

# 1<sup>st</sup> AVENUE AND CENTER STREET ROAD SAFETY ASSESSMENT Regional Intergovernmental Council



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## 1.0 Executive Summary

The purpose of this study is to analyze the existing safety and capacity conditions and to determine potential countermeasures to reduce crash frequency at the intersection of 1<sup>st</sup> Avenue and Center Street in Nitro, West Virginia. The area around the intersection is mainly commercial with several single-family residences to the east of the intersection along 1<sup>st</sup> Avenue. A heavily trafficked bridge that connects the cities of Nitro and St. Albans over the Kanawha River is located approximately 500 feet south of the intersection. Channelized right-turn lanes are located on the northbound and eastbound approaches. Pedestrian facilities (i.e., crosswalks, pedestrian push buttons, pedestrian signal heads and sidewalk) are not provided at the intersection. Overhead lighting is provided at the intersection. One of the overhead light poles on the west side of the intersection was struck several years ago and has not been replaced.

Crash data from January 1, 2016 through December 31, 2020 was downloaded from the ReportBeam website. In the five-year study period, there were 100 collisions with 33 (33 percent) resulting in injury. Three of the injury collisions were serious injury collisions. No fatalities were reported in the study area. Left-turn collisions were the most prominent crash type, accounting for 61 total collisions with 28 (46 percent) resulting in injury. Out of the 61 left-turn crashes, 59 crashes resulted from westbound left-turning vehicles failing to yield to eastbound vehicles on 1<sup>st</sup> Avenue. These collisions were likely due to driver confusion reading the protected/permissive signal head as well as drivers just not selecting an appropriate gap. Some drivers may think the green ball on the protected/permissive signal head indicates that they have the right-of-way, especially if the green ball follows a green arrow. If the vehicles in front of them are continuously turning left, drivers may continue to follow them after the light switches from a green arrow to a green ball.

Based on the crash patterns and traffic operations in the study corridor, the following countermeasures are recommended:

### Short-Term

- Add “Left-Turn Yield on Green” intersection signage (\$500 – 2022 Dollars).
- Coordinate with WVDOT to replace fallen light pole on 1<sup>st</sup> Avenue to the west of Center Street (\$5,500 – 2022 Dollars).

### Medium-Term

- Consider installing a protected-only westbound left-turn phase with dual westbound left-turn lanes (\$867,000 – 2025 Dollars). While this improvement is being funded and designed, the protected-only phase can still be implemented. This can be done either by improving the signal timings to provide more green time for the westbound left-turn movement or by adding temporary pavement in the median as a short-term measure to accommodate the queued traffic.

### Long-Term

- Consider removing one through lane in each direction and adding a shared-use path on the north side of the roadway (\$1,210,000 – 2027 Dollars).
- Construct a roundabout if the congestion at the intersection of MacCorkle Avenue SW (US 60) and 3<sup>rd</sup> Street across the bridge in St. Albans is mitigated and more roundabouts are constructed in the area to familiarize drivers with their operations.

## 2.0 Purpose

The purpose of this study is to analyze the existing safety and capacity conditions and to determine potential countermeasures to reduce crash frequency at the intersection of 1<sup>st</sup> Avenue and Center Street in Nitro, West Virginia. The study area is shown below in **Figure 1**.



Figure 1: Study Area

### 3.0 Existing Conditions

The area around the intersection is mainly commercial with several single-family residences to the east of the intersection along 1<sup>st</sup> Avenue. Several residential neighborhoods are located to the south of the intersection along Main Avenue, which intersects Center Street approximately 400 feet south of 1<sup>st</sup> Avenue. A heavily trafficked bridge that connects the cities of Nitro and St. Albans over the Kanawha River is located approximately 500 feet south of the intersection.

#### Roadway Conditions

1<sup>st</sup> Avenue is a two-way four-lane divided roadway with a speed limit of 45 mph around the functional area of the intersection. Approximately 950 feet west and 1,150 feet east of the intersection with Center Street, 1<sup>st</sup> Avenue transitions into a two-way two-lane roadway with a center two-way left-turn lane (TWLTL). Center Street is a two-way four-lane divided roadway with a speed limit of 25 mph. Sidewalk is not provided along 1<sup>st</sup> Avenue and is only provided along the west side of the bridge on Center Street to the south of the intersection. An active railroad crossing is located approximately 275 feet south of the intersection.

#### Intersection Conditions

The intersection of 1<sup>st</sup> Avenue and Center Street is a three-legged signalized intersection. The westbound left-turn approach has protected/permissive left-turn phasing as shown in **Photo 1**. Backplates are provided on the signal heads for the eastbound and westbound approaches. The lane configuration is illustrated in **Figure 2**. Channelized right-turn lanes are located on the northbound and eastbound approaches. The eastbound right-turn lane has an exclusive receiving lane on Center Street; however, this lane ends just north of the bridge which is approximately 360 feet from the channelized right-turn. The northbound right-turn lane is yield-controlled and does not have an acceleration lane along 1<sup>st</sup> Avenue. Pedestrian facilities (i.e., crosswalks, pedestrian push buttons, pedestrian signal heads and sidewalk) are not provided at the intersection. Overhead lighting is provided at the intersection. One of the overhead light poles on the west side of the intersection was struck several years ago and has not been replaced.

#### Site Visit Observations

A site visit was performed at the the intersection on April 5<sup>th</sup>, 2022 from 2:00 PM to 4:00 PM. The attendees were from Burgess and Niple, Regional Intergovernmental Council (RIC), West Virginia Department of Transportation (WVDOT), and the Nitro Police Department. The mayor of

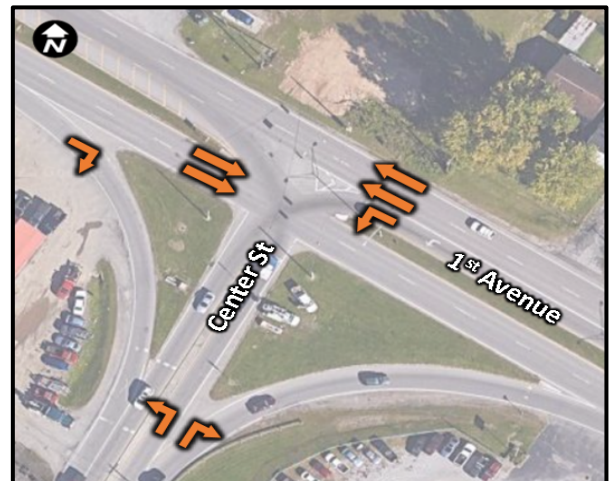


Figure 2: Lane Use Configuration



Photo 1: Westbound Left-Turn Signal Operation

the city of Nitro also attended the field review. Observations from the site visit are summarized below:

- Bicyclists and pedestrians were observed traveling through the intersection, shown in **Photo 2** and **Photo 3**.
- The signal pole on the southeast corner of the intersection is frequently struck as part of a secondary collision or as a result of vehicles avoiding another collision and running off the road. The damaged pole is shown in **Photo 4**.
- At the eastbound right-turn channelized lane from 1<sup>st</sup> Avenue, even though vehicles had their own add lane on Center Street, drivers treated the movement as more of a merging movement.
  - The add lane only extends about 360 feet from the channelized right-turn lane which may be contributing to drivers feeling as though they must immediately merge onto Center Avenue. As a result, the efficiency of the signal was reduced due to vehicles queuing back into the intersection.
- The driveway of Abbott’s Wrecker is located on the eastbound channelized right-turn lane, shown in **Photo 5**. The truck traffic has resulted in some pavement damage along the turn lane.
- During a few signal cycles, vehicles in the westbound left-turn lane would queue outside of the storage length of the turn lane, shown in **Photo 6**. However, the majority of the queued traffic was able to get through the intersection within one cycle.



**Photo 2: Bicycle traffic along Center Street**



**Photo 3: Pedestrian Traffic along 1<sup>st</sup> Avenue**



Photo 4: Signal Pole on Southeast Corner of Intersection



Photo 5: Driveway of Abbott's Wrecker



Photo 6: Westbound Left-Turn Queueing

## 4.0 Data Collection

Turning movement counts were collected for 24 hours on Tuesday, April 7<sup>th</sup>, 2020 for the intersection of 1<sup>st</sup> Avenue and Center Street. The peak hours were determined to be 7:00 AM to 8:00 AM and 4:15 PM to 5:15 PM. The volumes were adjusted to account for the changes in traffic volumes due to the COVID-19 pandemic using existing 24-hour 2019 counts. An adjustment factor of 2.05 and 1.61 was used for the AM and PM peak, respectively. The final adjusted 2022 rounded peak hour counts are shown in **Figure 3**. Raw traffic counts are provided in **Appendix A**.

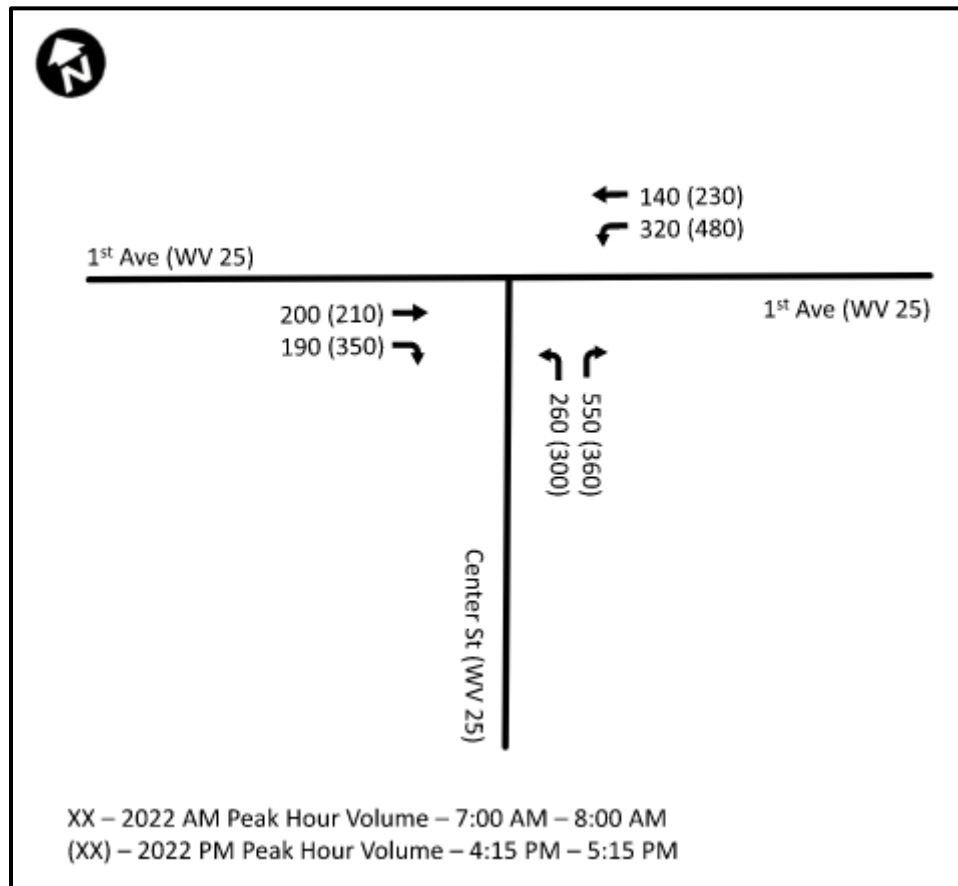


Figure 3: 2022 Adjusted Peak Hour Volumes

## 5.0 Existing Capacity Analysis

Intersection capacity was evaluated at the intersection of 1<sup>st</sup> Avenue and Center Street using the existing 2022 peak hour traffic volumes, existing lane configurations, and existing traffic control using *Synchro*, version 11. *SimTraffic* was used to obtain 95<sup>th</sup> percentile queue lengths. *SimTraffic* is the microsimulation package included with *Synchro*. Analysis results are from the Highway Capacity Manual (HCM) 6<sup>th</sup> Edition Module within *Synchro*. The videos from the traffic counts were utilized to obtain approximate signal timings for the analysis. The existing conditions analysis is summarized in **Table 1** with analysis output provided in **Appendix B**.

**Table 1: Existing Operational Analysis (2022) at 1<sup>st</sup> Avenue and Center Street**

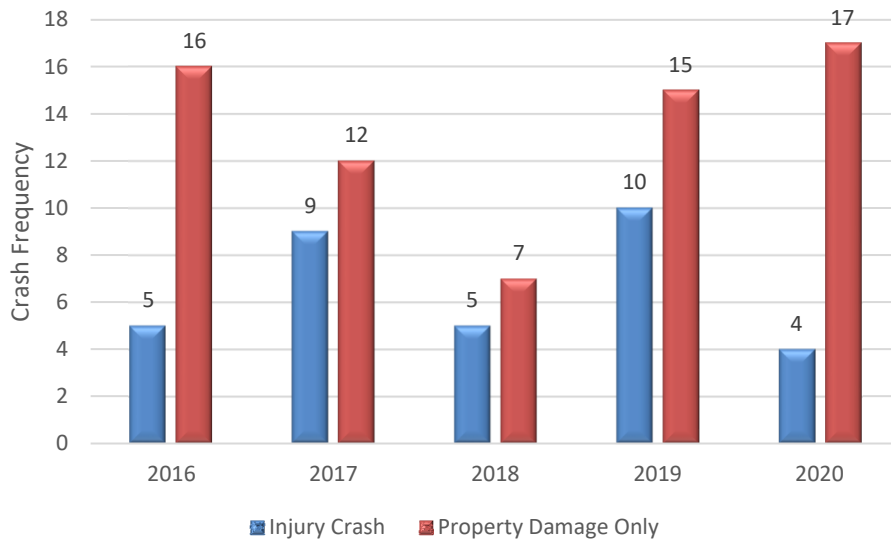
	Overall Intersection	Eastbound 1 <sup>st</sup> Avenue		Westbound 1 <sup>st</sup> Avenue		Northbound Center St	
		TH	RT	LT	TH	LT	RT
<b>AM Peak Hour</b>							
LOS	B	A	-	A	A	C	-
Delay	13.3	6.4	-	9.9	6.1	26.6	-
v/c		0.11	-	0.47	0.08	0.59	-
95 <sup>th</sup> % Queue		84'	-	166'	69'	190'	-
		A - 6.4		A - 8.8		C - 26.6	
<b>PM Peak Hour</b>							
LOS	B	A	-	B	A	C	-
Delay	14.8	6.4	-	13.4	6.3	29.6	-
v/c		0.11	-	0.70	0.12	0.68	-
95 <sup>th</sup> % Queue		88'	-	246'	139'	215'	-
		A - 6.4		B - 11.1		C - 29.6	

The existing condition analysis shows that the intersection of 1<sup>st</sup> Avenue and Center Street operates at level of service (LOS) C or better for all approaches and movements during both peak periods. The westbound left-turn 95<sup>th</sup> percentile queue is longer than the existing storage length. During field observations, the queues were occasionally spilling out of the westbound left-turn lane and into the through lanes.

## 6.0 Existing Safety Analysis

### Crash Trends and Analysis

Crash data from January 1, 2016 through December 31, 2020 was downloaded from the ReportBeam website. Each crash report was reviewed to determine potential factors contributing to crashes. A collision diagram that shows crash patterns by illustrating the approximate location of each reported crash is provided in **Appendix C**. In the five-year study period, there were 100 collisions with 33 (33 percent) resulting in injury. Three of the injury collisions were serious injury collisions. No fatalities were reported in the study area. **Figure 4** shows the frequency of crashes by severity per year.



**Figure 4: Frequency of Crashes by Year and Severity**

**Figure 5** shows the crash frequency in the study area by the crash type. Left-turn collisions were the most prominent crash type, accounting for 61 total collisions with 28 (46 percent) resulting in injury. Out of the 61 left-turn crashes, 59 crashes resulted from westbound left-turning vehicles failing to yield to eastbound vehicles on 1<sup>st</sup> Avenue. These collisions were likely due to driver confusion reading the protected/permissive signal head as well as drivers just not selecting an appropriate gap. Some drivers may think the green ball on the protected/permissive signal head indicates that they have the right-of-way, especially if the green ball follows a green arrow. If the vehicles in front of them are continuously turning left, drivers may continue to follow them after the light switches from a green arrow to a green ball.

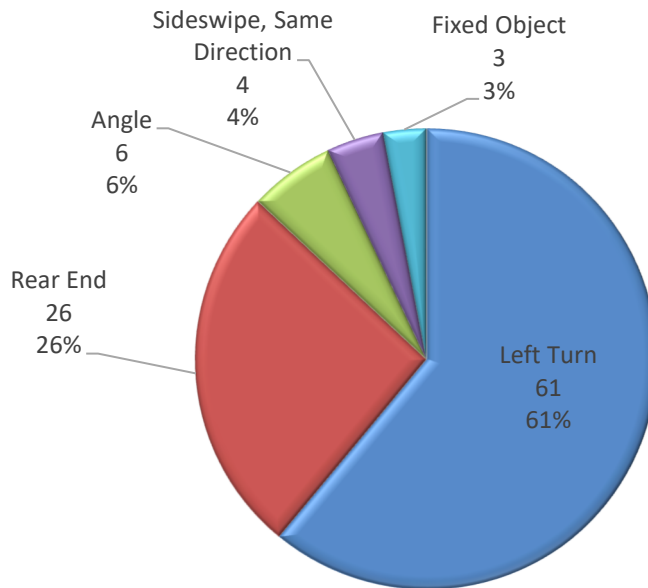


Figure 5: Frequency of Crashes by Crash Type

Rear end collisions were next most common crash type, with the highest crash pattern occurring in the westbound left-turn lane. This crash pattern likely occurred due to congestion and drivers unexpectedly stopping when the westbound left-turn traffic signal changes from protected to permissive.

### Highway Safety Manual Analysis

Using the Interactive Highway Safety Design Model (IHSDM), an analysis was conducted using the methodologies outlined in the *Highway Safety Manual* (HSM). The following three factors are calculated from the HSM analysis:

- **Predicted Crash Frequency ( $N_{\text{predicted}}$ )** – How the site would be expected to perform relative to 1,000 similar sites with comparable volumes.
- **Expected Crash Frequency ( $N_{\text{expected}}$ )** – Average performance of the site over an extended period of time based on actual crash history.
- **Potential for Safety Improvement (PSI)** – Difference between expected crash frequency and predicted crash frequency. A positive PSI indicates that the location is performing poorly compared to similar locations and safety improvements would likely have a significant impact in reducing the crash frequency.

The results from the IHSDM Analysis for the intersection are summarized in **Table 2**. Output from the IHSDM is included in **Appendix D**.

**Table 2: Existing HSM Analysis Results**

	Fatal and Injury Crashes	Property Damage Only Crashes	Total
N <sub>predicted</sub>	0.74	1.41	2.15
N <sub>expected</sub>	4.25	10.60	14.85
PSI	<b>9.19</b>	<b>3.51</b>	<b>12.70</b>

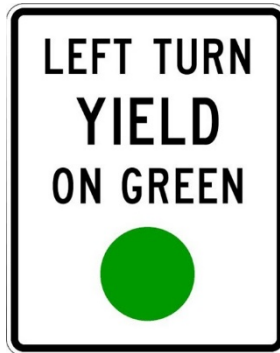
This intersection is estimated to have approximately 13 more crashes per year and 9 more injury crashes than other intersections with similar volumes and geometric characteristics.

## 7.0 Countermeasures for Consideration

The following countermeasures were identified to mitigate crashes and improve safety within the study area.

### Short-Term

- **Add “Left-Turn Yield on Green” intersection signage.** Over half of the crashes at the intersection were related to westbound left-turning vehicles failing to yield to eastbound vehicles at the intersection. Adding “Left-Turn Yield on Green” intersection signage is recommended for the westbound approach as an immediate improvement, so westbound drivers are more aware they do not have the right-of-way on a green ball. This sign is shown in **Figure 6**.



**Figure 6: Recommended Left-Turn Signage**

- **Coordinate with WVDOT to replace fallen light pole to the west of Center Street.** Enhancing the intersection lighting with the additional light pole is recommended to improve visibility at the intersection. Out of the 100 crashes at the intersection, 25 percent occurred under dark-lighting conditions.

### Medium-Term

- **Consider installing a protected-only westbound left-turn signal phase with lengthened storage lane.** This signal modification would eliminate the need for westbound left-turning drivers to assess and select adequate gaps in traffic along eastbound 1<sup>st</sup> Avenue which would likely reduce many of the left-turn collisions. The westbound left-turn lane would need to be lengthened to accommodate the additional queueing. There is adequate space in the

grass median to accommodate the turn lane. The current 230-foot lane will be lengthened to approximately 300 feet. This layout is shown in **Figure 7**.

- **Consider installing a protected-only westbound left-turn signal phase with dual westbound left-turn lanes.** Adding the dual left-turn lanes would help to accommodate more volume with the protected-only left-turn phasing as well as provide more storage for vehicles to queue without impact the through lanes. In addition to adding the dual left-turn lanes, the eastbound right-turn lane would be brought into the intersection and signalized to operate as an overlap with the northbound left-turn movement. This right-turn movement would also have the right-of-way when the westbound through movement is served. The layout of this improvement is shown in **Figure 8**.
  - This improvement would also benefit the flow of traffic on Center Street as eastbound right-turning traffic was often observed yielding to westbound left-turning traffic when both movements were in exclusive lanes. While the dual left-turn lanes will not be evenly utilized, there is a longer distance provided for vehicles to merge before the bridge than under current conditions.
  - The Abbott's Wrecker driveway will need to be modified/relocated with this improvement.

### Long-Term

- **Consider removing one through lane in each direction and adding a shared-use path on the north side of 1<sup>st</sup> Avenue.** Based on initial capacity analysis, two through lanes in each direction on 1<sup>st</sup> Avenue are not required for acceptable intersection operations. Furthermore, the second through lane in both directions only extends a few hundred feet on either side of the Center Street intersection. As part of this improvement, the northbound right-turn lane would have an add lane which would allow northbound right-turning traffic to accelerate along 1<sup>st</sup> Avenue in an add lane before merging with traffic on 1<sup>st</sup> Avenue. Adding a shared-use path would create a better environment for pedestrians and bicyclists to travel along 1<sup>st</sup> Avenue. There are currently no sidewalks or pedestrian facilities in the area. The shared-use path would need to be part of a larger corridor connectivity project along 1<sup>st</sup> Avenue through coordination with West Virginia Division of Transportation (WVDOT). This layout is shown in **Figure 9**. While illustrated with the extended westbound left-turn lane, this reconfiguration can also be constructed in conjunction with the dual westbound left-turn lane option.
- **Consider constructing a roundabout:** This improvement would mitigate the current left-turn crash problem and decrease serious injury angle collisions. Installing a roundabout would also create a better environment for pedestrians and bicyclists. There is concern that the queuing on the bridge would back into the roundabout and create congestion in the roundabout, especially from westbound left-turning vehicles stuck in the queue. This improvement should not be considered until congestion at the intersection of MacCorkle Avenue SW (US 60) and 3<sup>rd</sup> Street across the bridge in St. Albans is mitigated. Additionally, this improvement may require a multi-lane roundabout. In communities where roundabouts are not prevalent, it is best that single lane roundabouts be constructed first so drivers become familiar with roundabouts. A multi-lane roundabout can be confusing for some drivers, especially those not familiar with roundabouts in general.



Protected-Only Westbound Left-Turn Phase with  
Extended Westbound Left-Turn Lane

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FIGURE 7



Protected-Only Westbound Left-Turn Phase with  
Dual Westbound Left-Turn Lanes

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FIGURE 8

0 50  
25 100  
SCALE IN FEET

1st Avenue Reconfiguration with Shared Use Path

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FIGURE 9

## 8.0 Countermeasure Evaluation

### 8.1 Operational Evaluation

Operational analysis was conducted for the countermeasures discussed in **Section 7.0** of this report. The analysis was conducted with *Synchro*, version 7 utilizing the Highway Capacity Manual, 6<sup>th</sup> Edition module. The analysis utilized the existing 2020 traffic volumes for the AM and PM peak periods. The goal of this analysis is to confirm that the safety recommendations at the intersection can operate at acceptable levels of service. Detailed results can be found in **Appendix E**. Signal timings were optimized.

The operational analysis for changing the westbound left-turn operation from protected/permisive to protected-only is shown in **Table 3**.

**Table 3: Operational Analysis Results – Protected-Only Westbound Left-Turn**

	Overall Intersection	Eastbound 1 <sup>st</sup> Avenue		Westbound 1 <sup>st</sup> Avenue		Northbound Center St	
		TH	RT	LT	TH	LT	RT
<b>AM Peak Hour</b>							
LOS	C	B	-	E	A	C	-
Delay	31.8	18.7	-	56.6	6.3	25.0	-
v/c		0.23	-	0.93	0.08	0.57	-
95 <sup>th</sup> % Queue		117'	-	237'	73'	181'	-
		B – 18.7		D – 41.3		C – 25.0	
<b>PM Peak Hour</b>							
LOS	C	C	-	D	A	D	-
Delay	33.8	23.5	-	47.6	5.4	40.8	-
v/c		0.26	-	0.92	0.11	0.78	-
95 <sup>th</sup> % Queue		137'	-	291'	169'	218'	-
		C – 23.5		C – 33.9		D – 40.8	

All movements will operate at level of service (LOS) E or better during both peak periods. The westbound left-turn is near capacity in both the AM and the PM peak hours. The westbound left-turn lane will need to have additional storage added so that queues do not spill into the adjacent westbound through lane.

**Table 4** summarizes the operational results for adding dual left-turn lanes at the westbound left-turn movement.

**Table 4: Operational Analysis Results –Protected-Only Westbound Dual Left-Turn Lanes**

	Overall Intersection	Eastbound 1 <sup>st</sup> Avenue		Westbound 1 <sup>st</sup> Avenue		Northbound Center St	
		TH	RT	LT	TH	LT	RT
<b>AM Peak Hour</b>							
LOS	C	B	C	D	A	C	-
Delay	25.6	18.7	23.6	39.9	6.4	25.0	-
v/c		0.23	0.49	0.82	0.08	0.57	-
95 <sup>th</sup> % Queue		123'	89'	166'	71'	179'	-
		C - 21.1		C - 29.7		C - 25.0	
<b>PM Peak Hour</b>							
LOS	D	C	E	D	A	C	-
Delay	37.7	21.7	61.9	44.6	5.9	34.3	-
v/c		0.26	0.96	0.91	0.12	0.73	-
95 <sup>th</sup> % Queue		129'	143'	183'	90'	226'	-
		D - 46.8		C - 32.1		C - 34.3	

Understanding that the dual westbound left-turn lanes will not be used evenly, a lane utilization factor of 0.57 was assumed to account for the lane imbalance. Providing dual left-turn lanes for the westbound left-turn movement improves the westbound left-turn operations over the single-lane protected left-turn alternative. The volume to capacity ratio is less than the single-lane protected left-turn but is still near capacity in the PM peak hour. Bringing the channelized eastbound right-turn into the signal will decrease the efficiency of this movement, but it will remove the merge add lane that is currently causing observed queueing at the intersection. During the PM peak, the eastbound right-turn movement operates at LOS E and is near capacity.

**Table 5** summarizes the operational results for removing one through lane in each direction on 1st Avenue. The westbound left-turn movement was evaluated as protected-only in a single lane in this alternative.

**Table 5: Operational Analysis Results – Remove One-Through Lane in Each Direction and Protected Westbound Left-Turn**

	Overall Intersection	Eastbound 1st Avenue		Westbound 1st Avenue		Northbound Center St	
		TH	RT	LT	TH	LT	RT
<b>AM Peak Hour</b>							
LOS	C	C	-	E	A	C	-
Delay	32.6	22.0	-	56.6	6.6	25.0	-
v/c		0.43	-	0.93	0.15	0.57	-
95th % Queue		143'	-	251'	88'	184'	-
		C - 22.0		D - 41.4		C - 25.0	
<b>PM Peak Hour</b>							
LOS	C	C	-	D	A	D	-
Delay	34.7	28.0	-	47.6	5.9	40.8	-
v/c		0.49	-	0.92	0.21	0.78	-
95th % Queue		151'	-	346'	394'	226'	-
		C - 28.0		C - 34.1		D - 40.8	

Removing a through lane in each direction with a protected-only westbound left-turn lane operates at LOS E or better for all movements. The westbound left turn is near capacity for both the AM and PM peak. The westbound left turn will have to be extended to store the 346 feet queue during the PM peak. The current storage length of the left-turn lane is approximately 230 feet.

### 8.2 Safety Performance Analysis

A safety analysis was also performed for protected-only left-turn alternatives and compared to the existing safety performance of the intersection. The safety benefit for the protected-only left-turn alternative and the dual left-turn lane alternative have the same safety benefit, as the same type of crashes are being reduced. A Crash Modification Factor (CMF) of 0.58 for all crash types and severities was used from CMF Clearinghouse. This CMF was based on changing the left-turn phasing from protected/permissive to protected-only on a major approach at a high-speed intersection. The results of the HSM analysis are summarized in **Table 6**. The IHSDM output is provided in **Appendix F**. Crash modification factors were not available or applicable to the study site for the other potential improvement options.

**Table 6: Protected-Only Westbound Left-Turn Movement – HSM Analysis Results**

	Fatal and Injury Crashes	Property Damage Only Crashes	Total
N <sub>Expected</sub> - Existing	4.25	10.6	14.85
N <sub>Expected</sub> - Proposed	2.47	6.15	8.62
Crash Reduction	-1.78	-4.45	-6.23

The total crash frequency decreased in both fatal and injury crashes and property damage collisions, with the largest decrease occurring in property damage only collisions. The total predicted crashes at this intersection decreased by six crashes per year by protecting the left-turn movement

### 8.3 Cost Considerations

The cost estimates for the proposed improvements are summarized in **Table 7**. A detailed breakdown of the construction cost estimates is provided in **Appendix G**. Cost estimates include a 30 percent contingency and 20 percent design cost. The medium-term improvements were inflated for a 2025 construction year and the long-term improvements were inflated for a 2027 construction year. The cost estimates do not include right-of-way costs or utility relocation which may be required as a result of the improvements. The cost of removing a through lane in each direction does not include the cost of the shared use path as that will be part of larger corridor-wide project.

The cost of the dual westbound left-turn lanes includes the cost of a new signal at the intersection.

**Table 7: Cost Estimate Summary**

Short-Term Improvements	
	Cost Estimate (FY 2022)
“Left-Turn Yield on Green” Signage	\$500
Replace Light Pole	\$5,500
Medium-Term Improvements	
	Cost Estimate (FY 2025)
Protected-Only Westbound Left-Turn Lane	\$112,000
Dual Westbound Left-Turn Lanes	\$867,000
Long-Term Improvements	
	Cost Estimate (FY 2027)
Removing Through Lanes	\$1,210,000

**Table 8** summarizes the benefit-cost ratios of modifying the westbound left-turn movement from protected/permissive to protected-only left-turn, extending the left-turn lane at 1<sup>st</sup> Avenue and Center Street, and adding dual left-turn lanes. The monetized safety benefit was calculated assuming a 20-year service life of the improvement. A detailed breakdown of the safety benefit calculations is provided in **Appendix H**. The crash costs were obtained from the *Crash Costs for Highway Safety Analysis*, Appendix C. These costs were in 2016 dollars. An inflation factor of 21.8% (from USinflationcalculator.com) was used to bring the safety costs to 2022 dollars.

**Table 8: Benefit/Cost Summary**

	Safety Benefit	Cost Estimate (2022 dollars)	Benefit/Cost Ratio
Protected-Only Left-Turn Lane	\$9,021,000	\$96,000	93.97
Dual Left-Turn Lanes	\$9,021,000	\$745,000	12.11

While the benefit-cost ratio of modifying the left-turn movement from protected/permissive to protected-only left-turn and extending the left-turn lane is much higher than the dual left-turn lane

alternative, the addition of the dual left-turn lanes at the intersection would provide a better benefit to traffic operations.

## 9.0 Conclusions and Recommendations

Based on the crash patterns and traffic operations in the study corridor, the following countermeasures are recommended:

### Short-Term

- Add “Left-Turn Yield on Green” intersection signage (\$500 – 2022 Dollars).
- Coordinate with WVDOT to replace fallen light pole on 1<sup>st</sup> Avenue to the west of Center Street (\$5,500 – 2022 Dollars).

### Medium-Term

- Consider installing a protected-only westbound left-turn phase with dual westbound left-turn lanes (\$867,000 – 2025 Dollars). While this improvement is being funded and designed, the protected-only phase can still be implemented. This can be done either by improving the signal timings to provide more green time for the westbound left-turn movement or by adding temporary pavement in the median as a short-term measure to accommodate the queued traffic.

### Long-Term

- Consider removing one through lane in each direction and adding a shared-use path on the north side of the roadway (\$1,210,000 – 2027 Dollars).
- Construct a roundabout if the congestion at the intersection of MacCorkle Avenue SW (US 60) and 3<sup>rd</sup> Street across the bridge in St. Albans is mitigated and more roundabouts are constructed in the area to familiarize drivers with their operations.