City of Staunton 10 PSI Intersections Improvement Study

Staunton, Virginia

FINAL REPORT - DRAFT

January 2022

STARS VDOT

City of Staunton

10 PSI Intersections

Improvement Study

Final Report

January 2022

Prepared for

Virginia Department of Transportation

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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. PSIs indicate 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 study intersections downtown 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 (Staunton Capital Improvement Plan pg. 24). 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 study area.

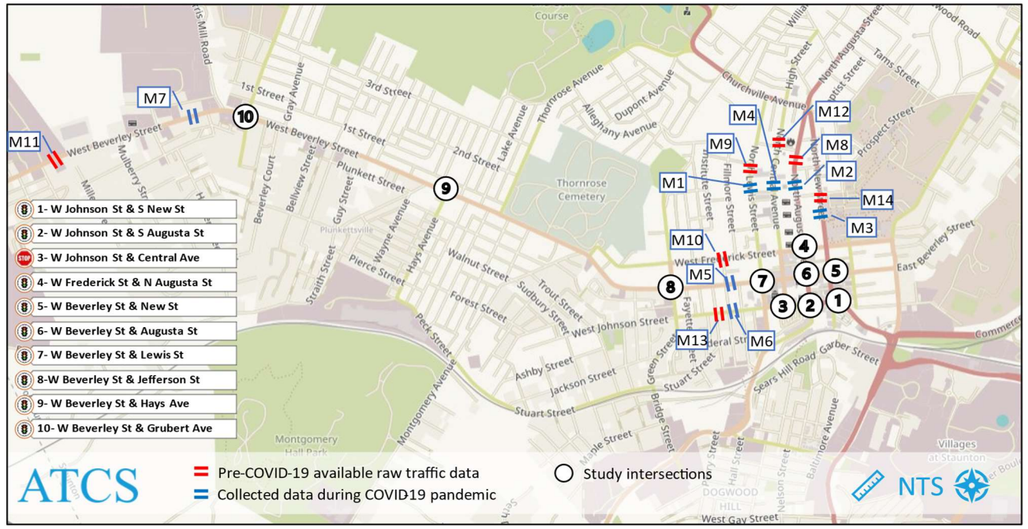

Figure 1. Study Area and Available Mid-Block Traffic Volume Counts

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 in the timeframe of traffic data collection (November 2020), overall volumes remained below typical levels. In order to ensure the collected data represents as close to normal conditions as possible, 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 traffic volume data collected from many count stations yearly. 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, as collected in the field for 15-minute intervals, at four locations collected in 2019. The during pandemic data from 2020 was collected at seven mid-block locations for 48 hours and two hours during 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 raw data, and ADT from mid-block counts collected during the pandemic to determine the overall difference in volume. Additionally, pre-pandemic design peak hours are calculated from multiplying AAWDT by K factors and directly calculated from raw data where available. These calculated design peak hour volumes are then compared to during pandemic peak hour data from 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 Error! Reference source not found.

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 peak period and PM peak period. 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 existing year 2020 and design year 2035.

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

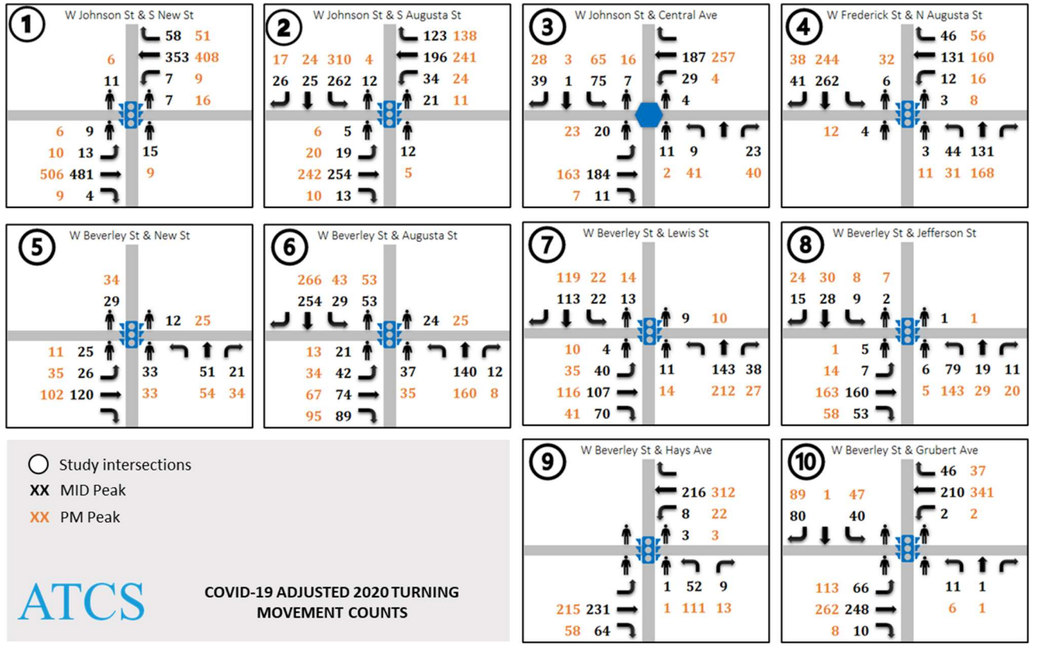

Figure 2. 2020 COVID-19 Adjusted Turning Movement Counts

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 future Year 2035, 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 areas and no significant redevelopments are planned. Therefore, they suggested that a linear annual growth rate of 0.5% would be 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. S New Street is a one-way street northbound, north of the intersection, and southbound, south of the intersection. There are crosswalks along all four legs 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.

The intersection level of service (LOS), delays, and queue lengths are shown in Error! Reference source not found.

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

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 1 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 along all four legs of the intersection with ramps at all corners of the intersection. Sidewalks are present along both sides of West Johnson Street and Augusta Street.

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

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Figure 4. Aerial of West Johnson St and Augusta St

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 1 left turn lane and 1 shared through/right turn lane along westbound Johnson Street, 1 shared left turn/through/right turn lane along eastbound Johnson Street, and 1 left turn lane and 1 right turn lane along southbound Central Avenue. The entrance to the Wharf parking lot is located to the southeast of this intersection. There are crosswalks along the north and west legs 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.

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

Figure 5. Aerial of West Johnson St and Central Ave

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**, Fredrick Street (VA 254) is a two-lane one-way westbound street that consists of 1 shared left turn/through lane and 1 through/right turn lane. Augusta Street consists of 1 left turn lane and 1 shared through/right turn lane northbound and 1 through lane and 1 right turn lane southbound. Fredrick 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 (US 250/US 11 Business) has street parking within its northern leg in both directions. Augusta Street's southbound approach has a raised median divider separating southbound through and southbound right turn lanes. There are crosswalks along all four legs 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 Fredrick 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	7.7	A	45	8.2	A	57
		NBR						
	North Augusta Street	SBL	24.6	C	157	22.5	C	129
		SBT						
		SBR	0.4	A	0	0.4	A	0
	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 (VA 254) 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 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.

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

Figure 7. Study Intersections along Beverley Street

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	7.8	A	28	12.5	B	30
		EBT						
		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	23.6	C	115	24.3	C	126
		NBT						
		NBR						
	Augusta Street	SBL	9.4	A	16	9.5	A	21
		SBT	12.1	B	112	11.9	B	116
		SBR						
	West Beverley Street	EBL	18.0	B	60	18.9	B	61
		EBT						
		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	18.8	B	99	23.4	C	141
		NBT						
		NBR						
	Lewis Street	SBL	5.3	A	9	7.9	A	12
		SBT	5.6	A	35	8.5	A	49
		SBR						
	West Beverley Street	EBL	18.9	B	55	16.2	B	51
		EBT						
		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 1 shared left-turn/through/right turn lane along eastbound West Beverley Street and northbound and southbound Jefferson Street. There are crosswalks along all four legs of the intersection with ramps at all corners of the intersection. Sidewalks are present along both sides of West Beverley Street and Jefferson Street.

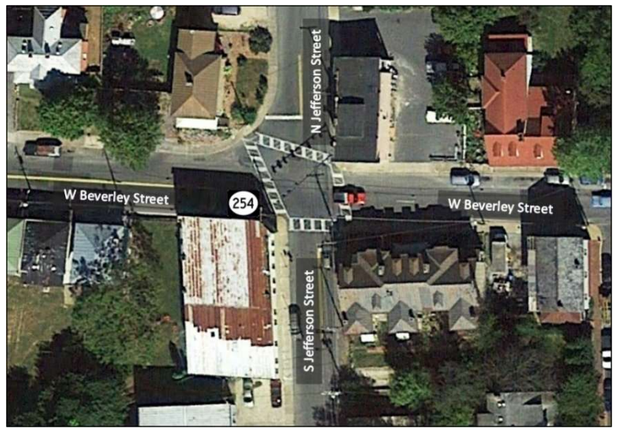

Figure 8. Aerial of West Beverley St and Jefferson St

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 all the way to Downtown Staunton and ends at South Coalter Street (past Downtown). The area surrounding this intersection is mostly residential, with a few local businesses. There is street parking along with 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 1 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 leg of the intersection. Sidewalks are present along both sides of West Beverley Street and Hays Avenue.

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

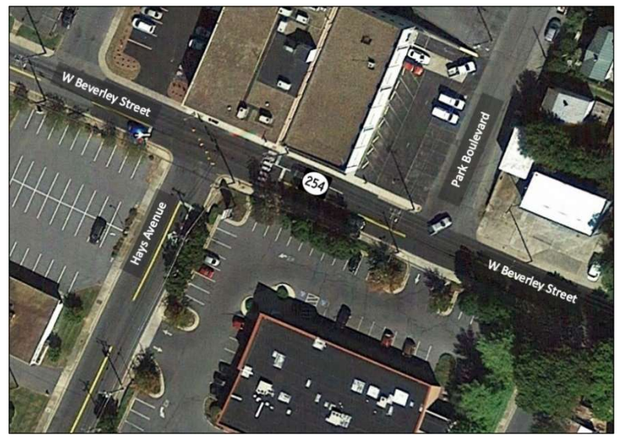

Figure 9. Aerial of West Beverley St and Hays Ave

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 1 left turn, 1 through, and 1 right turn lane along eastbound Beverley Street, 1 left turn lane and 1 shared through/right turn lane along westbound Beverley Street, and 1 shared left turn/through/right turn lane along northbound and southbound Grubert Avenue. There is a crosswalk along the north leg 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	8.8	A	171	10.2	B	196
		EBR	0	A	0	0	A	0
	West Beverley Street	WBL	35.0	C	8	38.0	D	8
		WBT	15.0	B	194	21.7	C	330
		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 and FR-300 crash reports 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.

The crash data was evaluated to identify crash locations and patterns, the severity of crashes, and likely causes for crashes. 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 Johnson Street and New Street had a total of 28 crashes from January 2013 to the end of October 2020, in which 22 crashes occurred between 2015 and 2019. **Figure 11** shows the number of crashes per year.

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 12** 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

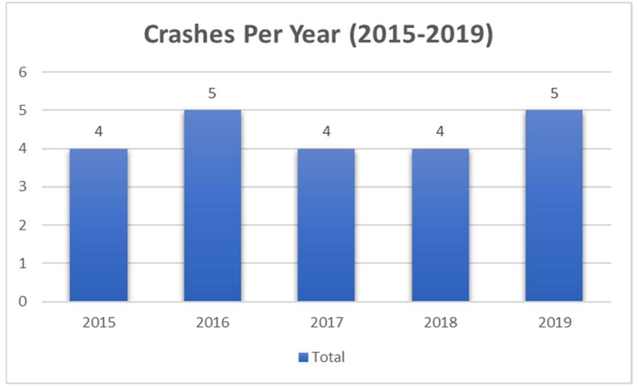

Figure 11. Number of Crashes Per Year for W Johnson St at S New St

intersection. And 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 is 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.

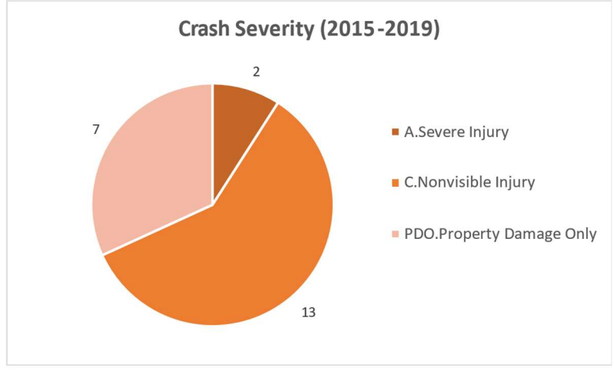

Figure 13 Crash Severity for W Johnson St at S New St

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 signpost. 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 leg 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.

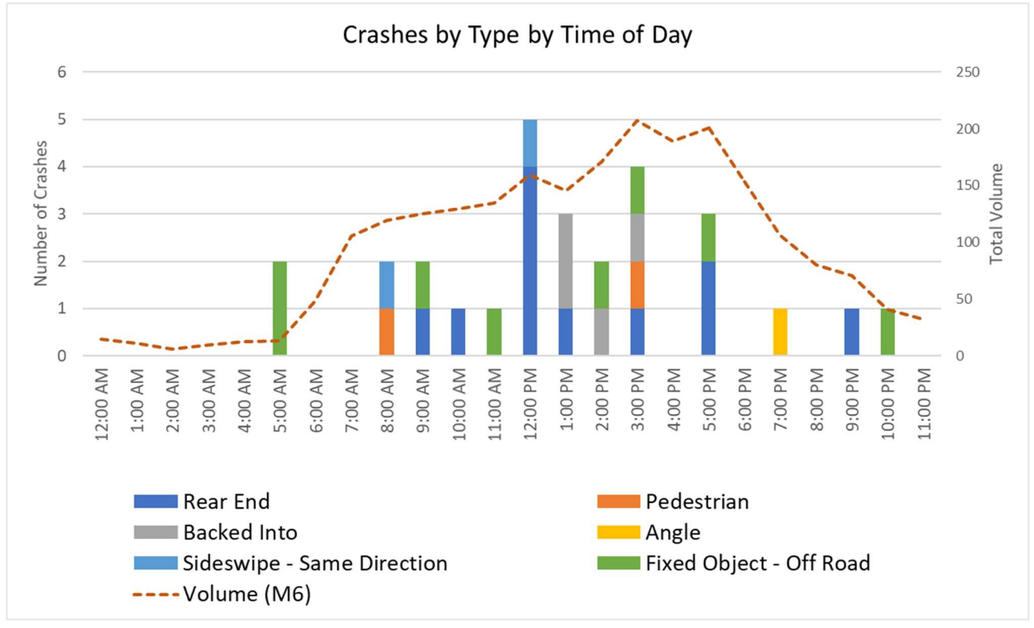

Figure 12 Crash Type Per Time of The Day for W Johnson St at S New St

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 it is 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 is pedestrian signal at all four side of the intersection. Currently, they are not programmed to reservice modes its 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.**

Out of the 17 crashes, 9 (53%) have resulted in an injury with a severe injury crash. **Figure 16** shows the crash severity for crashes between 2015 and 2019.

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 remaining half of rear-end crashes occurred at the eastbound and westbound receiving lanes.

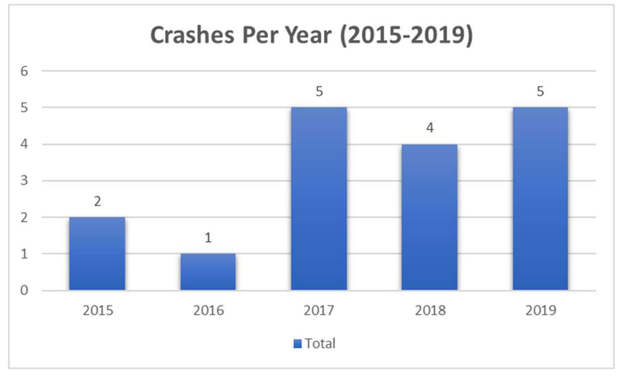

Figure 15 Total Crashes Per Year for W Johnson St at Augusta St

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.

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.

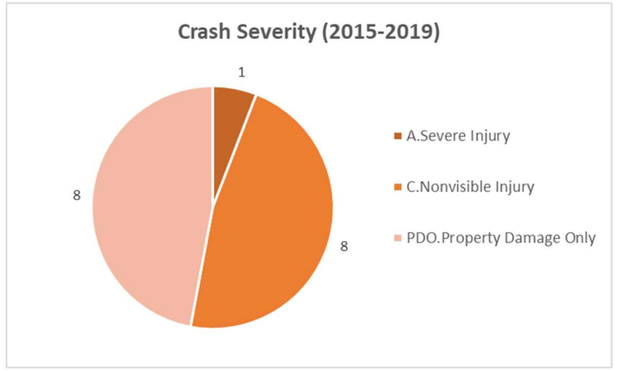

Figure 16 Crash Severity for W Johnson St at Augusta St

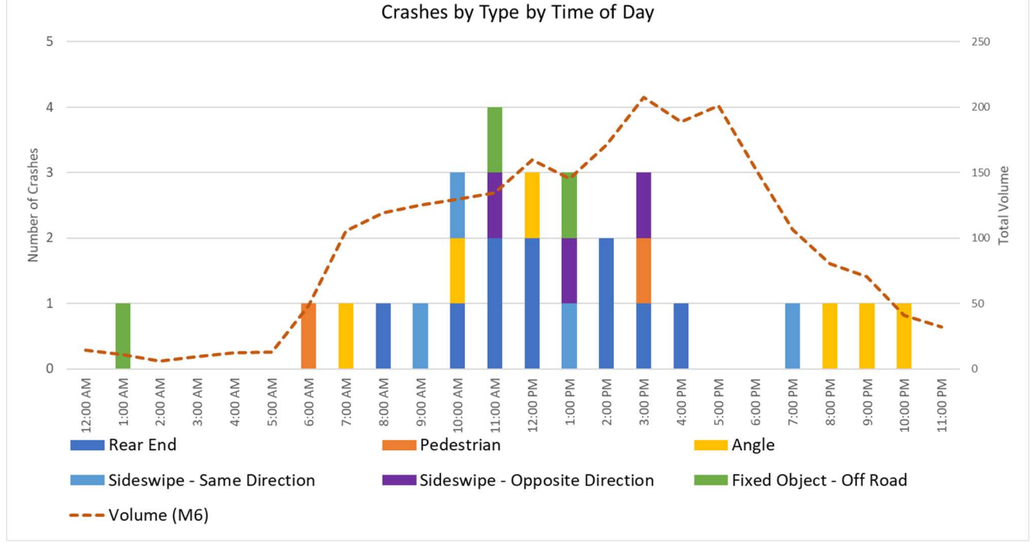

Figure 17 Crash Type Per Time of The Day for W Johnson St at Augusta St

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

From the site visit observation following points were noted:

- 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 is no pedestrian signal.
- There are no bike facilities.
- There is no crosswalk marking; instead, the crosswalk area is separated by brick pavers surface.
- Both eastbound and westbound left-turn movements have a five-section signal head, and they operate as protected/permissive phases.

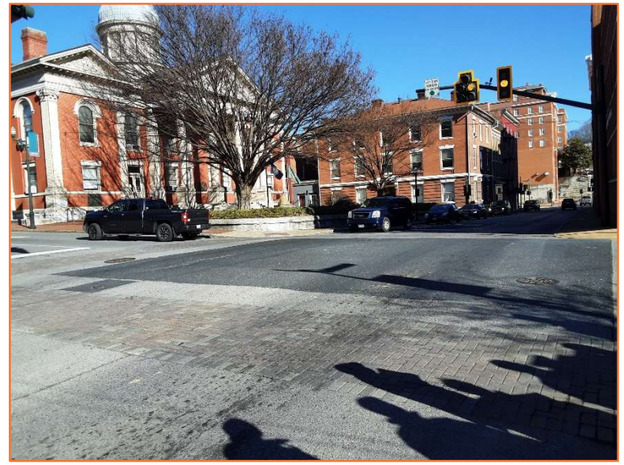

Figure 18 Site Visit Photo of W Johnson St at Augusta St

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 parking in the northwest quadrant of the intersection failed to yield to a westbound vehicle. The vehicle leaving the parking lot was trying to turn southbound right onto West Johnson Street.

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

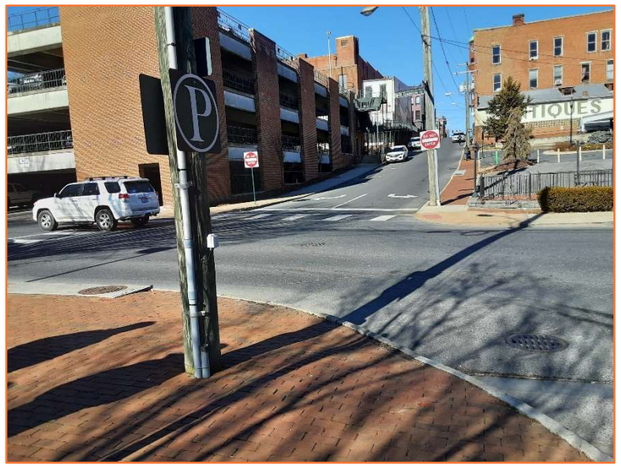

Figure 19 Site Visit Photo of W Johnson St at Central Ave

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

The intersection of West Fredrick Street and Augusta Street had 20 crashes from January 2013 to the end of October 2020. Looking at the average crashes per year, it is lower than four crashes. **Figure 20** shows the total crashes per year from 2015 to 2019.

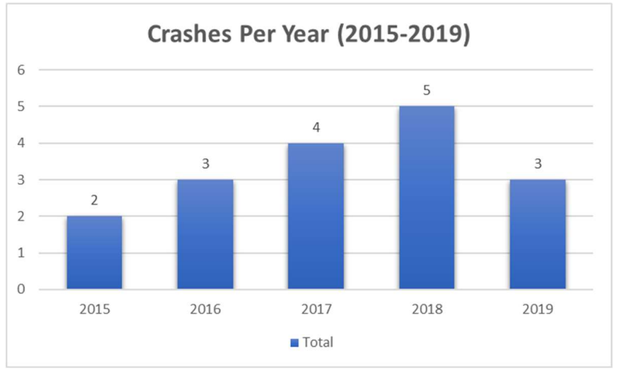

Figure 20 Total Crashes Per Year for W Fredrick St at Augusta St

Most crashes fall into injury crash severity group (65%), with one Severe Injury. See **Figure 21** for crash severity groups for crashes from 2015 to 2019.

The most common type of crash was angle crashes (8 total crashes). Three angle crashes occurred between the southbound and westbound movements through the intersections. 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 traveling southbound through and northbound and westbound left-turning movements. In both crashes, the FR-300 report stated 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.

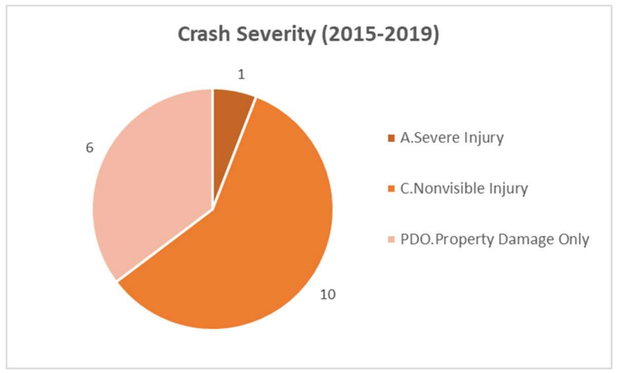

Figure 21 Crash Severity for W Fredrick St at Augusta St

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).

In the northern leg, there were two crashes where vehicles backed into another vehicle, one of which involved a vehicle was trying to back into a parking spot, while the other involved a vehicle that was leaving and backed into another vehicle.

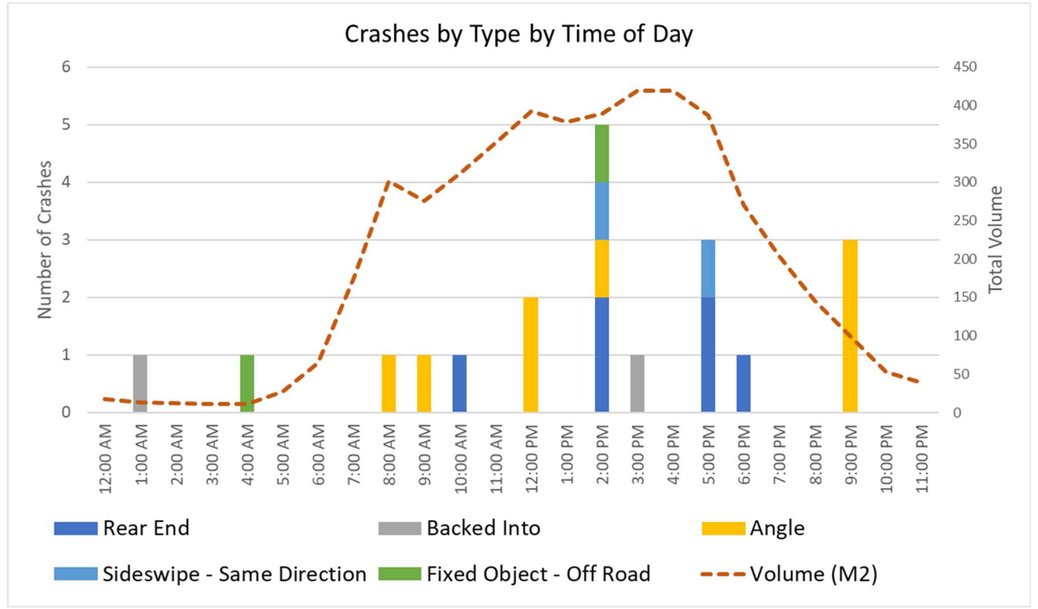

Figure 22 Crash Type Per Time of The Day for W Fredrick St at Augusta St

Figure 22 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.

3.3.4.1. Field Review

The site visit highlighted the following needs to be evaluated:

- Pedestrian curb ramps are not up to ADA requirements.
- There is no pedestrian signal.
- There is no crosswalk marking; 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.

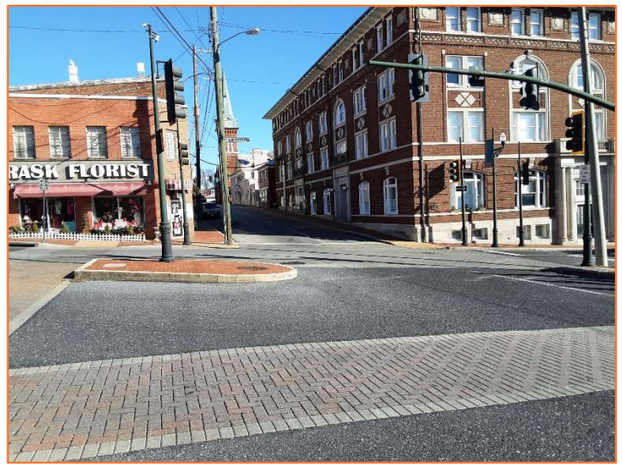

Figure 23 Site Visit Photo of W Fredrick St at Augusta St

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. Looking at the total number of crashes per year, there was only one crash in 2015 and 2016. However, after 2016 number of crashes increased to four to three crashes, as shown in **Figure 25**.

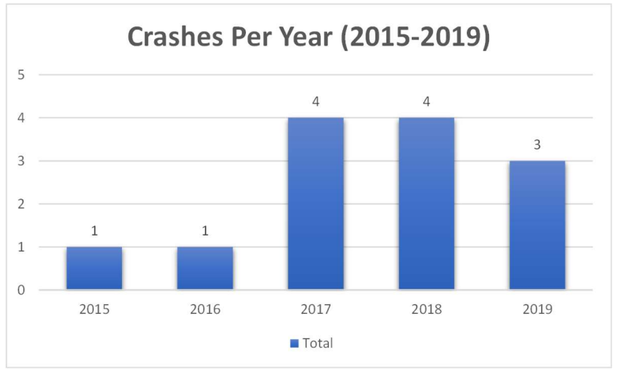

Figure 25 Total Crashes Per Year for W Beverley St at New St

More than half of the crashes that happened between 2015 and 2019 were resulted in injury crashes. See **Figure 26** for the summary of crash severity between 2015 and 2019.

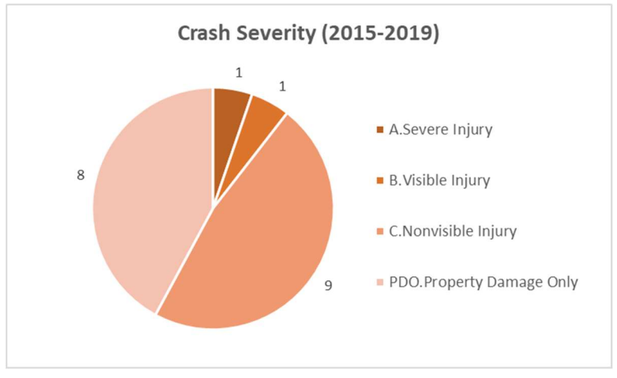

Figure 26 Crash Severity for W Beverley St at New St

The most predominant type of crash was angle crashes (9 crashes). Eight of the nine angle crashes occurred between eastbound and northbound through movement. 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. **Figure 24** shows that most of the angle crashes occurred during non-peak hours, and a total of six crashes occurred during the night, five of which were angle crashes.

This intersection also had seven same-direction sideswipe crashes. Three of these crashes occurred in the northbound approach. The FR-300 report stated that vehicles turning right hit a legally parked vehicle on the left side of S 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.

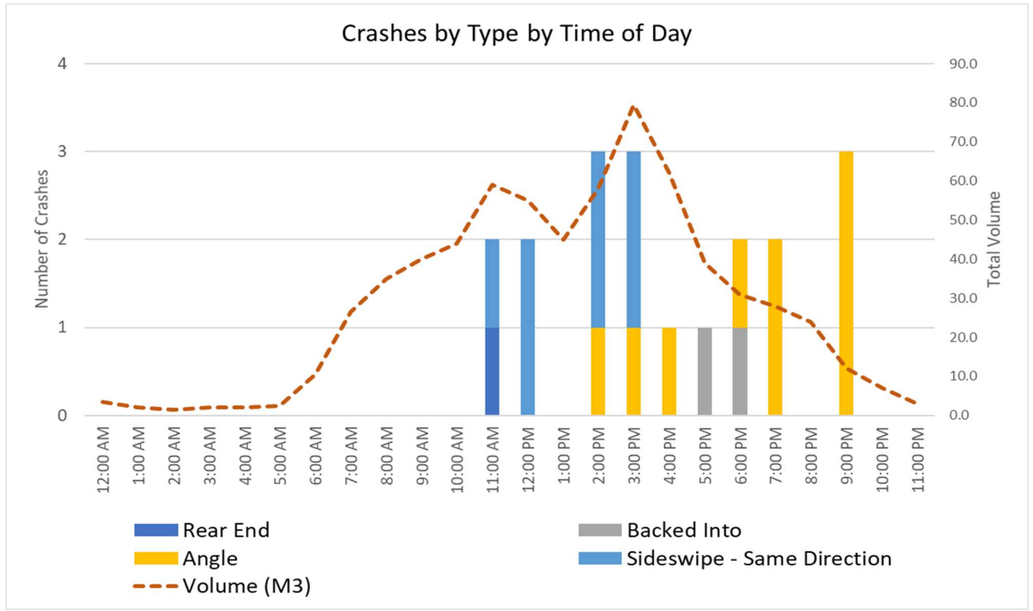

Figure 24 Crash Type Per Time of The Day for W Beverley St at New St

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 are not up to 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 is no crosswalk marking; instead, the crosswalk area is separated by brick pavers surface.
- There is no pedestrian signal.
- There are no bike facilities.

A parking spot is right at the northbound stop bar, which creates unsafe conflict points within the intersection area.

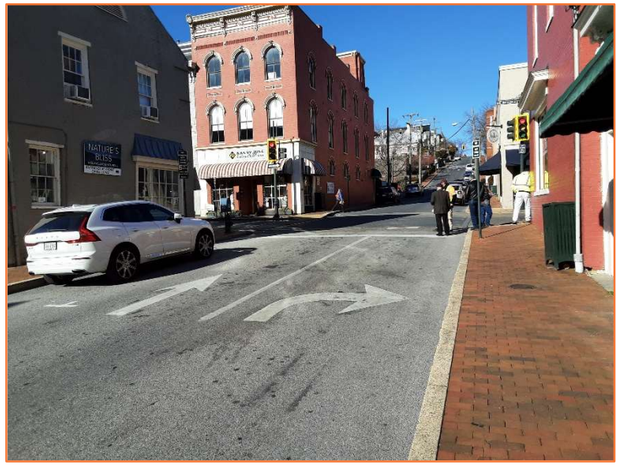

Figure 27 Site Visit Photo of W Beverley St at New St

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 28**, the total crashes per year distribution between 2015 and 2019 shows that 2017 had the highest number of crashes with nine crashes.

Of the 26 total crashes between 2015 and 2019, 21 crashes (81%) resulted in injuries. **Figure 29** shows the crash severity categories for the total crashes between 2015 and 2019.

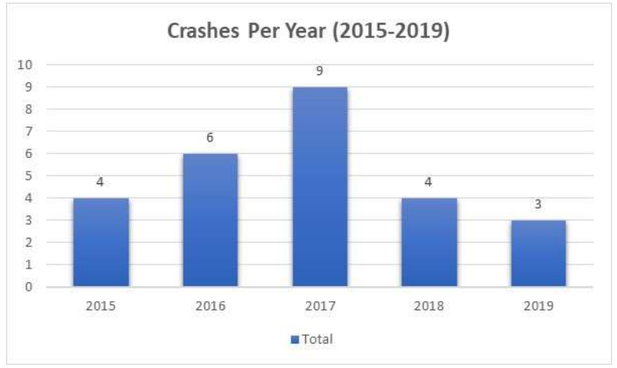

Figure 28 Total Crashes Per Year for W Beverley St at Augusta St

Angle crashes were the most common crash type. Nine of the 17 angle crashes occurred between the southbound through and eastbound through movement. The FR-300 report stated that drivers disregarded the traffic signal and ran the red light in all the crashes. 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.

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.

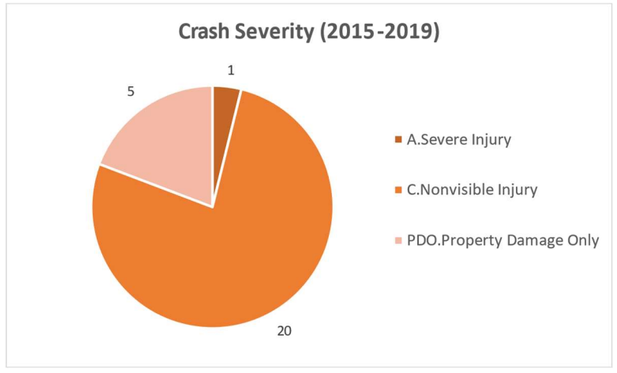

Figure 29 Crash Severity for W Beverley St at Augusta St

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 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.

The crashes occurred throughout the day and night, which shows no clear trend by the time of the day or traffic volume peaks. **Figure 30** shows collision type by time of the day and traffic volume distribution at the M2 counting location.

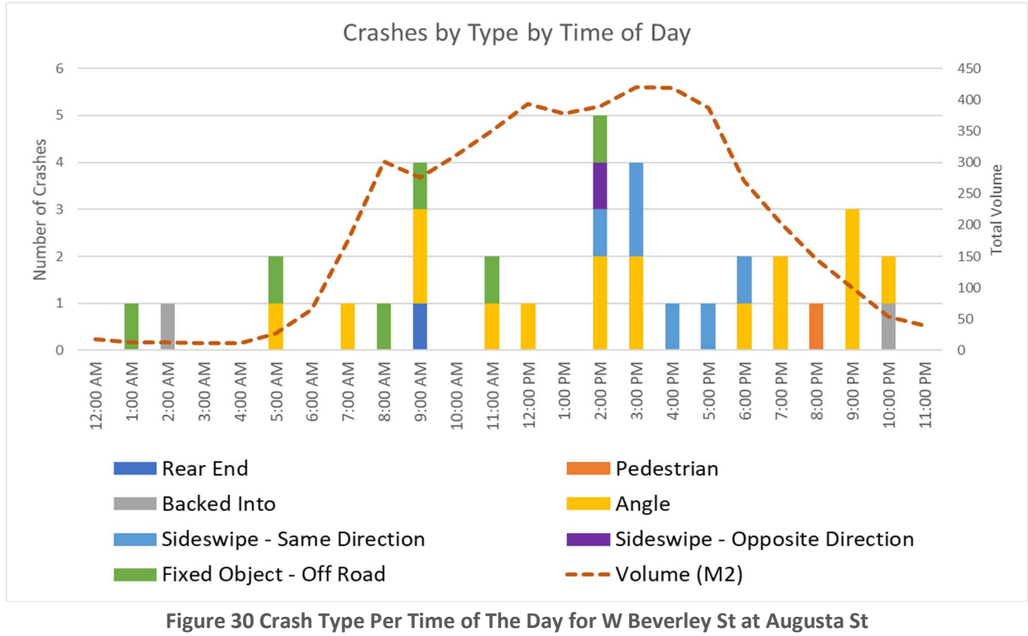

Figure 30 Crash Type Per Time of The Day for W Beverley St at Augusta St

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 are not up to ADA requirements.
- There is no crosswalk marking; instead, the crosswalk area is separated by brick pavers surface.
- There is no pedestrian signal.
- There are no bike facilities.

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

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.

The majority of the crashes are 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** shows crash severity categories for total crashes between 2015 and 2019.

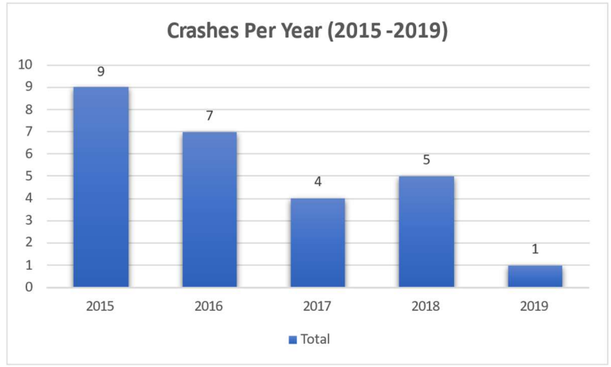

Figure 32 Total Crashes Per Year for W Beverley St at Lewis St

This intersection had the highest number of recorded crashes out of all ten study intersections. Beverley Street is a one-way eastbound street at this intersection, and Lewis Street is a two-way street northbound and southbound. The intersection had a total of 37 angle crashes (88% of total) over a span of eight years. The highest of the crashes frequency occurred during the morning period. Even though the PM traffic volume peak is higher, the crash frequency during the PM peak is lower than the AM peak. **Figure 34** shows the total crashes by collision type by the time of the day and traffic volumes at counting location M5.

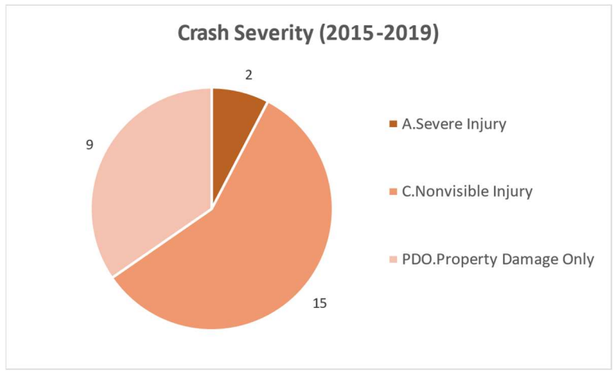

Figure 33 Crash Severity for W Beverley St at Lewis St

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 crashes, six happened in wet weather, and one happened in snowy conditions. For all 19 angle crashes, the FR-300 reports stated that in eight of the 19 crashes, the vehicle from the southbound approach ran the red light, and in the remaining 11 crashes, the vehicle from the eastbound approach ran the red light. 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 crosswalk.

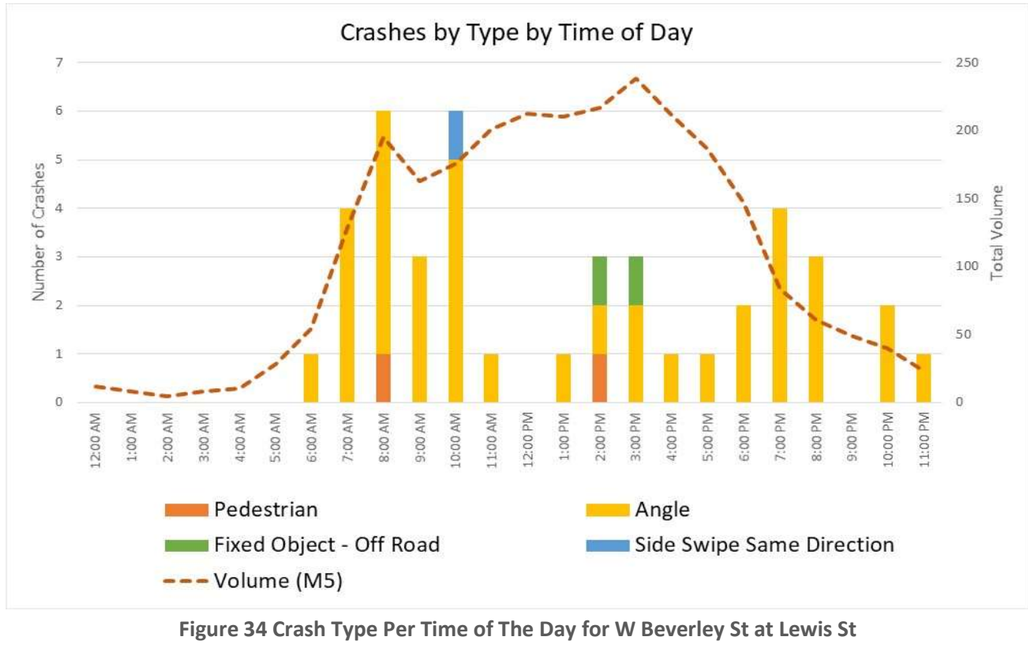

Figure 34 Crash Type Per Time of The Day for W Beverley St at Lewis St

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 is no pedestrian signal.
- Curb ramps are not up to ADA standards.
- Regulatory sign (No Turn on Red) is not MUTCD compliant.
- There are marked crosswalk on three side of the intersection (North, South, West) and the eastside has pavers instead of marking.
- Evaluating the need for southbound left-turn lane.

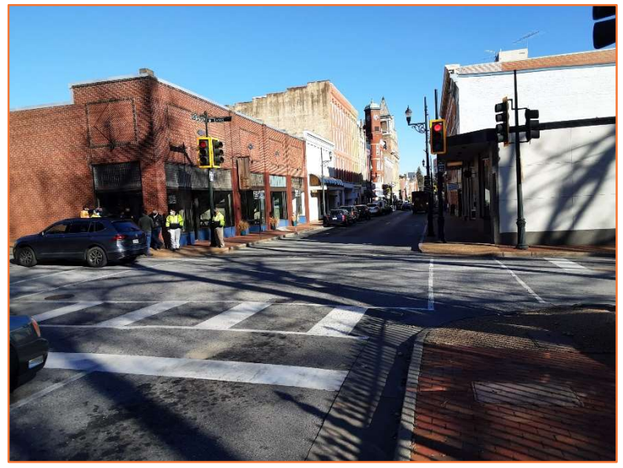

Figure 35 Site Visit Photo of W Beverley St at Lewis St

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. Looking at the recent five years of crash history, the number of crashes goes down from four crashes in 2016 to zero crashes in 2019. **Figure 36** shows the total number of crashes per year from 2015 to 2019.

Crash severity shows that are injury crashes with one of them was a severe injury, resulted from an angle crash between an eastbound through and northbound left-turn movement. **Figure 37** summarizes crash severity during the 2015 to 2019 time period.

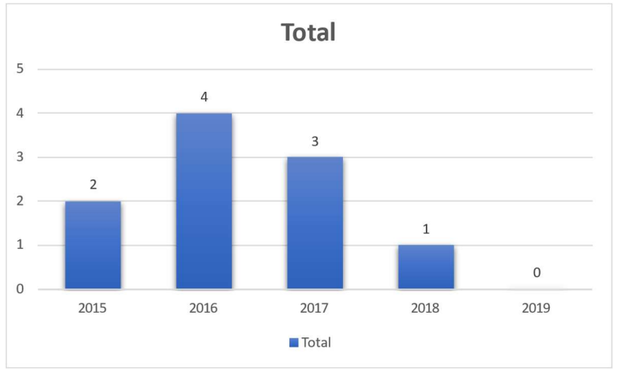

Figure 36 Total Crashes Per Year for W Beverley St at Jefferson St

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

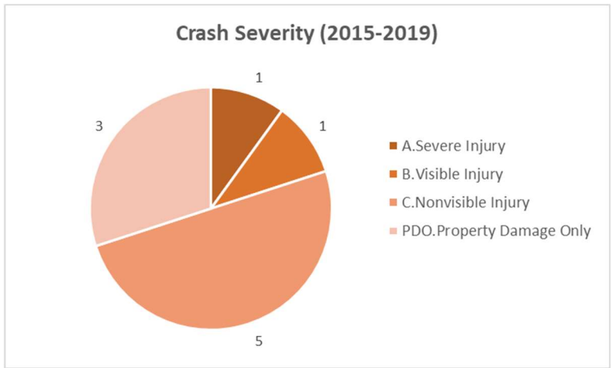

Figure 37 Crash Severity for W Beverley St at Jefferson St

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 vehicle turning northbound left. 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 the traffic signal. There were also two rear-end crashes and four same-direction sideswipe crashes. Which occurred randomly throughout the day; no time of the day related trends were 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.

Figure 38 shows the total number of crashes by collision type and time of the day with traffic volume at the M5 counting location. Generally, the crashes occurred throughout the day. The highest crash frequency period

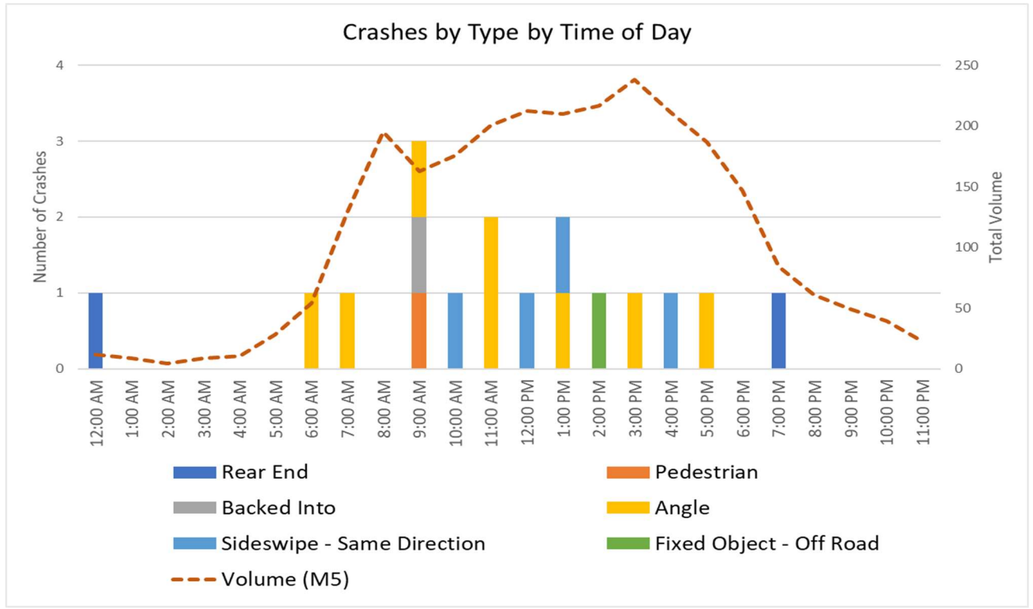

Figure 38 Crash Type Per Time of The Day for W Beverley St at Jefferson St

is 9:00 am, in which three crashes occurred. The graph shows no clear relations between traffic volume peak hour and crash frequency.

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 are not up to ADA standards.
- There is no pedestrian signal.
- There are marked crosswalk at side of the intersection.
- Evaluation of traffic signal need.
- Geometrical improvement to shortening pedestrian crossing distance.

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

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. 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 40** shows the total number of crashes per year for the most recent five years of available data.

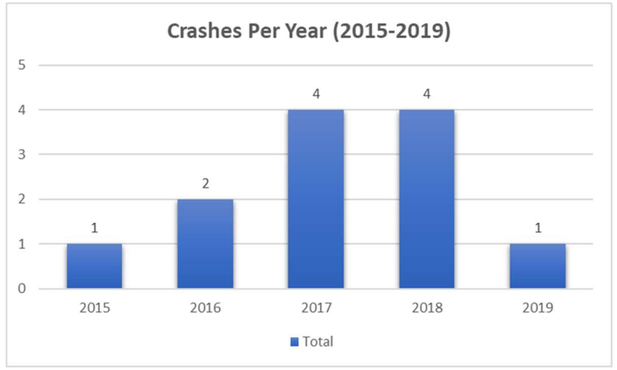

Figure 40 Total Crashes Per Year for W Beverley St at Hays Ave

Figure 41 shows the crash severity categories for crashes that occurred between 2015 and 2019, which shows 10 out of the 12 (83%) crashes have resulted in Nonvisible Injury crashes.

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 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.

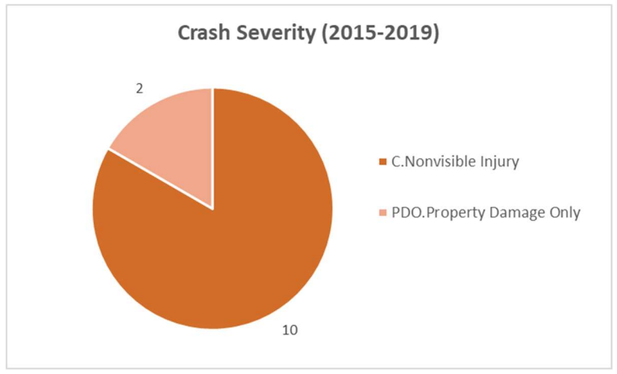

Figure 41 Crash Severity for W Beverley St at Hays Ave

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.

Figure 42 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 to 7:00 pm, with no defined patterns. Furthermore, the crash frequencies show no direct connection to traffic volume peak hours.

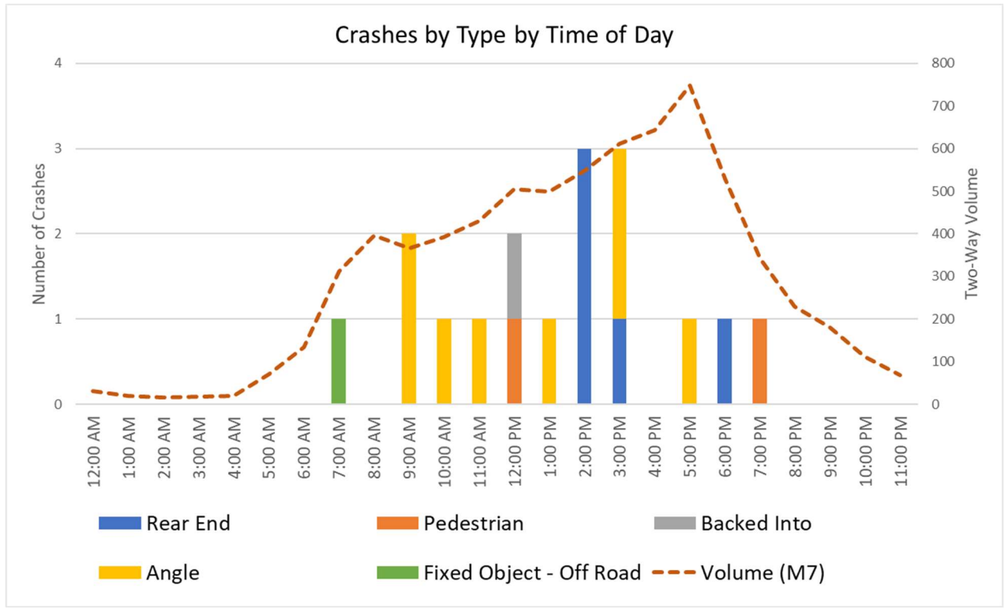

Figure 42 Crash Type Per Time of The Day for W Beverley St at Hays Ave

3.3.9.1. Field Review

The site visit observations were noted as follow:

- There is no pedestrian signal and no pedestrian crossing on the Hays Avenue approach.
- Curb ramps are not up to ADA requirements.
- Hays Avenue stop bar is far back from the intersection.
- 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 30 plus years old and has limitation 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 increased in the past five years from two crashes in 2015 to four crashes in 2019 as shown in **Figure 44.**

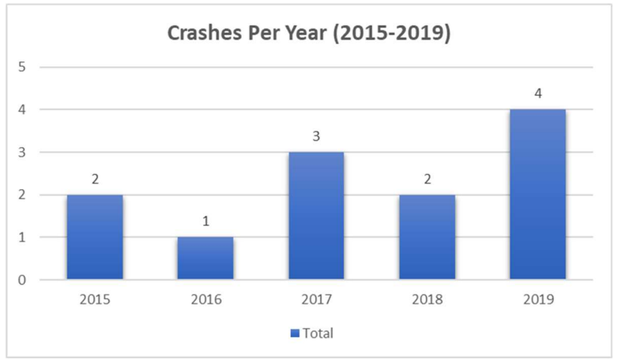

Figure 44 Total Crashes Per Year for W Beverley St at Grubert Ave

Figure 45 shows the severity categories for crashes that occurred between 2015 to 2019. Most of the crashes resulted in injury crashes with one of them being a severe injury.

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.

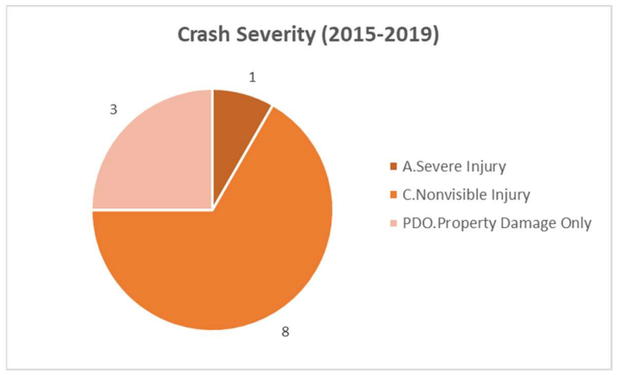

Figure 45 Crash Severity for W Beverley St at Grubert Ave

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 46 shows the total number of crashes by collision type and time of the day with traffic volumes at the M7 counting location. 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.

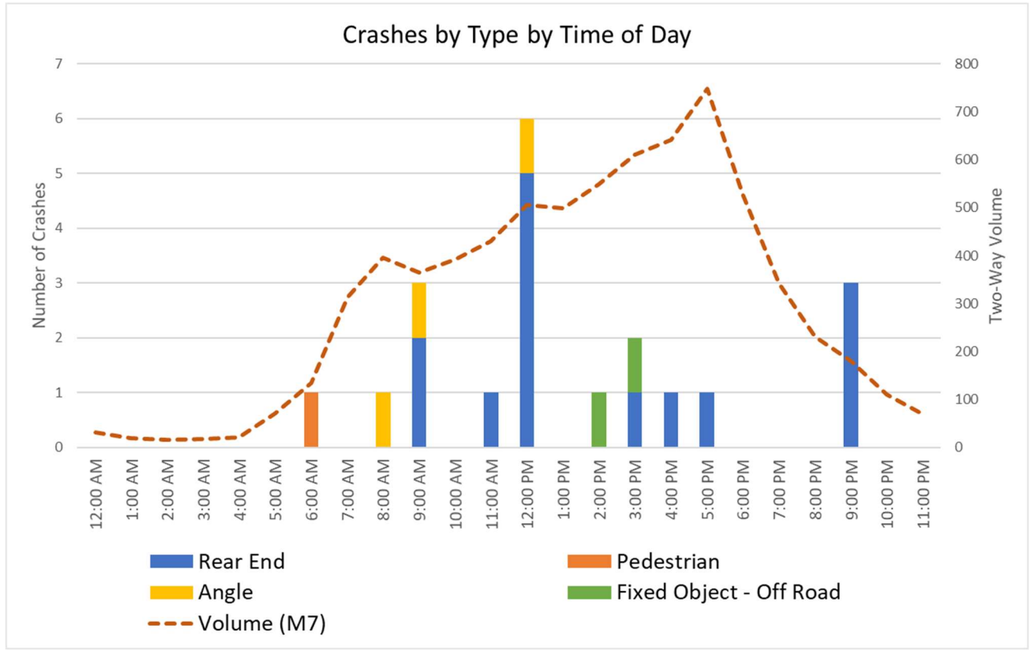

Figure 46 Crash Type Per Time of The Day for W Beverley St at Grubert Ave

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, No-Build Conditions analyses, field observation, 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 impact. The quantitative analysis was performed for improvements such as proposing a new intersection control system, adding/reconfiguring turn lanes, and signal phasing operation changes. And for the improvements that quantitative analysis was not applicable, a qualitative assessment was performed, 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, as each group's implementation strategy varies, which creates a significant difference in cost estimates. Group one estimates are developed using quantity take-off and industry knowledge using 2022 costs, assuming the city forces will implement the improvements. Group two estimates are 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, and 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 are 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 the ADA requirements
2. Upgrading crosswalks to high visibility crosswalks
3. Adding pedestrian signals at signalized intersections where not present
4. Adding white edge line marking as border to the existing brick paver crosswalks

Additionally, count data and 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 of 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 In 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 vehicles 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 a year to complete. A concept sketch of this alternative is shown in **Figure 50**.

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 a converting the traffic signal to a HAWK signal which vehicles will stop only when the pedestrian phase activated this will allow a diagonal crossing to accommodate the high number of pedestrians. With this alternative eastbound and westbound left-turn movements will 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 City forces implement it and most of the existing signal structure/equipment will be used. And it has a short-term schedule of less than a year to complete. A concept sketch of this alternative is shown in Error! Reference source not found..

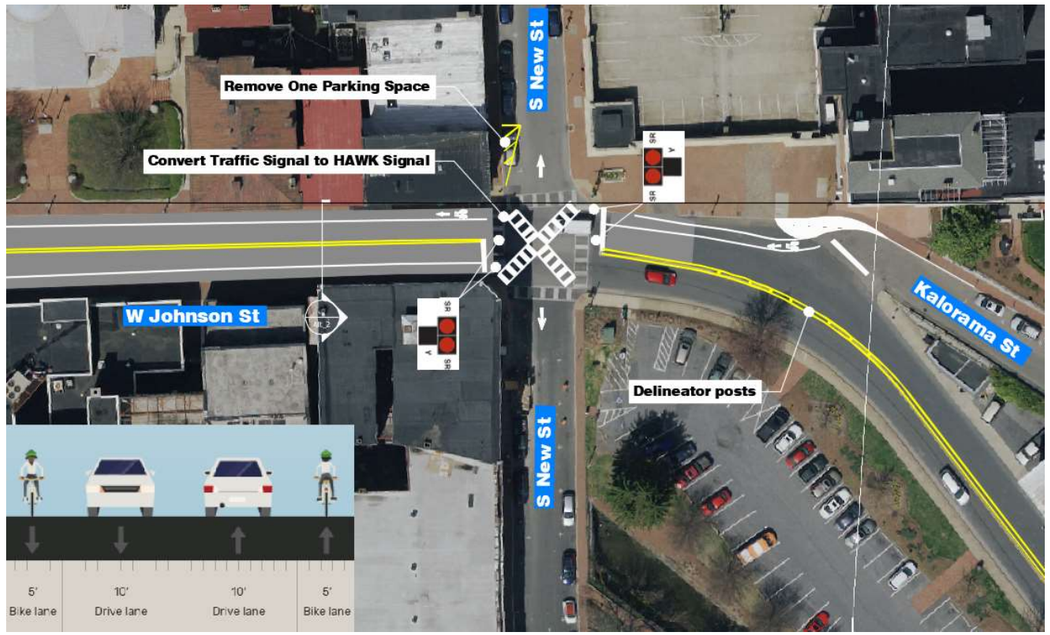

Figure 49 Alternative 2 Concept Sketch

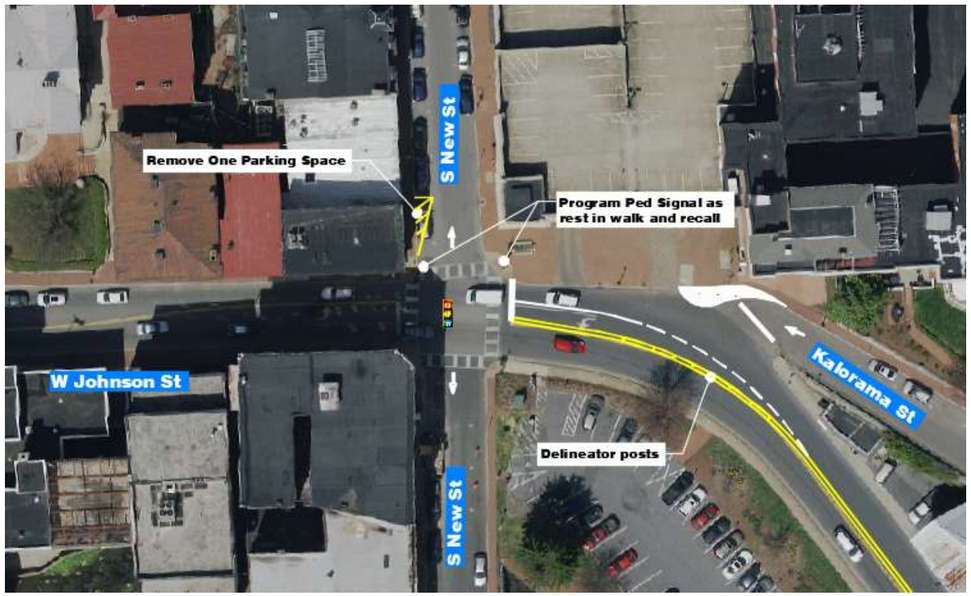

Figure 50: Alternative 1 Concept Sketch

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 a year to complete, and will be implemented by City forces.
- **Alternative 2:** This alternative also has a low-cost estimate of $50,000 and a short-term schedule of less than a year to complete, which City forces could implement.

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

All the 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 Error! Reference source not found..

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

Augusta Street and Johnson Street's 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

.

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 N Central Avenue and Augusta Street. Reconfiguring Augusta Street to a single lane approach and receiving lane allows a wider turning radius for 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**.

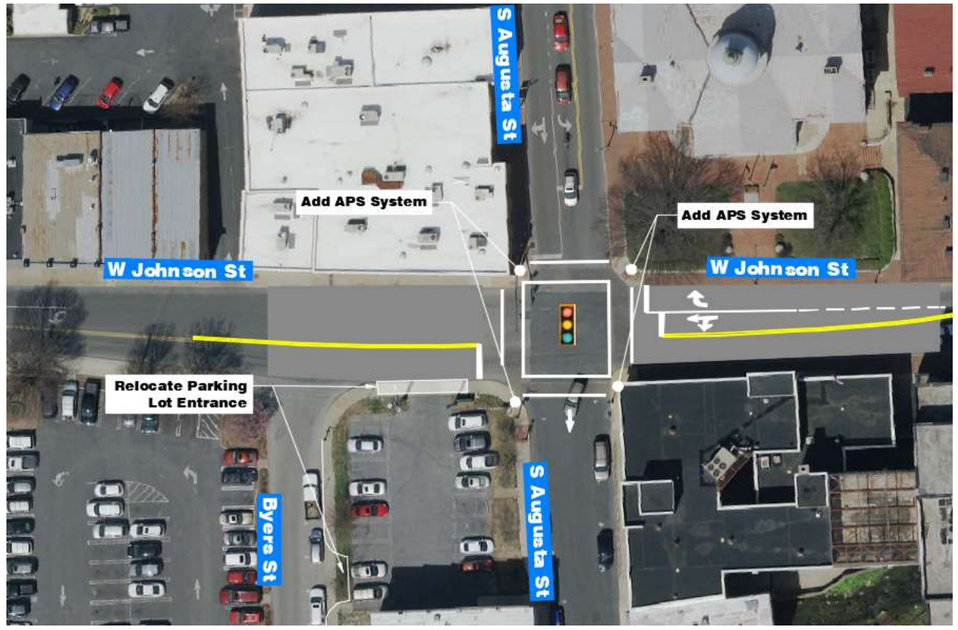

Figure 51 Alternative 1 Concept Sketch

Figure 52 Alternative 2 Concept Sketch

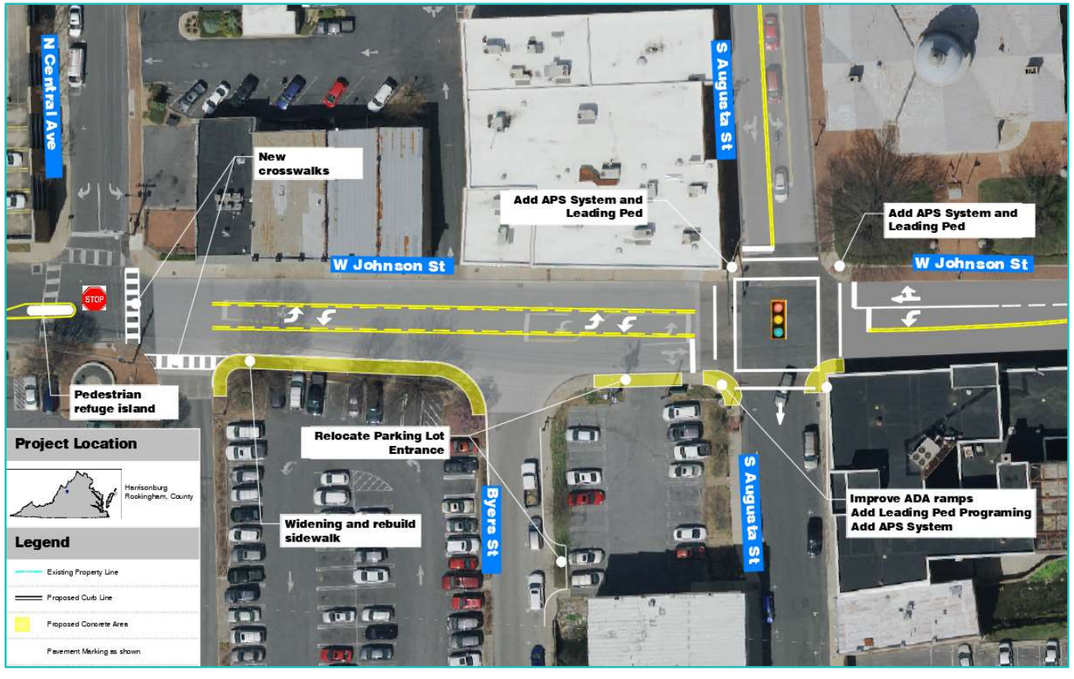

Figure 53. Alternative 3 Concept Sketch

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 similarly.
- **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			
		SBR												
	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									
		EBR												
	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 and 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 along Johnson Street and the sidewalks along Johnson Street would be rebuilt and widened. 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 primary issues identified in the existing conditions analysis. There are three alternatives developed and they 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 would be adding a pedestrian refuge island 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 and add one across the Parking Lot Entrance to 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 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 a continuation of the bike lane proposed in Alternative 2 of 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

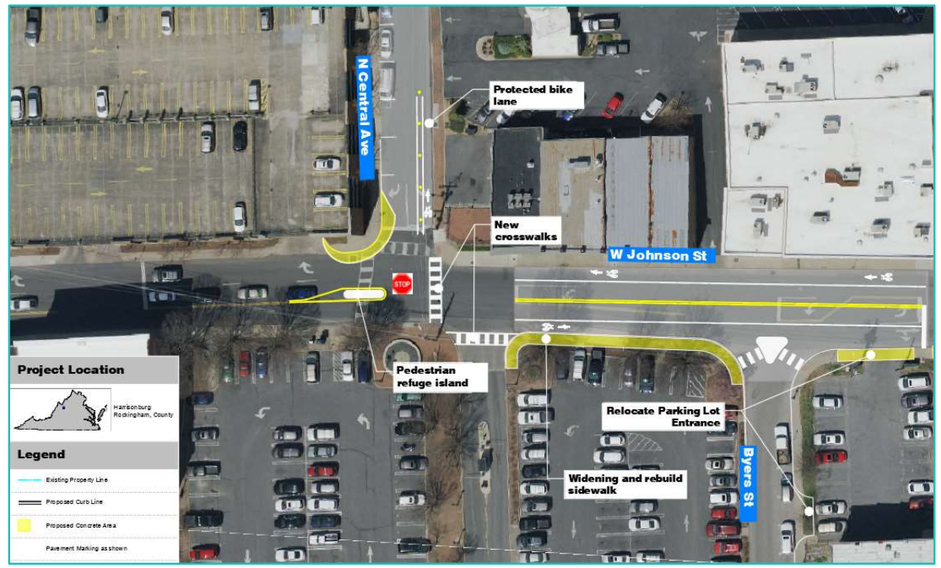

Figure 55. Alternative 2 Concept Sketch

4.11.3.1. Traffic Operations

Alternatve 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 asuming it be implemented by city forces including engineering, and 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, and will be implemented by City forces.

4.11.3.5. Recommendation

The proposed alternatives focused on safety and multimodal improvement, as they were primary issues identified in the existing conditions analysis. There are two alternatives developed and they 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 southbound right turn radius from Augusta Street to Fredrick Street would be reduced due to the bulb out. 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 a 3-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 operations conditions. 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 city expand on this concpt and potentially can be etended from Lewis Street to Coalter Street. It has to be noted, this alternative will not provide much benefits to the study intersection but it can be combined with Alernative 1. Additionally, traffic signal modifications will be required to accommodate the cycke track. A concept sketch of this alternative is shown in **Figure 59**.

Figure 56. Alternative 1 Concept Sketch

Figure 57. Alternative 2 Concept Sketch

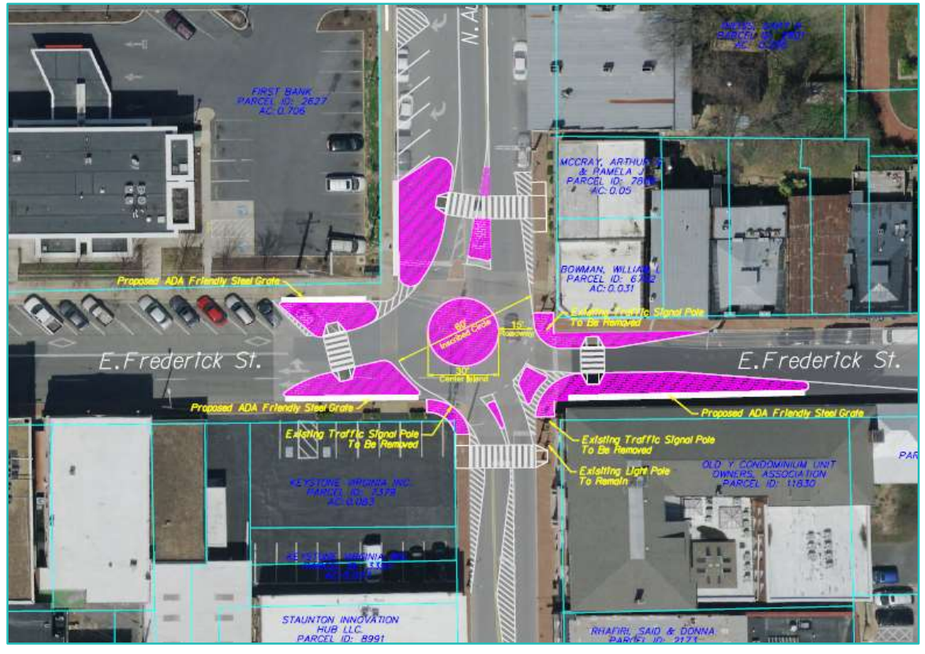

Figure 58. Alternative 3 Concept Sketch

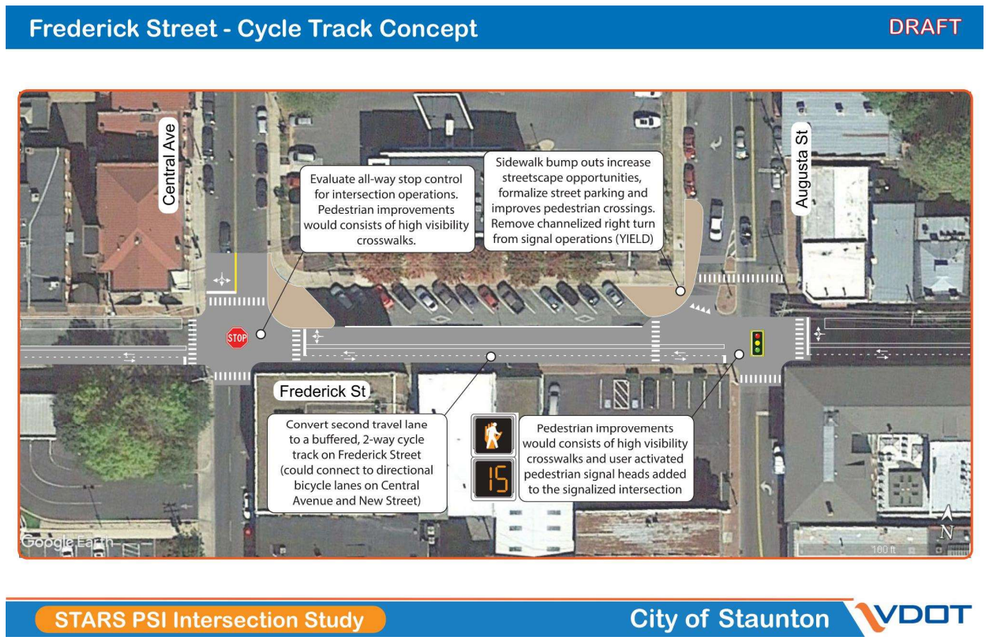

Figure 59. Cycle Track Concept for Frederick Street

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 a 3-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 improve conditions 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

There are three alternatives developed, and they were evaluated for traffic operations, safety, multimodal improvements. The proposed alternatives focused on safety and multimodal improvement, as they were 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 Beverley Street from Lewis Street to New Street from the existing two-lane eastbound street to a single lane eastbound 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 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 level of improvements and specific concepts, there could be lower and higher cost versions pending final designs and preference. The current cost estimate assumes a lower cost option based on pavement marking and minor concrete work.

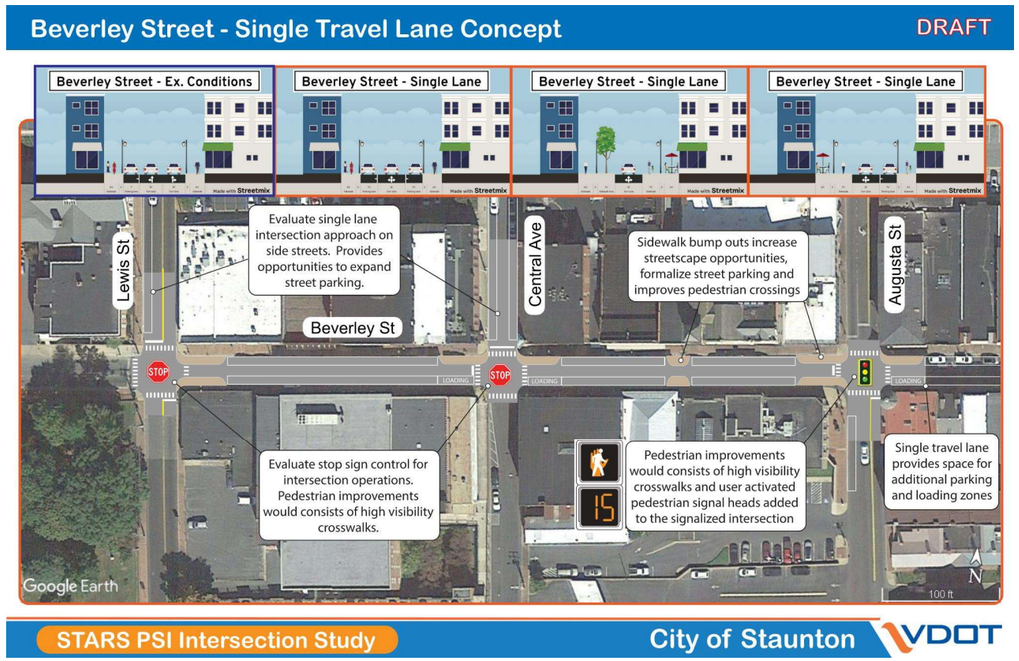

Figure 60 Single Lane Travel Concept for Beverley Street

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 Error! Reference source not found..

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 Error! Reference source not found.

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 corridor improvement, has a cost estimate of $250,000. A concept sketch of this alternative is shown in **Figure 60**

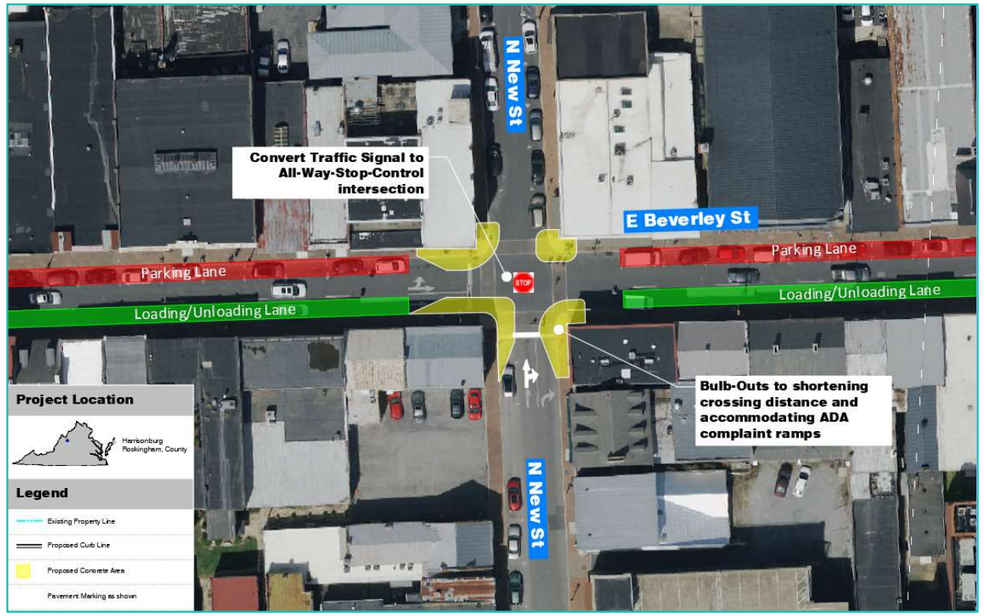

Figure 61 Alternative 1 Concept Sketch

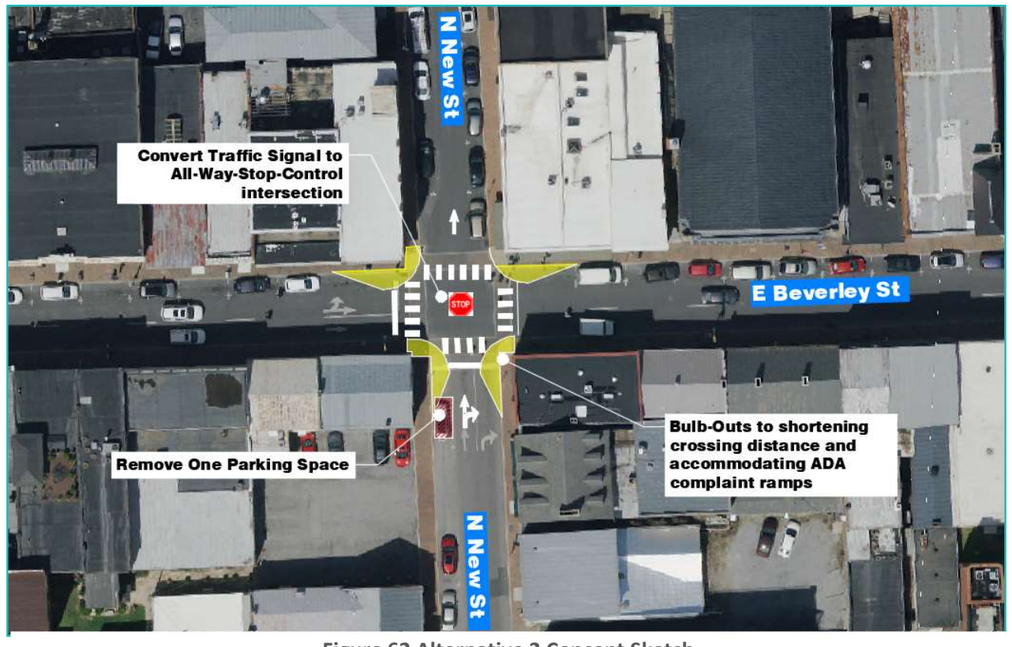

Figure 62 Alternative 2 Concept Sketch

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 unwarranted traffic signal and converting the intersection to a 3-way stop-controlled intersection.
- **Alternative 2:** This alternative also will improve traffic operations by converting the intersection to a 3-way stop-controlled intersection.
- **Alternative 3:** This alternative will have similar traffic operation 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 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 *One travel lane concept*				$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 primary issues identified in the existing conditions analysis. There are two alternatives developed and they 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 a 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. And 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 a 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 as 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 a year to complete. A concept sketch of this alternative is shown in **Figure 65**.

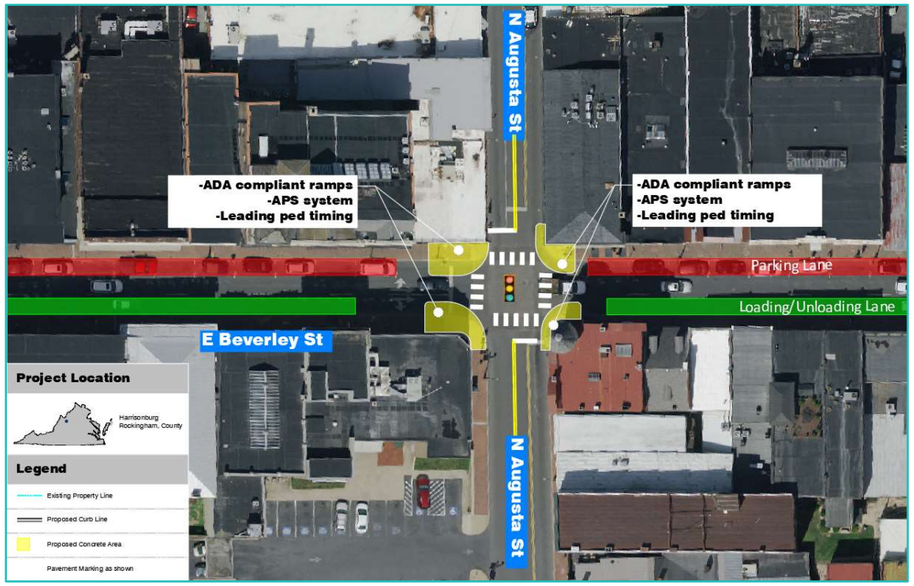

Figure 63. Alternative 1 Concept Sketch

Figure 64. Alternative 2 Concept Sketch

Figure 65. Alternative 3 Concept Sketch

4.11.6.1. Traffic Operations

Alternative 1 and Alternative 2 have similar traffic operations as they both have same traffic signal and lane configuration, they are different in repurposing the north side pavement area which has no impact on traffic operations. Alternative 3 is different in eastbound appraoch 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 operational improvements due to the reduction of the southbound and eastbound traffic to one-lane.
- **Alternative 2:** Similar to Alternative 1, this alternative will not have operational improvements due to the reduction of the southbound and eastbound traffic 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 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	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, one lane East Beverley Street reduces conflict points and create 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 and 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 a year to complete.
- **Alternative 3:** This alternative has a low-cost estimate of $50,000 and a short-term schedule of less than a year to complete.

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

Alternatives	Traffic Operations	Safety	Multimodal	Cost
Alternative 1 *One travel lane concept*				$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 primary issues identified in the existing conditions analysis. There are three alternatives developed, and they 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 All-Way Stop Control (AWSC) intersection and reducing the southbound and eastbound approaches to a single lane, which allows 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**.

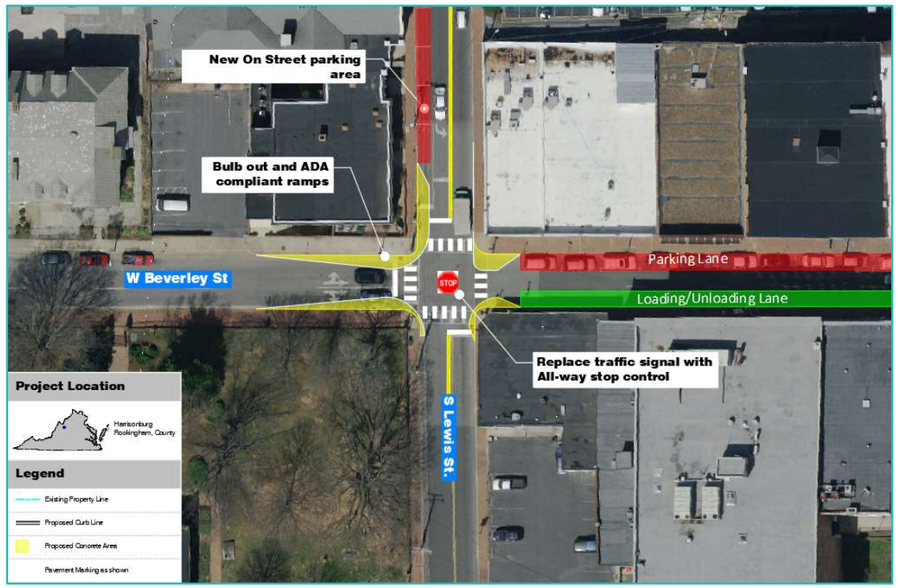

Figure 66. Alternative 1 Concept Sketch

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 AWSC intersection, however, with 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	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 the lane changes and creating a dedicated space for loading/unloading activity, reducing driver confusion of 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 is the primary focuses are 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 with Beverley Street eastbound and both Jefferson Street approaches being single lane approaches. The proposed diameter would be 50 feet and the roundabout would have 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**.

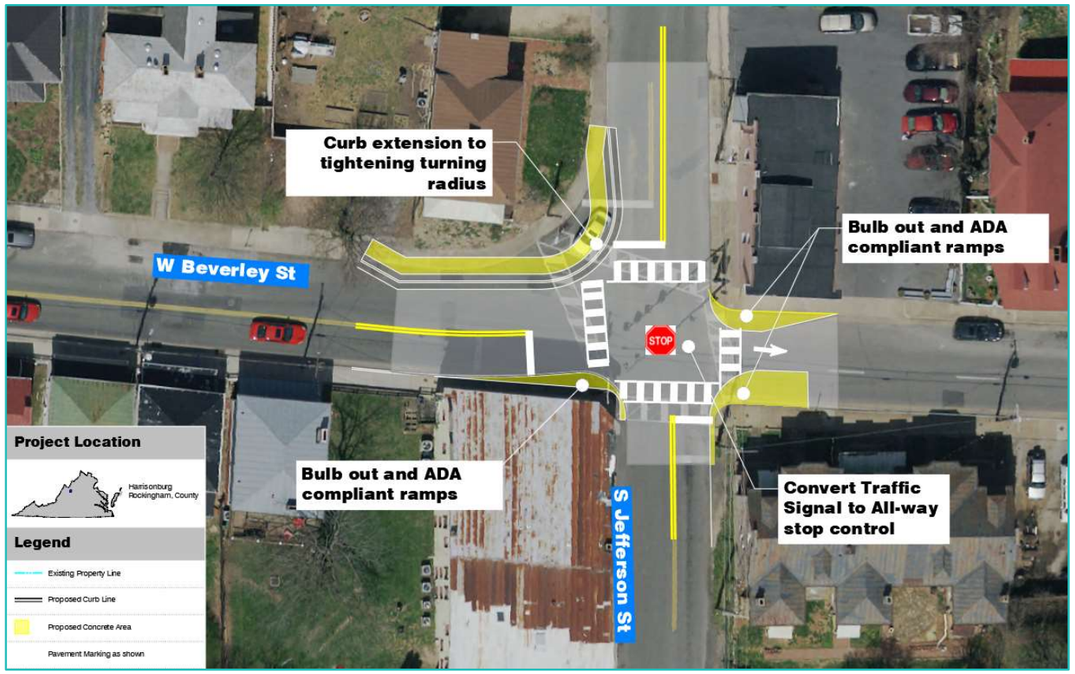

Figure 67. Alternative 1 Concept Sketch

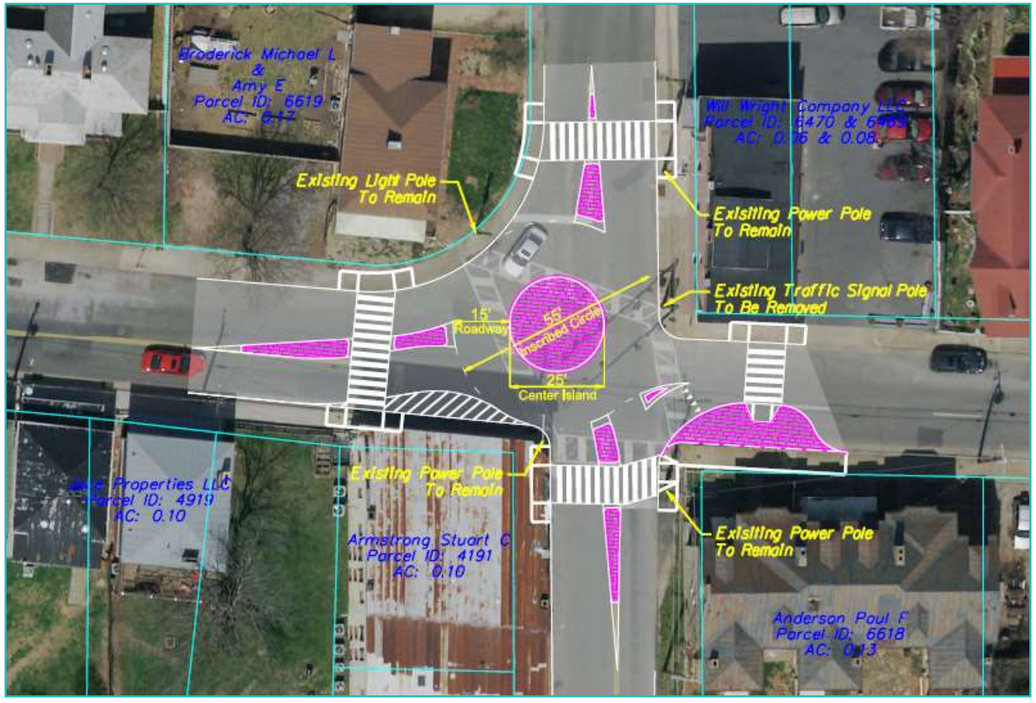

Figure 68. Alternative 2 Concept Sketch

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 addition of the 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 primary issues identified in the existing conditions analysis. There are two alternatives developed and they 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 the traffic signal upgrade 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 eastbound left turn. Pedestrian improvements include adding a crosswalk across Hays Avenue and 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 and 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 and 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 and 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 and 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

Figure 70. Alternative 2 Concept Sketch

Figure 71. Alternative 3 Concept Sketch

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 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 primary issues identified in the existing conditions analysis. There are two alternatives developed and they 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 accommodation, operational, and safety improvements. Pedestrian improvements include adding a west side crosswalk and sidewalk connection at the intersection's northwest corner. Traffic operational improvement includes reconfiguring side streets operation phases from split to permissive. And with multiple safety improvements, including adding flashing yellow arrows for eastbound and westbound left-turn movements, adding delineator posts to restrict full access within functional area of the intersection, proposing curb bulb-outs at service road entrance, and repurposing the eastbound three-lane segment into two through travel lanes and Two-Way Left Turn Lane (TWLTL) to provide space 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 to complete schedule. A concept sketch of this alternative is shown in **Figure 72**.

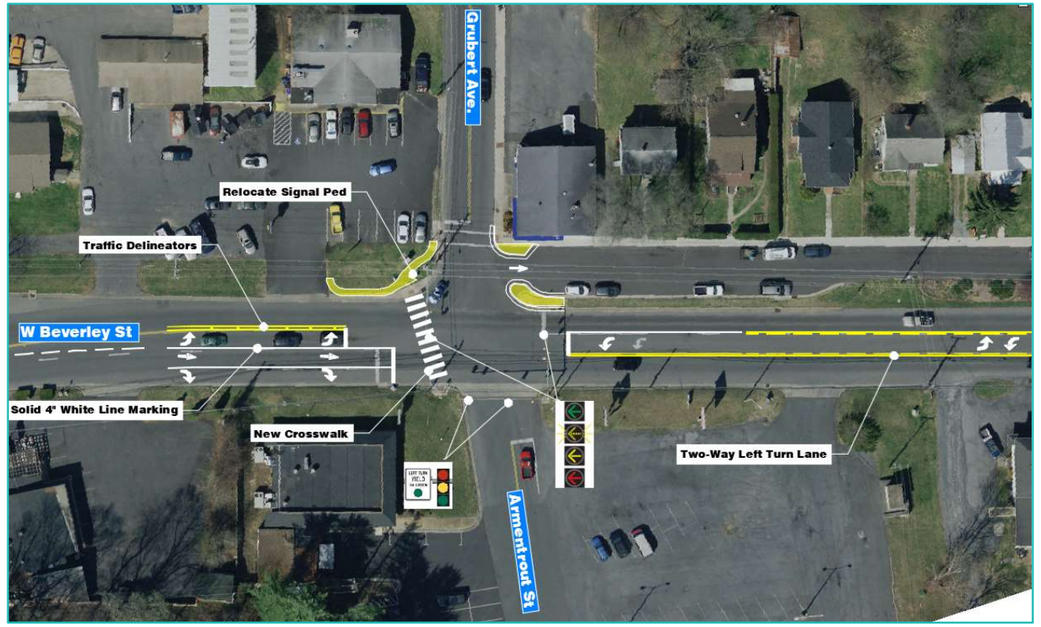

Figure 72. Alternative 1 Concept Sketch

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 improvement and pedestrian accommodation. 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 for the entire period of time 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. 487 people responded to the survey.

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 where you live, your primary use of the study area, and what modes of travel you use through the study intersection.

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 other locations than Augusta county and the City of Staunton. The majority 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 intersection. **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.

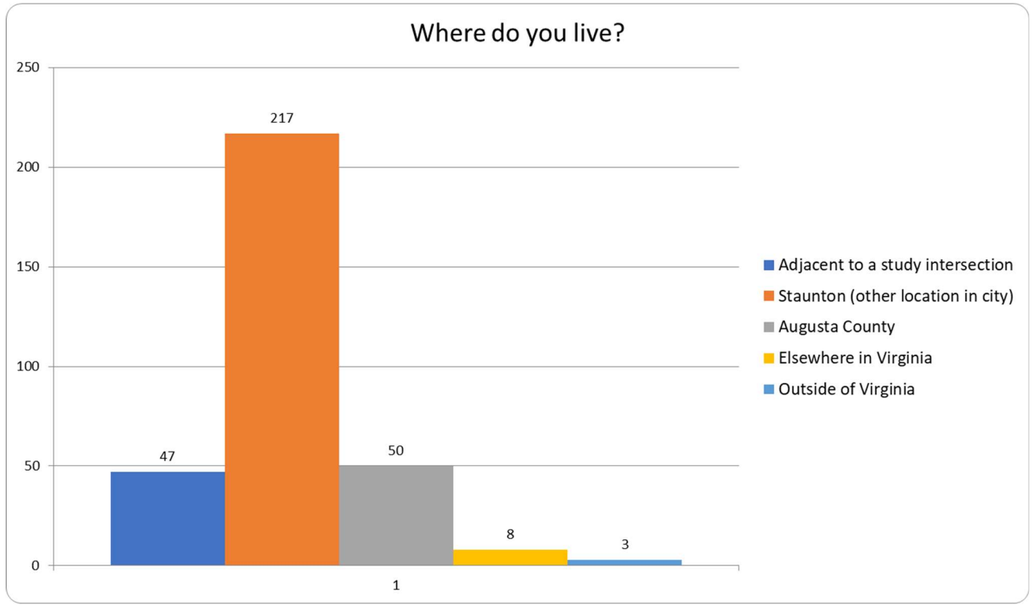

Figure 74 Survey Participants Location

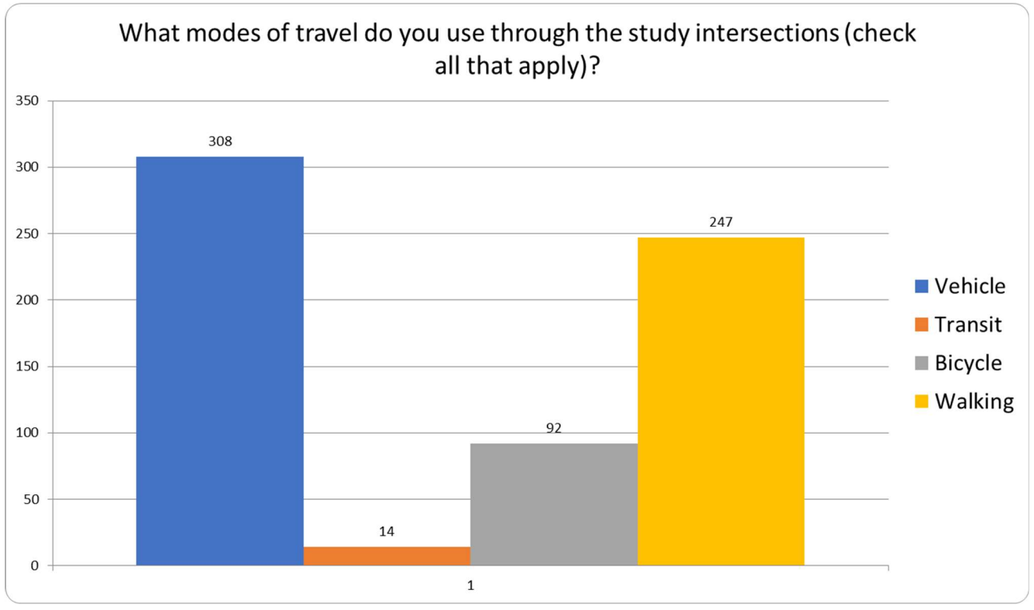

Figure 73 Survey Participants Modes of Travel

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 the participants agreed to the identified needs, with Johnson Street and Augusta Street intersection being the highest percent (91%) and 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 proposed improvements at study intersections, which shows 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 are 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 overreaching 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 the projects in the Staunton District, the scoring factors with 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 that assume that the City can find other funding sources than SMART SCALE, and some of them can be 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 and then presented to the study team to review and shortlist 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 transporation 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**Error! Reference source not found.. The the details of each alternative presented in Chaper 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