CITY OF McMinnville OREGON

Transportation System Plan

Appendix I
Neighborhood Traffic Calming Program

transpoGROUP

I Neighborhood Traffic Calming Program

This appendix summarizes the McMinnville Neighborhood Traffic Calming Program, including Policy Process and Guidance for Implementation. These documents were originally prepared in 2005 for the City of McMinnville by Kittelson & Associates.

City of McMinnville

Traffic Calming Devices

Policy Process Document

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

City of McMinneville, Oregon

Traffic Calming Devices

Policy Process Document

2006

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Neighborhood Traffic Calming Program

Cars provide 21st century society with tremendous mobility and accessibility. But the benefits of vehicle travel have potentially negative impacts as well. In some cases, as motorists travel through residential streets, the speeds can be too high, or too many motorists can be using a street intended for lower volumes of traffic. These speeding motorists and high traffic volumes can decrease the livability and safety along residential streets.

Traffic calming tools are available to reduce the negative effects of automobile use and help restore the proper balance between automobiles and people in a neighborhood. Common traffic calming tools include speed humps, neighborhood traffic circles, curb extensions, and medians, although there are many other less commonly used devices available. Properly implemented, traffic calming measures improve the safety and comfort of pedestrians, bicyclists, and motorists alike. The City of McMinnville recognizes the potential benefits to quality of life that traffic calming offers and developed the Neighborhood Traffic Calming Program (NTCP) to guide future consideration of traffic calming in McMinnville.

NTCP Policy Statement

The following policies will apply to the evaluation and design of potential traffic calming devices within McMinnville:

- Only streets with functional classifications of "local" or "minor collector" are covered under the NTCP. Higher order and commercial streets may have traffic problems that warrant traffic calming. However, developing solutions in these situations requires a citywide rather than neighborhood initiative, as these roadways serve the travel needs of, and are destinations for, multiple neighborhoods.
- Residential streets should primarily serve vehicles traveling to a local destination, while the arterial network should serve trips of a regional nature to the extent possible. Where this does not occur, the NTCP may be used to address the issue of "cut-through" traffic.
- Traffic speeds exceeding the speed limit decrease safety and livability for residents. The NTCP is an appropriate tool to use to address speeding problems.
- Traffic calming plans will consider effects on neighboring roadways and develop solutions with a system-wide perspective to ensure that problems are solved rather than simply shifted to adjacent streets or neighborhoods.
- Traffic calming plans will preserve emergency vehicle access to meet City standards. To ensure that this goal is met, traffic calming plan development will actively include representatives from the Police and Fire Departments.
- Citizens will be involved at all stages of the NTCP process. The program will rely on citizen input to identify problems and develop appropriate context-sensitive solutions that satisfy neighborhood needs.

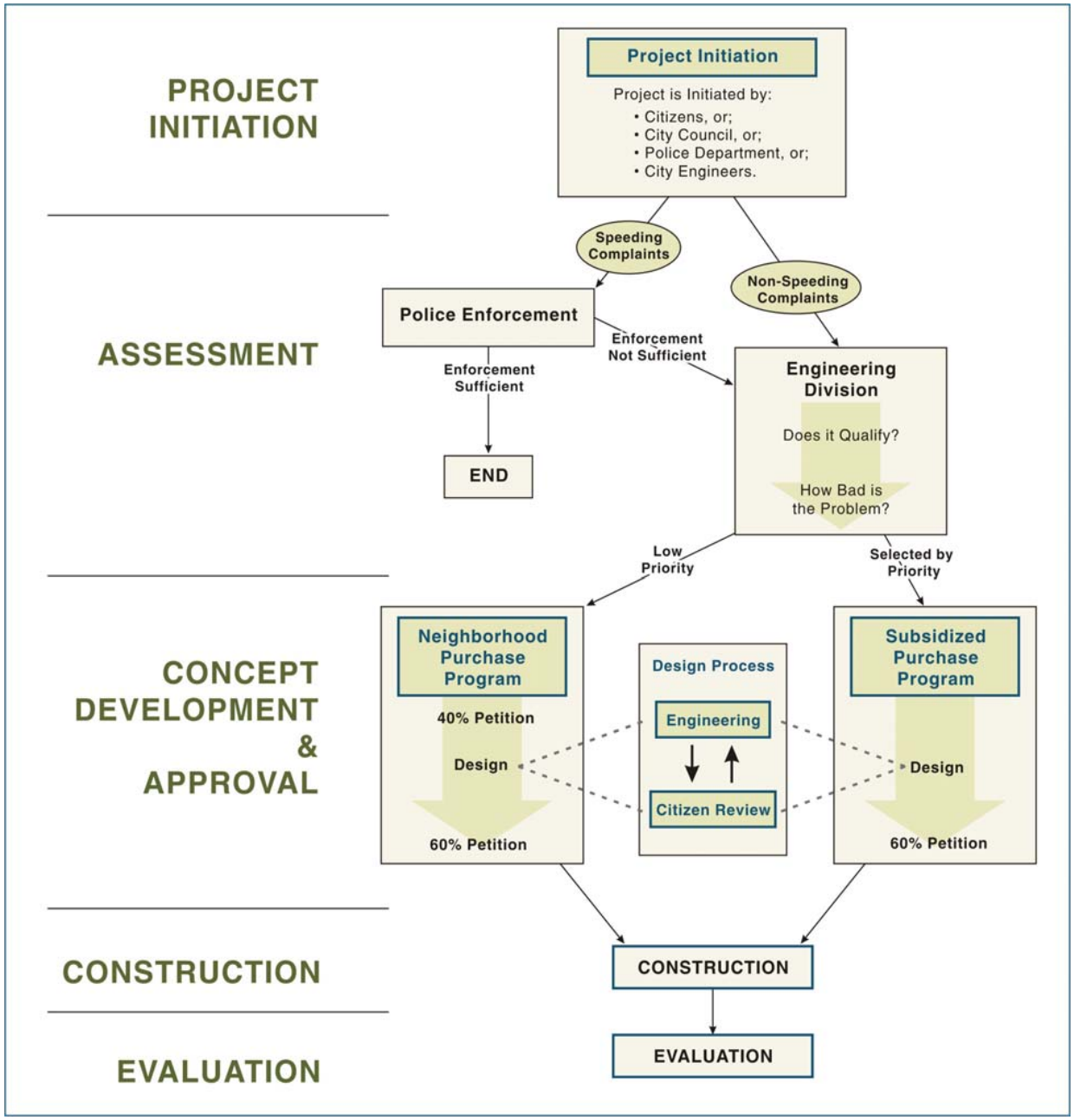
- Requests for traffic calming will be evaluated using the process outlined in the Neighborhood Traffic Calming Program Process.

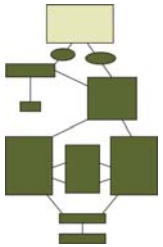
NTCP Process

The NTCP Process informs citizens of the process that will guide planning and prioritization of future traffic calming projects. This process allows the city to work closely with residents to identify and seek solutions to traffic problems in McMinnville.

The NTCP process relies on citizen participation. Past experience with traffic calming shows that citizen participation is a necessary element in successful traffic calming projects. Meaningful citizen participation ensures accurate identification of problems and potential solutions and decreases the chance for future removal of traffic calming measures.

The NTCP process outlined schematically in Figure 1 has been developed to facilitate collaboration between residents and City Staff, and to allow City Staff to develop priorities for funding improvements in an open process. The following provides a more detailed description of each step in the NTCP process.





Step 1: Initiation

A project can be initiated in one of four ways:

- By a citizen, group of citizens, or neighborhood association. A valid request requires a petition with signatures from at least 10 households. The petition must include a statement specifically identifying the nature of the complaint (e.g., speeds, volumes, etc.).
- The McMinnville Police Department may initiate a project based on field observations.
- The City's Engineering Division may initiate a project based on field observations.

The City Council may refer streets to the relevant department for further evaluation.

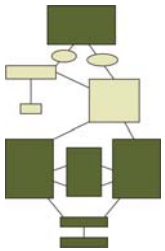
Complaints regarding speeding will be directed to the Police Department, while other complaints will be handled by the Engineering Division. Upon reception of a speeding complaint, the Police Department will conduct speed enforcement along the segment on at least three separate occasions. Based on observations and data collected during the enforcements, the Police Department will determine whether to refer the complaint to the Engineering Division for possible traffic calming treatment.

The Engineering Division will evaluate all non-speeding complaints and any traffic speed complaints referred by the Police Department. All streets will be analyzed as segments. The Engineering Division will define segments on a case-by-case basis based on the nature of the complaint. Typically, segments will respect natural barriers, will not cross major streets, and will only operate under one functional classification.

The Engineering Division will first verify that the street in question qualifies for traffic calming under the NTCP. In order to qualify for the NTCP, a street segment must satisfy the following conditions:

The functional classification for the street in the adopted McMinnville Transportation System Plan is either "Local Street" or "Minor Collector."

At least 75% of the adjacent land-use along the street segment is either residential or zoned for residential use.



Step 2: Preliminary Evaluation

Once the Engineering Division verifies that a segment qualifies for the NTCP, they will collect data to determine the extent of the traffic problem. The following data will be collected:

- Traffic speeds
- Traffic volumes
- Physical characteristics (e.g. number of lanes, extent of bike lanes or sidewalks, etc.)
- Other data deemed pertinent by the Engineering Division

The NTCP offers two ways for a neighborhood to receive traffic calming: the Neighborhood Purchase Program, where neighborhoods pay the full cost of improvements; and the City Subsidized Program, where costs are shared between the City and neighborhoods. Only the highest priority segments will qualify for the City Subsidized Program.

Table 1 shows the criteria for each program. Where sidewalks are missing from one or both sides of the street segment but the speed or volume criteria are not met, that segment qualifies for the Neighborhood Purchase Program. However, the only traffic calming device that can be purchased in this case is sidewalks.

The following sections describe the City Subsidized and Neighborhood Purchase programs.

City Subsidized Program

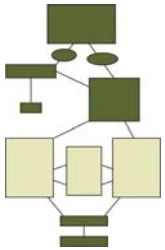
Step 3: Prioritization

Street segments that qualify for the City Subsidized Program will be prioritized by the City Engineering Division to determine the order in which problems will be addressed. This ensures that the most significant traffic problems are addressed first. The Engineering Division will score each segment based on the rating system shown in Table 2.

In situations where a project's priority is low and a neighborhood would like to expedite the process, the neighborhood may choose to utilize the Neighborhood Purchase Program to obtain the desired traffic calming.

Table 1 --Program Criteria

Criteria	Programs
85th percentile speed more than 5 mph higher than posted speed limit	Both
ADT greater than 1,000	Both
No sidewalk on one or both sides of the street	Neighborhood Purchase Program



Step 4: Design/Costing

Once the Engineering Division initiates a project from the prioritized list, the Engineering Division will identify the households included in the project area. The Engineering Division will determine the project area on a case-by-case basis. Typically, the project area will include all households within 300 feet or within one block of the segment; project areas for collector streets may be significantly larger.

Next, the City will schedule an open house to discuss the project. Households within the project area will be notified of the open house. The first open house will familiarize the citizens in the project area with the traffic calming process and give citizens an opportunity to ask questions or voice concerns about the project under consideration. The City will also use the open house to provide an overview of different traffic calming measures and potential options for the segment in question.

There are many different traffic calming tools that can be used to address neighborhood traffic concerns. While speed humps are an effective and popular method of traffic calming, many projects will require different solutions. An implementation guidance document for traffic calming devices is given in Appendix "A" to help guide the design process. The guidance document provides only general information for the most common traffic calming measures and is not intended to be comprehensive. The absence of a device from the guidance document does not preclude its incorporation into a project.

Minor collectors will qualify for a limited number of traffic calming devices. Because these streets are designed to carry higher traffic volumes and handle emergency vehicles on a regular basis, not all traffic calming tools are appropriate. Approved devices for minor collectors will typically include horizontal deflection devices, but may include vertical deflection in certain instances. Local streets that are not on emergency response routes qualify for all types of traffic calming devices. The City Traffic Engineer will use engineering judgment to make the final determination on the appropriateness of devices.

Additionally, a Neighborhood Advisory Committee (NAC) will be established at the first open house. Ideally, the NAC will comprise residents of the project area and have between five and ten members. The NAC will work with the Engineering Division during the design and costing process to ensure that neighborhood concerns are taken into account.

The NAC will work with the City following the open house to develop a preliminary design for the street segment, including a cost estimate. The fire department will be included in this, and all other phases of the design. The Engineering Division should provide guidance on the project costs that the City is willing to pay. Where possible, plans should focus on developing a series of treatments rather than a single device. Because traffic problems typically occur along an entire segment, treatments must address the entire segment as well. Depending on the nature of the problem, traffic calming treatments may be required every several hundred feet.

Once the preliminary design is complete, a second open house will be scheduled for residents of the project area. This open house will allow the NAC and City to gather feedback and suggestions on the preliminary design.

The Engineering Division, with assistance from the NAC and representatives of the fire department, will prepare design plans for the project based on comments from the second open house. The plans will also include a cost estimate. At this point, the Engineering Division must declare what portion of the project cost the City will pay. The residents of the project area will be responsible for paying the remaining costs. The City will base its

Table 2 -- Project Scoring

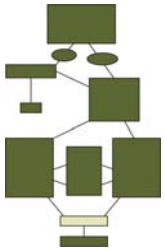
Category	Points	Basis for Point Assignment
85th Percentile Speed	0-40	4 points for every mph greater than 5 mph over the posted speed limit.
Average Daily Traffic Volume	0-20	1 point for every 200 vehicles.
Sidewalks	0-20	Segments will be awarded 1 point for every 5 percentage points of missing sidewalk coverage. Segments with no sidewalks would receive 20 points while a segment with a sidewalk on only one side would receive 10 points.
Pedestrian Generators	0-20	5 points for each school, school crossing, church, library, park or community center on street segment (20 points maximum).
Total Possible Points:	100	

contribution on available funding and project priority.

Step 5: Approval/Payment

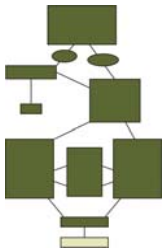
Before a project can be approved, a petition must be signed by at least 60% of households in the project area. The City's Engineering Division will prepare the petitions and project information for distribution by the NAC. The NAC is also required to raise the neighborhood's share of the project cost before construction begins, if neighborhood funding is being utilized.

The neighborhood share can be raised in any number of ways, and need not come entirely from within the neighborhood. Residents of other cities have had success using bake sales and garage sales as a means to raise money for traffic calming projects. The NAC has one year from submittal of a valid petition to raise the required money and deposit it in a bank of good standing.



Step 6: Construction

When the project has been approved and the necessary neighborhood contributions have been raised, the City will prepare detailed plans for constructions. The plans will be reviewed by all affected City Departments prior to construction. Once the detailed plans are reviewed, City crews or contractors will install the traffic calming devices.



Step 7: Evaluation

The Engineering Division will collect speed and volume data for the street segment once at six months and again at one year after installation is complete. The City will also seek comments from residents regarding the project. The City will document the results of this data collection effort. This data will help the City determine the effectiveness of the traffic calming measures, which will benefit future traffic calming projects.

Neighborhood Purchase Program

The Neighborhood Purchase Program follows the same steps as the City Subsidized Program with the major exception that the City is not expected to pay any construction costs. Additionally, 40% of the households in a project area must sign a petition prior to the design phase stating that they are interested in pursuing the Neighborhood Purchase Program and understand the neighborhood's financial responsibilities. Requiring this preliminary show of support keeps the City and neighborhoods from spending considerable amounts of time designing projects with low levels of support.

City of McMinnville

Traffic Calming Devices

Guidance for Implementation

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

City of McMinnville, Oregon

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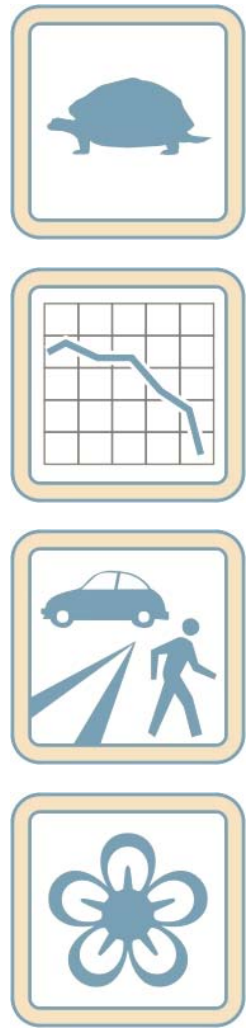

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Benefits of traffic calming are represented by a set of four icons:


Speed reduction


Traffic Volume Reduction


Conflict Reduction


Opportunity for Landscaping

These Icons appear in full color intensity when the benefit level is high and in a faded color when the technique yields only a minor benefit.

Guidance for Implementation of Traffic Calming Devices

Categories of Devices

Traffic calming devices fall into 3 general categories:

- Vertical Deflection
- Horizontal Deflection
- Obstruction

Good traffic calming plans have a combination of devices from more than one of these categories and the devices are implemented from a systemwide perspective.

Vertical deflection techniques include speed humps, and are the most commonly used method of traffic calming. Vertical devices cause drivers to slow down by altering the surface of the roadway, making high-speed travel unpleasant. They are the most proven method of reducing driver speeds.

Horizontal devices protrude into the travelway from the curb or the median, forcing drivers to alter their paths. In addition to slowing drivers, horizontal traffic calming can increase the visibility of pedestrians and keep drivers attentive. They are typically not as successful as vertical devices in reducing speeds.

Obstructions are used to restrict automobiles from making certain movements, and can sometimes be used to close a street segment entirely. They are generally considered the most drastic type of traffic calming, as they can decrease mobility substantially.

The following pages give more complete descriptions of the most typical traffic calming devices, as well as general guidelines on costs and implementation. This document cannot cover all devices, nor can it provide detailed designs or costing, as the individual needs of each project will be different. The guidance provided here simply gives an overview of common traffic calming devices.

Information found in this document relied substantially on the following sources:

http://www.trafficcalming.org

Institute of Transportation Engineers, *Canadian Guide to Neighbourhood Traffic Calming*, Ottawa, Canada, 1998.

Cost Estimates also used information provided by the City of Portland Office of Transportation.

Vertical Deflection Techniques

Vertical deflection techniques change the surface of the roadway, typically by raising it. Drivers must slow down to travel over the vertical deflection to avoid an uncomfortable bump. Additionally, vertical traffic calming devices may be used in conjunction with crosswalks to improve the visibility of pedestrians. In this case, crosswalks are placed along the top of the vertical deflection, thus placing pedestrians more squarely in drivers' fields of vision. Vertical deflection techniques are most often applied to lower speeds and improve pedestrian crossings.

Common Vertical Deflection Techniques

Speed Hump

Description:	Speed humps are raised area s of the roadway that vertically deflect the wheels of traversing vehicles. Their purpose is to reduce vehicle speeds.
Effectiveness:	Numerous studies have shown speed humps to be among the most effective tools to reduce speeds. Size and spacing of the humps determines the extent of speed reduction.
Disadvantages:	Speed humps can lead to increased noise from braking and accelerating and adversely affect emergency vehicles response times.
Design Guidelines:	Speed humps of different sizes are available to create different effects. Narrower and higher humps result in the most speed reduction. Speed humps should be installed in a series rather than alone. The size and spacing of humps must be tailored to the roadway's desired speed Typical spacing between humps ranges from 200 to 600 feet. Shorter spacings result in lower travel speeds Short spacing and narrow humps can be used to reduce speed to as low as 20mph. Where desired speeds are higher, hump spacing should be increased. In general speed humps should not be used where desired speeds are higher than 30mph. Placement typically includes advanced signage, and striping on the hump to advise motorists and cyclists of the location of the bump.
Location Principles:	Speed humps should not be placed within 50 ft. of intersections along local streets or within 100 ft. of intersections along collectors. Where possible, avoid steep grades and driveways. Typically more than an 8% slope is considered too steep for speed bumps Drainage inlets should be avoided if possible, and curb clearance should be adequate to allow for drainage. Placement near streetlights enhances visibility.
Approximate Cost:	$2,000

Speed Humps Variations for Emergency-Vehicles

There are several variations of speed hump design that address concerns related to emergency vehicles and other heavy vehicles.

An emergency split-hump is a variation of the traditional speed hump, where a hump is placed on only one side street and offset from a hump on the opposite side of the street. The advantage of this type of placement is that emergency vehicles can weave around the humps rather than travel over them, thus reducing the negative impact to emergency response times. Humps are typically accompanied by median islands to prevent vehicles from avoiding the hump.

Similarly, Albany, Oregon has successfully employed a speed hump with a center piece missing just large enough for an emergency vehicle to pass through unimpeded by traveling in the center of the roadway.

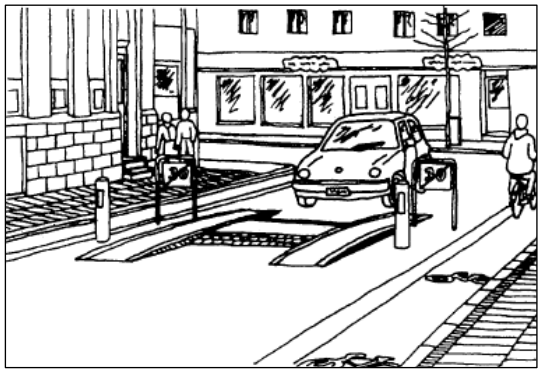
Split-humps and other emergency-vehicle friendly speed humps may be

appropriate on collectors or other emergency response routes where speed humps would otherwise be inappropriate. Costs of these measures are similar, though somewhat higher, to the cost of a traditional speed hump. Placement on local streets should be avoided, as low traffic volumes will encourage cars to take advantage of the provisions for emergency vehicles.

Another speed hump variation that is appropriate for emergency vehicles and other heavy vehicles is the combi hump, which has been used in Denmark. The design includes three humps: one for cars (in the middle) and two for heavy vehicles (either side of the hump for cars). The hump for cars is more severe than that for heavy vehicles. Cars are forced to travel over the more severe hump because their wheel bases are not wide enough to allow them to take advantage of the heavy vehicle humps.

Examples of Speed Hump Variations

Split-Hump



Combi Hump

Raised Crosswalk

Description:	Raised crosswalks are marked pedestrian crosswalks constructed at a higher elevation than the adjacent street. Their purpose is to reduce vehicle speeds and improve the safety and comfort of pedestrians.
Effectiveness:	Similar effect on traffic speeds as speed humps. However, as raised crosswalks are not typically placed in a series, speed reduction is diminished. Raised crosswalks also improve pedestrian comfort and visibility crossing the street.
Disadvantages:	Raised crosswalks can lead to increased noise from braking and accelerating and adversely affect emergency vehicles response times. Speed reduction is isolated to the immediate vicinity of the device
Design Guidelines:	Like speed humps, raised crosswalks should not be used where desired speeds are higher than 30 mph or on steep grades. Catch-basins should be installed on uphill edge of crosswalk, as the crosswalk must extend to the curb. Placement typically includes advanced signage to advise motorists and cyclists of the upcoming speed hump, and striping to delineate the crosswalk area. Pedestrian crosswalk signs are required at uncontrolled locations. Curb extensions and/or medians may be combined with raised crosswalks to assure appropriate visibility.
Location Principles:	Raised crosswalks should be located at intersections or at mid-block locations with high pedestrian volumes (e.g. near schools or parks). In mid-block locations special consideration should be given to whether or not a mid-block crossing is appropriate Curb extensions and/or medians may be combined with raised crosswalks to assure appropriate visibility.
Approximate Cost:	$3,000

Speed Table

Description:	Speed tables are similar to raised crosswalks except that they are wider and have a trapezoidal shape. They are intended to improve pedestrians' abilities to cross the street safely and securely.
Effectiveness:	Speed tables have a smaller effect on speeds than raised crosswalks do, as the vertical change is not as great. Mainly, speed tables improve pedestrian comfort and visibility crossing the street.
Disadvantages:	Speed tables have a small negative effect on emergency vehicles.
Design Guidelines:	Like speed humps, speed tables should not be used where desired speeds are higher than 30 mph. Catch-basins should be installed on uphill edge of crosswalk, as the crosswalk must extend to the curb.
Location Principles:	Speed tables should be located at intersections or at mid-block locations with high pedestrian volumes (e.g. near schools or parks). In mid-block locations special consideration should be given to whether or not a mid-block crossing is appropriate Placement typically includes advanced signage to advise motorists and cyclists of the upcoming speed hump, and striping to delineate the crosswalk area. Pedestrian crosswalk signs are required at uncontrolled locations. Curb extensions and/or medians may be combined with speed tables to assure appropriate visibility.
Approximate Cost:	$2,500

Raised Intersection

Description:	Raised intersections are entire intersections, including crosswalks, that are constructed at a higher elevation than adjacent roadways. The intent of raised intersections is to reduce vehicle speeds and better define crosswalk areas.
Effectiveness:	Raised intersections have been shown to decrease traffic speeds. They also serve to better define pedestrian areas. Speed reduction is in the immediate vicinity of the intersection
Disadvantages:	Speed tables have a small negative effect on emergency vehicles. Cost of raised intersections is high compared to other measures.
Design Guidelines:	Raised intersections should not be installed where desired speed is greater than 30 mph. Raised intersections are most applicable on narrow streets, as costs increase quickly as with wider streets. The height of a raised intersection should match the existing sidewalk heights. Placement typically includes advanced signage for uncontrolled approaches to advise motorists and cyclists of the upcoming speed hump, and striping to delineate the transition areas.
Location Principles:	Raised intersections are appropriate at intersections along local and collector residential streets.
Approximate Cost:	$20,000 - $75,000, varies considerably based on the size of the intersection

Textured Crosswalk

Description:	Textured crosswalks are crosswalks that incorporate textured or patterned surfaces providing visual contrast with adjacent roadways. They are intended to more clearly delineate pedestrian crossing areas.
Effectiveness:	Textured crosswalks have no effect on vehicle speeds or volumes. They may improve pedestrian crossing abilities and street appearance.
Disadvantages:	Texturing may be uncomfortable for bicyclists and those people in wheelchairs or strollers. Also, some texturing may wear down quickly.
Design Guidelines:	Texturing on crosswalks should be on the edges, while the center is smooth. Smooth surfaces provide stable footing and are more comfortable for people in wheelchairs and strollers.
Location Principles:	Textured crosswalks should be located at intersections where crosswalks need delineation. Mid-block locations are often not appropriate for textured crosswalks, unless they are combined with curb extensions or medians to create additional motorist awareness.
Approximate Cost:	$2,000

Horizontal Deflection Techniques

Horizontal deflection techniques are used to narrow and/or curve the vehicle travelway. Altering the roadway in this manner forces drivers to use caution and slow down. Cautious drivers are more aware of their surroundings and thus able to react quickly to potentially dangerous situations. Additionally, horizontal devices narrows the driver's field of vision and focuses their attention on the street. When combined with a crosswalk, horizontal traffic calming also reduces pedestrian crossing distances, making crossing the street safer and easier.

Typically, horizontal techniques are used where pedestrian crossings are particularly long or challenging and where speeds are high. Horizontal traffic calming may also be applied in some cases where vertical techniques are undesirable because of negative effects on emergency vehicles.

Generally, horizontal traffic calming tools work best in a series of varying devices (horizontal and vertical), rather than as standalone devices. Good plans may accommodate several types of horizontal traffic calming on one road segment.

Common Horizontal Deflection Techniques

On-street Parking

Description:	On-street parking reduces the available roadway width for automobile travel by allowing curb-side parallel parking. This is intended to slow motor vehicles and provide a buffer between the sidewalk and the travel-way.
Effectiveness:	On-street parking is an inexpensive measure to implement, and can result in significantly lowered speeds where the parking is well-utilized.
Disadvantages:	There may not be enough demand for on-street parking to make a significant difference to street characteristics.
Design Guidelines:	Decisions on allowing on-street parking must consider the available right-of-way on a street. On-street parking on one side of a roadway requires approximately 8 feet of right-of-way. In some cases, on-street parking would reduce the available travel-way to unacceptable levels. On very wide streets, however, on-street parking may not narrow the roadway sufficiently to reduce traffic speeds.
Location Principles:	On-street parking should not be allowed within 20 feet of a stop sign or crosswalk. Areas that have poor sight-distance may not be appropriate locations for on-street parking.
Approximate Cost:	$75 per sign. Number of signs needed varies based on segment length.

Raised Median Island

Description:	Raised median islands are elevated median constructed along the centerline of a roadway. Their purpose is to lower traffic speeds and improve the ability of pedestrians to cross the street by narrowing travel lanes and and the driver's field of vision.
Effectiveness:	Raised median islands have been shown to reduce vehicle speeds moderately. There are documented safety benefits for pedestrians of raised medians. However, these findings have not been specifically applied to raised median islands.
Disadvantages:	Raised median islands may require removal of on-street parking. In some cases, median islands can result in increased bicycle-motorist conflicts.
Design Guidelines:	On collectors, raised median islands can be used in conjunction with crosswalks to reduce speeds and improve pedestrian crossings. Median islands can create conflicts between bicyclists and motorists that should be considered during design. On collectors, median islands may be accompanied by bike lanes to reduce this effect. On local streets, raised median islands should be used to reduce traffic speed. Median islands should include "Keep Right" signs to direct traffic around the island. Stopping should be prohibited in the area of the median island. Roadway markings on local streets indicating the presence of cyclists can help reduce bicycle-automobile conflicts.
Location Principles:	Raised median islands are typically placed at on either side of an intersection or at mid-block locations, especially where there are high pedestrian volumes. Here they can be used to improve the safety of marked crosswalks.
Approximate Cost:	$12,000 - $25,000, depending on the size of the island

Neighborhood Traffic Circle

Description:	A neighborhood traffic circle is a raised island in the center of an intersection that forces cars to travel through the intersection in a counterclockwise direction. The purpose of a traffic circle is to reduce speeds and the number of conflicts. Neighborhood traffic circles differ from roundabouts in that they have no splitter islands, or yield lines, have much smaller radiuses, and are intended for low-volume intersections
Effectiveness:	Traffic circles have significant benefits for reducing speeds and crashes. Speed reduction is in the immediate vicinity of the intersection unless incorporated into a series of traffic calming devices.
Disadvantages:	Traffic circles can be difficult for emergency vehicles and trucks to navigate because of the small turning radii that traffic circles require. Some bicyclists feel that they create cyclist-motorist pinch-points where drivers tend to swerve into the path of cyclists.
Design Guidelines:	An intersection should have similar traffic volumes on all approaches when a traffic circle is considered. Otherwise, traffic on the higher-volume approach may fail to yield. Maintenance provider should be firmly established in the design phase for landscaped traffic circles. No advance signs are required. Yield-control is recommended on all approaches.
Location Principles:	Traffic circles can be placed at intersections along local and collector streets.
Approximate Cost:	$25,000

Curb Extension

Description:	A curb extension is a horizontal extension of the curb into the roadway. Their purpose is to lower traffic speeds and, when used in conjunction with crosswalks, reduce the crossing distance for pedestrians.
Effectiveness:	Curb extensions have been shown to reduce vehicle speeds moderately. They also reduce pedestrian crossing distance and increase the visibility of pedestrians.
Disadvantages:	Curb extensions are not compatible with bike lanes. Additionally, installation of curb extensions often requires removal of some street parking.
Design Guidelines:	Curb extensions are most effective where pedestrians have difficulty crossing the street. When used without crosswalks, curb extensions should be placed in series with other horizontal traffic calming devices such as traffic circles and median islands. Curb clearances to allow for drainage should be provided or the extension must include curb and gutter. Object markers or delineation markers are optional for curb extensions.
Location Principles:	When used in conjunction with a crosswalk, curb extensions should be placed at intersections or at mid-block locations where there are high pedestrian volumes. Here they can be used to improve the safety of marked crosswalks. Curb extensions without crosswalks should be placed in series at mid-block locations.
Approximate Cost:	$15,000

Chicane

Description:	A chicane is a series of curb extensions on alternating sides of the roadways. They force drivers to navigate them by weaving back and forth. Chicanes are used to reduce cut-through traffic, and reduce travel speeds.
Effectiveness:	Chicanes are very effective at both reducing travel speeds and traffic volumes. One-lane chicanes, where cars traveling in opposite directions cannot pass through the chicane simultaneously, are most effective. Chicanes have been shown to reduce crashes as well.
Disadvantages:	Chicanes may divert traffic to adjacent local streets. They can also create conflicts between bicyclists and motorists and require the removal of on-street parking.
Design Guidelines:	Chicanes should only be applied where desired speeds are 30 mph or less. They should be placed close to streetlights for visibility and are not advisable on streets with steep grades. A chicane should consist of at least 3 curb extensions. To reduce bicycle-automobile conflicts, bicycle bypasses that don't require cyclists to traverse the chicane should be used wherever possible. Design should include curb clearance adequate for drainage. Chicanes require signing to prohibit parking or stopping within the chicane. Two-way, one-lane chicanes also require signs notifying drivers to yield to oncoming traffic.
Location Principles:	Chicanes should be placed at mid-block locations, no closer than 70 ft to the nearest intersection.
Approximate Cost:	$10,000 - $30,000, depending on the landscaping required and the roadway width.

Obstructions

Obstructions are used to physically restrict allowable movements for motor vehicles. This can range from simply disallowing a left-turn to completely closing a street. Because obstructions necessarily reduce connectivity and emergency vehicle access, they should be considered only where vertical or horizontal traffic calming would not be effective. However, they are an effective method of reducing traffic volumes.

There are two primary uses for obstructions: to divert cut-through traffic to a higher-order facility and to reduce traffic volumes on bicycle boulevards. Consequently, obstructions are most applicable on local streets rather than collectors.

When planning obstructions, it is important to maintain bicycle and pedestrian connectivity even while reducing automobile connectivity. This makes non-motorized modes relatively more attractive, and may increase the number of people choosing to walk or bike to their destinations.

Allowing for Bicycle Access

Examples of Obstruction Techniques

Directional Closure

Description:	A directional closure is a vertical barrier extending to the center of a roadway, effectively obstructing one direction of traffic. The purpose of a directional closure is to divert through traffic to another street.
Effectiveness:	Directional closures are very effective in reducing traffic volumes. They are also associated with moderate reductions in speed.
Disadvantages:	Directional closures reduce access for residents and may divert traffic to adjacent streets that are not traffic calmed.
Design Guidelines:	Directional closures are ideally placed at intersections between local streets and higher order roadways, with the local street receiving the treatment. This has the effect of guiding traffic onto higher-order roadways. Designs should incorporate bicycle access and allow for emergency vehicle circumvention. Signing indicating the closure and allowable turns to motorists must be provided for directional closures. Pavement markings indicating bicycle access may accompany a directional closure.
Location Principles:	Directional closures should prevent entrances to a street, rather than exits. This prevents drivers from mistakenly entering a dead-end street.
Approximate Cost:	$15,000

Intersection Channelization

Description:	Intersection channelization uses raised islands to physically obstruct and direct traffic in an intersection The purpose of channelization is to divert through traffic to another street.
Effectiveness:	Intersection channelization effectively reduces traffic volumes. Channelization can also provide refuge islands for pedestrians.
Disadvantages:	Intersection channelization reduces access for residents and may divert traffic to adjacent streets that are not traffic calmed.
Design Guidelines:	Channelization at intersections between local streets with low volumes should be avoided, as many drivers will likely circumvent the obstructions. Design of channelization should provide for bicycle access always and pedestrian refuge islands where applicable. Signing is required for intersection channelization to notify motorists of allowable movements.
Location Principles:	Channelization is ideally placed at intersections between local streets and higher order roadways, with the local street receiving the treatment.
Approximate Cost:	$10,000

Raised Median through Intersection

Description:	A raised median through an intersection is an elevated median placed along the centerline of a roadway that prevents left-turns and through movements between the intersecting streets. Their purpose is to divert through traffic to another street.
Effectiveness:	Raised medians are very effective at reducing traffic volumes, as the devices are typically difficult to circumvent.
Disadvantages:	Raised medians reduce access for residents and emergency vehicles and may divert traffic to adjacent streets that are not traffic calmed.
Design Guidelines:	Design of raised medians should provide for bicycle access and handicap-accessible pedestrian refuge islands. The medians should extend at least 15 feet beyond the intersection to prevent driver circumvention.
Location Principles:	Raised medians are ideally placed at intersections between local streets and higher order roadways, with movements to and from the local street being restricted. Median islands require “Keep Right” signs to guide motorists around the median. Minor-street approaches require signs notifying drivers that they must turn right at the intersection.
Approximate Cost:	$8,000

Diverter

Description:	A diverter is a raised barrier placed across an intersection such that all traffic is prevented from traveling straight through the intersection. Diverters are used to reduce cut-through traffic from neighborhood streets.
Effectiveness:	Diverters can reduce traffic volumes by as much as 70%, as the devices are typically difficult to circumvent.
Disadvantages:	Diverters reduce access for residents and emergency vehicles and may divert tr affic to adjacent streets that are not traffic calmed.
Design Guidelines:	Design of diverters should provide for full bicycle access through the diverter. Because diverters increase emergency response time, diverters should be used only when problems are severe. Neighborhoods with multiple diverters may have significantly reduced connectivity. Diverters require “Single Curve” signs advising motorists of the upcoming turn. Signs to prohibit parking in the diverter area are also required.
Location Principles:	Diverters should be placed at intersections between local streets on streets with cut-through traffic problems.
Approximate Cost:	$10,000

Full Closure

Description:	Full closures are physical obstructions that completely close off entrances and exits from one end of a street segment. Full closures are used to reduce cut-through traffic from neighborhood streets.
Effectiveness:	Full closures are an extremely effective means of reducing traffic on a local street. However, they are not appropriate for multiple streets in a single area.
Disadvantages:	Full closures reduce access for residents, and may delay emergency vehicles and divert traffic to adjacent streets that are not traffic calmed.
Design Guidelines:	Design of full closures should provide for full bicycle access through the closure. Designs should also seek to accommodate emergency vehicles. Dead-ends should be signed with cul-de-sac signs notifying drivers of the upcoming closure.
Location Principles:	Full closures may be used on local streets with severe cut-through traffic problems. They are not appropriate for collectors.
Approximate Cost:	$10,000

Summary of Issues

Determining appropriate traffic calming devices for a particular situation is not a purely objective exercise. Multiple devices may be able to solve a problem from an engineering perspective; final selection of a design will thus be based on other considerations as well, such as cost, aesthetic impact, and public opinion.

Traffic calming plans must also be developed with a systemwide perspective. Poorly designed traffic calming can simply shift problems to parallel streets and adjacent neighborhoods rather than solve them. For this reason, techniques that divert considerable amounts of traffic should only be used where traffic volumes are unacceptably high. In these cases, diverted traffic should be focused toward higher-order streets with a larger carrying capacity rather than onto other local streets.

Creating a design that satisfies all involved parties will require a detailed design process with significant interaction between public officials and private citizens. However, carefully designed traffic calming plans have a proven track record of creating safer and more livable communities, and are well worth the effort they take to create.