TRAFFIC SAFETY TOOLBOX

Speeding Countermeasures Toolbox for Vermont

VERMONT
AGENCY OF TRANSPORTATION

THE UNIVERSITY OF VERMONT
TRANSPORTATION RESEARCH CENTER

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Speeding Countermeasures and the Use of this Toolbox

Reducing vehicle speeds is an important strategy for reducing the risk and severity of collisions and ensuring the safety of drivers, pedestrians, and cyclists, especially in transition zones, where rural highways with higher posted speeds (typically 50 mph) enter a village or town center. This Traffic Safety Toolbox ("Toolbox") of speeding countermeasures is intended for use by Vermont towns with posted speeds that are not widely adhered to by drivers, whether in a transition zone entering a village or town center (roads with speed limits of 35 mph and above and functional classifications of 3 or 4), or within the community itself (roads and streets with speed limits below 35 mph and functional classifications of 5 or higher), as illustrated below.

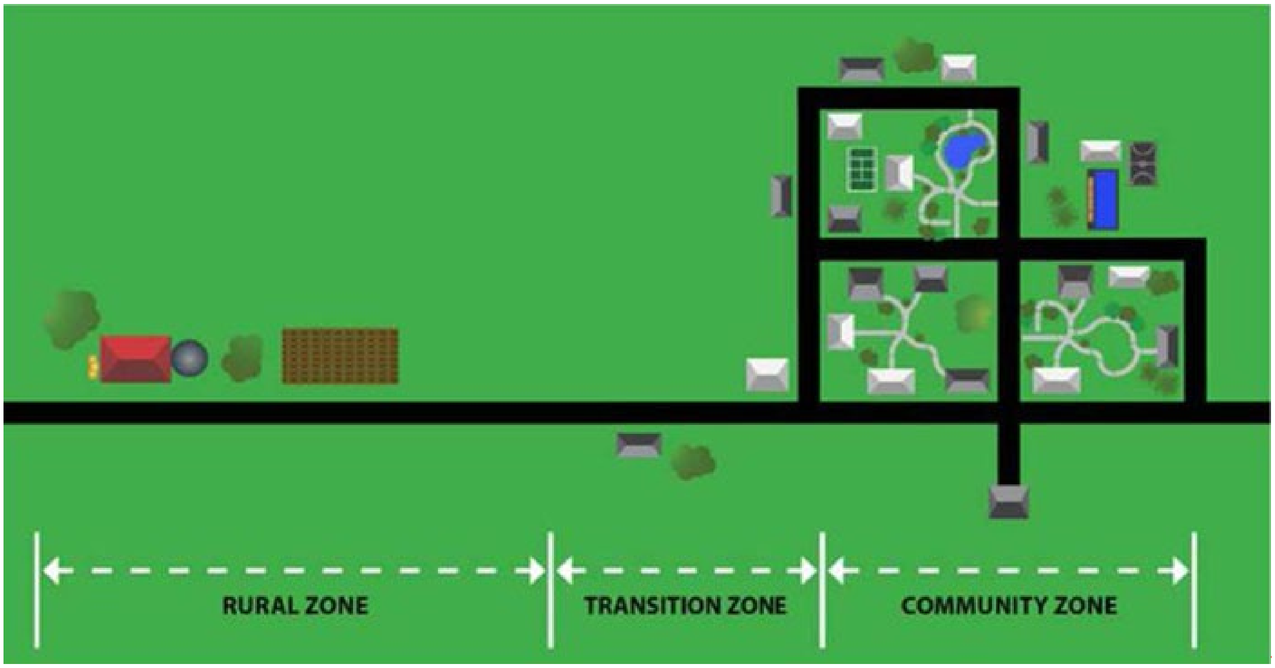


Diagram of a rural highway transition zone into a village or town center (FHWA, 2018)

Speeding countermeasures are engineered features designed to encourage drivers to reduce speeds below the posted or advisory speed limit. Speeding countermeasures are used in transition zones to help reduce speeds as the posted speed limit decreases before a vehicle enters a rural village or town center. In order to ensure a high rate of motorist compliance, transition zones must be properly designed with realistic and clearly-posted speed limits. The complementary objective of speeding countermeasures is to help make the roadway self-enforcing, with physical and perceptual measures that make it most comfortable for the motorist to drive at or below the posted speed limit. Once drivers are within the village or town center, speeding countermeasures continue to make drivers uncomfortable exceeding the posted speed limit. For a comparison of two typical transition zones in Vermont, refer to two of the field tests conducted during this project: Middlebury VT-30 and Hardwick VT-14.

Speeding countermeasures can be physical engineered features that provide a horizontal or vertical deflection of the roadway, or passive, perceptual measures, typically applied to the roadway surface or installed near the shoulder. Materials used for speeding countermeasures include delineator posts and tubes, precast concrete or plastic curbing, removable rubber speed humps, precast or wood planters, rolled asphalt, pavement markings, and signage.

This Toolbox provides an overview of the countermeasures that are appropriate for the Vermont context in a set of profile sheets, acting as a “launch point” to more detailed resources describing the full process of implementing these countermeasures. That process includes background data collection, community involvement, design, and construction/installation. In the profile sheets that comprise the Toolbox, users will find lists of more comprehensive resources that will guide this process. Following the profile sheets, users will find information attesting to the use of speeding countermeasures in Vermont in a series of case studies and field tests. For each case study and field test, a fact sheet is provided that demonstrates a real-world example of the use of speeding countermeasures in Vermont.

Maintenance of Speeding Countermeasures

Countermeasure effectiveness and durability requires alignment between the maintenance required and the responsible agency’s capabilities. Pavement markings are low-cost and easy to install but require frequent replacement to be effective. Winter maintenance must be responsive to the need to maintain visibility of pavement markings during snowfall, and vertical deflections are also less effective when they are left snow-covered. Winter conditions do not prohibit the installation of traffic calming measures, but winter maintenance activities must be considered when treatments are physically within the road or modify the roadway alignment or cross-section. Speeding countermeasures can be damaged or worn down from winter maintenance activities. Snow removal methods may require adjustments, including using smaller or modified equipment and modified procedures. Snow removal operations may take longer after speeding countermeasures are installed, increasing maintenance costs over time.

Items/Strategies Often Mistaken as Speeding Countermeasures

Some engineered roadway features are commonly mistaken for speeding countermeasures. The following roadway design features are not speeding countermeasures, but are installed with a distinct alternate purpose, as indicated:

- Rectangular rapid flashing beacons: used to highlight the presence of a pedestrian in a crosswalk, requiring a full stop for crossing pedestrians. Not intended to reduce speed when the beacon is not activated.
- Roundabouts: designed to handle higher volumes and speeds than mini-roundabouts. Generally, do not fit within the footprint of residential collector or local road like a neighborhood traffic circle. Therefore, roundabouts typically require a higher level of design and right-of-way adjustment than a mini-roundabout or neighborhood traffic circle. The accepted threshold between mini-roundabouts and full roundabouts is an inscribed circle diameter of 90 feet.

- Advisory speed signs: used to advise a lower speed, for example, along a curve on a rural highway. These signs have very specific uses in situations where safe speeds are lower than the speed limit. They are not intended to slow traffic more generally, nor are they enforceable.
- Speed limit signs: rarely effective alone for reducing travel speeds. Experience has shown that drivers tend to travel at the speed that is most comfortable, based on the surrounding roadway environment. Speed limits set at levels less than those expected by drivers eventually lead to increased disregard for the signed speed limit and can create new safety hazards.
- Stop signs: implemented for certain operating conditions at a 3- or 4-way intersection. As with speed limits, drivers must recognize the need for the stop or they will eventually begin to ignore it. In the case of stop signs, this disregard would potentially pose a risk to other motorists or pedestrians. Studies on the use of stop signs as a standalone solution for speed control indicate that drivers will exceed speed limits between stops to make up for lost time if they feel that the stop signs serve no other purpose than to slow traffic. For this reason, stop signs are not allowed to be used as speeding countermeasures in the Manual on Uniform Traffic Control Devices (MUTCD, 2009 (2022)).
- Warning signs, except as required to complement speeding countermeasures: often used to help indicate the presence of driveways, sharp curves, or S-turns to help drivers safely navigate a rural highway, especially at night. They are not specifically intended to reduce speeds.

Speeding Countermeasures Not Approved for Use

Some experimental speeding countermeasures are not approved for use currently. The removal of centerline striping, which is often used in conjunction with advisory shoulders, has been shown to reduce speeds in one study (Cooper and Wright, 2014). However, this measure is not currently approved for use as a speeding countermeasure, as there has been no additional supporting evidence since the 2014 study.

Definitions and Related Concepts

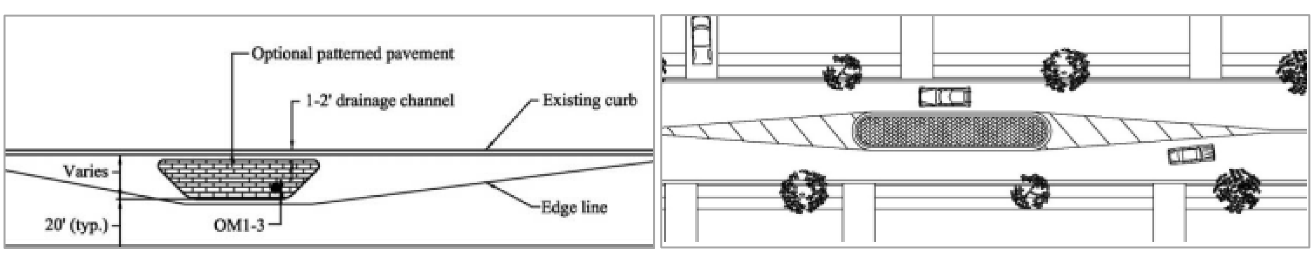
Speeding countermeasures are a subset of all traffic calming strategies, which include a broad array of measures designed for speed reduction, volume reduction, and re-routing of traffic. Traffic calming strategies intended to reduce traffic volumes or re-route traffic are not within the scope of this Toolbox.

Speed management strategies, more generally, include regulatory processes for setting and enforcing speed limits, as well as the potential use of speeding countermeasures to complement posted speeds. These regulatory processes are outside of the scope of this Toolbox. Setting and enforcing speed limits are often viewed as a means of reducing vehicle speeds, but research has shown that speed limit reductions alone are not typically effective at reducing speeds.

The connections between the names of different speeding countermeasures and the actual physical strategies they include are inconsistent in the field of practice. A prime example is the road diet strategy. A road diet is generally defined as a roadway reconfiguration that reduces vehicle travel lanes and utilizes the extra space for other modes and uses. FHWA focuses this definition primarily on the most common reconfiguration, which is the conversion of an undivided four-lane roadway to a three-lane roadway with a center two-way, left-turn lane (FHWA, 2014). The variability within this definition comes from the variety of uses it allows for the edge space that is freed up by conversion, including bike lanes, additional shoulder space, and on-street parking. Some agencies include this type of conversion under the more general strategy of Complete Streets (FHWA, 2018; Swan, 2019; GDCI, 2016). Other agencies, though, distinguish the individual calming sub-strategies within this definition, separating on-street parking and the lane narrowing that often results from a road diet as unique speeding countermeasures (Toronto, 2016; Kingston, undated). We define road diet in this Toolbox to be consistent with the definition used by FHWA (FHWA, 2014), leaving lane or street narrowing as a separate countermeasure.

In Vermont, the term Complete Streets connotes a set of principles that require designers to consider how a project will incorporate the needs of all facility users, throughout a project's planning, design, construction, and maintenance phases (VTrans, 2012). These principles may result in a variety of safety benefits but are not specifically intended to reduce vehicle speeds, so the term Complete Streets is not used to describe a speeding countermeasure or a traffic calming strategy in this Toolbox. The concept of Complete Streets is broad and wide ranging, meaning that a single set of rules or practices cannot be applied and/or implemented on all projects.

Design considerations for speeding countermeasures make reference to terms that may not be familiar to all users of this Toolbox. Traffic islands are horizontal deflections used to separate, control or direct traffic, or to provide refuge for pedestrians and cyclists crossing a roadway. They can provide space for placement of traffic control devices or landscaping. "Edge islands", distinguished from "center (or median) islands" are constructed at the outside edge of a travel lane, as opposed to the center. They provide a curbed barrier between the travel lanes and other edge features like drainage, on-street parking or bike lanes:



Examples of an edge island (left) used with a choker and a median island (right) used to narrow lanes (DelDOT, 2012)

Profiles of Recommended Speeding Countermeasures for Vermont

A wide array of resources was reviewed to identify speeding countermeasures that would be suitable in Vermont. Resources from the Federal Highway Administration (FHWA, 2018) and Canadian (cold weather) resources from Quebec (Berthod and Leclerc, 2013), Kingston (Kingston, undated), and Ottawa (Swan, 2019) were particularly useful in this process.

The following table provides a list of the speeding countermeasures that are recommended for use in Vermont, their acceptability on the state highway system, and the applicability and frequency of each countermeasure's use across seven criteria. For each criterion, the countermeasure is rated as follows:

- ++ indicates most favorable or most common
- + indicates moderately favorable or moderately common
- – indicates not favorable or not common

Click on a Speeding Countermeasure Name in the table to see its profile sheet. Each profile sheet includes context, design considerations, pros and cons, and frequency of use in Vermont. Specific costs are omitted because they will vary widely with the implementation context. The profile sheets are intended to give users a brief overview of each speeding countermeasure. Users will likely need more detailed information and, in some cases, a full design with construction procurement to implement countermeasures in their community. Before installing any of these on state highways, assistance from the Agency of Transportation should be sought. For towns considering how to reduce vehicle speeds, it is first important to measure speeds to determine the need for speeding countermeasures before they are implemented.

++ most favorable / most common
+ moderately favorable / moderately common
– not favorable / not common
seek seek Agency review/assistance

Type	Speeding Countermeasure	Frequency of Use in Vermont	Snow and Ice Control	Emergency Response	Cost / Maintenance	Speed Reduction Potential	Within Village or Town Center (< 35 mph)	Within Transition Zone (> 35 mph)	Acceptable on VT Highways?
Horizontal deflections	Lane or street narrowing	+	+	+	+	+	++	++	seek
	Lateral shift	+	+	+	+	+	+	+	seek
	Bulbout / pinchpoint / choker	+	+	+	+	+	++	–	seek
	Median island	+	+	+	+	+	+	+	seek
	Mini-roundabout	–	–	+	–	++	++	–	seek
	Neighborhood traffic circle	+	+	+	–	++	++	–	no
Vertical deflections	Speed hump or cushion	+	–	+	–	++	++	–	no
	Raised crosswalk / speed table	+	–	+	–	++	++	–	no
	Raised intersection	–	–	+	–	++	++	–	no
Perceptual, or passive, measures	Road diet	+	++	++	+	+	++	+	seek
	Radar speed feedback signs	++	++	++	+	+	++	+	seek
	Transverse line markings	+	++	++	+	+	+	++	no
	Gateway signing / landscaping	++	++	++	++	+	–	++	seek
	Transverse mumble strips	–	+	+	+	+	+	+	no
	[SLOW]/[-- MPH] pavement word marking	–	++	++	+	+	+	–	no

PROFILES OF SPEEDING COUNTER-MEASURES

HORIZONTAL DEFLECTIONS

LANE OR STREET NARROWING

A common countermeasure for transition zones

Lane narrowing with shoulder striping (GDCI, 2016)

Median striping used to narrow lanes on US-7 in Ferrisburgh, VT

Narrowing involves the reduction in the striped lane width or the curb-to-curb width of a street to encourage drivers to reduce speed. Lanes can be narrowed using pavement markings, removable vertical traffic control devices, or permanent installations such as medians, curbing, or a road diet.

FACTS AT A GLANCE

PROS

- Absolute speeds can be reduced to 32 mph or less
- Refuge areas can improve pedestrian crossing safety and add landscaping
- Removable devices can be used to facilitate snow and ice control in winter
- Inexpensive when only pavement marking are used

CONS

- Only a modest (4%) speed reduction potential
- Possible loss of on-street parking
- Pavement markings require increased maintenance where snow removal is common
- Permanent devices can impact snow removal operations

USE IN VERMONT

- Moderately common

CONTEXT

Narrowing can be an effective method of reducing vehicle speeds in transition zones. The required change in alignment, in addition to the visual appearance of narrowed lanes encourages most motorists to reduce speed by making them aware of streetside objects. For lane width reductions, the additional area between the edge of lane and the edge of the curb or shoulder can be used for parking, as a pedestrian facility, or as a bicycle lane. Lane width reductions can also be accompanied by the introduction of a center island, providing a pedestrian crossing refuge, or a gateway/landscaping area.

DESIGN CONSIDERATIONS

Consider for state highways only if daily traffic volumes are 4,000 or less. Design for large vehicles to navigate narrowed lanes and to accommodate cyclists if either are present. Center islands used for narrowing should include MUTCD-compliant signs to alert motorists of their presence, especially if encountered in a transition zone. Consider phased construction to alert motorists to new obstacles. Center islands may be supplemented by low-lying landscaping to maintain sight lines and minimize maintenance. Lane narrowing with pavement markings can be used within the transition zone or town center.

For Further Information: VTrans, 1998; FHWA, 2018; DelDOT, 2012; GDCI, 2016; TAC, 2018; Ewing and Brown, 2009

PROFILES OF SPEEDING COUNTER-MEASURES

HORIZONTAL DEFLECTIONS

LATERAL SHIFT

Effective for a wide range of speeds in transition zones

Typical lateral shift with curb extensions

Lateral shift along US-2 entering Danville, Vermont

FACTS AT A GLANCE

PROS

- Median can provide a refuge island for a crosswalk and an opportunity for gateway signing and landscaping
- Mountable curbs can be used to allow passage by large vehicles
- Ideal for a range of reductions in transition zones

CONS

- Not effective without opposing traffic, as drivers can maintain higher speeds
- Separated bike lane is often not feasible
- Pavement markings require frequent maintenance to remain effective
- May require removal of on-street parking
- Barrier curbs can be a problem for large vehicles

USE IN VERMONT

- Moderately common

A lateral shift is a realignment of the travel lanes and centerline of an otherwise straight roadway away from a straight line. A typical lateral shift separates opposing traffic using a median island or pavement markings, but strategically placed curb extensions or shoulder obstructions can also be used.

CONTEXT

A lateral shift can serve as an alert to motorists in a rural setting entering a community where lower speeds are required, effective across a relatively wide range of speed reductions. Use of a median island not only separates opposing traffic but can be used for a turn lane that prevents rear-end collisions with left-turning traffic. A barrier or mountable curb can be used for a curb extension or median island. Curb extensions can provide space on alternating sides of the road for on-street parking, but median islands allow existing edge drainage to remain, so tend to be less costly.

DESIGN CONSIDERATIONS

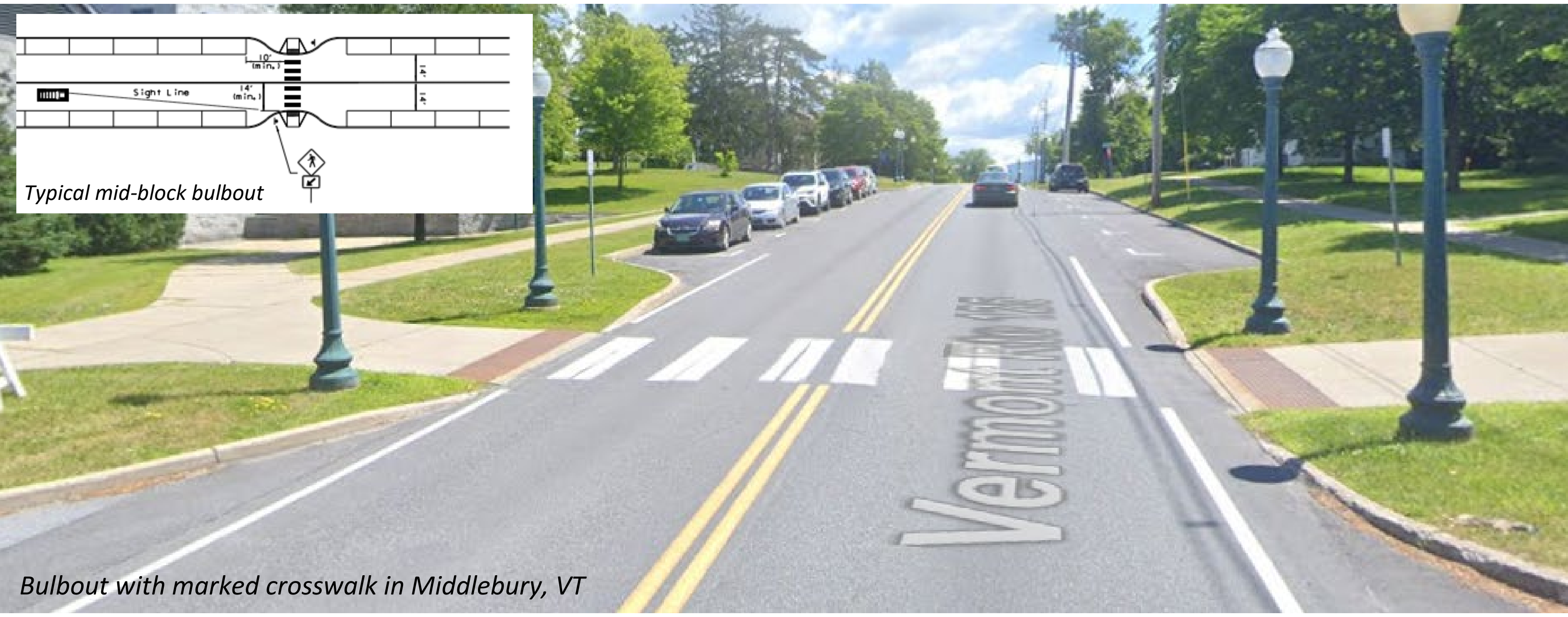
A shift of 1 lane-width is a common design target. Consider on state highways only if daily traffic volumes are 4,000 or less. The typical maximum for the reduced speed is 35 mph. Ensure adequate stopping sight distance or warning signs on a crest vertical curve. Max grade limitations must also be met. Islands and curb extensions can include signs or landscaping to draw attention. Use of mountable curbs avoids the need to offset from the edge line as is required for a barrier curb. Edge line tapers should be MUTCD-compliant. On a street with bicycle traffic, shared-lane markings and signage should be included.

For Further Information: FHWA, 2018; DelDOT, 2012; Kingston, undated; FHWA, 2016b; Ewing and Brown, 2009

HORIZONTAL DEFLECTIONS

BULBOUT/PINCHPOINT/CHOKER

A countermeasure suited to a variety of contexts



Typical mid-block bulbout

Bulbout with marked crosswalk in Middlebury, VT

FACTS AT A GLANCE

PROS

- Provides protection for parked vehicles
- Can improve signal timing at intersections
- Reduces pedestrian crossing distances
- Provides better visibility for pedestrians
- Provides space for aesthetic improvements

CONS

- Descreased turning radii at intersections could be a problem for large vehicles
- Increased maintenance considerations
- May reduce on-street parking
- Realignment of curb may require relocation of drainage features and utilities

USE IN VERMONT

- Moderately common
- Middlebury VT-125 Case Study and Field Test

Bulb-outs reduce width at an intersection or mid-block crossing by reconstructing the curb line in a "bulb" fashion, providing shorter crossing distances, narrower lanes, space for furniture or landscaping, and improving visibility of waiting pedestrians, all of which work to reduce vehicle speeds.

CONTEXT

Bulbouts work particularly well on village streets and in town centers where there is limited turning traffic of large vehicles like maintenance trucks, buses, or industrial equipment. They are also well suited to streets that accommodate one-way traffic or minor streets in residential areas. At signalized crossings, pedestrian crossing distance is reduced, which can improve signal timing. At a mid-block location, a bulbout is sometimes called a choker or a pinchpoint, and it can be combined with a raised crosswalk to achieve greater speed reductions. Bulbouts also afford crossing pedestrians better visibility of traffic.

DESIGN CONSIDERATIONS

Created by either curb extensions or edge islands. A curb extension offers more opportunity for landscaping, but an edge island leaves the existing edge open, for drainage or a bicycle bypass lane. The curb extension for the choker is typically constructed to a width of 6 to 8 feet and offset from the through traffic by 1.5 feet. Landscaping added should not interfere with sight lines. Consider phased construction to accommodate drivers to the new infrastructure. Bulbouts typically have the effect of reducing the curb radius. Appropriate for streets with a speed limit of 25 mph or lower.

For Further Information: VTrans, 1998; VTrans 2019; DelDOT, 2012; FHWA, 2016b; Ewing and Brown, 2009

PROFILES OF SPEEDING COUNTER-MEASURES

HORIZONTAL DEFLECTIONS

MEDIAN ISLAND

A supplementary countermeasure for many contexts

Pedestrian refuge with angled opening (VTrans, 2019)

Typical median island (DelDOT, 2012)

Median island with pedestrian refuge in Burlington, Vermont

FACTS AT A GLANCE

PROS

- Can be combined with a lateral shift in a transition zone or with a raised crosswalk within a town center or village to achieve greater speed reductions
- Useful for wide and/or multilane roads
- Decreases exposure for vulnerable users

CONS

- Can exarcerbate snowdrifts on the roadway
- Openings must be maintained for pedestrian refuge, especially in winter
- Poorly maintained refuge areas may cause an unsafe situation for pedestrians
- Only a moderate speed reduction potential when used alone

USE IN VERMONT

- Moderately common

Mid-block median islands are islands in the center of a road to reduce roadway width and provide refuge areas for pedestrians to decrease the crosswalk length that is exposed to traffic. This speeding countermeasure is particularly appropriate for wide and/or multilane roads.

CONTEXT

Median islands have the potential to reduce vehicle speeds in three ways. They typically result in narrowed lanes, provide space for landscaping or gateway signing, and improve visibility of crossing pedestrians. They benefit drivers by highlighting an upcoming midblock pedestrian crossing and provide a location for a pedestrian crossing sign in the middle of the street, if needed. Travel lanes are typically narrowed to obtain appropriate median width for a pedestrian refuge. The island can supplement a lateral shift in a transition zone or a raised crosswalk in a village to achieve greater speed reductions.

DESIGN CONSIDERATIONS

Median islands have a preferred width of 8 feet and a minimum width of 6 feet to provide refuge for cyclists, people with strollers, and wheelchairs propelled by attendants. The 6-foot width is also the minimum needed to correctly install detectable warning surfaces in the median. For wider islands, it is preferred to angle the opening that pedestrians will use to encourage them to face oncoming traffic as they traverse the refuge, ensuring that they assess whether there is a gap before crossing. The use of median islands as opposed to curb extensions avoids the need to relocate drainage or bike lanes.

For Further Information: VTrans, 1998; VTrans, 2019; FHWA, 2018; DelDOT, 2012; FHWA, 2016b; Ewing and Brown, 2009

MINI-ROUNDABOUT

Effective for low speeds within a village or town center

Mini-roundabout in Manchester, Vermont

Typical mini-roundabout (DelDOT, 2012)

FACTS AT A GLANCE

PROS

- Also reduces congestion and delay when used as a replacement for an all-way stop-controlled intersection
- Can be developed to fit within existing right-of-way of a four-way intersection
- Emergency vehicles are typically able to navigate the traversable center island
- Moderate (10%) reductions of 85th percentile speeds

CONS

- Cannot provide explicit priority for transit the way a traffic signal can
- Not suited for approaching speeds over 35 mph
- Approach channels complicate snow removal

USE IN VERMONT

- Not common

Mini-roundabouts are functionally similar to regular roundabouts, except the diameter is smaller and the central island is sometimes traversable. Motorists must yield to pedestrians and vehicles already in the intersection, so geometric features and yield control maintain low speeds in a village or town center.

CONTEXT

Designed properly, a mini-roundabout reduces speeds and enhances an intersection for nonmotorized users. They are an ideal treatment for unsignalized intersections of local streets with daily traffic volumes of 15,000 or less. Neighborhood traffic circles are similar to mini-roundabouts. A traversable center island can facilitate passage of emergency and snow removal vehicles. With training, snow and ice control at mini roundabouts can be relatively easy.

DESIGN CONSIDERATIONS

Mini-roundabouts are designed for traffic to circulate counterclockwise around, or partially over, a center island, but is not suited for approaching speeds over 35 mph. They can be installed on a crest vertical curve only if there is adequate stopping sight distance or warning signs. The circulating lane typically slopes away from the center island at 1 to 2 percent to maintain drainage. Typical signage includes a Yield sign on each approach. Pedestrian crossings should be marked to clarify crossing locations and priority. The MUTCD provides a sample striping layout for a mini-roundabout.

For Further Information: FHWA, 2018; FHWA, 2010; MUTCD, 2009 (2022); DelDOT, 2012; FHWA, 2016b; Ewing and Brown, 2009

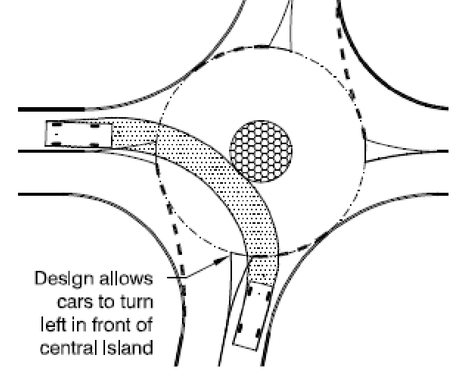
HORIZONTAL DEFLECTIONS

NEIGHBORHOOD TRAFFIC CIRCLE

Effective speed reduction within a village or town center

Neighborhood traffic circle in Burlington, Vermont

Typical neighborhood traffic circle (FHWA, 2012)



FACTS AT A GLANCE

PROS

- Can be designed to fit within right-of-way constraints of a traditional 4-way intersection
- Moderate speed reductions are possible within the intersection

CONS

- Can not provide explicit priority for transit or emergency vehicles the way a traffic signal can
- Not suited for approaching speeds over 35 mph
- Can be obstructive for left-turning maintenance or emergency vehicles without a traversable center island
- Provides less of a speed reduction effect than does a mini-roundabout because it does not have splitter islands

USE IN VERMONT

- Moderately common

Neighborhood traffic circles, or intersection islands, are round islands that reduce speeds as vehicles are routed around the island rather than straight through the intersection. The presence of the center island has been shown to reduce vehicle speeds and minimize points of conflict.

CONTEXT

The circle can simply be a painted area, but a raised curb and landscaping are most effective. A traversable center island facilitates passage of large vehicles but limits the speed-reducing effectiveness. Neighborhood traffic circles are similar to mini-roundabouts but lack the raised channelization to guide approaching traffic into the circulation pattern, making it possible for left-turning traffic to violate the circulation direction. Some local jurisdictions permit this movement to allow large vehicles to make a left turn through the intersection. Limit to streets with less than 1,500 vpd traffic volume.

DESIGN CONSIDERATIONS

A typical neighborhood traffic circle is designed to fit within the travel lanes of an existing intersection with a radius that is too small for a left-turning truck, emergency vehicle, or bus, even with a mountable center island curb. Lack of splitter islands allow larger vehicles to make alternate left turns. Drainage typically works best if the cross-section slopes away from the traffic circle, further reducing vehicle speeds. When pedestrian volumes are high, consider raised crosswalks to further reduce vehicle speeds and highlight the presence of pedestrians. Stop or Yield signs can be used on the approaches.

For Further Information: FHWA, 2018; FHWA, 2010; MUTCD, 2009 (2022); Ewing and Brown, 2009; Kingston, undated

VERTICAL DEFLECTIONS

SPEED HUMP OR CUSHION

A very effective self-enforcing speed reduction measure

Prefabricated speed cushions (DelDOT, 2012)

Speed hump in Burlington, Vermont

Typical speed hump (Stantec, 2020)

FACTS AT A GLANCE

PROS

- 28% reductions in 85th percentile speed and absolute reductions to 27 mph or less have been reported
- Prefabricated cushions can be removed and reused

CONS

- Inappropriate within a transition zone given the high variability of vehicle speeds
- May impact snow removal
- May reduce space for on-street parking
- Speeds generally *increase* between humps if spaced too far apart
- Potential for increased noise from vehicles traversing the hump

USE IN VERMONT

- Moderately common

A speed hump is an elongated mound in the roadway extending across the travel lane at a right angle to the traffic flow. They are designed to be tolerable to drivers traveling below the posted speed limit, but uncomfortable for drivers at higher speeds (generally above 25 mph).

CONTEXT

Speed cushions, or lumps, consist of two or more raised areas extending across the travel lane, with breaks in the wider tire path of a typical large emergency vehicle or transit bus, allowing those vehicles to pass without slowing. The breaks are far enough apart that passenger vehicles must ride over the hump. Prefabricated speed humps and cushions are used in short-term and seasonal applications, such as trial projects and event-specific calming for construction or special events. Since they are secured with pavement anchors and bolts, they can usually be installed by municipal maintenance crews.

DESIGN CONSIDERATIONS

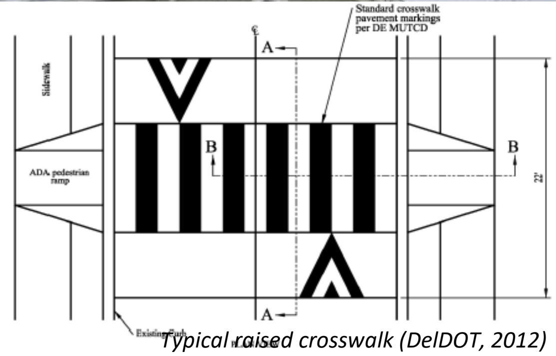
Speed humps design standards recommend spacing a series of humps 260 to 500 feet apart to be effective across longer distances. The most common speed hump design is a 2.95 to 3.94 inches high and 141.7 inches long symmetrical mound of asphalt. Prefabricated speed cushions are manufactured rubber sections that, when assembled, meet the required size and shape needed. Generally installed on roads with daily traffic less than 3,000. Follow the marking and signing guidelines provided in MUTCD Section 3B.25 and 3B.26 and Section 2C.29.

For Further Information: VTrans, 1998; FHWA, 2018; MUTCD, 2009 (2022); DelDOT, 2012; Stantec, 2020; FHWA, 2016b; Ewing and Brown, 2009

VERTICAL DEFLECTIONS

RAISED CROSSWALK OR SPEED TABLE

A very effective self-enforcing speed reduction measure



Typical raised crosswalk (DelDOT, 2012)

Raised crosswalk in Jericho Center, Vermont

FACTS AT A GLANCE

PROS

- Raised crosswalks can be placed midblock or at an intersection
- Significant reduction (20%, or up to 7 mph) of 85th percentile speed

CONS

- Not suited to transition zones
- Raised surface can complicate snow and ice control
- Slows emergency vehicles and affects comfort of patients being transported
- May reduce space for on-street parking
- Speeds can *increase* between tables if a series are spaced too far apart
- Potential for increased noise due to braking/acceleration and loose objects in trucks

USE IN VERMONT

- Moderately common

Speed humps with a flat-topped profile are referred to as speed tables. Raised crosswalks are speed tables with pavement markings or texture for a crosswalk on the flat portion. Speed tables have the potential to slow vehicles, providing a high-visibility location for pedestrians to cross the street.

CONTEXT

Speed tables are generally placed on roads with daily traffic of 5,000 or less and speed limits of 35 mph or less in a series for longer straighter roads. Adding a crosswalk on the table is determined by the need for a pedestrian crossing at the location unless one already exists. They should not be installed on steep grades that encourage high speeds or within braking zones before traffic signals. Speed tables are typically long enough for the entire wheelbase of a passenger car. Increased noise can be caused by vehicle braking/acceleration and loose items in truck beds.

DESIGN CONSIDERATIONS

Speed tables share the same profile design as speed humps, but an additional 118.1 inches to 141.7 inches of pavement is constructed at full height to meet the sidewalk. Higher design speeds can be accommodated with longer speed tables and spacing must be controlled to prevent speeding between a series of tables. Drainage can be provided by a longitudinal taper for tables, but a raised crosswalk will need to utilize a trench drain with ADA-compliant grates. Follow the marking and signing guidelines provided in MUTCD Section 3B.25 and 3B.26 and Section 2C. 29.

For Further Information: VTrans, 1998; FHWA, 2018; MUTCD, 2009 (2022); DelDOT, 2012; Ewing and Brown, 2009; Swan, 2019; FHWA, 2016b

PROFILES OF SPEEDING COUNTER-MEASURES

VERTICAL DEFLECTIONS

RAISED INTERSECTION

An effective countermeasure in villages and town centers

Raised intersection in Burlington, Vermont
Typical raised intersection (DelDOT, 2012)

FACTS AT A GLANCE

PROS

- Well suited within a community where lower speeds are needed
- Can be used at a signalized or stop-controlled intersection
- Considerable speed reduction within the intersection, where most conflicts occur

CONS

- Raised surface can complicate snow and ice control
- Slows emergency vehicles and affects comfort of patients being transported
- Does not significantly reduce speeds outside the intersection
- Significant impacts on drainage systems and utilities - usually costly to implement
- Can increase noise from traversing vehicles

USE IN VERMONT

- Not common

At a raised intersection, the entire roadway surface is raised to be level with (or slightly below) the top of the curb. Raised intersections can effectively slow traffic on four approaches simultaneously, and through the intersection where vehicle and pedestrian collisions are more likely to occur.

CONTEXT

A raised intersection is essentially a speed table that covers an entire intersection, including the crosswalks, providing better visibility of pedestrians for drivers wherever they may be in the intersection. It effectively highlights the presence of pedestrians at all four crossing locations but can be costly when compared to raised crosswalks. Raised intersections are especially useful in town centers where speed humps would result in an unacceptable loss of on-street parking. Aesthetic treatments such as textured pavement surfaces can help promote lower speeds but should be made skid resistant.

DESIGN CONSIDERATIONS

Raised intersections share the same Watts profile design as speed humps, but additional pavement is added to the entire intersection, including the crosswalks. They are appropriate for intersections whose approaches have speed limits of 25 mph or less but should not be used if there are high volumes of turning traffic at the intersection. Color contrasts and detectable warning truncated domes at edges enable pedestrians with vision impairments to detect the crossing. Follow the marking and signing guidelines provided in MUTCD Section 3B.25 and 3B.26 and Section 2C. 29.

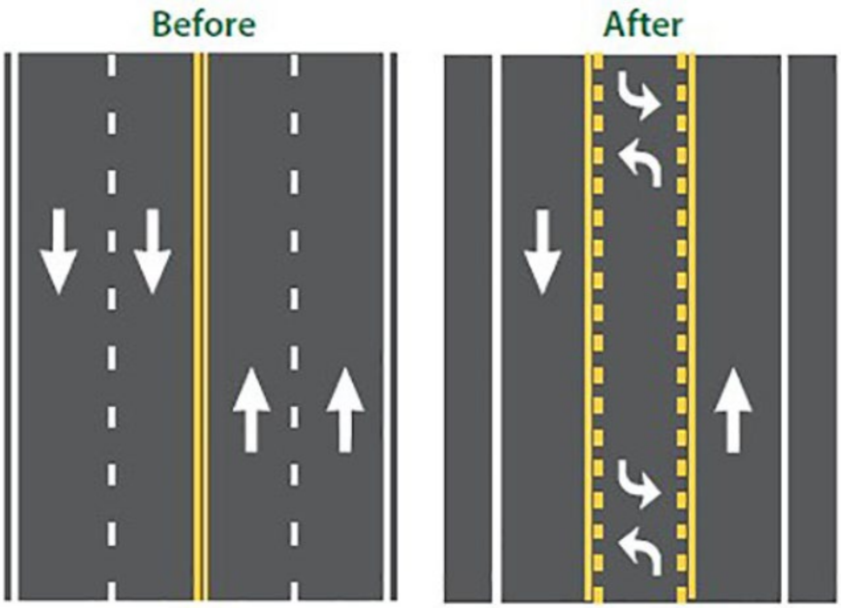
For Further Information: VTrans, 1998; FHWA, 2018; MUTCD, 2009 (2022); DelDOT, 2012; Swan, 2019; Ewing and Brown, 2009

PROFILES OF SPEEDING COUNTER-MEASURES

PERCEPTUAL / PASSIVE

ROAD DIET

A countermeasure that does more than reduce speed



Road diet schematic (FHWA, 2014)

Road diet implementation in Burlington, Vermont

A road diet is a reconfiguration of the entire width of a roadway to slow vehicles and support non-auto modes of travel. The most common reconfiguration is the conversion of an undivided four-lane roadway to a three-lane roadway with a center two-way left-turn lane and bike lanes or on-street parking.

FACTS AT A GLANCE

PROS

- Can be used at the end of a transition zone or within a village or town center
- Moderately effective at reducing 85th percetile speeds (5 mph)
- Often improves visibility for turning drivers
- Inexpensive if only markings and signs are needed
- Reduces sideswipe and rear-end crashes

CONS

- Not appropriate where very high daily traffic volumes (above 20,000) are present
- Signal timing optimization may be necessary to avoid unacceptably long queues

USE IN VERMONT

- Moderately common

CONTEXT

The road diet reconfiguration typically reduces capacity for vehicles but adds features like on-street parking, bike lanes, sidewalks, and pedestrian refuges. Median islands can occupy the space allocated to the center left-turn lane where left-turns are not needed. Road diets are typically accompanied by supplementary countermeasures like median islands, bulbouts, and narrowed lanes, but the reconfigurations alone provide safety benefits, provide for increased use by non-motorized modes, reduce speeds of motor vehicles, and reduce the speed differential between adjacent lanes of traffic.

DESIGN CONSIDERATIONS

Parts 2, 3, 4, and 9 of the MUTCD describe signing, marking, and signalling three-lane roadways with provisions for bicycles, and pedestrians. Consider a phased reconfiguration to allow drivers to adjust and only implement on state highways with daily volumes of 4,000 or less. Consider context when determining widths of lanes, bike lanes, parking spaces, shoulders, and sidewalks. If a reconfiguration involves new pavement marking, it is extremely important that the old pavement markings are completely removed, as remnants of paint or grooved pavement can nullify safety improvements.

For Further Information: FHWA, 2014; FHWA, 2018

PROFILES OF SPEEDING COUNTER-MEASURES

PERCEPTUAL / PASSIVE

RADAR SPEED FEEDBACK SIGN

Encouraging speed reduction through feedback

Radar speed feedback signs in Vergennes (left) and Burlington (right), Vermont

Radar speed feedback signs (RSFS) provide a real-time dynamic display of a driver's speed to encourage compliance with posted speed limits. Used in conjunction with a regulatory speed limit sign, drivers receive immediate confirmation of their actual speed in comparison to the speed limit.

FACTS AT A GLANCE

PROS

- Cost effective when compared with construction of physical measures
- Moderate speed reductions (2 to 8 mph), with more significant reduction of excessive speeds (10+ mph over posted speed limit)

CONS

- Not appropriate where very high daily traffic volumes (above 20,000) are present
- Effectiveness may reduce over time unless regularly enforced by local police
- Radar speed estimation is compromised by occlusion
- Not as effective as regular consistent law enforcement

USE IN VERMONT

- Common
- Newfane and Williston Case Studies and Vergennes VT-22A Field Test

CONTEXT

RSFS are typically used in a transition zone or in an area where driving the appropriate speed for the highway conditions is particularly critical, such as school speed zones. The RSFS measures an approaching car's speed and displays it in large, lighted numbers, but does not initiate enforcement. RSFS are most effective upstream of staffed speed enforcement. When requested by towns for state highways, RSFS are considered only where the 85th percentile speed exceeds the posted speed limit by at least 3 MPH during the time-period of concern, the posted speed is 35 mph or less, and a speed transition exists.

DESIGN CONSIDERATIONS

The display text must be at least 12 inches high and visible from distances up to 800 feet. In rural areas without raised curbs, the device should be 78.7 to 157.5 inches from the edge line. In urban or residential areas with raised curbs, the device should be within 78.7 inches of the curb. When the RSFS are activated, the display format shall NOT include animation, rapid flashing, strobing, dissolving, scrolling or other dynamic elements. On state highways, RSFS must be permitted by VTrans with compliance and acceptance documented by the district. Adherence with MUTCD Chapter 2L is imperative.

For Further Information: VTrans, 2009; MUTCD, 2009 (2022), DelDOT, 2012; Swan, 2019; Kingston, undated; FHWA, 2016b

PERCEPTUAL / PASSIVE

TRANSVERSE LINE MARKINGS

Encouraging speed reduction through feedback

Typical dragon's teeth (Kingston, undated)

Transverse line markings in Jamaica, Vermont

FACTS AT A GLANCE

PROS

- Can be optimized to achieve modest speed reductions of up to 4%
- Inexpensive when compared to construction of physical deflections
- No adverse effects on large maintenance or emergency vehicles
- Can supplement vertical delfections when used within a town center or village

CONS

- Need to be re-installed frequently due to tire wear and winter maintenance
- Speed reductions are minimal when used alone
- Visibility reduced in winter from snow and salt residue

USE IN VERMONT

- Moderately common

Transverse line markings are placed within a lane with progressively reduced spacing to give drivers the impression that their speed is increasing. They consist of a parallel series of white transverse lines on both sides of the lane that are perpendicular to the center line, edge line, or lane line.

CONTEXT

Transverse line markings may be either chevrons, dragon's teeth, full-lane transverse bars, or peripheral transverse bars. The longitudinal spacing between markings is progressively reduced from upstream to downstream in the marked portion of the lane, except in the case of dragon's teeth, which are also increased in size to provide the illusion that a lane is narrowing. They are sometimes called "optical speed bars" or "horizontal signing". The speed reduction potential of transverse line markings is low when used alone, but they are frequently used with a vertical deflection countermeasure.

DESIGN CONSIDERATIONS

Markings should not be greater than 12 inches in width and shall not be used in lanes that do not have a longitudinal line (center line, edge line, or lane line) on both sides of the lane. Spacing guidelines of optical speed bars are provided in FHWA's Low-Cost Treatments for Horizontal Curve Safety. MUTCD Section 3B.22 stipulates that transverse line markings be white. Recommended spacing between bars varies depending on the desired target speed and the speed differences. Should not be used in place of roadside signage, since pavement markings will not always be visible in winter weather.

For Further Information: MUTCD, 2009 (2022); Kingston, undated; Swan, 2019; FHWA, 2016a; FHWA, 2018; Ding et al., 2020; FHWA, 2016b

PERCEPTUAL / PASSIVE

GATEWAY SIGNING / LANDSCAPING

Speed reduction through identity and aesthetics

Gateway signing entering Jamaica, Vermont

FACTS AT A GLANCE

PROS

- No adverse effects on large maintenance or emergency vehicles
- Contributes to the aesthetics of the town center
- Modest speed reductions of 1-6 mph are achievable, with more significant reductions of excessive speeds
- Cost and maintenance can be offset by partnerships with local charitable organizations

CONS

- Can be obscured by snow in winter if not high enough
- Landscaping that is more effective at reducing speeds, like trees, must be maintained to ensure sign visibility
- Speed reductions are highly dependent on design

USE IN VERMONT

- Common

"Gateways" are sign installations that may include landscaping at the border of a town center or village that identify the community for motorists. Gateway signs provide an indication to motorists that they are entering a denser region of land use, pedestrian, and motor vehicle activities where lower speeds prevail.

CONTEXT

One of the factors that seems to contribute to higher speeds on residential roads is a lack of physical features close to the travel lane. Additional streetscape elements such as trees or ornamental bushes placed near the curb line or shoulder will restrict the field of vision to give drivers a more "confined' feeling. The additional streetscaping elements not only help to reduce travel speeds but can add to the aesthetic quality of the community. Enhanced streetscape elements are often used in the transition zone with a decorative sign indicating the name of the town center or village being entered.

DESIGN CONSIDERATIONS

Avoid reducing stopping sight distances around curves or at access points with signs or tall vegetation. 10 V.S.A. §494 contains stipulations for "Welcome To" signs erected and maintained by a town. Signs must be outside the right-of-way and should not exceed 64 square feet. No more than two signs may be maintained in any one direction on any highway. Signs shall meet the criteria of the Travel Information Council. Landscaping elements should conform to the VTrans Landscape Guide and trees or signs in a state highway right-of-way must be permitted by VTrans and conform to policy on public street trees.

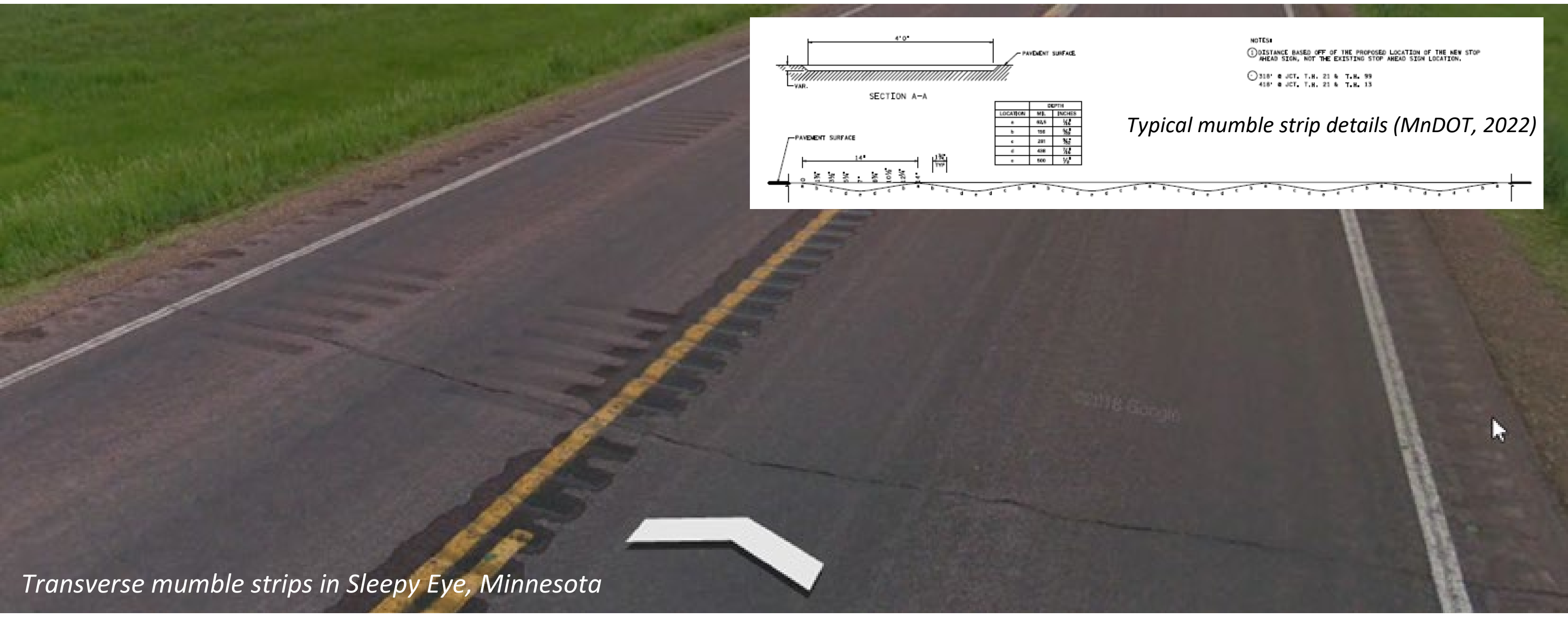
For Further Information: VTrans, 1998; FHWA, 2018; Ewing and Brown, 2009; VCASLA, 2002; VTrans, 2015

PROFILES OF SPEEDING COUNTER-MEASURES

PERCEPTUAL / PASSIVE

TRANSVERSE MUMBLE STRIPS

Speed reduction through cabin noise and vibration



Typical mumble strip details (MnDOT, 2022)

Transverse mumble strips in Sleepy Eye, Minnesota

Transverse mumble strips are a series of strips of grooved pavement across the lane to alert drivers to the need to be more aware and reduce speeds. They are shallower and less sharp than traditional rumble strips, so are less disturbing to nearby residents, but still alert drivers to reduce speeds.

FACTS AT A GLANCE

PROS

- Grooved pavement can remain effective in winter, when paint markings are not
- Moderate speed reductions are likely in transition zones with more significant reduction of excessive speeds possible, especially with larger vehicles

CONS

- Can be obscured by snow/ice in winter if not maintained carefully
- Can be damaged by snow removal, requiring increased maintenance
- Even the reduced external noise of mumble strips can be unacceptable to nearby residents
- Effect may be limited to location where installed

USE IN VERMONT

- Not common

CONTEXT

Entering a transition zone, most drivers have become inattentive, but through noise and vibration, mumble strips attract the attention of drivers to features such as unexpected changes in alignment or other conditions requiring a reduction in speed. The resulting noise can be unacceptable in residential areas. Therefore, these devices should not used in residential areas. Mumble strips are similar to traditional rumble strips, but mumble strips have a sinusoidal wave pattern that lessens the external noise produced when vehicles traverse them. Traditional rumble strips do not have the wave pattern.

DESIGN CONSIDERATIONS

A typical series of mumble strips includes 5 to 7 grooves in a group, spaced according to the expected speed of vehicles traversing them. MnDOT has developed a detailed specification for the sinusoidal pattern of grooves, which reach a maximum depth of only ½”, as across each 14-inch wave. Grooves are cut in 4-foot-wide sections across the wheel tracks to ensure contact with a variety of wheelbases.

For Further Information: VTrans, 1998; MnDOT, 2022

PROFILES OF SPEEDING COUNTER-MEASURES

PERCEPTUAL / PASSIVE

[SLOW] / [-- MPH] PAVEMENT MARKINGS

A supplementary countermeasure for many contexts

[25 MPH] pavement marking in Jericho Center, Vermont

[SLOW] pavement markings advise drivers to proceed slowly with increased attention, as when other countermeasures are present that require speeds lower than the posted speed limit. [-- MPH] pavement markings supplement speed limit signs to remind drivers of the lawful speed limit.

FACTS AT A GLANCE

PROS

- Amongst the most inexpensive countermeasures to implement
- No adverse effects on large maintenance or emergency vehicles
- Can be used to supplement a variety of countermeasures in transition zones or within a town center or village

CONS

- Winter maintenance can cause significant damage to the pavement marking which increases maintenance costs
- Speed reductions are minimal when used alone
- Visibility is reduced in winter due to snow cover and salt residue

USE IN VERMONT

- Not common

CONTEXT

These pavement markings are suited to transition zones and streets within a town center or village. [-- MPH] markings are intended to supplement existing signage and reinforce compliance with speed limits, whereas [SLOW] markings typically accompany other countermeasures. The oversized markings attract attention better than typical signs in the clutter of the streetscape, providing emphasis for important regulatory, warning, or guidance messages. They also do not require diversion of the driver's attention from the roadway. For this treatment to be effective, markings must be designed properly.

DESIGN CONSIDERATIONS

Markings within the wheel path should include a skid-resistant material. Height is designed for the expected driving speed but should not be less than 6 feet. If a pavement marking word message consists of more than one line of information, it should read in the direction of travel. The longitudinal space between words should be at least four times the height of the characters for low-speed roads, but not more than ten times the height of the characters. Word markings should be no more than one lane in width, proportionally scaled to fit within the lane width. Refer to MUTCD Section 3B.20 for marking details.

For Further Information: FHWA, 2016a; FHWA, 2018; MUTCD, 2009 (2022); Kingston, undated; FHWA, 2016b

Field Test Fact Sheets

These field tests demonstrate the type of speed-data collection that is needed to support implementation of speeding countermeasures and provide a site-specific evaluation of the effectiveness of selected countermeasures in Vermont. From an initial set of sites identified by the research team through a review of online press, a subset were identified where field data collection would be feasible. The review focused on transition zones where speeding is or was a problem for a village or town center and speeding countermeasures have been implemented or are being considered. For the subset of sites, the research team collected comprehensive hourly speed and volume data for the transition direction of flow after the lowest reduced speed limit posting.

Selected sites consisted of VT-22A northbound transitioning from 50 mph to where the state highway ends in the town of Vergennes, VT-30 northbound transitioning from 50 mph to where the state highway ends in the town of Middlebury, VT-125 eastbound transitioning from 50 mph to where the state highway ends in the town of Middlebury, and VT-14 northbound transitioning from 50 mph to where the state highway ends in the town of Hardwick. For each field test, contact was made with the Vermont State Police, local police, local department of public works, and other relevant stakeholders before setting up the data collection. Data was collected using the mobile traffic monitoring platform (MTMP), a trailer-mounted radar-based traffic speed/flow sensor with portable power. The fact sheets provide a description of the site, the data collection effort and the results. Use the grid below to navigate to a specific field test fact sheet.

Hardwick VT-14 Field Test	Middlebury VT-30 Field Test
Middlebury VT-125 Field Test	Vergennes VT-22A Field Test

FIELD TEST OF SPEEDING COUNTERMEASURES

Traffic entering Hardwick from the south on VT-14 encounters no formal speeding countermeasures and local businesses experience unacceptable speeds beyond the transition zone

Hardwick VT-14 Field Test

TOWN
Hardwick, Vermont

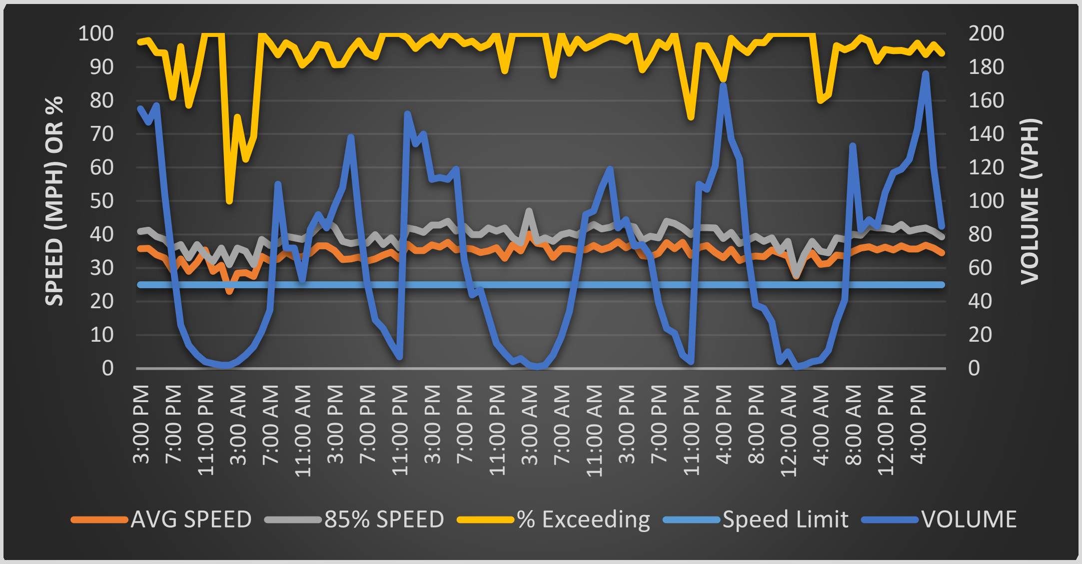
HIGHWAY
VT-14 NB

COUNTERMEASURES
None

SPEED LIMIT
25 mph

Site Description and Data Collection

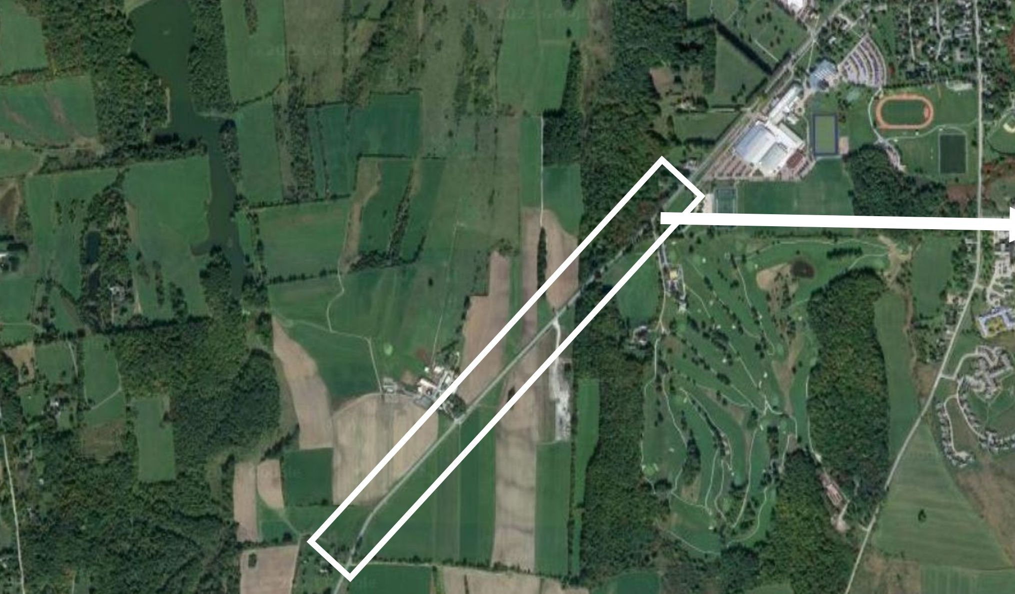
In the transition zone entering the town of Hardwick on VT-14 northbound, the posted speed limit drops from 50 mph to 40 mph, then to 25 mph where the state-maintained highway ends. Apart from a slight narrowing of the roadway at the 25-mph posting, no formal speeding countermeasures are present, and a busy local business owner just past the 25-mph posting reports that excessive speeding affects access to their parking lot. Speed data was collected from 3:00pm on Wednesday, January 25th, 2023, to 7:00pm on Tuesday, January 31st, 2023 for all traffic on VT-14 northbound, just past the 25-mph posting. UVM's mobile traffic monitoring platform (MTMP) was used to collect data.



Results and Conclusions

Speeds through this transition zone show evidence of falling to the 40 mph limit but fail to reduce any further by the time the 25-mph posted speed limit is reached. Average speed and 85th percentile speed remained above the speed limit for the entire observation period, with many hours during which 100% of the vehicles were exceeding the 25-mph posted speed limit. Additional perceptual/passive countermeasures and horizontal deflections and law enforcement will be necessary to reduce speeds to acceptable levels.

SPEEDING COUNTERMEASURES TOOLBOX FOR VERMONT



FIELD TEST OF SPEEDING COUNTERMEASURES

Traffic entering Middlebury through the Middlebury College campus on VT-30 northbound has no formal speeding countermeasures, but the campus provides a visual indication that speed limits are reduced

TOWN
Middlebury, Vermont

HIGHWAY
VT-30 NB

COUNTERMEASURES
None

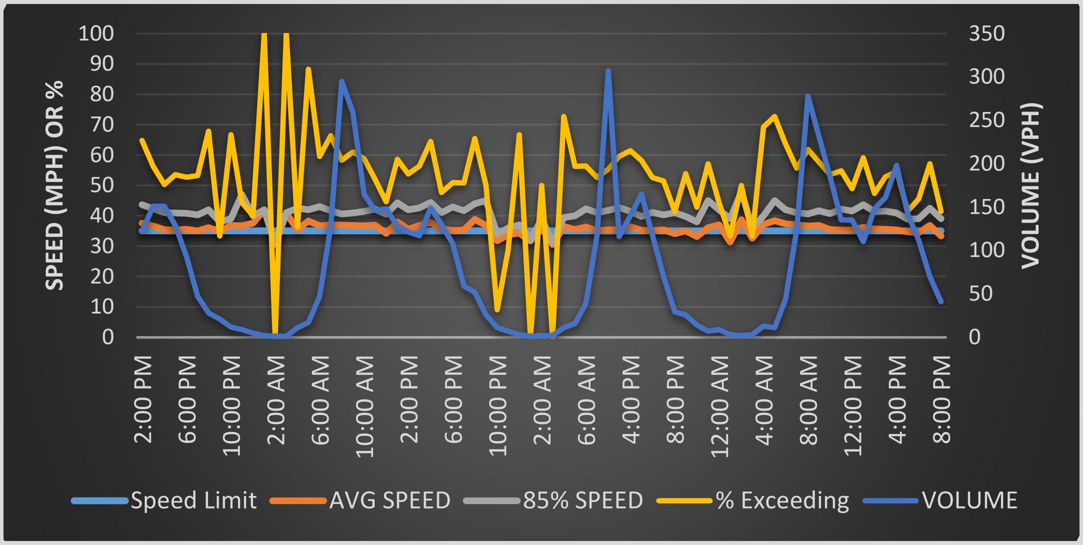
SPEED LIMIT
35 mph

SPEEDING COUNTERMEASURES TOOLBOX FOR VERMONT

Middlebury VT-30 Field Test

Site Description and Data Collection

In the transition zone (white rectangle above) entering the town of Middlebury on VT-30 northbound, the posted speed limit drops from 50 mph to 35 mph where the state-maintained highway ends, then eventually to 25 mph within the town center further north. Apart from a significant upgrade within the transition zone and a slight narrowing of the roadway at the 35 mph posting, no formal speeding countermeasures are present. Speed data was collected from 2:00pm on Monday, December 5th, 2022, to 8:00pm on Friday, December 9th, 2022 for all traffic on VT-30 northbound, just past the 35 mph posting. UVM's mobile traffic monitoring platform (MTMP) was used to collect data.



Results and Conclusions

Speeds through this transition zone show evidence of slowing from 50 mph at the start but fall slightly short of the full reduction to the posted speed limit of 35 mph, with an 85th percentile that is hovering around 40 mph for most of the observation period. Therefore, a speeding countermeasure is likely necessary to encourage the modest additional reduction of about 5 mph that is needed. For this type of modest reduction, several of the perceptual/passive countermeasures are well suited.

FIELD TEST OF SPEEDING COUNTERMEASURES

Narrowed lanes, on-street parking, and bulbout crossings were installed to calm traffic entering Middlebury through the Middlebury College campus on VT-125 eastbound

Middlebury VT-125 Field Test

TOWN
Middlebury, Vermont

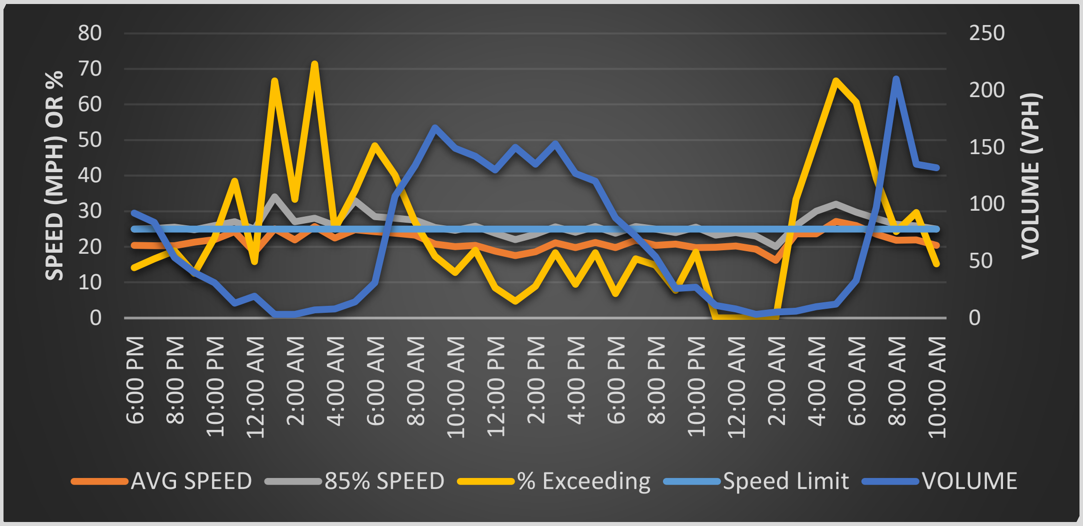
HIGHWAY
VT-125 EB

COUNTERMEASURES
Lane Narrowing and Bulbouts

SPEED LIMIT
25 mph

Site Description and Data Collection

In the transition zone entering the town of Middlebury on VT-125 eastbound, the posted speed limit drops from 50 mph to 40 mph, then to 25 mph where the state-maintained highway ends. Due to issues in the 1990s with high vehicle speeds in the 25-mph zone, which features several pedestrians crossing for the Middlebury College campus, a collaborative effort was made between the town, the college, and VTrans to reduce vehicle speeds. Narrowed lanes, on-street parking, and bulbout crossings were installed to calm traffic entering Middlebury through this area. Speed data was collected from 6:00pm on Monday, January 16th, 2023, to 10:00am on Wednesday, January 18th, 2023 for all traffic on VT-125 eastbound, just past the calming features. UVM's mobile traffic monitoring platform (MTMP) was used to collect data from the specific location where the effects of the speeding countermeasures would be revealed.



SPEEDING COUNTERMEASURES TOOLBOX FOR VERMONT

Results and Conclusions

These countermeasures have successfully reduced speeds to a level that is relatively compliant with the posted speed limit. Only for very brief periods overnight and early morning did the 85th percentile exceed 25 mph, indicating a satisfactory condition. Average vehicle speeds were under 25 mph for almost the entire observation period.

FIELD TEST OF SPEEDING COUNTERMEASURES

A radar speed feedback sign (RSFS) and gateway signing are used to reduce speeds in the transition zone (white rectangle) on VT-22A northbound entering the town of Vergennes

TOWN
Vergennes, Vermont

HIGHWAY
VT-22A NB

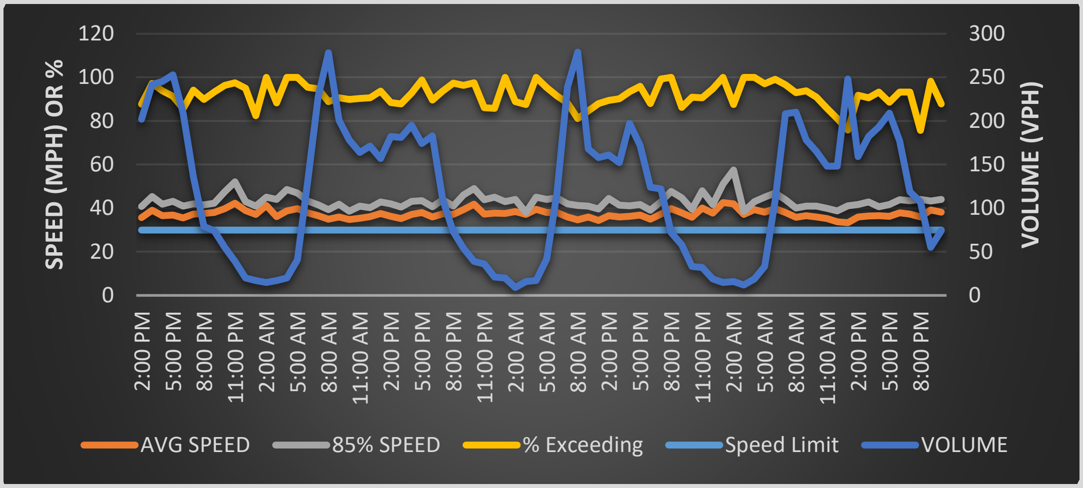
COUNTERMEASURE
Radar speed feedback sign

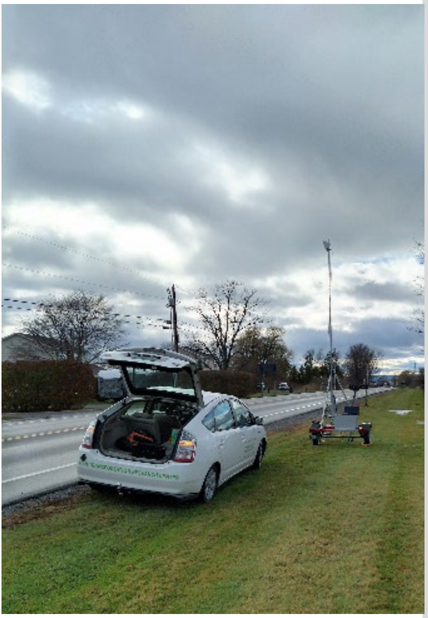
SPEED LIMIT
30 mph

Vergennes VT-22A Field Test

Site Description and Data Collection

In the transition zone entering the town of Vergennes on VT-22A northbound, the posted speed limit drops from 50 mph to 30 mph where the state-maintained highway ends. Due to issues with high vehicle speeds along this downward-sloping transition to the 30-mph zone, the town installed an RSFS on the second 30-mph posting to reduce vehicle speeds. A gateway sign marks the beginning of the transition zone. Speed data was collected from 2:00pm on Monday, November 28th, 2022 to 10:00pm on Friday, December 2nd, 2022 for all traffic on VT-22A northbound, about 200 feet past the RSFS. UVM's mobile traffic monitoring platform (MTMP) was used to collect data from where the effects of the RSFS would be revealed.





Results and Conclusions

These countermeasures do not seem to be effectively reducing vehicle speeds to acceptable levels in this transition zone. It appears that any effect that the RSFS was having on compliance with the speed limit has subsided. Both the average speed and the 85th percentile speed remained above the speed limit for the entire observation period, with several hours in which 100% of the vehicles were exceeding the 30-mph posted speed limit. Additional perceptual/passive countermeasures and horizontal deflections may be necessary to further reduce speeds to acceptable levels.

Case Study Fact Sheets

To further enhance the relevance of this Toolbox to the experiences of Vermont towns, a series of case studies were conducted in selected towns. Towns were identified with input from the TAC supplemented by a review of the online press to find notable examples. The case studies consisted of identifying and interviewing contacts for towns with experience in the selection and implementation of speeding countermeasures. The case studies included consist of the towns that were willing to provide an interview – Lincoln, Middlebury, Newfane, and Williston. They provide specific examples of the implementations of speeding countermeasures in Vermont with contacts who can attest to the lessons learned from the implementation. Each fact sheet includes an overview of the implementation, a description of the lessons learned from the implementation, and identification of the funding source, location, and goals of the implementation, as well as contact information for the interviewee.

Lincoln Case Study	Middlebury Case Study
Newfane Case Study	Williston Case Study

CASE STUDY OF SPEEDING COUNTERMEASURES

FUNDING
Town Highway Budget
Town Sign Budget

LOCATIONS
East River Road
West River Road
South Lincoln Road
Quaker Street

GOALS
Improve pedestrian and cyclist safety
Reduce speeding

INTERVIEW CONTACT
Bill Finger, Chair
admin@lincolnvermont.org

SPEEDING COUNTERMEASURES TOOLBOX FOR VERMONT

Due to a lack of local police enforcement and concerns with vehicle speeding endangering pedestrians and cyclists, the Town of Lincoln decided to install radar speed feedback signs and “advisory bike lanes” to reduce vehicle speeds.

Town of Lincoln Case Study

OVERVIEW
Due to concerns for pedestrian safety from speeding traffic near the Lincoln Community School on East River Road (a Class 2 highway with a speed limit of 30-mph) the Town of Lincoln installed radar speed feedback signs (RSFSs) for their low maintenance and perceived effectiveness at reducing speeds without police enforcement. RSFSs were added at three transition zones entering town – first on East River Road, then later on West River Road, and South Lincoln Road.

RSFSs provide no consequence to drivers going above the speed limit, but instead are aimed at bringing the drivers’ attention to the speed limit. The interview contact considered RSFSs to be most effective for drivers who intend to drive under the speed limit but who have not been attentive to the reduction in a transition zone. According to the interview contact, the RSFS on East River Road was considered to be successful, so two more were installed. At the time of purchase, each RSFS was around $5,000. According to the interview contact, in time the RSFSs became less effective as drivers got used to them, so the town feels that mobile RSFSs would be more effective.

Due to an increase in cycling through the town, particularly on Quaker Street, “advisory bike lanes” were installed to improve cyclist safety. These features consist of dashed bike lanes on both sides of the road within the vehicle travel lanes, since the roadway lacks the necessary width for bike lanes. The interview contact would have preferred to install full bike lanes on Quaker Street, but lacking the width they installed advisory bike lanes, as it is relatively flat with a high volume of cyclists. These features are not a recommended speeding countermeasure in Vermont because FHWA has ended testing of these features, so they are no longer allowed. However, the interviewee felt that they could change the drivers’ perception of the roadway width while providing extra space for pedestrians and cyclists. These features were being allowed under a formal MUTCD experiment, but FHWA has issued a moratorium on new experiments. This form of traffic calming was referred to by the interview contact as “reminder lanes”. These features are typically accompanied by a removed centerline, which allows traffic to cross over into opposing lane to bypass cyclists.

LESSONS LEARNED
The contact reported that Quaker Street is a state-maintained highway, so it was assumed that the centerlines are repainted by VTrans annually. The “reminder lanes” do not fade as quickly because they are not within the plow tracks.

CASE STUDY OF SPEEDING COUNTERMEASURES

Due to speeding concerns on VT-125 through the Middlebury College campus, several countermeasures were installed through a collaboration between the Town of Middlebury, Middlebury College, and the Vermont Agency of Transportation.

FUNDING
Town of Middlebury
Middlebury College
VTrans

LOCATIONS
VT-125

GOALS
Improve pedestrian safety
Reduce speeding

INTERVIEW CONTACT
Tom Hanley
thanley@middleburypolice.org

SPEEDING COUNTERMEASURES TOOLBOX FOR VERMONT

Middlebury Case Study

OVERVIEW

The transition zone from VT-125, west of the town of Middlebury through the Middlebury College campus, was identified as a speeding concern in the 1990s due to concerns for the safety of pedestrians. VTrans, the Town and the College collaboratively decided to implement speeding countermeasures to reduce speeds to the 35-mph speed limit by installing several speeding countermeasures.

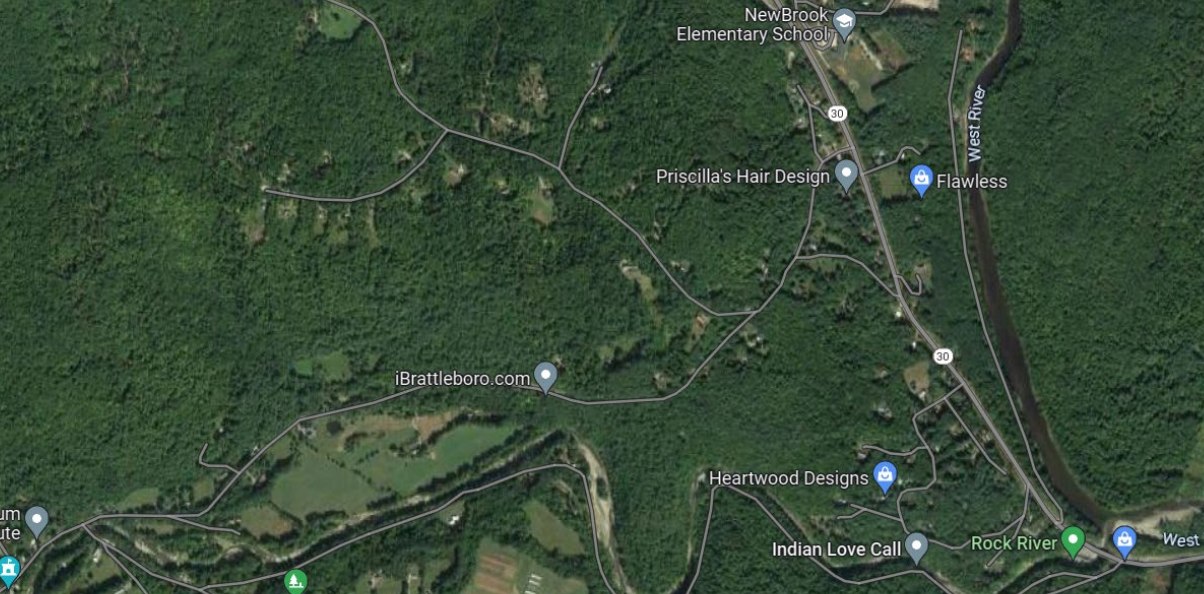
Several different features were added along the ¼-mile segment of VT-125 through the campus. Visual cues and horizontal deflections were preferred over vertical deflections due to concerns from the Town related to winter maintenance and upkeep around vertical deflections.

Structures that were installed along the route included several bulbouts with decorative street lights to highlight pedestrian crossings and frame on-street parallel parking spaces, all of which are thought to encourage reduced speeds. The interview contact stated that changing the driving environment to appear more congested with the on-street parking slows traffic down and has been considered the most effective change. Other changes made to improve pedestrian safety include expanding and illuminating crosswalks to increase pedestrian visibility. At first, radar speed feedback signs (RSFSs) were also added in an effort to maintain reduced speeds, and two types of flashing beacons were tested for the crosswalks.

LESSONS LEARNED

The interview contact reported that the RSFSs were not considered to be effective, due to the consistency of the drivers that came through this segment of roadway. RSFSs were thought to be more effective for locations with transient traffic. On more residential roadways, they were found to become ineffective over time.

Initially, a yellow flashing beacon light was also installed at the crest of the hill, but it was ultimately removed because it did not seem to have a strong effect on speed. Overhead flashing beacons were also put above the crosswalks, though they were ultimately removed because they were considered ineffective. The interview contact stated they seemed to have no functional purpose and failed to improve safety. Instead, rectangular rapid flashing beacons (RRFBs) were put at the crosswalks and were perceived as being more effective. However, in time these too were removed in place of the decorative street lighting so that pedestrians would be more visible to drivers at night.



CASE STUDY OF SPEEDING COUNTERMEASURES

The Town of Newfane uses portable and fixed radar speed feedback signs to address speeding in the village and nearby communities. Cost, maintenance, effectiveness, and implementation were considered in making the selection.

FUNDING

Grant for Sign Replacement
Traffic Safety Town Budget
Town Sign Budget

LOCATIONS

Newfane Village
South Newfane Village
Village of Williamsville
Brookside

GOALS

Improve pedestrian safety
Reduce speeding

INTERVIEW CONTACT

Jay Wilson, Road Foreman
newfanegarage@newfanevt.org

Mays, 2022

SPEEDING COUNTERMEASURES TOOLBOX FOR VERMONT

Town of Newfane Case Study

OVERVIEW

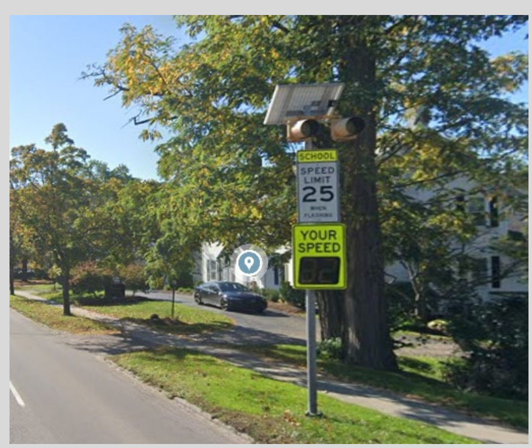
The Town of Newfane selected radar speed feedback signs (RSFSs) to reduce speeding in the village and neighbouring communities because they believed them to be low maintenance, cost-effective, and easy to install/move. RSFSs were thought to be the best way to discourage speeding without enforcement, as the town does not have a police department. The first RSFS was installed on Dover Road in 2019, where the speed limit drops from 35 mph to 25 mph for the covered bridge in Williamsville. Other implementations of RSFSs were in 30-mph zones in Newfane Village and the other surrounding communities.

The interview contact reported that the RSFS typically lead to a 10-15% speed reduction in the sight zone of the sign, but mainly for drivers who have been inattentive to a reduction in the speed limit in a transition zone. However, since there is no consequence for speeding in these areas, they expected the effect of the RSFS to be reduced over time. Heights and sizes of speed limit signs were also updated, and pedestrian advisory signs were added. Speed limits were also painted on the pavement on Dover Road.

The RSFSs in Newfane and nearby villages include strobing lights, a red flashing border, even though strobes and flashing borders are not MUTCD compliant. The total cost of each RSFS in 2018 was about $3,000, including solar panels and mounting brackets. Software is provided to access the speed data recorded by the RSFS, but there is a $400 per year fee to access it after the first year. The software can also allow users to turn the signs on and off, control the lights, and provide speed data remotely.

LESSONS LEARNED

The interview contact noted that previous RSFSs in Newfane were portable when there was a greater police presence in the area, and had similar effectiveness to the permanent RSFS, calling drivers' attention to their speed resulting in slowing for drivers who were unintentionally speeding. The portable RSFS, though, were more of a hassle to continue to move, and the interview contact noted that one drawback to RSFSs is that the solar power source is more challenging to keep charged in winter conditions and the panels must be reangled for the winter sun to get the most charging from them. When putting in future RSFS, the interview contact also noted that it is helpful to locate them on a straight line of sight for drivers to read and for the radar to be most effective.



CASE STUDY OF SPEEDING COUNTERMEASURES

FUNDING
Town of Williston

LOCATION
North Williston Road

GOALS
Improve pedestrian and cyclist safety
Improve traffic resiliency
Calm traffic

INTERVIEW CONTACT
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SPEEDING COUNTERMEASURES TOOLBOX FOR VERMONT

After conducting a scoping study, the Town of Williston decided to implement several traffic calming measures to improve safety on North Williston Road between US-2 and the Winooski River in Essex.

Town of Williston Case Study

OVERVIEW

The Town of Williston sought to address speeding on North Williston Road from US-2 to VT-117, where 85th percentile speeds were 10-15 mph over the posted speed limit of 35 mph. To accomplish this, additional signage, road markings, and perceptual measures were put in place as recommended by the Williston Road Traffic Calming Assessment. Before implementing these measures, a scoping study was initiated by the Chittenden County Regional Planning Commission and the Town. Recommendations from the Assessment were carried forward for implementation by the scoping study. The projects took five years to complete, due to the process of conducting public meetings to gather community feedback.

For the scoped area, rectangular rapid flashing beacons, centerline rumble strips, chevrons, and radar speed feedback signs (RSFS) were implemented. The combination of rumble strips, chevrons, and RSFS at Peterson Lane and Fay Lane helped to inform drivers of the upcoming S curve. Four-way stop control was added at the intersection of Mountainview Road and North Williston Road, with the expectation of slowing traffic in the corridor, even though the use of stop signs to slow traffic is explicitly forbidden by MUTCD. RSFSs were installed in the southbound lane at Fay Lane and Golf Course Road with the intent of reducing speeds before the S curve and entering the village. RRFBs were installed at both the crosswalk at Fairway Drive and Tamarac Road, and at the top of the hill of Unity Lane. Other countermeasures considered included curbed medians, temporary speed tables, warning beacons, intersection warning signs, gateway treatments, and banners. Of these, only median islands, speed tables and gateway treatments are speeding countermeasures recommended for Vermont. Gateway signs must comply with 10 V.S.A. §494.

LESSONS LEARNED

Temporary speed tables were installed on North Williston Road, but due to residential complaints about noise and winter maintenance concerns, they were removed. According to the interview contact, the speed tables were unsuccessful since drivers slowed to pass the speed table and then sped up to make up the time. The noise was more acceptable in a different location with a 25-mph speed limit. The implementation of centerline rumble strips also had residents concerned about noise, so the strips were partially filled in to reduce noise but to retain effectiveness. However, centerline rumble strips are also not speeding countermeasures.

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