

# **TRAFFIC CALMING GUIDE FOR NEIGHBORHOOD STREETS**

**Traffic Engineering Division  
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# TRAFFIC CALMING GUIDE FOR NEIGHBORHOOD STREETS

## I. INTRODUCTION & OVERVIEW

The “Traffic Calming Guide for Neighborhood Streets” (hereafter referred to as The Guide) provides guidance for a Locality to pursue and implement traffic calming in their neighborhoods under VDOT’s traffic calming program, on streets maintained by VDOT. The Guide supersedes VDOT’s previous “Traffic Calming Guide for Local Residential Streets.”

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 is focused on addressing issues on existing streets. Ideally, new residential developments would implement traffic calming concepts within the initial roadway design such as horizontal alignment shifts, roundabouts etc. In lieu of or in addition to these, the various traffic calming measures in the Guide may be considered as well. The design & review of subdivision development plans 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.

The Guide reflects a restructured process where the County or Town (referred to hereafter in the Guide as the Locality) works with the local community members to initiate and conduct the traffic calming process, which includes scheduling and facilitating community meetings, securing community approval, developing the traffic calming plan and getting the plan endorsed by the Board of Supervisors (BOS) or the Town Council. VDOT’s involvement comes later in the process, at the evaluation/approval and implementation phase. The complete process is described on the following pages.

## II. TRAFFIC CALMING –ROLES & PROCESS

### **Roles of Locality & VDOT**

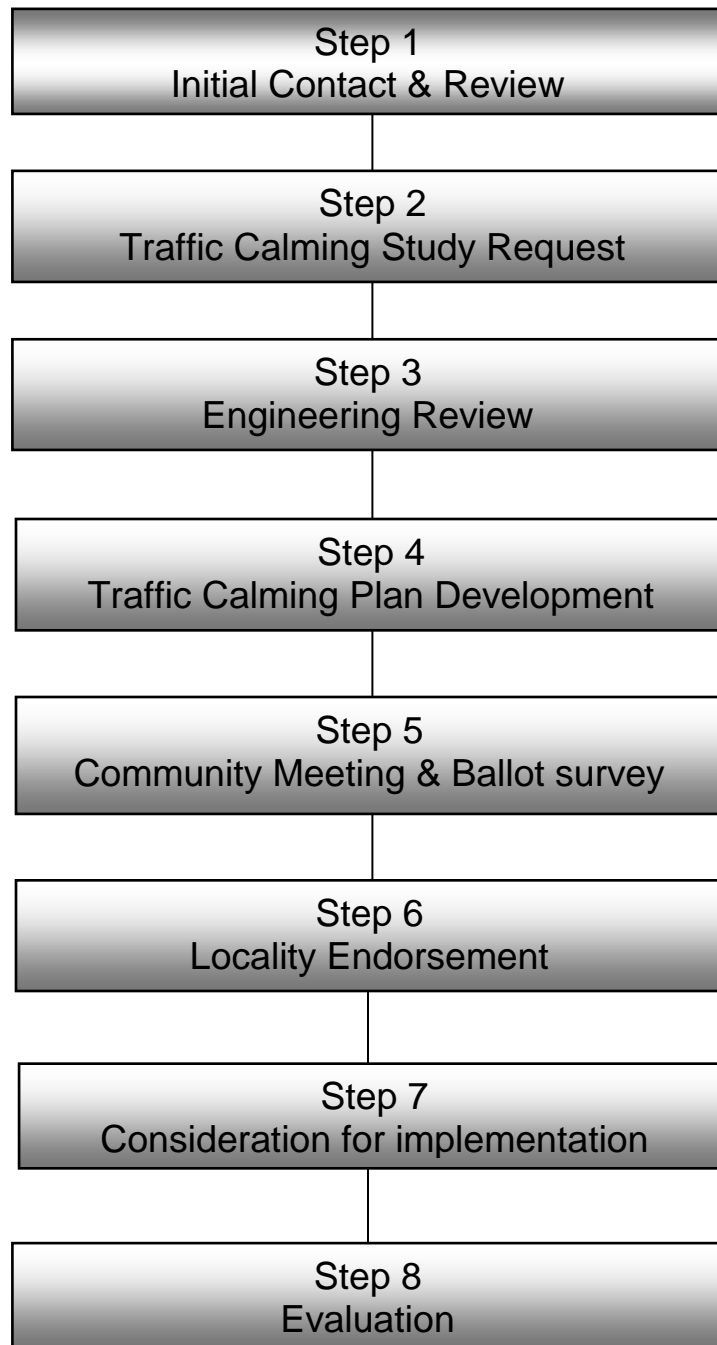
Locality: Works with local community members, acting through the Board of Supervisors or the Town Council (where traffic calming is taking place within a town), to initiate and implement the traffic calming process (Steps 1 – 6) which includes developing a traffic calming plan, scheduling and facilitating meetings, garnering community support for the proposed plan, developing and documenting the proposed plan etc.

VDOT: -In Fairfax, Prince William, and Loudoun Counties, VDOT is represented by the Northern Virginia District Traffic Engineer (DTE) or their representative for the entirety of the traffic calming process. For all other areas of the state where traffic calming is being proposed; VDOT is represented by the local Resident Engineer/Administrator (RA) or their representative who serves as the primary liaison to the community and coordinates with the local DTE or their representative to jointly review, approve, implement and evaluate the traffic calming plan (Steps 4, 7–8).

### **The Traffic Calming Process**

The process that the Locality must follow for traffic calming on their streets is detailed below. Figure 1 shows the steps of the process with the details for each step laid out on the subsequent pages.

**FIGURE 1 - THE TRAFFIC CALMING PROCESS**



### **Step 1: Initial Contact & Review**

The Board of Supervisors (BOS) or the Town Council is initially contacted by local community members for a traffic calming project in their community. Before proceeding it must be confirmed that the street(s) meet the basic eligibility requirements for participation in 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 where the residences face the street (rather than reverse-frontage) and are connected to the street via driveways. Neighborhood, subdivision streets typically have a functional classification of "local." In some cases, a street with a classification of "collector" or "arterial" may also have the characteristics of a neighborhood street and thus be appropriate for consideration of traffic calming.
3. Street must have a speed limit of 25 mph or less. Unposted, residential streets generally have a statutory speed limit of 25 mph. VDOT can confirm upon request the governing speed limit on the subject street(s) as established by the appropriate statutory provisions and VDOT's policy and procedures.

### **Step 2: Traffic Calming Study Request**

For street(s) meeting the basic eligibility requirements above for traffic calming a request for an engineering review and traffic calming study may then be made by the Home Owners Association (HOA) or Civic Association (CA) of the community to the District Supervisor or a Town council member. If there is no HOA or CA, a letter containing signatures from a minimum of 10 residents along the street(s) being requested for a review is acceptable. The District Supervisor or Town council member takes the request to the full Board of Supervisors or the Town Council for their review and agreement.

The request needs to include the location of the street(s) being requested for review and contact information of community members, typically 4 to 5 residents, who will serve as community task force members. One resident needs to be identified as a lead contact for the task force.

Responsibilities of task force members include:

- Informing the community through informational meetings attended by the locality staff of relevant actions related to the traffic calming proposal such as the development of the traffic calming plan, details of the VDOT traffic calming process etc.
- Building community support for the conceptual traffic calming plan.
- Securing the agreement of affected property owners.
- Reviewing and approving the conceptual traffic calming plan.

- Distributing the ballots to the property owners (via mail, electronic means etc.) in the defined ballot survey area. The survey area does not include the impacted area.

Definitions:

- Task Force Members are a group of local residents within the ballot survey or impacted area that will carry out the development of the traffic calming plan.
- Ballot survey area includes residences located on the street(s) identified for traffic calming measures and residences on other streets whose sole or primary access is onto the street(s) identified for traffic calming measures and who would be considerably inconvenienced if they chose an alternate route.
- Impacted area is the area identified by the Locality which includes those residences that may use the street(s) where traffic calming is being considered, but have alternate access routes.
- Affected property owners are those residences adjacent to any physical devices indicated on the plan whose written signatures must be obtained.

Upon agreement by the Board of Supervisors or the Town Council to pursue traffic calming on the requested streets, they proceed to Step 3.

**Step 3: Speed Study, Engineering study/review and Traffic Count**

The locality conducts an engineering review, traffic count and speed study of the road to determine if the street(s) qualify for the development of a conceptual traffic calming plan.

- i. The engineering field review determines if the geometry of the street is suitable for traffic calming e.g. horizontal curves, steep grades and related sight distance issues, drainage or location of road access points.
- ii. In order to be eligible for further consideration of traffic calming the street(s) 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.
- iii. The level of traffic determines the type & extent of traffic calming to be considered:
  - Streets with a traffic volume between 600 and 4,000 vehicles per day may be considered for the full range of traffic calming measures included in the Guide.
  - Streets with less than 600 vehicles per day (vpd) may be considered for the pavement marking and administrative options.
  - Where traffic volumes on the study street exceed 4,000 vehicles per day alternative actions should be considered as this level of traffic indicates issues pertaining more to capacity of the overall street network.

The locality provides the results of the study to the District Supervisor and any affected County Fire and Rescue Department or public schools, and VDOT.



#### **Step 4: Traffic Calming Plan Development**

The Locality, in coordination with VDOT then develops a conceptual traffic calming plan choosing among the various options and considering the features and requirements of the various devices presented in the Guide.

The Locality then works with the task force members and District Supervisor's or Town Council staff to:

- Identify the impacted and ballot survey areas
- Review the conceptual plan and available options
- Solicit comments
- Obtain signatures of agreement from each of the affected property owners (templates will be provided by the Locality to the task force for the signatures)
- Secure concurrence of the plan from the task force members.

#### **Step 5: Community Meeting & Ballot survey**

The proposed plan shall then be presented to the community at a formal public meeting held by the locality and a ballot survey drawn solely from the ballot survey area, shall be conducted in order to measure & determine community support for the proposed traffic calming plan.

The ballot survey shall comprise the following:

- A single ballot per residence or business address.
- A "No" ballot indicates disapproval of the entire plan. A "Yes" ballot indicates concurrence with the entire plan.
- A minimum of 50% of residences or businesses in the ballot survey area should cast and return a ballot for the survey to be considered valid.
- A minimum of 60% of the total number of ballots cast should support the traffic calming plan.
- Ballots that do not clearly indicate "YES" or "NO" e.g., ballots indicating a partial approval of specific elements in the plan, blank ballots, or ballots marked with more than one vote will not be counted as either "YES" or "NO" but are to be considered as a "non-response" and only counted as part of the 50% minimum ballot return requirement for the ballot survey area.

#### **Community Voting Rules**

The following rules will govern the voting and approval of any traffic calming plan:

- Only residences in the ballot survey area are entitled to vote on the plan.
- Voting shall be conducted by ballot, with only one vote per residence allowed.
- Wording on the ballot must be approved by the locality. A sample ballot template will be provided by the locality.

- Accompanying the ballot shall be voting procedures, a copy of the tax map based plan, and a communication (e-mail, letter, etc.) providing information about the types and locations of all traffic-calming devices.
- Ballots must be received (or postmarked) by a date, as pre-determined by the task force, to the appropriate District Supervisor's office.
- A person who is a renter of a particular residence may vote in lieu of the owner of a particular residence, if such owner currently does not reside at the address, and is approved by the HOA/CA or District Supervisor's office.
- Properties that are vacant, bank-owned properties and properties in foreclosure may be considered as vacant and are not included in the balloting process.
- The proposed traffic calming plan shall be approved as a whole integrated plan, e.g., a "YES" vote indicates approval for all measures in the proposed traffic calming plan; a "NO" vote indicates disapproval for a least one or more of the proposed measures in the traffic calming plan.
- A minimum of 50% of residences in the ballot area shall cast and return a ballot for the vote to be considered valid (or some higher minimum if required by the local supervisor).
- Out of the total ballots cast, a 60% minimum approval rate is required for the traffic calming plan to be implemented.
- Ballots received after the official postmark or 'received by' dates are to be unopened and not counted.
- Ballots that do not clearly indicate approval or disapproval for the whole integrated traffic-calming plan, e.g., ballots modified and indicating a partial approval of specific elements in the plan are to be considered as a "non-response".
- Blank ballots or ballots marked with more than one vote are to be considered as a "non-response".
- "Non-response" ballots are counted as part of the total eligible residences in the ballot area from which the minimum return and approval rate is required to be determined.

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

If the proposed traffic calming plan is approved by the community in accordance with the required ballot survey process, the Locality endorses the plan by resolution of the BOS or Town Council. The resolution should state that a formal public meeting was held wherein the proposed Traffic Calming Plan was presented and subsequently approved by 60% of residences or businesses in accordance with the required ballot survey process. The Locality then conveys its endorsement via the resolution with related documentation, to VDOT and request installation of the devices. The resolution should convey the proposed traffic calming plan, the type of funding to be used, the engineering study/review, the streets and households identified as part of the ballot survey area and the results of the ballot survey.

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

Upon receiving the submittal of the community-approved plan and endorsement of the BOS, VDOT will consider the construction of the final traffic calming plan (through VDOT or contract forces) depending on their local funding priorities and the availability of resources, materials and equipment needed.

### Prioritizing streets for implementation of traffic calming

Where there are multiple streets proposed for traffic calming and competing for limited funds, a prioritization process can be used to select the priority of streets for implementation. The ITE Handbook suggests a prioritization scheme utilizing various measures representing the relative need for traffic calming such as vehicle speeds (e.g. operating speed minus speed limit), the extent of pedestrian activity (e.g. the # of pedestrians crossing the roadway), the degree of development (e.g. number of driveways or traffic volumes) etc. for each street. Any measures or combination of the measures that represent the concerns of the communities and are agreeable to all concerned could be used as appropriate.

### Funding

The type and extent of funds that may be utilized available on should be discussed with the local residency. Note that streets subject to VDOT's Secondary Street Acceptance Requirements (SSAR) - generally, those subdivision streets for which 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. Construction and maintenance costs for the remaining 7 feet must be funded entirely by the locality.

### Step 8: Evaluation -VDOT

VDOT will confirm that the traffic calming plan was appropriately implemented and the traffic calming devices properly installed including all necessary traffic control devices, and ensure that there is no safety, operational, or maintenance issue.

Subsequent to installation (1-3 months is suggested) a follow-up review may be conducted to evaluate the effectiveness of the traffic calming measures such as a comparison of the operating speeds before / after installation. VDOT may wish to disseminate any findings and recommendations from any such review through the Board of Supervisors in order to obtain feedback from those involved in the plan development.

## **Modification of Traffic Calming Devices**

Where an unforeseen safety, maintenance, or operational issue develops, VDOT reserves the right to modify (adjust, relocate, remove etc.) the relevant traffic calming measures as necessary to resolve the issue.

Where the Locality wishes to add, remove or; substantially alter traffic calming devices approved and implemented in their traffic calming plan they must do so using the identical process (and funding sources) utilized for the original plan (e.g. develop revised plan, obtain approval signatures of affected residents, get community approval through a ballot survey, receive the BOS or Town Council endorsement and get VDOT's review and approval).

### **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 public information campaigns), posting certain types of signs that promote speed reductions, and utilizing pavement markings to reduce the number of lanes and/or the pavement travel widths. The additional pavement width available through the various reductions is reallocated to add parking, 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 that are 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 a 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.

Similarly, the "Virginia 2017-2021 Strategic Safety Highway Safety Plan" available at [http://www.virginiadot.org/info/resources/SHSP/VA\\_2017\\_SHSP\\_Final\\_complete.pdf](http://www.virginiadot.org/info/resources/SHSP/VA_2017_SHSP_Final_complete.pdf) provides extensive information on aspects of safety related to speeding and pedestrians in Virginia and strategic efforts to address these issues. VDOT's "Bicycling and Walking in Virginia" web page at <http://www.virginiadot.org/programs/bikeped/default.asp> covers the safety and legal aspects of bicyclists and pedestrians in Virginia.

### **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

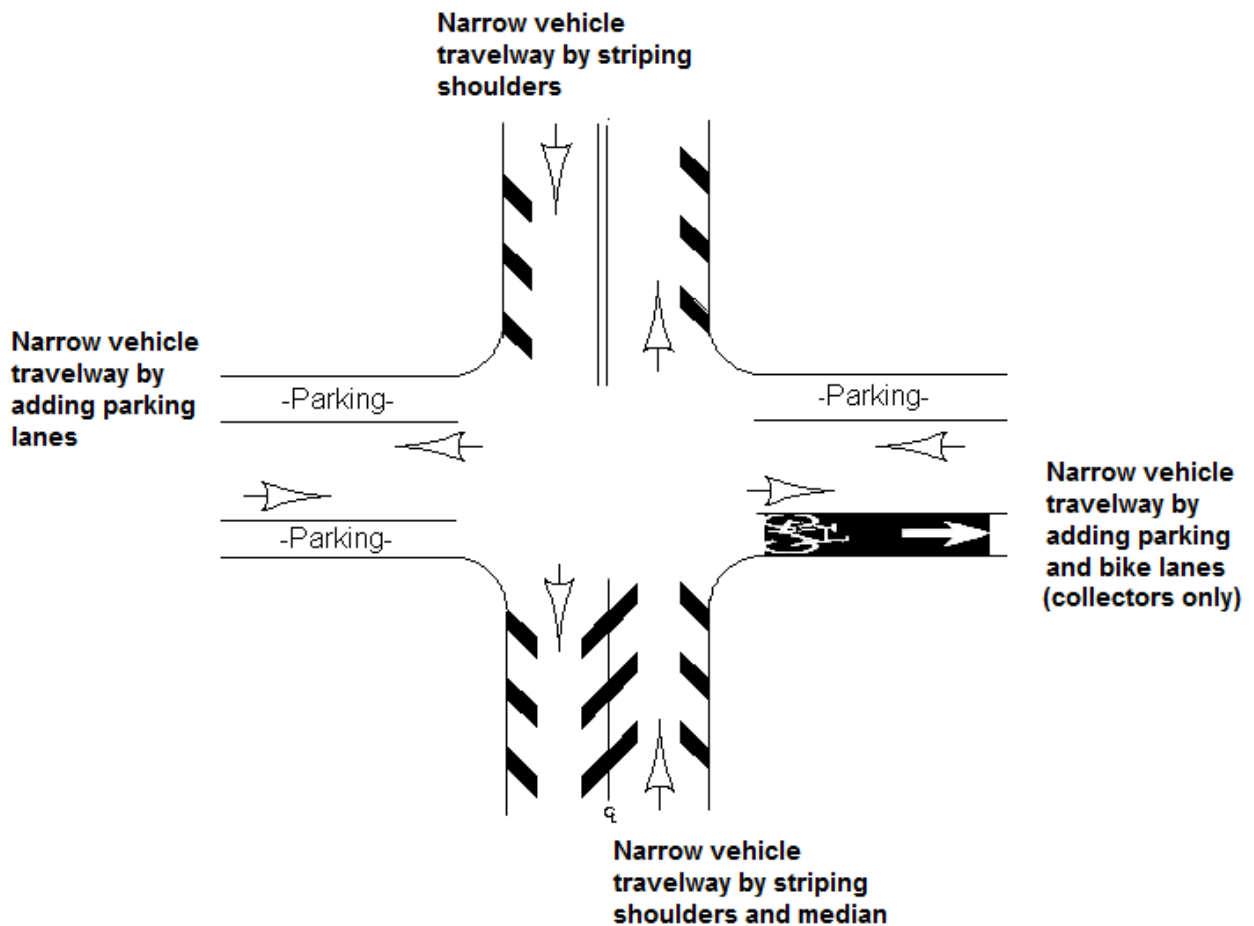
FHWA (Federal Highway Administration “Engineering Countermeasures to Reduce Speeds” –see references) indicates an average reduction in operating speeds of about 2 mph.

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**



**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-stripping pavement to add a bike lane**



### Description

Narrowing the travel lanes tends to make drivers drive slower. The additional pavement made available by narrowing can then be 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 should be considered a normal part of the vehicle mix on the street and do not require marked or designated bike lane. Designated bike lanes may be established on collector roads as appropriate and where they connect to a network of bike lanes on adjacent streets or 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 should only be installed 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 would be installed 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 provided approaching the sign and at least 100 feet between any other signs.

### Advantages

- May potentially be used as a portable assembly that allows for use at alternative 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

Installation may be impacted by issues with connecting to 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 an additional \$200 fine to be imposed in addition to other fines, for speeding on residential streets. These signs may be installed on any street identified and approved for traffic calming in the Guide. Alternatively, where they are the only measure being sought these signs may be implemented following the requirements of VDOT's policy (see [http://www.virginiadot.org/programs/resources/FINAL\\_POLICY\\_ADDL\\_FINE\\_June\\_17\\_1999.pdf](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 (4 total signs indicating the begin and ending of the additional fines).

## **2. Horizontal, Vertical and Narrowing Devices**

These traffic calming devices are constructed and installed on the pavement surface and physically narrow or create vertical or horizontal shifts in, the travelway that constrain vehicles to travel through or over the devices.

These devices can be particularly effective in slowing vehicles because they physically constrain vehicles to pass over, through and around physical obstructions on the roadway.

Although neighborhood streets do not generally serve as primary emergency or transit routes, where the horizontal, vertical and narrowing devices are used on such streets emergency response (as well as transit) times can be significantly impacted; 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. Therefore, on streets that serve as major emergency or transit routes it is recommended that the non-intrusive measures (pavement markings and signs) be used. Also speed lumps are specifically designed for emergency vehicle use.

Note: only a street making up a portion of a routing that directly connects to, or is used to provide direct access to, an emergency facility such as a hospital or a fire station would be considered a major emergency or transit route.

The horizontal, vertical and narrowing devices also can impede 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 (particularly speed humps and speed lumps -for passenger vehicles), is increased noise to nearby residents due to vehicles passing over the devices.

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.

## Horizontal, Vertical and Narrowing Devices –Speed Hump

**FIGURE 5.1 –Speed Hump**



### 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 more immediate response by motorists to reduce 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**



**FIGURE 6.2 –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**



**Figure 7.2 – 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**



### Description

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” typically covers the area of intersection and is therefore generally dictated by the overall size 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 2 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

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

These devices are generally located at mid-block.

### Advantages

May be used similar to a gateway, located at the entrance to a community.

### Disadvantages

- Narrows travel-way for bicyclists.
- 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 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**



**Figure 11.2 - Crosswalk Refuge –Offset “Z”-option**



### 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

Where there is 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 may be struck by vehicles especially snow plows etc.

## Effectiveness

Although data specific to a crosswalk refuge is not available 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)**



**Figure 12.3 – Chicane (Two-way travel)**



Description

Chicanes are built adjacent to the curb on alternating sides of the street in sets of three in order to introduce a 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 placed at mid-block where a median or other non-traversable barrier separates the travel directions in the vicinity of the chicane. When used where vehicles travel in both directions with no physical separation between the travel directions vehicles tend to cross the centerline to make their travel path as smooth as possible (since the motorist can see no there is no approaching traffic in the opposing lane). This cross-centerline behavior is a potential safety concern and contributes to a general ineffectiveness of the device in terms of speed reduction.

In the above Figure 12.1, the two travel directions are entirely separated by a raised median. As shown in Figure 12.2, the travel directions are separated in the vicinity of the chicane by utilizing a raised median, yet another traffic calming device. To address this issue in order to construct these devices on two-lane roads with travel in two directions,

as an alternative, a barrier can be installed to separate the travel directions in the vicinity of the chicane.

The spacing between the alternating constructions as well as the available travelway width for vehicles traveling through them, influences the extent of 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**



**Figure 13.2 – 1-Lane, 1-Way Choker**





### Description

A mid-block, curb extension that reduces the width of the travel lane that may also incorporate widening the planting strip where landscaping may be added or enhanced. They are often used to facilitate parking downstream of the device.

### Placement

Chokers are generally placed 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 also 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 pedestrian's 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 for certain combinations produce 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/](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 suitable for use as traffic calming devices and therefore are excluded from consideration as a traffic calming option in the Guide.**

Numerous studies show that unwarranted stop signs actually increase speeds on residential streets as motorists proceed through without stopping in an attempt to make up time lost at stops they perceive as unnecessary. Thus safety for pedestrians, especially for small children is decreased due to their expectation that vehicles will stop as required when in reality vehicles may proceed through the stop signs perceived as unnecessary without stopping.

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 intended for use 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 were reduced is not clear. See report at [http://www.virginiadot.org/vtrc/main/online\\_reports/pdf/11-r9.pdf](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 for 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 among them being speed reduction they are not generally considered traffic calming devices. The cost and extent of effort to implement a roundabout does not generally fit within the intended scope and budget for traffic calming on neighborhood streets. However, where appropriate a roundabout can be pursued via other processes as provided by VDOT.

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## 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 considered in regard to 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 includes a video which shows various calming measures in operation. <http://www.virginiadot.org/programs/faq-traffic-calming.asp>.
2. **Implement measures on an area wide basis** - Ideally traffic calming should take an area-wide approach to ensure that problems are not simply relocated to adjacent local streets and parallel roadways. Identify groups of measures to be implemented in stages if funding for the entire plan cannot be secured initially.
3. **Consider the features of the street** –The appropriateness of a particular device also depends on the traffic, the available pavement width, the available intersection space (for roundabouts) etc. FIGURE 1 – Subdivision street characteristics pertaining to the selection of traffic calming devices should be considered when choosing among the various options.
4. **Consider existing traffic control devices** (signs and pavement markings) that might affect the need for as well as the type and location of the traffic calming devices on a street. A lack of appropriate traffic control devices; particularly those that reinforce appropriate 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, one for each travel direction to notify motorists entering the street of the speed limit.
5. **Consider all services and usage of the roadway**– Emergency services (police, fire, and hospital), transit (buses), schools, sanitation services, maintenance (snow plow vehicles), business/industrial/trucking, bicyclists should be considered and consulted when developing the plan. 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.
  - i. For streets that serve as major emergency or transit routes it is recommended that the non-intrusive measures be used as much as possible. Alternatively, for such streets speed lumps are specifically



designed to accommodate emergency vehicles and minimize impacts on speed reduction. Although most subdivision streets would not normally be used as a major emergency or transit routes local fire, police, hospitals and emergency medical services and transit personnel should be consulted to confirm the routes they use. Only a street making up a portion of a transit route or a routing that directly connects to, or is used to directly connect to and access, an emergency facility such as a hospital or a fire station would be considered a major transit or emergency route.

- 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. Local fire departments should be consulted to determine the dimensions of the vehicles they use so that they can be accommodated in the proposed plan and to avoid implementing measures that impede these vehicles. Speed lumps can be designed to accommodate the specific vehicles.
- 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) are encouraged for these cases.
- iv. For collector streets identified in a local and/or regional bicycle plan as being part of a designated bicycle network; the use of non-intrusive measures (particularly pavement markings that create a bike lane) or the horizontal, vertical and narrowing devices that are more accommodating for bicyclists (e.g. speed lumps vs. speed humps, speed tables etc.) are recommended.

**FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices**

Type of Measure	Action	Street Characteristics <sup>1</sup>	Minimum striped travelway width <sup>2</sup>	Other Considerations
<b>NON-INTRUSIVE MEASURES - Pavement Markings</b>				
Two-lane, two-way street	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).	ADT < 401 vpd	18 feet	* Physical pavement width may be greater than striped width.
		400 < ADT < 1501 vpd	20 feet	
1500 < ADT < 2001 vpd		22 feet	* A parking lane requires additional pavement width (7 feet in residential or mixed use areas and 8 feet in commercial areas).	
ADT > 2000 vpd OR: mixed-use area with truck traffic > 5%		24 feet (22 feet where no crash pattern indicates wider pavement)		
One-lane, one-way street		Use 1/2 of above minimum widths vs. traffic volumes		
<b>NON-INTRUSIVE MEASURES - Signs</b>				
Speed Display Sign <sup>4</sup>	Install signs where appropriate for speed limit signs	Streets with single lane per travel direction	NA	Confirm location of speed limit signs with VDOT
Additional \$ 200 Fine Sign <sup>4</sup>			NA	
<b>VERTICAL MEASURES</b>				
Speed Hump	Install physical measures on and across the travelway		NA	Consider locations of manholes, drain inlets, adjacent to driveways and other entrances
Speed Lump				
Speed Table				
Raised Crosswalk <sup>5</sup>	Install physical measures on and across the travelway at an intersection or at mid-block.	Street has an existing marked crosswalk or one is proposed and approved by VDOT		
<b>HORIZONTAL MEASURES</b>				
Chicane	Install physical measures in groups of three along shoulder on alternating sides of street at mid-block.	Requires physical separation between travel directions in the vicinity of chicane	Use above minimum widths vs. traffic volumes OR: may use minimum 10 feet travelway width for each travel direction at and through device (only) for ADT < 1501 vpd and truck traffic (in mixed-use area) <= 5%. Otherwise.	Consider locations of manholes, drain inlets, adjacent to driveways and other entrances
<b>NARROWING MEASURES</b>				
Choker	Install physical measures along shoulder on one or both sides of street to narrow travelway at mid-block.	Street has sufficient width	Use above minimum widths vs. traffic volumes OR; may use 15 feet minimum width through traffic calming device at mid-block locations for “give way to opposing vehicle” operations where ADT < 2001 and truck traffic (in mixed-use area) <= 5%. No pavement striping should be used for this case.	
Curb Extension (neckdown)	Install physical measures along one or both sides of street to improve pedestrian crossings at an intersection or at mid-block.	Where there is on-street parking and an existing pedestrian crosswalk (or at proposed location approved by VDOT)		
Raised Median Island	Install physical measures in median area of travelway at an intersection or at mid-block.	Street has sufficient width	May use minimum 10 feet travelway width for each travel direction through device for ADT < 1501 vpd and truck traffic (in mixed-use area) <= 5%. Otherwise use above minimum widths vs. traffic volumes.	Engineering study and VDOT approval required
Crosswalk Refuge <sup>5</sup>		Street has an existing marked crosswalk or one is proposed and approved by VDOT. Street must have sufficient width.		

(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 5-5 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.”

(6) See VDOT Road Design Manual, Appendix A, Section A-3, page A-53 for design criteria for Roundabouts.

## 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 the various of the 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 is recommended in order to minimize placing additional, redundant devices at an increased cost.

Where a closer spacing of traffic calming devices is desired recommended the distance between devices should not be less than 200 feet in order to provide an adequate distance for vehicles 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 (see discussion on warning signs etc. pertaining to devices below).

#### Location

Speed Humps, speed lumps, speed tables, chicanes, chokers, and raised median islands are generally located at mid-block while raised intersections, bulb-outs and roundabouts are located at the intersections of streets.

Raised Intersections are specifically intended for installation 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 be placed at mid-block as well, similar to a chicane 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, 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" 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 posted speed limit. It is recommended that these signs be installed at the beginning of the street section identified for traffic calming, one in each travel direction, in order to reinforce the posted speed limit for vehicles entering the section of street designated for traffic calming. Additional installations may then be placed where it is appropriate to further indicate the posted 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.virginia-dot.org/business/resources/traffic\\_engineering/memos/TE-374\\_1\\_Pole\\_Mounted\\_Speed\\_Display\\_Signs.pdf](http://www.virginia-dot.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 installations would generally be dictated by where it is 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.

## **Warning signs etc. pertaining to traffic calming devices**

Ensure that all related regulatory and warning signs and pavement markings pertaining to the specific devices are installed. Regulatory and warning signs as well as pavement markings that were generally identified as being recommended or required for the various devices is indicated or discussed 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, speed display signs and speed display signs) included in the Guide no specific additional regulatory or warning signage is identified however, there may be signs or markings 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.

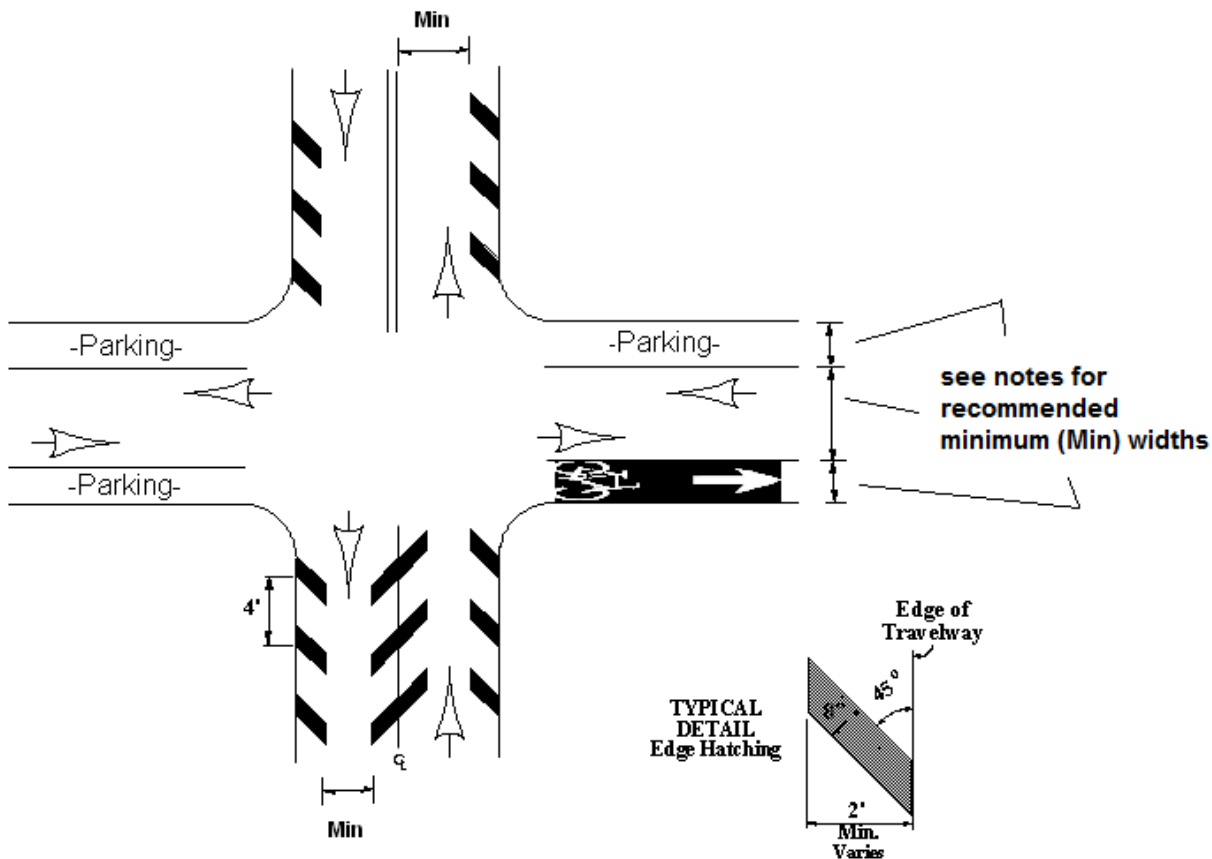
### **III. Conceptual Drawings of Traffic Calming Measures**

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 per VDOT's Roadway Design Manual, Road and Bridge Standards and Road and Bridge Specifications that apply and; that signs and pavement markings are in accordance 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.



**FIGURE A-2**

**POLE MOUNTED SPEED DISPLAY (PMSD) SIGN**



**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.virginia.gov/business/resources/traffic\\_engineering/memos/TE-374\\_1\\_Pole\\_Mounted\\_Speed\\_Display\\_Signs.pdf](http://www.virginia.gov/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**



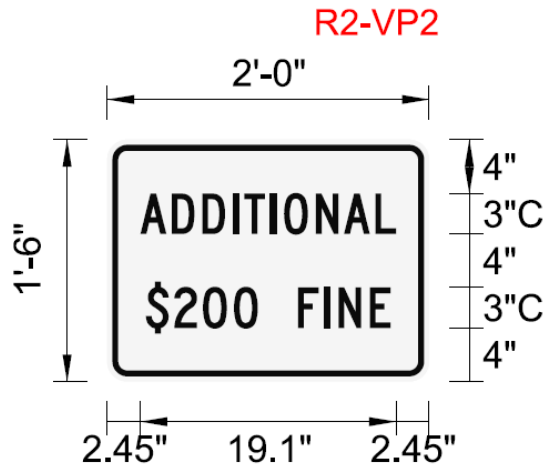
**NOTES:**

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.

**Figure A-3.1**

**\$200 ADDITIONAL FINE SIGN DETAIL**

SIGN DETAIL



SIGN NUMBER	name
WIDTH x HGHT.	2'-0" x 1'-6"
BORDER WIDTH	0.44"
BORDER INSET	0.38"
PANEL RADIUS	1.13" plus 0.38"
MOUNTING	Overhead
BACKGROUND	TYPE: Reflective
	COLOR: Black/White
LEGEND/BORDER	TYPE: Reflective
	COLOR: Black/Black

SYMBOL	ROT	X	Y	WID	HT

Dimensions are in Inches, tenths

Letter locations are panel edge to lower left corner

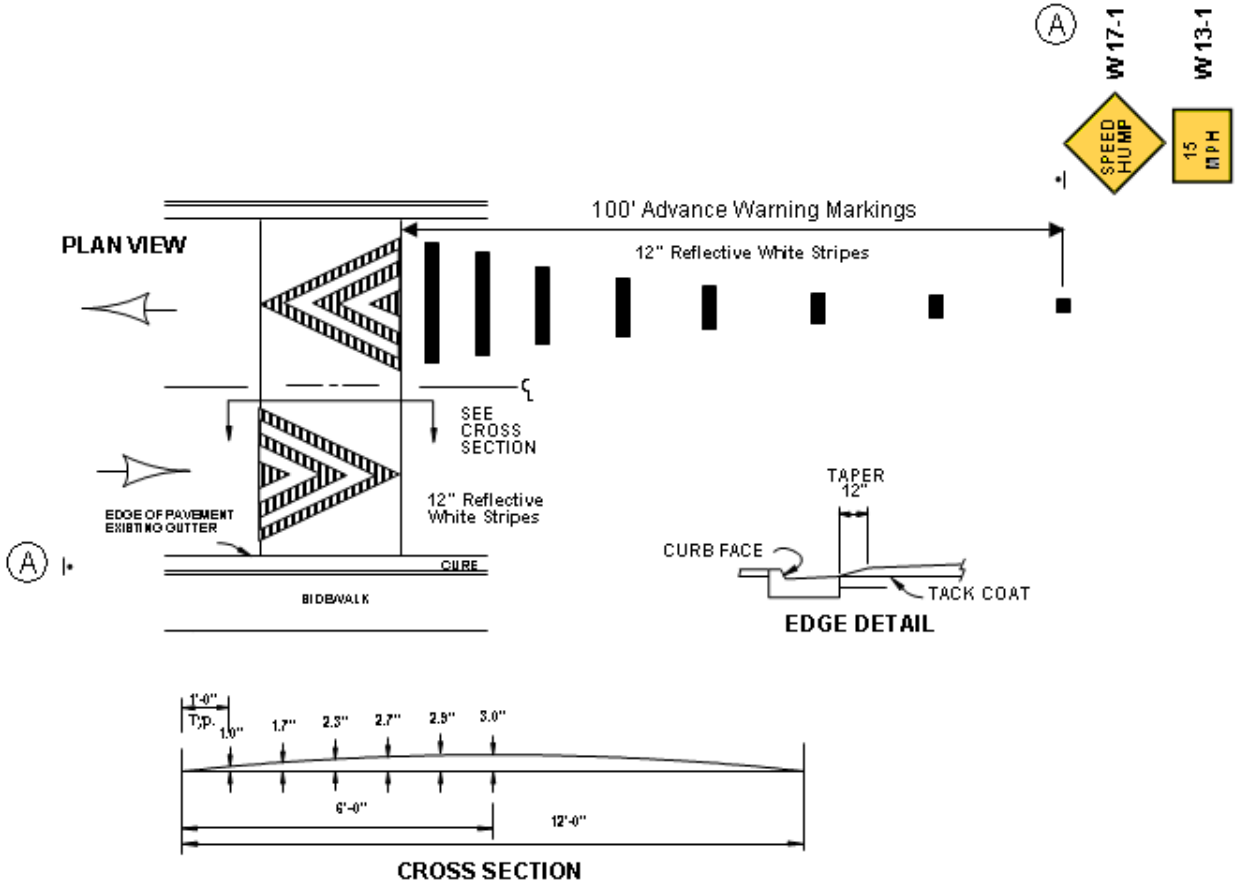
LETTER POSITIONS (X)													LENGTH	SERIES/SIZE						
A	D	D	I	T	I	O	N	A	L									C 2000		
2.5	4.8	7.1	9.4	10.2	12.2	13.2	15.6	17.7	20									19.1	3	
\$	2	0	0		F	I	N	E											C 2000	
2.9	5	7.1	9.5	11.2	14.2	16.2	17.3	19.6											18.2	3

**NOTES:**

- 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.

**Figure A-4**

**SPEED HUMP**

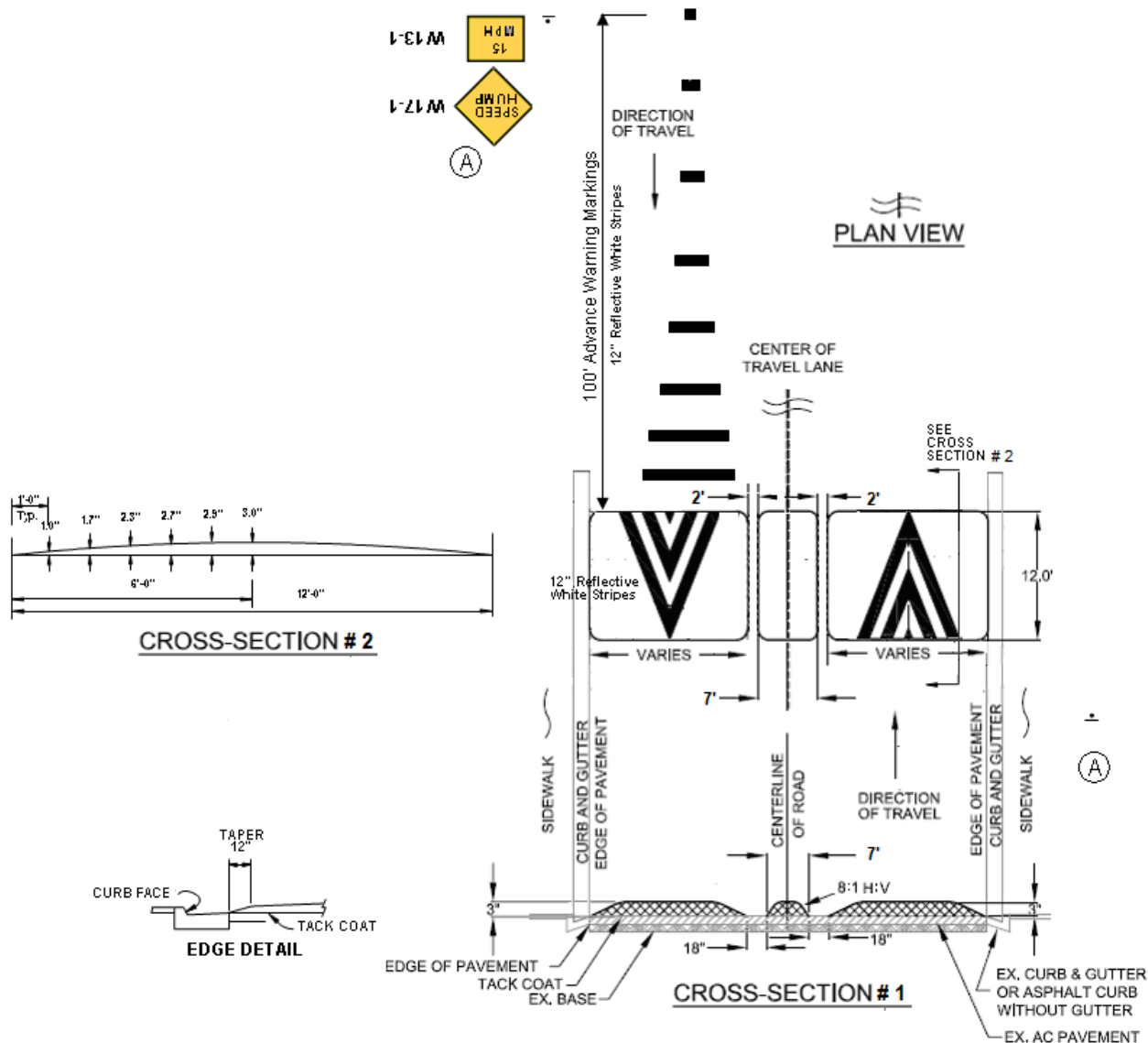


**NOTES:**

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."

# Figure A-5

## SPEED LUMP

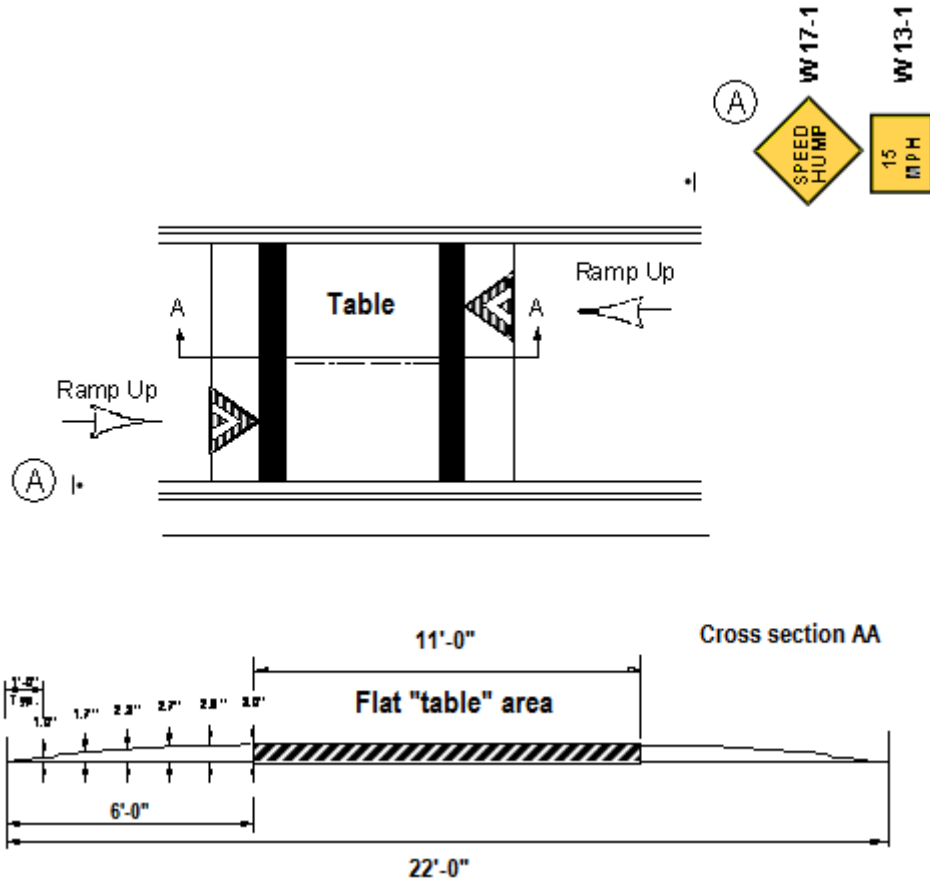


### NOTES:

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. Striping 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**

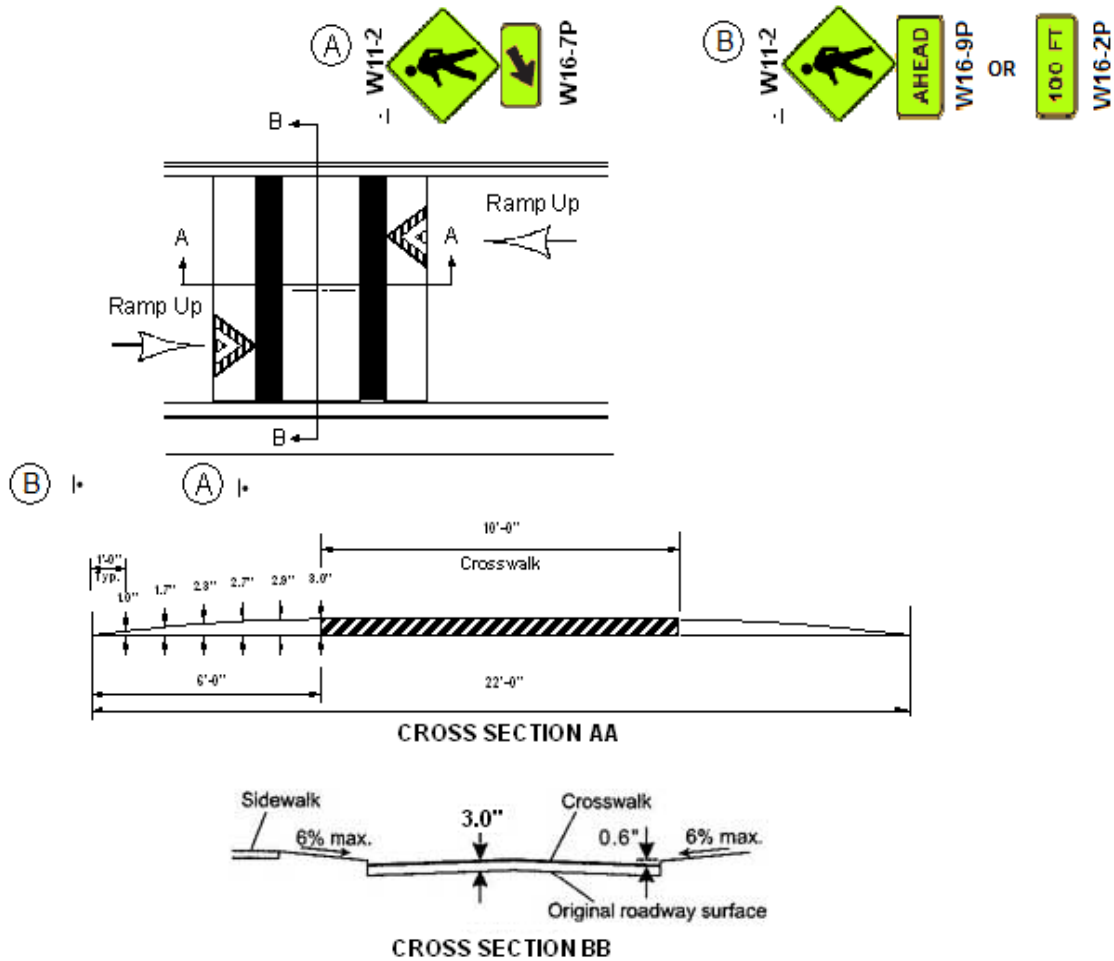


**NOTES:**

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."

**FIGURE A-7**

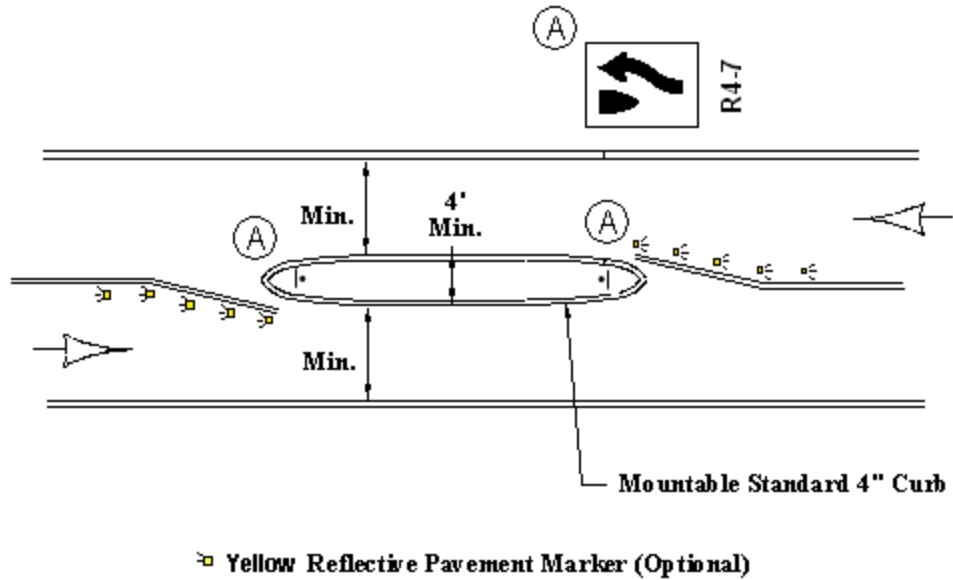
**RAISED CROSSWALK**



**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.

**FIGURE A-8**  
**RASIED MEDIAN ISLAND**



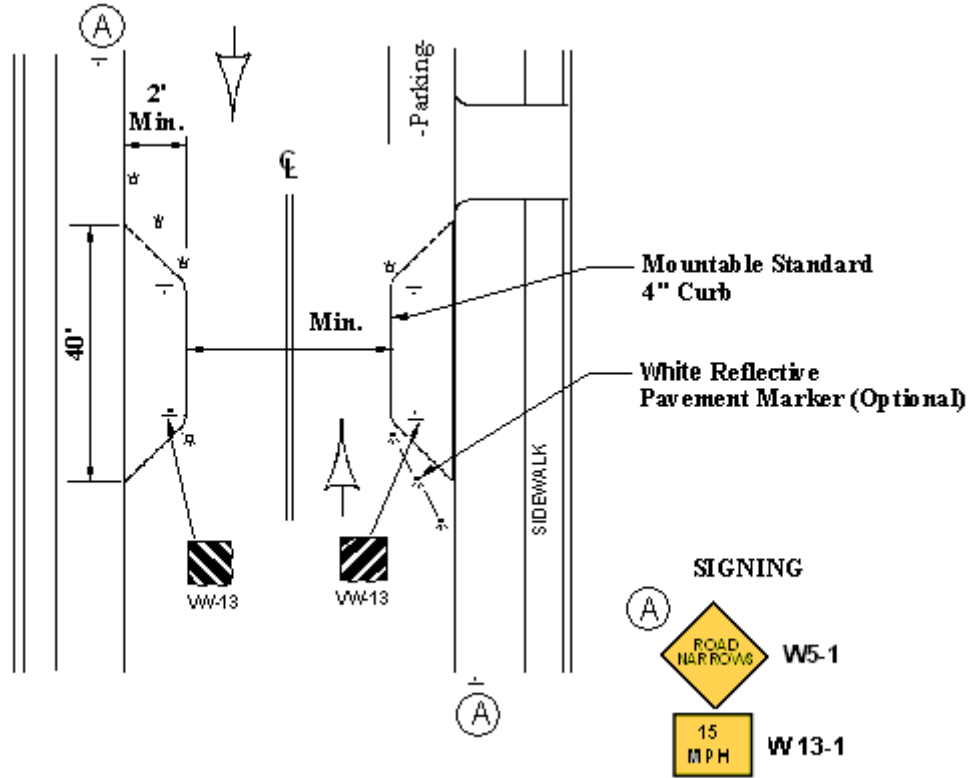
**NOTES:**

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

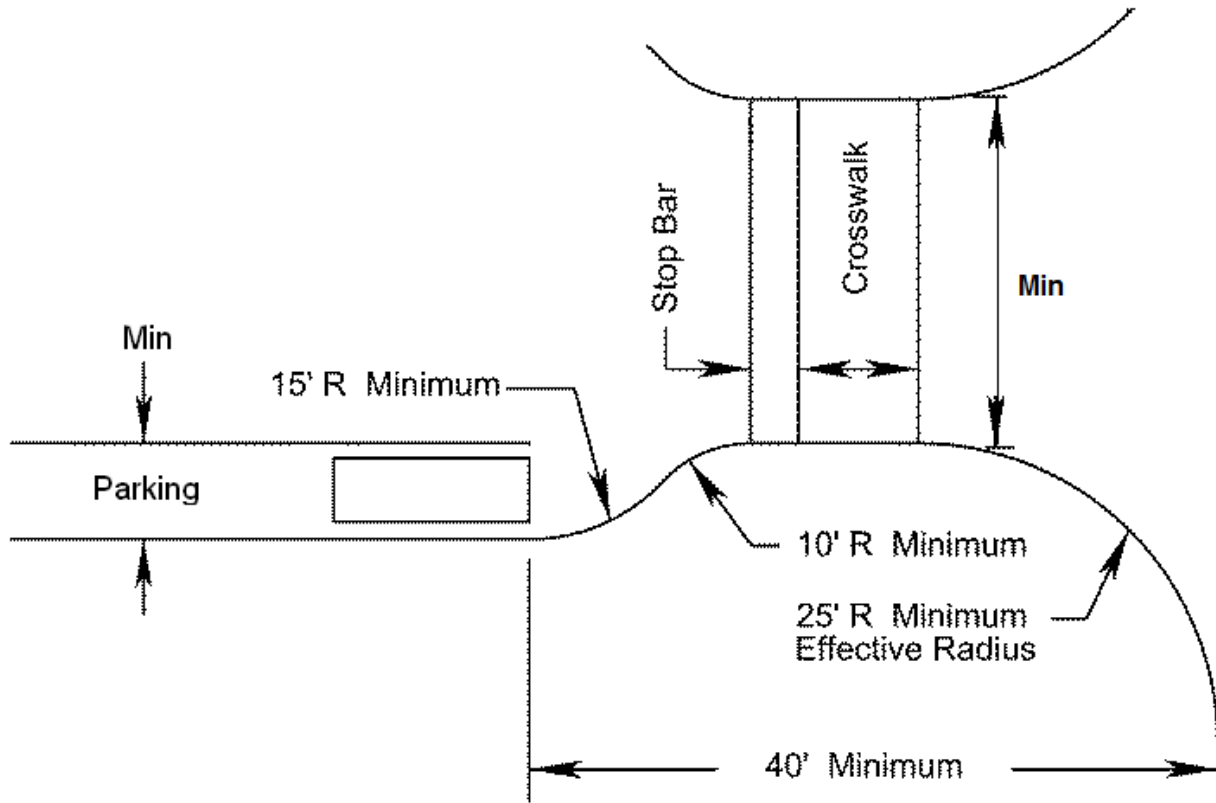


#### NOTES:

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

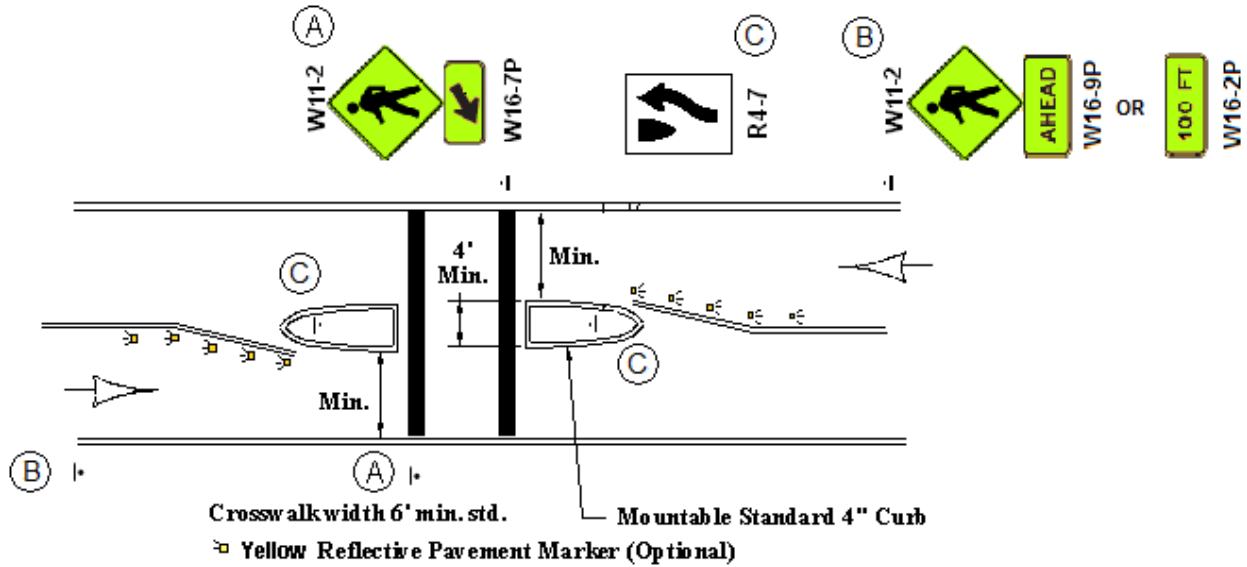
### CURB EXTENSION (NECKDOWN)



#### 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.

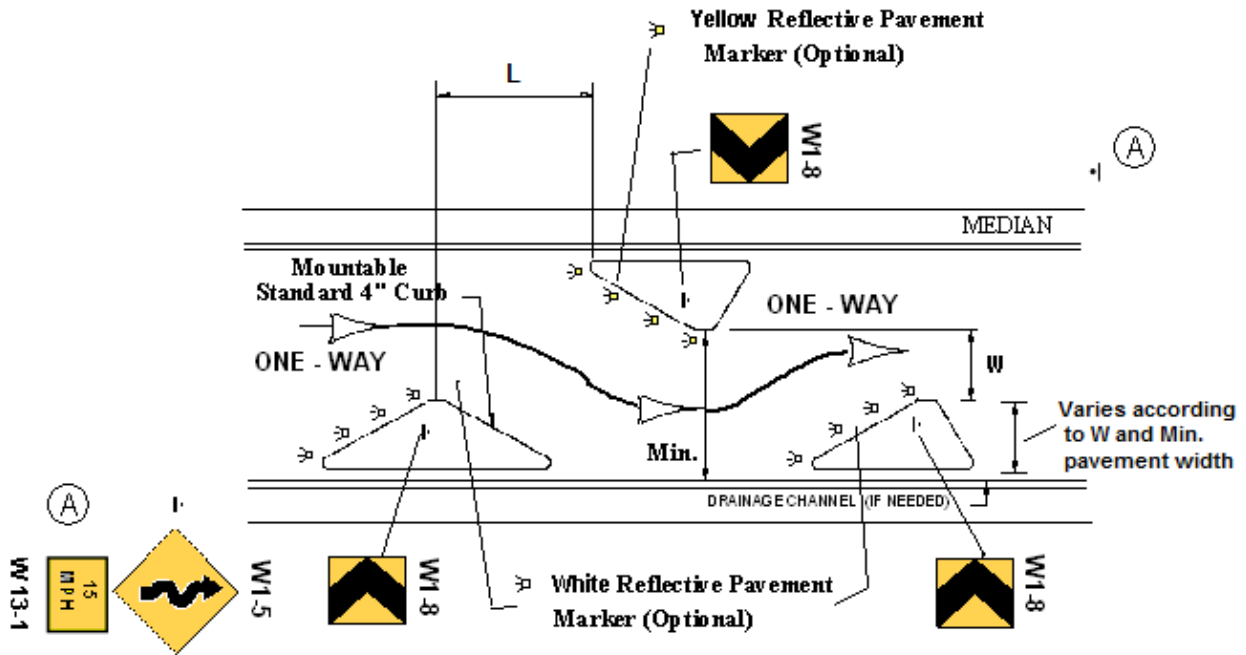
**FIGURE A-11**  
**CROSSWALK REFUGE**



**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.

Maximum stagger length 'L' required to achieve indicated passenger car speed for travelway width of 15 feet		
Free view width 'W' (feet)	Stagger length 'L' (feet)	
	20 mph	25 mph
+3.5	23	30
0	30	40
-3.5	36	50

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.

Minimum stagger length 'L' (feet) for SU-30 Truck free width view 'W' = 0.0 feet			
Travelway width (feet)	10	11	12
Stagger Length 'L' (feet)	40.0	34.0	29.0

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.