DEVELOPING A MUNICIPAL TRAFFIC CALMING PROGRAM

Pioneer Valley Planning Commission

Raised Intersection, College Street, Amherst

In 2009, the Town of West Springfield requested that the Pioneer Valley Planning Commission develop a toolkit of traffic calming examples in the Pioneer Valley as a first step toward developing a comprehensive traffic calming program for their town. The following document, "Best Practices in Traffic Calming in the Pioneer Valley," is the result of this effort. This toolkit describes traffic calming strategies, local experiences with these strategies, and how these strategies can be implemented through a comprehensive traffic calming program.

WHAT IS TRAFFIC CALMING?

Traffic calming establishes roadway features that make drivers slow down. In addition, traffic calming strategies are sometimes intended to reduce traffic volumes when installed on local cut-through streets. Traffic calming reduces dangerous driving behaviors and makes travel easier, safer and more pleasant for pedestrians and bicyclists, which in turn promotes greater use of these environmentally friendly modes of transportation. Traffic calming measures improve neighborhood livability for nearby residents, and traffic calming enhancements can also help make streets more attractive and pleasant when they include sidewalks, trees, street furniture and other aesthetic and functional improvements. Finally, traffic calming measures increase safety for other drivers and reduce the probability and severity of crashes, particularly at roadway intersections and driveway entrances.

A traffic calming program:

- Establishes a comprehensive approach and community-wide policies for implementing traffic calming measures;
- Promotes the use of traffic calming solutions at problem locations;
- Helps the community to prioritize and fund traffic calming projects; and
- Establishes procedures for involving the public and making sound traffic calming decisions.

DEVELOPING A COMPREHENSIVE PROGRAM

A comprehensive traffic calming program can be established by a municipality with a committee or commission comprised of staff and volunteer residents. It can be helpful for the program to be staffed by the Department of Public Works or other municipal staff or consultants. The first step is to develop policies that outline how the program will identify and select traffic calming locations and appropriate traffic calming measures. In addition, procedures must be established to respond to resident requests for traffic calming, and to ensure that new traffic calming installations are supported by the immediate neighborhood. Finally, and critically, a funding source for the traffic calming

program must be identified. For example, a general fund budget line item and/or traffic mitigation fees from development projects may be used to pay for traffic calming installations.

Typically, the following process would be followed to identify and select traffic calming locations and appropriate remediation measures:

1. Committee identifies potential traffic calming locations
   - Traffic calming locations may be identified by municipal staff, consultants or residents
   - Locations identified by residents must be accompanied by a neighborhood petition signed by a certain proportion of residents on the affected streets

2. Committee evaluates potential traffic calming locations
   - Use a ranking sheet to help assess the severity of the problem
   - For community-driven projects, prioritize those that already have gained community support through neighborhood networking and meetings

3. Committee selects projects to be assessed by municipal staff or consultants

4. The committee has an engineering analysis conducted
   - Collect accident data
   - Conduct traffic counts and record travel speeds
   - Assess signage
   - If traffic calming is necessary, consult map of primary and secondary emergency vehicle routes and speak with appropriate emergency personnel
   - Identify, evaluate and recommend appropriate traffic calming measures

5. The engineering assessment is presented to the committee and discussed
   - Affected residents are invited to attend

6. Committee ranks the priority of the project and determines funding availability
   - Additional community meetings may be required to ensure neighborhood support for a proposed traffic calming installation

7. The selected traffic calming strategy is installed

8. Post-installation data is collected and assessed to determine the efficacy of the traffic calming installation (return to step five if necessary)
   - If a temporary installation was tested, determine whether a permanent measure is appropriate

In addition to installing traffic calming measures at problem locations, a comprehensive traffic calming program can help make roads safer to begin with by establishing a Complete Streets Policy. A Complete Street is a road that is designed with narrower travel lanes and other measures that promote safe driving, walking and biking. A Complete Streets Policy is a locally adopted policy enforced by the Planning Board, the Department of Public Works and others to ensure that new roads and major road reconstruction projects are carefully designed to balance the needs of automobiles, pedestrians and cyclists.

Best Practices in Traffic Calming in the Pioneer Valley

Prepared by Pioneer Valley Planning Commission

Pedestrian Crosswalk, College Street, Amherst

What is Traffic Calming?

Traffic calming is often defined broadly to include all measures that alter the behavior of motorists and improve conditions for pedestrians and cyclists. Sometimes, traffic calming is defined more narrowly to include measures applied in locations in which motorists are exceeding the design speed of a given road.

In short, traffic calming establishes roadway features that make drivers slow down. In addition, traffic calming strategies are sometimes intended to reduce traffic volumes when installed on local cut-through streets.

What are the Benefits of Traffic Calming?

Traffic calming reduces dangerous driving behaviors and makes travel easier, safer and more pleasant for pedestrians and bicyclists, which in turn promotes greater use of these environmentally friendly modes of transportation. Traffic calming measures improve neighborhood livability for nearby residents, and traffic calming enhancements can also help make streets more attractive and pleasant when they include sidewalks, trees, street furniture and other aesthetic and functional improvements. Finally, traffic calming measures increase safety for other drivers and reduce the probability and severity of crashes, particularly at roadway intersections and driveway entrances.

How is Traffic Calming Achieved?

Traffic calming can be applied to many different situations, but the greatest focus is often in urban and residential areas, as well as on main roads through the center of small towns and villages. Traffic calming strategies must be tailored to each specific situation. Strategies typically fall into three general categories: 1) narrowing the real or apparent width of the street; 2) making vehicle paths more curved; and 3) creating vertical displacement along the vehicle path. Some strategies do not fall within these categories, including street closure, visual messages, such as signage, as well as education, training and publicity. Street closure is a strategy often employed when other measures implemented on cut-through streets fail, and although it can be controversial to implement, it is the most effective way to eliminate cut-through traffic. Other measures, including signage, education and publicity, can be incorporated into a comprehensive traffic calming program. For all traffic calming measures, it is critical to consult and communicate clearly with emergency personnel during the planning process prior to the installation of a traffic calming measure, as gaining support from emergency personnel can be difficult. In addition, it is equally important to consult and communicate with the public during the planning process. Finally, it should be noted that traffic control devices

should conform to the most recent edition of the Manual on Uniform Traffic Control Devices (MUTCD).

Strategy 1) Narrowing the real or apparent width of the street can be achieved through relatively inexpensive measures such as on-street parking, bike lanes, and travel lane width reduction. More comprehensive measures include medians, crossing islands and road diets[1], as well as street design changes that narrow the real or perceived width of a road through urban design features, including placing sidewalks, buildings, trees and street furniture (lighting, benches, bike racks, bus shelters , etc.) along the street.

Strategy 2) To make vehicle paths more curved, traffic calming measures include lane offsets, short medians, crossing islands, and mini-traffic circles. Intersection measures include roundabouts, neckdowns (curb extensions), lane offsets, and crossing islands.

Strategy 3) Finally, vertical displacement along a vehicle path can be achieved through speed humps and tables, raised crosswalks and intersections, and textured pavements such as pavers and stamped concrete.

Textured Pavement at a Raised Intersection on Grove Street, Northampton causes cars to slow down through visual cues and textural changes

Why a Pioneer Valley Traffic Calming Toolkit?

This Toolkit has been compiled to share examples of traffic calming measures employed in the Pioneer Valley. Each example includes a general description of the traffic calming measure and its benefits, a discussion of how that traffic calming measure has been implemented in example Pioneer Valley communities, and a discussion of considerations for implementing that traffic calming measure.

What Examples are Included in this Toolkit?

This toolkit includes raised crosswalks and intersections, speed cushions, modern roundabouts, speed humps and tables, road narrowing, pedestrian refuges, and neckdowns (curb extensions). The toolkit also addresses comprehensive traffic calming programs. A matrix comparing these traffic calming tools is included at the end of this document. A list of additional resources is also provided at the end of this toolkit.

[1] Road diets are a traffic calming strategy used to reduce vehicle speeds by narrowing a roadway through a reduction in the number of lanes or lane width. Road diets are often conversions of four-lane undivided roads into three lanes (two through lanes and a center two-way left turn lane).

RAISED CROSSWALKS

Raised Crosswalk in Amherst. Bollard light flashes when crossing (left)

What are Raised Crosswalks?
Raised crosswalks are flat-topped speed humps with pedestrian crosswalk markings. They are often also accompanied by signage. Brick, paint or textured materials can improve their appearance, draw attention to them, and enhance safety and speed-reduction.

What are the Benefits?
Raised crosswalks are designed to make pedestrians more visible to approaching motorists and to reduce vehicle speeds at points where pedestrians cross the road. In addition, raised crosswalks can improve accessibility by allowing a pedestrian to cross at a nearly constant grade without the need for a curb ramp.

Raised Crosswalks in Amherst
The Town of Amherst has several lighted, raised and textured crosswalks along the portion of College Street (Route 9) that runs through the Amherst College campus, between South Pleasant Street and Dickinson Street. These crosswalks have textured and colored pavement, with crossing lights elevated about three feet above the road on bollards next to each crosswalk. These lights are activated immediately by pedestrian push buttons installed on the bollards. Since these crosswalks were installed, no pedestrians have been hit by cars, except in a single unusual case in which a driver suffered a heart attack and lost control of his vehicle.

Raised Crosswalks in Northampton
In the Summer of 2010, The City of Northampton completed the installation of two raised crosswalks near the Jackson Street School. This project was funded through a Safe Routes to School grant. The project included widening sidewalks, installing a ramp to the rail trail, and installing two raised crosswalks. The design for this project was completed by MassDOT, and the project will serve as a model for another traffic calming project on Conz Street, near the Northampton

Raised Crosswalk, Elm Street, Northampton

Senior Center, where the city plans to narrow the traffic lanes and possibly install two to three raised crosswalks, vertical granite curbs, and sidewalk improvements to improve safety for the elderly and people with disabilities. In addition to these, Smith College recently installed raised crosswalks that create safer pedestrian crossings along Elm Street. Also, the State Street neighborhood is going through a public process to evaluate the results of a temporary speed hump installation that may result in a raised crosswalk at the Trumbull Road intersection to promote safer pedestrian crossings.

Considerations

Data provided by www.trafficcalming.org, a website sponsored by Fehr and Peers Transportation Consultants, show that 22-foot speed tables, which are similar to raised crosswalks, decrease 85th percentile travel speeds[2] by 18 percent (based on 58 sample sites) and also decrease traffic accidents by 45 percent (based on eight sample sites). The estimated cost of raised crosswalks is $4,000.

Raised crosswalks work well at key pedestrian crossing locations where low speeds are desired but a somewhat smooth ride is needed for larger vehicles. While speed bumps are more effective at reducing speeds, raised crosswalks are gentler on vehicles. However, one drawback to the raised crosswalks is that they can delay emergency vehicles, so it is important to consult with emergency responders prior to installation.

Originally, the Amherst crosswalks also included integrated lights that were installed directly into the crosswalk pavement. Although they were eye-catching, they were difficult to maintain, and eventually all were removed. The lights suffered damage from exposure to water, salt and dirt that became caught in the lighting fixture. In addition, imperfections in the road caused by frost heaves sometimes made the lights difficult to see. As a result, when individual lights stopped working, they were removed and replaced with asphalt. Meanwhile, the flashing pedestrian lights installed on bollards by the sidewalk have been easy to maintain and can also be seen easily by drivers.

[2] The 85th percentile travel speed, a term commonly used by traffic engineers, is the speed at which 85 percent of the traffic is travelling.

RAISED INTERSECTIONS

Raised Intersection, College Street, Amherst

What are Raised Intersections?

Raised intersections are similar to raised crosswalks, except that the raised flat area covers an entire intersection. There are ramps on all approaches and often brick or other textured materials on the flat section. Raising the level of the intersection allows the crosswalks to be more readily perceived by motorists to be "pedestrian territory."

What are the Benefits?

Raised intersections are designed to make pedestrians more visible to approaching motorists and to reduce vehicle speeds at points where pedestrians cross the road. In addition, some raised intersections improve accessibility by allowing a pedestrian to cross at a nearly constant grade without the need for a curb ramp. Raised intersections provide traffic calming for two streets at the same time.

Raised Intersection in Amherst

The Town of Amherst has one raised intersection on College Street (Route 9). In this case, College Street is intersected by an Amherst College Road (Butterfield Terrace), and the intersection is small enough that it made sense to raise the entire area rather than construct up and down ramps for each pedestrian crossing. While the town's other raised pedestrian crosswalks are about 10 feet wide, the raised intersection is about 50 feet wide. Otherwise, the raised intersection is very similar to the town's raised crosswalks, with crosswalks that have pedestrian-activated crossing lights.

Considerations

Raised intersections should be considered for intersections with limited space, with substantial pedestrian activity and where other traffic calming measures would be unacceptable because they take away scarce parking spaces. Information provided by www.trafficcalming.org suggests that while raised intersections can calm two streets at once, they tend to be expensive, and they are less effective at reducing speeds than other measures such as speed humps and raised crosswalks.

Speed Cushions, City of Greeley, Colorado

What are Speed Cushions?

Speed cushions are a series of small speed bumps with space between them. The design of speed cushions forces cars to slow down as they ride with one or both wheels on the humps. However, the wider axle of emergency vehicles such as fire engines and ambulances allows them to straddle the relatively narrow cushions without slowing down response times.

What are the Benefits?

Although relatively new, speed cusions are growing in popularity due to their ability to slow cars without affecting emergency vehicles or busses. Speed cushions also can be less expensive than other options.

Speed Cushions in Amherst

Amherst purchased several portable rubber speed cushions that have been used in several parts of town, including Lincoln Avenue. However, while the speed cushions did reduce travel speeds, some vehicles are able to move to avoid them, at least partially (allowing the vehicle to pass over the speed cushion with just one wheel). In addition, while the speed cushions did reduce speeds, they did not reduce the volume of cut-through traffic. On Lincoln Avenue, the speed cushions did not reduce speeds as much as desired, and they did not reduce volumes, so they were eventually taken out so other solutions could be tried. In addition to internal use, Amherst has also lent its speed cushions out to other communities that have desired to try them.

Considerations

Speed cushions should be considered if there is an area requiring moderate speed reductions, and if the road is along an emergency vehicle route. However, speed cushions may have limited effectiveness at reducing cut-through volumes, depending on the desirability of the cut through and other site specific factors. Portable speed cushions are cost effective, as they allow a community to relocate the devices if they prove to be ineffective.

Although Amherst found its speed cushions to be less effective than desired, some communities have reported speed cushions to be just as effective as speed humps. The materials that the speed cushions are constructed may affect the outcome, with the options including rubber (used in Amherst), concrete, and asphalt. While it is easier and more temporary to install preformed rubber speed cushions, which need only to be bolted down, asphalt and concrete may have a greater effect on slowing traffic, although definitive data do not exist. However, some anecdotal reports suggest that there is little difference in performance between paved versus rubber speed cushions. Another consideration is that constructing paved cushions requires some skill and practice, while rubber cushions provide uniformity of design for every installation. However, rubber speed cushions cannot be used in winter, as they are easily damaged by snow plows.

MODERN ROUNDABOUTS

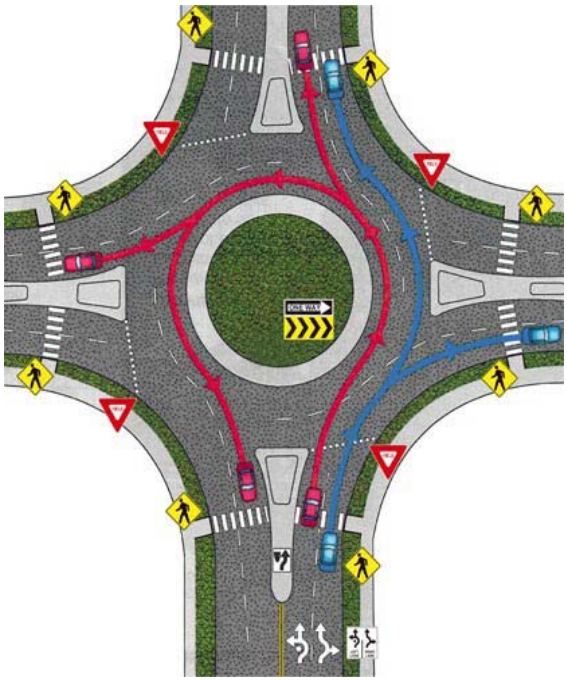
Modern Roundabout under construction at UMass-Amherst

What are Modern Roundabouts?

Roundabouts are road junctions in which traffic is channeled in a circular direction around a central island. Modern roundabouts are designed differently than older traffic circles, allowing them to be safer and to handle higher volumes of traffic.

The term modern roundabout is used in the United States to differentiate it from the nonconforming traffic circles or rotaries of the past whose design was the cause of traffic backups and safety problems. Although the U.S. installed the first rotaries in the world, they became unpopular due to their operational problems. More recently, however, there has been a growing interest in roundabouts due in part to its success in some countries in Europe, as well as Australia.

Modern roundabouts are both smaller than older designs, and they have different yield rules. They are defined by two basic design principles: 1) They have a *yield-at-entry*, also known as a *yield-to-left* rule, giving vehicles already within the circle the right away (rather than the other way around, with vehicles already inside the circle yielding to entering vehicles); and 2) entry speeds are reduced by pointing the entering traffic towards the central island, which then deflects vehicles to the right, so that no traffic stream is able to move straight through the intersection.[3] Thus, cars must slow down to yield, must negotiate a curve sharp enough to reduce their speed, and as they exit, slow speeds are maintained by the relatively tight radius of the roundabout and exit lanes.



Modern Roundabout Diagram
Minnesota Department of Transportation

What are the Benefits?

Roundabouts help to maintain a steady but slowed stream of traffic. They promote a smooth movement of vehicles into and out of an intersection, minimize queues at intersections, and seamlessly handle a high proportion of U-turns. In addition, they are inexpensive to operate, providing an alternative to a traffic signal, and, if designed properly they enhance safety for pedestrians

[3] http://www.alaskaroundabouts.com/history.html

and vehicles. One study of eight intersections found that, on average, roundabouts have resulted in a 29 percent reduction in accidents where installed.[4] Another study of 21 intersections in the U.S. found that roundabouts reduced injury crashes by 80 percent, and all crashes by 40 percent.[5] Additional studies show similarly high levels of crash reduction, injury reduction, and sever injury / fatal crashes. If well-landscaped, roundabouts can reduce the total paved area and provide aesthetic improvements.

Modern Roundabouts in the Pioneer Valley

Several modern roundabouts designed for traffic calming and enhanced pedestrian safety are being installed in the Pioneer Valley, including one in Florence at the intersection of North Main Street and Bridge Road (by Look Memorial Park), one at the University of Massachusetts Amherst, and one at Atkins Corner in Amherst. These enhanced roundabouts are designed so that pedestrian crossings are set back from the roundabout at least one car length. By designing the roundabout in this manner, drivers yield to pedestrians before entering and after leaving the roundabout – while entering, traveling in, and exiting the roundabout, drivers do not need to also negotiate interactions with pedestrians.

Vehicles exit the roundabout, then yield to pedestrians / bicyclists

Vehicles yield to pedestrians / bicyclists, then enter the roundabout

At the Florence roundabout, splitter islands were installed to give pedestrians a resting point in the center of the crossing - and these islands also narrow the width of the road at crossing points, further promoting slow vehicle speeds. This design works well for one lane roundabouts, which are the type proposed in the three local installations. In addition, entry and exit travel speeds are further reduced by curved entries to the roundabout, as well as traffic signs, pavement marking and lighting.

Considerations

Roundabouts are relatively expensive to construct, so the installations occurring in the Pioneer Valley are being funded primarily with federal transportation funds. The Florence roundabout cost approximately $1.6 million dollars.

[4] Roundabouts: An Informational Guide. The study conducted found a reduction from 9.3 to 5.9 accidents per year, based on a sample of 11 sites. http://www.trafficcalming.org/roundabouts.html

[5] http://www.northamptonma.gov/tpc/Modern_Roundabouts/

Florence Roundabout

Brick pavement at center creates a narrow travel lane and allows extra room for large turning radius vehicles

Splitter island provides a resting area and narrows lane widths at crossing points

Roundabouts should be considered at intersections with a history of traffic accidents, in locations where it is desirable to moderate traffic speeds on arterials, and at intersections that often back-up. They may be considered in lieu of road widening, or in lieu of traffic signals at freeway exits and entrances. Additional candidates include intersections with irregular approach geometry, and locations with a large right of way area. However, roundabouts can be difficult for large vehicles with large turning radii to use, and must be designed with a truck apron at the center over which the rear wheels of large vehicles can safely track. They must also be designed so that the circulating lane is not close to crosswalks. Roundabouts may require some on-street parking to be eliminated, and of course, any new landscaping must be maintained. In addition, topographic conditions can sometimes make it difficult to construct properly designed roundabouts, and roundabouts may not function well when two roads with very different traffic volumes intersect. If a roundabout is proposed at a single intersection within a network of traffic signals, it may not be effective.

Another important consideration is the negative perception of roundabouts held by some drivers, elected officials, and even transportation agencies. However, studies conducted in six communities in which single-lane roundabouts replaced stop signs or traffic signals found that while roundabouts were supported by less than 36 percent of drivers before construction, after one year the level of public support increased to about 70 percent on average.[6]

[6] http://www.northamptonma.gov/tpc/Modern_Roundabouts

SPEED HUMPS & SPEED TABLES

Temporary Speed Hump, State Street, Northampton

What are Speed Humps and Speed Tables?

Speed humps are installations in which the road is raised at a single location to cause vehicles to slow down. They are often tapered as they reach the curb to allow for drainage, and they are generally three to four inches high and 10 to 14 feet long in each direction of travel. Speed tables are flat-topped speed humps.

What are the Benefits?

Speed humps are relatively inexpensive, often in the range of about $2,000 dollars, and they are very effective at slowing travel speeds and reducing accidents. They are also relatively easy for bicycles to cross. On average, a 12-foot long hump reduces 85th percentile travel speeds by 22 percent.[7] Speed tables are smoother on large vehicles, though slightly less effective. On average, for a 22-foot speed table, there is an 18 percent reduction in 85th percentile travel speeds.[8]

Speed Humps and Speed Tables in Holyoke

In general, the City of Holyoke has found speed humps and speed tables to be effective in slowing traffic and sometimes in eliminating cut-through traffic at locations where drivers are using side streets to avoid traffic lights. For example, on Westfield Street and Homestead Avenue, speed humps now make these streets less desirable cut-through routes. Other streets with permanent speed humps include Vermont Street, Cane Road, and Dartmouth Street. Sometimes, temporary speed humps are used to evaluate speed hump locations, while other times, the city directly installs a permanent speed hump.

The City of Holyoke owns two sets of portable, temporary speed humps that cost approximately $12,000 ($6,000 each). The City has an ordinance that allows the city council to implement temporary traffic control measures on a six-month basis on local streets with a daily traffic count of less than 4,000 vehicles and a speed limit of 30 miles or less. In order for a location to be considered for a temporary speed hump, a certain number of property owners in the vicinity must sign a petition, a public hearing must be held, and then the city council must take a vote. Temporary speed humps are then installed after the city council votes that they are needed on a particular street.

Prior to installation of a temporary speed hump, the city conducts a traffic count on the street, and after the installation, additional traffic counts are taken to determine whether there is a change in traffic speeds or volumes. Once this process is complete, the speed hump is uninstalled and, if

[7] From an average of 33.3 to 25.6 miles per hour, based on a sample of 15 sites

[8] From an average of 36.7 to 30.1 miles per hour, based on a sample of 58 sites

needed, moved elsewhere in the city. Based on the effectiveness of the temporary speed hump, the city decides whether a permanent speed hump should be installed.

In Holyoke, this process has resulted in several permanent speed humps and speed tables being installed. At the same time, this process has allowed the city to assess whether speed humps are an appropriate solution for a given location. For example, on Old Jarvis Avenue, the city installed two temporary speed humps to reduce cut-through traffic, the resulting traffic data was inconclusive – vehicles did slow down and the volume of traffic was not greatly reduced. As a result, the neighbors are still deliberating whether to file a petition to install permanent speed humps at this location.

Speed Table, Vermont Street, Holyoke

Speed Humps in Northampton

As is the case in Holyoke, Northampton often installs temporary speed humps prior to moving forward with a permanent installation. For a location to be considered, a neighborhood meeting is held to ensure that a majority of residents want the temporary speed hump. After the temporary speed hump is removed from that location, if residents want to request a permanent speed hump, they must submit a request letter that is signed by at least 90 percent of neighborhood residents.

Installation of a permanent speed hump on Grove Street, Northampton

For example, on Grove Street, the community was concerned about speeding, as well as the use of the street as a cut-through. In response, Mass Development (the Village Hill developer) and the city worked together to install a sidewalk, vertical curbing and two sets of temporary rubber speed humps. These 14 foot wide, four inch high speed humps were purchased for approximately $5,000 each from trafficlogix.com. They were installed to allow for drainage on each side, and they were placed 300 to 500 feet apart along the street. The city conducted traffic counts before and after the speed hump installation, and found that they reduced speeds eight to nine miles per hour on average, depending on the direction traveled. The city recently installed permanent speed humps at this location.

Permanent speed humps are constructed of asphalt and are 10 feet wide with six inch humps. The city has received overwhelmingly positive feedback about permanent speed humps from residents, and even residents who live right in front of speed humps have expressed support for these installations.

Considerations

Although temporary speed humps can be a useful tool for testing the effectiveness of a speed hump at a given location, transporting, installing, and uninstalling these devices requires community resources. Holyoke reports that it takes three to four personnel half a day to either install or uninstall a temporary speed hump. It takes up to a full day to uninstall a speed hump from one location and then install it at another location. Temporary speed humps must be uninstalled in the fall in preparation for winter, and to properly uninstall a temporary speed hump, pavement holes created by the bolts that secure the speed bump must be filled.

Permanent speed humps, which cost about $2,000 to install, are effective at slowing down traffic and sometimes at reducing or eliminating cut-through traffic. Data available on 12- and 14-foot speed humps reveal significant decreases in travel speeds and accidents. 12-foot speed humps have been found to decrease accidents by 11 percent[9], and 14-foot humps have been found to decrease accidents by 41 percent[10]. Therefore, speed humps are good for locations where very low speeds are desired, and conflict with ambulance routes is not a major concern. However, speed humps can increase noise levels when wheels hit the pavement, which can be bothersome in residential areas.

The City of Holyoke has not had problems with plowing or drainage as a result of speed hump installations. However, speed humps must be sited and designed to ensure that they do not obstruct stormwater drainage or other utilities. In addition, speed humps force large vehicles and emergency vehicles with rigid suspensions to travel at slower speeds, so it is critical to plan their installation in cooperation with the local fire department and emergency services. Placing a speed hump in the right location to be effective can be a challenge when balancing traffic calming goals with these other considerations.

[9] From an average of 2.7 to 2.4 accidents per year, based on a sample of 49 sites, http://www.trafficcalming.org

[10] From an average of 4.4 to 2.6 accidents per year, based on a sample of five sites, http://www.trafficcalming.org

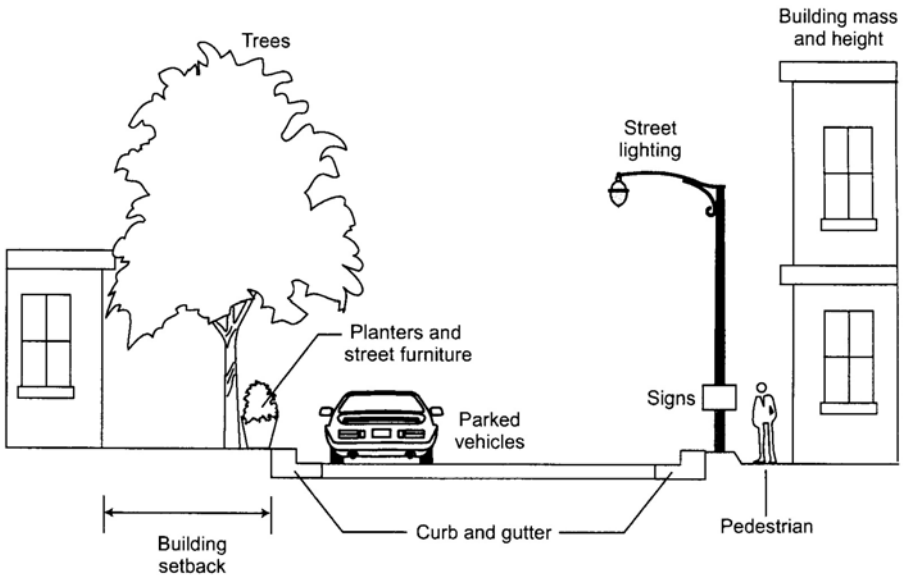
New pavement markings establish narrower 10 foot travel lanes on West Farms Road, Northampton

What is Road Narrowing?

Road narrowing is a real or perceived reduction in roadway width. Physical road narrowing is accomplished by reducing the travel lane width, often to 10 feet. Road narrowing results in visual changes to roads that cause drivers to reduce vehicle speeds and to be more attentive to pedestrians.

What are the Benefits?

Road narrowing has been shown to reduce speeds and vehicle crashes. Drivers on narrower roads also have a greater tendency to yield to pedestrians.



Visual Narrowing: Elements of Apparent Width
MassDOT, Massachusetts Highway Department Road Design Manual, 2006 Edition

Road Narrowing in Northampton and Holyoke

The City of Northampton has been pursuing road narrowing projects that reduce travel lane widths from 12 to 10 feet where possible. On Elm Street, Smith College painted new lines that included bike lanes and created narrower automobile lanes. On West Farms Road and Prospect Avenue, the city found that repairing potholes caused driving speeds to increase, so when these roads were ready for repaving, the project was designed with new pavement markings that created narrower lanes. To accomplish this, the roads were painted with double yellow center lines and new shoulder lines to create 10 foot travel lanes. In another location, the city requested MassDOT to paint bike lanes along Route 66. Route 66 was wide enough to accommodate five foot bike lanes (the required width for an approved bike lane in Northampton) on both sides of the road. These new bike lanes run along Route 66 from the Westhampton town line to Florence Road. As the bike lane ends, it turns into a dashed

line. Closer to town, four foot bike lanes have been painted. This city has not yet collected data on the effectiveness of this road narrowing project.

The City of Holyoke had some success with an unusual approach to road narrowing. Dwight Street is a one-way arterial road that previously consisted of two 10-foot traffic lanes and a shoulder. This road connects Route 91 and the Joseph E. Muller Bridge, so it accommodates heavy morning and evening traffic volumes. However, at other times, when drivers were alone on Dwight Street, the two 10-foot wide, single direction lanes made the road feel very wide, which promoted speeding. Several accidents (and near-accidents) occurred as a result of vehicle speeding, and the city decided to address the problem. To do this, the road was re-striped to create a single 12 foot travel lane, a three foot bike lane, and parallel parking on both sides of the street. Although bicycles do not frequently use the new bike lane, the road now appears much narrower (even though the travel lane is actually wider), causing drivers to drive slower Also, now that the road is a single lane, some drivers are operating as "pace cars", or cars which, by observing the speed limit, force others behind them to do the same. This treatment has also been used on Hampden Street, which operates as a one-way street in the opposite direction of Dwight Street.

Considerations

Road narrowing is a versatile traffic calming approach that can be accomplished through measures such as painting lines for new bike lanes, allowing on-street parking, and installing curb extensions. Measures that result in perceived road narrowing without changing lane width include planting trees next to the street and allowing new buildings to be developed close to the street. Road narrowing is different from other traffic calming strategies because it makes slower speeds seem more natural to drivers, as opposed to other treatments that physically force lower speeds or restrict route choice. It can also be a good choice along emergency vehicle routes, where speed humps and similar measures may create problems for ambulances. In Northampton, this was the case on Prospect Avenue, which is a primary route for emergency vehicles.

Road Narrowing on Elm St, Northampton: Painted lines and bike lane are used to narrow the auto lane

Beginning of Dwight Street in Holyoke: Two lanes in same direction with bike lane and shoulder

Dwight Street narrows from two travel lanes to one

Dwight Street: One travel lane, two parking lanes, and a bike lane

PEDESTRIAN REFUGES

Vegetated Pedestrian Refuge, Resnic Boulevard, Holyoke

What are Pedestrian Refuges?

Pedestrian refuges are raised islands located at the center of a street that narrow the travel lanes and provide a resting place for pedestrians. Pedestrian refuges are often landscaped, and they are fitted with a gap to allow pedestrians to walk through at a crosswalk.

What are the Benefits?

Pedestrian refuges provide the benefits of road narrowing and enhance pedestrian safety. They have been shown to reduce vehicle speeds and crashes, reduce traffic volumes, and cause drivers to yield to pedestrians. They provide a pedestrian resting space and strong visual cue to drivers, enhancing pedestrian safety. If landscaped, they provide aesthetic benefits. Trees and benches can be included to provide pedestrians with a comfortable resting area.

Pedestrian Refuges in Holyoke

The City of Holyoke installed two pedestrian refuge islands at the intersection of Resnic Boulevard/ West Franklin Street and Jackson Parkway / Pine Street. Resnic Boulevard is a busy arterial road that connects Route 391 with Route 202 and Beech Street. At the selected traffic calming location behind Holyoke High School, Resnic Boulevard now narrows from four lanes to two lanes with a raised, vegetated pedestrian refuge island on one side of the intersection, and a raised, concrete pedestrian refuge on the other. There are new crosswalk pavement markings, as well as new crossing signals. Based on speeds measured before and after the installation, the city found that the pedestrian refuges are effective at slowing down traffic. The city did not conduct traffic counts before the installation, so the effect of the installation on traffic volumes is unknown. Overall, the city has found that the installation has improved safety for pedestrians and cars moving through the neighborhood as well. However, there have been some problems with getting high school students to use the crosswalks, as the crosswalks are not always along their shortest walking route.

High school students cross Resnic Boulevard pedestrian refuge

Resnic Boulevard pedestrian refuges are fitted with a gap along the crosswalk

Considerations

On average, pedestrian refuges decrease 85th percentile travel speeds by seven percent.[11] Their speed reduction effect is moderate, though they do facilitate safe pedestrian crossings. In some cases, a pedestrian refuge installation may require elimination of some existing on-street parking. Also, pedestrian refuges islands require major road reconstruction, so they can be expensive. In Holyoke, the cost to reconstruct approximately 1,000 linear feet of roadway was approximately $675,000. This included installation of the Resnic Boulevard pedestrian refuges, repaving of the intersection of Resnic Boulevard and Jackson Parkway / Pine Street, installation of new signals and pedestrian crosswalks across both of these streets, and painting new lane markings. As was the case in Holyoke, a project of this size must be justified based on the volume of vehicles using the street, as well as the importance of the crossing point (in this case, a key crossing point for Holyoke High School students). However, pedestrian refuge projects need not be so large in scope; projects involving only the installation of a small pedestrian island are reported to cost between $5,000 and $15,000 dollars.

View of pedestrian crosswalk gap and new crossing signal at the Resnic Boulevard pedestrian refuge

Landscaped Pedestrian Refuge, South Pleasant Street, Amherst

[11] From an average of 34.9 to 32.3 miles per hour miles per hour based on a sample of seven sites

NECKDOWNS

Neckdown, Holyoke Street, Holyoke

What are Neckdowns?

Neckdowns are curb extensions at intersections. The sidewalk is widened, or bulbs out, to narrow the roadway. Neckdowns cause cars to drive more slowly by narrowing the roadway, and they make intersections easier to cross by shortening the crossing distance for pedestrians. Finally, they reduce the curb radius at intersections, reducing the travel speeds of turning vehicles.

What are the Benefits?

Neckdowns reduce traffic speeds and make crossing easier and safer for pedestrians. They improve pedestrian circulation, and make pedestrians easier for vehicles to see. They reduce speeds, especially for right-turning vehicles, yet turns can be negotiated by large vehicles.

Neckdowns in Holyoke

The City of Holyoke has installed neckdowns at a number of pedestrian crossing locations along Holyoke Street. In the winter, plow drivers need to know the locations of these installations, but plowing has not been a problem. If a plow hits a neckdown, this pushes the truck to the left, which has the potential to cause traffic accidents. This makes it important for plow drivers to be attentive and to know the locations of curb extensions, as you cannot see them beneath a large quantity of snow. The city does not mark the curb extensions with signs, but there are often signs for other purposes on the curb extensions that mark their location.

The city simulated an additional neckdown by installing concrete planter barrels. This trial installation worked well, so the city decided to install a permanent neckdown in that location. However, this project was never funded by the City Council, so it was not installed.

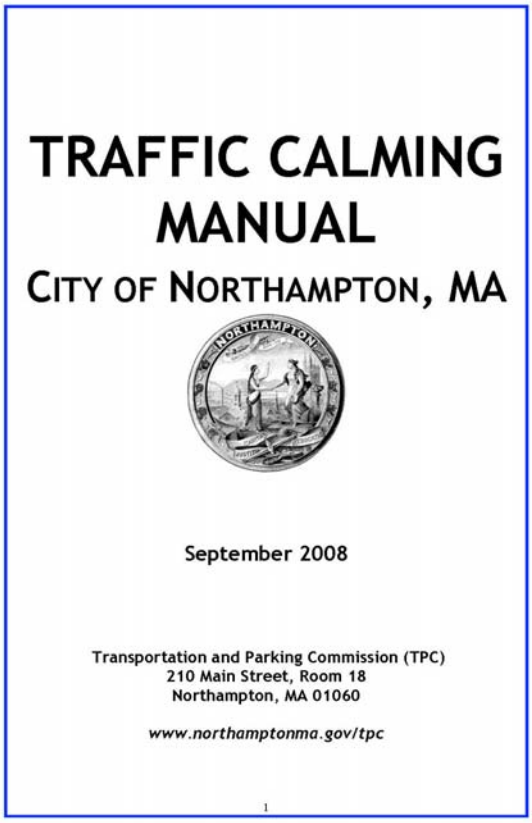
Considerations

Curb extensions should be considered at key pedestrian crossings, and neckdowns work well at intersections with substantial pedestrian activity. They are moderately effective at reducing vehicle speeds. Neckdowns may slow down right-turning emergency vehicles, and they may require some on-street parking near the intersection to be eliminated. Finally, they may also require bicyclists to briefly merge with auto traffic. Neckdowns cost between $40,000 to $80,000 for an entire intersection (bulb outs at all four corners). Each set of bulb outs costs between $20,000 and $40,000. As mentioned previously, it is very important to alert snow plows of the location of all neckdowns.

Pedestrian Crosswalk at Neckdown

Street Parking and Neckdown

COMPREHENSIVE TRAFFIC CALMING PROGRAMS



What is a Traffic Calming Program?
A traffic calming program establishes a comprehensive approach and community-wide policies for implementing traffic calming measures.

What are the Benefits?
A formalized program promotes the use of traffic calming solutions at problem locations and helps the community to prioritize and fund traffic calming projects. A traffic calming program establishes methods for involving the public and making sound traffic calming decisions. Formal procedures help the municipality respond to citizen requests for traffic calming installations, and ensure that new traffic calming installations are supported by the immediate neighborhood.

Traffic Calming Program in Northampton
In 2005, the City of Northampton adopted Transportation Policies that directed the Transportation and Parking Commission to develop a program for implementing traffic calming measures throughout the community. After considerable study and research, the Commission developed a Draft Northampton Traffic Calming Program document. A joint public hearing on the document was held between the Commission and the Board of Public Works (which has direct jurisdiction over city streets) in 2007 to gather public input on the proposed program. In September 2008, the Draft Northampton Traffic Calming Program was finalized and adopted by the Transportation and Parking Commission and Board of Public Works. The resulting Traffic Calming Manual, which can be downloaded from the Transportation and Parking Commission webpage,[12] was sent to the Northampton City Council for its review and potential endorsement. The city also designated staff to help coordinate the traffic calming program.

To date, the city has found it useful to have a traffic calming program with a manual and policies. In 2009, the Transportation and Parking Commission processed seven traffic calming applications. As part of this effort, the city developed a ranking sheet to help evaluate and prioritize potential traffic calming projects, as well as procedures for citizen-driven traffic calming requests. The city also created a map of primary and secondary routes for their emergency vehicles, and this map is consulted, in conjunction with discussions with emergency response personnel, to help select and design appropriate traffic calming strategies at different locations.

[12] http://www.northamptonma.gov/tpc/uploads/listWidget/6504/NorthamptonTrafficCalmingManual.pdf

An initial traffic calming request is submitted by one person (a resident, city staff, or other party) with signatures of neighborhood residents who are in support of the request. For example, the Transportation and Parking Commission received an application with approximately 200 signatures to consider traffic calming at the intersection of Prospect Avenue and Jackson Street. Other locations that have been considered through this process include State Street, the Ward three neighborhoods in the vicinity of Hawley Street and Hockanum Road, and the Bay Street neighborhoods. When considering a traffic calming application, the Transportation and Parking Commission prefers requests that have already gained community support through neighborhood networking and meetings. Once a request is placed on the Transportation and Parking Commission agenda, the applicant is asked to present its application and to demonstrate neighborhood support for the application. Next, the application is sent to the Department of Public works for an engineering assessment. A city engineer conducts traffic counts, records travel speeds, collects accident data, and assesses signage. If possible, within two months the city engineer reports back to the Transportation and Parking Commission to present the study results and recommendations. The applicants are invited to attend this meeting, and the Transportation and Parking Commission then ranks the priority of the project. If mitigation funds are available in that neighborhood, these funds may be used to pay for the project. Mitigation funds are collected by the Planning Department from development projects that affect traffic in the different neighborhoods of the city. Because mitigation funds are often not available in priority traffic calming locations, the city is considering the creation of a regular general fund budget line item for traffic calming projects.

Maintaining Traffic Calming Installations

Maintenance requirements for traffic calming installations vary. For permanent, raised installations, including crosswalks and intersections, as well as speed cushions, humps and tables, the pavement should last many years if installed properly. For installations that involve painted pavement, including crosswalks, intersections, speed tables and humps, road narrowing and roundabouts, painted markings must be refreshed from time to time. To keep markings extremely visible (e.g. for crosswalks) paint should be refreshed on an annual basis. Alternatively, specialty pavements with integrated colors cost more up front, but do not require annual repainting. These integrated pavements require periodic cleaning to reduce wear and may eventually be recoated to maintain a specific look. Finally, for installations designed with drainage in mind, occasional sweeping may be required to remove leaf buildup.

For temporary installations, including rubber speed humps or cushions, each device must be removed and reinstalled when moved to a new location, and must also be stored for winter. When removed, the bolts that hold the device to the pavement leave holes that must be filled with asphalt. It takes approximately three to four workers one day to install and half a day to uninstall a temporary speed hump.

Landscaping also requires maintenance. Traffic calming measures that may include landscaping include roundabouts, road narrowing, and pedestrian refuges. The extent and type of selected vegetation will determine maintenance requirements. If hardy, drought and salt resistant, low-maintenance vegetation is selected, the costs to maintain landscaping can be minimized. The need to replace plants that do not survive can be reduced through careful plant selection, providing sufficient space for each selected species, and adequate attention to initial plant establishment.

With regard to snow plowing, if properly installed, raised installations do not inhibit plowing. However, when neckdowns are installed, plow drivers must take care to know their locations so that the plow vehicles are not forced unexpectedly into the oncoming traffic lane. Plow drivers will want to know the locations of raised islands as well, to avoid hitting curbs.

Overall, the city has had a positive experience with its traffic calming program, and traffic calming concepts are beginning to catch on. This process has helped to promote traffic calming, involve the public and establish a decision-making process. As a result, the city has now begun to establish the track record and momentum needed to secure city funds to implement traffic calming projects.

Considerations

When establishing a traffic calming program, it is critical to balance public participation with sound traffic engineering analysis. Requests for traffic calming measures often come from neighborhood groups, but it is important to adjudicate and prioritize these requests, and to design traffic calming measures, based on data collection and skilled interpretation. The Massachusetts Highway Department Road Design Manual warns that the petition process can require significant resources and can be divisive. However, the city of Northampton has found the process to be helpful in identifying critical traffic calming locations, as well building the credibility and political support required to request general funds for the traffic calming program. Finding the right balance between citizen participation and technical assessment is part of the process of developing an effective community-wide traffic calming program.

In addition to installing traffic calming measures at problem locations, a comprehensive traffic calming program can help make roads safer to begin with by establishing a Complete Streets Policy. A Complete Street is a road that is designed with narrower travel lanes and other measures that promote safe driving, walking and biking. A Complete Streets Policy is a locally adopted policy enforced by the Planning Board, the Department of Public Works and others to ensure that new roads and major road reconstruction projects are carefully designed to balance the needs of cars, pedestrians and cyclists.

Traffic Calming and Emergency Vehicles

Because traffic calming installations are designed to slow vehicles down, they can slow emergency vehicles down as well (depending on which strategy is selected). In addition, emergency personnel often voice concerns that traffic calming installations (particularly raised installations) can cause damage to emergency vehicles. Although there is little evidence available to support or quantify the extent of emergency vehicle damage related to traffic calming measures, the potential to damage vehicles, especially larger and heavier vehicles, is certainly present if certain types of installations are taken at too great a speed.

In general, the competing interests of speed reduction and emergency response time can create friction between municipal departments and can even cause political conflicts. This makes it critical for a traffic calming program to gain the support of emergency personnel and to ensure that appropriate traffic calming strategies are selected along emergency routes. It is also important to educate emergency personnel about the benefits of traffic calming, including increased safety for pedestrians, cyclists and drivers.

To help select appropriate traffic calming strategies, a map of primary and secondary routes for emergency vehicles should be consulted. For example, while a speed hump may be appropriate for a residential neighborhood street, a speed table might be more appropriate along a secondary emergency route, and a speed cushion might be more appropriate along a primary emergency route. Alternatively, in some locations, road narrowing or horizontal displacement will be more appropriate choices than traffic calming strategies that cause vertical displacement.

In addition to consulting a map of emergency routes, input from emergency personnel should always be solicited, as site specific considerations can affect which traffic calming strategy is most appropriate in a given location. Overall, from selecting appropriate traffic calming strategies to minimizing conflict and fostering program support, successful traffic calming programs require collaboration with local emergency response personnel.

SUMMARY OF TRAFFIC CALMING TOOLS

WHAT IT IS	PROS	CONS, COSTS & CONSIDERATIONS	EXAMPLES
Raised Crosswalks			
Flat-topped speed humps with pedestrian crosswalk markings Often accompanied by signage, painted markings, and/or brick or other textured materials	Make pedestrians more visible and reduce pedestrian-related traffic accidents Reduce vehicle speeds where pedestrians cross Improve accessibility by allowing pedestrians to cross at a nearly constant grade, removing the need for a curb ramp Provide a smooth ride for larger vehicles	Not as effective at speed reduction as speed humps Potential delays to emergency vehicles Cost $4,000 to install Work well at key pedestrian crossing locations where low speeds are desired by a somewhat smooth ride is needed for larger vehicles	College Street, Amherst Jackson Street, Northampton Elm Street, Northampton
Raised Intersections			
Raised, flat area that covers an entire intersection, with ramps on all approaches Often have brick or other textured materials	Make pedestrians more visible Reduce vehicle speeds where pedestrians cross Improve accessibility by allowing pedestrians to cross at a nearly constant grade, removing the need for a curb ramp Provide a smooth ride for larger vehicles Provide traffic calming for two streets instead of one	More expensive than raised crosswalks Less effective than raised crosswalks and speed humps Work well at intersections with limited space and substantial pedestrian activity	College Street and Butterfield Terrace, Amherst
Speed Cushions			
Series of small speed bumps installed across a road with spaces between them	Slow cars, but allow emergency vehicles to straddle the cushion without slowing down Portable rubber speed cushions provide design uniformity and allow a community to relocate the device if it is ineffective	Some non-emergency vehicles are able to move to avoid or partially avoid the speed cushion Work well in areas requiring moderate speed reductions and if road is along an emergency route Tend to be less expensive than other options, but some communities have reported otherwise Installing paved cushions requires skill	Amherst (not currently out)

WHAT IT IS	PROS	CONS, COSTS & CONSIDERATIONS	EXAMPLES
Modern Roundabouts			
Road junctions where traffic is channeled in a circular direction around a central island Designed differently than older traffic circles to be safer and to handle higher traffic volumes Have *yield-at-entry* rules	Maintain a steady but slowed stream of traffic, promoting smooth movement of vehicles and minimizing queues at intersections Inexpensive to operate (versus traffic signals) Enhance safety for pedestrians and reduce accidents Can reduce the total paved area and provide aesthetic improvements Enjoy widespread public support in studies conducted one year after installation May be considered in lieu of road widening	Expensive – costs are upwards of $1.5 million dollars Negative perception of roundabouts prior to installation Must be designed with a truck apron for large vehicles to be able to navigate through May require a large right of way area or some on-street parking to be eliminated Can work well at intersections with a history of traffic accidents or backing up, to moderate traffic speeds on arterials, at intersections with irregular geometry, or in lieu of traffic signals at freeway exits	UMASS Campus, Amherst North Main Street and Bridge Road, Florence Atkins Corner, Amherst
Speed Humps and Tables			
Where the road is raised at a single location. Generally 3 to 4 inches high Speed tables are flat-topped speed humps	Relatively inexpensive Very effective at slowing traffic, reducing accidents, and sometimes can reduce cut-through traffic Temporary humps help to evaluate effectiveness If installed properly, do not inhibit plowing or proper drainage Speed tables are smoother for large vehicles	Requires resources to install and uninstall temporary speed humps, which cannot be used in winter Permanent speed humps cost about $2,000 each; Temporary speed humps cost about $5-6,000 each Speed tables are less effective than speed humps Potential delays to emergency vehicles, particularly for speed humps Good for locations with minimal conflict with ambulance routes where very low speeds are desired	Holyoke (changing locations) Vermont Street, Holyoke (speed table) Grove Street, Northampton (speed hump)
Road Narrowing			
A real or perceived reduction in road width May involve reducing travel lane width, often to 10 feet	Reduces vehicle speeds and accidents Makes slower speeds and yielding to pedestrians more natural to drivers Versatile tool, and can be inexpensive if repainting lane markings or allowing on-street parking	Can be expensive, e.g. streetscape improvements Can take a long time to achieve goals, e.g. if changing building setback distances Can be used to establish bicycle lanes	West Farms Road, Northampton Prospect Avenue, Northampton Dwight Street, Holyoke

WHAT IT IS	PROS	CONS, COSTS & CONSIDERATIONS	EXAMPLES
Pedestrian Refuges			
Raised islands located at the center of a street to narrow travel lanes and provide a resting place for pedestrians Often landscaped	Enhance pedestrian safety and experience Reduce vehicle speeds, accidents and traffic volumes Make slower speeds and yielding to pedestrians more natural to drivers If landscaped, provide aesthetic benefits	Speed reduction effect is moderate Small pedestrian islands cost approximately $5-15,000 Can be expensive if part of larger road reconstruction project – e.g. in Holyoke, $675,000 to reconstruct 1,000 linear feet of roadway Can work well at key pedestrian crossing points	Resnic Boulevard and Pine Street, Holyoke
Neckdowns			
Extensions, or bulb outs, of the curb at intersections in order to narrow the roadway	Make intersections safer for pedestrians Slow cars down through road narrowing and reduction of turning radius Reducing the pedestrian crossing distance Can be negotiated by large vehicles Easy to simulate a neckdown with a concrete planter barrel to test a potential location	Plow drivers must know the locations of curb extensions, which are buried under snow – Hitting one pushes the plow to the left, which has the potential to cause traffic accidents May require bicyclists to merge with auto traffic Cost $20-40,000 per set of curb extensions Can work well at key pedestrian crossing points	Holyoke Street, Holyoke
Comprehensive Traffic Calming Program			
A comprehensive approach and community-wide policies for implementing traffic calming measures	Promotes use of traffic calming Helps the community prioritize and fund projects Establishes methods for involving the public and making sound decisions Public process helps the municipality respond to resident concerns, identify potential locations, and build political support needed to allocate funds	May use existing staff or require additional staff resources A public petition process requires resources and can be divisive It is critical to balance public participation with sound traffic engineering analysis	Northampton[13]

[13] http://www.northamptonma.gov/tpc/uploads/listWidget/6504/NorthamptonTrafficCalmingManual.pdf

Additional Resources

Massachusetts Highway Department Road Design Manual
http://www.vhb.com/mhdGuide/mhd_Guidebook.asp

City of Northampton Traffic Calming Manual
http://www.northamptonma.gov/tpc/uploads/listWidget/6504/NorthamptonTrafficCalmingManual.pdf

TrafficCalming.org, Fehr & Peters Transportation Consultants, Walnut Creek, CA, 2005
www.trafficcalming.org

Manual on Uniform Traffic Control Devices (MUTCD)
http://mutcd.fhwa.dot.gov/

National Complete Streets Coalition
http://www.completestreets.org/

Institute of Transportation Engineers
http://www.ite.org/traffic/