

Memorandum

To: Nathan Bragunier, Director of Public Works, Susquehanna Township

From: Patrick Wright, LTAP

Date: May 15, 2023

Subject: Wood Street Traffic Calming, Susquehanna Township, Dauphin County

Safety Concern and Background Data

In response to a technical assistance request from Susquehanna Township, LTAP discussed traffic issues with the Township to examine traffic calming concepts for Wood Street. The Township has received complaints about speed of traffic.

Observations for Wood Street

Figure 1 shows the PennDOT Type 5 Map image of the study area for Wood Street. We reviewed data provided by the Township, including traffic and crash data.

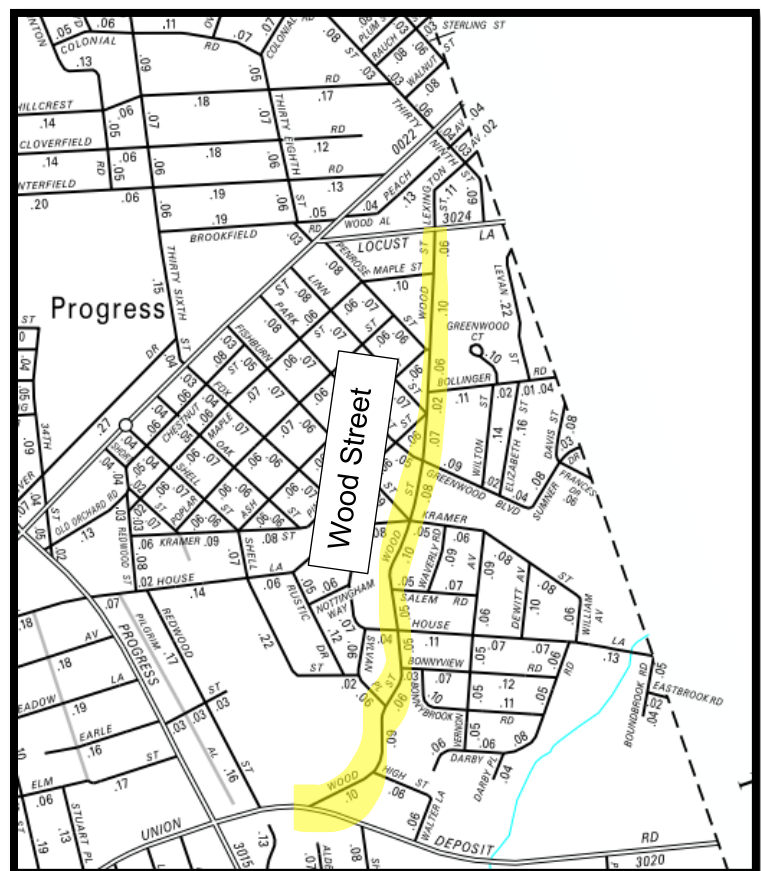


Figure 1: Type 5 Map of Wood Street

Wood Street is a paved two-lane, two-way, Township-owned roadway. It runs north-south from Union Deposit Road (SR 3020) to Locust Lane. Wood Street has a center line double yellow pavement marking, curbs, and some sections with sidewalks (see Figure 2). It is posted at 25 MPH and is 30 feet wide curb to curb. On-street parking was not observed; we did observe a few pedestrians, but no cyclists.

The land use is residential, with Susquehanna Township Middle School at the southern end by Union Deposit Road. The study section is 0.84 miles long per the PennDOT Type 5 Map.



Figure 2: Wood Street

Wood Street provides access to the neighborhood streets in the area and provides a north-south connection between Union Deposit Road and Locust Lane. It is also an emergency access route according to the Township.

Traffic Data for Wood Street

Per the PennDOT Traffic Information Repository (TIRe), Wood Street carries about 3,094 vehicles per day (vpd) according to count data from 07/2019. It is classified as a collector roadway. Historical traffic data from TIRe is shown in the table below:

From April 20-26, 2023, Susquehanna Township conducted speed and traffic count studies at two locations on Wood Street: one location at Sylvan Place and one location at Greenwood Boulevard (see Figure 3). The results are:

Sylvan Place:

- 85% percentile speed = 27.4 MPH
- 50% percentile speed = 24.1 MPH
- Pace = 19-29 MPH
- Average daily traffic = 2,521 vpd

Greenwood Boulevard:

- 85% percentile speed = 30.4 MPH
- 50% percentile speed = 21.8 MPH
- Pace = 20-30 MPH
- Average daily traffic = 2,165 vpd

Date	Volume
July 18, 2019	3,094
Aug 21, 2014	2,621
Nov 04, 2009	3,261
Sep 25, 2008	3,014
May 06, 2003	5,350
Aug 19, 1998	5,259

In a December 18, 2020 traffic calming study from HRG to the Township, the data showed that the 85th percentile speed was 34.2 MPH (the location and date of data collection was not provided). The current data shows a speed reduction from 34.2 MPH in 2020 to 28.9 MPH (average of both 2023 count locations), which is a reduction of 5.3 MPH.

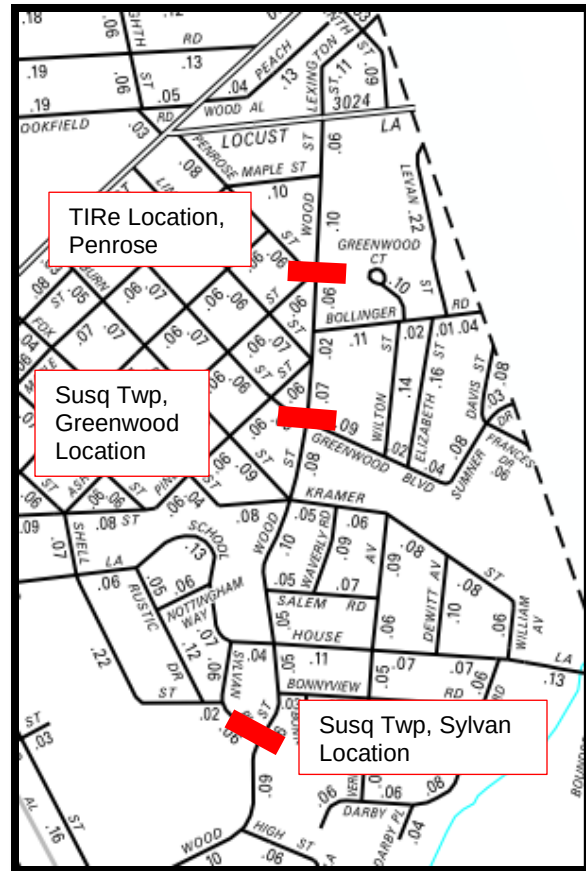


Figure 3: Traffic data collection locations

Crash Data for Wood Street

LTAP reviewed the Pennsylvania Crash Information Tool (PCIT) reported crash data for the most recent five years (January 2018 – December 2022) for Wood Street. There were seven reported crashes, which included 4 angle crashes and 3 hit fixed object crashes on Wood Street (see Figure 4).

The most common cited driver actions were running the stop sign (3), speeding (2), and too fast for conditions (2).

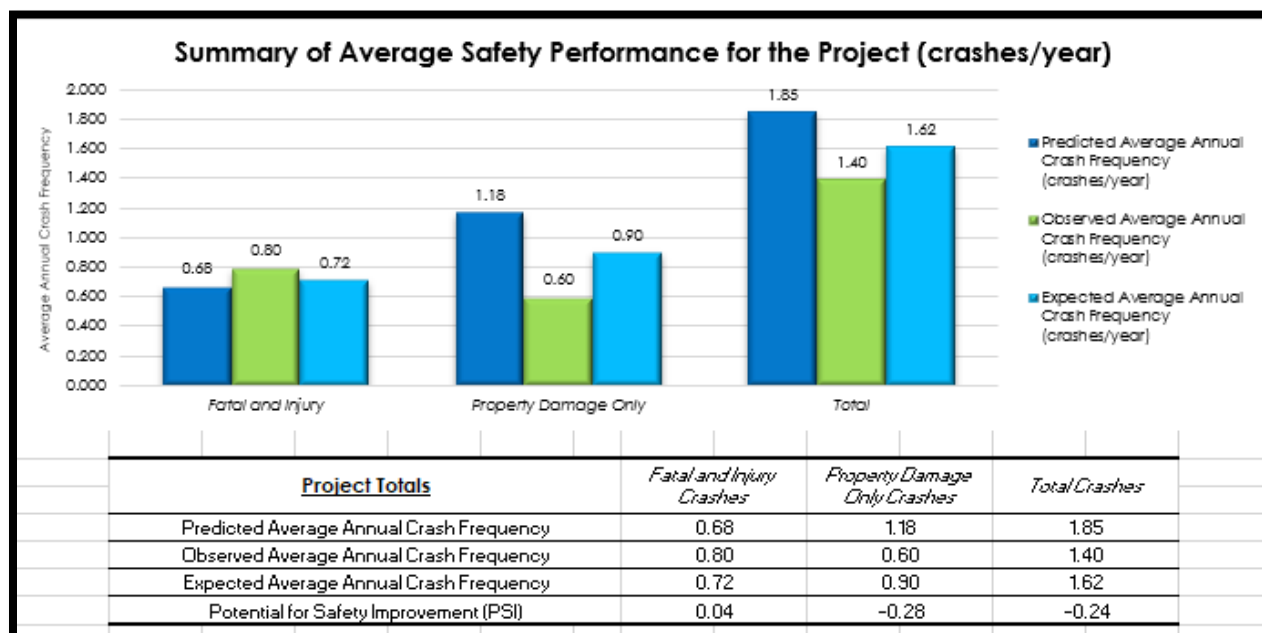
The December 18, 2020, HRG study mentioned a total of 42 crashes. This may have included non-reportable crashes and crashes at the intersections with Locust Lane/Union Deposit Road.

Based on the current traffic and crash data, LTAP assessed Wood Street using PennDOT's Highway Safety Manual Tool A. A summary of the assessment is shown in the graphic below.



Figure 4: PCIT crash map for Wood Street

The assessment shows that Wood Street averages 1.4 crashes per year (green bar), and that the predicted crash rate for this roadway is 1.85 crashes per year (dark blue bar). The predicted crash rate is based on crash rates developed for similar intersections within PennDOT District 8-0. The crash rate for Wood Street is less than similar roadways.



Existing Traffic Calming Devices

The Township installed 4 traffic calming features on Wood Street per the HRG study. One is located south of Sylvan Place, one north of Kramer Street, one north of Bollinger Road, and one south of Maple Street (see Figure 5). The devices were installed at the distances shown on Figure 5. These distances exceed the maximum recommended spacing per PennDOT Publication 383, *Pennsylvania's Traffic Calming Handbook*. They also exceed the guidance in the Institute of Transportation Engineers (ITE) *Guide to Vertical Deflection Speed Reduction Techniques*.

The traffic calming devices installed are speed cushions, but not consistent with PennDOT and national standards. The HRG study recommended the use of the speed cushions over traditional speed humps since Wood Street is an Emergency Access Route. Speed cushions may lessen the response time delay when compared to speed humps per Publication 383, by allowing emergency vehicles to straddle the cushions (see Figure 6).



Figure 6: Fire Engine straddling middle speed cushion



Figure 5: Speed cushion locations

The speed cushions deployed on Wood Street typically consist of an 9-foot-wide hump, a 2-foot-wide gap, a 4-foot-wide hump, a 2-foot-wide gap, and an 11-foot-wide hump. Each hump has a tapered edge of about 1 foot (see Figure 7).



Figure 7: Width dimensions of speed cushion near Penrose

Per PennDOT Publication 383 and the ITE guide, the speed cushions should be 6 feet wide. The 6-foot width allows the passage of wider emergency vehicles with little disruption but will affect narrower vehicles.

The current 4-foot-wide cushion in the center of Wood Street permits vehicles to move to the center of the roadway and straddle the middle cushion, without slowing down (see Figure 8).



Figure 8: Example of vehicle straddling middle cushion

PennDOT Publication 383 and the *Manual on Uniform Traffic Control Devices* (MUTCD) specify the signing and pavement marking requirements for the speed cushions. The signs and pavement markings on Wood Street are consistent with the requirements, except the width of the pavement markings is less than the 12 inches required (see Figure 9).



Figure 9: Signs and pavement markings

Discussion on Speeding and Speed Limits

The topic of speed on neighborhood streets is a highly discussed issue in Pennsylvania and other states. Residents on a neighborhood street want a low traffic volume, low speed roadway that reduces the negative impacts of vehicular traffic. These negative impacts of vehicles include safety (especially for pedestrians and bicyclists), noise, pollution, and others.

Conversely, residents also want a convenient and efficient transportation network to travel to work, shopping, school, and many other destinations.

Balancing these needs on a neighborhood street can be complex. This is also complicated by the design of the roadway itself. What is too fast is often a perception of a pedestrian or a resident and can vary depending on their situation. When walking along or crossing the street to access a mailbox, a person will perceive most vehicles as a potential safety threat and are thus judged to be traveling too fast.

This perspective changes for a person when they are driving a vehicle. When the road is wide and straight and there are no perceived hazards, traveling at 35 MPH or more may feel safe and appropriate regardless of what the speed limit signs say.

Nevertheless, we do know that speed does affect safety in many ways. For pedestrians, the faster a vehicle is traveling, the higher the chance of injury and death. Figure 10 shows that at 30 MPH, there is a 50% chance of death. Thirty (30) MPH is the 85th percentile speed for Wood Street. As the speed of a vehicle slows, the chance of a pedestrian death lowers—at 20 MPH, the chance is 18%. Even small reductions in speed can have a major impact on safety.

Figure 10 also shows that slower speeds increase the ability of a driver to see a pedestrian on the side of the road (cone of vision). As speeds increase, the cone of vision narrows, and drivers may not even notice pedestrians standing or walking alongside of the roadway at 40 MPH requiring more stopping sight distance (see Figure 11).

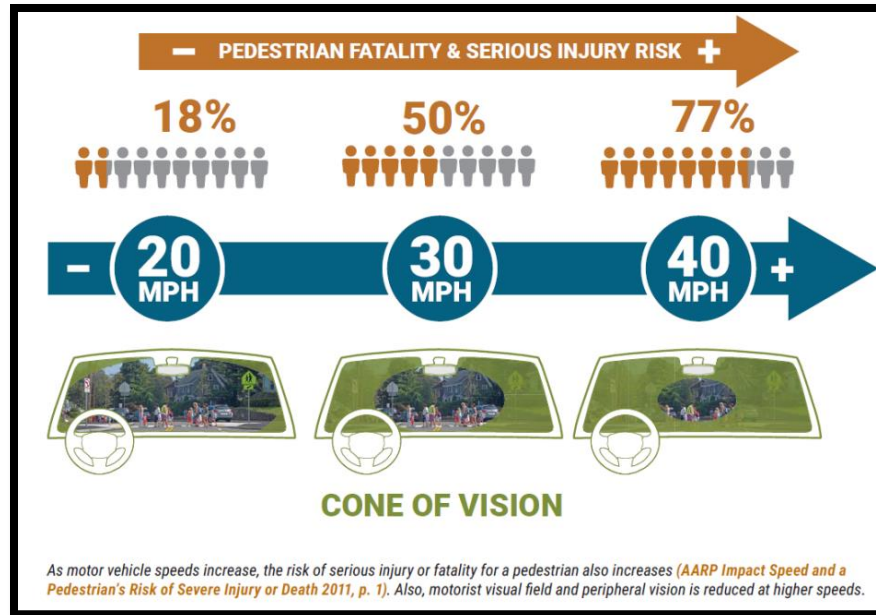


Figure 10: Relationship between speed and the percent change of a pedestrian death

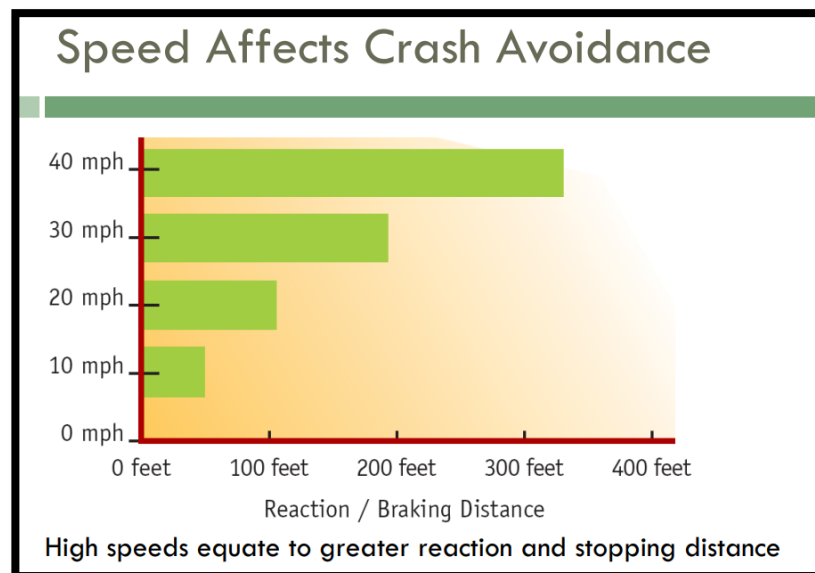


Figure 11: Relationship between speed and stopping distance

Figure 10 and Figure 11 graphics source: <https://idot.illinois.gov/Assets/uploads/files/About-IDOT/Misc/Peer-Exchange-Seminar/06%20-%20Module%20%20-%20FHWA%20Perspective%20%28Peter%20Eun%29.pdf>

The design of the roadway is the single most important factor affecting speed. Studies show that people will drive at speeds they feel comfortable at, given the design features of the roadway such as lane widths, roadway geometry, roadway alignment, presence of parking/curbs/trees/buildings, and other features regardless of the speed limit signs.

Roadways that are visually constrained and narrow have lower speeds. These constraints can include narrow lane widths, curbing, parked vehicles, trees, and buildings closer to the edge of the road (see Figure 12). While parking is permitted on Wood Street, it is rarely utilized, which does not provide any traffic calming effect.



Figure 12: Example of a narrow street with visual cues that constrain speeds

Roads that are wider leaving the driver's perspective more open will have higher speeds. This is also true for roadways that are straight and afford a driver a long view ahead (see Figure 13).



Figure 13: Wide streets with no curbs or parked vehicles will have higher speeds

Studies also show that altering the speed limit will have little effect on the speed of most vehicles. Studies show that the main positive result of lowering the speed limit is a reduction in the number of the faster groups of vehicles, which will have a positive effect on safety.

- Portland Oregon Study: <https://www.portland.gov/transportation/vision-zero/news/2020/12/1/analysis-indicates-20-mph-speed-limit-reduced-driving>
- Boston, Massachusetts Study: <https://www.iihs.org/topics/bibliography/ref/2168>

Both studies, as well as others, show the 85th percentile speeds remain consistent when comparing speeds before and after the speed limit reduction. Both studies also do show the positive result of reducing excessive speeders.

Thus, to impact the speed of vehicles, more than altering the speed limit is required—the design of the roadway itself must be altered, as well as consistent enforcement, education, and other measures.

Street Classification of Wood Street

Wood Street currently operates as a neighborhood collector distributing traffic to the neighborhood streets in the area. Further, it provides a north-south connection between Union Deposit Road and Locust Lane. As such, Wood Street is expected to carry more traffic than a typical residential street.

Whether the volumes on Wood Street are consistent with the expectations of the Township, and the residents, is a key discussion point. Wood Street is not a typical low volume residential street; it is designed and linked as a connector street. Whether the current operation is acceptable will drive future actions of the Township.

Traffic Calming Policy and Devices

Township staff indicated that there is no traffic calming policy for the Township. While this memo will provide some discussion of traffic calming, the Township should develop and adopt a formal traffic calming policy to support their traffic calming effort.

PennDOT Publication 383, *Pennsylvania's Traffic Calming Handbook*, outlines the process to develop a traffic calming policy. Publication 383 also discusses the steps for a typical traffic calming plan development and implementation. These processes are important to follow to avoid issues that often occur during traffic calming implementation, such as:

- Why is the Township spending resources on XXX Street and not mine?
- What devices are acceptable to deploy on Township roads, given the needs of all road users as well as emergency responders?
- What level of speeding/volume is an issue that should be addressed with traffic calming?
- What threshold of community acceptance is required to apply traffic calming on a street?
- Where will the devices be placed (not in front of my house!)?
- How many and what devices are needed?
- What are the standards for the traffic calming devices?
- What are the other traffic control devices required?
- What are the side effects of the different traffic calming devices?
- How will outreach and coordination be accomplished with residents?

A traffic calming policy can help the Township provide answers to the community and avoid future problems. There are many communities throughout Pennsylvania with example traffic calming policies, as well as information in Publication 383 on how to develop a policy.

Publication 383 suggests thresholds for the application of traffic calming. For speed, Publication 383 suggests that the 85th percentile speed should be 10 MPH over the posted speed limit. For traffic volume, Publication 383 suggests that volumes should be over 1,000 vehicles per day.

Wood Street meets the volume threshold but does not meet the speed threshold.

These are suggested thresholds and may differ from actual thresholds the Township establishes in its traffic calming policy. Recent research shows that many communities in the USA use an 85th percentile speed of 5-7 MPH over the posted speed limit as a threshold, compared to the 10 MPH suggested in Publication 383.

Publication 383 Speed Humps/Cushions

Speed humps/cushions (see Figure 14) are one of the more common traffic calming devices used in PA and in the USA. Speed cushions are an improved form of speed humps and have the same effect as speed humps. The design is intended to lessen the impact on emergency response vehicles as well as bicycles and other vehicles (such as farm equipment), while still slowing other traffic. Speed cushions are used in several communities in PA (Philadelphia uses them for their traffic calming program [<https://www.phila.gov/services/streets-sidewalks-alleys/request-a-traffic-calming-and-safety-study/>]). Deploying a series of speed humps/cushions along a street can reduce speeds 4-5 MPH, per PennDOT Pub 383.

Advantages/Disadvantages of Traffic Calming Concepts

PennDOT Publication 383 identifies the advantages and disadvantages of each of the traffic calming devices. While each device may slow traffic, there will be other side effects such as displacement of traffic to other streets, impacts on emergency vehicles/other larger vehicles, maintenance impacts, and others.

Since the speed cushions have been deployed on Wood Street, the Township should be aware of these negative impacts.



Figure 14: Example speed cushion, Philadelphia

Assessment of Existing Traffic Calming on Wood Street

While there is not a lot of data available, the data does suggest that the speed cushions have had some effect on traffic speed and volumes on Wood Street. The data shows a speed reduction from 34.2 MPH in 2020 to 28.9 MPH (average of both 2023 count locations), which is a reduction of 5.3 MPH. The traffic volume from the April 2023 counts is an average of 2,343 vpd, which is less than the 3,094 vpd from TIRE in July 2019.

These volume and speed reductions are consistent with the expected benefits of speed cushions (see Figure 15). The figure shows a typical speed reduction of 6 MPH and a volume reduction of about 250 vehicles (about 10%).

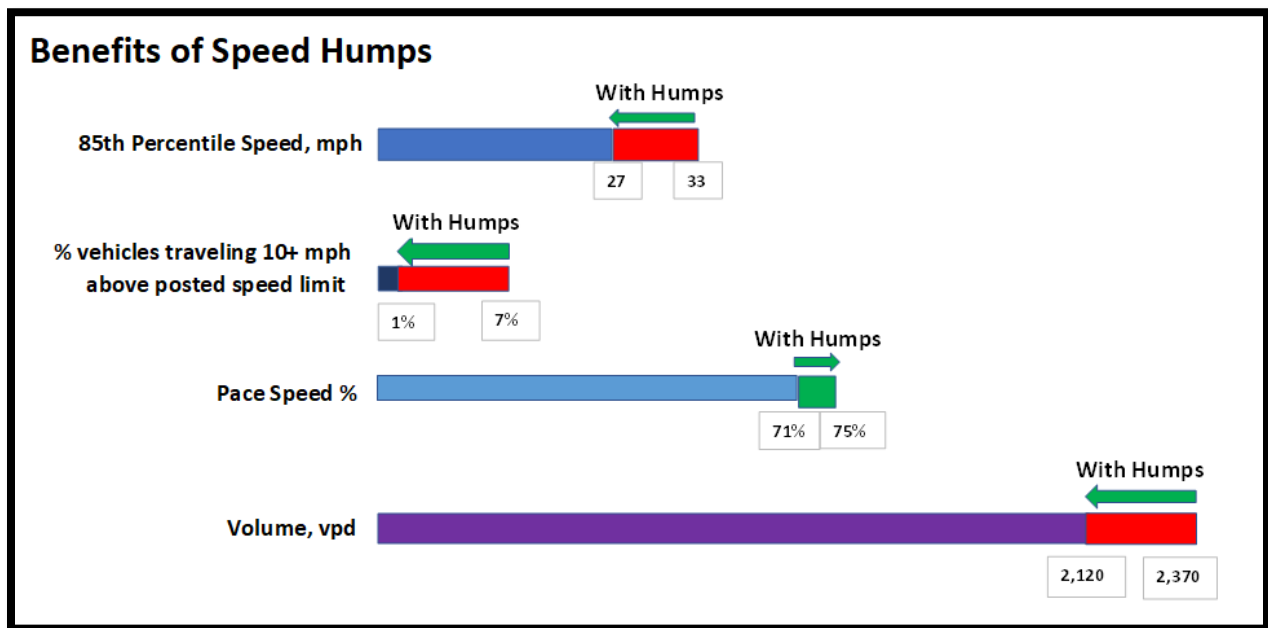


Figure 15: Benefits of speed humps/cushions (Source: ITE Guide)

A major concern is the application of any traffic calming that delays emergency response vehicles since Wood Street is a designated Emergency Response Access Route by the Township. **The ITE guide states that for these routes, speed humps should not be installed, and other techniques considered.** Since the devices have been deployed for several years, the Township should have some experiences with the impact of the devices on response times. This should be a key part of the evaluation on whether the Township removes the devices.

If the Township wants to keep the traffic calming, however, there are four issues that should be addressed, including:

- The design/layout of the speed cushions
- The spacing of the speed cushions
- The pavement markings
- Other speed management options to consider.

While this assessment presents a discussion of these issues, if the Township wants to move forward, they should work with a qualified traffic engineer with traffic calming experience to design the traffic calming devices. Furthermore, the Township should address emergency response vehicle access. Lastly, the Township should prepare and adopt a traffic calming policy before implementing devices.

Speed Cushion Design and Layout

The speed cushions should be redeployed in a design consistent with PennDOT Publication 383 and the *ITE Guide to Vertical Deflection Speed Reduction Techniques*. The ITE guide was published in December 2022, and contains the latest design guidelines. PennDOT is also updating Publication 383; however, that is not available yet but expected soon.

A key design feature is to deploy a 6-foot-wide cushion in the travel lane in each direction. The 6-foot-wide cushion will allow the emergency vehicles to traverse the cushion with less delay. Further, the center cushion must be a minimum of 6 feet, centered on the center line. The center cushion width can be widened up to 10 feet to account for the width of Wood Street. This will reduce the potential for vehicles to drive down the center of Wood Street.

Given the 30-foot width of Wood Street, the arrangement could be:

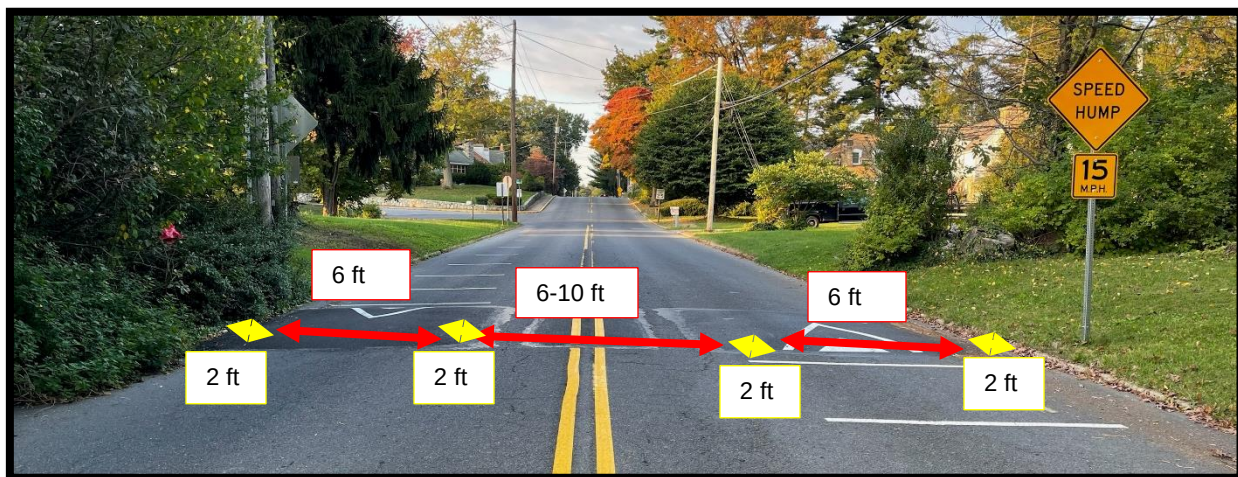


Figure 16: Schematic for speed cushion layout

In addition to adjusting the layout, the speed cushions should adhere to the shape, height, and taper design guidelines. A detail showing the City of Philadelphia Streets Department speed cushion detail is in the Appendix.

Speed Cushion Spacing

PennDOT Publication 383 suggests a spacing of 275 feet for a desired 85th percentile speed of 25 MPH. The ITE guide recommends a range of 250-500 feet. The Township engineer should review the existing placement of the devices, the guidelines for placement (including areas to avoid, such as driveways, intersections, horizontal/vertical alignment thresholds), and determine if the Township can deploy additional devices.

Additional devices will impact the speeds throughout the corridor and produce a more consistent speed profile of vehicles traveling on Wood Street. More consistent speeds, and more vehicles in the pace speed is a proven safety benefit (Source: ITE guide).

Signs and Pavement Markings

The signs and pavement markings must follow the requirements in PennDOT Publication 383 and the MUTCD. While the existing pattern of markings looks like the requirements, the width of the lines is not compliant.

Split Speed Humps

The City of Portland created a split speed hump concept (<https://www.portland.gov/transportation/engineering/documents/p-442r/download>) for their emergency service routes. The split speed hump diagram is shown in Figure 17.

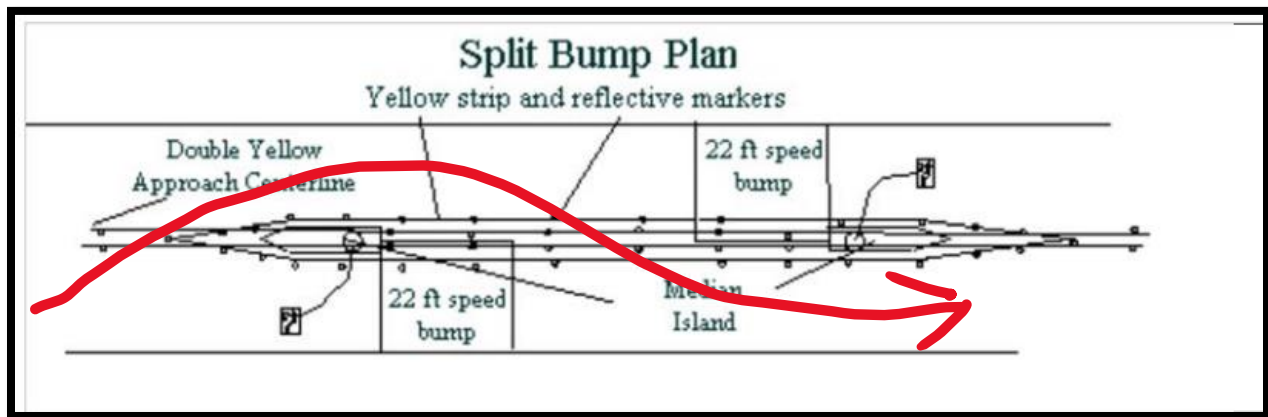


Figure 17: City of Portland Split Speed Hump

The design uses a median to keep traffic in their lane; but the median is split to allow emergency vehicles to travel around the speed humps (see red path in Figure 17). Whether or not these are appropriate for Wood Street should be studied by the Township engineer.

Hardened Centerline

The Township could consider adding yellow flexible delineator posts to the centerline approaching each hump. The intent of these devices would be to keep vehicles in their lane and traversing the speed cushion. However, this would also impact the emergency vehicles since the humps in the travel lane are wider than 6 feet.

Other Speed Management Options

The Township can consider combining the speed cushions with other traffic calming devices, such as traffic circles at intersections, chicanes, and chokers. This will depend on what devices the Township is willing to consider, the traffic calming policy, and the study by the engineer.

Traditional speed management methods include using signs, pavement markings, and other devices to supplement (or in lieu of) physical traffic calming features. The Township can consider the following:

- Installing of additional speed limit signs
- Enhancing the conspicuity of the speed limit signs
 - Adding reflective white channel post strips to the sign installation
 - Adding conspicuity plaques (W16-102P) or flags to the sign assembly.
- Using targeted enforcement
- Periodically deploying speed trailers
- Conducting speed management education/outreach with the community
- Restriping the roadway to create a parking lane/shoulders/pedestrian/bicycle lanes.

The parking lane/shoulder will narrow the visual width of the roadway, as well as provide a marked space for pedestrians and cyclists (see Figure 18). Shoulders/pedestrian/bike lanes are an FHWA proven safety countermeasure. Information on shoulders/pedestrian/bike lanes are in PennDOT Publication 13, *Design Manual Part 2-Contextual Roadway Design* (<https://www.dot.state.pa.us/public/pubsforms/Publications/PUB%2013/April%202021.pdf>) as well as the FHWA *Small Town and Rural Multimodal Networks* guide (https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/page05.cfm)

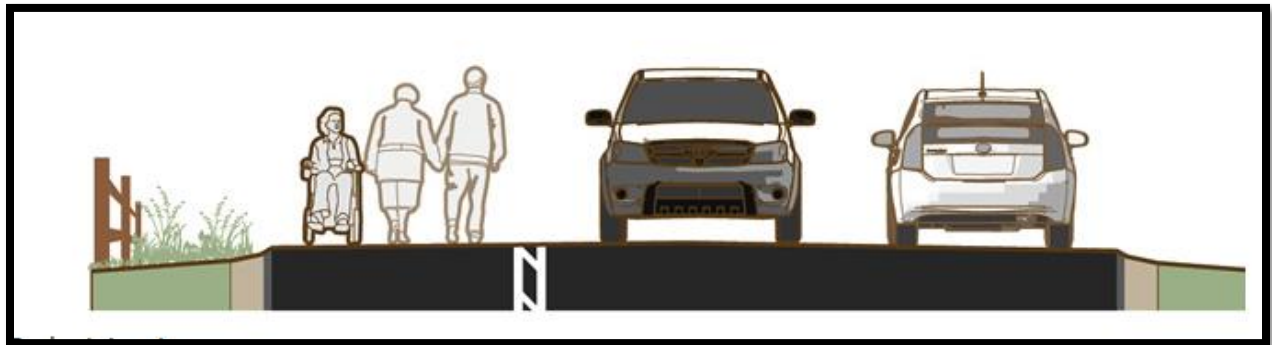


Figure 18: Pedestrian lane concept (FHWA *Small Town and Rural Multimodal Networks* guide)

Temporary Treatments/Applications

The Township can also consider temporary applications of traffic calming, including the options above. Many communities in PA and the US are using a combination of pavement markings, flexible delineator posts, temporary traffic calming devices, and temporary curbing to install traffic calming features. The temporary features lower the initial costs and allow all involved to test the advantages and disadvantages of the traffic calming devices (see Figure 19, Figure 20, and Figure 21). Publication 383, Chapter 4 provides guidance for temporary installation.



Figure 19: Temporary speed cushions, Philadelphia



Figure 20: Temporary curb extensions, Baltimore



Figure 21: Temporary traffic circle, Lancaster

Summary and Next Steps

Traffic calming is a proven technique to reduce the speed of traffic, as shown in Publication 383 and the national references. However, traffic calming devices do have side effects. Furthermore, the residents' reaction to the devices can vary from approval to anger at their installation.

Based on a review of available data, discussions with Susquehanna Township staff, and traffic calming resources, the Township can consider

- Developing and adopting a traffic calming policy
- Conducting community outreach per Publication 383
- Working with a qualified engineer to redeploy or remove the speed cushions
- Deploying other traffic calming techniques and traditional speed management methods.

Outreach, community acceptance, traffic studies, and design of the concepts in an open forum is vital to the success of traffic calming.

References

Field observations, discussions with municipal personnel, application of state/federal traffic control device guidelines, highway safety research, and traffic engineering experience are largely responsible for the content and findings of this memo. In addition, specific references that were consulted include:

- 2009 Current Edition of the *Manual on Uniform Traffic Control Devices* (MUTCD)
- PennDOT Publications 13, 46, 111, 212, 236, and 383.
- PA Vehicle Code (Title 75)
- PA Code (Title 67, Chapter 212)
- Institute of Transportation Engineers (ITE) Traffic Calming Measures (<https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/>)
- FHWA Traffic Calming e-Primer (https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm)
- ITE *Guidelines for the Design and Application of Speed Humps* (<https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/>)
- ITE *Guide to Vertical Deflection Speed Reduction Techniques* (<https://www.ite.org/technical-resources/topics/traffic-engineering/guide-to-vertical-deflection-speed-reduction-techniques>)
- FHWA Safe Transportation for Every Pedestrian (STEP): https://www.fhwa.dot.gov/innovation/everydaycounts/edc_5/step2.cfm
- FHWA Proven Safety Countermeasures (<https://safety.fhwa.dot.gov/provencountermeasures/>)

Pennsylvania LTAP is willing to clarify and provide additional information relating to any of the potential solutions listed.

Appendix

Philadelphia Streets Department Speed Cushion Detail

