposed alternatives. Analysis results were obtained using HCM 6 methodologies, where applicable. Otherwise, HCM 2000 was used to compare Build and No-Build conditions.

4.6. Safety

As part of the crash analysis, the proposed alternatives were evaluated for their expected safety improvement and crash reduction by comparing the Crash Modification Factors (CMFs) published by VDOT, where applicable. CMF is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site.

4.7. Multimodal Benefits

Multimodal improvements were the focus of the study, specifically at locations where the City identified multimodal improvement needs. The alternative evaluations for multimodal improvements were based on a qualitative assessment. In some cases, the comparison is between no facility and a facility.

4.8. Travel Impact

Travel impacts include restricting a movement or redirecting it through a different travel route. The evaluation is based on additional delays added to the impacted drivers to navigate the new route, compared to delays reduced to other drivers by the improvement.

4.9. Cost Comparison

As discussed in Section 4.2 (Planning Level Cost Estimates), planning level cost estimates were developed for each alternative and compared as part of the alternative analysis.

4.10. Area-wide Intersection Improvements

In addition to the individual intersection improvements, there were several countermeasures that were identified across all study and adjacent intersections that would benefit safety and multimodal users of the study area where not currently installed. These applications are not contingent upon recommended alternatives and could be implemented independently and generally for lower costs. These include:

1. Upgrade curb ramps to comply with ADA requirements
2. Upgrading crosswalks to high visibility crosswalks
3. Adding pedestrian signals at signalized intersections where not present
4. Adding white edge line markings as border to the existing brick paver crosswalks

Additionally, the collected count data and volume analysis indicated that several of the signalized intersections, and some that are adjacent to study intersections in the downtown area such as Frederick & Lewis, do not meet signal warrants during peak hour periods. Given the higher volume peak periods do not meet regular warrants, it is therefore likely that they do not meet any MUTCD volume thresholds for signalization throughout the entire day. It is strongly recommended that these intersections be further studied to document signalization justification or recommend removal and decommissioning. In many cases, an All Way Stop Controlled (AWSC) Intersection would be a safety benefit, especially where existing signals are shoulder mounted and combined with unwarranted traffic conditions. Statewide study and analysis in Virginia has shown that both severe and all crashes can be reduced by an average of 24% by converting these unwarranted signals to ASWC. The conditions in the study area may result in much higher reductions in crashes at these intersections and also reduce long term maintenance liabilities for the City.

4.11. Intersection Alternative Screening

4.11.1. West Johnson Street at South New Street – Signalized (Intersection 1)

Alternative 1 – Kalorama Street One-Way

This alternative prevents vehicles from making a westbound left or U-turn from Kalorama Street. Double yellow lines will be continuously painted with delineator posts to prevent left-out and left-in movements to/from Kalorama St. Kalorama Street's approach will receive a stop bar and improved pavement delineation (marking only based on low-cost improvement) to identify its a one-way street and assist with vehicle stopping. Other changes include removing one parking space on New Street's northern leg and converting pedestrian signals into recall mode. This alternative has a low-cost estimate of \$20,000 and a short-term schedule of less than one year to complete. A concept sketch of this alternative is shown in **Figure 49**.

Alternative 2 – Kalorama Street One-Way, Single Lane Eastbound and Westbound Approaches, Bike Lane

This alternative explores the effects of removing the left turn bays at both approaches along Johnson Street and converting them to a single lane. The additional space will accommodate a bike lane along both sides of Johnson Street. This alternative also proposes converting the traffic signal to a HAWK signal, which vehicles will stop only when the pedestrian phase activated, thus allowing a diagonal crossing to accommodate the

high number of pedestrians. With this alternative, eastbound and westbound left-turn movements will be permissive only. The restricted turning movements, lane markings, and delineations for Kalorama Street proposed in Alternative 1 would also be implemented in this alternative. The removal of one parking space on New Street's northern leg would also be implemented in this alternative. This alternative has a low-cost estimate of \$50,000, assuming the use of City forces and resuing most of the existing signal structure/equipment. This alternative has a short-term schedule of less than one year to complete. A concept sketch of this alternative is shown in **Figure 50**.

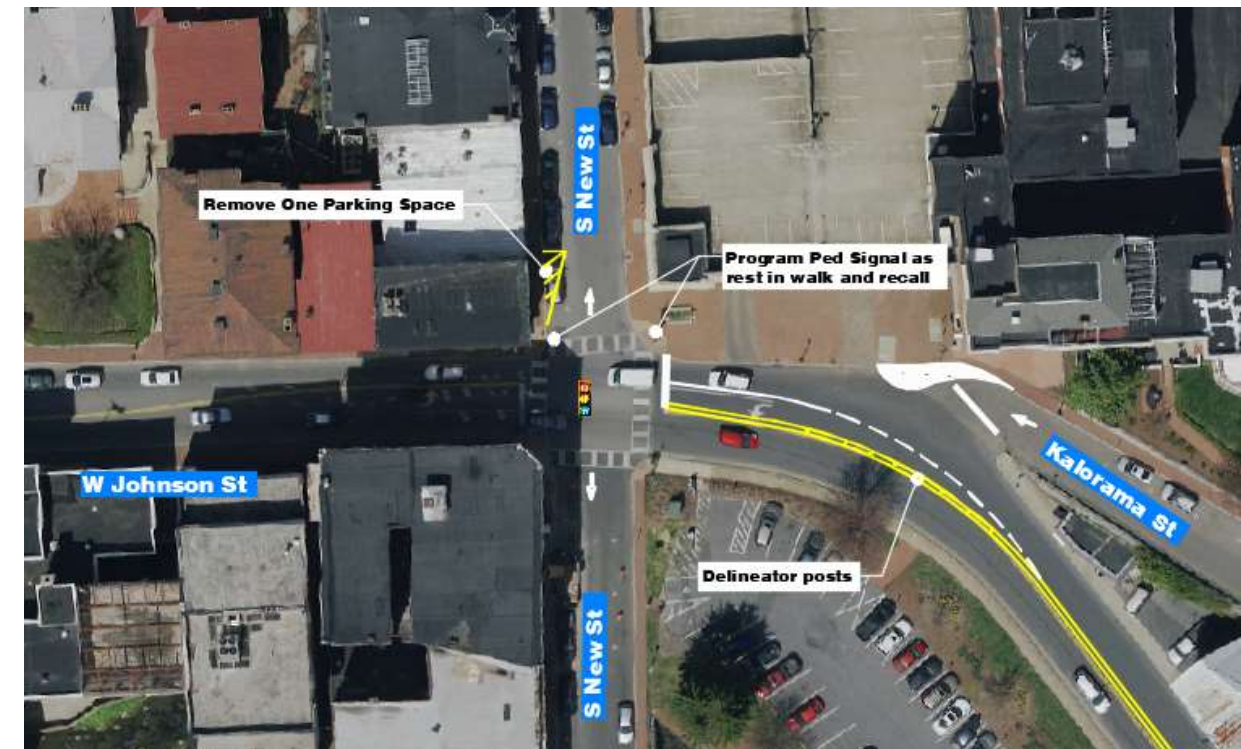


Figure 49. Alternative 1 Concept Sketch - West Johnson Street at South New Street

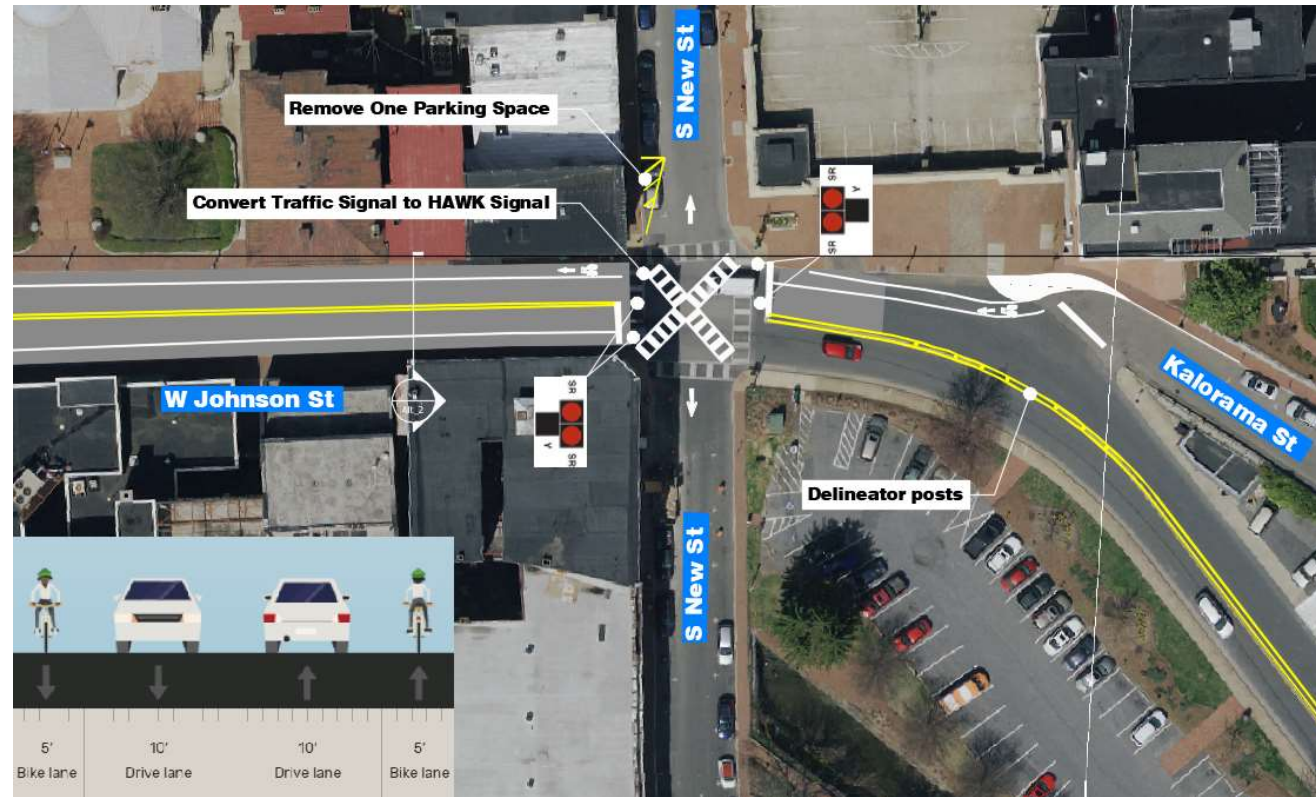


Figure 50. Alternative 2 Concept Sketch - West Johnson Street at South New Street

4.11.1.1. Traffic Operations

Alternative 1 and Alternative 2 were evaluated with respect to traffic operations. See Table 11 for the summary of the evaluation.

- **Alternative 1:** This alternative will have no quantitative impact on traffic operations since the changes will not directly change the MOE results.
- **Alternative 2:** This alternative also proposes a HAWK signal to replace the existing traffic signal. Operations for all approaches are improved with this alternative.

Table 11. MOE Summary for West Johnson Street at South New Street

2035 PM Peak Hour - Delay, LOS and Queue Summary											
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1			2035 ALT 2		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
W Johnson St & S New St	W Johnson St	EBL	1.3	A	0	4.0	A	5	6.6	A	107
		EBT	4.8	A	0	8.4	A	172			
		EBR									
	W Johnson St	WBL	12.1	B	11	10.4	B	10	5.5	A	82
		WBT	34.6	C	358	26.7	C	323			
		WBR									
Overall			18.6	B		16.8	B		6.0	A	

4.11.1.2. Safety Evaluation

- **Alternative 1:** The proposed changes in this alternative will have safety benefits by eliminating the westbound left and U-turns from Kalorama Street and increasing pedestrian safety through converting the pedestrian signal to recall mode.
- **Alternative 2:** The proposed changes in this alternative will have safety benefits by eliminating the westbound left and U-turns from Kalorama Street and increasing pedestrian safety with the installation of the HAWK signal.

4.11.1.3. Multimodal

- **Alternative 1:** This alternative will improve pedestrian crossing by converting the pedestrian signals to recall mode. Also, the removal of the parking space along New Street increases the pavement area for bikes.
- **Alternative 2:** This alternative creates the opportunity to repurpose the pavement area for bike lanes and proposes a HAWK signal and diagonal crossings to help accommodate the high number of pedestrians.

4.11.1.4. Travel Impact

Alternative 1 will have no impact on travel routes through the intersection, but it will restrict westbound left-turns and U-turns from Kalorama Street onto Johnson Street. In addition to the restriction at Kalorama Street, Alternative 2 also proposes removing the left turn bays along Johnson Street and reducing these approaches to a single lane.

4.11.1.5. Cost Comparison

- **Alternative 1:** This alternative has a low-cost estimate of \$20,000 and a short-term schedule of less than one year to complete. Implementation will be by City forces.
- **Alternative 2:** This alternative also has a low-cost estimate of \$50,000 and a short-term schedule of less than one year to complete. Implementation could also be done with City forces.

Table 12. Alternative Evaluation for West Johnson Street at South New Street

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1				\$20,000
Alternative 2				\$50,000

4.11.1.6. Recommendation

Both proposed alternatives at this intersection are targeted toward safety improvements. There are two alternatives developed which can be categorized as low-cost improvements. Both alternatives were evaluated for traffic operations, safety, multimodal improvements. The recommended alternative for this intersection is Alternative 2.

4.11.2. West Johnson Street at Augusta Street – Signalized (Intersection 2)

Alternative 1 – Single Lane Eastbound Approach, Reconfigured Westbound Approach

This alternative would reconfigure the lanes approaching the Augusta Street intersection. The existing eastbound approach of one left turn bay and a shared through and right turn lane would be converted to a single lane. The existing westbound approach of one left turn bay, one shared through, and the right turn lane would be converted to a dedicated right-turn lane with a shared through and left-turn lane. Alternative one also proposes the addition of an Accessible Pedestrian Signal (APS) system. This device communicates information about "walk" and "don't walk" information in non-visual formats (audio and vibrations) to blind and low vision pedestrians. The APS system would be added to all pedestrian approaches at this intersection. Additionally, the parking lot entrance on Johnson Street will be relocated to Byers Street. This alternative has a low-cost estimate of \$50,000 and a schedule of 1-2 years to complete. A concept sketch of this alternative is shown in Figure 51.

Alternative 2 – Single Lane Eastbound and Westbound Approach, Johnson Street Bike Lane

Alternative 2 would convert both eastbound and westbound approaches to single lanes. The single-lane would allow vehicles to turn left, right, and go through from both approaches along Johnson Street. The additional existing pavement width would be allocated to bike lanes along both sides of Johnson Street. The sidewalks along Johnson Street would also be rebuilt and widened. This alternative would convert the Byers Street access to right-in/right out. This alternative has a cost estimate of \$150,000 and a schedule of 1-2 years to complete. A concept sketch of this alternative is shown in Figure 52

Alternative 3 – Single Lane Southbound and Eastbound Approach, Reconfigured Westbound Approach
 Alternative 3 proposes the following changes to lane configurations: westbound Johnson Street would have a left-turn lane and a shared through/right turn lane, eastbound Johnson Street would have a shared left-turn/through/right turn lane, and Augusta Street would have a shared left-turn/through/right turn lane. This alternative also proposes a two-way left-turn lane along Johnson Street between North Central Avenue and Augusta Street. Reconfiguring Augusta Street to a single lane approach and receiving lane allows a wider turning radius for the westbound right-turn movement. Similar to Alternative 2, the parking lot entrance will be relocated from Johnson Street to Byers Street, and sidewalks surrounding this intersection will be rebuilt and widened. This alternative has a cost estimate of \$150,000 and a schedule of 1-2 years to complete. A concept sketch of this alternative is shown in Figure 53.



Figure 51. Alternative 1 Concept Sketch – West Johnson Street at Augusta Street



Figure 52. Alternative 2 Concept Sketch – West Johnson Street at South Augusta Street

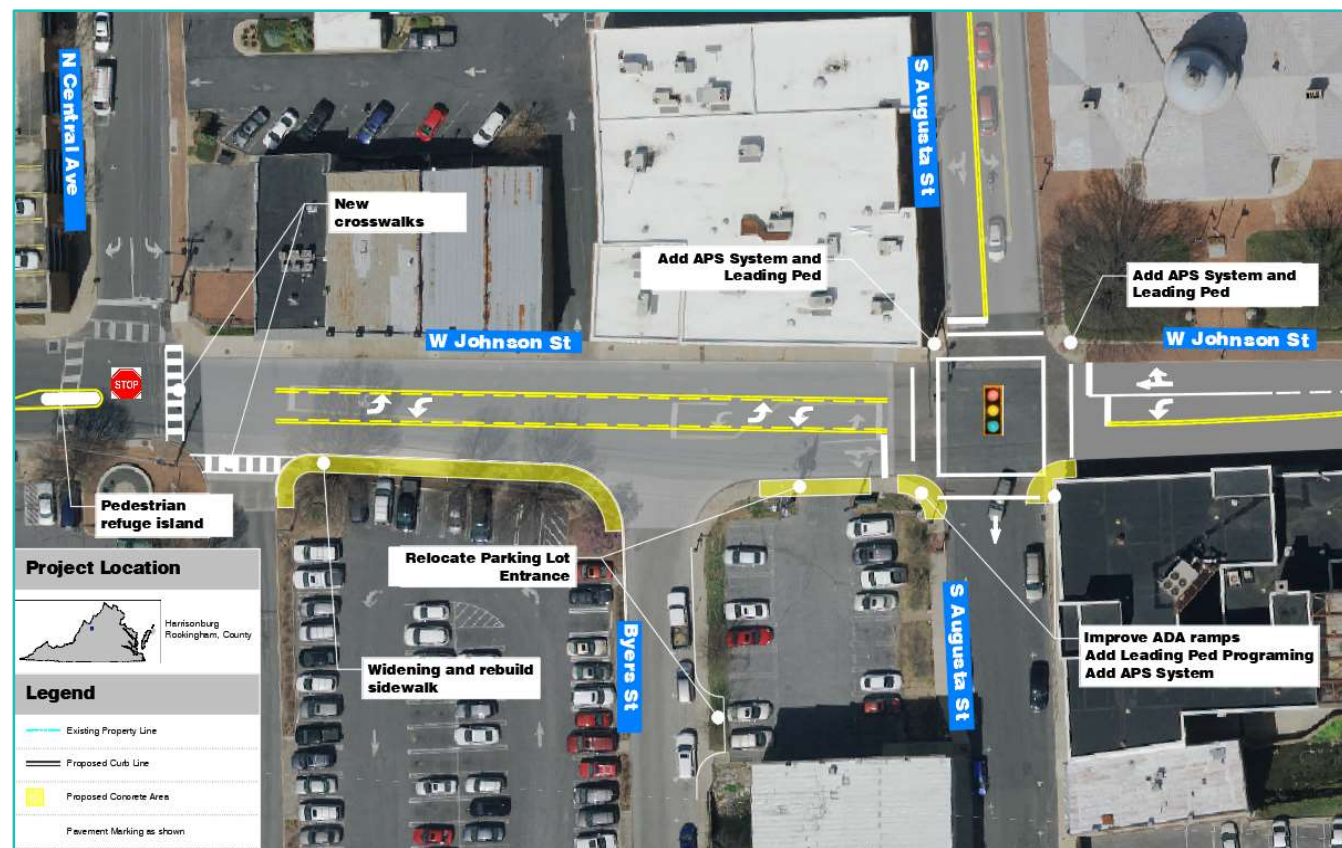


Figure 53. Alternative 3 Concept Sketch – West Johnson Street at Augusta Street

4.11.2.1. Traffic Operations

Each alternative was evaluated with respect to traffic operations. See Table 13 for the summary of the evaluation.

- **Alternative 1:** This alternative will slightly improve traffic operations and reduce 95th percentile queues.
- **Alternative 2:** This alternative will have similar traffic operations as Alternative 1 with additional delay to the westbound approach, which will remain in Level of Service C, removal of the left turn lanes on Johnson Street has minimal operational impacts to the intersection due to the low left-turn volumes
- **Alternative 3:** This alternative will downgrade the alternative will slightly increase delay, but the overall intersection Level of Service will stay as C.

Table 13. MOE Summary for West Johnson Street at Augusta Street

		2035 PM Peak Hour - Delay, LOS and Queue Summary												
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1			2035 ALT 2			2035 ALT 3		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Johnson Street & South Augusta Street	South Augusta Street	SBL	21.1	C	273	14.7	B	174	17.4	B	186	18.7	B	217
		SBT	7.4	A	16	7.3	A	22	8.4	A	24			
	West Johnson Street	EBL	8.9	A	14	26.7	C	159	21.4	C	150	22.0	C	154
		EBT	26.5	C	167									
	West Johnson Street	WBL	7.4	A	9	23.7	C	133	27.0	C	192	28.5	C	214
		WBT	28.6	C	181									
		WBR	4.4	A	29									
	Overall			23.6	C		18.6	B		21.6	C		23.1	C

4.11.2.2. Safety Evaluation

- **Alternative 1:** This alternative increases pedestrian safety with the addition of the APS system.
- **Alternative 2:** This alternative increases pedestrian safety with the addition of the APS system, two crosswalks, and widened sidewalks. This alternative increases bike safety through the addition of bike lanes. The relocation of the parking lot entrance to Byers Street increases safety along Johnson Street.
- **Alternative 3:** This alternative increases pedestrian safety with the addition of the APS system, two crosswalks, and widened sidewalks. The relocation of the parking lot entrance to Byers Street increases safety along Johnson Street.

4.11.2.3. Multimodal

- **Alternative 1:** This alternative includes an APS system that improves pedestrian safety for blind and low vision pedestrians.
- **Alternative 2:** This alternative proposes bike lanes and rebuilt and widened sidewalks along Johnson Street. New crosswalks are proposed across the Wharf Parking Lot entrance and across Johnson Street. Additionally, this alternative includes an APS system, which increases pedestrian safety for blind and low vision pedestrians.
- **Alternative 3:** This alternative creates the opportunity to repurpose the pavement area for bike lanes and parking. Additionally, the sidewalks along Johnson Street would be rebuilt and widened

and an APS system will be installed which increases pedestrian safety for blind and low vision pedestrians.

4.11.2.4. Cost Comparison

- **Alternative 1:** This alternative has a low-cost estimate of \$50,000 and a schedule of 1-2 years to complete.
- **Alternative 2:** This alternative has a cost estimate of \$150,000 and a schedule of 1-2 years to complete.
- **Alternative 3:** This alternative has a cost estimate of \$150,000 and a schedule of 1-2 years to complete.

Table 14. Alternative Evaluation for West Johnson Street at Augusta Street

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1				\$50,000
Alternative 2				\$150,000
Alternative 3				\$150,000

4.11.2.5. Recommendation

The proposed alternatives focused on safety and multimodal improvement, as they were the primary issues identified in the existing conditions analysis. The three alternatives that were developed were evaluated for traffic operations, safety, multimodal improvements. The recommended alternative for this intersection is Alternative 2.

4.11.3. West Johnson Street at Central Avenue – Unsignalized (Intersection 3)

Alternative 1 – Addition of Pedestrian Refuge Island and Crosswalks

The improvements to this intersection consist of adding a pedestrian refuge island in the crosswalk crossing Johnson Street, which improves pedestrian safety but reduces storage for the westbound through movement at Lewis Street to the west. Other improvements would include adding crosswalks across the Wharf parking lot entrance and across Johnson Street. Currently, only two of the three approaches at this intersection have crosswalks. This alternative would add the third crosswalk and add an additional crosswalk across the Parking Lot Entrance in this already high pedestrian heavy area. This alternative has a low-cost estimate of \$40,000 and a schedule of 12-18 months to complete. A concept sketch of this alternative is shown in Figure 54.

Alternative 2 – Addition of Pedestrian Refuge Island, Crosswalks, and Bike Lanes

The improvements to this intersection would be adding a pedestrian refuge island in the crosswalk crossing Johnson Street and adding crosswalks across the Wharf parking lot entrance and across Johnson Street. This alternative also offers multimodal improvements with the addition of the separated bike lanes along Central Avenue, which is a continuation of the bike lane proposed in Alternative 2 at the West Johnson Street at Augusta Street intersection. This alternative has a low-cost estimate of \$45,000 and a schedule of 1-2 years to complete. A concept sketch of this alternative is shown in Figure 55.



Figure 54. Alternative 1 Concept Sketch – West Johnson Street at Central Avenue



Figure 55. Alternative 2 Concept Sketch – West Johnson Street at Central Avenue

4.11.3.1. Traffic Operations

Alternative 1 and Alternative 2 were evaluated with respect to traffic operations. See **Table 15** for the summary of the evaluation.

- **Alternative 1:** This alternative will have no quantitative impact on traffic operations since the changes will not directly change the MOE results.
- **Alternative 2:** This alternative has minimal impacts on traffic operations.

Table 15. MOE Summary for West Johnson Street at Central Avenue

2035 PM Peak Hour - Delay, LOS and Queue Summary											
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1			2035 ALT 2		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Johnson Street & Central Avenue	Central Avenue	SBT	11.5	B	14	11.5	B	14	12.6	B	17
		SBR									
	West Johnson Street	EBL	0.0	A	0	0.0	A	0	0.0	A	0
		EBT									
	West Johnson Street	WBT	0.0	A	0	0.0	A	0	0.0	A	0
		WBR									
Overall			2.7	A		2.7	A		2.3	A	

4.11.3.2. Safety

- **Alternative 1:** This alternative proposes a pedestrian refuge island and new crosswalks across the Wharf Parking Lot entrance and Johnson Street, which would increase pedestrian safety.
- **Alternative 2:** In addition to the Alternative 1 safety improvements, this alternative proposes protected bike lanes along Johnson Street.

4.11.3.3. Multimodal

- **Alternative 1:** This alternative proposes a new pedestrian refuge island and two new crosswalks.
- **Alternative 2:** This alternative proposes a new pedestrian refuge island, two new crosswalks, and protected bike lanes.

4.11.3.4. Cost Comparison

- **Alternative 1:** This alternative has a low-cost estimate of \$40,000. This assumes implementation by City forces, which includes engineering. This alternative has a schedule of 12-18 months to complete.
- **Alternative 2:** This alternative has a low-cost estimate of \$45,000 and a schedule of 1-2 years to complete. Implementation by City forces is also assumed for this alternative.

4.11.3.5. Recommendation

The proposed alternatives focused on safety and multimodal improvement, as they were the primary issues identified in the existing conditions analysis. The two alternatives that were developed were evaluated for traffic operations, safety, multimodal improvements. The recommended alternative for this intersection is Alternative 2.

Table 16 Alternative Evaluation for West Johnson Street at Central Avenue

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1				\$40,000
Alternative 2				\$45,000

4.11.4. West Frederick Street at Augusta Street – Signalized (Intersection 4)

Alternative 1 – Reduction of Southbound Right Turn Radius with Bulb Out

This alternative consists of removing the existing raised pedestrian refuge and replacing it with a crosswalk. The lane configurations from all approaches would remain the same as the existing conditions. The proposed bulb out would reduce the southbound right turn radius from Augusta Street to Frederick Street. This new pavement would shorten the length of the intersection’s existing northern and western crosswalks. This alternative has a low-cost estimate of \$50,000 and a schedule of 12-18 months to complete. A concept sketch of this alternative is shown in **Figure 56**.

Alternative 2 – Single Lane Northbound Approach and Channelized Southbound Right-Turn

This alternative consists of converting this intersection to an all-way stop controlled intersection. The lane configuration in the northbound direction would be changed to a one-lane shared through/right turn lane. The existing directional median for the southbound approach would remain, and a bulb-out curb extension would be added to channelize right turns. The western crosswalk would be tied into the existing directional median and would be connected to the proposed bulb out curb extension. The existing street parking along Augusta Street’s southbound approach would be converted to angled parking. This alternative has a cost estimate of \$100,000 and a schedule of 1-5 years to complete. A concept sketch of this alternative is shown in **Figure 57**.

Alternative 3 – Roundabout Intersection

This alternative consists of converting this three-approach signalized intersection to a roundabout. The proposed roundabout would have one circulating lane with one approach lane from the northbound, southbound, and westbound approaches. Similarly, there would be one receiving lane in the northern, southern and western legs of the roundabout. The circular island of this roundabout would be traversable. This roundabout concept offers safety improvements for vehicles and pedestrians, and significantly improves traffic operations. This alternative has a high-cost estimate of \$1,000,000-\$3,000,000 and a schedule of 3-7 years to complete. A concept sketch of this alternative is shown in **Figure 58**.

Cycle Track Concept for Frederick Street

This alternative involves converting the second westbound travel lane on Frederick Street to a buffered, two-way cycle track from Central Avenue to Augusta Street. It is recommended that the City expand on this concept to potentially extend the cycle track from Lewis Street to Coalter Street. It should be noted that this alternative will not provide much benefits to the study intersection, but can be combined with Alternative 1. Additionally, traffic signal modifications will be required to accommodate the cycle track. A concept sketch of this alternative is shown in **Figure 59**.



Figure 56. Alternative 1 Concept Sketch - West Frederick Street at Augusta Street

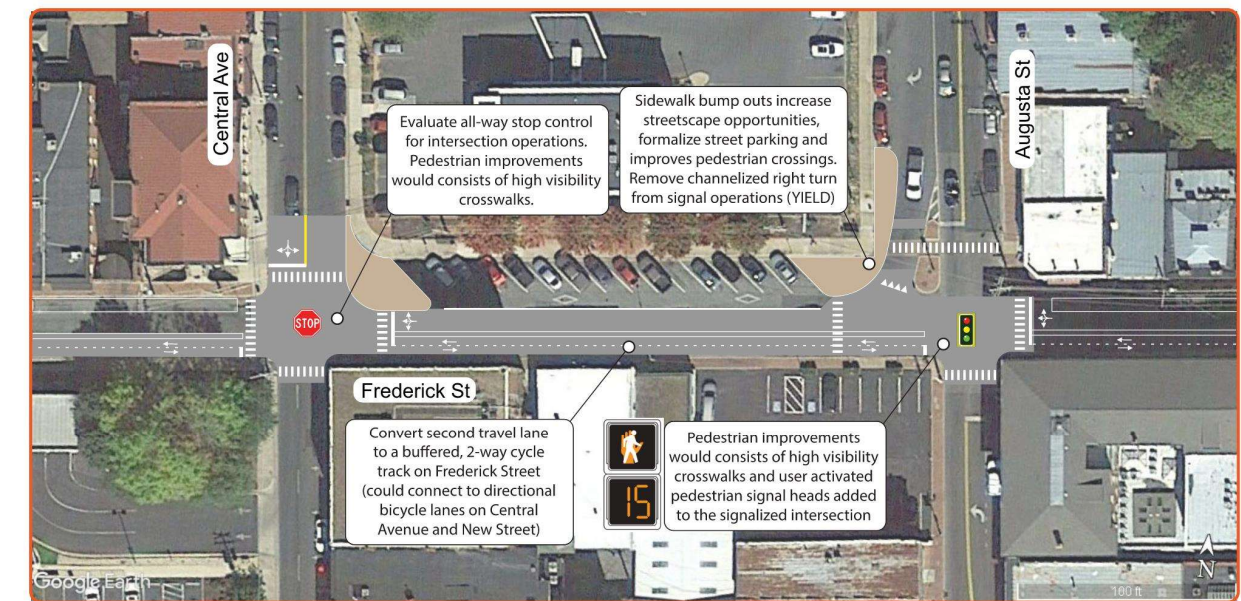


Figure 58. Alternative 3 Concept Sketch - West Frederick Street at Augusta Street



Figure 57. Alternative 2 Concept Sketch - West Frederick Street at Augusta Street

Frederick Street - Cycle Track Concept DRAFT



STARS PSI Intersection Study City of Staunton VDOT

Figure 59. Cycle Track Concept for Frederick Street

4.11.4.1. Traffic Operations

Alternatives 1, 2, and 3 were evaluated with respect to traffic operations. See **Table 17** for the summary of the evaluation.

- **Alternative 1:** This alternative will have minimal, or no impact on traffic operations.
- **Alternative 2:** This alternative will affect traffic operations by converting the intersection to an all-way stop-controlled intersection. The northbound lane configuration will be converted to a one-lane shared through/right turn lane. A bulb-out curb extension will be added to channelize southbound right turns.
- **Alternative 3:** This alternative will significantly improve traffic operations by converting the intersection to a roundabout.
- **Cycle Track Concept:** This alternative will have minimal, or no impact on traffic operations.

Table 17. MOE Summary for West Frederick Street at Augusta Street

2035 PM Peak Hour - Delay, LOS and Queue Summary														
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1			2035 ALT 2			2035 ALT 3		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Frederick Street & North Augusta Street	North Augusta Street	NBL	7.3	A	15	6.5	A	15	11.3	B	82	5.2	A	0.0
		NBT	8.3	A	61	7.3	A	60						
	North Augusta Street	SBT	25.3	C	162	18.6	B	141	21.4	C	150	8.8	A	1.7
		SBR	0.4	A	0	0.3	A	0	0.3	A	0			
	West Frederick Street	WBL	12	B	48	15.5	B	60	13.2	B	55	7.7	A	1.3
		WBT												
		WBR												
Overall		14.8	B		13.4	B		14.8	B		7.5	A		

4.11.4.2. Safety Evaluation

- **Alternative 1:** This alternative will improve pedestrian safety at the intersection by adding a new crosswalk and decreasing pedestrian walking distance across the northern and western crosswalks.
- **Alternative 2:** This alternative improves pedestrian safety by decreasing pedestrian walking distance through the intersection.
- **Alternative 3:** This alternative significantly increases safety for vehicles and pedestrians with the conversion to a roundabout.
- **Cycle Track Concept:** This alternative significantly improves pedestrian and cyclist safety through additional accommodations.

4.11.4.3. Multimodal

- **Alternative 1:** This alternative improves pedestrian safety and accessibility at the intersection.
- **Alternative 2:** This alternative improves pedestrian safety at the intersection.
- **Alternative 3:** This alternative improves pedestrian safety with the addition of the roundabout.
- **Cycle Track Concept:** This alternative improves pedestrian accessibility with the addition of the high visibility crosswalks and actuated pedestrian signals. The protected two-way bike lanes greatly improves safety for cyclists.

4.11.4.4. Cost Comparison

- **Alternative 1:** This alternative has a low-cost estimate of \$50,000 and a schedule of 12-18 months to complete.
- **Alternative 2:** This alternative has a cost estimate of \$100,000 and a schedule of 1-5 years to complete.
- **Alternative 3:** This alternative has a high-cost estimate of \$1,000,000-\$3,000,000 and a schedule of 3-7 years to complete.
- **Cycle Track Concept:** This alternative has a cost estimate of \$100,000.

Table 18. Alternative Evaluation for West Frederick Street at Augusta Street

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1				\$50,000
Alternative 2				\$100,000
Alternative 3				\$1,000,000-\$3,000,000
Cycle Track				\$100,000

4.11.4.5. Recommendation

The three alternatives that were developed were evaluated for traffic operations, safety, multimodal improvements. The proposed alternatives focused on safety and multimodal improvement, as they were the primary issues identified in the existing conditions analysis. The recommended alternative for this intersection is the Cycle Track Concept for Frederick Street.

Single Travel Lane Concept for Beverley Street

Intersections 5, 6, and 7 all share a common alternative which would convert the existing two-lane eastbound Beverley Street to a single lane eastbound street from Lewis Street to New Street, and utilize the curbside lane for safety, commercial, and multimodal improvements and uses. This alternative could be implemented by segments from east to west or all together as a corridor improvement. The alternative will repurpose the travel lane pavement area for on-street parking, loading, and unloading areas for local businesses and restaurants. This concept also proposes converting the side street approaches at Lewis Street, Central Avenue, and New Street to one lane to add on-street parking. There are also proposed pedestrian improvements consisting of mid-block crossings, high visibility crosswalks, user-activated pedestrian signal heads at signalized intersections, and sidewalk bump-outs to increase streetscape opportunities, formalize street parking, and improve pedestrian safety crossings. The follow sections show individualized intersection concepts of this alternative, as well as operational characteristics of the concept. A concept sketch of the full corridor alternative is shown in **Figure 60**. The cost estimate for this alternative would be dependent on the level of improvements and specific concepts. As a result, there could be lower and higher cost versions depending on final designs and preferences. The current cost estimate assumes a lower cost option based on pavement marking changes and minor concrete work.

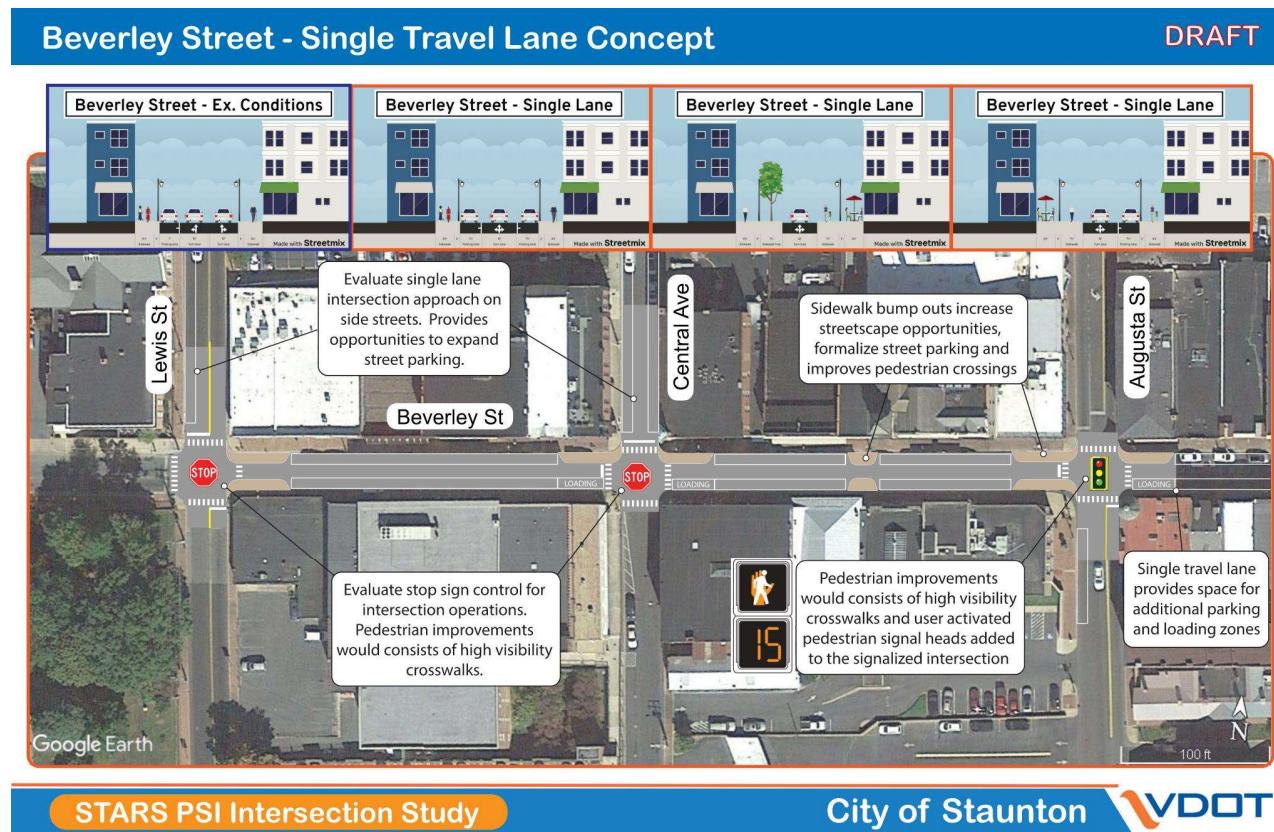


Figure 60 Single Lane Travel Concept for Beverley Street

4.11.5. West Beverley Street at New Street – Unsignalized (Intersection 5)

Alternative 1 – All-Way Stop-Control and Convert Beverley Street to a Single Lane

This alternative converts this intersection from a traffic signal to an all-way stop-controlled intersection, and reduces the eastbound northbound approaches to one travel lane. There are pedestrian safety improvements with the installation of bulb-outs, curb ramps, and painted crosswalks. This alternative has a low-cost estimate of \$60,000 and a schedule of 1-3 years to complete. A concept sketch of this alternative is shown in Figure 61.

Alternative 2 – All-Way Stop-Control and Pedestrian Improvements

This alternative also converts this intersection from a traffic signal to an all-way stop-controlled intersection and reduces the northbound approach to one travel lane, while maintaining two travel lanes for the eastbound approach. There are pedestrian safety improvements with the installation of bulb-outs, curb ramps, and painted crosswalks. This alternative has a low-cost estimate of \$50,000 and a schedule of 1-2 years to complete. A concept sketch of this alternative is shown in Figure 62.

Single Travel Lane Concept for Beverley Street

This alternative involves reducing the eastbound approach to one lane. Pedestrian improvements involve adding ADA compliant ramps and bulb-outs, which shorten crosswalk lengths. This alternative as part of a corridor improvement, has a cost estimate of \$250,000. A concept sketch of this alternative is shown in Figure 60



Figure 61 Alternative 1 Concept Sketch – West Beverley Street at New Street



Figure 62 Alternative 2 Concept Sketch – West Beverley Street at New Street

4.11.5.1. Traffic Operations

Alternative 1 was evaluated with respect to traffic operations. See **Table 19** for the summary of the evaluation.

- **Alternative 1:** This alternative will improve traffic operations by removing the unwarranted traffic signal and converting the intersection to an all-way stop-controlled intersection.
- **Alternative 2:** This alternative also will improve traffic operations by converting the intersection to an all-way stop-controlled intersection.
- **Alternative 3:** This alternative will have similar traffic operational benefits as alternative 1.

Table 19. MOE Summary for West Beverley Street at New Street

2035 Mid Peak Hour - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & New Street	New Street	NBT	12.3	B	20	7.6	A	-
		NBR	12.4	B	14			
	West Beverley Street	EBL	11.2	B	30	8.2	A	-
		EBT						
	Overall		11.6	B		8.0	A	

4.11.5.2. Safety Evaluation

- **Alternative 1:** This alternative will improve pedestrian and vehicular safety by converting the traffic signal to an all-way stop-controlled intersection.
- **Alternative 2:** This alternative also improves pedestrian and vehicular safety by converting the traffic signal to an all-way stop-controlled intersection.
- **Single Lane Travel Concept:** This alternative significantly improves pedestrian safety through the additional accommodations.

4.11.5.3. Multimodal

- **Alternative 1:** This alternative improves pedestrian safety and accessibility at the intersection.
- **Alternative 2:** This alternative improves pedestrian safety and accessibility at the intersection. Additionally, by reducing East Beverley Street to one lane, there are better cyclist accommodations.
- **Single Lane Travel Concept:** This alternative improves pedestrian accessibility with the addition of the high visibility crosswalks, actuated pedestrian signals, and bump outs.

4.11.5.4. Cost Comparison

- **Alternative 1:** This alternative has a low-cost estimate of \$60,000 and a schedule of 1-3 years to complete.
- **Alternative 2:** This alternative has a low-cost estimate of \$50,000 and a schedule of 1-2 years to complete.
- **Single Lane Travel Concept:** This alternative is part of a corridor improvement and has a cost estimate of \$250,000.

Table 20. Alternative Evaluation for West Beverley Street at New Street

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Beverley Street <i>One travel lane concept</i>				\$250,000
Alternative 1				\$60,000
Alternative 2				\$50,000

4.11.5.5. Recommendation

The proposed alternatives focused on traffic operations and safety, as they were the primary issues identified in the existing conditions analysis. The two alternatives that were developed were evaluated for traffic operations, safety, multimodal improvements. The recommended alternative for this intersection is Alternative 1.

4.11.6. West Beverley Street at Augusta Street – Signalized (Intersection 6)

Alternative 1 – Convert Beverley Street to a Single Lane

This alternative involves reducing the southbound and eastbound approaches to one lane. Pedestrian improvements involve adding ADA compliant ramps and bulb-outs, which shorten crosswalk lengths. This alternative has a low-cost estimate of \$60,000 and a short-term schedule of less than one year to complete. A concept sketch of this alternative is shown in

Figure 63.

Alternative 2 – Convert Beverley Street to a Single Lane and Add Parking Spaces

This alternative also involves reducing the southbound to one lane and repurposing the pavement area for on-street parking. The reduction of the eastbound approach to one lane is similar to Alternative 1. The pedestrian improvements include adding ADA compliant ramps and bulb-outs. This alternative has a low-cost estimate of \$60,000 and a short-term schedule of less than one year to complete. A concept sketch of this alternative is shown in **Figure 64**.

Alternative 3 – Reduce Southbound Augusta Street to Single Lane

This alternative involves reducing the southbound approach to one lane and maintaining the eastbound approach as a two lane approach. The pedestrian improvements include adding ADA compliant ramps and bulb-outs. This alternative has a low-cost estimate of \$50,000 and a short-term schedule of less than one year to complete. A concept sketch of this alternative is shown in **Figure 65**.

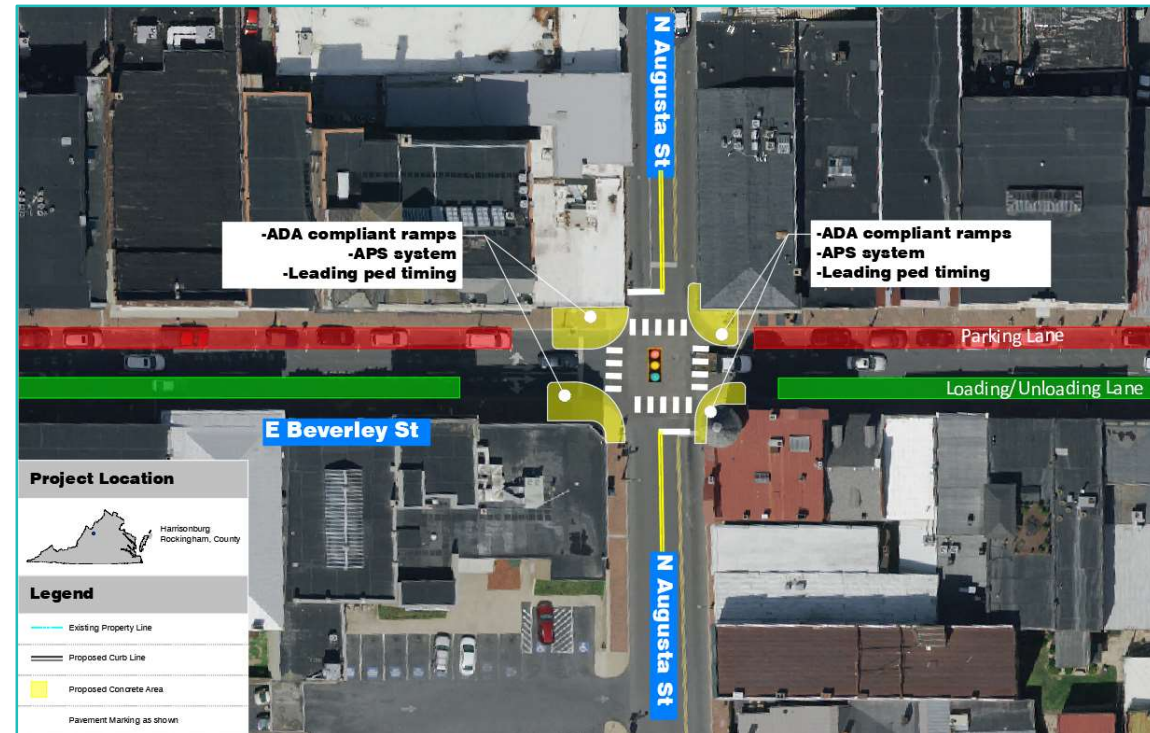


Figure 63. Alternative 1 Concept Sketch – West Beverly Street at Augusta Street



Figure 65. Alternative 3 Concept Sketch – West Beverly Street at Augusta Street



Figure 64. Alternative 2 Concept Sketch – West Beverly Street at Augusta Street

4.11.6.1. Traffic Operations

Alternative 1 and Alternative 2 have similar traffic operations as they both have the same traffic signal and lane configurations. However, they are different in repurposing the north side pavement area which has no impact on traffic operations. Alternative 3 is different in the eastbound approach lane configuration, as it will keep both travel lanes.

See **Table 21** for the summary of the evaluation.

- **Alternative 1:** This alternative will not have any operational improvements due to the reduction of the southbound and eastbound approaches to one lane.
- **Alternative 2:** Similar to Alternative 1, this alternative will not have any operational improvements due to the reduction of the southbound and eastbound approaches to one lane.
- **Alternative 3:** This alternative will have operational similar operational conditions as no-build conditions, with a slight increase in delay due to removing the southbound left turn lane.

Table 21. MOE Summary for West Beverley Street at Augusta Street

2035 PM Peak Hour - Delay, LOS and Queue Summary												
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1&2			2035 ALT 3			
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	
West Beverley Street & Augusta Street	Augusta Street	NBT	21.3	C	123	23.8	C	121	20.6	C	115	
		NBR										
	Augusta Street	SBL	9.2	A	24	16.1	B	149	21.8	C	149	
		SBT	12	B	125							
	West Beverley Street	West Beverley Street	EBL	18.8	B	63	28.2	C	148	19	B	64
			EBT									
			EBR									
	Overall		16.1	B		21.6	C		16.9	B		

4.11.6.2. Safety Evaluation

- **Alternative 1:** The proposed changes in this alternative will have safety benefits by reducing driver confusion and increasing pedestrian safety.
- **Alternative 2:** The proposed changes in this alternative will have safety benefits by reducing driver confusion and increasing pedestrian safety.
- **Alternative 3:** The proposed changes in this alternative will have safety benefits by increasing pedestrian safety.

4.11.6.3. Multimodal

- **Alternative 1:** This alternative will improve pedestrian crossing safety with the addition of the ADA compliant ramps and bulb-outs which shorten crosswalk lengths. Additionally, a one-lane East Beverley Street reduces conflict points and creates a safer corridor for cyclists.
- **Alternative 2:** This alternative will improve pedestrian crossing safety with the addition of the ADA compliant ramps and bulb-outs. Additionally, by reducing East Beverley Street to one lane, there are better cyclist accommodations.
- **Alternative 3:** This alternative will improve pedestrian crossing safety with the addition of the ADA compliant ramps and bulb-outs.

4.11.6.4. Cost Comparison

- **Alternative 1:** This alternative considers the full Beverley Street one lane concept, which has a cost estimate of \$250,000 and a schedule of 1 to 3 years to complete.
- **Alternative 2:** This alternative has a low-cost estimate of \$60,000 and a short-term schedule of less than one year to complete.
- **Alternative 3:** This alternative has a low-cost estimate of \$50,000 and a short-term schedule of less than one year to complete.

Table 22. Alternative Evaluation for West Beverley Street at Augusta Street

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1 <i>One travel lane concept</i>				\$250,000
Alternative 2				\$60,000
Alternative 3				\$50,000

4.11.6.5. Recommendation

The proposed alternatives focused on traffic operations and safety, as they were the primary issues identified in the existing conditions analysis. The three alternatives that were developed were evaluated for traffic operations, safety, multimodal improvements. The recommended alternative for this intersection is the Single Lane Travel Concept.

4.11.7. West Beverley Street at Lewis Street – Unsignalized (Intersection 7)

Alternative 1 – Convert Beverley Street to a Single Lane

This alternative proposes converting the traffic signal to an All-Way Stop Control (AWSC) intersection and reducing the southbound and eastbound approaches to a single lane, which allows for repurposing the existing pavement area on the north side of the intersection for on-street parking. The pedestrian improvements involve adding ADA-compliant ramps and bulb-outs. This alternative has a low-cost estimate of \$60,000 and a schedule of 1-2 years to complete. A concept sketch of this alternative is shown in Figure 66.



Figure 66. Alternative 1 Concept Sketch – West Beverley Street at Lewis Street

4.11.7.1. Traffic Operations

Alternative 1 was evaluated with respect to traffic operations. See Table 23 for the summary of the evaluation.

- **Alternative 1:** This alternative will reduce delays by converting the traffic signal to an AWSC intersection. However, with an AWSC intersection all drivers have to come to a complete stop before proceeding through the intersection.

Table 23. MOE Summary for West Beverley Street at Lewis Street

2035 PM Peak Hour - Delay, LOS and Queue Summary									
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1			
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	
West Beverley Street & Lewis Street	Lewis Street	NBT	22.1	B	156	10.4	B	34	
		NBR							
	Lewis Street	SBL	7.8	A	14	9.4	A	20	
		SBT	8.5	A	52				
	West Beverley Street	West Beverley Street	EBL	15.8	B	55	10.2	B	26
			EBT						
			EBR						
	Overall		16.6	B		10.1	B		

4.11.7.2. Safety Evaluation

- **Alternative 1:** The proposed changes in this alternative will have safety benefits by reducing lane changes and creating a dedicated space for loading/unloading activity, thus reducing driver confusion caused by unexpected stops.

4.11.7.3. Multimodal

- **Alternative 1:** This alternative will improve pedestrian crossing safety with the addition of the ADA-compliant ramps and bulb-outs. Additionally, converting East Beverley Street to one travel lane provides a safer corridor for cyclists by reducing conflict points and lane-change maneuvers.

4.11.7.4. Cost Comparison

- **Alternative 1:** This alternative has a low-cost estimate of \$60,000 and a schedule of 1-2 years to complete.

4.11.7.5. Recommendation

There is only one alternative proposed at this intersection, which primarily focused on safety improvement and pedestrian accommodation. The proposed geometrical changes will shorten the pedestrian crossing distance.

4.11.8. West Beverley Street at Jefferson Street – Unsignalized (Intersection 8)

Alternative 1 – Stop-Controlled Intersection

This alternative converts the existing signalized intersection to a stop-controlled intersection. Although crosswalks exist on all four approaches, this alternative proposes curb extensions and bulb-outs around the intersection to accommodate ADA compliant ramps. The curb extension for the southbound right turning vehicles will help tighten the turning radius and reduce turning speeds to increase pedestrian safety. This alternative has a cost estimate of \$150,000 and a schedule of 1-3 years to complete. A concept sketch of this alternative is shown in Figure 67.

Alternative 2 – Roundabout

This alternative would convert the existing signalized intersection into a roundabout. The roundabout would have a single circulating lane on eastbound Beverley Street and both Jefferson Street approaches consisting of single lane approaches. The proposed diameter would be 50 feet with a traversable, circular island. This alternative has a high-cost estimate of \$1,000,000-\$3,000,000 and a schedule of 3-7 years to complete. A concept sketch of this alternative is shown in Figure 68.

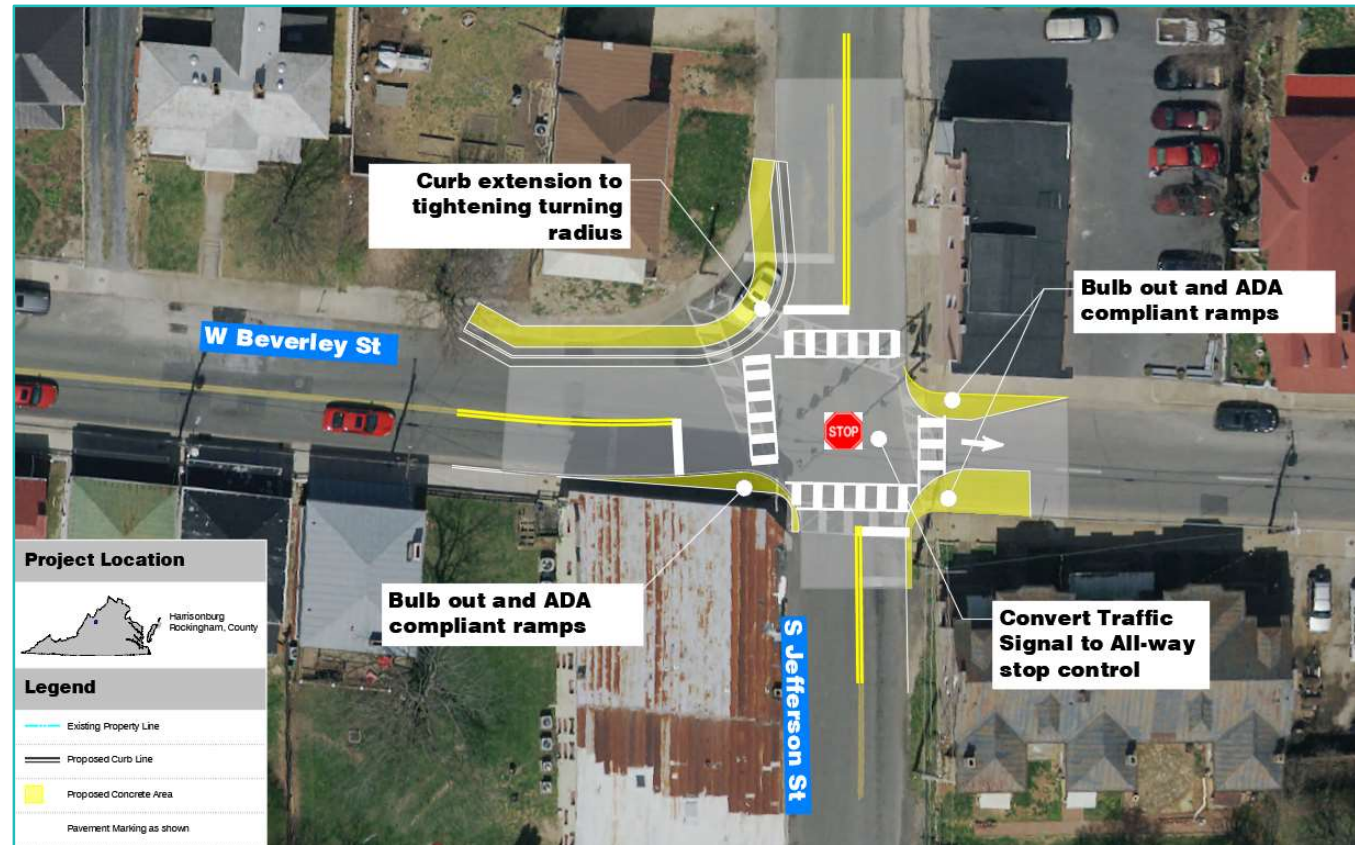


Figure 67. Alternative 1 Concept Sketch – West Beverly Street at Jefferson Street



Figure 68. Alternative 2 Concept Sketch – West Beverly Street at Jefferson Street

4.11.8.1. Traffic Operations

Alternative 1 and Alternative 2 were evaluated with respect to traffic operations. See **Table 24** for the summary of the evaluation.

- **Alternative 1:** This alternative provides significant operational benefits by converting the signalized intersection to an all-way stop-controlled intersection.
- **Alternative 2:** This alternative provides significant operational benefits by converting the signalized intersection to a roundabout.

Table 24. MOE Summary for West Beverley Street at Jefferson Street

2035 PM Peak Hour - Delay, LOS and Queue Summary											
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1			2035 ALT 2		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Jefferson Street	Jefferson Street	NBL	25.1	C	137	9.8	A	-	6.8	A	1.0
		NBT									
		NBR									
	Jefferson Street	SBL	12.2	B	39	8.2	A	-	4.6	A	0.3
		SBT									
		SBR									
	West Beverley Street	EBL	8.1	A	85	9.9	A	-	6	A	1.1
		EBT									
		EBR									
Overall		15.3	B		9.6	A		5.5	A		

4.11.8.2. Safety Evaluation

- **Alternative 1:** The proposed changes in this alternative will have safety benefits by reducing driver confusion and increasing pedestrian safety.
- **Alternative 2:** The proposed changes in this alternative will have safety benefits by increasing pedestrian safety.

4.11.8.3. Multimodal

- **Alternative 1:** This alternative will improve pedestrian crossing safety with the addition of the curb extensions and bulb outs to accommodate ADA compliant ramps.
- **Alternative 2:** This alternative will improve pedestrian crossing safety with the conversion to a roundabout.

4.11.8.4. Cost Comparison

- **Alternative 1:** This alternative has a cost estimate of \$150,000 and a schedule of 1-3 years to complete.
- **Alternative 2:** This alternative has a high-cost estimate of \$1,000,000-\$3,000,000 and a schedule of 3-7 years to complete.
-

Table 25. Alternative Evaluation for West Beverley Street at Jefferson Street

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1				\$150,000
Alternative 2				\$1,000,000 - \$3,000,000

4.11.8.5. Recommendation

The proposed alternatives focused on traffic operations and safety, as they were the primary issues identified in the existing conditions analysis. The two alternatives that were developed were evaluated for traffic operations, safety, multimodal improvements. The recommended alternative for this intersection is Alternative 2.

4.11.9. West Beverley Street at Hays Avenue – Signalized (Intersection 9)

Alternative 1 – Left-Turn Bay Along Eastbound Beverley Street at Park Boulevard

This alternative proposes and upgrade to the traffic signal system and adding a left-turn bay along eastbound Beverley Street at Park Boulevard. The existing westbound left turn bay at Hays Avenue will be shortened to accommodate this new eastbound left turn bay. Pedestrian improvements include adding a crosswalk across Hays Avenue with a pedestrian signal. This alternative has a cost estimate of \$200,000 and a schedule of 2-3 years to complete. A concept sketch of this alternative is shown in **Figure 69**.

Alternative 2 – Convert Beverley Street at Park Boulevard into Right-In/Right-Out

In addition to the traffic signal system upgrade, this alternative proposes converting the intersection at Beverley Street and Park Boulevard into a right-in/right-out intersection. Similar to Alternative 1, this alternative also proposes a left turn bay for eastbound Beverley Street at Park Boulevard and adds a crosswalk across Hays Avenue with a pedestrian signal. A concept sketch of this alternative is shown in **Figure 70**. This alternative has a cost estimate of \$210,000 and a schedule of 2-3 years to complete.

Alternative 3 – Convert Beverley Street at Park Boulevard into Right-In/Right-Out & Restrict Eastbound Left-Turn at Park Boulevard

This alternative proposes converting the intersection at Beverley Street and Park Boulevard into a right-in/right-out intersection by restricting access from eastbound Beverley Street. Similar to Alternative 1 and 2, this alternative also proposes the traffic signal system upgrade and adding a crosswalk across Hays Avenue with a pedestrian signal. This alternative has a cost estimate of \$200,000 and a schedule of 2-5 years to complete. A concept sketch of this alternative is shown in **Figure 71**.



Figure 69. Alternative 1 Concept Sketch – West Beverly Street at Hays Avenue



Figure 71. Alternative 3 Concept Sketch – West Beverly Street at Hays Avenue



Figure 70. Alternative 2 Concept Sketch – West Beverly Street at Hays Avenue

4.11.9.1. Traffic Operations

Alternative 1 and Alternative 2 were evaluated with respect to traffic operations. See **Table 26** for the summary of the evaluation.

- **Alternative 1:** This alternative significantly improves operational conditions by allowing the left-turn movement to operate in protected/permissive phase.
- **Alternative 2:** This alternative will have similar traffic operation benefits as Alternative 1.
- **Alternative 3:** This alternative will have similar traffic operation benefits as Alternative 1.

Table 26. MOE Summary for West Beverley Street at Hays Avenue

2035 PM Peak Hour - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1, 2, & 3		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Hays Avenue	Hays Avenue	NBL	57.2	E	185	17.3	B	82
		NBR	19.9	B	22			
	West Beverley Street	EBT	16.3	B	217	17.8	B	157
		EBR						
	West Beverley Street	WBL	53.4	D	52	6.7	A	13
		WBT	6.2	A	140	9.6	A	196
	Overall			19.4	B		13.9	B

4.11.9.2. Safety Evaluation

- **Alternative 1:** This alternative improves safety by increasing sight distance and by providing new pedestrian accommodations.
- **Alternative 2:** This alternative significantly improves safety by reducing conflict points and by providing new pedestrian accommodations.
- **Alternative 3:** This alternative also significantly improves safety by reducing conflict points and by providing new pedestrian accommodations.

4.11.9.3. Multimodal

- **Alternative 1:** This alternative will provide pedestrian accommodations with a new crosswalk and pedestrian signal.
- **Alternative 2:** This alternative will also provide pedestrian accommodations with a new crosswalk and pedestrian signal.
- **Alternative 3:** This alternative will also provide pedestrian accommodations with a new crosswalk and pedestrian signal.

4.11.9.4. Cost Comparison

- **Alternative 1:** This alternative has a cost estimate of \$200,000 and a schedule of 2-3 years to complete.
- **Alternative 2:** This alternative has a cost estimate of \$210,000 and a schedule of 2-3 years to complete.
- **Alternative 3:** This alternative has a cost estimate of \$200,000 and a schedule of 2-5 years to complete.

Table 27. Alternative Evaluation for West Beverley Street at Hays Avenue

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1				\$200,000
Alternative 2				\$210,000
Alternative 3				\$200,000

4.11.9.5. Recommendation

The proposed alternatives focused on traffic operations and safety, as they were the primary issues identified in the existing conditions analysis. The three alternatives that were developed were evaluated for traffic operations, safety, multimodal improvements. The recommended alternative for this intersection is Alternative 1.

4.11.10. West Beverley Street at Grubert Avenue – Signalized (Intersection 10)

Alternative 1 – Convert Beverley Street to Two-Way Left-Turn Lane

This is the only alternative combining multiple improvements that focuses on pedestrian accommodations and operational and safety improvements. Pedestrian improvements include adding a west side crosswalk and sidewalk connection at the intersection's northwest corner. Traffic operational improvements include reconfiguring side streets operations phases from split to permissive. Additional safety improvements include adding flashing yellow arrows for the eastbound and westbound left-turn movements, adding delineator posts to restrict full access within the functional area of the intersection, proposing curb bulb-outs at the service road entrance, and repurposing the eastbound three-lane segment into two through travel lanes and a Two-Way Left Turn Lane (TWLTL) to provide space for turning vehicles into commercial entrances along the segment. This alternative has a low-cost estimate of \$60,000-\$80,000 and a 1-2 years schedule to complete. A concept sketch of this alternative is shown in Figure 72.



Figure 72. Alternative 1 Concept Sketch – West Beverley Street at Grubert Avenue

4.11.10.1. Traffic Operations

Alternative 1 was evaluated with respect to traffic operations. See **Table 28** for the summary of the evaluation.

- **Alternative 1:** This alternative has operational improvements by reconfiguring signal operations of the side streets to operate in permissive phases instead of split phases.

Table 28. MOE Summary for West Beverley Street at Grubert Avenue

2035 PM Peak Hour - Delay, LOS and Queue Summary								
Intersection	Roadway	Lane Group	2035 No Build			2035 ALT 1		
			Delay (Sec/Veh.)	LOS	95th Q	Delay (Sec/Veh.)	LOS	95th Q
West Beverley Street & Grubert Avenue	Grubert Avenue	NBL	38.5	D	21	21.8	C	14
		NBT						
		NBR						
	Grubert Avenue	SBL	29.3	C	121	16.0	B	69
		SBT						
		SBR						
	West Beverley Street	EBL	42.6	D	162	6.7	A	45
		EBT	11.3	B	239	9.2	A	169
		EBR	0	A	0	0.0	A	0
	West Beverley Street	WBL	39	D	9	5.0	A	3
WBT		25.8	C	452	14.3	B	240	
WBR								
Overall			24.1	C		12.0	B	

4.11.10.2. Safety Evaluation

- **Alternative 1:** This alternative will improve safety by improving pedestrian accommodations and reducing driver confusion.

4.11.10.3. Multimodal

- **Alternative 1:** This alternative will provide pedestrian accommodations with the addition of a new crosswalk.

4.11.10.4. Cost Comparison

- **Alternative 1:** This alternative has a low-cost estimate of \$60,000-\$80,000 and a schedule of 1-2 years to complete.

4.11.10.5. Alternative Evaluation

There is only one alternative proposed at this intersection, with the primary focus on safety improvements and pedestrian accommodations. The proposed geometrical changes will shorten the pedestrian crossing distance.

5. PUBLIC INVOLVEMENT / SURVEY RESULTS

Following the development and analysis of the alternatives, a public involvement survey was developed to determine the public’s response to the alternatives and further investigate their demographics and what they perceived as the relevant issues within the study area. This survey was available online between August 2, 2021 and August 16, 2021. In addition to providing answers to questions, participants were asked to rank grouped alternatives at sections of the study area to determine the alternatives with the highest public approval.

5.1. Survey Design

The survey was designed to get public feedback on the general roadway and multimodal improvement concepts. Different improvement concepts are presented in the roadway section, such as All-Way Stop, mini-roundabout, signal operational improvement, and travel lane repurposing. Participants were asked to rate the improvement concept and the location where the improvement was proposed in the study area. In the multimodal section, pedestrian, bicycle, and signal improvements are presented with locations where the improvement is proposed. Participants were asked to rate the improvement based on their opinion from one to five, one being very unfavorable, three being neutral, and five being strongly in favor.

Additionally, some demographic questions were asked, such as place of residence, primary use of the study area, and what modes of travel are used through the study intersections.

5.2. Survey Participation

This survey was launched on August 2, 2021, and was available until August 16, 2021. There were 487 responses to the survey. Only 11 responses out of 325 were from outside of Virginia or locations other than Augusta County and the City of Staunton. The majority of the responses were from the City of Staunton (264), 47 responses were from people who live/work adjacent to one of the study intersections, and 217 were from other locations in the City. **Figure 74** shows the participants' response to the survey question “Where do you live?”.

The survey also asked participants about what modes of travel they use through the study intersections. **Figure 73** shows the response for each of the travel modes. Vehicle had the highest number of responses with 308 responses, then walking, bicycle, and transit.

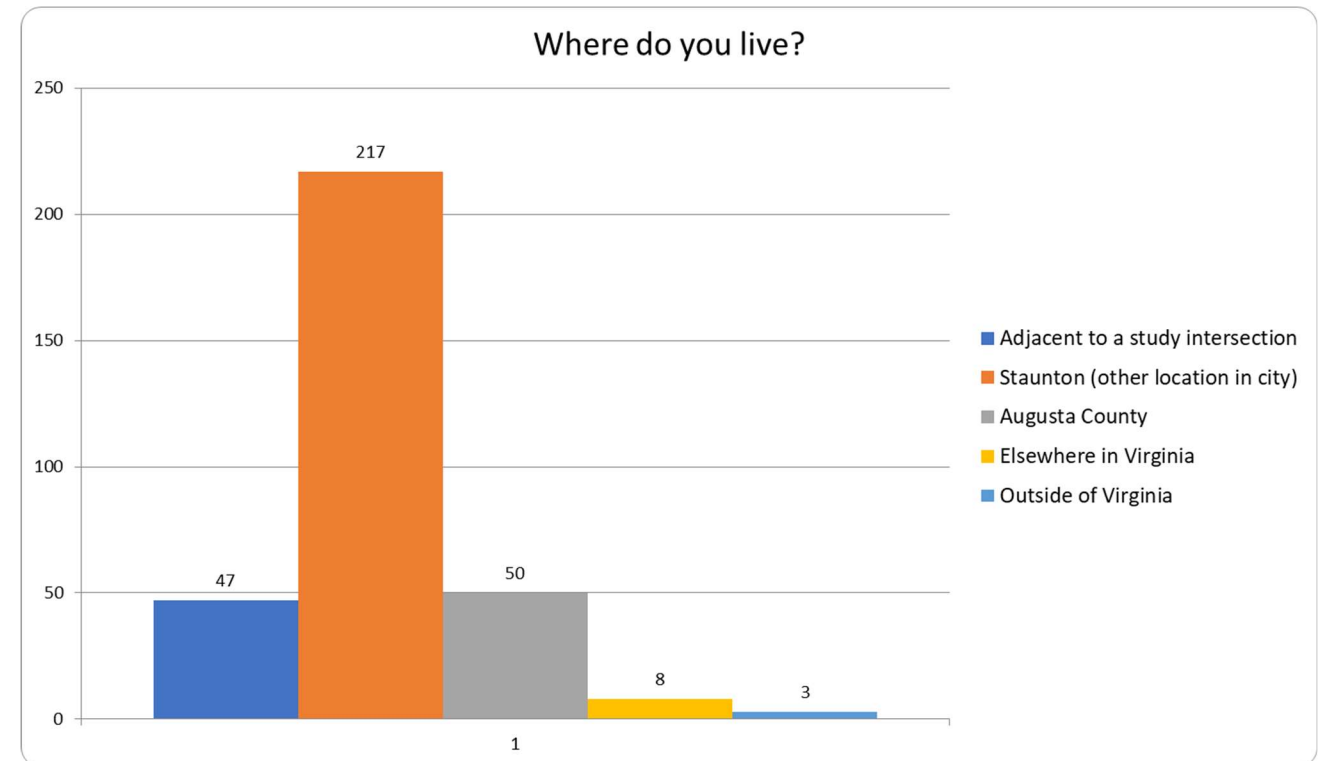


Figure 74 Survey Participants Location

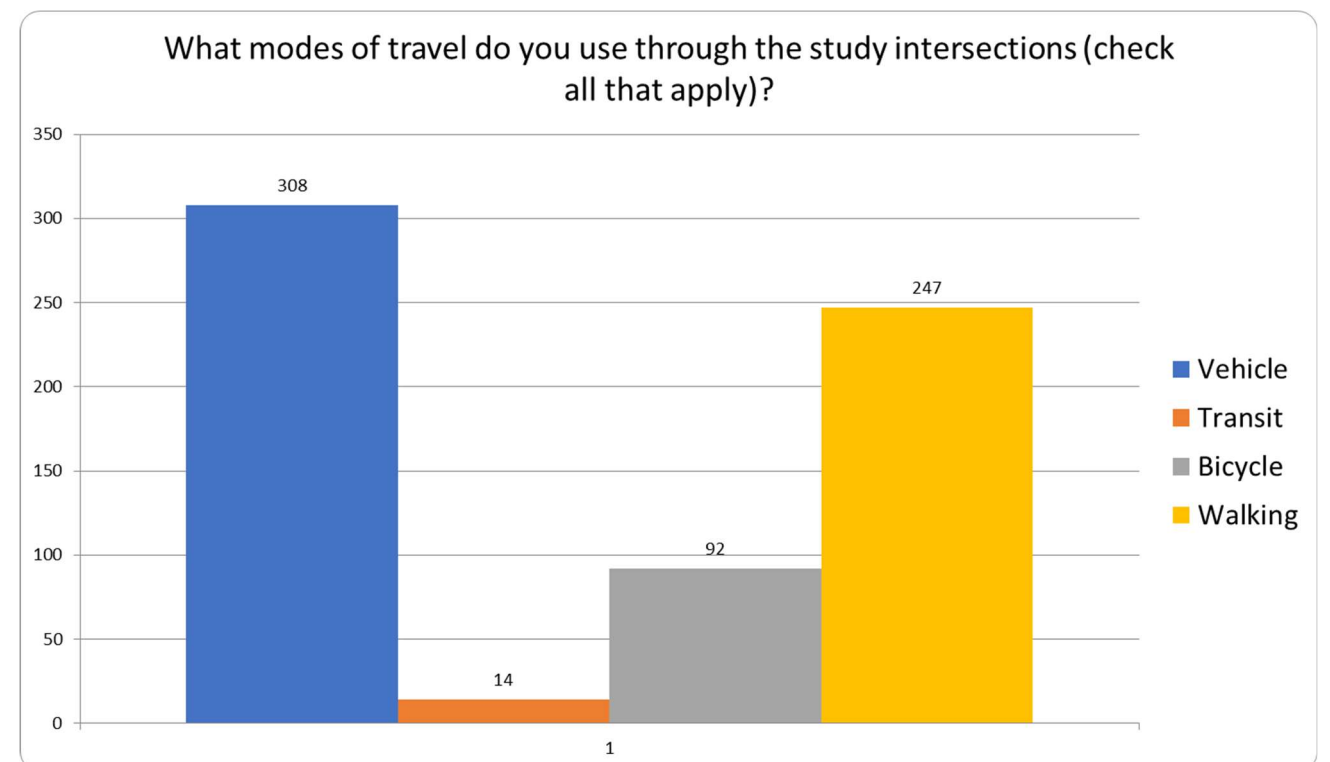


Figure 73 Survey Participants Modes of Travel

5.3. Survey Data Summary

The survey was designed to get public opinion on the identified needs and feedback on the proposed improvements. The participants were asked whether they agreed with the study intersections' identified needs. As shown in **Table 29**, all study intersections have 70% or more of participant agreement to the identified needs, with Johnson Street and Augusta Street intersection having the highest percent of agreement (91%) with the West Beverley Street and New Street intersection being the lowest with 72%.

Table 29 Survey Data Review

Intersection	Replies	Agree with Needs	%
Johnson and Augusta	318	289	91%
Beverley and Augusta	306	268	88%
Beverley and Hays	284	242	85%
Beverley and Lewis	300	255	85%
Beverley and Grubert	280	231	82%
Johnson and Central	319	253	79%
Johnson and New	293	230	78%
Beverley and Jefferson	305	235	77%
Augusta and Fredrerick	290	218	75%
Beverley and New	290	210	72%

Table 30 summarizes the public feedback on the proposed improvements at the study intersections. The results show that high visibility crosswalks and pedestrian signal heads had the most robust support with an average rating of 4.32 and 4.3, respectively. The other proposed improvements also got a good average rating of 3.3 and above. A summary of the key takeaways from the public involvement survey is as follows:

- The top three concerns for survey participants were congestion, safety, and multimodal access.
- The most favored roadway improvement options include improved signal operations, all-way stop control, and vehicular travel lane re-purposing. Mini roundabouts received split comments with concerns that the improvement type would not be context-sensitive.
- Pedestrian improvements were well received with support for both high-visibility crosswalks and curb extensions.
- Bicycle improvements received split comments for bike lanes and cycle track with concerns that these improvements do not provide adequate protection for cyclists.
- Signal improvements were well received with support for pedestrian signals and the hybrid pedestrian beacon, but with some concerns that participants are unfamiliar with the hybrid pedestrian beacon.

Table 30 Survey Data Summary for Proposed Improvements

Improvement	Ratings	Average	% 5 Star	% 1 Star	Comments	Summary
High Vis. Crosswalks	269	4.32	62.08%	4.09%	11	Overall support for the concept. Concerns regarding context sensitive application due to historical character.
Ped. Signal Heads	287	4.3	61.67%	4.18%	14	Significant overall support.
Curb Extensions	295	3.98	50.85%	8.81%	16	Overall support for the concept. Some concerns with vehicles striking curbs / truck movements and potential removal of parking to accommodate.
Signal Operations	249	3.84	34.54%	6.02%	11	Concerns over drivers understanding FYA. Requests for additional sidewalks and bike lanes on Beverley.
Hawk	269	3.84	43.87%	11.15%	9	Support but participants are unfamiliar with this
Pavement Re-Purposing	260	3.66	40.00%	15.00%	31	Overall support for concept. Specific to Beverley Street, concerns of increased delay with a single lane (waiting for cars to parallel park). Requests to incorporate bike lane.
Bike Lanes	290	3.63	46.21%	16.90%	22	Split comments in support and with concerns of bike lanes. Several comments that marked lanes do not provide adequate protection for cyclists.
Cycle Track	266	3.53	43.98%	18.80%	12	Split comments in support and with concerns of cycle track. Several comments indicate that a physical barrier would be needed to safely implement the concept..
All Way Stop Control	269	3.45	30.11%	15.99%	18	Overall support for the concept, but concerns over vehicles obeying stop signs (intentionally and unintentionally due to distractive driving) and driver inability to properly navigate AWSC intersection. Concerns with bicycle progression with stop signs.
Roundabout	265	3.33	38.49%	26.04%	24	Split comments in support and with concerns of roundabout. Concerns that improvement type would not be context sensitive. Idea has more support at Bev/Jefferson than Augusta/Frederick.

6. CONCLUSION AND RECOMMENDATIONS

This City of Staunton 10 PSI Intersections Improvements STARS study identified the operational, safety, and multimodal needs at the study intersections. The study also evaluated potential mitigation measures and improvement alternatives to address those issues. Then, an evaluation matrix was developed for each study intersection where alternatives were compared for operational, safety, and multimodal benefits and implementation cost. Preferred alternatives were selected based on benefits and implementation cost to gain public feedback and pursue funding and implementation.

6.1. Funding Strategy

There are several funding sources or revenue sharing programs that can be pursued to fund the improvements identified in this study:

SMART SCALE

Virginia’s SMART SCALE Process facilitates selecting the right transportation projects for funding and ensuring the best use of limited tax dollars. It includes five overarching steps as depicted below

Per the SMART SCALE Technical Guide, 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. For projects in

the Staunton District, the scoring factors are Safety, Accessibility, Economic Development (25 percent), Congestion Mitigation (15 percent), and Environment (10 percent). Not all proposed improvements identified in this study are good candidate projects for SMART SCALE funding due to the scale and scope. Several of these projects can also be packaged into one SMART SCALE application to achieve a better project score and recognize cost savings associated with completing the projects concurrently.

Other funding sources

There are many other funding sources that can be combined or they can be the only funding sources. Most of the proposed improvements are low-cost improvements, which assumes that the City can find other funding sources than SMART SCALE, with some of improvements implemented by City forces. Other funding programs are listed below:

- Capital Improvement Program
- Community Development Block Grant
- Highway Safety Improvement Program (HSIP) and Other Safety Program Funds
- Revenue Sharing
- No anticipated ROW Impacts: Projects that require additional right-of-way are typically costly and are not preferred.

6.2. Final Recommendations

The study proposed multiple alternatives for each intersection to address the identified issues. Each of the alternatives was evaluated for safety, traffic operational, and multimodal improvements and implementation cost. The alternatives were then presented to the study team to review and develop a shortlist of the feasible alternatives to be presented to the public for feedback. The recommended alternatives were selected based on quantitative engineering benefits, study team review, and public feedback.

Overall, the preferred alternatives would provide an improved multimodal and safe environment throughout the Downtown Staunton area at the study intersections. This would be accomplished through reduced conflicts, smoothed operations, systemic upgrades, multimodal upgrades, and other strategies. Each improvement would make the best use of the transportation space available, balance users of the intersections, and implement the current best practices for accommodating vehicular, bicycle, and pedestrian traffic.

The preferred alternatives for each intersection are shown below in **Table 31**. The the details of each alternative presented in Chapter 4. The majority of the recommended alternatives are low cost and have short-term implementation schedules of less than a year.

Table 31 Summary of Preferred Alternatives

Recommended Alternative				
	Intersection	Alternative	Cost	Schedule
1	East Johnson Street & New Street	2- Multimodal Improvement	\$50,000	Less than a year
2	East Johnson Street & Augusta Street	2- Multimodal Improvement	\$150,000	Less than a year
3	East Johnson Street & Central Avenue	2- Multimodal Improvement	\$45,000	Less than a year
4	Frederick Street & Augusta Street	4- Cycle Track	\$100,000	Less than a year
5	West Beverley Street & New Street	1 - AWSC Travel Lane Repurposing	\$250,000	1 - 2 years
6	West Beverley Street & Augusta Street	2- Travel Lane Repurposing		
7	West Beverley Street & Lewis Street	1- Travel Lane Repurposing		
8	West Beverley Street & North Jefferson Street	2- Mini Roundabout	\$1,500,000	5 - 10 years
9	West Beverley Street & Hays Street	2- Full Access at Park Blvd	\$200,000	5 - 10 years
10	West Beverley Street & Grubert Street	1- Signal Operational Improvement	\$80,000	1 - 2 years

APPENDIX A: FRAMEWORK DOCUMENT

APPENDIX B: TRAFFIC COUNTS

APPENDIX C: COVID-19 TRAFFIC VOLUME ADJUSTMENT MEMO

APPENDIX D: COLLISION DIAGRAMS

APPENDIX E: SYNCHRO OUTPUT

APPENDIX F: SUMMARY SHEETS