Takoma Park City Council Meeting – March 22, 2017
Agenda Item 2

Work Session
Presentation of the Takoma Park Safe Roadways Committee's Traffic Calming Recommendations Report

Recommended Council Action
Hear information presented.

Context with Key Issues

The Safe Roadways Committee has prepared a report making recommendations regarding traffic calming. They will present their report at the Work Session.

One of the recommendations is to evaluate speed limits on various street segments per the Federal Highway Administration's Methods and Practices for Setting Speed Limits, do three-week studies of vehicle, pedestrian and bike use, and then install traffic calming measures if needed. The Committee also recommends that the Council codify a rank-ordered list of traffic calming measures.

Although staff has not discussed the Report in depth, it does have some information to share concerning the Committee's recommendations.

Work Load. Many of the recommendations in the Report would require a greater level of City staff hours, even when consultants are retained to undertake the studies and community processes.

Speed Limits. There are many different ways to set speed limits in the document cited in the report, but the City is restricted by Maryland State law from having speeds lower than 25 mph unless stringent criteria are met. In general, it is better to have standard speed limits throughout the community so that drivers know what to expect. Except for major arterials, the City has advocated for having a 25 mph speed limit citywide. Maryland's default speed limit for neighborhood streets is 30 mph, so the 25 mph speed limit requires the installation of speed limit signs.

Timing of Speed Studies. Although the report urges looking at speeds during peak hours, speeding may more often occur when the roads are less crowded.

Traffic Calming Measures. Although the City has a petition process for requesting speed humps and may do bump outs or other simple measures as part of a small project, most traffic calming measure proposals are developed with traffic engineering consultant assistance while working with neighborhood residents and City staff. The projects are included in the City's annual budget. All traffic calming proposals require a Public Hearing process (including mailed notification of the Public Hearing) and must receive Council approval before installation can be scheduled. Part of the process is to examine impacts on adjacent neighborhood streets if the installation is done, and that impact is considered by the City Council when approval is requested.

When a traffic calming study is undertaken, speed studies are usually done as part of the research. Pedestrian and biking counts are not always done, but the expectation is that pedestrian and bicycle facilities must be included be safe. Many different types of traffic calming measures are considered, based on the particular location, engineering and maintenance best practices, and the preferences of the neighborhood.

Speed Humps. There are two standard models of speed humps that the City will install; one is the County-style similar to that shown on page 5 of the Report, the other is the City's style, which has an additional bump at the center. The petition process was developed to make sure the request was widely discussed by residents of the impacted street and adjacent blocks of the street. The goal was to make sure these decisions weren't made in a vacuum, and placed the onus on those interested in having a speed hump installed to do the initial leg work. If the Council wishes to amend the Code, some options could include amending the petition area to more closely resemble the requirements of the sidewalk process (which involves residents of the side streets), change the petition process to apply to traffic calming measures in general (rather than just speed humps), eliminate the petition process for speed humps, and/or just allow one speed hump design to be used.

Council Priority

A Livable Community for All
Environmentally-Sustainable Community
Fiscally Sustainable Government

Environmental Impact of Action

If changes were made in the City Code, there may be positive or negative environmental impacts based on changes in vehicle speeds, traffic calming materials, encouragement of non-motorized means of transportation, etc.

Fiscal Impact of Action

Increased staff time, consultant resources and costs of traffic calming measures other than speed humps are possible if the Report's recommendations were adopted. However, there could be a reduced fiscal impact if the primary finding of speed studies is that no traffic calming is needed.

Attachments and Links

- Takoma Park Safe Roadways Committee Traffic Calming Recommendations

Takoma Park Safe Roadways Committee
Traffic Calming Recommendations

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Introduction

Perceptions of road safety are of paramount importance to residents in their neighborhoods. But limiting travel through one neighborhood necessarily impacts other Takoma Park residents by shifting traffic to their neighborhoods, reducing routes through the city, and slowing emergency vehicle response to residents' houses.

The city's current approach to traffic calming is rather limited, consisting primarily of building speed bumps. *See* Takoma Park Municipal Code Chapter 13.28 and Takoma Park Administrative Regulation 96-1. Speed bumps, while sometimes effective at controlling speed immediately at

the bump, are not always the most effective way to lower average vehicular speeds and have numerous negative secondary impacts.

While alternative traffic-calming measures are present in the city, they are extremely limited. In order to produce a more balanced traffic-calming approach, and in order to ensure that the right traffic-calming solution is used for each location, the Safe Roadways Committee recommends the city rethink its traffic-calming approach, as reflected in this recommendation.

Specific Recommendations

The Safe Roadways Committee, after careful consideration, recommends the following actions, which are more thoroughly detailed later in the report:

1. Immediately amend Takoma Park Municipal Code Chapter 13.28 to eliminate the presumption that speed bumps/humps are the default traffic-calming measure of choice. The Safe Roadways Committee recommendations on Municipal Code amendments are included at Appendix 1;
2. Immediately repeal Takoma Park Administrative Regulation 96-1, which puts in place a speed bump petition process, and replace with administrative regulations that petition for broader traffic calming and do not have a bias for speed bumps. The Safe Roadways Committee recommendations on administrative-regulation amendments are included at Appendix 2;
3. Direct that city staff utilize the step-by-step process detailed below in the "Determining Appropriate Traffic Calming" section of this recommendation;
4. Ensure that each traffic-calming solution installed has no significant negative impact on emergency vehicle response times and delivery of emergency services;
5. Ensure that traffic-calming solutions chosen minimize negative secondary impacts;
6. Implement traffic-calming solutions that actively promote alternative modes of transportation, as directed by the City Council in Takoma Park Municipal Code, Section 2.16.110 to "encourage Takoma Park residents to use alternatives to driving, including walking, bicycling, and transit[;]"
7. In consultation with the Safe Roadways Committee, direct city Staff to adopt design standards for each traffic calming measure employed within Takoma Park and set a deadline for these design standards; and finally
8. As budgets permit, replace any traffic-calming measures that are inconsistent with the above recommendations.

Determining Appropriate Traffic Calming

In order to ensure the correct traffic-calming approach is used in each circumstance, it's essential that city staff and Council work through the following list for each request for traffic calming.

While these steps may add some time to the process, they will result in far more appropriate and effective solutions for each neighborhood. The Safe Roadways Committee recognizes that speed bumps are now implemented because they are easy and cheap and allow Council to

respond to upset constituents. But cheap-and-easy seldom produces the most effective remedies. It's important for the city to seek effective solutions without creating secondary problems.

Prior to considering the specific traffic-calming measures listed in the Traffic-Calming Measures section, below, it is important to conduct an analysis of speeds and usage. Council and staff should:

1. determine the appropriate street-segment speed by using the methods described in the Federal Highway Administration's Methods and Practices for Setting Speed Limits;
2. conduct a study that captures vehicle, pedestrian, and bike counts during morning and evening rush hours as well as any other times identified as problematic by residents. Pedestrian and bicycle counts should document the number of pedestrians using sidewalks vs. streets and the direction of travel (any studies, counts, or measurements should be taken for a period of time that captures sufficient data to be representative of the motor vehicle, pedestrian, and bicycles that travel the route, typically for at least a three-week survey period). Study should also note if there are surrounding sensitive uses such as a school, recreation center, dense housing, or other sensitive uses;
3. capture the average motor vehicle speed through the street segment over a no-less-than-three-week period; and
4. if the average traffic speed exceeds the speed determined appropriate under #1, above, then install traffic calming using the priority list in the Traffic-Calming Measures section, later in this report.

When designing a traffic-calming solution, the solution should slow average traffic speeds to within 10% of the speed limit appropriate for the street segment in question.

The speed limits on most streets in Takoma Park are 25 MPH, with a few streets set at 30 MPH or higher. When speeding complaints are addressed by the city, however, the resulting traffic-calming measures often aim to reduce average traffic speeds to less than the speed limit. An excellent example of this speed/traffic-calming mismatch is Maple Avenue between Carroll and Philadelphia. Maple Avenue's speed limit is 25 miles per hour, yet the speed bumps are set for only 5 miles per hour. The traffic calming is 80% slower than the speed limit. Either the speed limit is set 80% too high, or the traffic calming is 80% too slow. One or both is inappropriate.

Using the step-by-step process outlined above on Maple Avenue, one would first determine the appropriate speed limit on Maple. If the appropriate speed was lower than 25 mph, then the speed limit should first be lowered to below 25 mph and additional police enforcement resources should be focused on that street segment to see if the speed reduction was an effective traffic-calming measure, as discussed in the Traffic-Calming Measure section. Only if that lower speed and additional enforcement was unsuccessful at lowering average speed to within 10% of the new, lower limit, would physical traffic calming be installed. And that traffic calming would be engineered to slow traffic to within 10% of the new speed limit, not lower.

In addition to the step-by-step process outlined above, additional consideration should be given to keeping pedestrians safe not just through traffic-calming measures, but by getting people

out of the street. Most residents would not consider it appropriate to walk in the street on Ethan Allen Avenue. Because of this, the city and state constructed a sidewalk several years ago. There are residential streets in Takoma Park where it's appropriate to have people walk in the street. However, there are some streets where people who walk would like the alternative of not walking in the street such as routes to schools or high-traffic streets. On such streets, sidewalk installation should be first considered. If sidewalks are installed, the street may become safe enough that no additional traffic-calming measures are necessary.

No traffic-calming solution will stop all speeders, no matter how robustly constructed. When speed averages are within 10% of the appropriate speed limit for the street segment in question, the street speeds should be considered safe. If average speeds in a traffic study exceed this amount, then traffic-calming measures should be considered.

Traffic-Calming Measures

As noted, above, traffic-calming measures should be appropriate to the street segment on which they're installed. With that said, there are many available traffic-slowing options.[1] The Safe Roadways Committee recommends that the city codify the following rank-ordered list in a city ordinance:

1. Lower speed limit
2. Additional police enforcement
3. Sidewalk installation
4. Choke-points
5. Overall street narrowing
6. Chicanes
7. Speed tables
8. Raised crosswalks
9. Intersection bulb-outs

When the city initially decides that traffic calming is appropriate, it should choose the first item on the list. If that item does not slow traffic sufficiently when implemented, it can then move down the list, trying each of the traffic-calming measures listed in order shown until one is found that satisfactorily slows average speed to within 10% of the speed limit. The city can also utilize a combination of the traffic calming measures. It is important to always consider, however, the negative secondary impacts, discussed below.

With respect to speed bumps, in general, the Committee recommends against the use of speed bumps and humps due to their negative impact on emergency vehicle response times, environmental impacts, and negative impacts to bicyclists. As an initial action, the city should eliminate the current city-standard double bump speed bump design for all streets in Takoma Park. While the design may be appropriate for parking lots, the Institute of Transportation Engineers recommends use of the gentler speed humps designed to keep traffic at about 20

[1] See http://www.ite.org/traffic/tcmeasures.asp

mph. According to one paper analyzing the ITE's updated guidelines, "most agencies implement speed humps with a height of 3 to 3.5 inches (76 to 90 mm) and a travel length of 12 to 14 feet (3.7 to 4.3 m).[2] Speed humps are generally used on residential local streets." The design looks like the image in Figure 1.[3] As streets come up for repaving, existing bumps that do not conform to the design in Figure 1 should be removed and alternative traffic-calming measures considered, consistent with the evaluation process recommended in this report. We've attached the analysis referenced in this paragraph as Appendix 4.

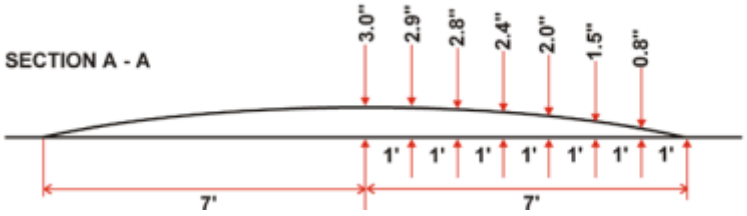

Figure 1

Please keep in mind that many requests for traffic calming are ultimately requests for traffic reduction and that improved bike lanes, sidewalks, and public transportation may ultimately result in lower traffic counts over time.

Negative Secondary Impacts of Traffic Calming

While traffic-calming has many benefits, there are also many negative secondary impacts that must be considered when deciding on appropriate solutions.

Frequently petitioners and the Council consider only the potential benefits and do not consider that some traffic-calming measures have real, measurable negative impacts. For example, some traffic-calming solutions can impact ambulance and firetruck response, slowing down travel to the emergency, and then again slowing traffic from the emergency to the hospital. Emergency-response impacts are covered, below.

Additionally, some traffic-calming measures increase local automobile and truck air pollution in measurable ways, increasing the risks of child and adult asthma attacks and contributing to long-term cardiovascular disease. Air quality impacts are also discussed, below.

Furthermore, since traffic through Takoma Park is relatively constant, reducing traffic on one Takoma Park street only shifts the traffic to other Takoma Park streets, harming some residents in favor of others. This "burden shifting" is covered, below.

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[2] Updated Guidelines for the Design and Application of Speed Humps Margaret Parkhill, P.Eng., Rudolph Sooklall, M.A.Sc, Geni Bahar, P.Eng. (2007) (http://nacto.org/docs/usdg/updated_design_guidelines_for_the_design_and_application_of_speed_humps_parkhill.pdf).

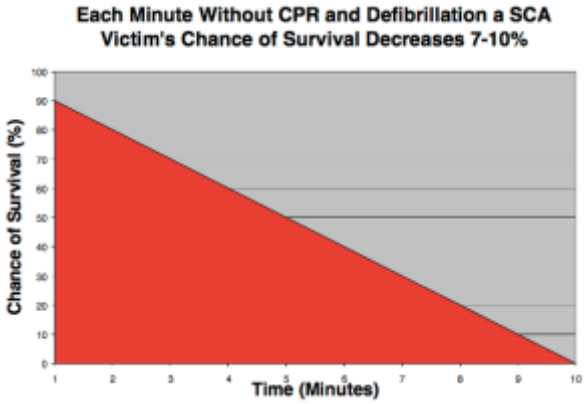
[3] Note that the "lip" of the hump, where the hump begins to rise from the street surface, should be no greater than 1/8" higher than the street surface to minimize impacts to bicycles.

Noise is another consideration related to some traffic-calming measures, and there are other impacts as well, which are also mentioned, below.

Emergency Vehicle Impacts

Many studies have looked at the impact of traffic calming on emergency vehicles and it's not good. Slower response times have been measured and can result, unfortunately, in death of patients. While the delays discussed below may seem small, when responding to sudden cardiac arrest, even small delays can be fatal.

According to the American Heart Association, in cases of sudden cardiac arrest where the heart stops due to a problem with the heart's electrical system (like an arrhythmia), death follows within 5 – 7 minutes if emergency responders do not restore normal heart rhythm.[4]



Source: American Heart Association (http://www.heart.org/idc/groups/heart-public/@wcm/@adv/documents/downloadable/ucm_301793.pdf)

Speed bumps and other traffic-calming measures can delay emergency vehicles by up to nearly 11 seconds at each traffic-calming measure (see Appendix 3 for details). According to an Austin, Texas, statistical model, traffic-calming measures save only one pedestrian, while the emergency vehicle delays they create cause the deaths of 37 people. The speed bumps' harm was 37 times greater than their benefit.

On a route through Takoma Park with eight speed bumps, emergency responders would experience delays of about 80 seconds, added to the 12½ minute average response time for Montgomery County ambulances,[5] this additional delay makes Takoma Park one of the more deadly locations in Montgomery County.

The Sudden Cardiac Arrest Foundation notes that "Sudden cardiac arrest (SCA) is a leading cause of death among adults over the age of 40 in the United States and other countries.[6] By way of comparison, sudden cardiac arrest kills about the same number of people as "Alzheimers disease, assault with firearms, breast cancer, cervical cancer, colorectal cancer, diabetes, HIV, house fires, motor vehicle accidents, prostate cancer and suicides combined."[7] As a result, response time in cardiac-arrest situations is extremely important.

[4] http://www.heart.org/idc/groups/heart-public/@wcm/@adv/documents/downloadable/ucm_301793.pdf
[5] https://www.montgomerycountymd.gov/MCFRS/Resources/Files/MasterPlan/AppendixG/TABLE%204%20-%202022%20BENCHMARKS%20FOR%20ERF.pdf
[6] http://www.sca-aware.org/about-sca
[7] Id.

In order to address this problem, consider that some forms of traffic calming do not substantially affect emergency-vehicle response times. These include speed limit reductions, sidewalk installation, street narrowing, and most choke points.

Burden Shifting

Traffic-calming measures are usually taken to alleviate a perceived problem in one location, but those measures affect the way traffic moves throughout the city on a larger scale and may result in problems on other streets. This issue of "burden shifting" from one street to another must to be taken into consideration when there are requests for traffic-calming measures.

Changes such as the addition of "do not enter" or "local traffic only" signs on one street result in cars taking alternative routes. Even speed humps and bump-outs that slow down traffic may result in drivers choosing to take a route that does not have these impediments. While this may be the goal of the residents on the street with the traffic-limiting measures, it may not serve the larger purpose of creating a safe city as a whole, and certainly shifts the traffic burden to other city residents. In fact, it may result in a cascade of requests for traffic-calming measures as traffic moves from one street to the next, and it can disadvantage those residents whose streets are not eligible for calming measures (state highways, roads used frequently by emergency vehicles, etc.), as well as residents who may be less comfortable making requests to the city (particularly lower income or non-native English speakers).

It is important to remember that not just "side streets" but also most of the main arteries in Takoma Park are residential. Single-family homes and small apartment buildings line most of Philadelphia/Ethan Allen, Carroll, and Flower Avenues; these "thoroughfares" are not much wider than an average side street and have the same speed limit (25 mph except for a portion of Philadelphia Ave). Pushing traffic to use these streets alone also affects more than just the people who live on them, since these main thoroughfares are used by people who live in many different parts of the city when they walk, bike, or bus to common destinations (the Metro, Old Town shops, etc.).

The aim of traffic calming should be to create a safer city as a whole with consideration for all streets and all residents. Measures should not be taken that improve conditions in one location, but negatively affect those in another location, and measures should be considered that improve conditions for all residents of the city.

Environmental impacts

Air Pollution

Academic research has proven that cars abruptly slowing down and speeding up leads to more carbon dioxide, a contributor to global warming,[8] nitrogen oxides, exposure to which decreases lung function and increases possibility of respiratory disease,[9] and particle matter, which also negatively impacts lung function and disease.[10] Particulate matter can have a huge effect on

[8] https://www.epa.gov/ghgemissions/overview-greenhouse-gases
[9] http://www.greenfacts.org/en/nitrogen-dioxide-no2/level-3/02-health-effects.htm
[10] https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

asthma, particularly in children. The American Academy of Pediatrics (AAP) notes that "Children are not little adults. A given dose of a pollutant will have a greater impact on children than on adults due to their smaller size and the nature of their growing bodies and developing brains."[11] The AAP made this comment as they lauded EPA's efforts to reduce particulate matter, including that from vehicles.

Researchers found that when drivers brake for speed bumps, their cars release tiny particulates from brake pads and tires, and when they speed up again, their vehicle exhaust releases large amounts of air pollution.[12] The researchers found on a street with speed bumps and a speed limit of 20 mph, a gasoline-powered car produced 64% more Nitrogen Dioxide (NO_2), 47% more Particulate Matter (PM), and nearly 60% more Carbon Dioxide (CO_2) emissions. Diesel vehicles are even worse, producing 98% more NO_2, 64% more CO_2, and 47% more PM.[13]

To reduce air pollution from traffic calming, the goal should be to keep traffic at a constant, safe speed, rather than having drivers slow down for the measure then stomp on the accelerator after the measure, only to stomp on the brakes for the next measure and to repeat the cycle over and over. Constant safe speeds reduce air pollution. Examples of traffic calming measures that allow for relatively constant speeds include speed limit reduction, roadway narrowing, and choke points.

Noise

Accelerating cars and trucks make tremendous noise in addition to copious air pollution. As engines rev and cars hit speed bumps, sound increases substantially. Noise levels measured before and after speed bumps produced considerable increases of noise levels near speed bumps. The average, maximum, and minimum noise level measurements at 20 meters (65.6 feet) were 74.3, 84.0 and 67.2 decibels, respectively. These noise levels exceed the standard limits recommended for noise levels in school areas (50 dB(A) day time at the boundaries).[14]

Add to the above noise squeaky brakes, large vehicles such as trucks or buses, or the sound of a vehicle with a low hanging muffler as it scrapes over the speed bump, the sounds are rapidly annoying, and as the study cited above shows, can be harmful, particularly to small children.

Other Impacts

- Speed bumps may increase the risk of wrecks for bicycles. Bicycles are least stable at the low speeds warranted by speed bumps. One of the city's stated aims is to make the roadways safe for all modes of transportation and to encourage alternative modes of transportation in addition to just cars. Improved roadways for bicycles can result in less

[11] https://www.aap.org/en-us/about-the-aap/aap-press-room/pages/AAP-Applauds-EPA-on-Strong-Particulate-Matter-Standards.aspx
[12] http://www.telegraph.co.uk/news/2016/06/10/calls-for-polluting-road-humps-to-be-removed-outside-schools/
[13] https://progrss.com/sustainability/20160617/uk-scientists-speed-bumps-increase-polution/
[14] http://sljp.sljol.info/articles/10.4038/sljp.v12i0.3155/galley/3359/download/

traffic, less pollution, less noise, and many of the goals sought during the process of traffic calming.

- Speed bumps may increase the risk of spinal and neck injuries for people with existing spinal injuries or prone to spinal injury from the substantial impact of going over a speed bump in some cars.
- The city may increase its liability for damage to drivers' vehicles from traversing speed bumps. Scrapes can be seen in the tops of various Takoma Park speed bumps, and at least one Takoma Park driver complained to the Committee of his car bottoming out on some Takoma Park speed bumps, even at the recommended speed.

Conclusion

In conclusion, the Safe Roadways Committee recommends substantially revising its traffic calming ordinance and regulation as described in this report. The city also should adopt an objective, repeatable process for evaluating whether traffic-calming measures are appropriate for given street segments, and if they are, the process must be one that assists in determining which traffic-calming measures are appropriate. It is not an exaggeration to say that lives are at stake. It's also important to continue moving our community away from the car as the primary mode of transportation and to a future like that envisioned by the City Council as one that "encourage[s] Takoma Park residents to use alternatives to driving, including walking, bicycling, and transit."

Appendix 1

http://www.codepublishing.com/MD/TakomaPark/#!/takomapark13/TakomaPark1328.html#13.28

SUGGESTED LAW RE-WRITE

13.28.010 Erection and maintenance of traffic calming measures.

A. In the regulation and supervision of traffic, the Director of Public Works is authorized to place, erect and maintain upon the public roadways of the city such traffic calming measures as the Council may direct, consistent with the standards established in this ordinance, at the locations designated by the Council or as determined by the City Manager or their designee.

B. In accordance with Chapter 2.12, the City Manager or their designee may establish such regulations and standards as are necessary to accomplish the purposes and intent of this chapter. (Ord. 2011-29 § 1, 2011/Ord. 2002-36 § 1 (part), 2002/prior code § 13-75)

C. The City Manager or their designee shall, after obtaining a valid petition for traffic calming on a city street, follow the following procedure to determine which traffic calming measures are appropriate:

1. determine the appropriate street segment speed by using the methods described in the Federal Highway Administration's Methods and Practices for Setting Speed Limits;
2. conduct a study that captures vehicle, pedestrian, and bike counts during morning and evening rush hours as well as any other times identified as problematic by residents. Pedestrian and bicycle counts should document the number of pedestrians using sidewalks vs. streets and the direction of travel (any studies, counts, or measurements should be taken for a period of time that captures sufficient data to be representative of the motor vehicle, pedestrian, and bicycles that travel the route, typically for at least a three-week survey period). Study should also note if there are surrounding sensitive uses such as a school, recreation center, dense housing, or other sensitive uses;
3. capture the average motor vehicle speed through the street segment over a no-less-than-three-week period; and
4. if the average traffic speed exceeds the speed determined appropriate under #1, above, then install traffic calming using the priority list later in this report.

D. Traffic Calming Priority List. The city shall utilize the following rank-ordered list to calm traffic on streets that have successfully petitioned for traffic calming:

1. Lower speed limit
2. Additional police enforcement
3. Sidewalk installation
4. Overall street narrowing
5. Choke-points
6. Chicanes
7. Speed tables
8. Raised crosswalks
9. Intersection bulb-outs

13.28.020 Guidelines for installation of traffic calming measures.

Except as specifically determined necessary for the safety and control of vehicles, pedestrians, traffic speed, and/or traffic volume, the City Manager or their designee shall adhere to the following guidelines for the installation of traffic calming measures on the public highways of the city:

A. Traffic Signs and Pavement Markings. Traffic calming measures, should be painted with distinctive markings, which should include reflective tape or paint, and traffic signs indicating the presence of the traffic calming measure should be placed on the right-hand side of the public highway at the approach to each such traffic calming measure.

B. Restrictions on Slope or Grade of Public Highway. Traffic calming measures should not be placed on a public highway where the slope is 8% or more.

C. Restrict Placement in Front of Driveways. Traffic calming measures should not be placed in front of a driveway.

E. Avoid Conflicts with Utility Access Points. Traffic calming measures should not be placed on or near underground utility access points, boxes, vaults, and manhole covers.

F. Distance from an Intersection or Stop Sign. Traffic calming measures should not be placed within 75 feet of an intersection or within 100 feet of a stop sign.

G. Proximity to Street Lights. Traffic calming measures should be located under street lighting whenever possible.

I. Minimum Visibility for Approaching Drivers. Traffic calming measures should be visible from a vehicle within 100 to 200 feet from its approach. (Ord. 2011-29 § 1, 2011)

13.28.030 Installation of Traffic Calming without a Petition

The city may install traffic calming that's consistent with the process set forth in section 13.28.010(C) and the traffic calming list in section 13.28.020 without a petition from city residents when appropriate. Requests for non-petition traffic calming should be initiated by a City Council Member or the City Manager.

Appendix 2

Proposed Administrative Regulation to replace Administrative Regulation No. 96-1

Traffic Calming - Petition Process and Installations

PURPOSE/SCOPE:

To provide written guidelines for the administration of *Takoma Park Code* Chapter 13, Vehicles and Traffic, as amended, pertaining to the installation of traffic calming measures. Traffic calming measures include signs, pavement markings, lower speed limits, additional police enforcement, sidewalk installation, overall street narrowing, choke-points, chicanes, speed tables, raised crosswalks, and intersection bulb-outs which restrict traffic flow, or channel or slow vehicle movement for the purpose of reducing traffic hazards and improving roadway safety.

PROCEDURES:

I. Request for Traffic Calming Installation.

A request for installation of one or more traffic calming measures can be made by petition.

A. Petition Request.

1. Residents of one or more blocks of a street can submit a petition to the City Manager indicating that the residents of at least two-thirds (2/3) of the households want one or more traffic calming measures to be applied on that street. This petition may also include a description of the specific locations of the proposed traffic calming measures, or may indicate that the locations will be determined in consultation with the Public Works Department. Proposed locations of traffic calming measures shall comply with the requirements of the *Takoma Park Code* and relative state and county laws, and shall not obstruct manholes or other accesses to utilities.

2. If a traffic control measure is being requested for only one block of a street, the petition must also be circulated to the residents living on the street within one (1) block of the requested installation site or block.

3. The City Clerk will validate the petition, will determine the total number of eligible households residing on the street, and will compute the percentage of households signing the petition. If that percentage is two-thirds (2/3) or greater, and after the requirements of Section I.B. have been complied with, the City Clerk will so inform the Council, who shall schedule a public hearing.

4. The city will then begin the evaluation process described in Takoma Park Municipal Code Section 13.28.010(C) to determine the appropriate traffic calming solution for the stretch of roadway on which the traffic calming is requested. Once the measure or measures is/are determined, the community will be informed as described, below.

B. Citizens' Association Meeting / Information Sheet.

1. When a traffic control measure request is made by petition, and after the city has conducted the evaluation process described in Municipal Code Section 13.28.010(C) & (D), the City Clerk shall notify the citizens' association or associations in whose area the request is located, and shall instruct the petitioners to contact the citizens' association most affected by the proposed traffic control measure to request that the association place a discussion of the traffic-control-measure request on the association's next meeting agenda.

2. If the citizens' association most affected by the proposed traffic control measure installation meets within 60 days of the date the association is notified, the petitioners shall ask the citizens' association to discuss the proposed traffic control measure at that meeting. The citizens' association may submit a letter to the

City Clerk within the 60 days either supporting, opposing, or taking no position on the proposed traffic control measure. If the citizens' association does not submit a letter, no assumption shall be made about the position of the citizens' association on the traffic control measure.

3. If the affected citizens' association does not meet within 60 days of the date the association is notified, or if there is no citizens' association covering the area where the proposed traffic control measure would be located, the petitioners shall call a meeting to discuss the proposed traffic control measure. The President (or other designated officer) of the affected citizens' association, shall be consulted about the time and place of the meeting, but petitioners shall be responsible for notifying residents of the affected "traffic impact area" as defined by the Traffic Impact Areas map that is adopted as part of these regulations. The traffic impact area includes the residential arterial roads within and immediately surrounding the area. If there is no citizens' association in the area of the proposed traffic control measure, the petitioners shall advise the City Clerk about the time and place of the meeting. The petitioners shall provide a letter to the City Clerk indicating the number of people attending the meeting and the sentiment of the attendees toward the proposed traffic control measure.

4. In order to advertise the meeting, petitioners are encouraged to prepare a one-page information flyer concerning the request. This flyer should include a sketch and description of the proposal, including the specific locations or numbered street block of the proposed traffic control measures as indicated in the petition, and a phone number of one of the petitioners to call for more information. Petitioners are encouraged to distribute this flyer to residents of the affected "traffic impact area" as defined in Section I.B.3.

C. City Clerk Authorized to Develop Standard Forms.

To assist residents in petitioning for traffic control measure, the City Clerk is authorized to develop and distribute a standard "Request for Traffic Control Measure Installation" petition form and a standard "Information Sheet" form.

II. Procedures for Traffic Calming Public Hearing.

A. Conduct of Public Hearing.

1. After having been notified by the City Clerk that a valid petition requesting traffic control measure installation has been received, and after the requirements of Section I.B. have been complied with, the Council will schedule a public hearing to solicit the opinions of the entire neighborhood and the city at large.

2. The City Clerk shall send notice of the public hearing to all residents of the street which is proposed to receive a traffic control measure installation, to the local neighborhood citizen association, and to adjoining neighborhood citizen associations. The public hearing shall be advertised in the Takoma Park newspaper of record.

3. After conducting the public hearing and declaring the hearing record closed, the Council shall announce its decision within fifteen (15) days of the close of the hearing record. Under extraordinary circumstances, this time limit may be extended by majority vote on the Council.

4. The Council may approve, approve with modifications, or deny the requested traffic control measure installation.

5. The City Clerk shall notify the petitioners, and their neighborhood or civic association of the Council's decision, which shall also be published in the City Newsletter or equivalent publication.

B. Guidelines for Evaluating the Public Hearing.

In addition to the standards and guidelines specified in the City Ordinance, the following criteria are intended to guide the Council in determining whether a request for a traffic control measure installation is reasonable and justified. These should not be considered exclusive criteria.

1. The street has not been identified and is not used by the Takoma Park Volunteer Fire Department as a primary fire and rescue route into a neighborhood.

2. The impact of traffic control measures on adjacent neighborhoods be assessed.

3. The petitioners have made efforts to provide broad notification to potentially affected residents.

III. Procedures for Removing a Traffic Control Measure Installation.

1. Removal of Traffic Control Measure Installations.

    1. Upon request of two-thirds (2/3) of the households of a street containing a traffic control measure installation, and after six months have elapsed from the initial installation of the traffic control measure(s), the Council may consider removing the traffic control measure installation, except as provided in Section III.B.

    2. The request for removal must be made by petition, subject to the procedures specified in Sections I.A. and I.B. above.

IV . Miscellaneous.

1. City Council Request

City Council members may initiate the installation of traffic control measures on streets within their wards. Street requested for traffic control measures will still undergo the evaluation process described in Takoma Park Municipal Code Section 13.28.010 to determine that particular traffic control measure(s) that is/are appropriate for the requested street(s).

2. Authority of City over Traffic Control Measures.

Nothing in these guidelines shall be construed as preempting the city at its initiative from installation, altering, maintaining, or removing a traffic control measure or installing a traffic control measure. The City Clerk will notify the appropriate neighborhood association and the affected residents of any proposed new traffic control measure installations or changes to an existing traffic control measure installation. The residents and the association will have an opportunity to discuss the proposed changes with the Council at a regular Council meeting before the changes are adopted and implemented.

V. Implementation Responsibility.

The Public Works Director or designee shall be responsible for advising the Council and public on the proper placement of traffic calming measures on city streets, and for overseeing the installation and maintenance of traffic calming measures in the city, consistent with Takoma Park Municipal Code Section 13.28.010.

PETITION FOR TRAFFIC CALMING MEASURE

We, the undersigned, request that traffic calming measure(s) be installed on _____ Avenue/Street.

Check one:

_____ Location(s) to be determined by the Public Works Director; OR
_____ At the following location(s): _____

NAME (printed)	SIGNATURE	ADDRESS	PHONE

GENERAL RULES:

1. Signatures from at least 2/3 of households on subject street(s) must be submitted.
2. Tenants as well as homeowners are to be included.
3. Only one signature per household will be considered.
4. If petition is for only one block of a street, blocks on either side must be petitioned.
5. If street being considered for traffic control measure(s) provides the only ingress/egress route for other street(s), the other street(s) must also be petitioned.
6. Community notification requirements must be met (see Administrative Regulation Sec.I.B.).

Appendix 3

Speed bumps, humps, tables, and raised cross walks have the most negative impact on emergency vehicles. According to one study conducted in Portland, Oregon, the following were the impacts of various measures:

22-foot Speed Humps:	0.0 to 9.2 seconds per hump
14-foot Speed Humps:	1.0 to 9.4 seconds per hump
Traffic Circles:	1.3 – 10.7 seconds per circle

According to the study, at the speed of 30 mph, fire engines experienced a 3.7 second delay, ladder trucks a 4.9 second delay, and ambulances a 1.7 second delay.[15] The author notes that as emergency vehicle speeds increase, the overall delay substantially increases. The chart, below, demonstrates this:

Speed Hump Response Delays for 25 MPH vs. 40 MPH

Vehicle	Response Speed	Delay Per Hump	% Delay For Faster Speed (40 mph)
EMS Unit	At 25 mph	1.3 seconds	
	At 40 mph	5.1 seconds	292%
Fire Engine	At 25 mph	2.8 seconds	
	At 40 mph	8.5 seconds	203%
Ladder Truck	At 25 mph	4.3 seconds	
	At 40 mph	10.3 seconds	139%

Source: The Influence of Traffic Calming Devices on Fire Vehicle Travel Times, Portland Bureau of Fire, Rescue and Emergency Service and Bureau of Traffic Management, January 1996.

Austin conducted a similar study of traffic calming on emergency response. Austin found delays of approximately 2 to 10 seconds, depending upon the type of emergency vehicle tested. "EMS units responding without a patient had an increase average of 2.2 seconds per hump compared to a 9.6 second increase when transporting a critically injured patient. Fire engine pumper trucks and ladder trucks experienced an average delay variation of 2.8 to 3.6 seconds per hump. These results were from test parameters requiring the drivers to maneuver over the humps at speeds of their own discretion or at 15 mph. They were to then regain a 30 mph cruising speed between the humps."[16]

Similar studies were conducted in Montgomery County, MD, Berkeley, CA, and Boulder, CO. The Montgomery County Fire and Rescue units experienced an average delay of 2.8 to 7.3

[15] Traffic Calming Programs & Emergency Response: A Competition of Two Public Goods, Leslie W. Bunte, Jr., University of Texas at Austin, May 2000, p. 51 (citing City of Portland, Bureau of Fire, Rescue & Emergency Services and Bureau of Traffic Management, "The Influence of Traffic Calming Measures on Fire Vehicle Travel Times," Portland, OR, January 1996, pp. 1-4).

[16] Bunte at pp. 52 - 53 (citing City of Austin Fire Department, "An Analysis of Speed Hump Effects on Response Times", Austin, TX, March 1996, p. 3).

seconds per speed hump and a delay range of 3.2 to 7.0 seconds maneuvering around the traffic circle test.[17]

In the Berkeley, CA test, the results for 12-foot rounded-top humps suggested an increase of 10 seconds per hump. This time delay was similar for both the engine and ladder units. For a 22-foot speed table (a bump with a flat top), the delays were approximately 3 seconds per hump for engines and 13 seconds for ladder trucks.[18]

And finally the Boulder, CO study showed a delay of 7.5 to 10 seconds for roundabouts.

Impact of Delays

Risk Benefit Ratio for Austin, TX

Policy/Program	Projected Risk	Projected Benefit	Risk/Benefit Ratio
Installation of Traffic Calming Devices	37 lives lost to SCA	1 pedestrian life saved	37 lives lost for 1 life saved
Installation of Opticoms to Reduce Response Time	1 pedestrian life lost	41 lives saved from SCA	1 life lost for 41 lives saved

Traffic-calming measures are supposed to slow down traffic, so it's no surprise that the emergency vehicles described above also are forced to slow down. But what's the impact of those emergency vehicle delays? A statistical model was developed to interpret the delayed response data listed above into lives lost. The model, when applied to the Austin, Texas data showed that an additional 37 lives would be lost due to delayed response times compared to the 1 life that would be saved by the installation of the traffic calming measure through "safer" streets. The harm of the speed bumps was 37 times greater than the benefit.[19]

[17] Bunte at p. 55 (citing Montgomery County Fire and Rescue Commission, *The Effects of Speed Humps and Traffic Circles on Responding Fire-Rescue Apparatus in Montgomery County, Maryland,* Montgomery County, Maryland, August 1997, pp. iv & v).

[18] Bunte at pp. 57 – 58 (citing City of Berkeley, Advance Planning Division, "An Evaluation of the Speed Hump Program in the City of Berkeley," Berkeley, CA, October 1997, p. 21 – 23).

[19] Bunte at p. 158 (using statistical method developed by Ray Bowman, 1999).

Appendix 4

Updated Guidelines for the Design and Application of Speed Humps

Updated Guidelines for the Design and Application of Speed Humps

Margaret Parkhill, P.Eng., Rudolph Sooklall, M.A.Sc, Geni Bahar, P.Eng.

Abstract

Speed humps have gained acceptance as a traffic calming device by North American and international jurisdictions. However, design and application varies widely between jurisdictions, and speed humps often meet resistance from residents and road users. In 1997, the Institute of Transportation Engineers (ITE) published a Recommended Practice for the design and application of speed humps. The recommended practice is now being updated to provide state-of-the-practice guidelines for speed humps and speed tables.

To update the ITE speed humps recommended practice, the experiences of agencies implementing speed humps were obtained through an extensive literature review. The literature review was supplemented with an online survey targeting North American and international jurisdictions.

This paper provides an overview of the recommended framework for an agency to follow to implement speed humps or speed tables in their jurisdiction. This framework is based on the experience documented by dozens of agencies. The framework includes:

- Develop and follow a formal public consultation process;
- Determine the needs of the street or neighborhood;
- Construct and maintain speed humps; and
- Monitor and evaluate speed hump effectiveness.

1. INTRODUCTION

Speed humps are one tool available in the traffic calming toolbox, and have gained acceptance by North American and international jurisdictions since their development in the early 1970s by the Transport and Road Research Laboratory (TRRL) in Great Britain. However, design and application varies widely between jurisdictions, and speed humps often meet resistance from residents and road users.

In 1997, the Institute of Transportation Engineers (ITE) published a Recommended Practice for the design and application of speed humps. Research has been conducted and lessons have been learned through experience regarding the design and implementation of speed humps since the publication of this guideline.

As a result, ITE initiated an update to the Recommended Practice to provide state-of-the-practice guidelines for the design and application of speed humps. State-of-the-practice guidelines were obtained through an extensive literature review on relevant published material. The knowledge base gained from the literature review was supplemented through an on-line survey of jurisdictions implementing speed humps. The on-line survey was designed to capture

information to fill the knowledge gap from the literature review. Jurisdictions in the United States, Canada, and internationally provided their experiences; close to 300 responses to the survey were received.

Guidance was also provided by an ITE Technical Advisory Committee (TAC) whose members have extensive experience in speed hump design and implementation. The update is currently under review, and is expected to be published later this year.

This paper provides an overview of the recommended framework for an agency to follow to implement speed humps or speed tables in their jurisdiction. This framework is based on the experience documented by dozens of agencies. The framework includes:

- Develop and follow a formal public consultation process;
- Determine the needs of the street or neighborhood;
- Construct and maintain speed humps; and
- Monitor and evaluate effectiveness.

Other common speed control measures currently used by various agencies are documented in ITE's "Traffic Calming: State of the Practice". (Ewing 1999)

1.1 Speed humps vs. speed bumps

A speed hump is a raised area in the roadway pavement surface extending transversely across the travel way. Speed humps are sometimes referred to as "pavement undulations" or "sleeping policemen". Most agencies implement speed humps with a height of 3 to 3.5 inches (76 to 90 mm) and a travel length of 12 to 14 feet (3.7 to 4.3 m). Speed humps are generally used on residential local streets.

A speed bump is also a raised pavement area across a roadway. Speed bumps are typically found on private roadways and parking lots and do not tend to exhibit consistent design parameters from one installation to another. Speed bumps generally have a height of 3 to 6 inches (76 to 152 mm) with a travel length of 1 to 3 feet (0.3 to 1 m).

From an operational standpoint, speed humps and bumps have critically different impacts on vehicles. Within typical residential operational speed ranges, vehicles slow to about 20 mph (32 km/h) on streets with properly spaced speed humps. A speed bump, on the other hand, causes significant driver discomfort at typical residential operational speed ranges and generally results in vehicles slowing to 5 mph or less at each bump.

Speed bumps of varying design have been routinely installed on private roadways and parking lots without the benefit of proper engineering study regarding their design and placement. Speed humps, on the other hand, have evolved from extensive research and testing and have been designed to achieve a specific result on vehicle operations without imposing unreasonable or unacceptable safety risks.

1.2 Speed tables

Speed tables are essentially flat-topped speed humps, and may have a textured material on the flat section with asphalt or concrete for the approaches. Speed tables are sometimes referred to as "trapezoidal humps" or "speed platforms". If marked as a pedestrian crossing, speed tables may also be referred to as "raised crosswalks" or "raised crossings".

Most agencies implement speed tables with a height of 3 to 3.5 inches (76 to 90 mm) and a travel length of 22 feet (6.7 m). Speed tables generally consist of 10 foot (3.1 m) plateau with 6 foot (1.8 m) approaches on either side that can be straight, parabolic or sinusoidal in profile. The longer lengths of speed tables provide a gentler ride than speed humps and generally result in vehicle operating speeds ranging from 25 to 30 mph (40 to 48 km/h) on streets depending on the spacing between speed tables. Speed tables are generally used on residential collectors, emergency routes or transit routes.

The City of Portland, OR has designed "split" speed tables for designated emergency routes. Split speed tables are also 22 feet (6.7 m) long and extend from curb to centerline on opposite sides of the street. Split speed tables are separated by a longitudinal gap that allows fire trucks to weave around the split speed humps in slalom-like fashion. The Portland Department of Transportation is currently testing this alternative speed table design. Split speed tables are not included in this paper.

2. PUBLIC CONSULTATION PROCESS

Traffic calming activities are carried out to reduce traffic speeds and volumes. Based on the experience of most agencies, it is critical to obtain the support of a substantial majority of all residents in a neighborhood targeted for traffic calming measures, including speed humps, prior to implementation. Therefore, it is important for agencies to develop a working relationship with communities and have well defined administrative procedures in place.

Based on a survey of agencies in North America and around the world, the large majority of agencies (77%) have a formal public consultation process for implementing speed humps.

It is recommended that each agency, prior to installing speed humps, develop a formal process for speed humps. Five key elements are recommended:

1. Appropriate legislation (policies, ordinances and regulations);
2. Request procedure;
3. Evaluation of requests;
4. Consultation (with the public and other agencies); and
5. Removal procedure.

2.1 Appropriate legislation

Statutory authority, constitutionality, and tort liability are the legal issues surrounding speed hump installation that jurisdictions should take into consideration. A jurisdiction must have the legal authority to implement speed humps on a given class of roadways, while respecting the

constitutional rights of affected landowners and road users, and minimizing the risks to road users. (Ewing 1999)

Before initiating a speed hump installation program, it is recommended that appropriate policies, regulations, and/or ordinances are developed to govern elements such as the community involvement process, hump design and location criteria, cost sharing relationships, installation and maintenance requirements, and evaluation/modification procedures. It is also important to clearly define the project area, that is, the area expected to be affected by speed hump implementation. For example, any property located within 250 feet (76 m) from the first and last speed humps is considered by the City of Beaverton (OR) to be part of the project area.

It is important that jurisdictions review state and municipal ordinances and regulations to ascertain if existing legislation could affect the implementation of speed humps. Existing legislation may have to be modified, or new legislation developed, before proceeding with speed hump installation (TAC 1998).

2.2 Request procedure

Speed hump installation may be requested by a single resident, though additional support from the community is generally needed at a later stage in the process for the project to remain eligible. The request procedure should clearly outline the expectations of all potentially impacted parties and the timing of their participation in the various stages of the process. The following components are recommended for inclusion into a speed hump request procedure:

- Develop a request or petition form which residents can use to request speed humps in their neighborhood. Many agencies have petition forms available on the internet, which residents can download, collect signatures, and return to the appropriate department;
- Identify the department that will be responsible for receiving speed humps requests and coordinating the overall process;
- Screen all requests received to determine eligibility. Common eligibility criteria include the 85^{th} percentile speed, the posted speed limit, and the average daily traffic. Some agencies also require support from a certain number or percentage of affected residents in order for a request to be eligible; and
- If a request meets all eligibility requirements, obtain wider community support before proceeding to the evaluation stage. Define the project area for the speed hump request in order to determine who to include in the process. Speed hump projects typically extend between higher-order streets.

The eligibility criteria will vary depending on the needs of each jurisdiction. Therefore, it is recommended that each implementing agency develop a customized speed hump request procedure with input from other relevant agencies (e.g., emergency services, transit agencies). Before proceeding to evaluation of a request, the eligibility criteria should be met.

2.3 Evaluation of requests

To evaluate the merit of installing speed humps, it is recommended that eligible requests be ranked to determine priority levels. Some agencies use a points system to evaluate and rank projects with points allocated based on certain elements, such as:

- Speed;
- Traffic volumes;
- Collisions (e.g., speed-related);
- Proximity to schools or other land uses where high numbers of children could be present, such as parks or playgrounds;
- Lack of sidewalks; and
- Designated bicycle routes.

During evaluation, traffic conditions in the neighborhood should be observed and data collected, such as daily traffic volume and operating speed. The data collection required will be determined by the evaluation criteria developed for the jurisdiction.

As part of the evaluation of requests, consideration should be given to the objectives of the installation (e.g., reduced speed, reduced infiltration or cut-through traffic). The objectives of the installation will guide the monitoring and evaluation of speed humps after implementation. Collection of data is a key part of the evaluation of speed humps both before and after implementation.

For those projects which receive the highest ranking, a preliminary design plan can be developed to show the potential locations of speed humps prior to initiating public and agency consultation.

2.4 Public and agency consultation

Consultation of proposed speed hump installations should include:

- Property owners, residents, and business owners. Special consultation should be considered with those residents or landowners directly adjacent to proposed hump locations;
- Emergency services (police, fire, ambulance, etc.); and
- Other groups such as school districts, nearby hospitals or emergency medical centers, transit operators, road maintenance workers, snow plow operators, and waste collection agencies.

At least one public meeting is recommended to have an open discussion of speed humps. Notification of the meeting should be provided well in advance, and the meeting should be held as close as possible to the study area. However, a single method of public involvement may not be suitable for every situation. More complex or controversial requests will require greater public education and involvement throughout the process.

At the public meeting, the scope and timing of the project can be discussed and the preliminary design plan should be presented for comments from all parties. Comment sheets could be distributed at the meeting, and collected at the end of the meeting. A deadline for resident comments after the meeting should be established. All comments received should be considered

fully in the decision-making process to arrive at the final design plan.

Most agencies perform another survey at this stage, and require a higher level of support from the public to continue with the implementation of speed humps. In order to gauge support, a mail-out questionnaire or survey can be conducted. Some agencies require the support of at least 67 percent of all residents before speed humps are installed. This ensures that a substantial majority of the affected people agrees with the project and there is a general acceptance of the final design plan.

2.5 Removal procedure

Most agencies require speed hump removal requests to be supported by a majority of residents, although poor traffic operations, emergency services or transit agencies may also initiate the removal procedure. Monitoring and evaluation of speed hump installations will assist in the determination of any unexpected problems that may have been created.

The removal procedure will vary depending on the needs of each jurisdiction. Therefore, it is recommended that each implementing agency develop a customized speed hump removal procedure with input from other relevant agencies (e.g., emergency services, transit agencies).

3. DETERMINE NEEDS OF THE STREET OR NEIGHBOURHOOD

Speed humps should be implemented only to address documented safety or traffic issues supported by a traffic engineering review. It is recommended that an engineering review be conducted to identify, quantify, and document the existing traffic issues on the street and in the neighbourhood. Issues could include speeding, cut-through traffic, or safety. It is important to review existing conditions and determine if there is a measurable problem, rather than a perceived problem (TAC 1998). Documented issues can then be used to support the implementation of speed humps, and to measure their effectiveness if implemented (Ewing 1999).

Installing speed humps in a community can be met by resistance from residents, thus community support and involvement are important for increasing awareness of speed humps and creating an atmosphere of acceptance and ownership (TAC 1998). By explaining the full context, setting residents' expectations appropriately, and discussing the potential benefits and disbenefits of speed humps and other traffic calming treatments, consensus on the most appropriate treatment for the neighbourhood is more likely achievable.

3.1 Roadway characteristics

In the United States and Canada, speed humps are generally installed on roadways functionally classified as local streets and neighbourhood or residential collector streets as defined in AASHTO's "A Policy on Geometric Design of Highways and Streets" (AASHTO 2004, pg 12; TAC 1998).

Many agencies install speed humps on roads with an urban cross-section (i.e., curb and gutter). Streets where speed humps are applied may or may not have sidewalks or bicycle facilities (such as on or off road trails). The surrounding land use for streets where speed humps are applied is generally residential in nature, and may include schools, parks or community centers.

Speed humps can be used on one-way or two-way streets (TAC 1998). Speed humps are not recommended on streets with more than two travel lanes. In addition, the pavement should have good surface and drainage qualities. The location of individual speed humps will depend on the presence of on-street parking, driveways, intersections, and other roadway features. Figure 1 shows a speed hump installed on a street with parking and bicycle lanes in the City of Portland, OR.

Speed humps are generally not recommended for use on bus routes or emergency vehicle routes (Ernish et al. 1998), or on streets that provide access to hospitals and emergency medical services. Speed tables may be more appropriate, and could be applied after consultation with representatives of the emergency services. The use of alternative traffic calming measures may also be considered for use on bus or emergency vehicle routes.

Figure 1: Speed hump on residential street with parking and bicycle lanes in Portland, Oregon

Photo by: Scott Batson (City of Portland, Oregon)

3.2 Traffic characteristics

Traffic operation elements include traffic speeds, traffic volumes and mix (including cut-through traffic), emergency vehicle access, transit routes, vehicle and cargo damage, and environmental impacts. The decision to install speed humps includes consideration of the posted speed limit and the operating speed of traffic. Speed humps are usually recommended only on streets where the

speed limit is 30 mph (50 km/h) or less. Speed humps are generally not considered appropriate where the 85th percentile speed is 45 mph (70 km/h) or more.

Spacing and location of the speed humps and the length of the road segment where the hump is installed affects operating speeds. The research available suggests that speed humps should be no more than 500 feet (152 m) apart where the desired 85th percentile operating speed is between 25 and 30 mph (40 and 48 km/h). Short road segments may require only a single speed hump even where two could be installed as acceleration opportunities are limited on a short segment.

The final locations of the humps are dependent on site specific considerations, making the determination of actual spacing and final location a complex task. After the general spacing and layout of the speed humps have been established, the final location of each hump is determined by considering vertical alignment, horizontal alignment, intersections, driveways, street lighting, on-street parking, pedestrian crossings, installation angle, and drainage and utilities.

Several studies have shown that speed humps reduce vehicle speed as measured by the 85th percentile speed, the percentage of drivers traveling over the speed limit, and the percentage of drivers traveling 10 mph or more over the speed limit.

The installation of speed humps should also consider traffic volumes in terms of the total volume of traffic, the presence of cut-through traffic, and the traffic mix. Each street requires individual assessment prior to implementation. An area-wide approach is needed to avoid simply diverting traffic from roads with speed humps to parallel untreated roads, but the extent of the diversion problem is unclear at present.

Speed humps have been shown to reduce traffic volumes. The combined results for speed humps and speed tables investigated in the City of Portland (OR) showed an average traffic reduction of 28 percent.

3.3 Pedestrians and bicyclists

The consideration of all road users, especially pedestrians and bicyclists, is another key component of the engineering review conducted prior to the installation of speed humps. Speed humps and speed tables are two traffic calming techniques that can be used to facilitate pedestrian and bicyclist movement and improve the safety of these road users (Zegeer 1998).

Speed tables can serve as raised marked crosswalks when they extend from curb to curb (Figure 2) and provide a flat surface suitable for pedestrians to use. Speed tables can facilitate pedestrian flow while providing vehicle speed control at the crosswalk location (Ewing 1999, Ernish et al. 1998). Parabolic or circular speed humps are too rounded or sloped for pedestrians to safely use.

Where a speed table is used as a raised pedestrian crosswalk, crosswalk design elements can be incorporated. Design element considerations include the following:

- The markings must be visible to motorists, especially at night. Inlay tape and thermoplastic are generally recommended for crosswalk pavement markings on speed tables (PBIC 2006)

- Granite and cobblestones finishes are not recommended because, although aesthetically pleasing, the surface may become slippery when wet, and may be difficult to cross for pedestrians who are visually impaired or using wheelchairs (PBIC 2006).

Figure 2: Raised pedestrian crosswalks can control vehicle speeds on local streets at pedestrian crossings

Photo by: Dan Burden

In general, bicyclists do not require extensive special provision (TAC 1998). Bicyclists may, however, be concerned that the vertical deflection of the speed hump will be uncomfortable and inconvenient and that abrupt slopes could even throw a bicyclist from their bicycle (PBIC 2006). Additional elements that could be considered to accommodate bicyclists include (DeRobertis and Wachtel 1996):

- Using a tapered edge before the curb to reduce the likelihood of pedal impact on hump. If this gap is too wide, it may promote gutter running by motor vehicles;
- Using speed humps that are less than 4" high;
- Providing adequate warning signs and markings;
- Ensuring that speed humps are far enough from intersections so bicyclists do not have to negotiate humps while turning; and
- Ensuring that speed humps are not installed on streets with vertical grade greater than 5 percent.

4. CONSTRUCT AND MAINTAIN SPEED HUMPS

Speed humps and speed tables are most often constructed on existing roadways (i.e., retrofit); however, speed humps and speed tables may be constructed on new roadways or during resurfacing projects.

It is recommended that jurisdictions planning to implement speed humps or speed tables develop standard construction procedures. Following these procedures will ensure more uniform speed humps and speed tables are constructed throughout the jurisdiction. The procedures should be used by both municipal staff and private contractors engaged to work on municipal roads.

The construction procedures should contain detailed working drawings showing development of the desired profile and allowable tolerances for speed hump height. Material specifications and construction guidelines can also be included.

Agencies have reported that parabolic or sinusoidal cross-sections are more difficult to construct than circular speed humps or speed tables with straight approaches. However, many agencies have successfully constructed parabolic and sinusoidal cross-sections within acceptable tolerances. This success is often related to the use of a speed hump profile template which is used to verify that the speed hump dimensions and profile are accurate within reasonable tolerances. Figure 3 shows the use of a speed hump profile template in Beaverton, OR to construct a parabolic speed hump. If the profile is incorrect, the effect of the speed hump will likely change, which might result in unanticipated or reduced effectiveness.

Figure 3: Use of speed hump profile template in Beaverton, OR

Photo by: Jabra Khasho (City of Beaverton, Oregon)

Care should be taken in the initial installation and monitoring of speed humps to minimize the risk of edge raveling and profile deformation exceeding established tolerances. It is important to maintain the appropriate design relationship between the hump or table and the street so the device continues to perform its intended purpose within allowable tolerances. From the experiences of several agencies, speed humps constructed of asphalt concrete tend to deform over time in the direction of traffic flow, while rubberized speed humps may develop ruts along

the wheel paths or curl up along the edges. Ambient temperature during construction as well as sufficiency of the bond between the new asphalt and the existing street also play a role in the durability an asphalt hump.

If maintenance activities, such as utility work or pavement resurfacing, result in speed hump pavement markings being reduced or eliminated, they should be promptly replaced or supplemented with temporary signs providing the same warning to motorists.

Experience has shown that speed humps and speed tables are generally not damaged by snow plowing activities. Snow removal crews in Montgomery County (GA) reported minimal impact or cost associated with speed humps (Wainwright 1998). The City of Edmonton (AB) experienced some damage to parabolic speed humps from snow plows; however, in most cases there was no damage since snow plow operators do not plow down to the pavement on local streets where speed humps are located. For jurisdictions which experience substantial snowfall, it is recommended that snow plow operators be informed of all streets with speed humps before the winter season starts.

5. MONITOR AND EVALUATE EFFECTIVENESS

Speed hump installations affect residents and road users; traffic speeds, volumes and travel time; roadway safety, noise levels and emissions. It is important to monitor and evaluate the effect of each speed hump or speed table installation project. Minimum monitoring and evaluation includes data collection and analysis of vehicle operating speed and traffic volume changes including traffic diversion. More extensive evaluation may include gathering feedback from residents and road users.

The type, number, and extent of studies performed to evaluate speed humps may vary based upon the particular circumstances and objectives of each installation. However, some review could be performed after each installation to determine if the desired results were achieved, or if unexpected problems were created. If the installation of speed humps resulted in undesirable safety or traffic operations issues, consideration can be given to mitigation efforts including possible removal of the humps.

Monitoring and evaluation may include several aspects of the speed hump installation, including impacts on residents, traffic operations and safety, and on the environment.

6. CONCLUSIONS AND RECOMMENDATIONS

Speed humps and speed tables are two of several geometric design techniques that may be used to control vehicular traffic speeds along a roadway. Positive results in terms of reduced operating speeds and reduced traffic volumes have been documented after speed hump installation.

The experiences of various agencies currently implementing speed humps across North America are documented in the updated ITE Recommended Practice along with findings from published research work. The ITE Recommended Practice also provides details on the design of speed humps and speed tables.

This paper provides an overview of the recommended framework for an agency to follow to implement speed humps or speed tables in their jurisdiction. This framework is based on the experience documented by dozens of agencies. General considerations for the implementation of speed humps as a traffic calming measure were discussed along with the importance of community involvement.

7. ACKNOLWEDGEMENTS

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