Safe Streets for All Frederick County, MD

Rural Roads – High Injury Network Evaluation

PROJECT NUMBER R4664431-240579.01

February 14, 2025

PRELIMINARY

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Rural Roads Introduction & Methodology

Using USDOT's Safe Street for All (SS4A) program grant, Frederick County has progressed their commitment to transportation safety, specifically focusing on the most significant roadway safety concerns on rural roads, developing both local implementation and systemic strategies to achieve the goal of zero roadway deaths. The County identified several key approaches to achieving rural road safety, including:

1. *Systemwide Rural Road Data Analyses*
2. *Systemic Program Development*
3. *High Crash Location Analyses*

Systemwide Rural Road Data Methodology

Initially, the project team reviewed available data sources to quantify the safety data and ensure that all impacted populations were being adequately included in safety initiatives. Therefore, the first step was to develop a robust GIS crash data set and interactive map for analyses.

Developing robust GIS crash data set

Due to data set limitations by roadway and timeframe, the Team was asked to utilize two sets of crash data in the Safe Streets for All – Rural Roads analyses. By combining the following two data sets, a more complete data set was created to include all County roadways from 2015 – 2023.

- The statewide Maryland State Police (MSP) open-source data only provided crash data for 2019 through 2023. Further, the state data was missing some crashes on the lower-level County roadways.
- Frederick County's RAVEN data included crash data extending to 2015. However, the RAVEN data was missing crash data on state roadways.

In order to ensure data integrity and avoid any duplication, staff completed the following steps:

- The raw data was merged and processed in excel, deleting any duplicates.
- Then the data was joined in ArcMap to further (visually) ensure no duplicates.
- The crash data was clipped to county boundary, identifying major crash subsets, such as injury severity, lighting, etc., and symbolized by crash characteristics.
- Finally, a thorough QA/QC process ensured accuracy and no duplication.

Once a thorough, reliable data set was established, a geographic information system (GIS) was used to analyze and spatially visualize the data to (1) develop high-injury network (HIN), (2) identify raised pavement marker "hot spots", and (3) generate a low-volume roadway crash rate.

Systemic Program Development Methodology

Low Volume Rural Road Crash Rate

Due to their typically low crash occurrence, low-volume rural roadways may be overlooked by larger efforts which aim to maximize benefit-cost. However, through the methodology described below, the Team derived a crash rate to signify when low-volume rural roadway incidents warrant enhanced attention. Building on the initial robust GIS data set, the Team:

- Synthesized "rural" road classification from SHA's "Roadway Classification Map", as was done for the HIN effort, with Frederick County's Average Daily Traffic (ADT) data
- Defined "low volume" as 400 ADT or lower as these roadways tend to have very few crashes and even two or three crashes may be indicative of an underlying roadway issue
- Included crashes within 50-ft of the roadway to ensure run-off-road crashes were suitably captured.
- Developed table of crashes per mile for each roadway, excluding roadways with no crashes since if all rural roads with 400 ADT or less were included, then those with no crashes would artificially lower the overall crash rate.

Results:

- Generally, there were 411 miles of rural roads with 400 ADT on which there were 1,043 crashes which results in a crash rate of **2.5 crash/mile**.
- However, by focusing on only roadways with crashes (304.35 miles), the crash rate increased to **3.43 crashes / mile**.

Raised Pavement Markers

Raised Pavement Markers (RPMs) are an established countermeasure to provide highway alignment information to drivers during hours of darkness, particularly during inclement weather. However, due to their installation and maintenance costs, their installation should be methodical. After performing an industry literature review, focusing on FHWA, SHA, and other local Maryland policies, the Team developed a flowchart (see *Appendix A: RPM Flow Chart*) to guide Frederick County on the most effective placement of RPMs.

Rural Road Nighttime "Hot Spot" Methodology

Using the established flowchart, the Team reviewed the GIS data to identify the top "nighttime hot spots" following the methodology outlined below:

1. Spatially join crashes using GPS coordinates to the nearest rural road volume layer, which allowed for the capture of single vehicle crashes located beyond the roadway to be included in the analyses.

2. Generate "Mile_Point" data attributes for all the crashes that were submitted without this data. For roads outside of the MSP ACRS system, these mile points are unique to this analysis and cannot be compared with limits provided by other government data sources.

3. Once crash data alteration is completed in Arc Pro, the data was exported in tabular format and read into RStudio for statistical analysis.
4. A summary of the statistical analysis conducted included:
    a. Filter crash data to only night-time crashes, which were defined in the crash report as “dark no lights,” “dark lights on,” “dark – unknown lighting,” or “dark unknown lighting”.
    b. Generate mile-long “Segment ID’s” and assign them to crashes based on where they are located along the unique roadway segment. (This step ultimately allows for the calculation of crashes per mile)
        i. If MP = 0.3, then Segment = 1
        ii. If MP = 1.2, then Segment = 2
5. Summarize the crash data so that the number of crashes by each unique 1-mile roadway segment in the dataset is available.
6. Determine what the crash threshold is for a unique roadway segment to score in the top five percent of segments
7. Use this threshold to discard all roadway segments that are below the 95% threshold. The segments above the threshold are considered the hot spots for nighttime crashes within Frederick County’s rural road network.

Hot-Spot Night-time Crash Segments:

The following top 5% segments were identified using the methodology described above with those *italicized* including at least a portion of an identified high-injury network corridor:

1. **Fingerboard Road** from Michael Mills Rd to Hopeland Rd
2. ***Dance Hall Road*** *from Addison Run to Gas House Pike*
3. ***Gas House Pike*** *from 0.75 MI East of Progress Dr to Dane Hall Rd*
4. ***Sabillasville Road (MD 550)*** *from just North of Camp Airy Road to 0.7 MI S of Eylers Valley Flint Road*
5. ***Sabillasville Road (MD 550)*** *from 1000 ft North of Eylers Valley Flint Road to Foxville Deerfield Road*
6. **Buckeystown Pike (MD 85)** from Tuscarora Road to Greenfield Road
7. **Buckeystown Pike (MD 85)** from Locust Run to North of Adamstown Road
8. ***Gas House Pike*** *from Crickenberger Road to New London Road*
9. **Ballenger Creek Pike** from Doubs Road to Cap Stine Road
10. **Lander Road** from Point of Rocks Road to Fry Road
11. **Crum Road** from Liberty Road to Stauffer Road
12. **Green Valley Road (MD 75)** from Urbana Pike (MD 355) to Prices Distillery Road

13. **Green Valley Road (MD 75)** from Glissans Mill Road to Arlington Mill Road
14. **Liberty Road (MD 26)** from Israel Creek to Crum Road
15. ***Main St (MD 26)*** *from Daysville Road to Liberty East Run*
16. **Hamburg Road** from Gambrill Park Road to Fire Tower Road
17. **New Design Road** from B&O RR Crossing to Al-Firdan Memorial Gardens Entrance
18. **New Design Road** from Tuscarora Road to Nolands Ferry Road

As shown in italics, six (6) of the hot-spot nighttime crash segments occur within at least a portion of an identified high-injury network corridor. Accordingly, the high-injury network report includes recommendations to address the higher nighttime crash rates with either RPMs or street lighting as is appropriate.

High-Injury Network (HIN) Methodology

Crash Data Analyses

Building on the robust GIS crash data set, the Team honed the data, as described below, to focus on rural road that are often "overlooked" by traditional safety evaluations:

- Used Maryland State Highway Administration's (SHA) "Roadway Classification Map" to identify "rural" roads, largely excluding municipalities within Frederick County, such as City of Frederick, Urbana, etc.
- Focused efforts on arterial and lower classifications, which excluded interstates, such as I-70, I-270, etc.
- Excluded other larger roadways that have received more intensive reviews and funding support from other sources, such as US 15. While sections of US 15 meet the "rural" definition, this project seeks to emphasize roadways that are historically overlooked and trust that other sources evaluating US 15 will address safety concerns along this critical north-south spine.
- Used established GIS data set to identify road segments with more than 2 KSI / Mile

The HIN identifies the roadway segments in Frederick County, MD where a high number of fatal and serious injury crashes have been reported from 2015 through 2023 with thirteen (13) roadway segments identified for additional site review. **Table 1** highlights the HIN segments and general crash statistics.

Table 1: Summary of HIN Road Segments

Location	Main Road	From	To	Miles	KSI/mile	KSI
1	**Woodville Road**	Old Bohn Road	Emerson Burrier Road	4.4	1.6	7
2	**MD 550 (Church St/ Sabillasville Road)**	Woodside Ave	1 mi N of Old Camp Airy Road	2.42	2.1	5
3	**MD 26 in Libertytown**	1/4 mi E of Louise St	Liberty East Run	1.37	3.7	5
4	**MD 550 (Sabillasville Road)**	250 ft N of Bentzel	3/4 mi N of Eylers Valley Flint Road	3.09	1.6	5
5	**Old Frederick Road**	New Cut Road	Orndorff Road	3.8	1.3	5
6	**MD 85 (Buckeystown Pike)**	Lily Pons Road	750 ft. E of Tuscarora Road	2.68	1.5	4
7	**Gas House Pike**	E. Progress Dr	MD 75	7.7	1.1	8
8	**Harp Hill Road**	750 ft S of Church Hill Road	S of Woodland Way Road	2.93	1.4	4
9	**Big Woods Road**	Big Woods Ct	Fingerboard Road	1.19	2.5	3
10	**Mountaindale Road**	Stull Road	1.28 mi west	1.28	1.6	2
11	**Mountville Road**	Ballenger Creek Pike	Catoctin Mountain Hwy	1.65	1.8	3
12	**Ball Road**	Reels Mill Road	1,830 ft west	0.35	5.7	2
13	**Dance Hall Road**	Gas House Pike	3,740 ft north	0.71	2.8	2

HIN Corridor Evaluation

The following steps have been followed to identify the safety strategies or countermeasures that can be implemented for each of the roadway segments on the HIN:

1. Identify the main crash attributes to be considered for each roadway segment. These attributes include Type of crash, By Year, Time of day (TOD), Lighting, Junction, Collision Type, Surface, Fixed Object, Weather, and Harmful Event.
2. Geolocate the crash data by latitude and longitude using a GIS map.
3. Locate clusters of crashes and initially review the cluster locations using google maps street view.
4. Identify possible countermeasures for combating crashes using tools like Federal Highway Administration (FHWA) Proven Safety Countermeasures, Crash Modification Factor Clearinghouse, and engineering judgement.
5. Perform data collection, field visits and safety analyses to investigate the possible countermeasures.
6. Provide final recommendations on the proposed countermeasures and associated crash reduction factors (CRF), based on the safety analyses.

The following sections of the report discuss the results for each of the roadway segments/locations.

Improvement Prioritization & Implementation

The study identifies a variety of short-, mid-, and long-term opportunities to address safety issues along the HIN corridors.

- *Low-Cost improvements* can be implemented quickly to improve safety in targeted areas. The proposed improvements primarily consist of signing and pavement marking upgrades which have been shown to increase driver awareness.
- *Mid-Cost improvements* include projects that may take time to design or additional financial resources to implement. These tools include rumble strips, pavement markings that may not be readily available in the shop, etc.
- *High-Cost improvements* are typically more expensive projects that may take many years to plan and implement. These projects may include new traffic signals, roundabouts, and changing geometric curb space. While these improvements involve greater expense and time, they can potentially yield the greatest safety benefits.

Location 1: Woodville Road

- The study corridor segment is 4.4 miles from Old Bohn Road to Emerson Burrier Road
- The posted speed limit is 40 MPH, which is signed consistently throughout the corridor.
- Woodville Road is an open section roadway that includes two 10-ft travel lanes. The corridor is composed of numerous horizontal and vertical curves.
- Woodville Road provides a connection between arterial corridors MD 26/Liberty Road and former MD 144/Old National Pike and serves as access to a number of residences.

Crash History

- *Total Crashes*: 37
- *Crash Severity*: 12 Injury Crashes (35% of corridor crashes) + 1 Fatal Crash
    - Fatal: On September 23, 2022, an angle collision at the two-way stop controlled Woodville Road and Harrisville Road resulted in a fatality, when the Harrisville Road motorist failed to stop at the stop sign and yield to the Woodville Road motorist.
- *Time of Day*: 17 (46%) of all crashes occurred between 3PM and 9PM

Intersection Crash Trend: A total of 13 (35%) intersection crashes, including one fatality at Harrisville Road, were reported on the study corridor. The intersection crashes occurred at:

- *Talbot Run Road* – 9 crashes, including 4 intersection related collisions. Seven accidents resulted in hitting fixed objects. Two were head on collisions.
- *Harrisville Road* – 7 crashes, including 5 intersection related collisions. One crash resulted in a fatality; 3 were angle collisions. Four accidents were the result of failure to yield or obey traffic signals and one due to aggressive driving/speeding.
- *Glissans Mill Road* – 7 crashes, including 3 intersection-related and 2 head-on collisions.

Single Vehicle Crash Trend: There were 19 (51%) single vehicle crashes reported with 11 of the single vehicle crashes reported under dark or low light conditions.

- Talbot Run Road vicinity – 6 crashes, all resulted in hitting stationary objects and 3 occurred on wet/icy roadway conditions.
- Glissans Mill Road – 4 crashes, two resulted in hitting fixed objects and two vehicles traveled off the road

As shown in **Figure 1**, these collisions occur throughout the study corridor.

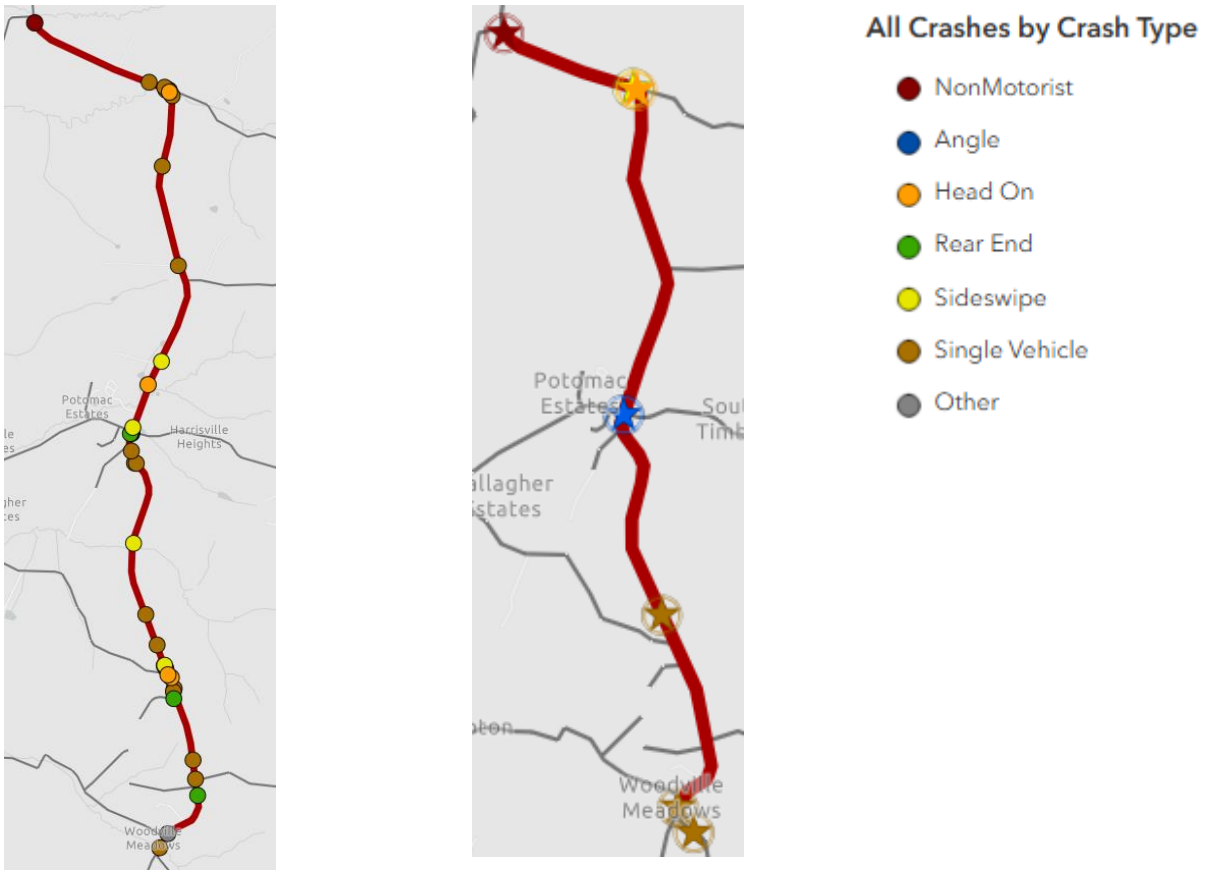


Figure 1: Woodville Road – All Crashes (left) and KSI only (right)

Traffic Analyses

Sight Distance

Ensuring both approaching and turning motorists have adequate sight distance is critical to avoid angle collisions. The AASHTO *green book* was referenced to assess sight distance adequacy. **Table 2** shows that all minimum sight distances are met at the critical intersections within the study corridor.

Table 2: Intersection Sight Distance – Woodville Road

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		385 ft	445 ft
Woodville Road at Harrisville Road			
Harrisville Road - EB	At Stopline	490’	515’
	At Edgeline	750’	515’
Harrisville Road - WB	At Stopline	290’	>1,000’
	At Edgeline	340’	>1,000’
Woodville Road at Talbot Run Road			
Talbot Run Road – NB	At Stopline	400’	>1,000’

[1]Requirement based on 40 MPH

Curve Study

Establishing the proper advisory speed for a curve is a critical step in ensuring the safety on roadways. A ball bank field assessment was completed to determine the appropriate advisory speed limit at Woodville Road and Talbot Run Road under clear, dry conditions on October 3, 2024.

Table 3: Curve Study Summary – Woodville Road

Travel Speed	NB Ball Bank Reading	SB Ball Bank Reading
40 MPH	20°	15°
30 MPH	11°	9°

For speeds of 25 – 30 MPH, the MUTCD recommends readings of 14° or less; therefore, a **30 MPH advisory speed limit** is appropriate for Woodville Road at Talbot Run Road.

Field Observations

- Woodville Road motorists appear agitated by motorists driving at the speed limit as shown by tailgating.
- Woodville Road at Harrisville Road
    - Harrisville Road approaches include both in-pavement "Stop Ahead" and advance warning signs.
    - Northbound Woodville Road includes an intersection warning sign with street name plaque and 25 MPH advisory speed limit plaque.
- Woodville Road at Talbot Run Road
    - Southbound Woodville Road approach includes a "turn" warning sign with a supplemental 30 MPH advisory speed limit plaque. No advanced advisory speed limit signing is provided on northbound Woodville Road approaching Talbot Run Road.
    - Chevrons and guardrail are present along both sides of Woodville Road through the Talbot Run Road curve, south of the intersection.

Recommended Improvements

Low Cost

- Install 10-inch wide edgelines along Woodville Road corridor to increase visibility of roadway edge.
- Install edgeline extensions on Woodville Road at Shirley Bohn Road to maximize available sight distance.
- Install advanced "Turn" warning (W1-1) sign with "Talbot Run Road" street name plate and 30 MPH advisory speed limit plaque (W13-1P) on northbound Woodville Road in advance of Talbot Run Road.
- Install reflective delineators along all guardrails to increase visibility of roadway edge.
- Install reflective tape on all sign posts, especially at:
    - Harrisville Road stop signs

- NB & SB Woodville Road turn warning signs approaching Talbot Run Road

Mid-level Cost

- Cut trees on east side of Woodville Road south of Harrisville Road to increase westbound Harrisville Road sight distance
- Install centerline rumble strips and edgeline rumble stripes along corridor to reduce head on, sideswipe and single vehicle run off road crashes, prioritizing the following sections:
  - #8103 Woodville to #8219, which includes the Talbot Run Road intersection
  - North of Glissans Mill Road to Mitchell Court
- Install "SLOW" and arrow in-street pavement markings on the Woodville Road approaches to Talbot Run Road.
- If low-cost improvements don't address single vehicle and dark lighting crash trends, install snow-plowable, permanent raised pavement markers (RPMs) along the entire corridor, to reduce the number of crashes occurring during dawn/dusk/nighttime hours.

Location 2: MD 550 (Church Street/Sabillasville Road)

- The 2.42-mi corridor continues from Woodside Ave to 1 mile north of Old Camp Airy Road.
- Speed Limit: starts as 40 mph from the northern end of the corridor before reducing to 35 mph near Catoctin High School and finally reducing to 25 mph near the intersections with the US 15 on/off ramps.

Crash History

- *Total Crashes*: 77
- *Crash Severity*: 28 Injury Crashes + 0 Fatal Crash
- *Statistics*: 36% of corridor crashes resulted in injury
- *Time of Day*: 32 (42%) of all crashes occurred between 12PM and 6PM

Rear End Crash Trend:

A total of nine (9) same direction rear end crashes were reported near the intersection of Sabillasville Road and the ramps to/from US 15.

Single Vehicle Crash Trend:

There were 44 (57%) single vehicle crashes reported with 26 (34%) occurring on wet/icy surface along this corridor (most of the wet surface crashes occurred at or near the horizontal curves on this corridor).

Figure 2 below shows the reported crashes along Church St/Sabillasville Road, categorized by crash type.

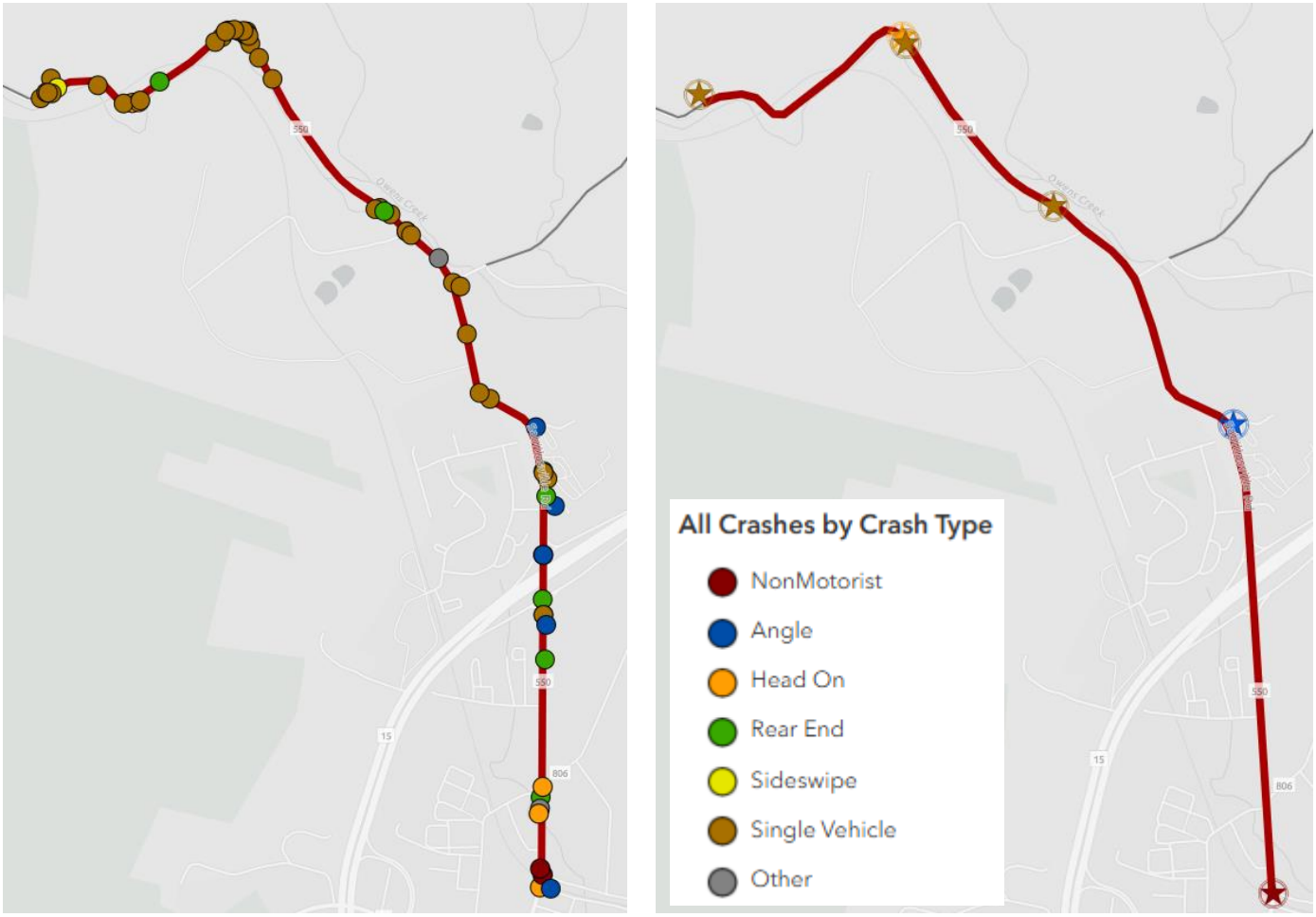


Figure 2: MD 550 / Church Street – All Crashes (left) and KSI Only (right)

Field Observations

- Missing curve warning signage (W1-2) at the horizontal curves near Old Camp Airy Road and the near the geographical coordinates, 39.65077728629942, -77.4218309917171.
- Faded hatching yellow pavement marking lines near the intersections of MD 550 (N Church St) and the US 15 on/off ramps.
- There is an existing driver speed feedback sign (25 MPH) located near the intersection of MD 550 (N Church St) and the US 15 eastbound off ramp.

Figure 3: Existing digital 25 MPH speed limit sign near the intersections of MD 550 (N Church St) and US 15 EB off ramp

Traffic Analysis

Speed Study:

A speed study was conducted on 10/9/2024 near the intersection of MD 550 and the ramps to/from US 15 and near the existing digital 25 MPH speed limit sign (see **Figure 3** above). The table below shows the results of the speed study:

Table 4: Speed Study Summary – MD 550/Church St

	NB	SB
Posted	35	25
Average	35	36
85th Percentile	38	40
10 MPH Pace	31-40	33-42
% Enforceable [1]	1%	62%

[1]Traveling more than 10 MPH over the posted speed limit

Recommended Improvements

Low Cost

- Install a W3-5 (speed reduction) warning sign in advance of the existing driver speed feedback sign and co-located 25 MPH speed limit sign.
- Request police enforcement of the speed limit near the intersection of MD 550 (N Church St) and the US 15 ramps.
- Install turn/curve warning signs (chevron alignment, one direction, and turn ahead) at all the horizontal curves along this corridor.
- Consider transverse rumble strips in advance of sharpest curve to better alert motorists to sharp horizontal alignment.
- Improve pavement markings near the intersections of MD 550 (N Church St) and the US 15 ramps to include the installation of yield lines, hatching, and centerline/edgeline extension line pavement markings.
- Refresh edge line pavement markings near Catoctin High School, using wider (10-inch) pavement marking lines, to reduce the frequency of fixed object (utility pole) crashes.

Mid-level Cost

- Install High Friction Surface Treatment to reduce the number of wet surface crashes at/near the horizontal curves along this corridor – these locations can be good candidates for testing high-friction surface treatment.
- Install snow-plowable, permanent raised pavement markers (RPMs) along the entire corridor, to reduce the number of crashes occurring during dawn/dusk/nighttime hours. ***Please note that per the Maryland State Highway Administration, RPMs are already scheduled to be installed on MD 550 following a recent pavement resurfacing project that was completed in 2024***.

Location 3: MD 26 (Liberty Road)

- The study corridor segment is 1.37 miles from 0.25-mi east of Louise Street to Liberty Terrace.
- The posted speed limit is 30 MPH and the speed limit is signed consistently throughout the study segment.
- MD 26 / Liberty Road is a mix of open, partial and closed section roadway with curb lines starting and stopping throughout the section.
- The section of MD 26/Liberty Road largely includes two travel lanes with on-street parking permitted on the south side.
- MD 26/Liberty Road connects the City of Frederick to Baltimore City via Libertytown and Eldersburg.

Crash History

- *Total Crashes*: 64
- Crash Severity: 16 Injury Crashes + 0 Fatal Crashes
- Statistics: 25% of corridor crashes result in injury
- Time of Day: 42% of all crashes occurred between 3PM and 9PM

Angle / Intersection Crash Trend: A total of 44 (69%) intersection crashes were reported on the study corridor and 22 angle collisions were intersection related. The majority of intersection crashes occurred at:

- MD 550/Mill Street/Woodsboro Road – 21 intersection crashes, which all occurred between 2019 and 2023. Intersection crash types included 17 angles, 2 “other”, 1 head on, and 1 rear end collision.
- MD 75/Church Street/Walnut Street experiences an influx of crashes beginning in 2020. There were 18 intersection crashes between January 2020 through December 2023. Crash types included 4 single vehicle, 3 left turns, 3 sideswipes, 2 angles, 3 rear end, and 2 “other”.

Single Vehicle Crash Trend: There were 11 (17%) single vehicle crashes reported with 6 of the single vehicle crashes reported under dark or low light conditions.

As shown in **Figure 4**, these collisions occurred throughout the study corridor.

Figure 4: MD 26/Liberty Road – All crashes (above) and KSI only (below)

Traffic Analyses

Speed Analysis

A spot speed study, using a radar gun, was conducted on January 15, 2025 on MD 26/Liberty Road west of Liberty Elementary School and in Libertytown at Trammels Alley (east of MD 550). Generally, traffic is traveling near the posted speed limit. The results of the speed study, shown in **Table 5** below, indicate that most motorists are traveling near the posted speed limit.

Table 5: Speed Study – MD 26/Liberty Road

	MD 26 west of Liberty ES		MD 26 at Trammels Alley	
	EB	WB	EB	WB
Posted	55 MPH	55 MPH	30 MPH	30 MPH
Average	53 MPH	51 MPH	33 MPH	35 MPH
85th Percentile	58 MPH	55 MPH	37 MPH	39 MPH
10 MPH Pace	50 – 59 MPH	47 – 56 MPH	27 – 36 MPH	29 – 38 MPH
% Enforceable [1]	0%	0%	2%	10%

Intersection Sight Distance:

A sight distance analysis was done at the intersection of MD 26/Liberty Road and MD 550/Woodsboro Road/Mill Street. **Table 6** shows adequate sight distance looking to the left, but northbound Mill Street sight distance is limited looking right, even when pulling up to the edgeline. **Figure 5** shows the obstructions for northbound Mill Street looking right.

Table 6: Intersection Sight Distance for MD 26/Liberty Road at MD 550/Woodsboro Road/Mill Street

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		290 ft	335 ft
NB Mill Street	At Stop line	**175 ft**	**225 ft**
	At Edge line	955 ft	**225 ft**
SB MD 550/ Woodsboro Road	At Stop line	**160 ft**	**130 ft**
	At Edge line	**230 ft**	840 ft

[1]Requirement based on 30 MPH (posted speed limit)

Figure 5: NB Mill Street at MD 26 – looking right (Note: utility pole, shrubbery and topography restricting available sight distance)

Field Observations

- Utility poles with leased street lighting consistently run along the southside of MD 26 / Liberty Road through Libertytown. There are many poles on the northside as well
- Existing signing along the corridor includes:
    - Eastbound MD 26/Liberty Road
        - A sidestreet/curve warning combination sign with supplemental street name plate is present for the South Street and Daysville Road intersections
        - Cross Road (W2-1) with supplemental street name plate is present for "Woodsboro Road / Mill St" as shown below

Figure 6: Eastbound MD 26/Liberty Road – Advanced cross road warning sign and street name plate

        - A "JCT MD 75" sign is the only advance eastbound MD 26 signing for the traffic signal at MD 75/Church St/Walnut St. However, the roadway is straight and the signal has adequate advanced sight distance.
- MD 26/Liberty Road at MD 75/Church St/Walnut St/Green Valley Road:
    - Each approach includes a single lane. Eastbound MD 26/Liberty Road operates with permissive phasing. Westbound MD 26 includes exclusive/permissive left-turn phasing. Northbound Walnut St and southbound Church St are split phased.
    - Pedestrian crosswalks and signalization are provided on the north, east and west legs.
    - Eastbound and westbound MD 26 right-turns on red are prohibited.
    - Intersection stop lines are pulled back from the intersection to allow heavy vehicles to safely maneuver through the intersection. A "Stop Here on Red" sign is provided for motorists.
    - Northbound Walnut St and southbound Church St include "Signal Ahead" warning signs.
- MD 26/Liberty Road at MD 550/Woodsboro Road/Mill Street:
    - Despite the advanced crossroad warning signs with supplemental name plate signs and route markers at the intersection, this intersection is easily overlooked by MD 26/Liberty Road motorists due its position at a vertical crest and the tightly spaced buildings both at and approaching the intersection.

- Southbound MD 550/Woodsboro Road motorists stopped at the stopline or just beyond must look "through" a residential porch to see oncoming eastbound MD 26 traffic, as shown in photo below.

Figure 7: Eastbound MD 26/Liberty Road at MD 550 intersection

Recommendations

Low Cost

- Install "Signal Ahead" warning signs on eastbound and westbound MD 26 approaching MD 75 with supplemental street name plates.
- Install edgeline extensions on MD 26 at MD 550/Woodsboro Road/Mill Street to maximize sidestreet motorists' sight distance.
- Install reflective tape on utility poles along southside of MD 26 from Artie Kemp Road to start of guardrail (approximately _1600-ft) pole for added nighttime edge of road visibility

High Cost

- Evaluate corridor street lighting and upgrade or supplement, where needed. MD 26/Main Street from Daysville Road to Liberty East Run was identified as "hot-spot nighttime crash segment".
- Install advanced vehicle detection at MD 26/Liberty Road and MD 75.
- Perform full intersection evaluation for all-way stop or traffic signal control at MD 26 and MD 550/Woodsboro Road/Mill Street to address angle collisions and limited intersection sight distance.
- Implement streetscape project, similar to New Market, adding consistent curb and gutter, sidewalks, crosswalks, pedestrian lighting within Libertytown, specifically from Liberty Elementary School to Libertytown Park, to better delineate space for each roadway user – motorists, parked vehicles, pedestrians, and bicyclists.
- *Long-Term*: Frederick County has proposed a Libertytown Connector to link MD 75 to MD 550 north of MD 26 to reduce the amount of truck and automobile traffic through town.

Location 4: MD 550 North (Sabillasville Road)

- This corridor section extends from 240 feet north of the intersection with Bentzel Road to 0.75-mi north of Eylers Valley Flint Road.
- The speed Limit along this section of Sabillasville Road is 30 MPH.

Crash History

- *Total Crashes*: 44
- *Crash Severity*: 15 Injury Crashes + 0 Fatal Crash
- *Statistics*: 34% of corridor crashes resulted in injury

Lighting: Twenty (20) of the crashes (45%) occurred under dark or low-light conditions.

Single Vehicle Crash Trend: There were 34 (77 %) single vehicle crashes reported of which 16 (36 %) occurred under dark or low light conditions. While single vehicle crashes occurred throughout the corridor, clusters of single vehicle crashes occurred near the horizontal curve at Foxville-Deerfield Road.

Figure 8 below shows the reported crashes along Sabillasville Road.

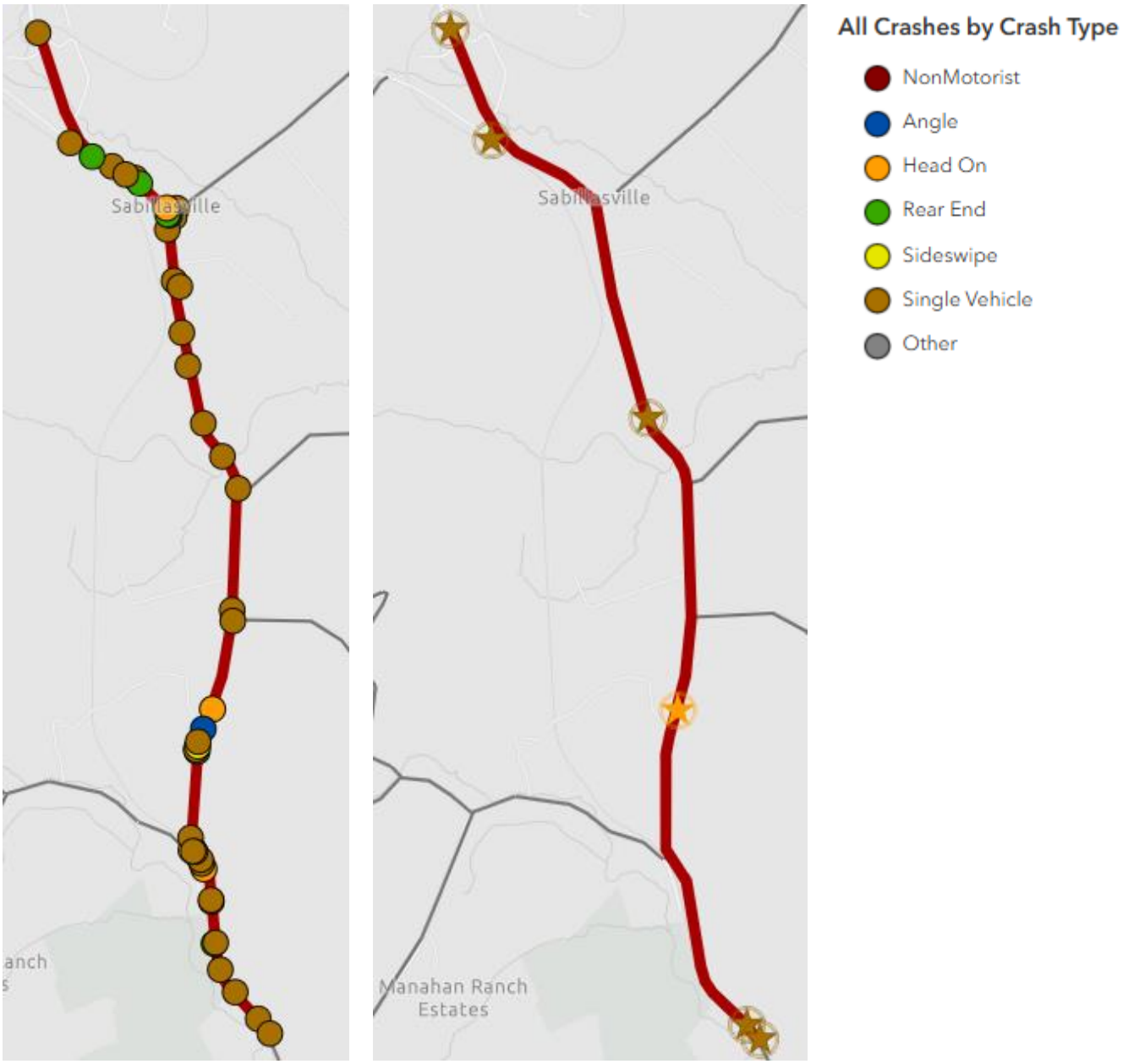


Figure 8: MD 550 / Sabillasville Road – all crashes (left) and KSI only (right)

Field Observations

- Sabillasville Road includes a number of horizontal curves and vertical crests.
- Pavement markings at the following intersections look faded and were not clearly visible: Sabillasville Road at Foxville Deerfield Road, and Sabillasville Road at Harbaugh Valley Road.
- The intersection of Sabillasville Road and Foxville Deerfield Road is very skewed in geometry – this T-intersection is stop controlled on the main street (Sabillasville Road) and uncontrolled on the side street (Foxville Deerfield Road). There is a railroad crossing on the Foxville Deerfield Road that is approximately 20 ft away from the edge of Sabillasville Road.

There are also existing flashing beacons, stop ahead and railroad crossing ahead warning signs in advance of the Sabillasville Road and Foxville Deerfield Road intersection.

Figure 9: Sabillasville Road and Foxville Road Intersection

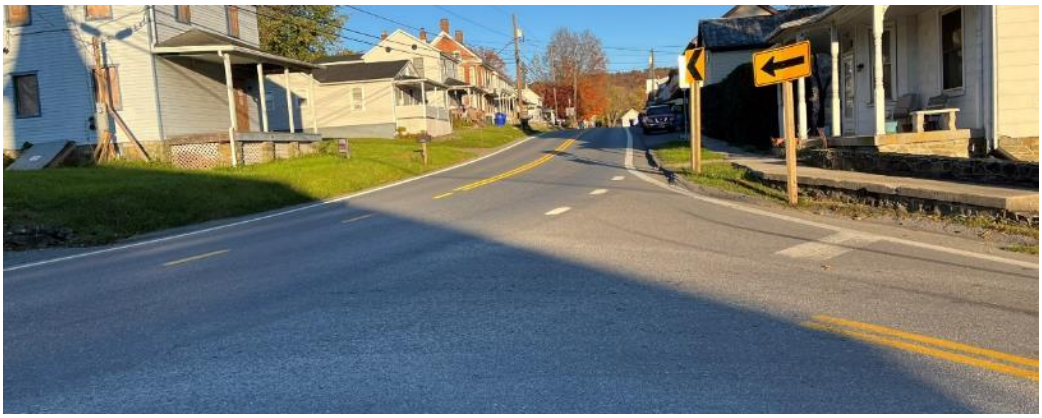


Figure 10: Poorly visible pavement markings (Sabillasville Road and Harbaugh Valley Road Intersection)

Traffic Analysis

Intersection Sight Distance

Due to the horizontal and vertical roadway curvature, there is limited sight distance on Sabillasville Road approaching Foxville Deerfield Road. **Table 7** summarizes the available sight distance.

Table 7: Stopping Sight Distance at the intersection of Sabillasville Road and Foxville Deerfield Road

Approach	AASHTO Requirement[1] (ft)	Available Sight Distance (ft)
NB Sabillasville Road	354	250
SB Sabillasville Road	354	380

[1]Requirement based on 40 MPH (posted speed limit) and 9% downgrade.

Please note that there are already existing advance warning signage and a flashing beacon on northbound Sabillasville Road, to address the inadequate sight distance.

Recommended Improvements

Low Cost

- Refresh the existing stop line and edge line pavement markings at the intersection of Sabillasville Road and Foxville Deerfield Road.
- Install dotted centerline extension pavement markings at the intersection of Sabillasville Road and Foxville Deerfield Road.
- Refresh the existing stop line and edge line pavement markings at the intersections of Sabillasville Road and Harbaugh Valley Road.
- Replace the existing 30 inches by 12 inches W4-4a(1) signs (Traffic from Right/Left does not stop) at the intersection of Sabillasville Road and Foxville Deerfield Road, with larger signs (36 inches by 15 inches), to improve the visibility of the warning signs.

Mid-level Cost

- Consider High Friction Surface Treatment at the Sabillasville Road and Foxville Road intersection since 3 out of the 8 intersection crashes were on wet surface.
- Install snowplowable, raised pavement markers (RPMs) along the entire corridor, to reduce the number of dark no light crashes. *Follow up discussions with Maryland State Highway Administration confirmed that SHA will be re-installing RPMs following a recent pavement resurfacing project that was completed in 2024.*

Long-term Improvements

- Perform a full traffic study to determine the appropriate traffic control device application at the Sabillasville Road and Foxville Deerfield Road intersection (e.g., all-way stop control, full signal, roundabout, etc).

Location 5: Old Frederick Road

- The 3.8-mile corridor begins at New Cut Road and continues to Orndorff Road.
- Speed Limit: 40 mph.

Crash History

- *Total Crashes*: 33
- *Crash Severity*: 4 Injury Crashes + 1 Fatal Crash
- *Statistics*: 15% of corridor crashes resulted in injury or fatality
    - Fatal: On May 03, 2020, single vehicle collision at Old Frederick Road and Old Mill Road resulted in a fatality, when the motorist hit a tree

Lighting: Fourteen (14) of the crashes (42%) occurred under dark or low-light conditions**. Figure 11** (at right) highlights the dark (navy blue) and low-light (gray) collisions north of Mud College Road, especially within the curve.

Figure 11 (Right): Dark (navy blue) and Low light (gray) crashes along Old Frederick Road from Mud College Road northward

Single Vehicle Crash Trend: There were 27 (82%) single vehicle crashes reported, including 9 under dark conditions. The majority (21) of single vehicle collisions involved striking fixed objects. Locations with the highest number of collisions are as follows:

- Mud College Road – 8 crashes, 5 involved hitting fixed objects
- Rocky Ridge Road – 4 crashes, all occurred during daylight and resulted in hitting fixed objects
- Old Mill Road – 4 crashes, 3 involved hitting fixed objects

Figure 12 below shows the reported crashes along Old Frederick Road, categorized by crash type.

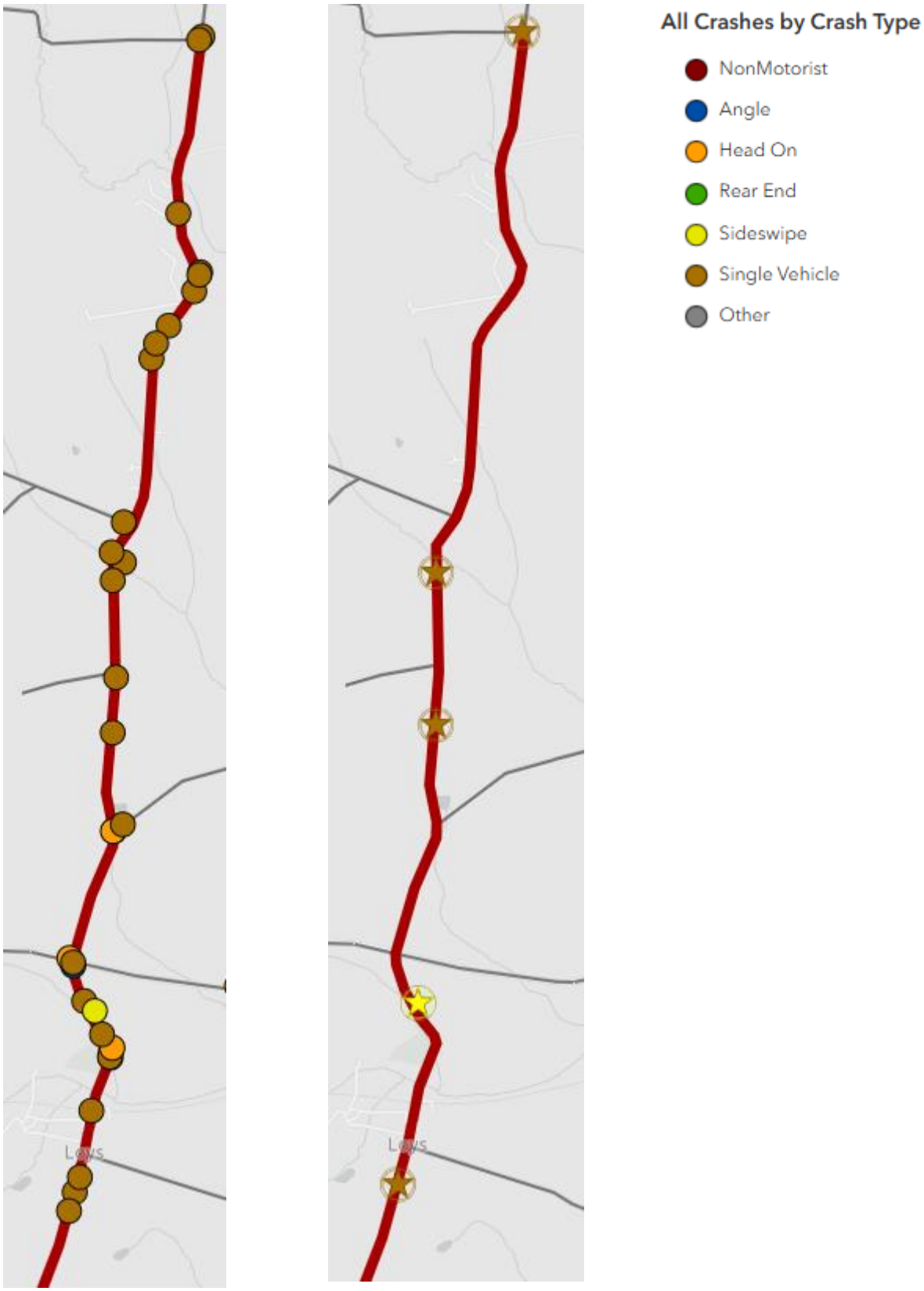


Figure 12: Old Frederick Road – all crashes (left) & KSI Only (right)

Field Observations

- Missing speed limit advisory plaques at curve warning signs.
- The intersection of Old Frederick Road and Rocky Ridge Road is very skewed in geometry.
- Numerous trees are present in the roadway clear zone near the address, 14726 Old Frederick Road, Rocky Ridge, MD 21778.

Figure 13: Intersection of Old Frederick Road and Rocky Ridge Road

Traffic Analysis

Sight Distance

A sight distance analysis was done at the intersection of Old Frederick Road and Rocky Ridge Road. **Table 8** shows adequate sight distance looking to the right, but northbound Old Frederick Road sight distance is limited looking left, even when pulling up to the edgeline.

Table 8: Intersection Sight Distance for Old Frederick Road at Rocky Ridge Road

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		480 ft	555 ft
NB Old Frederick Road	At Edge line	385 ft	900 ft
SB Old Frederick Road	At Stop line	500 ft	830 ft

[1]Requirement based on 50 MPH (posted speed limit)

There is an existing "stop sign ahead" warning sign on northbound Old Frederick Road and a "Cross Road" warning sign with supplemental road name plaque on eastbound Rocky Ridge Road.

A ball bank indicator was used to determine the curve advisory speed at the following two locations on Old Frederick Road:

- Near Mud College Road (the coordinates of this location are 39.62998775439405, -77.34934418733181), and
- Near the address 14708 Frederick Road, Rocky Ridge, MD 21778 (the coordinates of this location/curve are 39.64136388614537, -77.34356496693363).

The results of the ball bank indicator are shown in the table below.

Table 9: Curve Advisory Speed – Old Frederick Road

Speed	NB Ball Bank Reading	SB Ball Bank Reading
Curve near Mud College Road (1st Curve)		
40 MPH	14°	15°
30 MPH	**5°**	**8°**
Curve near 14708 Frederick Road (2nd Curve)		
40 MPH	12°	14°
35 MPH	9°	12°
30 MPH	6°	7°

The MUTCD horizontal curve design guide recommend 12° or less for speeds of 35 MPH and higher or 14° for speeds 25 – 30 MPH. Therefore, the recommended curve advisory speed for both curves is 30 MPH.

Recommended Improvements

Low Cost

- Install 30 MPH curve advisory speed limit plaques below the existing curve warning signs at the horizontal curves near Mud College Road and near 14708 Old Frederick Road.
- Install edge line extension pavement markings at the intersection of Old Frederick Road and Rocky Ridge Road.

Mid-level Cost

- Install snow plowable, permanent raised pavement markers along the entire corridor, to reduce the number of nighttime crashes.
- Consider implementing a dynamic curve warning system to reduce in-curve speeds, keeping drivers on the road through the curve north of Mud College Road.

Location 6: MD 85/Buckeystown Pike

- The study corridor segment is 2.68-miles.
- The posted speed limit is 50 MPH.
- This two-lane rural minor arterial generally includes 12-foot lanes and 2.5-foot shoulders.

Crash History:

- *Total Crashes*: 73
- *Crash Severity*: 23 Injury Crashes + 3 Fatal Crashes
- *Statistics*: 36% of corridor crashes resulted in injury or fatality
    - Fatal: On September 4, 2015, a westbound Lily Pons Road driver, driving under the influence, failed to stop at the stop sign, struck a southbound vehicle which caused the vehicle to overturn and eject two passengers, one of which was killed.
    - Fatal: On July 6, 2024 on a dark, wet roadway, a northbound Dickerson Road motorist approaching the MD 85/Buckeystown Pike intersection ran off the road, overturned and struck a sign post.
    - Fatal: On July 10, 2022, a southbound motorist approaching the curve just north of MD 28/Dickerson Road failed to navigate the curve, and exited the road where the vehicle struck a sign post and tree.
    - Time of Day: 37 % of all crashes occurred between 6AM and 12PM

Angle / Intersection Crash Trend:

A total of fifteen (15) angle and 29 (40%) intersection crashes, including one fatality at Oland Road/Lily Pons Road, were reported on the study corridor. The majority of intersection crashes occurred at:

- Lily Pons Road / Oland Road – 25 crashes, including 12 angle crashes where half occurred due to failure to yield/obey traffic control. Two were same direction left turn sideswipe collisions.
- Greenfield Road – 8 crashes, including three (3) rear end and three (3) angle collisions
- Dickerson Road – 6 crashes, including two (2) rear end and one (1) angle collision

Single Vehicle Crash Trend:

There were 36 single vehicle crashes reported, including one fatal crash, with 17 (47%) reported under dark conditions. The majority occurred under clear or cloudy weather conditions.

As shown in **Figure 14**, these collisions occur throughout the study corridor.

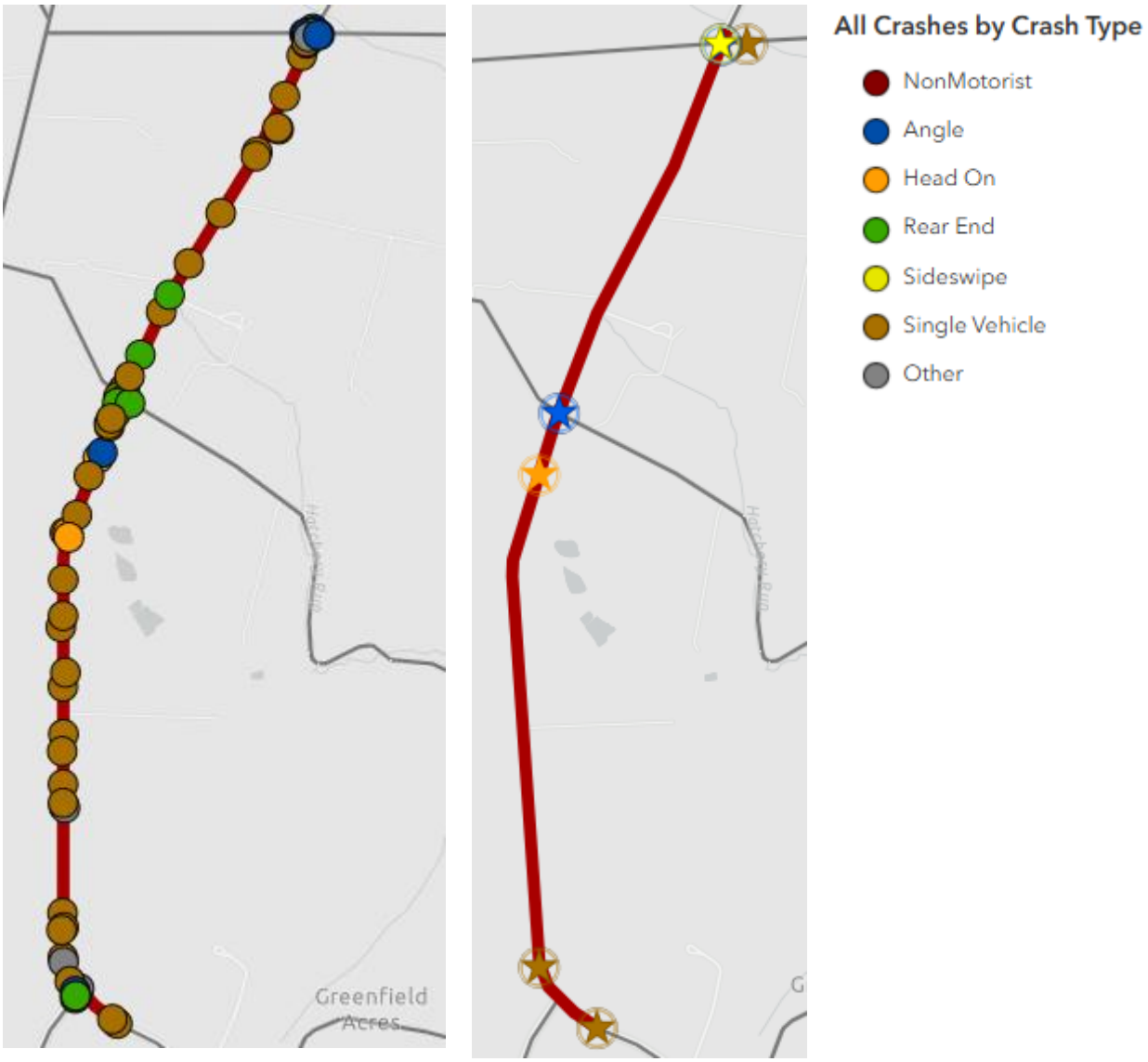


Figure 14: MD 85/Buckeystown Pike – All Crashes (left) and KSI only (right)

Traffic Analyses

Sight Distance

Ensuring both approaching and turning motorists have adequate sight distance is critical to avoid angle collisions. The AASHTO *green book* was referenced to assess sight distance adequacy. **Table 10** shows that all minimum sight distances are met at the critical intersections within the study corridor.

Table 10: Intersection Sight Distance - MD 85/Buckeystown Pike

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		480 ft	555 ft
Oland Road[2]	EB	950’	>1,000’
Lily Pons Road	WB	>1,000’	>1,000’
Greenfield Road	EB	800’	850’
Greenfield Road	WB	500’	975’
MD 28/Dickerson Road	EB	550’	735’

[1]Requirement based on 50 MPH
[2]Vehicles pull beyond the stopline to gain sight distance

Speed Analysis

A spot speed study, using a radar gun, was conducted on October 9, 2024 on Buckeystown Pike south of Greenfield Road. Generally, traffic is traveling at or near the posted speed limit. The results of the speed study, shown in **Table 11** below, indicate that most motorists are traveling near the posted speed limit.

Table 11: Speed study summary – MD 85 / Buckeystown Pike

	NB	SB
Posted	50	50
Average	51	49
85th Percentile	56	53
10 MPH Pace	46 – 55	46 – 55
% Enforceable [1]	4%	0%

[1]Traveling more than 10MPH over the posted speed limit

Existing Traffic Control Devices:

- Adequate signing and visibility of signs throughout corridor.
- Centerline and edgeline pavement markings consistent throughout corridor with adequate visibility.
- Centerline rumble strips are provided.
- Guardrail provided intermittently, primarily along the west side of MD 85/Buckeystown Pike. The guardrail appeared to be in fair condition.

Field Observations

- Most of the corridor is level and straight with the few curves well signed. There are two, short, southbound MD 85/Buckeystown Pike striped passing areas, though most of the corridor includes double yellow centerline markings.
- This section of MD 85/Buckeystown Pike consists of two 12-ft travel lanes and 2.5-ft shoulders.
- There were no bicycle facilities along the corridor.
- Utility poles line are present on both sides of MD 85/Buckeystown Pike for much of the corridor. Many of the utility poles include reflective tape (see image at right).
- The Lily Pons Road stop sign includes reflective striping on the sign post.

Recommended Improvements

Low Cost

- Install 10-in wide edgelines along corridor to highlight the edge of road and encourage reasonable speeds through the roadway section.
- Install reflective tape around each utility pole for added nighttime edge of road visibility
- Add retroreflective strip to sign posts, especially the sidestreet “stop” signs on EB Oland Road, on EB & WB Greenfield Road, and on NB MD 28 / Dickerson Road
- Replace existing “stop” signs on Lily Pons Road and Oland Road with oversized (48” x 48”) stop signs

Mid-Level Cost

- Install edgeline rumble stripes.
- Enhance the Lily Pons Road and Oland Road stop sign conspicuity by adding “Stop Beacon(s)” in accordance with MUTCD Section 4S.05
- Install RPMs along entire corridor. This section of MD 85/Buckeystown Pike was identified in the RPM “hot spot” analyses as well.

Location 7: Gas House Pike

- The 7.7-miles study corridor starts just east of E. Progress Drive (City of Frederick line) and continues to MD 75.
- The speed limit varies from 40 mph to 30 MPH due to changing roadway characteristics and surrounding land use. There are numerous advisory speed limits posted for curves and intersections along the corridor.

Crash History

- *Total Crashes*: 116
- *Crash Severity*: 40 Injury Crashes + 3 Fatal Crashes
- *Statistics:* 29% of corridor crashes resulted in injury or fatality
    - Fatal: On April 24, 2022, an eastbound motorcyclist just east of New London Road failed to navigate a vertical and horizontal curve, crossed the centerline, resulting in a head on collision with a westbound vehicle
    - Fatal: On March 19, 2022, a single vehicle traveling westbound on Gas House Pike west of Dance Hall Road failed to navigate horizontal curve and hit a tree before the vehicle caught fire.
    - Fatal: On April 09, 2017, an eastbound single vehicle lost control in a horizontal curve east of Central Church Road, went off road, overturned and hit embankment.
    - Two of the fatal crashes involved motorcycles. All fatalities involved vehicles failing to navigate horizontal or vertical curves.
- *Lighting*: 41 (35%) crashes occurred under low or dark lighting.

Intersection Crash Trend: A total of 27 (23%) intersection crashes were reported throughout the corridor. Half of the angle crashes were caused by drivers that did not yield or obey traffic signals. The majority of intersection crashes occurred at:

- Linganore Road – 40 crashes, including 12 intersection crashes (5 rear ends, 3 angle, 2 head on and 2 single vehicle).
- Boyers Mill Road - 6 crashes, all angle collisions
- Westwood Drive – 6 crashes, including 3 intersection crashes.

Single Vehicle Crash Trend: There were 60 (51%) single vehicle collisions, with 31 (27%) occurring under dark or low light conditions. The single vehicle crashes were clustered at:

- City Boundary to west of Dance Hall Road: 47 total (24 Single Vehicle, 16 Rear End, 1 Angle, 4 Left-Turn, 1 Pedestrian-related, 1 Sideswipe)
- Horizontal and vertical curves from Eaglehead Dr to east of Mandalong Way: 9 single vehicle crashes, of which 2 were on wet surface
- Horizontal and vertical curve east of Central Church Road: 11 single vehicle, 1 opposite sideswipe and 1 “other” crash; 7 of 12 were on wet/snow/ice/slush surface

Total Crashes: **Figure 15 and Figure** 16 below show the reported total and KSI crashes by type, respectively, along Gas House Pike.

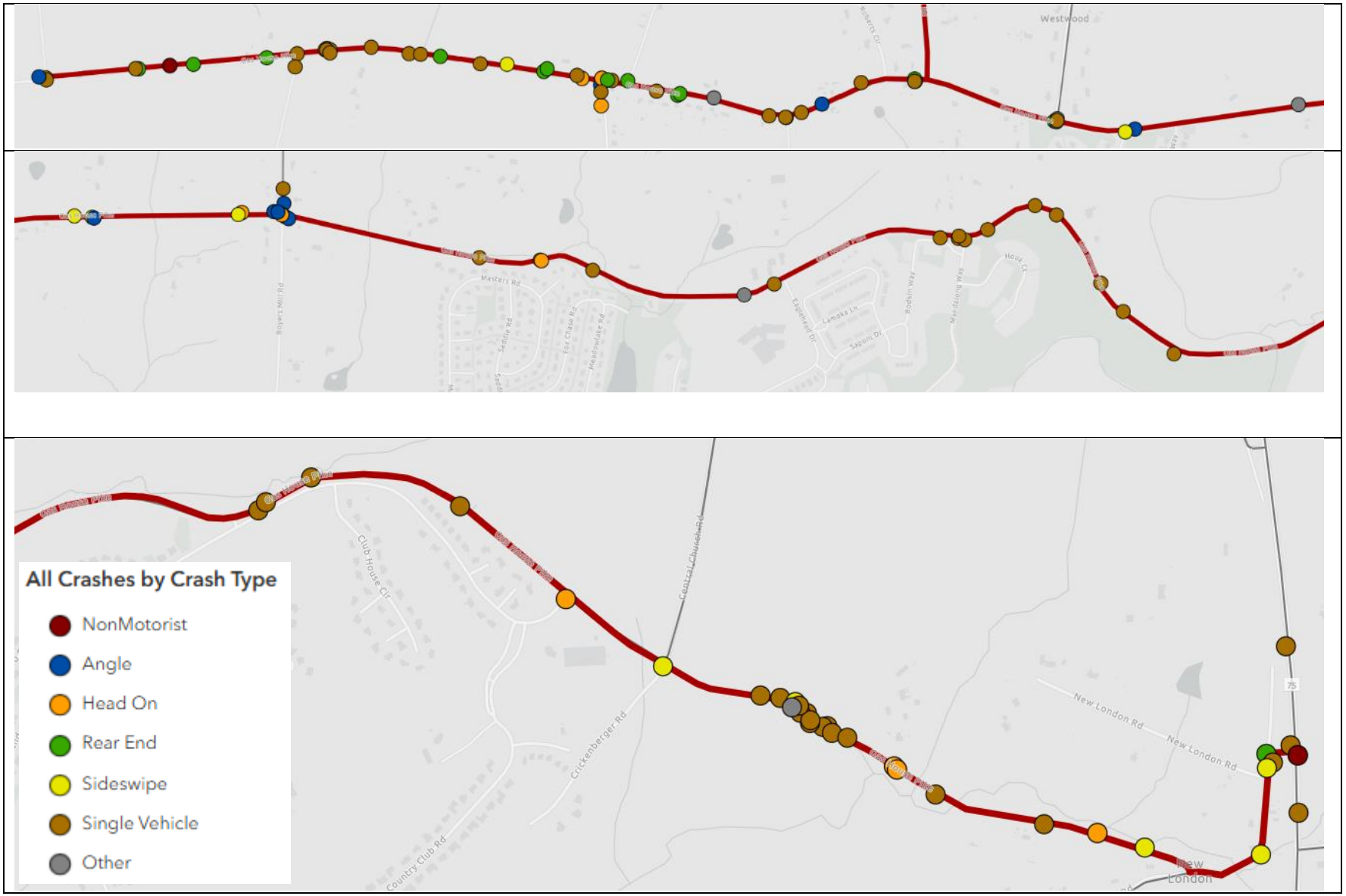


Figure 15: Gas House Pike crashes – Total by Type

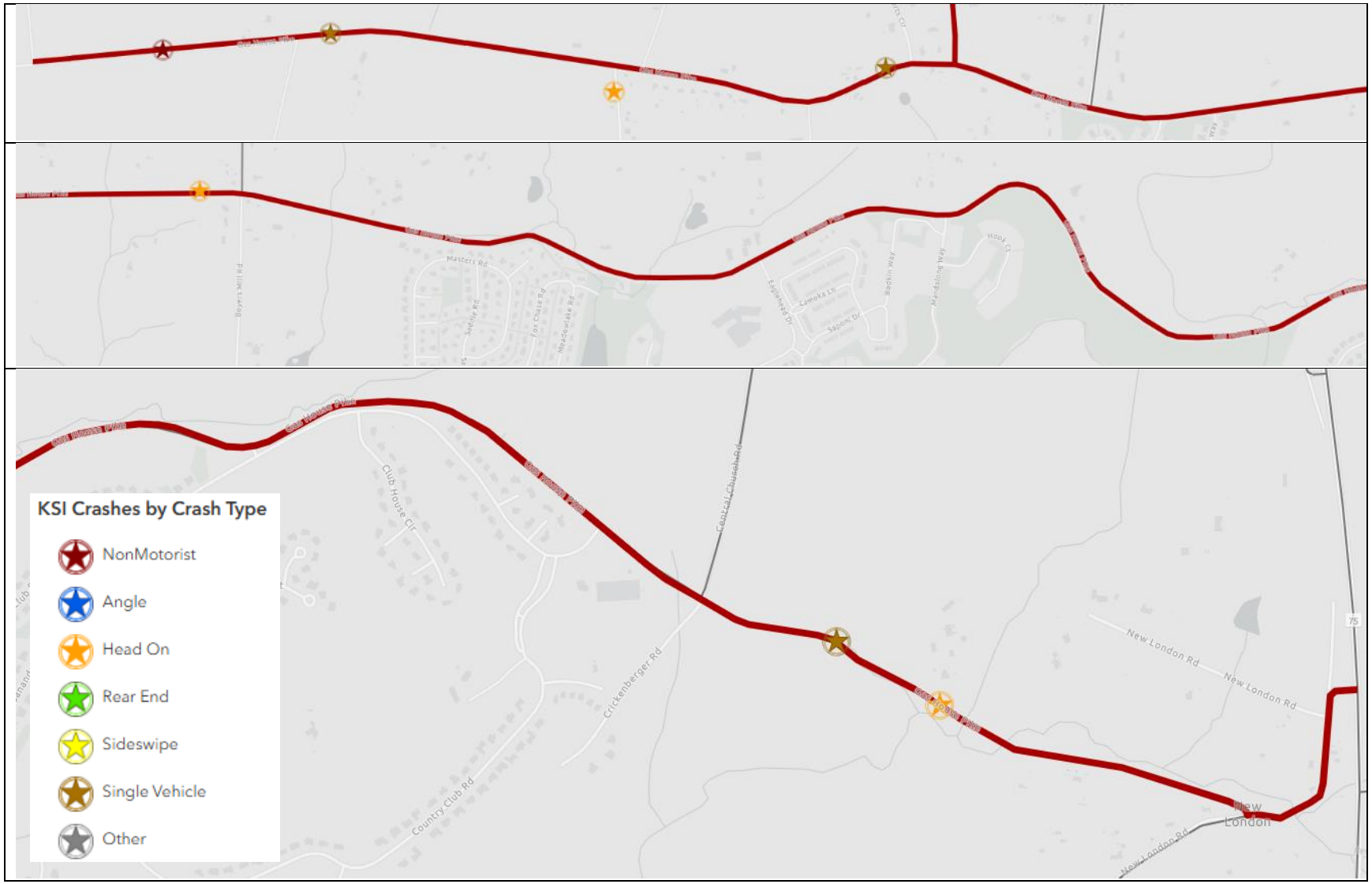


Figure 16: Gas House Pike crashes – KSI only

Traffic Analyses

Speed Study

A spot speed study, using a radar gun, was conducted on January 15, 2025 along the western corridor section, near #9203. Generally, traffic is traveling above the posted speed limit through this narrow, straight roadway segment. The results of the speed study are shown in **Table 12** below.

Table 12: Speed study summary – Gas House Pike

	EB	WB
Posted	40	40 MPH
Average	44 MPH	48 MPH
85th Percentile	49 MPH	51 MPH
10 MPH Pace	41 – 50 MPH	43 – 52 MPH
% Enforceable [1]	9%	43%

[1]Traveling more than 10MPH over the posted speed limit

Field Observations

- This long corridor section includes numerous vertical and horizontal curves and the roadway ranges from a narrow 21-ft section to a wider
- Gas House Pike does not include either centerline or edgeline rumble strips.

Recommended Improvements

Low Cost

- Install 10-in wide edgelines along corridor to highlight the edge of road and encourage reasonable speeds through the roadway section.
- Install reflective tape on all curve or turn warning signs
- Install oversized “STOP” signs and reflective tape on the All-Way Stop sign posts at Gas House Pike and Boyers Mill Road.

Mid-Level Cost

- Install centerline rumble strips.
- Install snowplowable RPMs along Gas House Pike corridor prioritizing the following sections, which were identified in the RPM “hot spot” analyses as well:
    - Progress Drive to Dance Hall Road
    - Crickenberger Road to New London Road
- Install high-surface friction treatment on Gas House Pike through curves and steep grade east of Central Church Road/Crickenberger Road.

Long-Term/Higher Cost

- Install LED leased lighting along utility poles located east of Crickenberger Road, where a high rate of nighttime single vehicle crashes occurred.
- Widen Gas House Pike at Linganore Road to provide westbound left-turn lane
- Extend current Gas House Pike modified minor arterial design to New London Road and MD 75 to provide recoverable shoulders, consistent guardrails and/or clear zone.

Location 8: Harp Hill Road

- The 2.93-miles study corridor starts 750 feet south of Church Hill Road and continues to south of Woodland Way Road.
- Speed Limit: varies from 40 MPH to 35 MPH based on changing roadway characteristics.

Crash History

- *Total Crashes*: 25
- *Crash Severity*: 4 Injury Crashes + 2 Fatal Crashes
- *Statistics*: 24% of corridor crashes resulted in injury or fatal crash
    - Fatal: On October 9, 2020, a malfunctioning vehicle hit a tree shrub at Meeting House Road, which resulted in a fatal injury
    - Fatal: On February 19, 2016, single vehicle hit tree shrub at Wolfsville Road, which resulted in a fatal injury
- *Time of Day*: 32 % of all crashes occurred between 6AM to 9AM

Single Vehicle Crash Trend: A total of 19 (76%) single vehicle crashes occurred, with 18 of them involving striking fixed objects. There were seven (7) dark no light crashes and six (6) tree shrubbery (fixed object) crashes reported along the corridor. Three (3) collisions with a tree were reported at the horizontal curves near the coordinates 39°32'58.6"N 77°32'55.0"W (milepoint 1.7 S).

Figure 18 below shows the reported crashes along Mountville Road, categorized by fixed object.

Field Observations

- Harp Hill Road has several horizontal and vertical curves.
- Many trees and shrubbery were within the roadway clear zone.
- Edge line and center line pavement markings look faded at some locations throughout the corridor.
- A damaged existing speed limit sign was located near 11425 Harp Hill Road, as shown below.

Figure 17: Damaged speed limit sign near 11425 Harp Hill Road

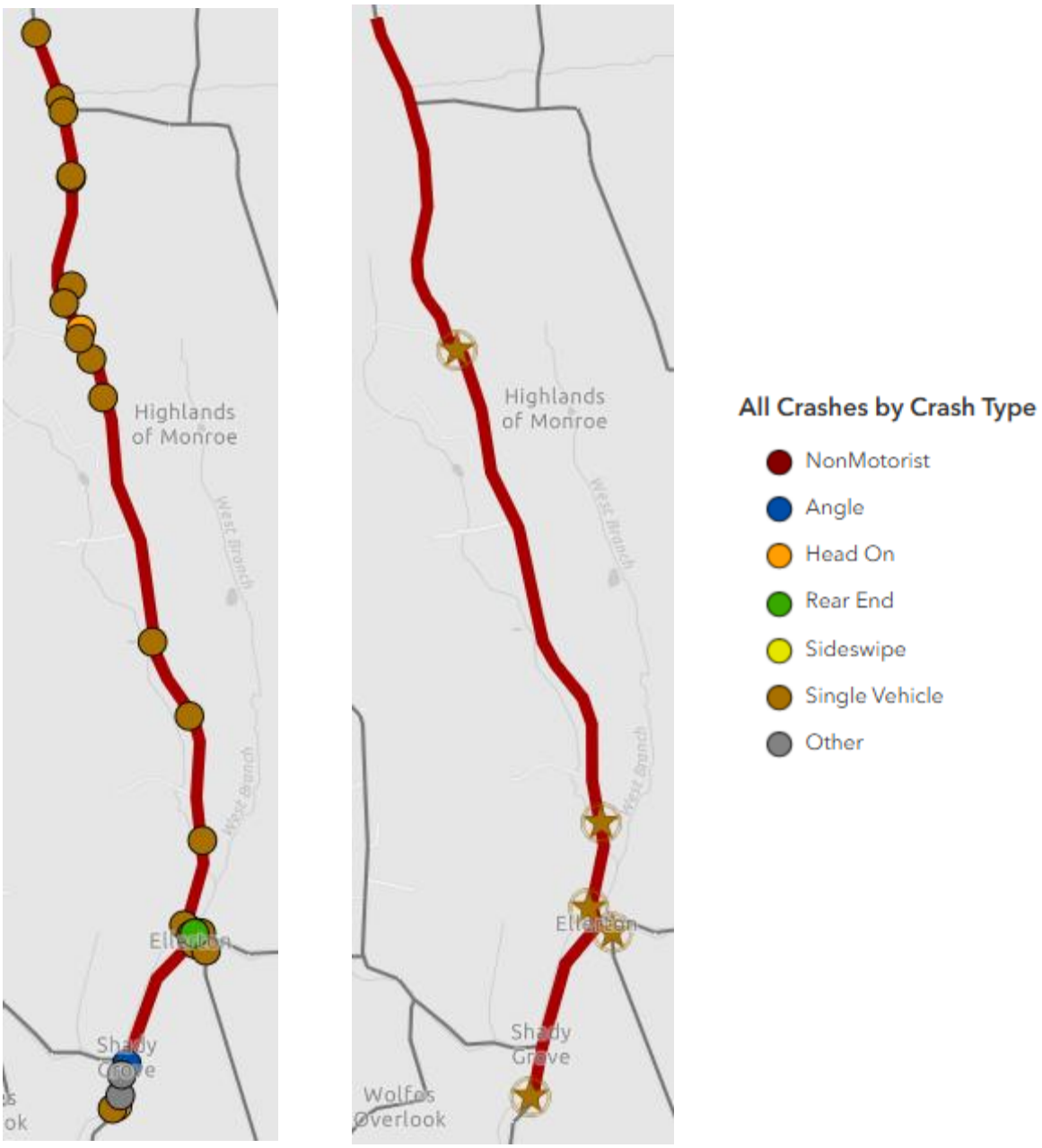


Figure 18: Harp Hill Road - All Crashes (left) and KSI only (right)

Traffic Analysis

Speed Study

A speed study was conducted on 10/9/2024 near 11425 Harp Hill Road (Harp Hill Road is assumed to run in a north south direction). Please note that there is an existing 25 MPH curve advisory speed limit plaque for the northbound Harp Hill Road traffic at this location. The table below shows the results of the speed study:

Table 13: Speed Study Summary – Harp Hill Road

	NB	SB
Posted	35	35
Average	36	40
85th Percentile	41	43
10 MPH Pace	29-38	35-44
% Enforceable [1]	6%	4%

[1]Traveling more than 10MPH over the posted speed limit

Recommended Improvements

Low Cost

- Tree trimming to increase the roadway clear zone and reduce the frequency/severity of fixed object/tree shrubbery crashes.
- Install one direction curve warning signs to supplement the existing chevron signs along each of the horizontal curves near 11425 Harp Hill Road.
- Replace the damaged speed limit sign near 11425 Harp Hill Road.
- Request police enforcement of the speed limit near 11425 Harp Hill Road.
- Refresh faded edge line or centerline pavement markings along the entire corridor.

Mid-level cost

- Install snow plowable, permanent raised pavement markers along the entire corridor, to reduce the dark no light crashes.
- Install traffic barrier w-beam on northbound Harp Hill Road, near 11614 Harp Hill Road, to reduce the frequency of run-off-the-road single vehicle crashes. The Crash Reduction Factor (CRF) for the installation of new guardrail along an embankment, is 7% for run off the road crash types (per the Crash Modification Factor Clearinghouse website).
- Consider implementing a dynamic curve warning system to reduce in-curve speeds, keeping drivers on the road through the curve at the horizontal curves near coordinates 39°32'58.6"N 77°32'55.0"W (milepoint 1.7 S), to reduce the frequency/severity of dark no light crashes.

Location 9: Big Woods Road

- This 1.9-mile segment of Big Woods Road is located south of MD 80.
- Speed Limit: 35 MPH

Crash History:

- *Total Crashes*: 21
- *Crash Severity*: 10 Injury Crashes + 0 Fatal
- *Statistics*: 48% of corridor crashes resulted in injury
- *Time of Day*: 43% of all crashes occurred between 12PM and 6PM

Single Vehicle Crash Trend: There were 12 (57%) single vehicle crashes and 5 were reported under dark light conditions.

As shown in **Figure 19**, these collisions occurred primarily between the northern most curves and on the straightaway south of the southern curve.

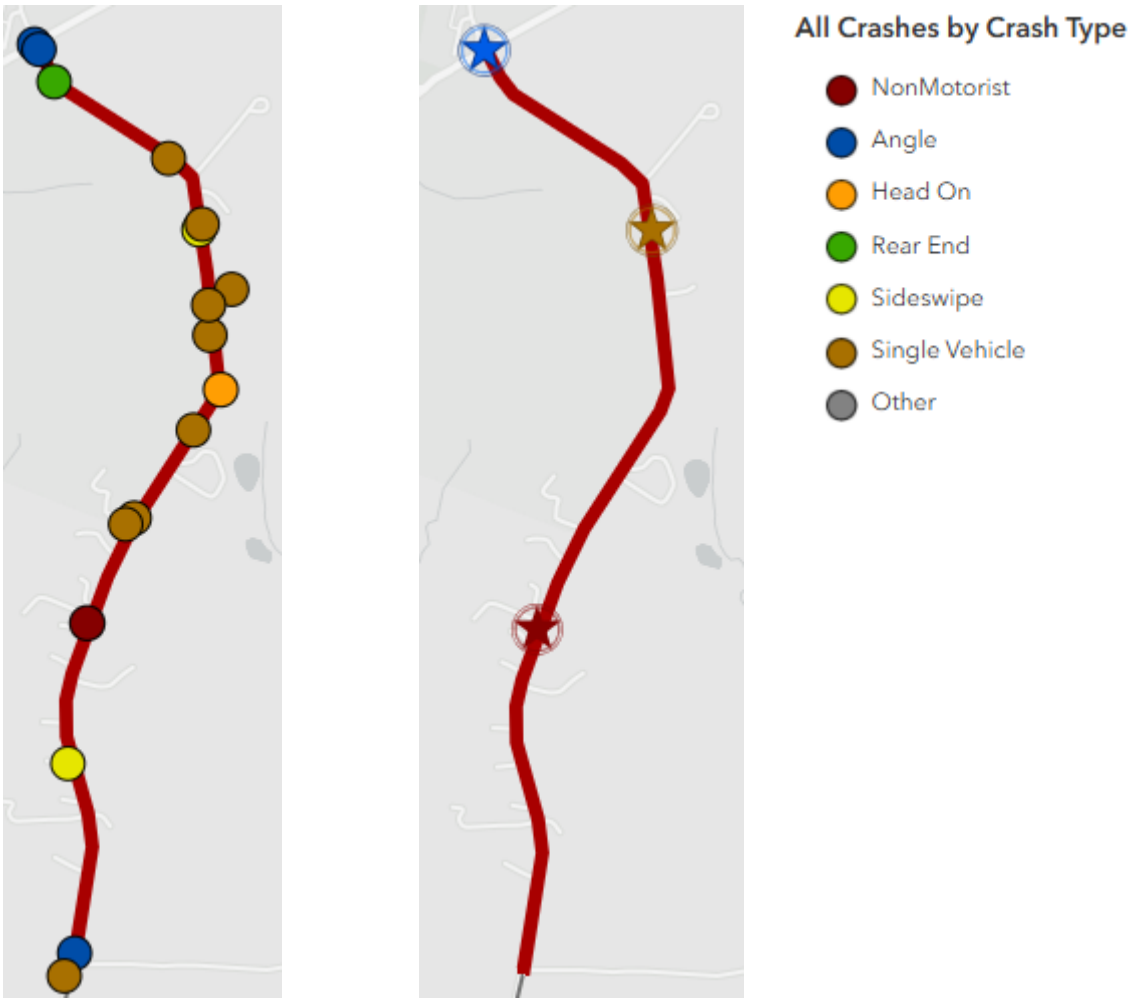


Figure 19: Big Woods Road – All Crashes (left) and KSI only (right)

Field Observations

The following observations were noted during the September 5, 2024 field visit:

- Big Woods Road includes narrow 10.5-ft travel lanes, several curves and hills within the study segment.
- There are two curves within the study segment. Each includes advanced "turn" warning signs with supplemental advisory speed plaques. Four chevron signs are placed within each curve, though one sign facing the northbound direction in the southern curve is slightly mangled.

Traffic Analyses

Speed Study

A spot speed study, using a radar gun, was conducted on September 5, 2024 on Big Woods Road between the two curves. Generally, southbound Big Woods Road traffic travels faster than northbound and exceed the posted speed limit. Based on the spot speed study, 24% of southbound speeds were enforceable, which may be due to the downgrade in the roadway between the two curves. **Table 14** below shows the speed study results. Southbound Big Woods Road motorists tend to exceed the posted speed limit with 24% enforceable.

Table 14: Speed study summary – Big Woods Road

	NB	SB
Posted	35	35
Average	37	42
85th Percentile	42	45
10 MPH Pace	30 – 39	37 – 46
% Enforceable [1]	3%	24%

[1]Traveling more than 10MPH over the posted speed limit

Recommended Improvements

Low Cost

- Install optical speed pavement markings approaching curves
- Install 10-in wide edgelines along corridor to highlight the edge of road and encourage reasonable speeds through the roadway section.
- Request increased speed enforcement efforts

Mid-Level Cost

- Extend guardrail (nonrecoverable slope) along east side of Big Woods Road further northward.
- Install temporary driver speed feedback signs on approach to curves

Location 10: Mountaindale Road

- The Mountaindale Road segment extends from the Stull Road intersection to 1.28 miles west.
- Speed Limit: 30 MPH.

Crash History

- *Total crashes*: 26
- *Crash Severity*: 8 Injury Crashes + 0 Fatal Crash
- *Statistics:* 31% of corridor crashes resulted in injury
- *Time of Day:* 58% of all crashes occurred between 3PM and 9PM

Angle/Intersection Crash Trend: A total of six **(**6) intersection and six (6) angle crashes were reported. All intersection crashes occurred at:

- Bethel Road- 6 intersection crashes, including 4 angle collisions of which 3 were due to failure to yield/obey traffic signals. Two collisions involved a pedestrian or bicyclist

Single Vehicle Crash Trend: A total of 15 single vehicle collisions were reported, with 7 striking a pole. Seven (27%) single vehicle crashes occurred under dark lighting conditions. The majority of single vehicle crashes occurred at:

- Putman Road - 4 crashes, all of them involved hitting fixed objects and two of them occurred on wet/icy roadway conditions
- Bethel Road - 5 crashes, two of them resulted hitting stationary object and one of them caused minor pedestrian injury
- 6826 Mountaindale Road horizontal curve – 3 crashes
- Larvadale Court - 2 crashes, one resulted in hitting pole due to wet/icy roadway conditions

Figure 20 below shows the reported crashes along Mountville Road, categorized by crash type.

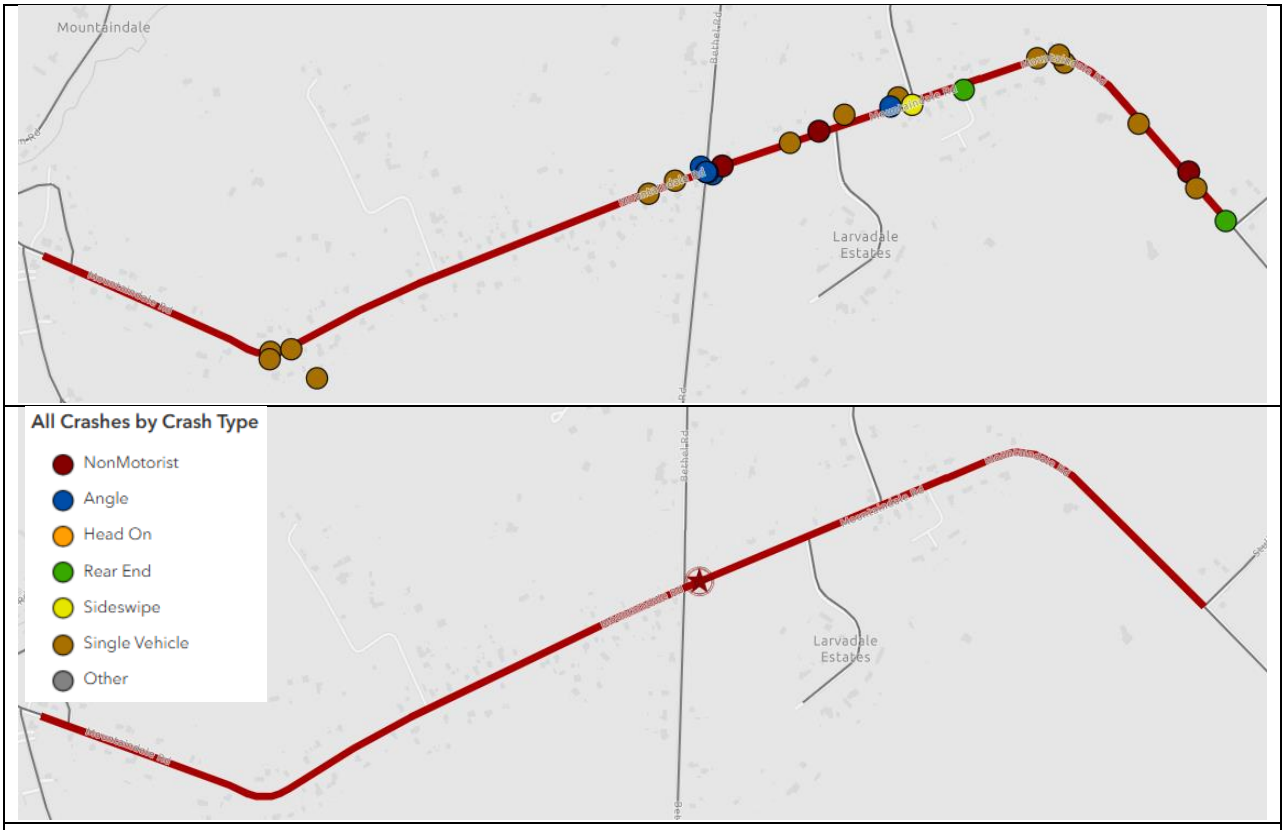


Figure 20: Mountaindale Road – All crashes (above) and KSI only (below)

Field Observations

- The Mountaindale Road and Bethel Road intersection is skewed in geometry.
- All existing regulatory and warning signs near the intersection of Mountaindale Road and Bethel Road are in good condition. Existing warning signs at this intersection include stop sign ahead, curve ahead, advisory speed and intersection ahead warning signs.
- Northbound traffic at the intersection of Mountaindale Road and Bethel Road typically drives about 20 feet past the stop bar before coming to a complete stop (Mountaindale Road is assumed to run in an east-west direction).
- Significantly faded stop bar for the southbound movement at the intersection of Mountaindale Road and Bethel Road (see **Figure 21** below).
- Obscured speed limit sign near the Mountaindale Road and Bethel Road intersection (see **Figure 22** below).

Figure 21: Faded Markings at Mountaindale Road and Bethel Road Intersection

Figure 22: Poorly visible speed limit sign near Mountaindale Road at Bethel Road Intersection.

Traffic Analysis

A sight distance analysis and a speed limit study were conducted at the intersection of Mountaindale Road and Bethel Road on 10/9/2024 (Mountaindale Road is assumed to run in an east west direction). **Table 15 and Table** 16 below show a summary of the results.

Table 15: Sight Distance summary – Mountaindale Road

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		290	290
NB Bethel Road	At Edgeline	450	Not restricted

[1]Requirement based on 30 MPH (posted speed limit)

Table 16: Speed Study Summary – Mountaindale Road

	EB	WB
Posted	30	30
Average	35	35
85th Percentile	38	38
10 MPH Pace	29-38	30-39
% Enforceable [1]	12%	10%

[1]Traveling more than 10MPH over the posted speed limit

Recommended Improvements

Low Cost

- Refresh existing stop bar pavement marking for the southbound movement at the intersection of Mountaindale Road at Bethel Road.
- Relocate the stop bar pavement marking located on northbound Bethel Road closer to the edge line of Mountaindale Road. The stop bar should not be placed more than 30 feet or less than 4 feet from the nearest edge of the intersecting traveled way.
- Install centerline and edge line extension pavement markings at the intersection of Mountaindale Road and Bethel Road.
- Trim trees and/or relocate the speed limit sign near the intersection of Mountaindale Road and Bethel Road, to improve the visibility of the sign.
- Refresh existing faded edge line pavement markings along the entire corridor.
- Install One Direction Large Arrow (W1-6) signs at the curve that is near 6826 Mountaindale Road, to reduce the fixed object crashes at this location.
- Request police enforcement of speed limit near the intersection of Mountaindale Road and Bethel Road.

Mid-Level Cost

- Install raised pavement markers along the entire corridor, to reduce the frequency of dark no light crashes.
- Install post mounted delineators near the fixed objects along this corridor, to reduce the frequency of run off the road (fixed object/other pole) crashes.

Long-term/High-Cost Improvements

- Consider the installation of street lighting near the Mountaindale Road and Bethel Road intersection to reduce the number of dark no light crashes.
- Consider implementing a dynamic curve warning system to reduce single vehicle crashes, keeping drivers on the road at the curve near 6826 Mountaindale Road.

Location 11: Mountville Road

- Corridor Limits: Ballenger Creek Pike to Us 15/Catoctin Mountain Hwy
- Speed Limit: 30 MPH.

Crash History

- *Total Crashes*: 40
- *Crash Severity*: 15 Injury Crashes + 1 Fatal Crash
- *Statistics*: 40% of corridor crashes result in injury or fatality
    - Fatal: On February 2, 2020, a northbound Catoctin Mountain Highway driver attempting to make a left turn hit an opposing vehicle head on and guardrail.

Angle/Intersection Crash Trend:

A total of 28 intersection and 15 angle crashes were reported at the study corridor. The majority of intersection crashes occurred at:

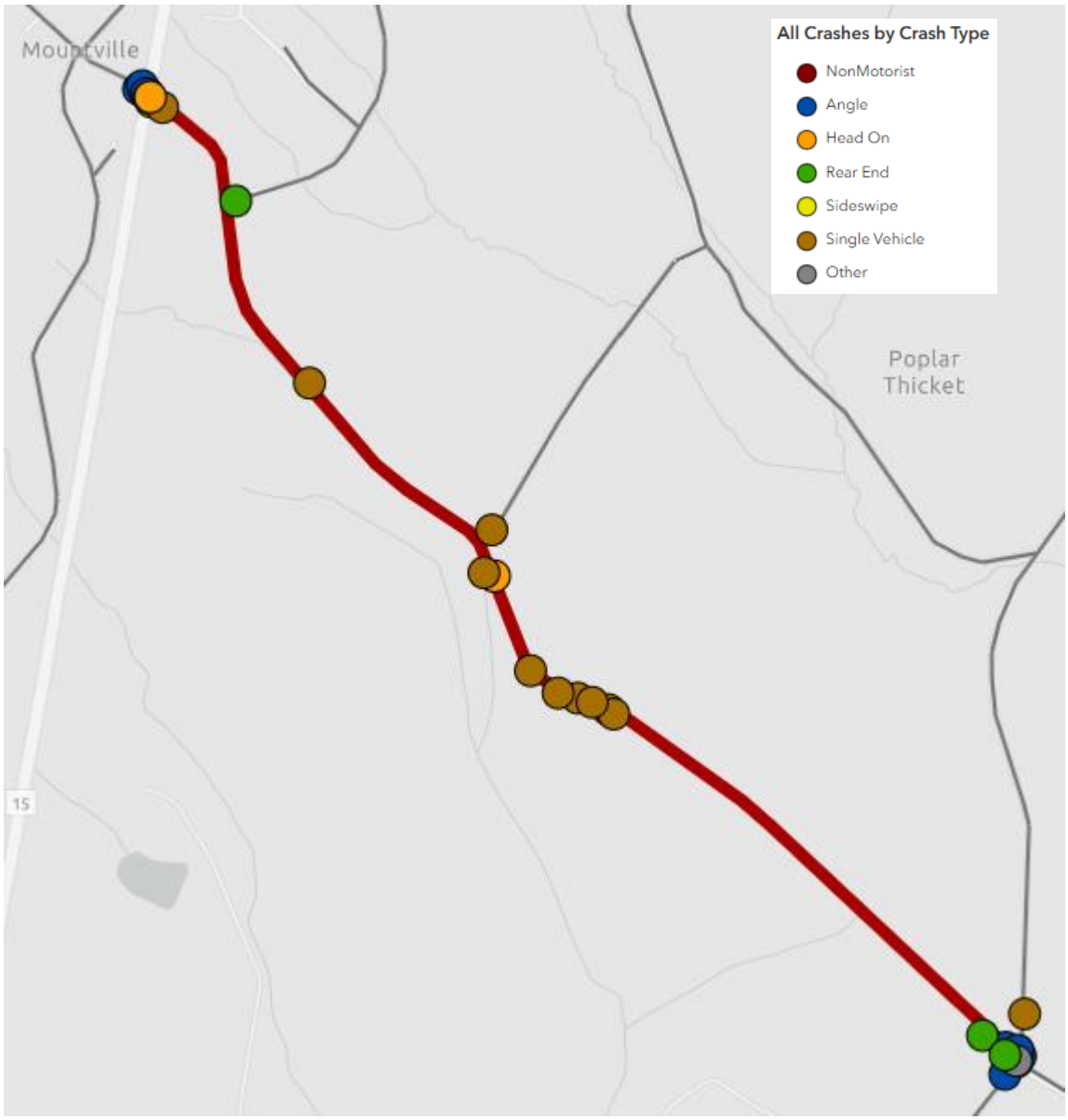
- *Catoctin Mountain Highway/US 15* - 16 crashes, including 8 angle and 5 rear end collisions
- *Ballenger Creek Pike* – 10 crashes, including 7 angle collisions

Single Vehicle Crash Trend:

There were 13 (68%) single vehicle crashes with 8 involving hitting fixed objects. The majority of single vehicle crashes occurred at:

- *Howard Stup Road* – 10 crashes, including nine single vehicle crashes.

Figure 23 below shows the reported crashes along Mountville Road, categorized by crash type.


All Crashes by Crash Type
NonMotorist
Angle
Head On
Rear End
Sideswipe
Single Vehicle
Other
Mountville
Poplar Thicket
15

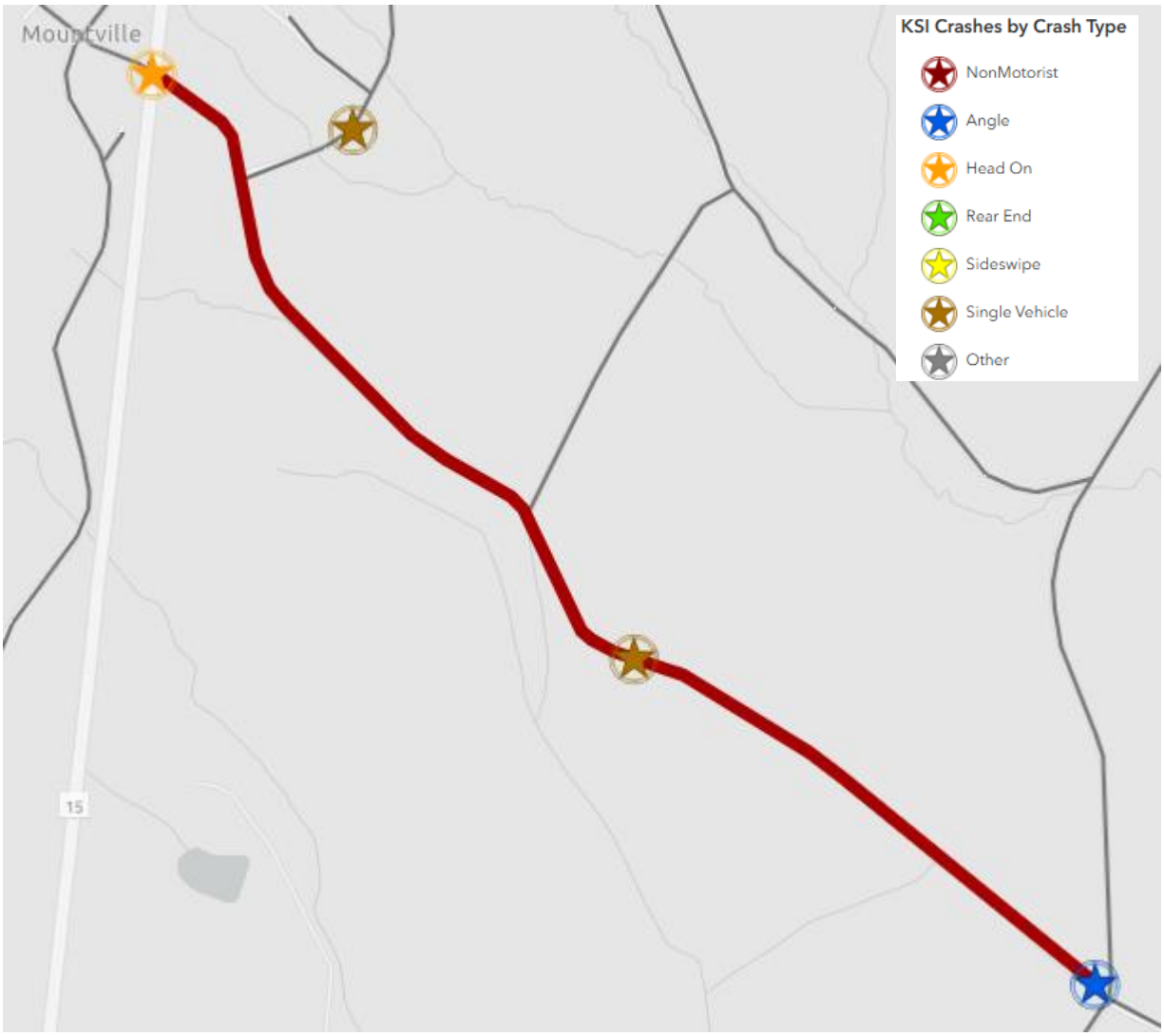


Figure 23: Mountville Road – all crashes (top) & KSI Only (bottom)

Field Observations

A field reconnaissance was conducted on September 5, 2024. Below is a summary of the field observations.

- Mountville Road features numerous horizontal and vertical curves.
- The intersections of Mountville Road at Ballenger Creek Pike, and Mountville Road at US 15 are skewed in geometry.
- The Mountville Road and Ballenger Creek Pike intersection is stop controlled on the minor street (Mountville Road) and uncontrolled on the main street (Ballenger Creek Pike).
- The Mountville Road and US 15 intersection is controlled using a full traffic signal (span wire) with advance Hazard Identification Beacons on both US 15 approaches and on eastbound Mountville Road.
- US 15 (near Mountville Road) is a mandatory headlight use area. A few drivers were observed not using their headlights.

- The westbound approach at the intersection of Mountville Road and US 15 has very limited sight distance.
- Police enforcement of the speed limit was observed along US 15, near Mountville Road, on 12/13/2024. A number of drivers were pulled over for speeding.
- All existing regulatory and warning signs near the intersection of Mountville Road and Ballenger Creek are in good condition. Existing warning signs at this intersection include stop sign ahead, curve ahead, advisory speed and intersection ahead warning signs.
- Eastbound Mountville Road traffic at the Ballenger Creek Pike intersection typically drives about 20 feet past the stop bar before coming to a complete stop.
- The stop line for westbound Mountville Road at Ballenger Creek is faded (see Figure 24below).
- Edge line extension pavement markings are faded making it difficult for approaching motorists to know how far they can pull up to the intersection (see **Figure 24** below).
- The speed limit sign near the intersection of Mountville Road and Ballenger Creek Pike is obstructed as shown in **Figure 25** below.

Figure 24: Faded pavement marking/stop bar at Mountville Road and Ballenger Creek Pike

Figure 25: Obstructed speed limit sign along westbound Ballenger Creek near Mountville Road

Traffic Analyses

Speed Study

To evaluate the existing speed of travel, speed data was captured using a radar gun on October 09, 2024. The speed data was captured along Ballenger Creek Pike, near Mountville Road. Mountville Road is stop controlled and has a posted speed limit of 30 MPH; while Ballenger Creek Pike is uncontrolled and has a posted speed of 35 MPH for the westbound approach and 40 MPH for the eastbound approach. Mountville Road is assumed to run in a north-south direction. The results of the speed analysis are shown in **Table 17** below.

Table 17: Speed study summary - Mountville Road and Ballenger Creek Pike

	EB	WB
Posted	40	35
Average	37	34
85th Percentile	40	38
10 MPH Pace	32-41	30-39
% Enforceable [1]	0%	0%

[1]Traveling more than 10MPH over the posted speed limit

Sight Distance

Subsequently, a sight distance analysis and a speed study were performed at the intersection of Ballenger Creek Pike (main street) and Mountville Road (side street). The results of the sight distance analysis are shown in **Table 18** and **Table** *19* below.

Table 18: Intersection Sight Distance - Mountville Road (SB) and Ballenger Creek Pike

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		335 ft	445 ft
SB Mountville Road	At Stop line	480 ft	565 ft

[1]Looking Left requirement based on 35 MPH and Looking Right requirement based on 40 MPH

Table 19: Intersection Sight Distance - Mountville Road (NB) and Ballenger Creek Pike

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		385 ft	390 ft
NB Mountville Road	At Edgeline	Unrestricted	500 ft

[1]Looking Left requirement based on 40 MPH and Looking Right requirement based on 35 MPH

Recommended Improvements

Low Cost / Quick Install

- Refresh existing stop bar pavement marking for the eastbound movement at the intersection of Mountville Road and Ballenger Creek Pike.
- Relocate stop bar pavement marking located on westbound Mountville Road closer to the edge of Ballenger Creek Pike. The stop bar should not be placed more than 30 feet or less than 4 feet from the nearest edge of Ballenger Creek Pike.
- Refresh existing edge line and center line extension pavement markings at the intersection of Mountville Road and Ballenger Creek.
- Trim trees or relocate the speed limit signs near the Mountville Road and Ballenger Creek Pike intersection, to improve the visibility of the signs.
- Trim the trees located near the curve that is approximately 1,000 feet south of the Mountville Road and Howard Stup Road intersection, to increase the roadway clear zone and reduce the frequency/severity of tree shrubbery crashes.
- Consider installing a "no turn on red" sign (R10-11b) for the eastbound approach at the Mountville Road and US 15 intersection, to reduce the frequency of the angle crashes[1].

Mid-level Cost

- If low-cost countermeasures fail to reduce the crash frequency, consider installing transverse rumble strips along westbound Mountville Road approaching Ballenger Creek.

Long-term/High-Cost Improvements

- In the future as traffic volume increase, perform a full traffic study to consider the installation of a roundabout at the intersection of Mountville Road and Ballenger Creek Pike to reduce the angle crashes.
- Reconstruct the traffic signal at the Mountville Road and US 15 intersection. The full signal reconstruction would replace the span wires with mast arms and allow for the installation of traffic signal backplates.

[1] Installation of overhead signs or backplates at the Mountville Road and Ballenger Creek Pike intersection may not be possible due to structural concerns (given the age of the existing signal/span wires). Structural analysis and inspection may be required. Fully reconstructing the signal may be considered as a long-term improvement.

Location 12: Ball Road

- This 0.35-mile segment of Ball Road begins at Reels Mill Road (east) and continues westward.
- Speed Limit: 35 MPH
- The total roadway width is 20-feet, though there are intermittent, variable width shoulders.
- Ball Road is hilly and curvy within the study limits and beyond.

Crash History:

- *Total Crashes*: 23
- *Crash Severity*: 9 Injury Crashes + 0 Fatal Crash
- *Statistics*: 39% of corridor crashes resulted in injury

Roadway Surface & Weather:

The majority of crashes along the study section occurred on dry (17 crashes, 74%) roadway and under cloudy conditions (16, 70%).

Single Vehicle Crash Trend:

Nearly all (18 crashes or 78%) were single vehicles with 15 of them resulting in hitting fixed objects. The majority of run-off-road crashes ultimately struck an embankment or guardrail.

Figure 26 below shows the reported crashes along Ball Road, categorized by crash type.

Figure 26: Ball Road – All crashes (above) and KSI only (below)

Field Observations

- Reels Mill Road forms two intersections with Ball Road. The Reels Mill Road north and south legs are separated by approximately 550-ft.

Figure 27: Reels Mill Road forms two off-set intersections with Ball Road. (Source: Google Maps)

- While much of Ball Road is hilly and windy, the two curves at Reels Mill Road and just west are sharper than the others along the corridor.
- WB Ball Road includes the following signing:
    - Upon approach to the eastern Reels Mill Road (north leg) intersection:
        - Sidestreet (W2-2) warning sign with supplemental "Reels Mill Road" street name plaque
        - "School Bus Stop Ahead" warning sign
        - "Reverse turn" (W1-3) warning sign with a 25 MPH advisory speed limit
    - Upon approach to the western Reels Mill Road (south leg) intersection:
        - "Reverse Curve" (W1-5) warning sign with a 25 MPH advisory speed limit
        - The curve through the intersection includes 3 chevrons
    - West of Reels Mill Road
        - Curve (w1-2) warning sign with a 25 MPH advisory speed limit
        - 2 chevrons
- EB Ball Road includes the following signing:
    - West of Reels Mill Road
        - Curve (w1-2) warning sign with a 25 MPH advisory speed limit
        - 2 chevrons
    - Upon approach to the western Reels Mill Road (south leg) intersection:
        - "Reverse Curve" (W1-5) warning sign
        - "Deer Crossing" warning sign
        - 3 chevrons
    - Upon approach to the eastern Reels Mill Road (north leg) intersection
        - Sidestreet (W2-2) warning sign with supplemental "Reels Mill Road" street name plaque

Traffic Analyses

Curve Study

Establishing the proper advisory speed for a curve is a critical step in ensuring the safety on roadways. A ball bank field assessment was completed to determine the appropriate advisory speed limit on Ball Road at the two curves west of Reels Mill Road under clear, dry conditions on October 3, 2024. Based on the readings, a **25 MPH and 30 MPH advisory speed limit** is appropriate for the eastern and western curves, respectively.

Table 20: Curve Study Summary – Ball Road

Travel Speed	EB Ball Bank Reading	WB Ball Bank Reading
Eastern Curve (Closest to Reels Mill Road, south leg)		
30 MPH	13°	11°
25 MPH	9°	8°
Western Curve		
30 MPH	11°	11°
25 MPH	8°	6°

The MUTCD horizontal curve design guide recommend 14° or less for speeds of 25-30 MPH. Therefore, the existing 25 MPH posted advisory speed limit signs are adequate.

Recommended Improvements

Low Cost

- Reflectors along guardrail to better direct motorists along roadway under low lighting conditions
- Install 10-in wide edgelines within study section to encourage lower speeds and highlight this section as a safety corridor
- Install in-pavement curve and advisory speed markings on eastbound and westbound approaches to both curves

Mid-level Cost

- Install high-surface friction treatment throughout study section

Location 13: Dance Hall Road

- This 0.71-mile segment of Dance Hall Road is located just north of Gas House Pike.
- Speed Limit: 30 MPH
- The total roadway width is 20-ft.
- Dance Hall Road is hilly and curvy with a sharp curve located approximately 1,000-ft north of Gas House Pike.

Crash History:

- *Total Crashes*: 24
- *Time of Day*: 54% of all crashes occurred between 8PM and 12AM
- *Crash Severity*: 9 Injury Crashes + 0 Fatal Crashes
- *Statistics*: 38% of corridor crashes resulted in injury
- *Lighting*: The majority (66%) occurred at nighttime with no lights.
- *Crash Type*: Nearly all (23 crashes or 96%) were single vehicle run-off-road crashes. Half of the run-off-road crashes ultimately struck tree shrubbery.
- *Roadway Surface*: Eleven (46%) occurred on a wet or snowy roadway.

As shown in Error! Reference source not found., the single vehicle collisions occurred throughout the study corridor, though clustering around the sharp curve just north of Gas House Pike.

Figure 28: Dance Hall Road - – All crashes (left) and KSI only (below)

Field Observations

- While there are no advanced sidestreet warning signs on Gas House Pike approaching Dance Hall Road, the intersection does include centerline skips and an edgeline extension. The "Dance Hall Road" street name sign is bent.
- The southbound Dance Hall Road "stop ahead" warning sign is obstructed by vegetation. Further, most Dance Hall Road signs are in fair condition though many are dirty or obstructed by vegetation, as shown below.

Figure 29: Southbound Dance Hall Road approaching sharp turn – Note: Turn (W1-1) sign is faded and dirty

- The sharp curve on Dance Hall Road north of Gas House Pike includes a "Large Arrow" (W1-6) sign for northbound and southbound Dance Hall Road. Northbound Dance Hall Road also includes a single chevron below the "Large Arrow" (W1-6) signs.
- Many northbound Dance Hall Road motorists brake hard as they enter the sharp curve just north of Gas House Pike.

Traffic Analyses

Sight Distance

Ensuring both approaching and turning motorists have adequate sight distance is critical to avoid angle collisions. The AASHTO *green book* was referenced to assess sight distance adequacy. **Table 21** shows that Dance Hall Road motorists cannot adequately see approaching Gas House Pike vehicles due to the vertical and horizontal curves in advance of the intersection.

Table 21: Intersection Sight Distance – Gas House Pike at Dance Hall Road

Approach		Looking Left	Looking Right
AASHTO Requirement[1]		445 ft	385 ft
SB Dance Hall Road	At Stopline	300 ft	280-ft

Based on 40 MPH on Gas House Pike

Speed Analysis

To evaluate the existing speed of travel, speed data was captured using a radar gun on September 11, 2024, between Gas House Pike and the first sharp curve on Dance Hall Road. The study finds that the majority of motorists exceed the 30 MPH posted speed limit, which is especially dangerous entering the sharp curve north of Gas House Pike.

Table 22: Speed study summary – Dance Hall Road just north of Gas House Pike

	NB	SB
Posted	30	30
Average	36	33
85th Percentile	39	38
10 MPH Pace	32 – 41	28 -37
% Enforceable [1]	13%	7%

[1]Traveling more than 10MPH over the posted speed limit

Curve Study

Establishing the proper advisory speed for a curve is a critical step in ensuring the safety on roadways. A ball bank field assessment was completed to determine the appropriate advisory speed limit on Dance Hall Road north of Gas House Pike under clear, dry conditions on October 3, 2024.

Table 23: Curve Study Summary – Dance Hall Road

Travel Speed	NB Ball Bank Reading	SB Ball Bank Reading
25 MPH	17°	19°
20 MPH	13°	15°
15 MPH	7°	7°

The MUTCD recommends readings of 16° or less for speeds of 20 MPH and under; therefore, a **15 MPH advisory speed limit** is appropriate for Dance Hall Road curve north of Gas House Pike.

Recommended Improvements

Low Cost

- Install advanced sidestreet and supplemental street name plaque on Gas House Pike 305-feet in advance of Dance Hall Road to warn approaching motorists since Dance Hall Road intersection sight distance is not met.
- Replace the "Dance Hall Road" street name sign at Gas House Pike.
- Install 10-inch wide edgelines along Dance Hall Road corridor to highlight the edge of road and encourage reasonable speeds through the roadway section.
- Install retroreflective striping to all sign supports, including:
    - SB "Stop Ahead" warning sign approaching Gas House Pike
    - NB & SB W1-1 "Turn" warning signs just prior to horizontal curve north of Gas House Pike
    - Large Arrow (W1-6) warning sign in horizontal curve north of Gas House Pike
    - NB & SB W1-2 "Curve" warning signs at second curve north of Gas House Pike
- Replace "Turn" (W1-1) warning signs on northbound and southbound to high retroreflective sheeting.
- Add "15 MPH" advisory speed limit signs below the existing "Turn" warning (W1-1) signs on northbound and southbound Dance Hall Road at the curve just north of Gas House Pike
- Once trees are cut back from the sharp turn north of Gas House Pike, install chevrons around the turn to supplement the advance "turn" warning and "large arrow" signs.

Mid-Level Cost

- Install edgeline rumble stripes along Dance Hall Road as well as rumble strips on the approaches to the sharp curve.
- Install RPMs, which were identified in the RPM "hot spot" analyses as well.
- Trim trees and vegetation back from edge of road to the maximum extent possible based on right-of-way.
- Consider curve just north of Gas House Pike for high-surface friction treatment
- Install experimental elongated pavement marking signs (W1-1), which would likely require experimentation approval from FHWA, on northbound & southbound Dance Hall Road approaching the horizontal curve north of Gas House Pike, such as curve (W1-2) warning sign example from Kansas below:

Figure 30: Sample Curve Sign pavement marking from Lecompton, KS (FHWA Traffic Control Devices Pooled Fund Study: Evaluation of Elongated Pavement Marking Signs, October 2014)

Conclusions & Recommendations

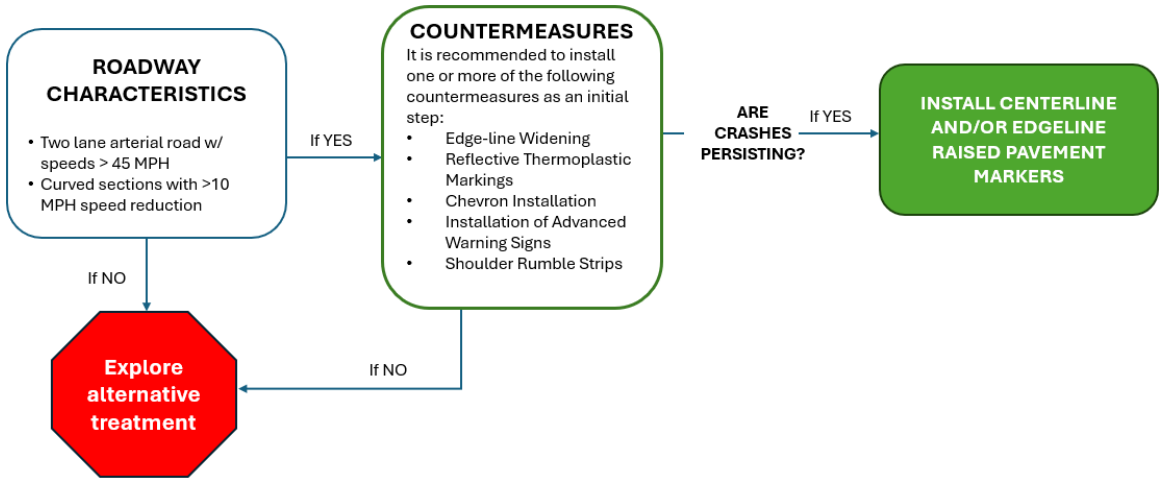
Rural road crashes can be challenging to address as they are dispersed throughout the County. However, through the Safe Streets for All grant, Frederick County has created a high-injury network to focus immediate spot safety countermeasures to improve safety on these rural roads.

While Frederick County rural roads generally include standard advanced signing, the high-injury network review identified both additional unique improvements as well as systemic treatments, such as wide edgelines, to further emphasize safety risks on these sections and compel motorists to adjust their driving behaviors accordingly. The recommended improvements and treatments are summarized in Appendix B: Recommendations Matrix and range from low cost with relatively quick implementation to higher costs, longer commitment. The Recommendations Matrix also identifies the Highway Safety Manual's Countermeasure Modification Factor for each recommendation to assist County staff in prioritizing implementation based upon highest anticipated safety improvement.

Using the established multi-prong approach to rural road safety as discussed above, Frederick County is well positioned to begin implementation of specific localized treatments, systemic safety countermeasures, and continue monitoring rural roads for focused attentional moving forward.

Appendix A: RPM Flow Chart

DECISION STEPS FOR RAISED PAVEMENT MARKINGS



Appendix B: Recommendations Matrix

Frederick County HIN Report: Low - Cost Recommendations Matrix						
HIN ID	**Location Description**	**Improvement Type**	**Description**	**Potential Treatment**	**CMF I.D.**	**CMF**
1	Woodville Road - Study Limits	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install 10-inch edgeline	9763	0.839
1	Woodville Road at Shirley Bohn Road	Pavement marking	Maximize intersection sight distance	Install edgeline extensions	9763	0.839
1	Wooodville Road approaching Talbot Run Road	Signing	Improve driver awareness & Reduce Driver Speeds	Install advanced “Turn” warning (W1-1) sign with “Talbot Run Rd” street name plate and 30 MPH advisory	2432	0.82
1	Woodville Road - Study Limits	Signing	Improve nighttime visibility	Install reflective delineators along all guardrails	10304	0.971
1	Woodville Road - Study Limits	Signing	Improve nighttime visibility	Install reflective tape on all sign posts, especially at: Harrisville Road stop signs; NB & SB Woodville Road turn warning signs approaching Talbot Run Road	8906	0.828
2	MD 550 (N Church St) and the US 15 Eastbound Off Ramp	Signing	Reduce driver speeds	Install a W3-5 (speed reduction) warning sign in advance of the existing driver speed feedback sign and co-located 25 MPH speed limit sign	62	0.85
2	MD 550 (Church Street/Sabillasville Road) - Study Limits	Signing	Improve driver awareness	Install turn/curve warning signs (chevron alignment, one direction, and turn ahead) at all the horizontal curves along this corridor	2432	0.82
2	MD 550 (Church Street/Sabillasville Road) - Study Limits	Pavement marking	Improve driver awareness	Consider transverse rumble strips in advance of sharpest curve to better alert motorists to sharp horizontal alignment	98	0.94
2	MD 550 (N Church St) and the US 15 Ramps	Pavement marking	Improve driver awareness	Install of yield lines, hatching, and centerline/edgeline extension line pavement markings	8867	0.899
2	MD 550 near Catoctin High School	Pavement marking	Increase visibility of roadway edge and reduce speeds	Refresh edge line pavement markings near Catoctin High School, using wider (10-inch) pavement marking lines	4751	0.623
3	Eastbound and Westbound MD 26 approaching MD 75	Signing	Improve driver awareness	Install “Signal Ahead” warning signs	62	0.85
3	Eastbound and westbound MD 26 approaching MD 75	Signing	Improve driver awareness	Install supplemental street name plates	2453	0.897
3	MD 26 at MD 550/Woodsboro Road/Mill Street	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install edgeline extensions	9763	0.839
3	Southside of MD 26 and Artie Kemp Road	Signing	Improve nighttime visibility	Install reflective tape on utility poles along southside of MD 26 from Artie Kemp Road to start of guardrail (approximately _1600-ft) pole	8906	0.828
4	Sabillasville Road and Foxville Deerfield Road	Pavement marking	Improve driver awareness and maximize sight distance	Refresh the existing stop line and edge line pavement	8880	0.718
4	Sabillasville Road and Foxville Deerfield Road	Pavement marking	Improve driver awareness	Install dotted centerline extension pavement markings	87	0.99
4	Sabillasville Road and Harbaugh Valley Road	Pavement marking	Improve driver awareness and maximize sight distance	Refresh the existing stop line and edge line pavement	8880	0.718
4	Sabillasville Road and Foxville Deerfield Road	Signing	Improve driver awareness	Replace the existing 30 inches by 12 inches W4-4a(1) signs (Traffic from Right/Left does not stop) , with larger signs (36 inches by 15 inches)	62	0.85
5	Old Frederick Road and Mud College Road	Signing	Reduce driver speeds	Install 30 MPH curve advisory speed limit plaques below the existing curve warning signs at the horizontal curves near Mud College Road and near 14708 Old Frederick Road	2431	0.82
5	Old Frederick Road and Rocky Ridge Road	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install edgeline extensions	9763	0.839
6	MD 85/Buckeystown Pike -Study Limits	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install 10-inch edgeline	9763	0.839
6	MD 85/Buckeystown Pike -Study Limits	Signing	Reduce fixed object crashes	Install reflective tape around each utility pole	8906	0.828
6	MD 85/Buckeystown Pike -Study Limits	Signing	Improve driver awareness	Add retroreflective strip to sign posts, especially the sidestreet “stop” signs on EB Oland Road, on EB & WB Greenfield Road, and on NB MD 28 / Dickerson Road	8906	0.828
6	Lily Pons Road and Oland Road	Signing	Improve driver awareness	Replace existing “stop” signs on Lily Pons Road and Oland Road with oversized (48” x 48”) stop signs	6053	0.841 - 1.053
7	Gas House Pike and Boyers Mill Road	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install 10-inch edgeline	4751	0.623

Frederick County HIN Report: Low - Cost Recommendations Matrix						
HIN ID	Location Description	Improvement Type	Description	Potential Treatment	CMF I.D.	CMF
7	Gas House Pike and Boyers Mill Road	Pavement marking	Increase visibility of roadway edge	Install reflective tape on all curve or turn warning signs	8906	0.828
7	Gas House Pike and Boyers Mill Road	Signing	Improve driver awareness	Install oversized “STOP” signs	8880	0.718
7	Gas House Pike and Boyers Mill Road	Signing	Improve driver awareness	Reflective tape on the All-Way Stop sign posts	8906	0.828
8	Harp Hill Road - Study Limits	Tree trimming	Increase roadway clear zone and reduce fixed object crashes	Cut trees/shrubbery to increase sight distance	1024	0.62
8	Harp Hill Road - Study Limits	Signing	Increase driver awareness	Install one direction curve warning signs to supplement the existing chevron signs along each of the horizontal curves near 11425 Harp Hill Road	10613	0.725
8	11424 Harp Hill Road	Signing	Improve driver awareness and reduce speeds	Replace the damaged speed limit sign near 11425 Harp Hill Road	62	0.85
8	Harp Hill Road - Study Limits	Pavement marking	Increase visibility of roadway edge and reduce speeds	Refresh faded edge line or centerline pavement markings along the entire corridor	102	0.55
9	Big Woods Road	Pavement marking	Improve driver awareness and reduce speeds	Install optical speed pavement markings approaching curves	10312	0.652
9	Big Woods Road	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install 10-inch edgeline	4751	0.623
10	Mountaindale Road at Bethel Road	Pavement marking	Improve driver awareness and maximize sight distance	Refresh existing stop bar pavement marking for the southbound movement at the intersection	8880	0.718
10	Mountaindale Road at Bethel Road	Pavement marking	Improve driver awareness and maximize sight distance	Relocate the stop bar pavement marking located on northbound Bethel Road closer to the edge line of Mountaindale Road.	8880	0.718
10	Mountaindale Road at Bethel Road	Pavement marking	Improve driver awareness and maximize sight distance	Install centerline and edge line extension pavement markings at the intersection	101	0.76
10	Mountaindale Road at Bethel Road	Tree trimming/Signing	Improve driver awareness and maximize sight distance	Trim trees and/or relocate the speed limit sign near the intersection of Mountaindale Road and Bethel Road, to improve the visibility of the sign	1024	0.62
10	Mountaindale Road - Study Limits	Pavement marking	Increase visibility of roadway edge and reduce speeds	Refresh existing faded edge line pavement markings along the entire corridor	4751	0.623
10	6826 Mountaindale Road	Signing	Reduce the fixed object crashes	Install One Direction Large Arrow (W1-6) signs at the curve that is near 6826 Mountaindale Road	10612	0.82
11	Eastbound of Mountville Road and Ballenger Creek Pike	Pavement marking	Improve driver awareness and maximize sight distance	Refresh existing stop bar pavement marking for eastbound Mountville Road and Ballenger Creek Pike	8880	0.718
11	Westbound Mountville Road closer to the edge of Ballenger Creek Pike	Pavement marking	Improve driver awareness and maximize sight distance	Relocate stop bar pavement marking.	8880	0.718
11	Mountville Road and Ballenger Creek Pike	Pavement marking	Increase visibility of roadway edge	Refresh existing edge line and center line extension pavement markings	102	0.55
11	Mountville Road and Ballenger Creek Pike	Tree trimming/Signing	Improve sign visibility	Trim trees or relocate the speed limit signs	1024	0.62
11	Mountville Road south of Howard Stup Road	Tree trimming	Increase clear zone and reduce fixed object crashes	Trim the trees located near the curve that is approximately 1,000 feet south of the Mountville Road and Howard Stup Road intersection	1024	0.62
11	Eastbound Mountville Road and US 15 intersection	Signing	Reduce the frequency of the angle crashes	Consider installing a “no turn on red” sign (R10-11b) for the eastbound approach	NA	None
12	Ball Road - Study Limits	Guardrail	Improve nighttime visibility	Install reflectors along guardrail to better direct motorists along roadway under low lighting conditions	10304	0.971
12	Ball Road - Study Limits	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install 10-in wide edgelines	9763	0.839
12	Ball Road and Reels Mill Road	Pavement marking	Improve driver awareness	Install in pavement curve and advisory speed markings on eastbound and westbound approaches to both curves	10312	0.652
13	Gas House Pike and Dance Hall Road	Signing	Improve driver awareness	Install advanced sidestreet and supplemental street name plaque on Gas House Pike 305-feet in advance of Dance Hall Road	2453	0.897
13	Gas House Pike and Dance Hall Road	Signing	Improve driver awareness	Replace the “Dance Hall Road” street name sign at Gas House Pike	62	0.85
13	Gas House Pike - Study Limits	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install 10-inch wide edgelines	9763	0.839
13	Gas House Pike - Study Limits	Signing	Improve driver awareness	Install retroreflective striping to all sign supports within corridor	8906	0.828
13	Gas House Pike - Study Limits	Signing	Reduce driver speeds	Replace “Turn” (W1-1) warning signs on NB/SB Dance Hall Rd to high retroreflective sheeting and Add "15 MPH" advisory speed limit below	2431	0.82
13	Northbound and Southbound Dance Hall Road	Tree trimming	Increase clear zone and reduce fixed object crashes	Trim trees from the sharp turn north of Gas House Pike	1024	0.62
13	Northbound and Southbound Dance Hall Road	Signing	Increase driver awareness	Install chevrons around the turn to supplement the advance “turn” warning and “large arrow” signs	2439	0.75

Frederick County HIN Report: Mid - Cost Recommendations Matrix						
HIN ID	Location Description	Improvement Type	Description	Potential Treatment	CMF I.D.	CMF
1	Woodville Road at Harrisville Road	Tree Trimming	Increase roadway clear zone and maximize intersection sight distance	Cut trees on east side of Woodville Road south of Harrisville Road to increase westbound Harrisville Road sight distance	1024	0.62
1	Woodville Road - Study Limits	Centerline and Edgeline Rumble Strips	Increase visibility of roadway centerline and edge	Install centerline and edgeline rumble strips. Prioritize the following sections: #8103 Woodville to #8219, which includes the Talbot Run Road intersection North of Glissans Mill Road to Mitchell Court	6974	0.702
1	Woodville Road at Talbot Run Road	Pavement Marking	Improve driver awareness and reduce speeds	Install “SLOW” and arrow in-street pavement markings on the Woodville Road approaches to	10312	0.652
1	Woodville Road - Study Limits	RPMs	Improve nighttime visibility	Install snow-plowable, permanent raised pavement markers (RPMs)	111	1.13-0.67
2	MD 550 (Church Street/Sabillasville Road) - Study Limits	High Friction Surface Treatment	Reduce the number of wet surface crashes	Install High Friction Surface Treatment at/near the horizontal curves along this corridor	7898	0.653
2	MD 550 (Church Street/Sabillasville Road) - Study Limits	RPMs	Reduce the number of crashes occurring during dawn/dusk/nighttime hours	Install snow-plowable, permanent raised pavement markers (RPMs)	111	1.13-0.67
4	Sabillasville Road at Foxville Road	High Friction Surface Treatment	Reduce the number of wet surface crashes	Install High Friction Surface Treatment at the intersection	7898	0.653
4	MD 550 North (Sabillasville Road) - Study Limits	RPMs	Improve nighttime visibility	Install snow-plowable, permanent raised pavement markers (RPMs)	111	1.13-0.67
5	Old Frederick Road - Study Limits	Curve Warning System	Reduce the frequency of run-off-the-road single vehicle crashes	Install dynamic curve warning system	1914	0.477 - 0.627
5	Old Frederick Road and Mud College Road	RPMs	Improve nighttime visibility	Install snow-plowable, permanent raised pavement markers (RPMs)	111	1.13-0.67
6	MD 85/Buckeystown Pike - Study Limits	Pavement marking	Increase visibility of roadway edge and reduce speeds	Install edgeline rumble stripes	3394	0.67
6	MD 85/Buckeystown Pike at Lily Pons Road and Oland Road	Signing	Improve driver awareness	Add beacons to "STOP" sign	447	0.9
6	MD 85/Buckeystown Pike - Study Limits	RPMs	Improve nighttime visibility	Install snow-plowable, permanent raised pavement markers (RPMs)	111	1.13-0.67
7	Gas House Pike and Boyers Mill Road - Study Limits	Pavement marking	Increase drivers maintaining travel lane	Install centerline rumble strips along corridor	9698	0.925
7	Gas House Pike and Boyers Mill Road - Study Limits	RPMs	Improve nighttime visibility	Install snow-plowable, permanent raised pavement markers (RPMs), prioritize locations: Progress Drive to Dance Hall Road and Crickenberger Road to New London Road	111	1.13-0.67
7	Gas House Pike east of Central Church Road/Crickenberger Road	High Friction Surface Treatment	Reduce the number of wet surface crashes	Install high-surface friction treatment on Gas House Pike through curves and steep grade east of Central Church Road/Crickenberger Road	7898	0.653
8	Harp Hill Road - Study Limits	RPMs	Improve nighttime visibility	Install snow-plowable, permanent raised pavement markers (RPMs)	111	1.13-0.67
8	11613 Harp Hill Road	Install traffic barrier w-beam	Reduce the frequency of run-off-the-road single vehicle crashes	Install traffic barrier w-beam, near 11614 Harp Hill Road (northbound)	8415	1.12
8	Harp Hill Road - near coordinates 39°32'58.6"N 77°32'55.0"W (milepoint 1.7 S)	Curve Warning System	Reduce the frequency of run-off-the-road single vehicle crashes	Install dynamic curve warning system	1914	0.477 - 0.627
9	Big Woods Road	Guardrail	Improve nighttime visibility	Extend guardrail (nonrecoverable slope) along east side of Big Woods Road further northward	10304	0.971
9	Big Woods Road - Study Limits	Signing	Improve driver awareness and reduce speeds	Install temporary driver speed feedback signs on approach to curves	6886	0.93
10	Mountaindale Road - Study Limits	RPMs	Improve nighttime visibility	Install raised pavement markers along the entire corridor	111	1.13-0.67
10	Mountaindale Road - Study Limits	Post mounted delineators	Reduce the frequency of run off the road (fixed object/other pole) crashes	Install post mounted delineators near the fixed objects along this corridor	102	0.55

Frederick County HIN Report: Mid - Cost Recommendations Matrix						
HIN ID	**Location Description**	**Improvement Type**	**Description**	**Potential Treatment**	**CMF I.D.**	**CMF**
11	Southbound Mountville Road and Ballenger Creek	Install transverse rumble strips	Reduce the frequency of angle crashes	Install transverse rumble strips along southbound Mountville Road, on the approach to the Mountville Road and Ballenger Creek Pike intersection	9046	0.71
12	Ball Road and Reels Mill Road	High Friction Surface Treatment	Reduce the number of wet surface crashes	Install High Friction Surface Treatment throughout study section	7898	0.653
13	Northbound and Southbound Dance Hall Road	Edgeline Rumble Strips	Reduce the number of run-off crashes	Install edgeline rumble stripes along Dance Hall Road	3394	0.67
13	Northbound and Southbound Dance Hall Road	Rumble Strips	Reduce the number of run-off crashes	Install transverse rumble strips on the approaches to the sharp curve on Dance Hall Road	11676	0.764
13	Northbound and Southbound Dance Hall Road	RPMs	Improve nighttime visibility	Install RPMs throughout corridor	111	1.13-0.67
13	Dance Hall Road -Study Limits	Tree trimming	Improve sight distance and reduce number of fix object crashes	Trim trees and vegetation back from edge of road to the maximum extent possible based on right-of-way	1024	0.62
13	Northbound and Southbound Dance Hall Road	Pavement marking	Improve driver awareness and reduce speeds	Install experimental elongated pavement marking signs (W1-1), which would likely require experimentation approval from FHWA, on northbound & southbound Dance Hall Road approaching the horizontal curve north of Gas House Pike.	*10312*	*0.652*
13	Gas House Pike and Dance Hall Road	High Friction Surface Treatment	Reduce the number of wet surface crashes	Install high-surface friction treatment on curve just north of Gas House Pike	7898	0.653

Frederick County HIN Report: High - Cost Recommendations Matrix						
HIN ID	Location Description	Improvement Type	Description	Potential Treatment	CMF I.D.	CMF
3	MD 26/Liberty Road at MD 75	Traffic signal improvement	Reduce angle collisions	Install advanced vehicle detection	1379	0.61
3	MD 26 and MD 550/Woodsboro Road/Mill Street	Intersection traffic control	Full Traffic Study to address angle collisions and limited intersection sight distance	Convert minor-road stop control to all-way stop control	310	0.25
3	MD 26 and MD 550/Woodsboro Road/Mill Street	Intersection traffic control	Full Traffic Study to address angle collisions and limited intersection sight distance	Install new Traffic Signal	320	0.33
3	From Liberty Elementary School to Libertytown Park	Street scape project	Implement street scape project to delineate space for each roadway user	Install curb and gutter	10231	1.21
3	From Liberty Elementary School to Libertytown Park	Street scape project	Implement street scape project to delineate space for each roadway user	Install sidewalks	11246	0.598
3	From Liberty Elementary School to Libertytown Park	Street scape project	Implement street scape project to delineate space for each roadway user	Install crosswalks	8880	0.718
3	From Liberty Elementary School to Libertytown Park	Install lighting	Reduce the frequency/severity of dark no light crashes	Intersection lighting	10993	0.792
3	From Liberty Elementary School to Libertytown Park	Install lighting	Reduce the frequency/severity of dark no light crashes	Improve street lighting illuminance	11026	0.679
4	Sabillasville Road and Foxville Deerfield Road	Intersection traffic control	Full Traffic Study	Install All-Way Stop Control	310	0.25
4	Sabillasville Road and Foxville Deerfield Road	Intersection geometry	Full Traffic Study	Install New Traffic Signal	320	0.33
4	Sabillasville Road and Foxville Deerfield Road	Intersection geometry	Full Traffic Study	Install Roundabout	9283	0.53
7	Gas House Pike at Linganore Road	Geometric	Reduce left turn collisions	Widen Gas House Pike at Linganore Road to provide westbound left-turn lane	3948	0.79
7	Gas House Pike to New London Road and MD 76	Shoulders	Reduce run-off crashes, fixed object and overturn in road	Extend current Gas House Pike modified minor arterial design to New London Road and MD 75, install Shoulders	6707	0.67
7	Gas House Pike to New London Road and MD 76	Guardrails	Reduce run-off crashes	Extend current Gas House Pike modified minor arterial design to New London Road and MD 75, install Guardrails	10304	0.971
7	Gas House Pike to New London Road and MD 76	Guardrails	Reduce run-off crashes	Extend current Gas House Pike modified minor arterial design to New London Road and MD 75, install Guardrails	37	0.56
7	Gas House Pike to New London Road and MD 76	Tree trimming	Increase roadway clear zone and reduce fixed object crashes	Extend current Gas House Pike modified minor arterial design to New London Road and MD 75, Clear zone	1024	0.62
10	Mountaindale Road at Bethel Road	Street lighting	Reduce the frequency/severity of dark no light crashes	Consider the installation of street lighting near the Mountaindale Road and Bethel Road intersection and at the curve near 6826 Mountaindale Road	10993	0.792
11	Intersection of Mountville Road and Ballenger Creek Pike	Intersection geometry	Reduce the rate of angle crashes	Consider the installation of a roundabout	9283	0.53
11	Mountville Road and US 15	Traffic Signal Reconstruction	Reduce the frequency of angle crashes and rear end crashes	The full signal reconstruction should replace the span wires with mast arms and install traffic signal backplates	9407	0.95