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HAGERSTOWN
SIGNAL
EVALUATION
STUDY



TECHNICAL MEMORANDUM
Locust and Mulberry Streets Signal Evaluation

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INTERNATIONAL



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Introduction

This technical memorandum presents the scope and outcomes of a traffic study conducted to determine the continued need for intersection signalization at 12 intersections along the Locust Street and Mulberry Street corridors in Hagerstown, MD. Locust and Mulberry Streets were identified in the 2025 Hagerstown Safety Action Plan (SAP) as having a high rate of fatal or serious injury crashes and a high number of vulnerable road user (VRU) crashes. A high proportion of corridor crashes occurred at the signalized intersections. One of the recommendations of the SAP for countermeasures to address safety on these corridors was to first determine the need for continued signalization at each intersection, with consideration of converting some of the signalized intersections to all-way stop control if signalization was determined to no longer be warranted. This study, Locust and Mulberry Streets Signal Evaluation Plan, is the result of that recommendation.

To determine the need for continued signalization at intersections along these corridors a thorough data collection effort was conducted. Data collected included:

- Vehicular Traffic Volumes
- Pedestrian Traffic Volumes
- Crash Data
- Roadway and Lane Configuration Data

The data collection of traffic volume counts relied primarily on open-source traffic data available from online sources, with validation using actual traffic counts at select locations conducted by the City of Hagerstown.

This data was then used to analyze the continued need and justification for signalization at each study intersection. Additionally, all-way stop control operational level of service



(LOS) was evaluated at locations where signal removal was considered. Analysis conducted included:

- Traffic Signal Warrant Analysis
- All-Way Stop Control Warrant Analysis
- Level of Service (LOS) Analysis for All-Way Stop Control Conversion
- Sight Distance Limitations for All-Way Stop Control Conversion

Study Area Overview

The purpose of the study was to enhance roadway safety along the Locust Street and Mulberry Street corridors in Hagerstown, MD, by evaluating the necessity of continued traffic signalization at existing signalized intersections. Through comprehensive traffic signal warrant analysis, the team assessed whether current traffic signals were justified based on factors such as traffic volumes, crash history, pedestrian activity, and the physical characteristics of each corridor.

Both Locust Street and Mulberry Street are single lane, one-way, urban roadways with a bicycle lane on one side and curbside parking on the other. They both have adjacent urban development with dense urban homes with stairs/stoops and narrow sidewalks along the curblines. Locust Street is a one-way urban street that serves as the northbound corridor of the one-way pair with Potomac Street for MD 65 through the central portion of the City of Hagerstown. It carries approximately 5000 vehicles per day (vpd) north of US 40. Mulberry Street is a local one-way urban street that carries traffic southbound one block east of Locust Street. It carries approximately 2500 vpd (typically about half the volume of Locust Street.) Though the roadway context and lane configuration of both Locust Street and Mulberry Street is similar, they carry significantly different traffic volumes and serve different purposes in the Hagerstown roadway network.

There are currently 16 signalized intersections within the study area: 10 along Locust Street and six along Mulberry Street. The existing signalized intersections along these corridors are depicted in Figure 1 and are:

- Locust Street and Lee Street
- Locust Street and Baltimore Street





- Locust Street and Antietam Street
- Locust Street and Washington Street
- Locust Street and Franklin Street
- Locust Street and East Avenue
- Locust Street and Randolph Avenue
- Locust Street and North Avenue
- Locust Street and Broadway
- Locust Street and Wayside Avenue
- Mulberry Street and Baltimore Street
- Mulberry Street and Antietam Street
- Mulberry Street and Washington Street
- Mulberry Street and Franklin Street
- Mulberry Street and East Avenue
- Mulberry Street and North Avenue



FIGURE 1: LOCUST ST AND MULBERRY ST CORRIDOR OVERVIEW





The four signalized locations intersecting with the US 40 one-way pair at Washington Street and Franklin Street were omitted from this analysis because they are considered critical to the coordinated operation of the Route 40 corridor. This results in 12 study intersections along the Locust Street and Mulberry Street corridors.

The study aims to improve safety and reduce crashes at critical intersections by identifying where traffic signals continue to be warranted and to explore opportunities to remove signals and install all-way stop sign control at locations where signals are found to be unwarranted. The findings and recommendations provide city officials with guidance for implementing effective traffic management solutions, ultimately supporting safer and more efficient traffic flow along these corridors.

Data Collection

To support the traffic signal warrant analysis, data was collected for vehicular traffic volumes, pedestrian traffic volumes, crash data, existing traffic signal data, and roadway and lane configuration data. To support the all-way stop control warrant analysis, data was collected for vehicular traffic volumes, roadway and lane configuration data, and sight distance data.

The data collection and analysis relied heavily on open-source, on-line data when available.

Traffic Volume

Vehicular traffic volume data was collected from the SHA online open data portal, Urban SDK, and Replica. To validate the open-source data, particularly from Urban SDK and Replica, the City of Hagerstown conducted manual counts at several intersections. The on-line data sources were compared with the City of Hagerstown validation counts and Urban SDK and SHA were identified as the providers of the most accurate information among these sources. The intersections where manual traffic counts were performed by the City of Hagerstown include Locust and Lee Streets, Locust and Baltimore Streets, Locust Street and North Avenue, Mulberry and Antietam Streets, and Mulberry Street and North Avenue.

At the locations with manual validation counts, those counts were used in the analysis. Open-source Urban SDK or SHA data were used for all remaining intersections. Average Daily Traffic (ADT) data was collected and summarized for both Locust Street and Mulberry Street and the side streets for all 12 intersections within the study area to





characterize existing traffic patterns and support operational evaluation. The results indicate that the primary numbered state routes such as MD 65 (Locust Street) and MD 11 (Baltimore Street), along with Antietam St west of Locust Street typically carry the highest traffic volumes. In contrast, the local streets, including Mulberry Street, Randolph Avenue, Wayside Avenue, and Lee Street, exhibit substantially lower ADT values. Figure 2 depicts the ADTs derived for the analysis area.



FIGURE 2: TRAFFIC VOLUME ON STUDY AREA

In addition to ADTs, hourly traffic volumes are one of the primary inputs for the traffic signal warrant analysis. Hourly traffic volumes were collected in the manual count data and were exported from the on-line data. Additionally, the open-source hourly counts were validated by applying the hourly traffic distributions collected in the manual counts.

Pedestrian Volumes

Pedestrian counts were exported from online data sources and compiled hourly at all 12 key intersections within the Locust Street and Mulberry Street study area to document





existing walking activity. Observed pedestrian volumes vary across the corridor, with the highest activity concentrated along the central area of Mulberry St and Antietam Street, where daily counts generally range from approximately 400 to over 600 pedestrians, reflecting stronger pedestrian demand in the downtown core. Moderate pedestrian activity is present along intersecting streets such as Antietam Street, Baltimore Street, Randolph Street, and East Street, with daily volumes typically between about 200 and 450 pedestrians. Peripheral locations exhibit lower pedestrian volumes, often under 200 pedestrians, indicating reduced walking activity farther from the core area. Overall, the spatial distribution of pedestrian volumes highlights a clear concentration of pedestrian movement in the downtown and mixed-use areas, providing important context for signal timing, pedestrian accommodations, and safety-focused intersection evaluations.

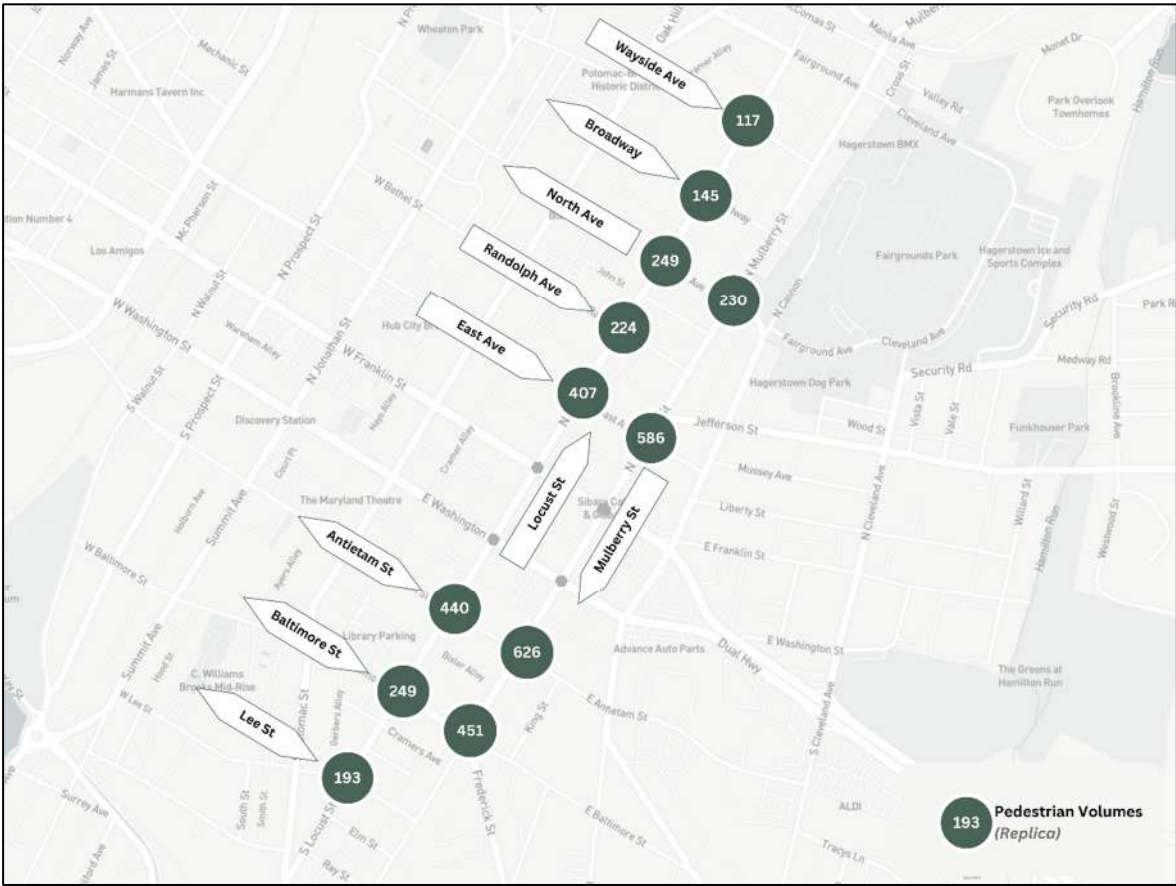


FIGURE 3: PEDESTRIAN VOLUME ON STUDY AREA





Intersection Crash History

Crashes reported from 2019 through 2023 were summarized at key intersections and roadway segments within the Hagerstown study area to identify locations with elevated safety concerns and support targeted operational and safety analysis. The distribution of crashes shows higher concentrations along the primary Locust and Mulberry Street corridors, particularly near major cross streets such as Baltimore Street, East Street, Lee Street, and Antietam Street, where intersection crash totals generally range from the low to mid-teens and reach the highest observed values along the corridor. Moderate crash frequencies are evident at several adjacent downtown intersections, while lower crash counts are observed toward the northern and southern extents of the corridors. Overall, the spatial pattern indicates that crash activity is concentrated at busier downtown intersections with higher traffic and pedestrian activity.



FIGURE 4: INTERSECTION CRASH DATA ON STUDY CORRIDORS





Traffic Signal Warrants

MUTCD Traffic Signal Warrants 1 through 9 were considered to evaluate all existing signalized intersections within the study area along the two corridors (Locust Street and Mulberry Street) with the exception of the signalized intersections at US Route 40 (Washington Street and Franklin Street). The evaluation considered vehicular volume warrants (Warrants 1, 2, and 3), Pedestrian Volume warrant (Warrant 4), Signal System Coordination warrant (Warrant 6), and Roadway Network Considerations warrant (Warrant 8). Not considered were School Crossing (Warrant 5) and Intersection Near a Railroad Crossing (Warrant 9), as they were determined to be not applicable at this location because none of the signalized intersections were within close proximity to either a school crossing or a railroad crossing. Crash data was analyzed; however the Crash Experience warrant (Warrant 7) was determined to not be relevant because the warrant is used to install a signal where reported crashes of a type susceptible to correction by installing a traffic signal can be reduced. Given that a traffic signal is already installed, this cannot be analyzed for existing crashes at an already signalized intersection. The MUTCD warrants considered are shown in Table 1.

TABLE 1: SUMMARY OF SIGNAL WARRANTS CONDUCTED

Warrant No.	Warrant Name	Applicability / Notes
Warrant 1	8-Hour Vehicular Volume	Evaluated
Warrant 2	4-Hour Vehicular Volume	Evaluated
Warrant 3	Peak Hour (Volume)	Evaluated
Warrant 4	Pedestrian Volume	Evaluated
Warrant 5	School Crossing	Not Applicable (N/A)
Warrant 6	Coordinated Signal System	Evaluated
Warrant 7	Crash Experience	Not evaluated
Warrant 8	Roadway Network (Volume)	Evaluated
Warrant 9	Intersection Near a Railroad Crossing	Not Applicable (N/A)





A Pennsylvania Department of Transportation (PennDOT) publicly available warrant analysis worksheet was used to evaluate the MUTCD traffic signal warrants. The warrant analysis worksheets for all 12 intersections are provided in the appendix.

Hourly traffic volumes derived as described in the Traffic Volume section of this memorandum were used as the basis for the traffic volume warrant analyses. The outcome of the warrant analysis is:

- The five point intersection of Mulberry/Baltimore/Frederick Streets is too complex for simple warrant analysis and is therefore not being considered for additional analysis or removal of a traffic signal under this analysis.
- No intersection met the Pedestrian Volume warrant.
- No intersection met the Peak Hour Volume warrant.
- No intersection met the Coordinated Signal System warrant. The Coordinated Signal System warrant is not to be applied to intersections that are spaced closer than 1000 ft within each other.
- No intersection met the Roadway Network warrant.
- No intersection fully met either the 8-hour volume or the 4-hour volume warrants, however some intersections met a subset of the hours of one or both of these warrants.

Table 2 summarizes the results of the MUTCD volume warrant(s) (8 -hour Volume and 4-hour Volume) evaluation for the signalized intersections along the Locust Street and Mulberry Street corridors in Hagerstown. As can be seen on the table, several Locust Street intersections are identified as partially meeting either the 8-hour or the 4-hour signal warrants, reflecting significant traffic demand on either the major or side street during a limited number of hours each day, while others with lower side-street volumes (such as Lee, Broadway, and Wayside) are shown as not meeting the volume condition during any hours of the day.





TABLE 2: SIGNAL WARRANT ANALYSIS

Corridor	Sidestreet	ADT (vpd) Major St	ADT (vpd) Side St	Signal Warranted	Warrant 1 (8 Hour Volume Condition A - Conditions A and B)	Warrant 2 (4 Hour/Peak Hour Volumes)
Locust	Lee	3925	1350	No	0/8 - 0/8	0/4
Locust	Baltimore	4400	5000	Partial	1/8 - 3/8	3/4
Locust	Antietam	4400	3483	Partial	0/8 - 0/8	1/4
Locust	East	5198	2636	Partial	0/8 - 2/8	0/4
Locust	Randolph	5198	1196	Partial	0/8 - 1/8	0/4
Locust	North	5198	2089	Partial	0/8 - 2/8	0/4
Locust	Broadway	5198	1056	No	0/8 - 0/8	0/4
Locust	Wayside	5198	872	No	0/8 - 0/8	0/4
Mulberry	Antietam	1760	3483	No	0/8 - 0/8	0/4
Mulberry	East	2599	2232	No	0/8 - 0/8	0/4
Mulberry	North	2599	2665	No	0/8 - 0/8	0/4

As can be seen in the table, none of the intersections fully satisfy Warrant 1 (8-hour Vehicular Volume) requirements. Most locations show 0 out of 8 hours meeting Conditions A or B, indicating that sustained daily volumes are ‘officially’ insufficient to justify signalization under this warrant. Limited partial significant volumes are observed at a few intersections (hi-lighted in blue), most notably Locust Street at Baltimore Street, which meets the warrant criteria for 1 to 3 of the 8 hours, and several other Locust Street locations that meet the criteria for 1 to 2 hours. These results indicate that while some intersections experience higher traffic volumes, they do not do so consistently throughout the day.

For Warrant 2 (4-hour Vehicular Volume), the findings are similarly limited. Nearly all intersections show 0 out of 4 hours meeting the warrant thresholds. The primary exception is Locust Street at Baltimore Street, which meets 3 of the 4 hours, representing the strongest support for signalization based on peak or concentrated traffic demand. Locust Street at Antietam Street also shows partially significant volumes, with 2 of 4 hours met, though this remains insufficient for a full warrant.





Along the Mulberry Street corridor, traffic volumes are generally lower than those on Locust Street. Major-street ADT ranges from 1,760 to 2,599 vpd, while side-street volumes range from approximately 560 to 3,483 vpd. As a result, none of the Mulberry Street intersections meet any partial hours of Warrant 1 or Warrant 2. Overall, the table indicates that volume warrants alone provide limited justification for continued traffic signal installation, with Locust Street at Baltimore Street standing out as the most supportable candidate based on vehicular volume criteria.



FIGURE 5: SUMMARY OF SIGNAL WARRANT ANALYSIS RESULTS

All-way Stop Control (AWSC)

Based on a study conducted by North Carolina Department of Transportation (see Figure 6), all-way stop control is considered to be the safest traffic control for intersections with single lane approaches with fewer than 5000 vpd. All-way stop control, where applicable





and warranted, is therefore being considered as the primary replacement option at locations where traffic signals may be considered for removal.

The referenced NCDOT Traffic Safety Unit criteria indicate that AWSC is typically the safest feasible intersection control for two-lane by two-lane intersections under lower-to-moderate traffic volumes. Specifically, intersections with major-street ADT below approximately 5,000 vpd (for injury-crash considerations) or 7,500 vpd (for all-crash considerations), combined with lower minor-street volumes, are expected to operate acceptably under AWSC without posing operational concerns.

Using these rules of thumb, intersections with ADT values at or below 4,000 vehicles per day on both approaches are generally anticipated to operate at acceptable LOS without the need for detailed capacity analysis. For intersections where one or both approaches fall within the 4,000 to 7,500 vpd range, Synchro LOS and capacity analysis is recommended to verify operational performance and to better understand delay, queueing, and peak-hour conditions. This approach ensures that AWSC remains operationally feasible and safe while providing quantitative support for intersections approaching the upper volume limits where additional analysis is warranted.

NCDOT Traffic Safety Unit Programs

- ❖ When considering INJURY crashes, AWSC is the safest feasible intersection design for 2-lane at 2-lane intersections where: Major street AADT is under 5,000 vehicles per day & Minor street AADT is under 5,000 vehicles per day.
- ❖ When considering ALL crashes, AWSC is the safest feasible intersection design for 2-lane at 2-lane intersections where: Major street AADT is under 7,500 vehicles per day & Minor street AADT is under 7,500 vehicles per day.

Under lower volume conditions, AWSC does not pose a threat to operations.

General rules of thumb regarding volumes:

- ❖ When the AADT on both roadways is 4,000 vehicles/day or less, the intersection is expected to operate at an acceptable level of service without the need for additional capacity analysis.
- ❖ When the AADT of either roadway is between 4,000 to 7,500 vehicles/day, or in unique situations with strong peak hours or directional volume, further capacity analysis may be warranted to verify operation and to know the scale of the expected delay.

- ❖ The upper limit for AWSC operations is when both roadways have AADT of 7,500 vehicles per day assuming typical conditions. Above these limits, the likely safest feasible intersection design is a single lane roundabout based on the SaFID chart.
- ❖ Turning movement counts may be needed at higher volume thresholds; however, Congestion Management Unit (CMU) may estimate these volumes from adjacent AADTs. Capacity analysis of AWSC is quick and easy, and CMU can assist with speedy turnarounds on requests.

FIGURE 6: NCDOT AWSC STUDY SUMMARY

All-Way Stop Control Warrant

An all-way stop control warrant analysis was conducted for all the study intersections to determine whether this traffic control option would be applicable, should the signal analysis result in a recommendation for signal removal. Since the study area was





centered within the densely developed urban area of the City of Hagerstown, with buildings typically located at the back of sidewalk, all of the intersections analyzed were determined to meet the sight distance warrant for all-way stop control. Table 3 reflects the outcome of the all-way stop control warrant analysis. Note that the intersections that partially met one hour or more of the traffic signal warrants are hi-lighted in blue.

TABLE 3: AWSC WARRANT ANALYSIS

Corridor	Sidestreet	ADT (vpd) Major St	ADT (vpd) Side St	All-Way Stop Warranted	8-Hour Volume Thresholds	Restricted Sight Lines
Locust	Lee	3925	1350	Yes	0/8	Yes (Buildings)
Locust	Baltimore	4400	5000	Yes	3/8	Yes (Buildings)
Locust	Antietam	4400	3483	Yes	0/8	Yes (Buildings)
Locust	East	5198	2636	Yes	3/8	Yes (Buildings)
Locust	Randolph	5198	1196	Yes	0/8	Yes (Buildings)
Locust	North	5198	2089	Yes	2/8	Yes (Buildings)
Locust	Broadway	5198	1056	Yes	0/8	Yes (Building)
Locust	Wayside	5198	872	Yes	0/8	Yes (Parking)
Mulberry	Antietam	1760	3483	Yes	0/8	Yes (Buildings)
Mulberry	East	2599	2232	Yes	0/8	Yes (Buildings)
Mulberry	North	2599	2665	Yes	0/8	Yes (Parking)

All-Way Stop Control Level-Of-Service (LOS)

An all-way stop control (AWSC) level of service (LOS) evaluation was conducted for all of the study intersections using Synchro 12, HCM 7th edition. Peak hour traffic volumes for each approach were used (even when they didn't occur in the same hour, they were input into the synchro model as if they did) in this analysis to reflect the most congested possible hour of the day and hence the worst level of service which might be experienced during the day. The analysis provides:

- Expected delay per vehicle (in seconds)
- Expected 95th percentile queue length (in number of vehicles)
- Operational level-of-service (LOS) for each intersection approach





Table 4 summarizes the AWSC LOS, delay, and queue length results for all of the study intersections along the Locust Street and Mulberry Street corridors, based on the Synchro analysis. Note that the intersections that partially met one hour or more of the traffic signal warrants are hi-lighted in blue. The Synchro analysis reports for all 11 intersections are provided in the appendix.

TABLE 4: AWSC ANALYSIS WITH LOS/DELAY

Corridor	Sidestreet	ADT (vpd) Major St	ADT (vpd) Side St	AWSC LOS/Delay (Corridor)	AWSC LOS/Delay (Sidestreet)	AWSC Queue Lengths Corridor/sidestreet
Locust	Lee	3925	1350	B / 11.1 sec	A / 8.5 sec	2.5 veh / 0.3 veh
Locust	Baltimore	4400	5000	C / 18.7 sec	B / 13.0 sec	5.0 veh / 2.2 veh
Locust	Antietam	4400	3483	C / 17.2 sec	B / 10.5 sec	5.2 veh / 1.0 veh
Locust	East	5198	2636	C / 17.2 sec	B / 12.3 sec	5.3 veh / 2.2 veh
Locust	Randolph	5198	1196	B / 13.9 sec	A / 9.4 sec	4.3 veh / 0.7 veh
Locust	North	5198	2089	C / 15.8 sec	B / 10.9 sec	4.9 veh / 1.5 veh
Locust	Broadway	5198	1056	B / 13.6 sec	A / 8.7 sec	4.2 veh / 0.3 veh
Locust	Wayside	5198	872	B / 13.6 sec	A / 9.0 sec	4.1 sec / 0.5 sec
Mulberry	Antietam	1760	3483	A / 8.7 sec	A / 8.7 sec	0.7 veh / 0.8 veh
Mulberry	East	2599	2232	B / 13.0 sec	B / 10.6 sec	3.4 veh / 1.5 veh
Mulberry	North	2599	2665	B / 13.6 sec	B / 11.5sec	3.5 veh / 2.0 veh

Along Locust Street, major-street ADT ranges from approximately 3,925 to 5,198 vpd, with side-street volumes generally lower, except at Baltimore and Antietam Streets. Overall, AWSC peak hour operations along Locust Street perform at LOS B to C on the corridor approaches, with average delays between 11 and 19 seconds. Side-street operations generally perform better, with most locations operating at LOS A or B and delays under 14 seconds, indicating acceptable stop-controlled performance.

Peak hour queue lengths along Locust Street are relatively short and manageable under AWSC conditions. Corridor queues range from approximately 2.5 to 5.3 vehicles, while side-street queues are less than 2.5 vehicles. Intersections such as Locust Street at Baltimore, Antietam, and East Streets show the highest corridor delays and queues, reflecting higher traffic demand, but still remain within ranges considered acceptable for





AWSC operations. Other locations, including Lee, Broadway, and Wayside Streets, exhibit LOS B or better with minimal queues, indicating efficient operation under stop control.

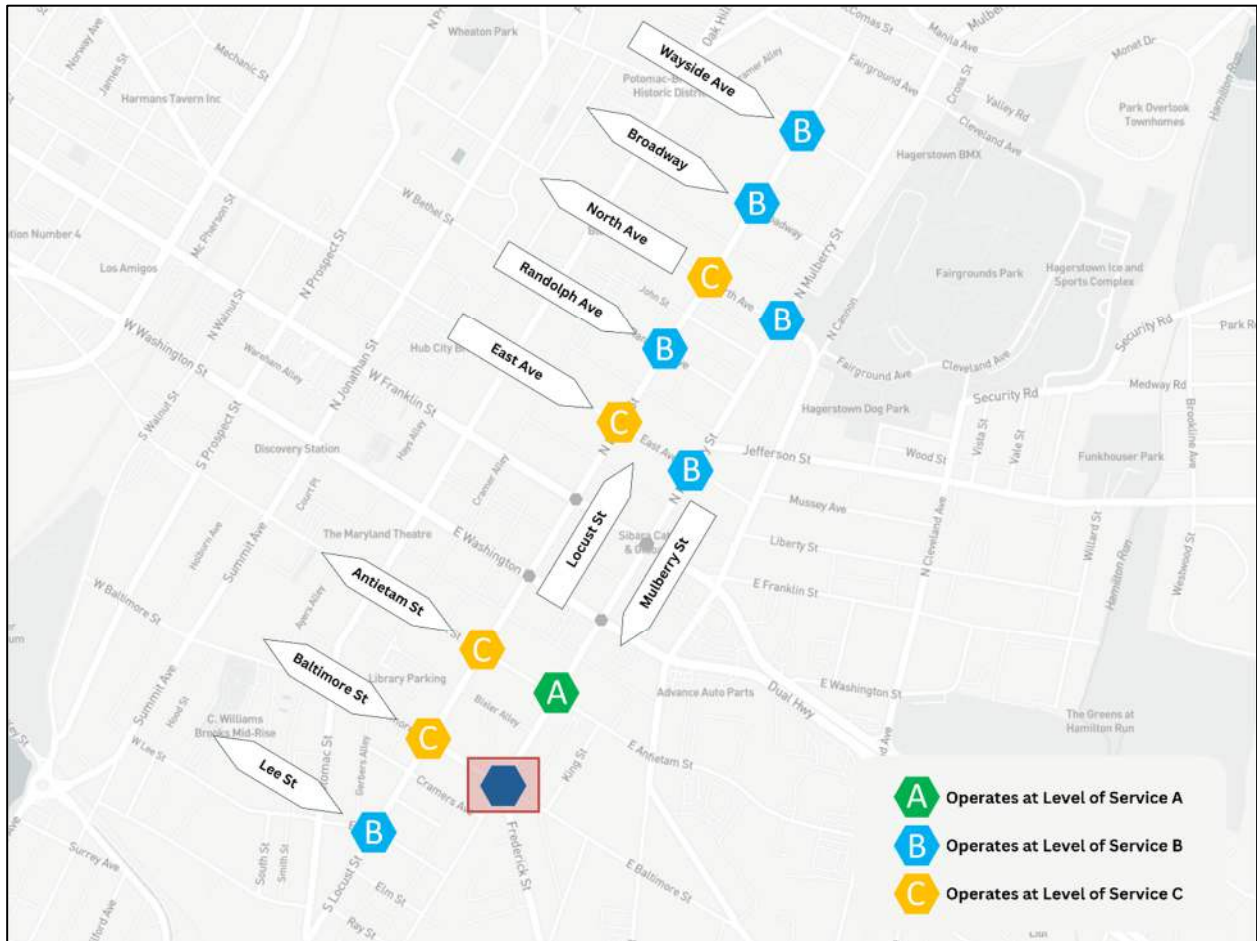


FIGURE 7: SUMMARY OF LOS/DELAY ANALYSIS RESULTS

Along the Mulberry Street corridor, traffic volumes are lower overall, and AWSC operations demonstrate good to very good performance. The analyzed intersections operate at LOS A or B for both corridor and side-street approaches, with average peak hour delays below 14 seconds. Queue lengths are short, ranging from less than 1 vehicle to about 3.5 vehicles, indicating minimal congestion and effective stop-controlled operation. This analysis shows that AWSC is operationally feasible.

In summary, the Synchro AWSC analysis indicates that most analyzed intersections operate at acceptable LOS with low delays and acceptable queues, supporting the feasibility of AWSC under existing traffic volumes. Even at higher-volume locations along





Locust Street, operations remain within acceptable thresholds, consistent with guidance that AWSC can function effectively at intersections with moderate traffic demand.

Analysis and Discussion

In analyzing the need and justification for signalization at the study intersections, traffic signal warrants, AWSC LOS, AWSC delay and AWSC queue lengths were analyzed. In general, traffic signal removal is recommended when traffic signals are no longer warranted. Replacement with all-way stop control provides the highest level of safety at intersections with low to moderate traffic volumes. Table 5 shows a summary of the outcomes of the traffic volumes, traffic signal warrants, all-way stop control warrants and all-way stop control level-of-service delay and queue lengths. The intersections recommended for the removal of the existing traffic signal and replacement with all-way stop control are hi-lighted in green.

TABLE 5: SIGNAL WARRANT AND AWSC ANALYSIS SUMMARY

Corridor	Sidestreet	ADT (vpd) Major St	ADT (vpd) Side St	Traffic Signal Warrants Met	All-Way Stop Warranted	All-Way Stop Avg Delay Corridor/sidestreet	AWSC Queue Lengths Corridor/sidestreet
Locust	Lee	3925	1350	No	Yes	11.1 sec / 8.5 sec	2.5 veh / 0.3 veh
Locust	Baltimore	4400	5000	Partial	Yes	18.7 sec / 13.0 sec	5.0 veh / 2.2 veh
Locust	Antietam	4400	3483	Partial	Yes	17.2 sec / 10.5 sec	5.2 veh / 1.0 veh
Locust	East	5198	2636	Partial	Yes	17.2 sec / 12.3 sec	5.3 veh / 2.2 veh
Locust	Randolph	5198	1196	Partial	Yes	13.9 sec / 9.4 sec	4.3 veh / 0.7 veh
Locust	North	5198	2089	Partial	Yes	15.8 sec / 10.9 sec	4.9 veh / 1.5 veh
Locust	Broadway	5198	1056	No	Yes	13.6 sec / 8.7 sec	4.2 veh / 0.3 veh
Locust	Wayside	5198	872	No	Yes	13.6 sec / 9.0 sec	4.1 sec / 0.5 sec
Mulberry	Antietam	1760	3483	No	Yes	8.7 sec / 8.7 sec	0.7 veh / 0.8 veh
Mulberry	East	2599	2232	No	Yes	13.0 sec / 10.6 sec	3.4 veh / 1.5 veh
Mulberry	North	2599	2665	No	Yes	13.6 sec / 11.5 sec	3.5 veh / 2.0 veh

As discussed in the introduction, Locust Street is the northbound part of the primary north-south one-way pair (MD 65) through the City of Hagerstown and experiences





significantly more traffic volume than the Mulberry Street corridor. The current signalization along Locust Street is operating as part of the City of Hagerstown Downtown Signal System and is reportedly programmed for progression north of Franklin St. For this reason recommendations to remove traffic signals at locations that are experiencing traffic volumes that would meet hourly traffic signal warrant thresholds for even part of some days may disturb the progression during those times and result in larger queues at the all-way stop control replacement, since the vehicles would likely be arriving in platoons. Analysis of this effect was beyond the scope of this study. Due to the possible unforeseen platooning effects during congested parts of the day, this study is not recommending removal of traffic signals at locations that experience a partial traffic volume warrant when the projected number of vehicles that would queue up at a replacement all-way stop would be five or more.

Conclusion

Based on the assessment of traffic signal warrants, AWSC LOS, AWSC delay, AWSC queue lengths and existing traffic operational characteristics at 11 signalized intersections along the Locust Street and Mulberry Street corridors in the City of Hagerstown, Maryland; seven intersections have been selected to consider traffic signal removal and replacement with all-way stop control. Those intersections are depicted in Figure 8 and are:

- Locust Street and Lee Street
- Locust Street and Randolph Avenue
- Locust Street and Broadway
- Locust Street and Wayside Avenue
- Mulberry Street and Antietam Street
- Mulberry Street and East Avenue
- Mulberry Street and North Avenue





FIGURE 8: SUMMARY OF SIGNAL CONVERSION TO AWSC RESULTS

To facilitate implementation of all-way stop control at the selected intersections, graphic representations of approach views to each of the seven intersections have been developed.

Safety enhancements to be considered at these intersections which are also depicted in the following graphics include:

- Installation of large (36" X 36") STOP signs (R1-1) on both sides of the approach (where possible)
- Installation of STOP bars (4' behind crosswalks on STOP approaches)
- High visibility crosswalks across all legs of each intersection
- Compliant ADA ramps at new crosswalk locations
- Removal of parking within 20 ft of all crosswalks (both sides of the streets, upstream and downstream)
 - Installation of No Parking signs



- Installation of hatched pavement marking
- Installation of red curb paint
- Enforcement of parking violations
- Installation of new double-sided ONE-WAY signs on opposing corners (facing vehicles and pedestrians)
- Installation of red reflective strips on stop sign posts at intersections that have a history of nighttime crashes:
 - Locust Street and Broadway
 - Mulberry Street and Antietam Street
 - Mulberry Street and East Avenue
 - Mulberry Street and North Avenue

As a demonstration project prior to the AWSC implementation, the City can consider placing the traffic signals at the selected intersections on all-red flash to simulate the all-way stop condition to thus observe resulting queue lengths. This will also allow observation of any potential disruption to progression on the Locust Street corridor prior to removal of the existing traffic signal equipment and full installation of all-way stop control.

If additional conspicuity for the all-way stop is found to be needed to draw motorist attention to the new/revised traffic pattern the following can be considered:

- Increased STOP sign size
- Red retroreflective strips on all STOP sign posts
- Border LEDs

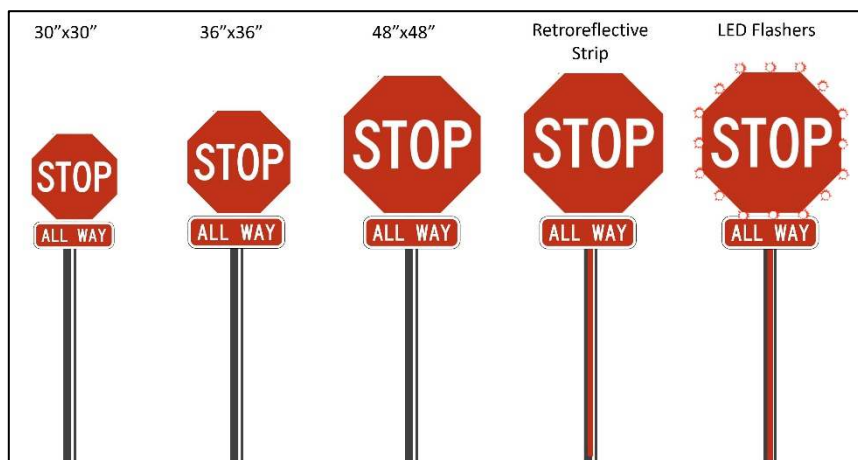


FIGURE 9: STOP SIGN CONSPICUITY FEATURES



Locust Street and Lee Street

Existing Condition - Northbound Locust St. Approach



Proposed AWSC condition - Northbound Locust St. Approach





Existing Condition – Eastbound Lee St. Approach



Proposed AWSC condition – Eastbound Lee St. Approach





Existing Condition - Westbound Lee St. Approach



Proposed AWSC condition - Westbound Lee St. Approach





Locust Street and Randolph Avenue

Existing Condition - Northbound Locust St. Approach



Proposed AWSC condition - Northbound Locust St. Approach

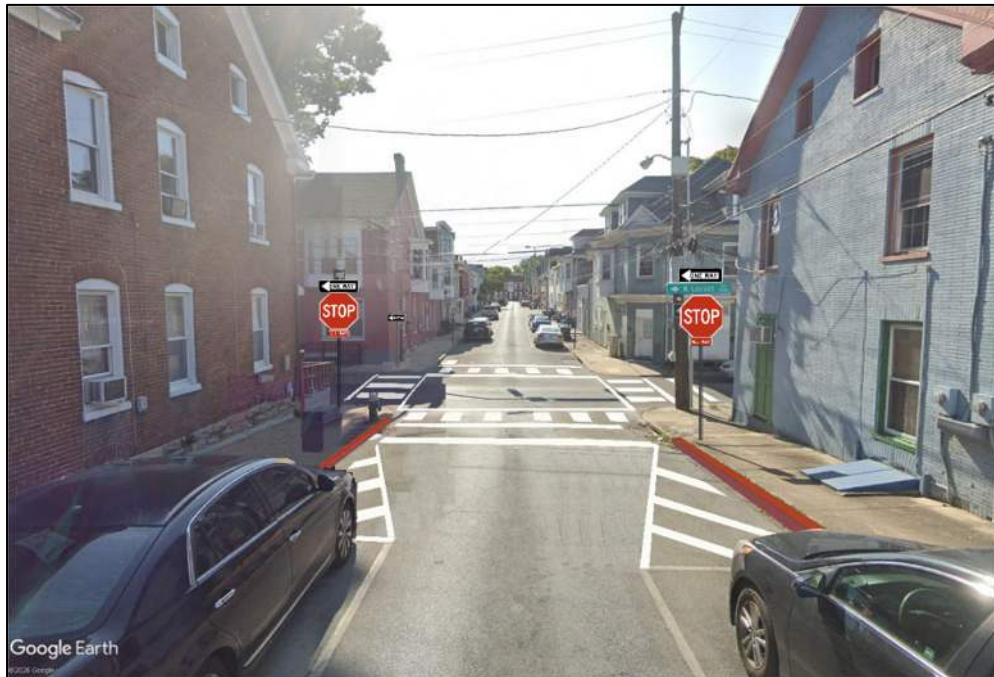




Existing Condition - Eastbound Randolph Ave. Approach



Proposed AWSC condition - Eastbound Randolph Ave. Approach





Locust Street and Broadway

Existing Condition – Northbound Locust St. Approach



Proposed AWSC condition – Northbound Locust St. Approach





Existing Condition - Eastbound Broadway St. Approach



Proposed AWSC condition - Eastbound Broadway St. Approach





Existing Condition - Westbound Broadway St. Approach



Proposed AWSC condition - Westbound Broadway St. Approach





Locust Street and Wayside Avenue

Existing Condition - Northbound Locust St. Approach



Proposed AWSC condition - Northbound Locust St. Approach





Existing Condition - Eastbound Wayside Ave. Approach



Proposed AWSC condition - Eastbound Wayside Ave. Approach





Mulberry Street and Antietam Street

Existing Condition - Southbound Mulberry St. Approach



Proposed AWSC condition - Southbound Mulberry St. Approach

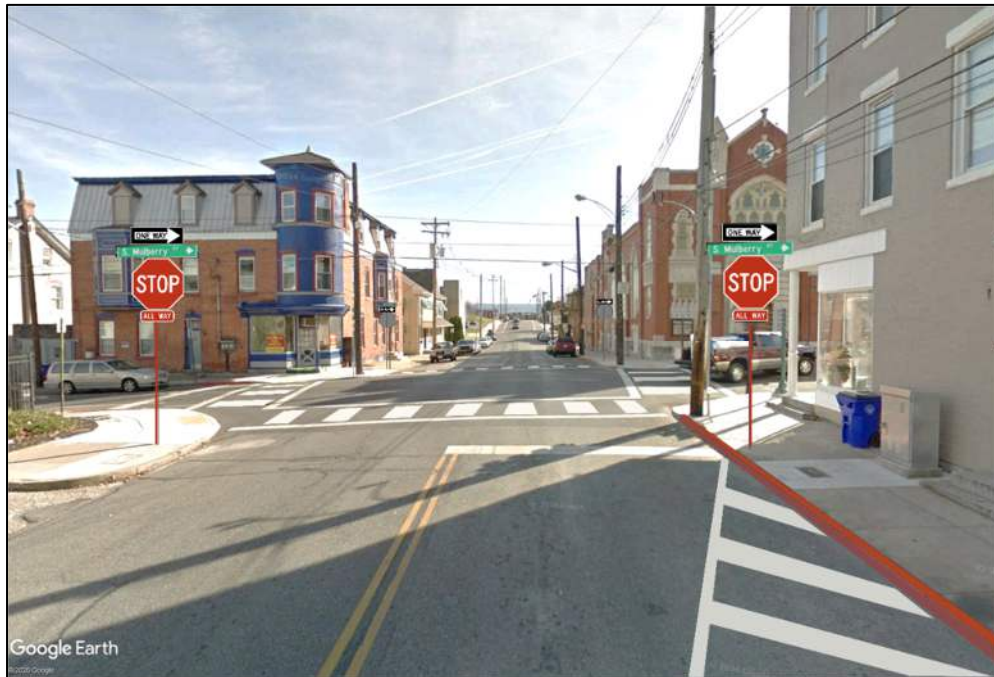




Existing Condition - Eastbound Antietam St. Approach



Proposed AWSC condition - Eastbound Antietam St. Approach





Existing Condition - Westbound Antietam St. Approach



Proposed AWSC condition - Westbound Antietam St. Approach





Mulberry Street and East Avenue

Existing Condition - Southbound Mulberry St. Approach



Proposed AWSC condition - Southbound Mulberry St. Approach





Existing Condition - Eastbound East Ave. Approach



Proposed AWSC condition - Eastbound East Ave. Approach





Mulberry Street and North Avenue

Existing Condition - Southbound Mulberry St. Approach



Proposed AWSC condition - Southbound Mulberry St. Approach





Existing Condition - Westbound North Ave. Approach



Proposed AWSC condition - Westbound North Ave. Approach





Appendix A: Traffic Signal Warrant Analysis Results



Appendix B: AWSC Synchro Analysis Results