TRAFFIC CALMING GUIDE
FOR
NEIGHBORHOOD STREETS

Traffic Engineering Division
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I. INTRODUCTION & OVERVIEW


The purpose of traffic calming is to lower vehicle speeds on neighborhood streets without restricting access. Traffic calming measures may also alleviate other issues such as cut-through traffic or through-truck traffic, where motorists or truckers, use neighborhood streets to avoid and bypass other nearby roads. Where there are persistent issues with through-truck traffic the “Through truck Restriction” program provides a process for restricting such traffic, (see http://www.virginiadot.org/programs/is-VDOTCommunityPrograms.asp for more information).

The Guide reflects a restructuring process where local residents of the community, the Home Owners Association (HOA) or the Civic Association (CA) initiate a request for traffic calming and study. County or Town staff (where traffic calming is taking place within a town) work with the local community to conduct the traffic calming process, working through the Board of Supervisors or the Town Council, as appropriate. VDOT’s involvement focuses on confirming the appropriateness of the community efforts at critical points in the process and coordinating the implementation of the approved plan.

The Guide focuses on existing streets. Ideally, new residential developments would implement traffic calming concepts within the initial roadway design such as horizontal alignment shifts, narrower lanes etc. Various traffic calming measures in the Guide may be options as well. The design & review of development plans for new subdivisions should identify and address traffic management concerns and incorporate geometric designs and traffic calming concepts that make streets less desirable for speeding and cut-through traffic.

II. TRAFFIC CALMING –ROLES & PROCESS

Roles of Local Government, Community & VDOT

Local Government: County or Town staff (generally referred to as the Locality in the Guide) work with the local community and through the Board of Supervisors (BOS) or Town Council (where traffic calming is taking place within a town), to guide and implement the traffic calming process and plan development (Steps 1 – 6 in Figure 1).

VDOT: VDOT representatives confirm the eligibility and feasibility of streets proposed for traffic calming and the proposed traffic calming plan and; coordinates
implementation as appropriate (Steps 1, 3, 4, 7 and 8 in Figure 1). In Fairfax, Prince William, and Loudoun Counties, the Northern Virginia District Traffic Engineer’s (DTE) office is the primary liaison for traffic calming. For all other areas of the state, the local Resident Engineer/Administrator (RA) is the primary liaison to the community for traffic calming; and coordinates with the DTE’s office as appropriate for the various processes.

**The Traffic Calming Process**

The process for traffic calming is below (see Figure 1) with the details for each step laid out on the subsequent pages.
FIGURE 1 - THE TRAFFIC CALMING PROCESS

- Step 1: Initial Contact & Review
- Step 2: Traffic Calming Study Request
- Step 3: Engineering Study/Review
- Step 4: Traffic Calming Plan Development
- Step 5: Community Support / Approval
- Step 6: BOS or Town Council Endorsement
- Step 7: Consideration for implementation
- Step 8: Evaluation
**Step 1: Initial Contact & Review**

To begin a traffic-calming project, local community members contact the BOS or the Town Council. The Locality confirms with VDOT that the street proposed for traffic calming meet the basic eligibility requirements for VDOT’s traffic calming program, which are:

1. Street is in the state system of highways owned and maintained by VDOT.
2. Street is within a neighborhood setting where the residences and businesses face the street rather than reverse-frontage (where houses along a street do not face or generally have access to the street). A typical neighborhood street for traffic calming is in a subdivision where there is a high density of residences and the street has a functional classification of “local”. A neighborhood street with similar characteristics may have a functional classification of “collector” or “arterial” and thus be appropriate for consideration of traffic calming.
3. Street has a posted speed limit of 25 mph or less. Unposted, residential streets generally have a statutory speed limit of 25 mph. However, VDOT must confirm this.

**Step 2: Traffic Calming Study Request**

After confirming the street meets the basic eligibility requirements for traffic calming, the Home Owners Association (HOA) or Civic Association (CA) gets approval from the Board of Supervisors or the Town Council to pursue traffic calming on the proposed street, conduct an engineering review and pursue a traffic calming study. If there is not an HOA or CA a minimum of 10 residents (or 10% of residents) along the street may secure approval from the BOS. Upon agreement by the Board of Supervisors or the Town Council to pursue traffic calming on the requested street, they proceed to Step 3.

**Step 3: Engineering Study/Review**

The Locality conducts an engineering review, traffic count and speed study of the road to determine if the street is suitable for traffic calming.

i. An engineering field review determines the suitability of the street for traffic considering the extent of horizontal curves and grades and any related sight distance issues, roadway drainage, extent and location of road access points etc. that may affect the location, extent and type of traffic calming implemented.

ii. A speed study determines the 85th percentile operating speed. In order to be eligible for further consideration of traffic calming the street must have an operating speed (85th percentile speed) of 10 mph or more above the speed limit (e.g. 35 mph or more where the speed limit is 25 mph) in at least one travel direction, measured outside of the peak hours of travel.

iii. A traffic count determines the average daily traffic (ADT) volume on the street for both travel directions. A 48-hour traffic count conducted on a Wednesday or Thursday is typical in order to determine the average daily traffic for a weekday.
(weekends, Mondays and Fridays experience non-typical travel patterns). The level of traffic determines the type & extent of traffic calming considered.

- Streets with a daily traffic volume between 600 and 4,000 vehicles per day (VPD) are appropriate for consideration of the full range of traffic calming measures in the Guide.
- Streets with less than 600 VPD are appropriate for consideration of signs, pavement marking and administrative options.
- Where traffic volumes on the study street exceed 4,000 VPD alternative actions to traffic calming are available such as the Additional $200 Fine Signs or Speed Display signs, under the specific programs for those signs (see discussion for those devices on pp. 16-17).

VDOT reviews the study results, confirms the appropriateness of the street for traffic calming and notes any items or limitations etc. that should be considered in developing the traffic calming plan.

**Step 4: Traffic Calming Plan Development**

The Locality, in coordination and consultation with VDOT, next develops a conceptual traffic calming plan following the requirements and considerations laid out in APPENDIX I: Development & Implementation of the Traffic Calming Plan. This section lays out the various considerations for the selection, location, installation, operation and maintenance aspects of the various traffic calming devices.

Agreement must be secured for each affected property owner of a residence or business where the physical location of a proposed traffic calming device or some portion (excluding warning signs posted for a device) lies within the roadway frontage of the property boundary. Note: the affected property owner may agree to the device affecting their property without agreeing with the entire traffic calming plan. Where a particular property owner does not concur with a particular device as it affects their property, other options such as shifting the location or proposing an alternate device should be considered.

**Step 5: Community Support / Approval**

Prior to soliciting community approval, the Locality identifies the survey area, coordinating with the local community, HOA, CA the District Supervisor's or Town Council and VDOT.

The survey area comprises (i) residences and businesses on the street identified for traffic calming and (ii) residences and businesses on other streets whose sole or primary access is the street identified for traffic calming and who would be considerably inconvenienced if they chose an alternate route.

The proposed traffic calming plan, along with the supporting information below, is presented or provided to the community within the survey area for their review for a
sufficient period of time (a minimum of 30 days is suggested). This may be through a public meeting(s) and/or electronic/postal distribution, or some other means or combination thereof that serves to inform the community of the proposal.

Supporting Information:

(i) A map that that indicates the location and approximate footprint of the proposed traffic calming devices along the street and the affected property boundaries.
(ii) A map that indicates the survey area including residences, businesses and the connecting streets.
(iii) Information about the nature and features of the proposed traffic-calming devices such as contained in the Guide.
(iv) The process and procedures that will be used to measure and document community support (e.g. petition, ballot survey etc.).

To measure and document community support the Locality conducts a petition, survey, or other process that ensures the accurate measure and documentation of support.

The measure and documentation of support shall hold to the following:

- Only occupied residences or businesses in the survey area are included/counted in measuring and documenting community support (e.g. signing a petition for traffic calming, cast a ballot/vote etc.).
- Each residence or business address gets a single signature or ballot/vote etc. to indicate agreement or disagreement with the entire plan.
- More than 50% of the occupied residences or businesses in the survey area must support the traffic calming plan in order for the plan to be implemented.

**Step 6: County Board of Supervisors or Town Council Endorsement**

Upon approval by the community of the proposed plan, the BOS or Town Council endorses the plan by a resolution. The resolution should state the following:

(i) The proposed Traffic Calming Plan was properly presented to the community in the affected survey area for their review and consideration
(ii) The plan was subsequently approved by (indicate percentage) of the occupied residences and businesses within the appropriate surveyed area
(iii) The intended source of funding (e.g. 50% secondary highway funds, 50% local funds).

The resolution and traffic calming plan is then conveyed to VDOT along with the following related documentation:

(i) The engineering study/review
A map depicting the streets and residences identified as part of the survey area

A description of the method used to measure and document community support (e.g. petition, survey etc.)

The survey documents and a summary of the survey results including the number of residences and businesses in the survey area and the number/percentage that support the proposed plan.

**Step 7: Consideration for Implementation – VDOT**

After reviewing and confirming the proposed plan, BOS resolution and survey results, VDOT will consider implementation of the traffic calming plan through VDOT contract forces or the Locality. The implementation of the plan by VDOT forces is dependent on their funding priorities and availability of resources, materials and equipment. Preferably, the Locality will implement the traffic calming plan where such an arrangement is acceptable to VDOT.

**Funding**

Secondary or locality-provided funds are the primary sources for funding. The Locality should consult with the BOS and the local VDOT residency office to determine potential funding sources. Note that streets subject to VDOT’s Secondary Street Acceptance Requirements (SSAR) - generally, those subdivision streets where plats and plans were submitted to the local government and VDOT on or after July 1, 2009 - are not eligible for VDOT funds on any portion of the street width that exceeds that specified in Appendix B (1) of VDOT’s Road Design Manual. To illustrate, on a subdivision street 36 feet wide where a minimum street width of only 29 feet is required by the SSAR standards VDOT funds for the cost of materials, construction and maintenance may only be applied for 29 feet of the total 36 feet width or 80 ½ % of the total cost. The remaining 19 ½ % of construction and maintenance costs must be funded entirely by the locality.

**Step 8: Evaluation - VDOT**

Following construction of the traffic calming plan, VDOT will review the installation and the related traffic control devices to ensure that there is no safety, operational, or maintenance issue.

Subsequent to installation (after 3 months is suggested), a follow-up review may be conducted to evaluate the effectiveness of the traffic calming measures in reducing the operating speeds or any safety issues etc. VDOT may wish to disseminate any findings and recommendations from such reviews through the Board of Supervisors in order to obtain feedback from those involved in the plan development.

**Modification of Installed Traffic Calming Devices**
Where a safety, maintenance, or operational issue arises following installation of a traffic calming device(s) VDOT or the Locality (where they installed the devices) may adjust, relocate or remove the relevant traffic calming device(s) as necessary to address the issue, with the same funding sources used to install the devices originally. The Locality must confirm the issue and any proposed changes with VDOT prior to their adjusting, relocating or removing a traffic calming device(s).

Where the Locality proposes to adjust, relocate or remove a traffic calming device(s) for other than a safety, operational, or maintenance issue they must use their secondary or local funds, secure (re)approval of the affected residents and likewise confirm the proposed changes with VDOT.

III. TRAFFIC CALMING MEASURES

The traffic calming devices included in The Guide are characterized as Non-Intrusive or Horizontal, Vertical and Narrowing devices and are discussed on the following pages.

1. Non-Intrusive Traffic Calming Devices

Non-intrusive measures include administrative measures such as a public information campaign, posting certain types of signs to promote speed reduction, and utilizing pavement markings to reduce the number of lanes and/or pavement travelway widths. The additional pavement width available through the various reductions may be reallocated for parking lanes, bike lanes, or sidewalks etc.

The Non-intrusive devices offer the advantage that they do not physically constrain vehicle maneuvers and thus are less invasive. This is particularly desirable for streets that serve as major emergency and bus routes. Other desirable aspects of the non-intrusive devices are that they involve standard signs and pavement markings easily recognized by motorists and; can generally be less costly overall than the horizontal, vertical and narrowing measures.

However, some non-intrusive applications may not be as effective because they do not physically constrain vehicles to reduce speed.

Following are the non-intrusive measures included in the Guide; Community Education, Community Gateways, Pavement Markings (travelway narrowing and roadway conversions), Speed Display Signs, Additional $ 200 Fine signs.

Non-Intrusive Devices - Community Education

Informing and reminding the community of speeding issues and concerns and the importance of driving safely in their neighborhood is an important step. Various resources and literature are available to inform the community on these various issues.
The Virginia Department of Motor Vehicles (DMV) has considerable literature and information on all aspects of safety including speeding and aggressive driving, school bus safety, bicyclists, pedestrians, teen drivers, mature drivers etc. which can serve to educate both motorists and pedestrians/bicyclists alike and raise the overall awareness of safety. See DMV’s site at https://www.dmv.virginia.gov/safety/#programs/index.asp for this information.


**Non-Intrusive Devices - Community Gateways**

**Figure 1.1 – Community Gateway**
Figure 1.2 - Community Gateway

Description

Gateway (Community) treatments involve the combined use of sign installations, landscaping, textured pavements, name plates, monuments, or other arrangements placed at the entrance to a neighborhood typically installed in order to communicate a sense of neighborhood identity as well as for community development and community pride purposes. The installations announce to motorists that they are entering a community where there is a significant change in the driving environment such as a transition from an urban to residential street.

Note: Funds for landscaping included in a gateway treatment may be limited to a minimal percentage of the construction funds budgeted for a proposed traffic calming plan and; the neighborhood association or other community group would be solely responsible for maintaining any landscaping.

Placement

The gateway is placed at the entrance or “gateway” to the community at a prominent location and should be large enough to attract the attention of motorists and to effectively communicate they are entering the neighborhood or community.

Advantages:

Provides an attractive addition to a community.

Disadvantages
- Generally, requires ongoing maintenance such as painting, renewing and watering the vegetation or possibly repairs. The neighborhood association or other community group would be responsible for maintaining these installations.

**Effectiveness**

FHWA (Federal Highway Administration “Engineering Countermeasures to Reduce Speeds” —see references) indicates an average reduction in operating speeds of about 2 mph.

**Cost**

The cost of gateways varies significantly according to the features included and the extent of the construction.

**Non-Intrusive Devices - Pavement Markings**

![Figure 2.1 – Pavement Marking Options](image)
Figure 2.2 – Narrow travelway by re-striping pavement

Figure 2.3 - Narrow travelway by re-striping to add parallel parking lanes
Figure 2.4 – Narrow travelway by re-striping pavement to add a bike lane

Description

Narrowing the travel lanes tend to make drivers drive slower. The additional pavement made available by narrowing is reallocated for parking and/or bicycle lanes etc. (see Figure 2.1 – 2.3 above). Incorporating this effort in conjunction with a re-paving project can save costs and minimize eradication as well as confusion to the motorists (i.e. a change with a paving project may be more easy to comprehend/tolerate than a separate effort to eradicate existing markings and then restripe etc.).

One option when adding parking lanes is to alternate parking along opposite sides of the street which introduces a physical change in the straight vista of a roadway, similar to that of a chicane (discussed further on) to promote reduced speeds.

Note: On local streets, bicyclists are a normal part of the vehicle mix and do not require marked or designated bike lane. Designated bike lanes are more appropriate on collector roads where they connect to a network of bike lanes on streets identified in a local and/or regional Bicycle Plan.

Placement
The desired features (e.g. add bike lanes and/or parking etc.) and available pavement width as well as the allowable minimum travelway widths (see Appendix I – Selection of Measures), dictates the type of pavement striping and its location.

Advantages

- Does not physically restrict driver maneuvers and thus will not impose speed reductions on emergency and transit vehicles
- Involves a standard traffic control device easily recognizable by motorists
- Pavement markings etc. may be less costly to implement than some of the other devices

Disadvantages

Restriping the pavement involves considerably more effort where significant eradication of existing pavement markings is required. Therefore, where this is the case it is recommended that this measure is implemented in conjunction with a re-paving project.

Effectiveness

FHWA suggests a reduction of 0.5 mph for narrowing lanes by pavement markings and a reduction of 4 mph for a road diet where a 4-lane road is reduced to three lanes.

Cost

An estimated cost of $5 per linear foot of pavement marking/striping, including eradication of existing markings and maintenance of traffic, is suggested. Special symbols such as bicycle emblem on a bike lane are approximately $300 each.
Non-Intrusive Devices - Pole Mounted Speed Display (PMSD) Sign

Figure 3.1 – Pole Mounted Speed Display Sign

Description

A Pole Mounted Speed Display (PMSD) Sign combines the regulatory speed limit sign with a radar speed feedback sign that displays the real-time speed of an approaching vehicle which tends to make motorists reduce their speed.

Placement

Signs are installed only on streets with a single through-travel lane per travel direction (e.g. a two-lane, two-way or one-lane, one-way street). Generally, one sign is placed at the beginning of the street section identified for traffic calming in each travel direction, in order to reinforce the posted speed limit for vehicles entering the section of street designated for traffic calming. At least 200 feet of visibility distance should be allowed approaching the sign and at least 100 feet between any other signs.

Advantages

- These signs can potentially be used as a portable assembly that allows for placement at alternating locations.
- Does not physically restrict driver maneuvers and thus will not impose speed reductions on emergency and transit vehicles.
- Involves a standard traffic control device easily recognizable by motorists.

**Disadvantages**

Installing these signs may be impacted by the availability of a power source.

**Effectiveness**

Various sources indicate an average sustained reduction in operating speeds of 5 mph may be achieved.

**Cost**

An estimated cost of $7,500 per installation is suggested, depending on whether solar or conventional power is used as well as the proximity of the power source.

**Non-Intrusive Devices - Additional $200 Fine Signs**

*FIGURE 4.1 – Additional $200 Fine Sign*
Description

The Additional $200 Fine Signs, when posted on a street, allow for imposing an additional $200 fine for speeding on residential streets. These signs are installed on any street identified and approved for traffic calming in the Guide.

Outside of the traffic calming program, these signs are implemented following the requirements of VDOT’s policy (see http://www.virginiadot.org/programs/resources/FINAL_POLICY_ADDL_FINE_June_17_1999.pdf ). The policy requires a formal acceptance process including a request by resolution of the local governing body for the signs, verification that there is a speeding problem and that the increased penalty has community support.

Placement

These signs are installed in conjunction with the posted speed limit sign and are placed at the beginning of the roadway section in each travel direction where the higher fines will apply. At least 200 feet of visibility distance should be provided approaching the sign and at least 100 feet between any other signs.

Advantages

- Does not physically restrict driver maneuvers and thus will not impose speed reductions on emergency and transit vehicles.
- Involves a standard traffic control device easily recognizable by motorists.

Disadvantages

The effectiveness of these signs in reducing vehicles speeds is unknown.

Effectiveness

The effectiveness of these signs is unknown.

Cost

The estimated cost for installing these signs, which consists of producing and installing the posted speed limit sign and the supplemental “Additional $200 Fine” plaque, is $750 per sign. The minimum estimated cost to install these signs on a street designated for the additional $200 fines is $3,000 (a total of four signs, two per travel direction indicating the beginning and ending of the additional fine street section).

2. Horizontal, Vertical and Narrowing Devices

These are traffic calming devices constructed and installed on the street pavement surface to narrow the travelway or create vertical or horizontal shifts on the roadway. These devices can be particularly effective in slowing vehicles because they physically
constrain vehicles to pass over, through or around physical obstructions on the roadway.

Horizontal, vertical and narrowing devices can also significantly affect emergency response (as well as transit) times; from three to ten seconds per device depending on the type of device and the vehicle traversing it; with the delay compounded by multiple devices.

Although neighborhood streets do not generally serve as primary emergency or transit routes, streets in close proximity to Fire/Rescue services and hospitals etc. or identified by the local Fire & Rescue Chief as having significant usage by their fire and rescue vehicles should use non-intrusive devices and speed lumps to minimize impacts for emergency vehicles. Similarly, streets on major (large bus) transit routes or that experience significant use by such vehicles should consider use of non-intrusive devices and speed lumps.

Some of the horizontal, vertical and narrowing devices such as speed humps can also affect bicyclists, and may introduce additional maintenance costs and considerations, particularly the horizontal, narrowing devices, which can create drainage issues if not appropriately located and constructed.

A disadvantage of the vertical devices is increased noise to nearby residents due to vehicles passing over the devices, particularly large trucks. This is particularly the case for speed humps and speed lumps (for passenger vehicles).

Following is a detailed description of the horizontal, vertical and narrowing Devices included in the Guide; Speed Humps, Speed Lumps, Chokers, Raised Crosswalks, Crosswalk Refuges, Raised Median Islands, Chicanes, and Speed Tables.
Description

A **Speed Hump** is a vertical device with a raised parabolic shaped area in the roadway, extending across the road at right angles to the traffic. The raised surface is higher, and occurs over a shorter travel distance than for other vertical devices. Speed humps are the most commonly used traffic calming devices.

Placement

Speed humps are placed at mid-block.

Advantages

Speed Humps are among the most recognizable traffic calming devices, which may promote a quicker response by motorists to reduce their speed.

Disadvantages

- Increases noise to nearby residents as vehicles pass over the device (particularly larger trucks)
- Impedes bicyclists
- Impacts travel times of emergency vehicles and transit (buses)
Effectiveness

FHWA & ITE (Institute of Transportation Engineers “Traffic Engineering Handbook, Sixth Edition”—see references) indicates an average reduction in operating speeds of 5 - 8 mph.

Cost

The estimated cost for a speed hump is approximately $2,000 depending on drainage conditions and materials used.

Horizontal, Vertical and Narrowing Devices – Speed Lump

FIGURE 6.1 – Speed Lump
Description

A Speed Lump is a modified Speed Hump where openings are added to accommodate emergency or other large vehicles to utilize the openings without traversing over the raised portion to minimize speed reduction. However, the sizing of the lumps ensures that passenger vehicles cannot likewise avoid traveling over at least one set of lumps.

Placement

Speed lumps are placed at mid-block.

Advantages

- Allows emergency vehicles and buses to traverse the device without reducing speed by utilizing the openings provided for those particular vehicles.
- Produces less noise than speed humps for emergency or other large vehicles.
- Speed lumps are more accommodating for bicyclists than speed humps, as bicyclists can utilize the openings to traverse the device.

Disadvantages
- These devices likewise increase noise to nearby residents for passenger vehicles.
- May encourage passenger vehicles to cross into the opposing lane in an attempt to straddle the humps provided for emergency vehicles. Providing a centerline stripe approaching the speed lump in each travel direction may discourage this.

Effectiveness

ITE & FHWA data indicate an average reduction in operating speeds of 5 - 9 mph.

Cost

The estimated cost for a speed lump is similar to a speed hump; approximately $2,000 depending on drainage conditions and materials used.

Horizontal, Vertical and Narrowing Devices – Speed Table

Figure 7.1 - Speed Table
Description

Speed Tables are similar to speed humps except they incorporate a flat “table” and thus provide an overall gentler transition than the speed hump. The top “flat area’ is sized to accommodate the most typical vehicle wheelbase (usually a passenger car) entirely on the top, but can be extended to accommodate other vehicles if desired.

Placement

Speed tables are placed at mid-block.

Advantages
Provides a more moderate vertical transition for crossing vehicles and therefore motorists experience less discomfort than when driving over speed humps or lumps.

Disadvantages

These devices likewise increase noise to nearby residents as vehicles pass over the device although to a lesser extent than speed humps.

Effectiveness

ITE & FHWA indicate an average reduction in operating speeds of about 7 – 9 mph for tables with the dimensions used in the Guide of 22 feet (in the direction of travel). For longer tables ITE indicates a speed reduction of about 4 mph.

Cost:

The estimated cost for a speed table ranges from $5,000–$15,000 depending on drainage conditions and the materials used.

**Horizontal, Vertical and Narrowing Devices – Raised intersections**

**Figure 8.1 – Raised Intersection**
Raised intersections incorporate a speed table concept across an entire intersection (see Figure 13.2) and thus provide traffic calming on all connecting streets.

**Placement**

By definition, these devices are located at the intersection of two or more streets. The top, "flat area" covers the area of the intersection.

**Advantages**

- Raised intersections can be visually attractive
- These devices provide traffic calming on 2 or more streets at once.
- Similar to speed tables, raised intersections typically have longer dimensions than speed tables so drivers feel even less discomfort vs. a speed table or speed hump/lump.

**Disadvantages**

- Raised intersections have a significantly higher cost however, they also provide calming on two or more streets at once.
- These devices likewise increase noise to nearby residents as vehicles pass over the device although to a lesser extent than speed humps.

**Effectiveness**

FHWA & ITE indicate an average reduction in operating speeds of about 0.3 - 1 mph.

**Cost:**

The cost for a raised intersection can range from an estimated $25,000 to $70,000 depending on the number and width of the streets at the intersection to be raised.
Horizontal, Vertical and Physical Devices – Raised Crosswalk

Figure 9.1 - Raised Crosswalk

Description

A Raised Crosswalk is identical to a speed table (see Figure 13 below), except that it utilizes the flat surface to provide a marked pedestrian crossing.

Placement

A raised crosswalk is placed where there is an existing, marked crosswalk or where one is warranted. New crosswalk locations require an engineering study and must be approved by VDOT.

Advantages

- Provides improved visibility and safety for pedestrians.
- Enhances the pedestrian environment at pedestrian crossing.
- Can increase the number of motorists yielding to pedestrians crossing at the raised device
Disadvantages

As discussed for speed tables, raised crosswalks likewise may not provide as much speed reduction as desired.

Effectiveness

ITE & FHWA indicate an average reduction in operating speeds of about 7 – 9 mph for tables with the dimensions shown in the Guide (22 feet with a top, flat area of 11 feet).

Cost

The estimated costs for a raised crosswalk is approximately $5,000 - $7,000, depending on drainage conditions and the type of materials used.

Horizontal, Vertical and Narrowing Devices – Raised Median Island

Figure 10.1 - Raised Median Island
Description

A Raised Median Island involves placement of a raised island in the middle of the roadway in order to narrow the vehicle travel lanes.

Placement

This device is generally located at mid-block but can also serve as a gateway treatment when located at the entrance to a community.

Advantages

Provides dual use, as both a narrowing device and a gateway, when placed at the entrance to a community.

Disadvantages

- Narrows travel-way for bicyclists.
- Presents a fixed object within the travel-way that vehicles may strike, especially snow plows, etc.

Effectiveness

FHWA indicates an average reduction in operating speeds of about 4 mph.

Cost

The estimated costs range from $6,000 - $9,000 per island.
Horizontal, Vertical and Narrowing Devices – Crosswalk Refuge

Figure 11.1 – Crosswalk Refuge
Description

A raised median in the middle of the roadway (see previous “raised median” device) with a cut provided to provide refuge for pedestrians. An optional design utilizes an offset on either side of the median (see Figure 10-2). Either design could also incorporate a raised crosswalk.

Placement

A crosswalk refuge is placed at an existing, marked crosswalk or where one is warranted. New crosswalks require an engineering study and must be approved by VDOT. Crosswalk refuges are desirable where vehicle speeds or the required crossing distance do not provide sufficient time for pedestrians to cross the street in a single movement.

Advantages

Provides additional safety in comparison to the standard crosswalk refuge, especially where there is no signal control such as at mid-block and T-intersection locations. In addition to providing a mid-block refuge for pedestrians so that they do not have to traverse the entire street, the “Z”-option crosswalk compels pedestrians to face, and thus more likely to be aware of approaching traffic before crossing the remaining section of the street, which may improve safety.
Disadvantages

- Narrows travel-way for bicyclists.
- Presents a fixed object within the travel-way that vehicles may strike, especially snow plows, etc.

Effectiveness

Although data specific to a crosswalk refuge was not found, these devices are very similar to raised median islands, which achieve a decrease in operating speeds of 4 mph (see below).

Cost:

The estimated cost for installing a raised concrete pedestrian refuge island (with landscaping) is about $10,000 to $30,000. The cost is less for an asphalt island or one without landscaping.

Horizontal, Vertical and Narrowing Devices – Chicane

Figure 12.1 – Chicane (Single lane, One-way travel)
Figure 12.2 – Chicane (Two-way travel)
Description

Chicanes are adjacent to the curb on alternating sides of the street in sets of three in order to introduce an S-shape travel path on a straight section of street that compels vehicles to slow down in order to negotiate the curved section.

Placement

These devices are at mid-block with a median or other non-traversable barrier to separate travel in each direction through the chicane. Note: With no physical separation between the travel directions drivers tend to cross the centerline to make their travel path as smooth as possible through the chicane, particularly an issue when there is a vehicle approaching in the opposing lane who may be doing the same. This cross-centerline behavior is a potential safety concern and contributes to a general ineffectiveness of the device in terms of speed reduction.

The appropriate applications of chicanes are in Figures 12.1 – 12.3. In Figure 12.1, the travel directions are separated by a raised median and in Figures 12.2 and 12.3 the travel directions are separated in the vicinity of the chicane by a raised median island.
The spacing and travelway width between the chicanes is varied to achieve more or less vehicle speed reduction. Closer spaced constructions and narrower travelway widths promote a greater reduction in speeds.

Advantages

Provides for adding greenery and thus enhance the attractiveness of the street.

Disadvantages

- Narrows travel-way for bicyclists and creates some loss of parking.
- Presents a fixed object within the travel-way that may be struck by vehicles especially snow plows etc.

Effectiveness

FHWA indicates an average reduction in operating speeds of 3 to 9 mph.

Cost

An estimated cost for asphalt chicanes of $10,000 (for a set of three chicanes) is suggested and $16,000 for a concrete set of three. Drainage may be the most significant cost consideration.

Horizontal, Vertical and Narrowing Devices – Choker

Figure 13.1 – 2-Lane, 2-Way Choker
Description

A choker is constructed at mid-block or as a curb extension to reduces the width of the travelway. They can also serve to widen the planting strip for landscaping. These devices are often used to facilitate parking downstream.

Placement

Chokers are generally located at mid-block.

Advantages

Provides protection for parking which increases safety for pedestrians as well as vehicles when entering and exiting the parking area.

Disadvantages

- Narrows travel-way for bicyclists and creates some loss of parking.
- Presents a fixed object within the travel-way that may be struck by vehicles especially snow plows etc.
Effectiveness

FHWA data indicates an average reduction in operating speeds of 1 - 4 mph.

Cost

An estimated cost per set of chokers of $5,000-$20,000 (including landscaping) is suggested, depending on site conditions and the extent of landscaping.

Horizontal, Vertical and Narrowing Devices – Curb Extension (bulb-out)

Figure 14.1 – Curb Extension (Neckdown)

Description

Curb extensions, also known as bulb-outs or neckdowns extend the sidewalk or curb line into the parking lane thus preventing vehicles from parking too close to a crosswalk and blocking visibility of pedestrian crossings. They also reduce the speeds of turning vehicles at intersections and effectively reduce the street width, which significantly improves pedestrian crossing distance and times as well.

Placement
Curb extensions should only be used where there is on-street parking. Curb extensions at intersections reduce the speeds of right-turning vehicles and serve to narrow the roadway, which reduces the crosswalk distance for pedestrians and enhances the safety of pedestrian crossings at the crosswalk.

**Advantages**

Shortens crossing distances for pedestrians, which increases safety and provides parking protection downstream with the goal of decreasing vehicle speeds as well.

**Disadvantages**

Requires additional considerations for accommodation of bus routes and bicycle lanes.

**Effectiveness**

FHWA data indicates an increase of vehicle speeds of 1 - 3 mph however; they can reduce the turning speeds of vehicles by 6-8 mph.

**Cost**

An estimated cost of $2,000 to $20,000 per corner is suggested, depending on design and site conditions where the accommodation of drainage is usually the most significant cost.

**IV. COMBINED MEASURES**

Combining one or more traffic calming devices can enhance aesthetics and have a greater speed reduction.

FHWA indicates a speed hump combined with a choker can generate an average reduction in operating speeds up to 13 mph and a speed table combined with a raised median island can create an average reduction in operating speeds up to 8 mph. Other combinations did not indicate significant enhancement of speed reductions but some combinations may be desirable for aesthetic reasons as well.

See FHWA’s “Engineering Countermeasures for Reducing Speeds” at https://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/ for various other combinations that may be considered.

**V. TRAFFIC CALMING MEASURES NOT INCLUDED IN THE GUIDE**

A number of other measures were considered and either prohibited for use as a traffic calming device altogether or not recommended due to cost, ineffectiveness etc. These are (1) Stop Signs (2) Enforcement of Speed Limits (3) devices that impose restrictions
on certain traffic movements (4) Speed Reduction Markings (5) Zigzag pavement markings (6) In-Roadway Warning Lights and (7) Roundabouts.

1. Stop Signs are not intended for use as traffic calming devices in order to reduce vehicles speeds. Numerous studies show that unwarranted stop signs actually increase speeding on residential streets, where motorists tend to proceed through a stop without stopping in an attempt to make up lost time at stops they perceive as unnecessary. Thus, safety for pedestrians, especially for small children is compromised due to their expectation that vehicles will stop as required when in reality they may not.

2. Although enforcement of speed limits is a traditional, proven and effective approach to reduce speeding past experience indicates that it is unreasonable to expect local enforcement agencies to continuously enforce speed limits on low volume residential streets. Therefore, this is not a sustainable measure.

3. Full or half-closures, diagonal diverters and forced turn islands (including forced right-turns) are not considered in The Guide as viable options as they impose restrictions on certain traffic movements that experience has shown to be unpopular and controversial in neighborhoods where they have been proposed.

4. Speed reduction markings are transverse markings placed on both edges of the roadway in a pattern of progressively reduced spacing to create the illusion of traveling faster and thus prompting motorists to reduce speed. However, per the MUTCD they are not suitable on long, straight sections of roadway or; areas primarily frequented by local drivers, the typical conditions where traffic calming is most likely to be implemented. Therefore, they are not as effective and so are not included in the Guide as a traffic calming measure.

5. Zigzag pavement markings involve lines painted on the pavement in a zig-zag pattern (see Figure 16.1) that serve to raise driver’s awareness of an approaching crossing with pedestrians and bicyclists and to promote a reduction of vehicle speeds. Although they have a modest cost and appear to be effective in producing a sustained reduction in vehicles speeds they have not been incorporated into the MUTCD and are considered experimental in nature. The U.S. Federal Highway Administration approved their use on an experimental basis in Virginia. A one-year study found both heightened awareness of the crossing by approaching motorists and a sustained speed reduction however, the extent to which speeds reduced is not clear. See report at http://www.virginiadot.org/vtrc/main/online_reports/pdf/11-r9.pdf for further details. It is also not clear if these markings would be effective on neighborhood streets where speeds are lower and are primarily frequented by local drivers.

6. In-Roadway Warning Lights involve beacons placed in the roadway surface at a marked crosswalk that flash (either automatically or manually) when a pedestrian is crossing the street and is within the crosswalk to provide additional warning to
motorists. Although these devices increase driver awareness of pedestrians when device is operating properly however, when this is not the case they create a false sense of security for pedestrians and approaching motorists as well. Additionally, the devices are costly to install and maintain, have a high failure rate, and pose potential liability issues if not maintained.

7. Although roundabouts have many well-known benefits they are not generally considered traffic calming devices per se and the cost and extent of effort to implement a roundabout does not generally fit within the intended scope and budget for traffic calming on a neighborhood street. However, where appropriate a roundabout can be sought outside the traffic calming program.
REFERENCES


3. Institute of Transportation Engineers and Federal Highway Administration Traffic Calming Measures https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/.


8. The Neighborhood Traffic Calming Process, Fairfax County’s Traffic Calming Policy, endorsed by the Fairfax County Board on February 23, 2009.


15. VDOT Road Design Manual; APPENDIX B(1). SUBDIVISION STREET DESIGN GUIDE for residential and mixed-use streets
   http://www.virginiadot.org/business/manuals-default.asp

16. VDOT’s Secondary Street Acceptance Requirements (SSAR)
   http://www.virginiadot.org/info/secondary_street_acceptance_requirements.asp


19. FHWA, “Selecting Pedestrian Improvements”
   https://safety.fhwa.dot.gov/saferjourney1/Library/matrix.htm
# APPENDIX

## DEVELOPMENT & IMPLEMENTATION OF THE TRAFFIC CALMING PLAN

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I. Selection of Traffic Calming Devices

When developing the traffic calming plan, the following items should be followed in selecting the appropriate traffic calming measures.

1. **Involve and educate the community and decision-makers** - Inform community and decision-makers of the purpose of traffic calming, the relevant issues in the traffic calming process, the nature of the various alternatives including their effectiveness and associated costs. Additionally, informing the community on the nature of the various traffic calming measures may enhance their overall effectiveness. The following link provides information on traffic calming and a video of various calming measures in operation. [http://www.virginiadot.org/programs/faq-traffic-calming.asp](http://www.virginiadot.org/programs/faq-traffic-calming.asp).

2. **Consider all service providers and users of the street** – Key entities of the community should be consulted when developing the plan, particularly the local Fire & Rescue Chief, major Bus transit operators and affected public schools and businesses. Other users of the street such as business/trucking and bicyclists are considered as well.

   i. **Emergency response times** (as well as transit) can be significantly increased by horizontal, vertical and narrowing devices; from 3 to 10 seconds per traffic calming device depending on the type of device and the vehicle traversing it, with the delay being compounded by multiple devices. Streets in close proximity to Fire/Rescue services and hospitals or are identified by the local Fire & Rescue Chief as having significant usage by their fire and rescue vehicles should utilize the non-intrusive devices and speed lumps to minimize the need for those users to reduce speeds. Similarly, streets on major (large bus) transit routes or that experience significant use by such vehicles should consider use of non-intrusive devices and speed lumps.

   ii. **Emergency (e.g. fire trucks) and maintenance vehicles** (snow plow operations etc.) require a minimum of 15 feet of clear travel way. Fire trucks require 15 feet of pavement in order to put down outrigger stabilizers when fighting fires. The local Fire & Rescue Chief should be consulted on the dimensions of the emergency vehicles they use to ensure they are accommodated in the proposed plan (e.g., speed lumps can be designed to accommodate specific vehicle widths).

   iii. For streets that provide primary access to industrial or business locations and that experience significant commercial truck traffic the non-intrusive measures or the horizontal, vertical and narrowing devices that better accommodate these vehicles (e.g. speed lumps vs. speed humps) should be considered for these cases.
iv. Streets identified as part of a designated bicycle network in a local and/or regional bicycle plan or other streets where there are significant bicyclists should be considered for non-intrusive measures (particularly pavement markings that create a bike lane) and speed lumps vs. speed humps or speed tables etc. that are more suitable for bicyclists.

3. **Implement measures on an area-wide basis** - Ideally traffic calming should take an area-wide approach to ensure that problems do not simply shift to adjacent local streets and parallel roadways. Implement traffic calming in stages where funding is not initially available for the entire plan.

4. **Consider the features of the street** – The appropriateness of a particular device depends on the traffic, the pavement width etc. FIGURE A indicates the required features of streets for consideration when choosing among the various devices.

5. **Consider appropriate traffic control devices** (signs and pavement markings) that may affect the need as well as the type and location of the traffic calming devices. A lack of appropriate traffic control devices; particularly those that reinforce proper vehicle speeds such as speed limit signs and advisory speed warning signs etc. may be a contributing factor in creating undesirable conditions such as speeding, cut-through traffic etc. The speed limit should be posted at the beginning of the street section identified for traffic calming in each travel direction to notify motorists entering the street of the speed limit.
### FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices

<table>
<thead>
<tr>
<th>Type of Measure</th>
<th>Action</th>
<th>Street Characteristics ¹</th>
<th>Minimum striped travelway/lane widths ²</th>
<th>Other Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>NON-INTRUSIVE MEASURES - Pavement Markings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two-lane, two-way street</td>
<td>Utilize pavement markings to narrow travelway width by striping pavement; may include addition of parking lanes or bike lanes (on collector streets where part of a designated bike route or bike plan).</td>
<td>ADT &lt; 401 vpd</td>
<td>18 feet *</td>
<td>* Physical pavement width may be greater than striped width.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>400 &lt; ADT &lt; 1501 vpd</td>
<td>20 feet *</td>
<td>* A parking lane requires additional pavement width (7 feet in residential or mixed use areas and 8 feet in commercial areas).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1500 &lt; ADT &lt; 2001 vpd</td>
<td>22 feet *</td>
<td>* A bike lane requires an additional 5 feet of pavement.</td>
</tr>
<tr>
<td>One-lane, one-way street</td>
<td></td>
<td>ADT &gt; 2000 vpd OR; mixed-use area with truck traffic &gt;5%</td>
<td>24 feet (22 feet where no crash pattern indicates wider pavement should be considered) *</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Use 1/2 of above minimum widths vs. traffic volumes</td>
<td></td>
</tr>
<tr>
<td>NON-INTRUSIVE MEASURES - Signs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed Display Sign ⁴</td>
<td>Install signs where appropriate for speed limit signs</td>
<td>Single lane per travel direction (Two-lane, two-way or; one-lane, one-way streets)</td>
<td>NA</td>
<td>Confirm the appropriate location of signs with VDOT. Additional $200 Fine Signs may not be posted on arterials.</td>
</tr>
<tr>
<td>Additional $200 Fine Sign ⁴</td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>VERTICAL MEASURES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed Hump</td>
<td>Install physical measures on and across the travelway</td>
<td></td>
<td>NA</td>
<td>Consider locations of manholes and drain inlets. Do not install adjacent to driveways or other entrances.</td>
</tr>
<tr>
<td>Speed Lump</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed Table</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raised Crosswalk ⁵</td>
<td>Install physical measures on and across the travelway at an intersection or at mid-block.</td>
<td>At existing marked crosswalk or where approved by VDOT.</td>
<td></td>
<td>Engineering study and VDOT approval required for location of crosswalks.</td>
</tr>
<tr>
<td>HORIZONTAL MEASURES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicane</td>
<td>Install physical measures in groups of three along shoulder on alternating sides of street at mid-block.</td>
<td>Requires physical separation between travel directions in the vicinity of chicane and; street width meets minimum travelway requirements.</td>
<td>10 feet minimum pavement width through device for each travel direction OR; 1/2 of above minimum travelway widths vs. traffic volume -whichever is greater.</td>
<td>where ADT &lt; 2001 and truck traffic (in mixed-use area) &lt;= 5%</td>
</tr>
<tr>
<td>NARROWING MEASURES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choker</td>
<td>Install physical measures along shoulder on one or both sides of street to narrow travelway at mid-block.</td>
<td></td>
<td>10 feet minimum striped lane width through device for each travel direction OR; 1/2 of above minimum travelway widths whichever is greater. OPTION: May use 15 feet travelway width through device at mid-block locations for “give way to opposing vehicle” operations. No pavement striping should be used for this case.</td>
<td>Consider locations of manholes, drain inlets, driveways or other entrances for mid-block installations.</td>
</tr>
<tr>
<td>Curb Extension (neckdown)</td>
<td>Install physical measures along one or both sides of street to improve pedestrian crossings at an intersection or at mid-block.</td>
<td>At existing marked crosswalk or where one is approved by VDOT and to accommodate on-street parking.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raised Median Island</td>
<td>Install physical measures in median area of travelway at an intersection or at mid-block.</td>
<td>street meets minimum travelway width requirements.</td>
<td>10 feet minimum pavement widths through device for each travel direction OR; 1/2 of above minimum travelway width vs. traffic volume -whichever is greater.</td>
<td>Engineering study and VDOT approval required for location of crosswalks.</td>
</tr>
<tr>
<td>Crosswalk Refuge ⁵</td>
<td></td>
<td>At existing marked crosswalk or where one is approved by VDOT. Street meets minimum travelway width requirements.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

1. All streets are residential or mixed-use streets functionally classified as “local” with a speed limit of 25 mph or less where traffic does not exceed 4,000 vpd and trucks are 5% or less except where indicated otherwise.
2. Per AASHTO Green Book Table S-5 for local roads and streets (travelway widths are exclusive of curb and gutter).
3. On local streets, bicyclists are considered a normal part of the vehicle mix and do not require a marked or designated bike lane. Designated bike lanes may be established on collector roads as appropriate.
4. These signs normally governed by separate VDOT policies however, when implemented within the traffic calming process per the Guide they likewise meet the requirements prescribed under the respective policies. Confirm locations with VDOT.
5. For requirements pertaining to pedestrian accommodations; see VDOT’s Traffic Engineering Instructional & Informational Memorandum IIM-TE-384.0 titled “Pedestrian Crossing Accommodations at Unsignalized Locations.”
II. Location, Installation, Operation and Maintenance Considerations

The following discusses the various items pertaining to the location, installation, operation, and maintenance aspects of the traffic calming devices included in the Guide.

**Location/Spacing & Placement of Horizontal, Vertical and Narrowing Devices**

**Spacing**

The spacing of horizontal, vertical and narrowing devices should not exceed a distance of 500 feet between subsequent devices. As noted in VDOT’s Roadway Design Manual; studies indicate that operating speeds are 30 mph or less when the tangent sections were no longer than 500 feet. Long tangent sections can be segmented by conditions that require a complete stop such as a T intersection or by conditions that require reduced speeds such as a traffic calming device. Therefore, this 500 feet spacing minimizes the need to place additional, redundant devices at an increased cost.

Where a closer spacing of traffic calming devices is desired the distance between devices should not be less than 200 feet so that motorists approaching the device at 25-30 mph may appropriately perceive and respond to the device and/or any warning signs posted for the device (see section on traffic control devices pertaining to devices below).

**Location**

Speed Humps, speed lumps, speed tables, chicanes, chokers, and raised median islands are generally located at mid-block with a minimum distance of 200 feet from an intersection.

Raised Intersections are installed at an intersection.

Curb Extensions (Neckdowns or bulb-outs) are generally installed at the intersection of streets with on-street parking in order to reduce turning speeds of vehicles as well as pedestrian crossing times and; provide protection for on-street parking. They may also be placed at mid-block, similar to a chicanne or choker.

Raised Crosswalks and Crosswalk Refuges are located where there is an existing marked crosswalk or; where they meet the requirements for a new crosswalk. New crosswalks, modifications to an existing crosswalk or any other pedestrian-related accommodations are governed by VDOT’s Traffic Engineering IIM-TE-384.0 titled “Pedestrian Crossing Accommodations at Unsignalized Locations” available at [http://www.virginiadot.org/business/resources/IIM/TE-384_Ped_Xing_Accommodations_Unsignalized_Locs.pdf](http://www.virginiadot.org/business/resources/IIM/TE-384_Ped_Xing_Accommodations_Unsignalized_Locs.pdf).

**Placement**
The placement of horizontal, vertical and narrowing devices should not interfere with existing driveways or entrances, roadway drainage and drainage structures, drainage inlets; etc. or obstruct access to other utilities (e.g. franchise utilities such as gas, power, telephone, water hydrants etc.). Therefore, these devices should be placed at least:

- 5 feet from any driveway, entrance or curb cut on a local street (additional clearance may be required for curb cuts utilized by trucks
- 15 feet from a fire hydrant, either side
- 2 feet from a manhole or utility cover on approach or 6 feet after

**Location & Placement of Non-Intrusive Measures**

**Pavement Markings**

The conceptual drawing for pavement markings indicates various items pertaining to their placement and location etc.

**Speed Display signs**

These signs are installed in conjunction with the speed limit (R2-1) sign and are limited to streets having only a single through-travel lane per travel direction (e.g. two-lane, two-way or one-lane, one-way streets). The placement of these signs is generally dictated by where it is appropriate to indicate the regulatory speed limit therefore the sign locations should be approved by VDOT. For street sections identified for traffic calming, speed limit signs would at a minimum, be installed at the beginning of the street section in each travel direction in order to reinforce the posted speed limit for vehicles entering the section of street. Additionally, place interim signs as appropriate to reinforce notification of the regulatory speed limit.

There are also various operational requirements for these signs. VDOT’s TE-374.1 Memorandum lays out the full requirements for the operation, size, specifications etc. of the speed display signs and is available at: [http://www.virginiadot.org/business/resources/traffic_engineering/memos/TE-374_1_Pole_Mounted_Speed_Display_Signs.pdf](http://www.virginiadot.org/business/resources/traffic_engineering/memos/TE-374_1_Pole_Mounted_Speed_Display_Signs.pdf).

**Additional $ 200 Fine Signs**

These signs are also installed in conjunction with the speed limit (R2-1) sign. The sign must be posted at the beginning of the section of street in each travel direction that has been designated for higher fines. Also, a sign must be posted in each travel direction where the section of street designated for higher fines ends. Additional, interim signs may be placed as appropriate to further indicate the posted speed limit.

**Gateway Treatments**
The location of gateway treatments should consider the clear zone requirements in VDOT's Road Design Manual; Appendix B(1), Section B(1)-5, Part A for any structures or landscaping, including fences, stone or brick mailbox posts, columns or walls that do not meet breakaway requirements. For curb and gutter streets with parking lanes, the clear zone is accommodated within the parking lane.

**Traffic Control Devices pertaining to traffic calming devices**

Ensure that all related regulatory signs (e.g. speed limit signs), warning signs and pavement markings pertaining to the street and the specific devices are installed.

Regulatory and warning signs as well as pavement markings generally recommended or required for the various devices are shown on the conceptual drawings. However, there may be additional signs or markings required depending on local conditions.

**Horizontal, vertical and narrowing devices**

Advisory speeds, where posted at a particular device, should generally indicate 15 mph - the recommended maximum speed for vehicles while traveling through or over those (horizontal, vertical and narrowing) devices. The goal for vehicle speeds traveling between these devices is 25-30 mph or less. Therefore, 200 feet of distance is recommended for vehicles approaching the horizontal, vertical and narrowing devices per Section 2C.05 of the 2009 MUTCD. This provides sufficient distance for a vehicle approaching the device at 25-30 mph to perceive the device and/or any warning signs posted for the device and reduce speed to 15 mph when passing over or through the device.

**Non-intrusive devices**

For the non-intrusive measures (pavement marking schemes and speed display signs) included in the Guide no specific additional regulatory or warning signage is identified however, other signs or markings may be required depending on local conditions.

**Size of Signs**

See the 2009 MUTCD Section's 2B.03 and 2C.04 for regulatory and warning sign sizes, respectively. Single-lane conventional (low speed) roads are typical of the residential streets covered in the Guide.

**Visibility of Measures**

Measures should be clearly visible day and night. Reflectors, buttons, highly reflective paint, or illumination should be used as appropriate. Landscaping (now or at maturity), or other features should not obstruct sight distances.

**Maintenance**
Long-term maintenance needs should be anticipated and accommodated in the design of the various devices as much as possible.

**Minimum Design Vehicle**

The minimum design vehicle for new subdivision streets is a single unit truck (AASHTO SU-30) therefore the traffic calming plan should determine (and address) whether this vehicle size should be accommodated on their existing streets.

**Parking**

On-street parking should not obstruct sight lines to installed devices for drivers, cyclists or pedestrians. Add additional “No Parking” zones where needed.

**Streetscape and Landscape**

Any streetscapes or landscaping installed as part of traffic calming measures (such as for gateway treatments, raised median islands, chicanes, chokers or curb extensions) should consider the requirements in VDOT’s Road Design Manual; Appendix B(1), Section B(1)-5, Part E.

Landscaping that encroaches onto the right of way can obscure pedestrians or vehicles entering the roadway from residences or side streets. The RDM specifies various constraints for the location, height etc. of landscaping to ensure that the appropriate unobstructed view is maintained to protect the safety of pedestrians, bicyclist, and motorists.

Funds for landscaping may be limited to a minimal percentage of the construction funds budgeted for a proposed traffic calming plan and; the neighborhood association or other community group would be solely responsible for maintaining any landscaping.
III. Conceptual Drawings of Traffic Calming Measures

Following are conceptual drawings that provide details relating to the installation and construction of the various traffic calming measures in The Guide, based on recommendations from industry literature and other sources and considering VDOT’s design, maintenance etc. requirements.

The following conceptual drawings illustrate details and requirements for the traffic calming installations included in the Guide. The designer/installer should confirm that the installations meet all current VDOT requirements that apply per VDOT’s Roadway Design Manual, Road and Bridge Standards and Road and Bridge Specifications. Signs and pavement markings should be in agreement with the latest version of the Manual of Uniform Traffic Control Devices (MUTCD) and the Virginia Supplement to the MUTCD (VaSupMUTCD).
FIGURE A-1

PAVEMENT MARKING OPTIONS

NOTES:

1. Each intersection leg indicates a different option for narrowing the travelway
   a. North leg divided facility – narrow travelway in each travel direction by hatching shoulder area
   b. South leg un-divided facility – narrow travelway by hatching shoulder area and roadway centerline
   c. East & West legs – narrow travelway by adding parking and bike lanes
2. See FIGURE 14 – GUIDE TO THE SELECTION OF TRAFFIC CALMING DEVICES in this document for minimum (Min) widths of travelways, parking lanes, and bike lanes. of travelways, parking lanes, and bike lanes.
3. See Part 3 of the MUTCD (Section 2B.17 in the 2009 version) for requirements, options and other considerations for pavement markings.
4. As per the 2009 MUTCD Section 3B.24 Cross-Hatching should be a minimum of 8" in width for speed limits of 45 mph or less.
NOTES:

1. Sign is to be mounted on the same pole and directly below, the speed limit (R2-1) sign as shown above.
2. The changeable display shall be programmed to go blank/no display when an approaching vehicle exceeds the posted speed limit by 20 mph or more.
3. The changeable display shall be programmed to display two dashes when the system is not operating.
4. Other than the speed display, the PMSD sign shall not incorporate animation, flashing, or any dynamic elements.
5. For full requirements on the operation, installation, size, specifications and maintenance aspects of these signs refer to see TED Memorandum 374.1 “Pole Mounted Speed Display Signs: Requirements” at http://www.virginiadot.org/business/resources/traffic_engineering/memos/TE-374_1_Pole_Mounted_Speed_Display_Signs.pdf or; the Virginia Supplement to the MUTCD.
Figure A-3

$200 ADDITIONAL FINE SIGN

NOTES:

1. Per the 2009 MUTCD Section 2B.17:
   i. The supplemental sign panel indicating that an “Additional $200 Fine” applies shall be posted below the regulatory R2-1 speed limit sign panel as shown above.
   ii. The “Additional $200 Fine” sign assembly shall be installed at the beginning of the zone in each travel direction where the higher fines have been designated.
   iii. A sign indicating “End Higher Fines Zone” shall be erected in each travel direction at the locations where the designation of higher fines ends.

2. Additional signs may be placed at interim locations between the beginning and ending of the designated higher fines zone, where it is desired to further reinforce the posted speed limit and/or the existence of the additional fines.

3. Sign should be located at least 100 feet should from any other signs.
$200 ADDITIONAL FINE SIGN DETAIL

NOTES:

1. The size requirements for the "Additional $200 Fine" signs are as shown above and as further indicated in the future version of the Virginia Standard Highway Signs book.
NOTES:

1. Leave gutter pan open to facilitate drainage.
2. Cross-section shows approximate maximum elevation rise of 3" for speed hump.
3. Per the 2009 MUTCD:
   i. Section 3B.25—speed hump markings are not required but if used they must comply per options in Section 3B.25.
   ii. Section 3B.26—the 100’ advance warning pavement markings are optional but if used they must comply with the dimensions and spacing per Section 3B.26.
   iii. Section 2C.29 advance warning sign (W17-1) is optional but if used, should include the advisory speed plaque (W13-1) and; sign may use “Speed Bump” instead of “Speed Hump.”
NOTES:

1. All notes for speed hump in Figure A-2 apply in addition to the following.
2. Cross-section #2 is identical to speed hump cross section.
3. Width of center lump is 7 feet with 2 feet of spacing between adjacent lumps which accommodates trucks, school buses, transit buses and other larger vehicles with an 8-foot width and ensures that passenger vehicles (typical width of 7 feet) cannot avoid traveling over at least one set of lumps. However, the width of the center lump can vary based on dimensions of local emergency vehicles to be accommodated.
4. Stripping to delineate the street centerline is recommended to discourage vehicles from crossing into the opposing lane in order to straddle the humps provided for emergency vehicles.
FIGURE A-6
SPEED TABLE / RAISED INTERSECTION

NOTES:

1. The flat “table” area length of 11 feet accommodates the typical passenger car wheelbase entirely on the top, but can be extended to accommodate other vehicles if desired. A length of 20 feet accommodates the typical single unit truck (AASHTO SU-30).

2. The “Ramp-up” transition shows an approximate slope of 4.2% (rise of 3” over 6’ run).

3. A raised intersection would mimic the speed table design for each approach where the “ramp-up” occurs prior to entering the intersection and the flat table area encompasses the entire area of intersection for the approaching streets and therefore in most cases will exceed 11 feet.

4. Leave gutter pan open to facilitate drainage.

5. A 12” wide, 1” depth grind around the perimeter of the device is recommended in order to allow the surface course to be keyed into the pavement for a more durable application, particularly for snow plowing.

6. Per the 2009 MUTCD:
   i. Section 3B.25 – speed hump (table) markings are not required but if used they must comply with options per Section 3B.25.
   ii. Section 2C.29 - warning sign W17-1 is optional but if used, should include the advisory speed plaque (W13-1) and; the sign may use “Speed Bump” instead of “Speed Hump.”
NOTES:

1. Located at an existing marked crosswalk or where a new location has been approved by VDOT.
2. New crosswalks, or modifications to an existing crosswalk or any other pedestrian-related accommodations are governed by VDOT’s Traffic Engineering Instructional & Informational Memorandum IIM-TE-384.0 titled “Pedestrian Crossing Accommodations at Unsignalized Locations”.
3. Cross-section shows approximate maximum elevation of 3” for speed table/crosswalk.
4. A 12” wide, 1” depth grind around the perimeter of the device is recommended in order to allow the surface course to be keyed into the pavement for a more durable application, particularly for snow plowing.
5. Leave gutter pan open to facilitate drainage.
6. Per the 2009 MUTCD:
   i. Section 3B.25 – speed hump (table) markings are not required but if used they must comply with options per Section 3B.25.
   ii. Section 2C.50 - the W11-2 may be used in advance of a crosswalk and if used; shall include supplementary plaque W16-9p or W16-2P. If used at the location of a crossing point, the W11-2 should include the supplemental W16-7P plaque.
7. Per the VaSupMUTCD the W11-2 sign must be fluorescent yellow-green.
NOTES:

1. Approaches to the intersection should not exceed 6 percent and entrances should be a minimum of 75-100 feet away.
2. The transition of the approach curb and any accompanying raised pavement markers shall be in conformance to the design or operating speed of the roadway, whichever is greater.
3. For minimum (Min) travelway width see FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices in this document.
4. Per the 2009 MUTCD Section 2B.32 - the R4-7 signs are recommended at locations where it is not readily apparent that traffic is required to keep to the right.
FIGURE A-9
CHOKER

NOTES:

1. May be placed along one or both sides of the road where there is sufficient pavement width.
2. For minimum (Min) travelway width see FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices in this document.
3. May be combined with a speed table, speed hump, or speed lump (see Figure’s A-2, A-3 and A-4).
4. Do not stripe centerline where (Min) travelway width of 15 feet is used as described in FIGURE A. or otherwise less than indicated in FIGURE A for normal operation.
5. Leave gutter pan open to facilitate drainage.
6. Per the 2009 MUTCD Section 2C.19 -Advisory warning sign W5-1 is optional according to the following (If used may also include the advisory speed plaque W 13-1):
   i. Where the (Min) travel way width allows two-way travel without requiring vehicles to use the adjacent lane or to give way to opposing traffic.
   ii. On low-volume roadways where the speed limit is 30 mph or less.
FIGURE A-10
CURB EXTENSION (NECKDOWN)

NOTES:

1. Located at an intersection with on-street parking and an existing marked crosswalk or where one is approved by VDOT.
2. May also incorporate a raised crosswalk (see Figure A-5).
3. Where a new crosswalk is proposed for installation, or there are modifications to an existing crosswalk; for requirements pertaining to pedestrian accommodations see VDOT’s Traffic Engineering Instructional & Informational Memorandum IIM-TE-384.0 titled “Pedestrian Crossing Accommodations at Unsignalized Locations”.
4. For minimum (Min) travelway width see FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices in this document.
5. Drawing from VDOT’s Road Design Manual, Appendix B(2), Section B(2)-3. See that section for additional considerations and design criteria.
FIGURE A-11
CROSSWALK REFUGE

NOTES:

1. Located at mid-block where there is an existing marked crosswalk; in order to provide a refuge at mid-block for crossing pedestrians.
2. May also incorporate a raised crosswalk (see Figure A-5).
3. New crosswalks, or modifications to an existing crosswalk or any other pedestrian-related accommodations are governed by VDOT’s Traffic Engineering Instructional & Informational Memorandum IIM-TE-384.0 titled “Pedestrian Crossing Accommodations at Unsignalized Locations”.
4. The CROSSWALK REFUGE device may be raised (see FIGURE A-5).
5. For minimum (Min) travelway widths see FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices in this document.
6. Leave gutter pan open to facilitate drainage.
7. Per the VaSupMUTCD the W11-2 sign must be fluorescent yellow-green.
8. Per the 2009 MUTCD:
   i. Section 2B.32 recommends R4-7 signs at locations where it is not readily apparent that traffic is required to keep to the right.
   ii. Section 2C.50 -the W11-2 may be used in advance of a crosswalk and if used; shall include supplementary plaques W16-9p or W16-2P. If used at the location of a crossing point, the W11-2 should include the supplemental W16-7P plaque.
FIGURE A-12
CHICANE

NOTES:

1. For minimum (Min) travelway width see FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices in this document.

2. See chart below for the maximum “Stagger Length” (L) for various travelway widths (Min) and Free View width ‘W’ to achieve the indicated passenger car speed through the chicane.

<table>
<thead>
<tr>
<th>Travelway width (feet)</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum stagger length 'L' (feet) for SU-30 Truck free width view 'W' = 0.0 feet</td>
<td>40.0</td>
<td>34.0</td>
<td>29.0</td>
</tr>
</tbody>
</table>

3. See chart below for the maximum “Stagger Length” (L) for various travelway widths (Min) to accommodate a single unit truck (AASHTO SU-30) for a free view width ‘W’ = 0.0 feet.

<table>
<thead>
<tr>
<th>Stagger length 'L' (feet)</th>
<th>20 mph</th>
<th>25 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3.5</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>0</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>-3.5</td>
<td>36</td>
<td>50</td>
</tr>
</tbody>
</table>
4. The transition of the approach curb and any accompanying raised pavement markers shall be in conformance to the design or operating speed of the roadway, whichever is greater.

5. Per the 2009 MUTCD Section 2C.07 - W1-5 signs are required where advisory speeds are 10 mph or more below the speed limit. W1-8 signs are required where advisory speeds are 15 mph or more below the speed limit and recommended where advisory speeds are 5 mph or 10 mph below the speed limit.