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City of San Diego Traffic Calming Guidelines

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Traffic Calming Guidelines

Acknowledgments

The City of San Diego Traffic Calming Guidelines and corresponding handbook represents the combined efforts of the Project Team and the Project Working Group. Through a series of monthly meetings, the elements of the Traffic Calming Guidelines were refined and improved to reflect the values of all San Diego communities. Furthermore, citizen input was received and incorporated into the Guidelines to ensure that a comprehensive collaborative process was developed which represented multiple points of view.

PROJECT TEAM

City of San Diego
Transportation Engineering
Operations Division

Duncan Hughes, Senior Traffic Engineer
Deborah VanWanseele, Deputy Director
Dayue Zhang, Project Manager

Katz, Okitsu & Associates
Joe De La Garza
Arnold Torma
Philip Trom

Fehr & Peers Associates, Inc.
Steve Brown
Jeff Gulden

Public Solutions
Mitch Berner

PROJECT WORKING GROUP

Andy Hamilton
WalkSanDiego / Air Pollution Control District

Kathy Keehan
San Diego Bicycle Coalition

Paul Metcalf
La Jolla Traffic and Transportation Board

Michael Powers
Greater North Park Planning Committee

Guy Preuss
Community Planners Committee

Neil Zerbe
City Resident

City of San Diego Staff

Nick Abboud
Planning Department

Crystal Cliame
Development Services Department

David DiPierro
Transportation Engineering Operations Division

Maureen Gardiner
Planning Department

Theresa Hall
City of San Diego Fire-Rescue Department

Officer Kevin Rausis
San Diego Police Department

Julio Fuentes
Transportation Engineering Operations Division

Ahmed Aburahmah
Transportation Engineering Operations Division

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INTRODUCTION

1.0 Introduction

1.1 Purpose and Need

The City of San Diego Traffic Calming Guidelines are a comprehensive set of measures intended to improve neighborhood safety and quality of life through the use of various roadway improvement strategies. Since roadway safety is an important and growing concern for San Diego residents, the City has recognized the need for a comprehensive program to expand upon the Traffic Calming measures included in the *City of San Diego Street Design Manual (2002).* The City of San Diego Traffic Calming Guidelines are intended to formalize the current process and help manage the numerous requests for traffic calming received by the City. The contents of this guideline document are not presented as firm requirements; rather, they provide a tool for citizens, City staff and other interested parties to use when developing effective traffic calming plans.

1.2 What is Traffic Calming?

Traffic calming is the process of minimizing the negative impacts associated with neighborhood traffic on residents, pedestrians, bicyclists and school children. When implemented, traffic calming measures can reduce neighborhood speeding, cut-through traffic, and reckless driver behavior on city streets. While roadways ensure both vehicle and pedestrian connectivity, excessive traffic or speeding can cause adverse neighborhood impacts resulting from their original design and placement. To avoid these negative impacts, city streets can be retrofitted to encourage safer driver behavior. While the guidelines and traffic calming measures presented in this handbook are intended to be implemented on residential streets, many of these measures can be successfully applied to major and collector roadways as well. New roadways can also be planned and designed with traffic calming in mind for residents, pedestrians, bicyclists and drivers.

1.3 Addressing Existing Concerns

This handbook (Guidelines) is part of the City's Traffic Calming strategy, and is intended to help address existing and future neighborhood concerns and to facilitate the coordination between City staff and residents so that they may work together to develop traffic calming solutions. Existing concerns may involve both speeding and cut-through traffic through existing neighborhoods. These concerns are addressed in the handbook by providing resources of available traffic calming measures along with information on selecting the appropriate traffic calming device to ensure its successful physical placement in the residential environment. The handbook also includes an extensive description of the implementation process in order to educate, encourage and guide active resident participation in the planning of neighborhood traffic calming measures.

1.4 Addressing Future Concerns

Besides addressing existing concerns, the Traffic Calming Guidelines have also been developed as a planning tool for City staff and developers concerned with avoiding traffic problems in future neighborhoods. This handbook includes a discussion of the design guidelines for new developments including infill (redevelopment) projects. When careful consideration is paid to the street layout, vehicle/pedestrian conflict areas and projected traffic volumes for new development, traffic calming features can be planned in advance to avoid future traffic or safety concerns.

1.5 The Origins of Traffic Calming

Early versions of traffic calming were practiced in places such as Eugene, Oregon; Seattle, Washington; and Berkeley, California in the early 1970s. More recently, traffic calming efforts were developed through the Intermodal Surface Transportation Efficiency Act (ISTEA 1991) as transportation engineers and planners began to confront the negative effects and social costs of automobile use. ISTEA was succeeded by the Transportation Equity Act for the 21st Century (TEA-21 1998) which referred to traffic calming by name and declared the process eligible for certain funding under this new program. TEA-21 was succeeded by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU: 2005), which maintained the traffic calming provisions from TEA-21 and also made traffic circles eligible for funding as safety improvements.

Local traffic calming programs in cities throughout the US typically developed in response to concerns over excessive speeds or other reckless driving behavior through residential neighborhoods. Out of the available tools, the vast majority of implemented calming devices included only speed humps. Current traffic calming programs increasingly seek to explore all tools available to the community in order to serve the needs and concerns of the greatest number of residents. These traffic calming programs have increased the use of tools other than speed humps and have helped guide the process of selecting the most appropriate traffic calming devices. Previous traffic calming standards in the City of San Diego have been included within the *City of San Diego Street Design Manual (2002)*, which contains the design details for several traffic calming tools and their uses. The new City of San Diego Traffic Calming Guidelines expand upon those standards.

1.6 Planning Ahead

While the field of traffic calming is dynamic and always changing, this effort represents the most current thinking gathered from other programs and from research conducted around the world. It is important to note that new traffic calming measures may be introduced at some point in the future, which may prove superior to the traffic calming tools described in this handbook. While the appropriate traffic calming devices and implementation philosophy may ultimately change, the City of San Diego Traffic Calming Guidelines are intended to be a living document, which can be enhanced to include other traffic calming tools or methods as they are developed.

1.7 A Handbook of Traffic Calming Guidelines

The handbook of Traffic Calming Guidelines is intended to help City staff improve safety and enhance the quality of life in both existing and future residential neighborhoods by providing roadway design features which slow traffic and improve pedestrian connectivity. This handbook first contains an overview of the City policies concerning residential safety and quality of life. Second, the handbook also contains a step-by-step plan to carry out these guidelines from the early stages of problem identification through the implementation of new traffic calming devices. New guidelines and action plans that specifically address neighborhood traffic calming are also included to provide direction on the appropriate selection of traffic calming measures including their desired results. This chapter is followed by the traffic calming tool kit, which describes each available device within the City of San Diego. The final chapter explains the design guidelines for new developments and includes strategies for avoiding traffic related concerns in new developments before they can occur. The handbook appendices include specific traffic calming design features, a photo reference guide, individual traffic calming tool design drawings, City of San Diego roadway classifications, and existing local traffic calming examples within San Diego County.

1.8 Background

Where are we now?

Currently, traffic calming in the City of San Diego is handled by City staff who receive individual requests from City residents for traffic calming projects in their neighborhoods. In addition, there is a limited Traffic Calming team that handles localized traffic calming issues on a community wide basis. However, City staff can also choose to use other traffic calming devices at their discretion. To initiate the first phase of a traffic calming project, a resident currently makes a request to the City. Most of the time, the request is directed to the Transportation Engineering Operations Division as a traffic request. However, for the project to move into the implementation phase, it must receive the approval of 75% or more of the affected residents fronting the project based on a circulated petition. Public input from the Community Planning Group is also considered as advisory, with City staff having the ultimate decision. In addition, funding must be identified for a project to proceed.

Existing Local Traffic Calming Examples

The results of previous traffic calming efforts in the City of San Diego have yielded several examples of existing traffic calming measures within the city. Appendix D contains a reference map, which illustrates the location and region of several traffic calming measures within the City and provides a list with their corresponding physical location. Also, countywide examples are also shown in the appendix to illustrate other agencies' usage of traffic calming tools.

GOALS, POLICIES AND ACTIONS

2.0 Goals, Policies and Guidelines

The underlying principle of traffic calming is the notion that city streets should be safe, particularly where children play, residents walk and people socialize in the outdoor environment. Traffic calming measures are installed for the purpose of increasing safety and thereby enhancing the livability of our communities.

2.1 Goals

Many of the goals and policies relating to traffic calming are contained in the *Strategic Framework Element* and *Draft Mobility Element* of the City's Draft General Plan (May 2006), which is the first update of the City's General Plan since 1979.

Two of the overall General Plan stated "Core Values" are:

- **Safe and Secure Neighborhoods**
- **Walkable Communities**

Enhancing the General Plan "Core Values" are the General Plan *Draft Mobility Element* goals which include:

> ***"A safe and comfortable pedestrian environment.*** *People enjoy walking in places where there are sidewalks shaded with trees, lighting, interesting buildings or scenery to look at, other people outside, neighborhood destinations, and a feeling of safety.*
>
> ***"A complete, functional, and interconnected pedestrian network, that is accessible to pedestrians of all abilities****. Pedestrian improvements in areas with land uses that promote pedestrian activities can help to increase walking as a means of transportation and recreation. Walkable communities offer public health benefits by providing opportunities for people to be active as a part of their everyday lives."*
>
> ***"Safe and efficient street design that minimizes environmental and neighborhood impacts.*** The quality of the roadway system affects us whether we travel by automobile, transit, bicycle, or foot, and influences which mode of travel we choose. Travel choices and routes are also affected by the connectivity of the street network. A high degree of connectivity is desirable as it allows for shorter travel distances between destinations and greater dispersal of traffic. Travelers benefit from shorter trips and multiple route options, and are more likely to walk or bicycle if distances are short."

These goals stress the fundamental nexus between having safe and walkable neighborhoods and a healthy quality of life. Furthermore, safe and walkable areas lead to more sustainable societies, which benefit all members of the community.

2.2 Policies

The City of San Diego currently has several policies regarding traffic calming which are consistent with the City's General Plan. Beyond the recognition of safe neighborhoods and walkable streets contained in the General Plan goals, other specific policies identify and guide the effort to design communities with pedestrians, safety and comfort in mind. The General Plan *Draft Mobility Element* includes the following policies:

> ***"Policy ME-A.1. Pedestrian Design** – Design and operate, sidewalks, streets and intersections to maximize pedestrian safety and comfort through a variety of street design and traffic management solutions.*
>
> ***"Policy ME-A.2. Safe Pedestrian Routes** – Design and implement safe pedestrian routes. Collaborate with appropriate community groups, and other interested private and public sector groups/individuals to design and implement safe pedestrian routes to schools, transit, and other highly frequented destinations.*
>
> ***"Policy ME-A.3. Education** – Engage in a public education campaign to increase drivers' awareness of pedestrians and bicyclists, and to encourage more courteous driving."*
>
> ***"Policy ME-C.5. Traffic Calming** – Install traffic calming measures to increase safety and enhance the livability of communities.*
>
> - *Use traffic calming techniques in appropriate locations to reduce vehicle speeds or discourage shortcutting traffic.*
> - *Choose traffic calming devices to best fit the situation for which it is intended.*
> - *Place traffic calming devices so that the full benefit of calming will be realized with little or no negative effect upon the overall safety or quality of the roadway.*
> - *Design traffic calming devices appropriately, including consideration for accessibility, drainage, underground utilities, adequate visibility, the needs of emergency, sanitation, and transit vehicles, and landscaping.*
> - *Weigh the undesired effects of traffic calming devices (increased travel times, emergency response times, noise, and traffic diversion) against their prescribed benefits."*
>
> ***"Policy ME-C.6. Environmentally Sensitive Design** – Locate and design new streets and freeways and, to the extent practicable, improve existing facilities to: respect the natural environment, scenic character, and community character or the area traversed; and meet safety standards.*
>
> - *Preserve trees and other aesthetic and traffic calming features in the median and along the roadside."*

The General Plan *Draft Urban Design Element* and *Noise Element* also includes several policies that reinforce the principles of traffic calming. These policies include:

> ***"Policy UD-B.5. - Neighborhood Streets** – Design or retrofit streets to improve walkability, strengthen connectivity, and enhance community identity. Emphasize the provision of high quality pedestrian and bikeway connections to transit stops/stations, village centers, and local schools. Design new streets and consider traffic calming where necessary, to reduce neighborhood speeding. Enhance community gateways to demonstrate neighborhood pride and delineate boundaries."*
>
> ***"Policy NE-B.2.** – Consider traffic calming design and traffic control measures that minimize motor vehicle traffic noise in noise-sensitive land use areas with due consideration to traffic impacts that may be created."*
>
> ***"Policy NE-H.3. – Reducing the Source Noise** – Consider noise attenuation measures and techniques addressed by the Noise Element as well as other feasible attenuation measures not addressed as potential mitigation measures to reduce the effect of noise on future residential and other noise-sensitive land uses to an acceptable noise level."*

2.3 Guidelines

While the *General Plan* goals and policies provide a foundation for the Traffic Calming Program as a whole, the guidelines included in the *San Diego Street Design Manual* (2002) help facilitate the physical implementation of various traffic calming devices. These guidelines include general design criteria regarding pedestrian safety such as:

- Marked crosswalks can be enhanced at some locations with traffic-calming treatments, traffic signals, pedestrian signals when warranted, or other substantial crossing improvements presented in these guidelines, and should not be used under the following conditions:
  (a) Where the 85% percentile speed exceeds 40 mph.
  (b) On a roadways with four or more lanes without additional traffic calming treatments such as islands, lighted crosswalks, etc.
  (c) On a roadway with poor illumination, poor sight distance, or very low pedestrian volumes.
- Residential street crossings are often combined with traffic calming measures that are designed to maintain low vehicle speeds, such as raised crosswalks, chicanes, and gateway narrowing.

- Curb extensions may be considered at the crosswalk to enhance pedestrian crossing visibility and reduce crossing distance.
- On streets that experience excessive vehicle speeds, pedestrian crossings should be enhanced with traffic calming measures, such as raised crosswalks or curb extensions.

Additionally, the *San Diego Street Design Manual* guidelines are further expanded within the *Design Guiding Principles* chapter of this handbook. The following sections continue to discuss the process of achieving the overall goals included in the *General Plan.*

PROJECT PROCESS AND IMPLEMENTATION

3.0 Project Process and Implementation

This chapter describes a process that can be used to succesfully provide traffic calming improvements. This section can be used by City staff and residents seeking to find solutions to neighborhood traffic calming issues.
The process is separated into four key components, each consisting of specific steps that should be considered during the development of a street/neighborhood traffic management plan (i.e. a set of neighborhood traffic management solutions). The four components of the process are:

- **Plan Initiation** – Residents submit a detailed request for the investigation of traffic related issues. Traffic data, or other relevant information, is gathered by Transportation Engineering Operations Division staff and the issue under investigation is deemed deserving of action or not.

- **Plan Development** – Staff notifies all relevant participants, residents, and committees and the study area is determined. Participants meet and set guidelines for the decision making process in order to begin developing and choosing the best course of action to treat the issue. Various options are analyzed.

- **Plan Support** – Surveys and/or petitions assess neighborhood support. Responses are counted and staff determines if minimum response rates are satisfied to implement the proposed treatment. Staff then determines if City Council approval is needed.

- **Plan Implementation** – The proposed plan is presented for final approval. Needed funding is identified and design details are presented. Public notification is sent. Construction of the treatment then commences accompanied by appropriate educational measures.

Each step of these components is discussed in greater detail below and graphically shown on the program process flowchart (pgs. 16 & 17).

3.1 Plan Initiation

The first component of the process is plan initiation. This component describes how the traffic calming process is initiated and how requests are handled and considered for treatment. The **Bold** letters are intended to serve as a reference to the steps shown in the process flowchart.

(A) The process is started when residents request Transportation Engineering Operations Division staff to investigate speeding, cut-through traffic or other traffic-related safety issues within their neighborhood. The request should be sufficiently detailed for staff to understand the traffic-related issues within the neighborhood. Additionally, citizens' requests may filter through the Police Department, Council Office, or local Community Planning Groups.

(B) Staff will review the request **(B.2)** and determine if a significant issue has been identified. If so, it is considered deserving of focused action **(B.3)** or deserving of treatment as a traffic calming issue **(C.1)**. If not, it is not considered significant and no action is taken **(B.1)**. To complete this process staff may need to conduct minor data collection. This initial investigation allows staff to determine the type and magnitude of the problem and best course of action. It could also lead to other solutions, for example, concerns may be addressed through maintenance (trees blocking a stop sign), targeted police enforcement, or education as detailed at the end of this chapter. Staff will investigate every request and the requestor will be advised of the action taken by staff regarding their request. For more information on focused actions see below.

Focused Actions (B.3)

Through the traffic calming process, staff may determine that the issue in question is deserving of action but that permanently constructed traffic calming devices are not the most cost-effective approach. Focused actions may include police enforcement, education, maintenance, monitoring, traffic operations, etc. These focused actions are intended to provide a solution to traffic issues on a single street or in a relatively small area. Focused actions include both city actions and neighborhood actions as explained below.

City Action – generally falls into either enforcement or traffic operations and maintenance. Staff may decide the best solution is to increase enforcement in the affected area by employing one of the following:

- Radar speed trailers
- Increased police presence (targeted speed enforcement)

Radar trailers can be a relatively inexpensive alternative to traffic calming. Increased police enforcement is dependent on police availability. These methods can be effective in reducing speed in the short-term, but unless increased police enforcement is continued, driver behavior will often revert back to pre-enforcement levels. For more information refer to Chapter 5.0 – *Traffic Calming Toolbox*.

Traffic operations and maintenance can be altered by the City to reduce neighborhood impacts. The following are examples of traffic operations and maintenance changes that City staff may choose to implement. These improvements are described in Chapter 5.0 – *Traffic Calming Toolbox*.

- Centerline/Edgeline lane striping
- Centerline Botts Dots
- Trimming of vegetation to improve sight distance
- Signal timing changes on arterials or collectors
- Vehicle prohibitions implemented via signage

- Signage changes
- Turning movement restrictions

These items are relatively inexpensive and easy to implement in comparison to tools implemented through the formal traffic calming process. However, resources from the City's operations and maintenance departments will be needed and staff should ensure those resources are available.

Staff will need to gauge the effects of the action to ensure it is benefiting the neighborhood. Additions or removal will be at the discretion of staff and should be made with neighborhood input.

Neighborhood Action – is an effective way for neighbors to become positively involved in bringing change to their local streets. The following methods allow individual neighborhoods to take action to address the issues at a local level with support from City staff. These methods are intended to advise and educate drivers in the neighborhood.

- ***Neighborhood Signs*** may be posted at the entrances to the neighborhood raising driver awareness about the type of area they are entering.
- ***Trash Can Brigades*** provide materials (stickers) for residents to place on their trash cans. The stickers can display slogans such as "slow down".
- ***Pledge Programs*** involve the neighbors pledging to improve their driving behavior. Symbols such as bumper stickers can be used to identify pledge program participants.
- ***Speed Watch and Warning Letters*** involve radar guns used by citizens to check motorist speeds in the neighborhood. Corresponding warning letters can be sent to individuals who do not obey the speed limit.

As with any local activity, neighborhood actions can evolve from the aforementioned activities and new methods of traffic education may become available. Neighborhood action should be carried out with assistance from City staff.

(C) Once staff has determined that the issue is of a traffic calming nature **(C.1)** beyond what would typically be covered under a "Focused Action," they will further determine if the issue is localized or neighborhood-wide. A localized issue **(C.2)** pertains to a relatively small area (a street or set of streets) where implementation of traffic calming treatment would not cause spillover affects to adjacent streets. An example of this could be a residential street connecting two arterials with no other streets in the neighborhood providing through access between the two arterials. If a traffic calming treatment intended to reduce travel time through the neighborhood were introduced on the cut-through route, then the cut-through traffic would be redirected to the arterials. Another example of a localized issue could be a speed related issue on a collector leading

from a subdivision to an arterial. Introducing a traffic calming treatment intended to reduce speed on the collector would not cause spillover onto adjacent residential streets.

If an issue is determined by staff to be localized then it follows the localized traffic calming process **(C.2)** as described below.

(C.2) Localized Traffic Calming Process

Issues that are determined to be localized can follow a more streamlined process for treatment. The following describes the localized traffic calming process (as shown on the accompanying flowchart).

(a) City staff begins the localized process by reviewing information about the issue and identifying a treatment. The proposed treatment should be consistent with the traffic calming toolbox (Chapter 5.0 – *Traffic Calming Toolbox*) and any additional City guidelines. If possible, proposed treatments found to be effective for similar issues should be used as guides.

(b) Staff consults with affected agencies (i.e., fire department, police department, transit agencies, school districts, environmental services, and street division) to gather their input on the proposed treatment. Fire department approval must be received before continuing the process. If the fire department does not approve of the treatment as proposed by staff or any alternatives, then a denial letter is sent to the requestor informing them that the plan to implement a traffic calming treatment on their street(s) was unsuccessful.

(c & d) The City next circulates a petition to residents of the affected street or set of streets where treatment is desired. Residents need to complete and return the petition with 75% or more of the responses in support of the proposed treatment. If the plan fails to receive approval of at least 75%, then it is not continued. The requestor will be informed that the plan to implement the proposed traffic calming treatment on their street(s) was unsuccessful.

(e) After approval from residents, the proposed plan will be sent to the local Community Planning Group for public input. Input from the Community Planning Group will be considered advisory with the City having the ultimate decision.

(f) Staff will identify the funding. Special contributions might be available through resident's organizations for treatment in certain areas.

(g) Once the plan has been fully approved and funding is available, a work order for construction of the treatment will be sent to the Street Division.

(h) Before construction, staff will notify the public and affected agencies regarding the implementation of a traffic calming device. Notification helps ensure that motorists and other road users, including fire and emergency response

vehicles, are familiar with the device and that they can continue to use the roadway in a safe manner.

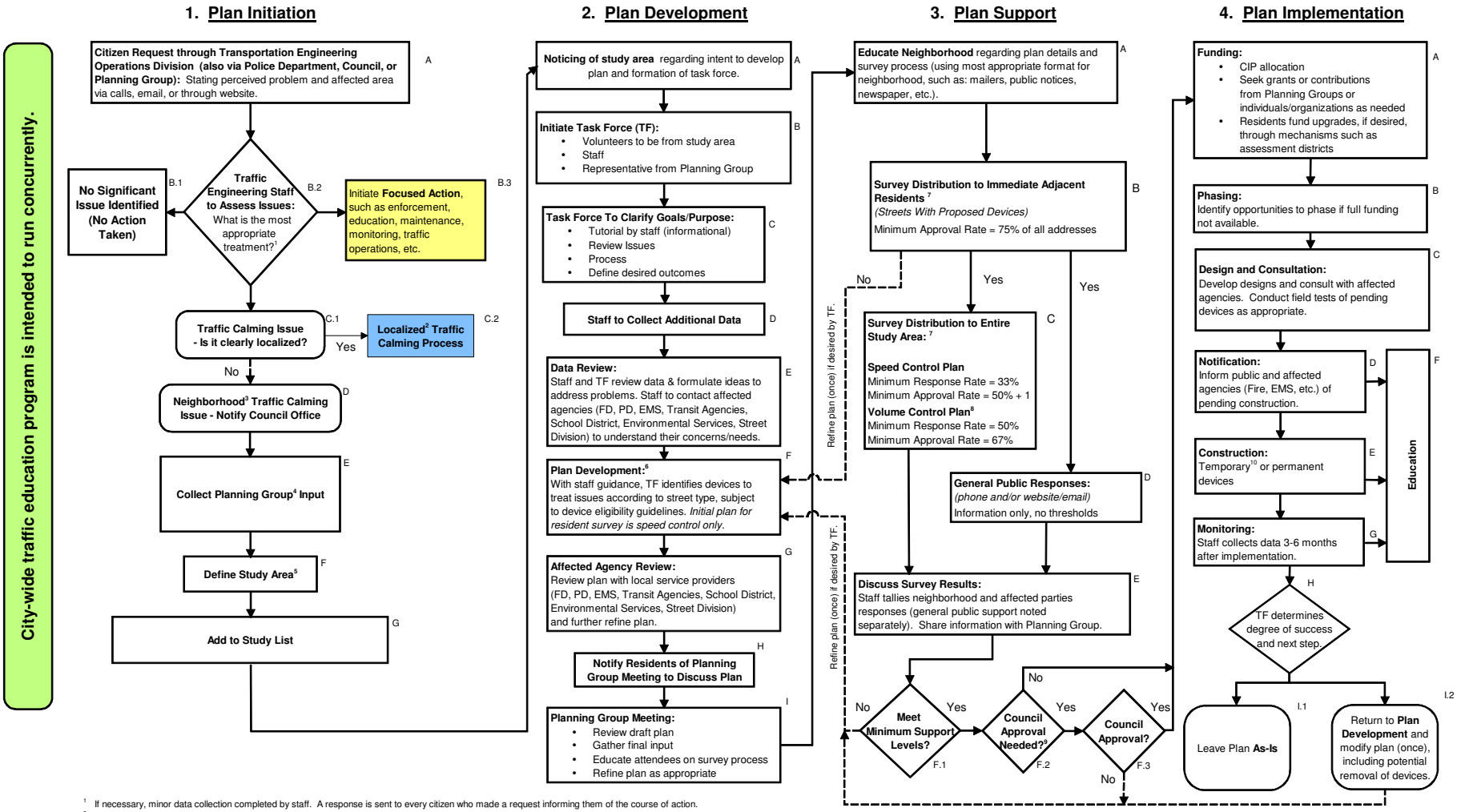
(i) The traffic calming device will be installed.

(D) A traffic calming issue, not previously determined to be localized, is treated as a neighborhood traffic calming issue. An example of a neighborhood traffic calming issue is when a traffic calming treatment on one street, if implemented, would simply result in moving the problem to an adjacent street or to several adjacent streets or neighborhoods. Once the issue is determined to be of a neighborhood scale, the appropriate City Council office is notified. Funding and staff resources are assessed to establish viability of project.

(E) After the City Council office notification, staff begins to collect input from the Community Planning Group or its equivalent. The Planning Group will help determine if the problem is recent, on going, broad, or narrow.

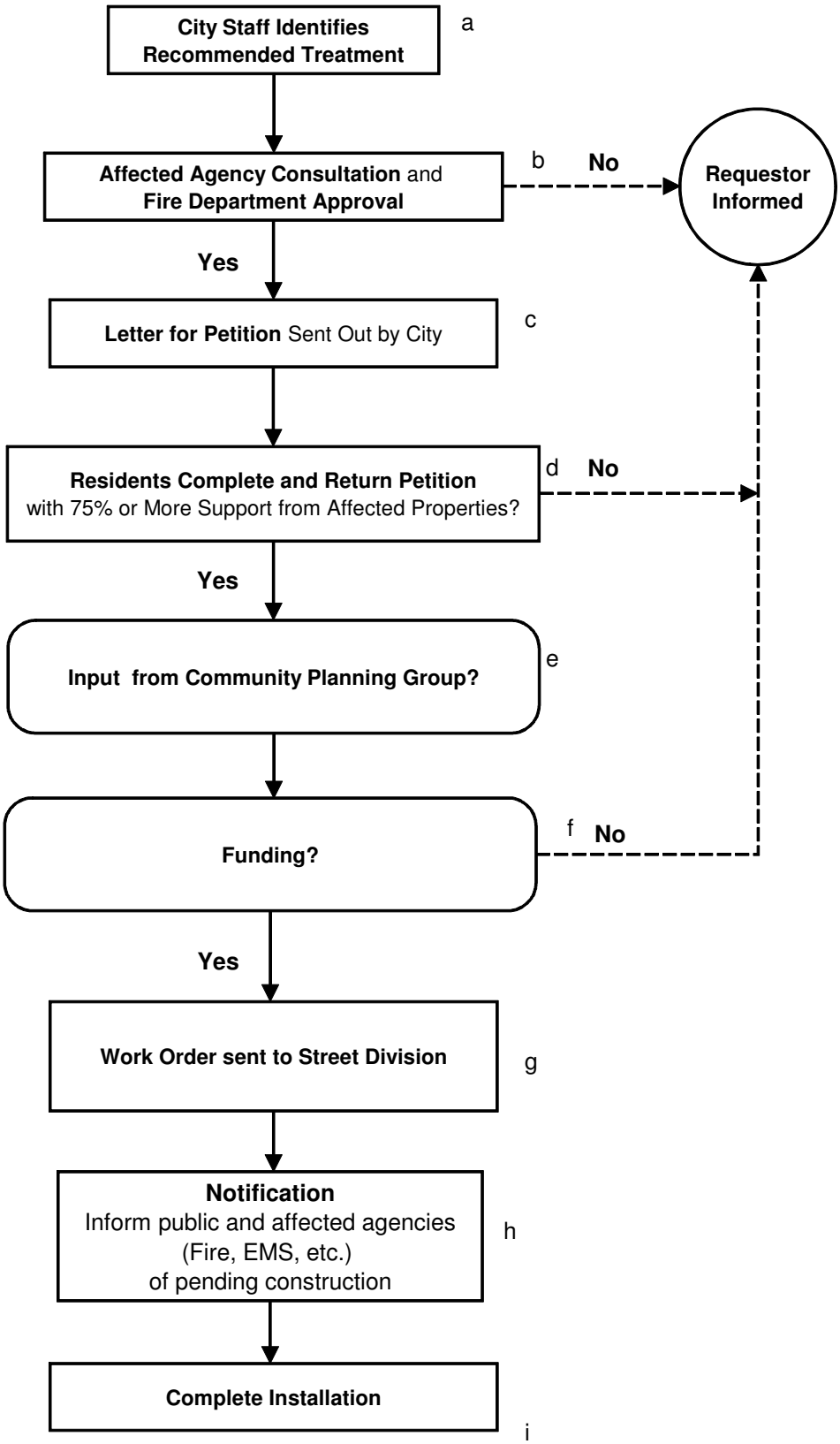
(F & G) Once the issue is determined to be a neighborhood traffic calming issue **(D)** and planning group input has been collected **(E)**, staff will define the study area **(F)**. The study area should include streets that are materially affected by the proposed actions and should generally be bounded by major features (arterials, streets, rivers, canyons, etc.). Traffic calming treatments may be applied to multiple streets within the study area. Once the study area is defined, it is added to the study list **(G)**.

Process Flowchart - City of San Diego Traffic Calming Program



[1] If necessary, minor data collection completed by staff. A response is sent to every citizen who made a request informing them of the course of action.
[2] Localized issue pertains to a street or set of streets where traffic calming treatments would not impact adjacent streets (refer to Localized Traffic Calming Process flowchart).
[3] Neighborhood issue pertains to an area where traffic calming treatments may impact adjacent streets.
[4] The designated community planning group or its standing committee for traffic issues.
[5] Study area to include streets that are materially affected by the proposed actions and should generally be bounded by arterials, freeways, rivers/canyons, etc.
[6] First plan to be speed control plan. If that plan is determined insufficient, then revised plan may include volume control measures.
[7] Multi Unit Dwellings' response does not count toward the minimum response rate. Surveys include three questions: (a) Do you support the proposed plan? (b) Would you oppose a traffic calming device adjacent to your property? (c) Would you support neighborhood funding for aesthetic upgrades of certain traffic calming devices?
[8] Volume control plan represents second pass through plan development, approval, and implementation if speed control plan is first found to be ineffective.
[9] Conditions that might warrant City Council approval are: certification of environmental documents, General Plan amendments, Community Plan amendments, or project cost exceeds $1,000,000 (one million).
[10] Temporary devices are constructed at staff discretion based on previous experience. Temporary devices can be converted to permanent devices after 6 months of acceptable performance.

Localized Traffic Calming Process



3.2 Plan Development

Plan development starts once adequate staff resources and project funding are identifed.

The plan development component begins after staff has defined the study area. This section describes how the neighborhood task force, staff, and other affected agencies work together to develop a plan to treat traffic related issues. This discussion relates to the broader neighborhood process. Discussion of the localized process can be found in the preceding section. Letters in bold correspond to individual steps in the plan development component.

(A & B) Staff notifies the Community Planning Group about the selection of their neighborhood area to participate in the traffic calming plan **(A)**. Following the notice, a neighborhood planning group meeting will be held. The meeting is intended for staff to provide an overview of the process to develop, approve, and implement a neighborhood traffic management plan. At this meeting, residents will have the opportunity to volunteer for the task force **(B)**. Members of the task force should largely be residents or business owners from the study area. The task force should include a representative from the Planning Group. The task force will meet with City staff to review and develop a plan for their neighborhood. Although all residents have the opportunity to provide input and receive updates as the plan develops, the task force is more actively involved, committing the time and effort necessary to develop a comprehensive plan.

Residents not selected for the task force are welcome to attend all meetings, and time will be allocated on the agenda for public comments/questions.

(C) Once the task force is formed they will meet with staff to clarify their goals and purpose. The meeting will accomplish the following.

- Neighborhood Traffic Management Tutorial – Staff presents an overview of the program and devices. This is intended to be for informational purposes only and not a prescription of what should be implemented.
- Review traffic-related issues – Discuss the type of issue(s), location(s), and time of occurrences.
- Refine study area (if necessary) – Staff will refine the study area based on street(s) affected by the traffic-related issues or that may potentially be affected by development of a neighborhood traffic management plan.
- Review traffic data – Review the initial data collected and determine if additional data collection is necessary.
- Define desired outcomes – Clearly defined outcomes need to be formed as a benchmark for results.

(D) If additional data collection is necessary then staff will collect traffic data based on the study area as previously defined.

(E) City staff and the task force will schedule a meeting(s) to review traffic data within the study area and formulate ideas to address problems. Data regarding the traffic related concerns and traffic data would be compared to the guidelines (see Chapter 4.0 – *Design Guiding Principles*) to determine which devices may be most appropriate. At this point in the process, staff can also begin to contact affected agencies (FD, PD, EMS, Transit Agencies, School Districts, Environmental Services, Street Division) to better understand their needs and concerns.

(F) The main purpose for the task force is to identify issues and serve as liaison to the Community Planning Group and the residents, and provide feedback to staff proposals.

The initial plan development may consider the following speed reduction devices to treat the traffic related concerns (see Chapter 4.0 – *Design Guiding Principles* for more information):

- Vertical Devices – Speed lumps, speed humps, speed tables, etc.
- Horizontal Devices – Traffic circles, chicanes, lateral shifts, etc.
- Signing and Marking Devices – Lane striping, botts dots, speed legends, etc.
- Narrowing Devices – Bulbouts, chokers, center island narrowings, etc.

Because volume reduction measures (i.e. partial closures or forced turn islands) intentionally divert traffic to another street, new issues can occur as a result. For this reason, volume reduction devices are not proposed until all other options have been shown to be ineffective at reducing the traffic-related impacts.

(G) Once staff and the task force have developed a plan they feel appropriately addresses the traffic-related issues, City staff will solicit additional feedback from other agencies that may be potentially affected by the plan. The intent of this process is to identify concerns and potential modifications to the plan. The following agencies will likely be involved in reviewing most plans:

- City of San Diego Fire Department and EMS
- City of San Diego Police Department
- Transit Agencies
- Local School District
- Environmental Services
- Street Division

Staff will share the input from these agencies with the task force, and the task force will revise the plan accordingly.

(H & I) A neighborhood meeting will be arranged by the Community Planning Group to present the proposed plan to the neighborhood at-large to gather input prior to the approval process **(H)**. At this meeting the task force will present a map of the proposed plan and describe the types and locations of devices proposed **(I)**. At this time, residents can also determine what, if any, aesthetic improvements are desired. Changes to the proposed plan can be made as necessary. This Planning Group meeting is intended for informational purposes.

Residents are informed of the approval process and ballots/petitions they will receive once the proposed plan is refined.

3.3 Plan Support

The plan support component assesses the amount of neighborhood support for the proposed plan.

(A) Prior to surveys being distributed, residents, bussines owners, and property owners are informed regarding the pending plan details and of the approval process.
This could be carried out through public notices, mailers, newspaper and also through neighborhood association newsletters.

(B) Staff and the Task Force distribute surveys to neighborhood residents who are immediately adjacent to the proposed device(s). The immediately adjacent addresses are determined by location. For devices placed at an intersection, responses should come from addresses within 150 feet in each direction of the device. For devices placed within a residential block, responses should come from address only within that block. A minimum approval rate of 75 percent must be met from the immediate adjacent resident survey. If the minimum approval rate is not met, the task force has one opportunity to revise the plan if desired.

(C) Once the 75% approval rate has been met by the adjacent residents, the survey will be distributed to the entire study area. A minimum response rate and support rate must be met from individuals in the study area before the plan moves forward. For implementation of speed reduction devices, a minimum of 33 percent of all surveys must be returned with a simple majority of those responses in favor of the plan (50% + 1). For example, if 100 surveys are mailed out, at least 33 must be returned with 17 or more of those in favor of the proposed plan. If the plan includes volume reduction measures, a minimum of 50 percent of ballots must be returned with 67 percent or more of those responses in favor.

Apartments present a unique situation because residents may be less likely to respond. For this reason, surveys from apartment units are not counted toward the minimum response rate, but will be counted in favor or against the proposed plan.

(D) Responses from the general public will be recorded separately. Those responses will be considered for information purposes only, with no thresholds of approval required.

(E) City staff will count all received ballots, and determine whether the minimum response rate and support rate are satisfied. If the minimum number of ballots is not received, neighborhood residents could be reminded to submit their mail back postcards in order to meet the minimum response rate. Staff will then share this information with the Planning Group.

(F) If the minimum response rate is met **(F.1)** but the support rate is not, then the task force has one opportunity to revise the plan if desired. This would require modifying the plan to address the aspects of the plan that were not favored by residents. Modifying the plan would also require consulting the affected agencies, holding a public meeting to present the revised plan, and redistributing ballots to the study area.

If the minimum response rate and support rate are met, then staff determines whether the proposed plan needs City Council approval **(F.2)**. Conditions that may require Council approval are if a proposed plan needs certification of environmental documents, General Plan amendments, Community Plan amendments, or high project cost.

If the plan needs City Council approval, and the plan is not supported by a majority of the Council, then the plan may be modified to address the aspects of the plan that were not favored **(F.3)**. Similar to the plan revision described in F.1, staff and the task force would have one opportunity for revision.

If the Council approves the plan, or if Council approval is not needed, then the plan continues to the implementation component.

3.4 Plan Implementation

The final component of the traffic calming process is plan implementation. The implementation phase is similar for both the localized process and this broader neighborhood process. As in the previous sections, letters in bold correspond to individual steps in the plan implementation component.

(A) Staff will develop a funding means for each plan as part of the annual CIP process, which will typically involve gas tax, sales tax, and other transportation funding sources. Staff and the task force may also want to seek grants or contributions from Planning Groups or individuals and/or organizations. This is also the opportunity for residents to fund upgrades. Collecting from residents for upgrades is not mandatory and may present problems, especially when collecting from residents who don't support traffic calming in their neighborhood. If funding for upgrades is needed, a collection mechanism such as assessment districts may be appropriate.

(B) If full funding is not available, the project may be phased to accommodate the funds available.

(C) Staff will present the detailed designs to affected agencies. If necessary, staff and the affected agencies may conduct field tests of the pending devices. For example, the fire department could test the effects of navigating fire engines through pending devices.

Traffic cones could be used to outline the dimensions of the devices and trial runs conducted to determine the impact on fire engine maneuverability.

(D) Before construction, staff will notify the public and affected agencies (Fire, EMS, etc.) regarding the planned implementation of a traffic calming device. Notification helps ensure that motorists and other road users are familiar with the device before it is built.

(E) The traffic calming devices can be constructed either as temporary or permanent devices. Temporary devices can be constructed at staff's discretion based on previous experience with the device. These temporary devices can be converted to permanent devices after six months of acceptable performance.

(F) Education is planned to run concurrently with Notification, Construction, and Monitoring in order to aid roadway users in the proper maneuvering within and around the pending devices. Education helps ensure that all users can continue to use the roadway in a safe manner. Some examples include posting informational signs, hosting seminars, and distributing flyers.

(G & H) After construction of the approved plan, staff will monitor the devices and collect data 3-6 months after implementation **(G)** as well as rely on the task force and community members for feedback on the constructed devices. Based on the task force and/or community members' feedback and collected data, staff will determine the next steps **(H)**. For example, the approved plan may have produced reasonable and satisfactory results and therefore there is nothing further for City staff to do **(I.1)**.

(I.2) If the approved plan has not produced reasonable and satisfactory results, staff can recommend one or more of the following:

- Collect additional traffic data as deemed appropriate.
- Modify constructed devices as deemed appropriate.
- Construct additional speed reduction devices as deemed appropriate.
- Return to Plan Development and modify the plan.

The plan can be revised once. This includes the removal of devices found to be ineffective. If staff determines that speed reduction devices will not adequately address the traffic-related concern, then staff can recommend the use of volume reduction measures.

3.5 Citywide Education Activities

A citywide education program regarding traffic safety is intended to run concurrent with the traffic calming program. Its purpose is to increase driver and pedestrian awareness, including such topics as traffic laws and information regarding the traffic calming program. Several methods exist for conveying traffic education, which are described below. This list is not exclusive, and additional methods should be used if found to be effective.

Handouts/flyers – a standard booklet or tri-fold type handout is very versatile. They can be distributed individually at street fairs, in lobbies, in public meeting rooms, or other places of public gathering. Additionally, handouts can be distributed citywide by inclusion in utility bills. The effectiveness of the handout largely depends on its design and format. Handout styles and colors that are most successful at gaining the public's attention should be used.

Slides/graphics – a still slide (or computer graphic) can be displayed on City TV. The information displayed on the slide can be a traffic education reminder or an announcement for the traffic calming program (with appropriate contact information). Information displayed on the slides should be easy to read and understand in a short time.

Presentation materials – a standard set of traffic education presentation materials should be created to be used in planning and City Council meetings. Information contained in these materials should be clear, concise, and easy to understand. City staff is responsible for implementing and continuing a traffic education program. Staff should also set the goals of this program and monitor the results.

DESIGN GUIDING PRINCIPLES

4.0 Design Guiding Principles

Selecting the most appropriate tool is an important step, which can often determine the success or failure of a neighborhood traffic calming project. Unfortunately, there are no easy recipes to govern which traffic calming measure should ultimately be chosen since all situations are often unique and typically involve multiple variables.

However, the design guiding principles contained within this chapter are intended to guide both City residents and staff members in the selection of the most appropriate traffic calming tool. This chapter explains the categories of traffic calming as well as the potential issues neighborhood residents should consider in choosing a traffic calming measure. This section is not intended to provide detailed engineering drawings[1] but rather to provide guiding principles that can be applied to all traffic calming projects. These guiding principles are also reflected in the *General Plan* policies stated earlier in Chapter 2.0.

4.1 When is Traffic Calming Appropriate?

> ***Guiding Principle #1:*** *Traffic calming should address only speed and traffic volume concerns.*

Establishing if traffic calming is warranted is necessary in order to determine if neighborhood residents and City staff should proceed with seeking solutions to their issue through this program. Fundamentally, traffic calming devices are meant to address the concerns of residents on local residential streets and are intended for the purpose of restoring or preserving the character and quality of the street by reducing unsafe traffic speeds or decreasing higher than acceptable traffic volumes. Changes to the road created by a traffic calming measure should enhance the overall street environment and make residential roadways friendlier to pedestrians.

Traffic calming measures are not intended to address safety issues at intersections, to mitigate noise or other externalities from roadway arterials. Traffic calming is also not meant to create any modal shift or alteration of the roadway network and should not be installed merely to create uses for the roadway that were not otherwise intended.

4.2 Addressing the Problem with Traffic Calming

> ***Guiding Principle #2****: The traffic calming device chosen for a particular problem should best fit the situation it is intended to solve. The device may not eliminate or address all demands associated with neighborhood concerns or complaints, but should effectively solve the primary concern.*

[1] Detailed design drawings can be found in Appendix B, while an explanation of various design features is included in Appendix A.

Traffic calming tools vary in their range of control, impact and cost. These tools also differ in design and look. The fundamental differences in these measures are based on their basic **purpose** and **design**. Understanding these factors can increase the possibility that the best tool will be selected. As mentioned before, the **purpose** of the available traffic calming tools falls into two fundamental categories:

- Devices that reduce **Speed**
- Devices that reduce **Volume**

Similarly, the **design** of the available traffic calming tools can be organized into four categories in order to assist in understanding the available choices:

- **Vertical Deflection Tools:** Calming tools that require vehicles to slow down in order to progress slowly and safely over the deflection (such as with a speed lump).
- **Horizontal Deflection Tools:** Calming tools that require vehicles to slow down in order to safely navigate around or through the device in the direction it is designed (such as with a choker or roundabout).
- **Awareness Measures:** Calming tools like the posting of signs, restrictions of movement, or new striping and can effectively reduce speeds or volumes by creating driver awareness of pedestrians, or creating the threat of traffic tickets by restricting turns. Tools of awareness and safety are basic steps of traffic calming and should be examined as a primary measure before physical solutions are considered. They are designed to induce the driver to change their behavior voluntarily rather than through the requirements of a permanent physical device.
- **Diversion Measures:** Calming tools that divert traffic in a particular direction or prevent traffic from traveling through a certain point (such as with a road closure).

Tools that reduce SPEED

Calming devices that reduce speed are designed to reduce excessive neighborhood speeds to acceptable levels. These tools either induce drivers to reduce their own speeds through awareness measures or can directly force drivers to decrease their speeds via physical changes to the roadway, which can prohibit reckless driving behavior. Speed reduction methods are generally preferable to volume reduction methods in that they do not induce circuitous trips and therefore do not increase travel distances for local residents. Also, some devices, such as Raised Medians or Bulbouts have a dual purpose of providing safer pedestrian crossings and making pedestrians more visible. Tools with multiple uses such as these may be preferable in areas with higher than average pedestrian traffic. The various traffic calming measures which can reduce speed, include:

Vertical Deflection Measures

- Speed Lumps, Speed Humps
- Speed Tables
- Raised Crosswalk

- Intersection Table / Raised Intersection

Horizontal Deflection Measures

- Angled Parking
- Angled Slow Points
- Bulbouts/Pop-Outs/Curb Extension
- Chicanes
- Chokers
- Raised Median / Pedestrian Refuge
- Roundabouts
- Short Intersection Median
- Traffic Circles
- Treatment on Curve
- Curb Radius Reduction
- Realigned T-Intersection

Awareness Measures

- Gateway / Entrance Feature
- Permanent Driver Feedback Sign
- Signage
- Roadway Striping
- Temporary Radar Speed Trailer
- Temporary Enforcement

Tools that reduce VOLUME

Traffic calming devices that reduce volume are designed to reduce excessive cut-through traffic on residential streets that should otherwise be traveling on collectors or arterials. The tools that may be used in order to reduce volume can include awareness measures, such as signs restricting turn movements, or physical measures that direct the path of cut-through traffic in an undesirable direction via diverters or road closures. The traffic calming measures that reduce volume include:

Diversionary Measures

- Diagonal Diverters
- Full Street Closure / Cul-de-sac
- Median Barriers/ Channelization
- Partial Street Closures/ Semi-diverter
- Right-In / Right-Out Island

Awareness Measures

- Signage
- Turn Restrictions

4.3 How Should the Traffic Calming Tool be Placed?

> ***Guiding Principle #3****: The location of the traffic calming device shall be placed where the full benefit of calming will be realized so long as there is little or no negative effect upon overall safety or quality of the roadway.*

The most important consideration in choosing what traffic calming tool presents the best solution, is whether or not the tool can be physically implemented. The choice of tool may be constrained by the limitations of the roadway, since residential streets vary in terms of the parking supply and need, roadway width, and the presence or width of sidewalks. For example, streets with inadequate parking availability should opt for calming devices that will not require excessive removal of parking. These are important aspects to recognize when determining the feasibility of a traffic calming project. Issues or complaints with tool placement may bring into question the overall effectiveness of the measure, which can be avoided by taking the above issues into account.

4.4 How Should the Tool be Designed?

> ***Guiding Principle #4****: Traffic calming devices will be clearly marked and visible during the day and night. Where appropriate, they should include warning signs on all approaches of traffic affected by the device. All physical devices will be designed with aesthetics in mind to provide for landscaping and visual contrast in the roadway.*

Calming measures vary in effectiveness depending on their design. Effects of awareness and respect from drivers can differ depending on where the tool is placed. Designing a device should take into account if:

- There is adequate provision of warning signs
- The device will maintain adequate sight distances along the roadway and at driveways and intersections for both drivers and pedestrians
- The device will settle into the character of its surroundings
- The device will be viewed as a nuisance
- The device will be fully obeyed once it is placed
- The device will unsafely prevent emergency response vehicles from traveling to their destination
- The device will be placed near a school so that pedestrian crossings are not affected
- The device will block access to driveways
- The device will block drainage
- The device will be marked, signed and visible during both daytime and nighttime hours

The likelihood of driver compliance with new installations should be evaluated based on the location and situation. A well designed device will increase the possibility that

drivers will obey the visual cues of the device. Given that some calming tools were designed with higher volume streets in mind, these tools may not be suitable for all residential streets (i.e. forced right turns).

4.5 Balancing Competing Interests

> ***Guiding Principle #5****: The traffic calming implementation process is a series of discussions and decisions on how best to resolve the concern or complaint. Desired effects of traffic calming devices will be weighed against their prescribed benefits. It is ultimately up to the users of the street which trade-offs should be made in order to achieve the desired goal.*

Trade-offs are inherent with all traffic calming devices. This means that everyone's desires cannot necessarily be met. The participants need to be aware of these trade-offs and be willing to accept the negative consequences in return for the benefits associated with the treatment. Some measures will calm vehicular traffic but will be less accommodating to bicycle riders or may slightly decrease trip efficiency. The Toolbox presented in Chapter 5.0 details the advantages and disadvantages of each tool. Physical implementation also carries certain trade-offs since some tools will require the use of portions of the right-of-way and will remove some amount of street parking. Other tools like medians will prevent access to some driveway access from both directions of travel.

Other more typical byproducts of certain traffic calming measures which should be considered include:

Travel Time Impacts: Traffic calming in general is contrary to the purpose of driving – to get from one place to another in the shortest, most efficient manner. Traffic calming attempts to hinder driver natural behavior by introducing such things as speed reducing devices and restricting certain movements. These traffic calming measures increase travel time. When implementing a traffic calming treatment it is understood that the motorists' inconvenience is necessary to improve the quality of life for others. For example, neighborhood residents may want to reduce traffic and speeding through their neighborhood by placing traffic calming measures on a cut-through route. This may negatively affect both the cut-through motorists and neighborhood residents alike.

Emergency Response Times: Traffic calming creates a conflict between two public safety goals. Minimizing emergency response times is an important public safety objective. Reducing speeds on residential streets also increases public safety. Implementation of traffic calming furthers the goal of residential street safety but it can hamper emergency response times. This trade-off needs to be recognized as a part of the traffic calming process.

Noise: Another drawback that must be considered when choosing among various tools of traffic calming is the creation of additional noise, such as that which stems from many vertical measures. In selecting a traffic calming device, tools that are the least likely to

bring with them the creation of additional noise should be given priority so as to maintain the environmental quality of the residential area.

Street Diversion: Driver behavior is difficult to predict; therefore, the outcome of implementing a traffic calming treatment may not be as originally desired. For example, introducing a speed reducing device may cause traffic to take another residential street. It should be considered unacceptable to merely reroute traffic to other residential streets unless the diversion results in a more equitable distribution of traffic.

It is important to understand that in choosing between options, the livability of the neighborhood takes precedence over marginal motor vehicle efficiency. In addition, residential streets containing calming measures, in accordance with their design guidelines, should still provide for the efficient use of the street amongst all users.

4.6 Consistency with Community Values and City Policy

> ***Guiding Principle #6:*** *Neighborhood traffic calming measures should represent community values.*

Whatever tool is chosen as the best solution to a given complaint should take into account and enhance community values. The calming measure should also follow the principles defined in the above chapter as well as conforming to the *City of San Diego Street Design Manual (2002)*, the *Traffic Operations Manual* and the *Landscape Design Manual* where applicable.

The overarching desire of any community is to maintain a vibrant, peaceful, and safe daily lifestyle. Residents are entitled to participate in the maintenance of these qualities through many means of civic involvement. A city's traffic calming program is one process among many others available to these citizens. Traffic calming is intended to help contribute to the overall quality of life of a community by contributing to the improvement of our streets so that residents can enjoy good health, peace of mind, and civic pride. If a proposed traffic calming measure can be shown to contribute to these ends, the measure should be considered. Accordingly, if the proposed measure would be detrimental to these ends, it should not be considered.

TRAFFIC CALMING TOOLBOX

5.0 Traffic Calming Toolbox

The following chapter contains the various traffic calming tools available as well as a comprehensive Usage Guide. The Usage Guide serves as a quick reference for all tools in the Toolbox, which is organized to differentiate between tools that aim to reduce speed and tools that aim to reduce volume. Furthermore, the Usage Guide enables the comparison of each tool based on three general categories: effectiveness, potential impacts and roadway classification. The effectiveness categories enable the comparison of tools regarding differences in speed reduction, volume reduction, pedestrian safety and collision reduction which are ranked on a one to three scale to assist in the tool selection process. The potential impacts section shows the ancillary effects of each device including loss of parking, access restrictions, EMS/Fire access and response times, transit issues and noise/pollution issues. The road classification category explains the appropriate application of the tool on residential, collector and/or major roadways.[2]

The Toolbox includes individual one-page information sheets for each tool which explain the tool, show its primary purpose, include an illustration and photograph[3], and offer its advantages, disadvantages, and potential results. The intent of the handbook is to include all of the available traffic calming tools that conform to adopted City policy. While each tool has a positive traffic calming effect in reducing either traffic speeds or overall traffic volumes, there are also negative impacts associated with the tools that should be considered before proceeding with installation.

5.1 Measured Effectiveness

Each device in the Toolbox includes an explanation of the tool's measured effectiveness in order to supply quantitative data to assist in the tool selection process. The speed reduction and volume reduction data is intended to show the device effectiveness between the devices, as with a series of speed humps, not at the device itself. Where quantitative data is not available, insufficient data is stated as "I/D."

5.2 Costs

The Toolbox and corresponding Usage Guide includes cost information in order to assist in the overall tool selection process. The cost range provided for the tools is:

- Low: < $10,000;
- Medium: $10,000 - $50,000;
- High: > $50,000

For each of the tool sheets, more detailed costing information is provided within the designated cost range to aid in the tool selection process where costs are a concerning factor. While the provided costs include what is required to plan and implement each

[2] Appendix C includes the complete list of roadway classifications as published in the *City of San Diego Street Design Manual (2002).*

[3] Appendix E contains a photo reference list of all photos shown in the Toolbox.

device, there are several potential factors which may ultimately influence final costs. These components, including the tools affected are:

- **Drainage Improvements** may be required for streets with unique roadway alignments or pre-existing drainage problems. If the proposed traffic calming feature would fundamentally alter the drainage patterns for a roadway, improvements would be required. The price of these improvements would be dependent on size and feasibility.

  Potentially Affected Tools: Bulbouts, Chicanes, Angled Slow Point, Chokers, Short Intersection Median, Raised Median, Treatment on a Curve, Median Barriers, Raised Crosswalk, Intersection Table, Partial Street Closure, Full Street Closure, Diagonal Diverter, Curb Radius Reduction, Traffic Circles, Roundabouts, and Gateway Entrance Feature.

- **Landscaping Improvements** may be desirable by communities wishing to beautify their neighborhood and the surrounding street system. In addition to adding an aesthetic touch to the project, landscaping can also aid in the visual narrowing the roadway which can further help to reduce travel speeds. This type of improvement may strengthen the overall impact of a device especially if speeding is a primary neighborhood concern.

  All traffic calming measures that include landscaping improvements must be consistent with the *City of San Diego Landscape Technical Manual*. This manual includes standards, guidelines, and criteria for all landscaping in the public right-of-way, such as location, plant selection, maintenance, median landscaping, irrigation and electrical services. Also, it is important that landscape improvements not impair sight distances at intersection approaches or on curved roadway segments. These improvements should also not block traffic signal indicators, traffic signs, pavement markings or street lights.

  The additional costs for landscaping improvements are potentially significant. These costs stem from the purchase and installation of the landscaping feature in addition to the required on-going maintenance. Typically, the maintenance costs are much greater than the installation costs since traffic calming features are designed to be permanent improvements to the neighborhood. As stipulated in the *City of San Diego Street Design Manual (2002)*, watering and maintenance will need to be assured through an agreement with the City for all street trees and landscape plantings through street tree permits, encroachment removal and maintenance agreements, or through maintenance assessment districts.

  Potentially Affected Tools: Bulbouts, Chicanes, Angled Slow Point, Chokers, Short Intersection Median, Raised Median, Treatment on a Curve, Median Barriers, Raised Crosswalk, Partial Street Closure, Full Street Closure, Diagonal Diverter, Traffic Circles, Roundabouts, Gateway Entrance Feature, and Realigned T-Intersection.

- **Decorative Pavement Treatments** such as brick pavers, interesting or unusual color patterns, or concrete stamping can also add an aesthetic touch to a traffic calming device. Similar to landscaping improvements, decorative pavement can influence traffic speeds given the inherent visual deflection of the device. The additional price of decorative pavement treatments is due to the cost of the material, additional installation time and on going required maintenance.

  Potentially Affected Tools: Bulbouts, Chicanes, Angled Slow Point, Chokers, Short Intersection Median, Raised Median, Treatment on a Curve, Median Barriers, Raised Crosswalk, Intersection Table, Partial Street Closure, Full Street Closure, Diagonal Diverter, Traffic Circles, Roundabouts, Gateway Entrance Feature, Speed Tables, Right-In/Right-Out Island, and Realigned T-Intersection,

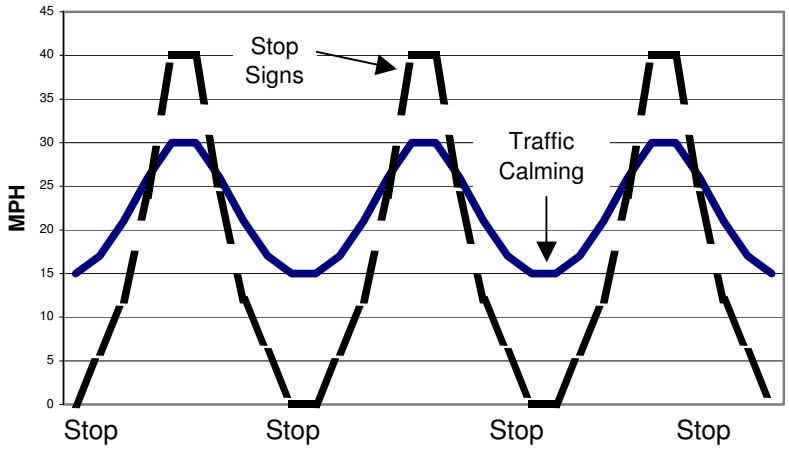
- **Device Size** may also strongly influence the final price of a traffic calming feature since larger features would require more raw materials and possibly increase the need for additional roadway striping. The required size of any device may be dependent on the size and scale of the neighborhood or area where the device is placed. For example, roadway widths may require a device to cover a larger surface area since a device that is too small within a larger roadway may not yield the desired results of either speed or volume reduction.

  Potentially Affected Tools: Bulbouts, Chicanes, Angled Slow Point, Chokers, Short Intersection Median, Raised Median, Treatment on a Curve, Median Barriers, Raised Crosswalk, Intersection Table, Partial Street Closure, Full Street Closure, Diagonal Diverter, Curb Radius Reduction, Traffic Circles, Roundabouts, Speed Lumps, Speed Tables, Curb Radius Reduction, and Roadway Striping.

5.3 Stop Signs

Stop signs have been removed as an option in the Toolbox based on the common misconception that stop signs are a form of traffic calming. In reality, stop signs are actually a traffic *control* device. While many citizens believe that stop signs help reduce speeds on their streets, studies have shown that mid-block speeds are as great or greater than those without stop signs. Drivers are tempted to try and make up for lost time by accelerating to higher speeds in between stop causing the increase in mid-block speeds. This phenomenon is known as “speed spiking” which is illustrated with the following graphic. Inappropriate use of stop sign control also creates unnecessary neighborhood noise due to braking, deceleration and acceleration of vehicles at the signs. In addition, inappropriate stop sign placement provides a false sense of security to pedestrians as drivers tend to roll through stop signs or fail to stop if the signs are perceived to be unnecessary (i.e. little or infrequent side street traffic encountered).

Stop Signs Versus Traffic Calming



However, stop signs can be advantageous where they are warranted but should not be installed specifically as a traffic calming measure. The purpose of stop signs is to assign the right-of-way between motorists, pedestrians and cyclists at an intersection. To that end, the Manual of Uniform Traffic Control Devices (MUTCD Part 2B-5) and the California Supplement (Part 2B-5) set forth guidelines for the installation of stop signs. The California Supplement even reinforces the idea that stop signs are not meant as traffic calming in specifically stating that a stop sign is "not a 'cure all' and is not a substitute for other traffic control devices." Also, the MUTCD specifically states, "stop signs should not be used for speed control" (Part 2B-5).

TOOLBOX USAGE GUIDE

City of San Diego Traffic Calming Toolbox Usage Guide

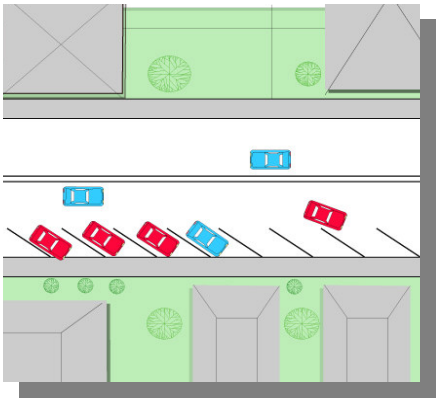
LEGEND Ranking Color Codes and Numbers		Effectiveness				Potential Impacts					Applicable Roadway Classification			Cost**	Page
		Speed Reduction	Volume Reduction	Pedestrian Safety	Collision Reduction	Loss of Parking	Access Restrictions	EMS/Fire Issues	Transit Issues	Noise/Pollution	Residential	Collector	Major		
High Effectiveness	1														
Moderate Effectiveness	2														
Low to Zero Effectiveness	3														
Does Not Apply	X														
SPEED REDUCTION TOOLS															
Angled Parking		2	X	X	X						✔	✔		Low	
Angled Slow Point		1	2	X	3	✔		✔			✔	✔		Medium	
Bulbout/Pop-Out/Curb Extension		2	3	1	3	✔		✔	✔		✔	✔	✔	High	
Chicane		1	2	X	2	✔		✔			✔	✔		Medium	
Choker		1	2	X	2	✔					✔	✔		Low	
Curb Radius Reduction		2	3	2	3			✔	✔		✔	✔	✔	Medium	
Gateway/Entrance Feature		1	3	2	3	✔		✔			✔	✔		Medium	
Intersection Table/Raised Intersection		1	3	1	3			✔	✔	✔	✔	✔		High	
Permanent Speed Feedback Sign		2	3	X	X						✔	✔	✔	Medium	
Raised Crosswalk		1	2	1	X	✔		✔	✔	✔	✔	✔		Medium	
Raised Median/Pedestrian Refuge		2	3	2	3	✔	✔				✔	✔	✔	Medium	
Realigned T-Intersection		1	3	X	3	✔	✔	✔	✔		✔	✔		Medium	
Roadway Striping		2	X	3	3	✔					✔	✔	✔	Low	
Roundabout		1	2	3	1	✔		✔	✔		✔	✔	✔	High	
Short Intersection Median/Median Slow Point		2	3	2	3	✔	✔	✔	✔		✔	✔		Medium	
Signage		3	3	3	X						✔	✔	✔	Low	
Speed Hump		1	2	X	2			✔	✔	✔	✔	✔ *		Low	
Speed Lump		1	2	X	2			✔	✔	✔	✔	✔ *		Low	
Speed Table		1	2	X	2			✔	✔	✔	✔	✔		Medium	
Temporary Radar Speed Trailer		2	3	X	X						✔	✔	✔	Medium	
Temporary Enforcement		2	3	X	X						✔	✔	✔	High	
Traffic Circle		1	2	3	1			✔	✔		✔			Medium	
Treatment on a Curve		2	X	X	3	✔	✔	✔		✔	✔	✔		Low	
VOLUME REDUCTION TOOLS															
Diagonal Diverter		2	1	3	1		✔	✔	✔		✔			Medium	
Full Street Closure/Cul-De-Sac		2	1	3	1		✔	✔	✔		✔			Medium	
Median Barrier/Channelization		3	1	3	1		✔	✔	✔		✔	✔		Medium	
Partial Street Closure/Semi-diverter		2	1	2	2	✔	✔	✔	✔		✔			Medium	
Right-In/Right-Out Island		2	1	2	1	✔	✔	✔			✔	✔		Low	
Turn Restriction		3	1	X	3		✔				✔	✔	✔	Low	

* May only be used on low ADT two-lane collectors that do not have two-way left-turn lanes or dedicated left-turn pockets.

** The cost range for all tools is: Low (<$10,000), Medium ($10,000-$50,000) and High (>$50,000). See Chapter 5.2 for detailed cost information.

SPEED REDUCTION TOOLS

ANGLED PARKING



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

None Identified

Cost: **Low**

($2.00 per linear foot along curb length)

ANGLED PARKING is generally used to increase the number of available parking spaces. However, a positive by-product can be a reduction in vehicle speed. Drivers may slow down in anticipation of vehicles backing out of parking spaces.

Another option for angled parking is to provide back-in parking which may decrease the accident potential associated with traditional back-out parking.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

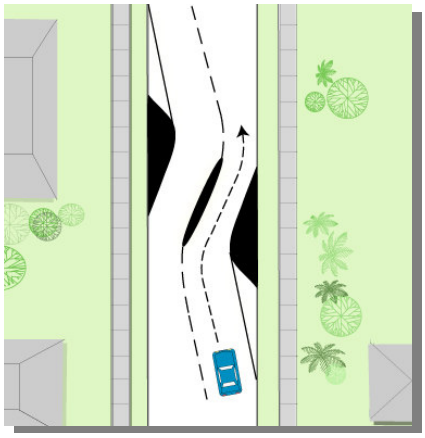
ADVANTAGES

- Speed reduction
- Maintains emergency response access
- Increase parking

DISADVANTAGES

- May encourage cars from other streets to use available parking
- Potential bike impacts

ANGLED SLOW POINT



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

VOLUME REDUCTION

Cost: **MEDIUM**

($20,000 to $40,000)

ANGLED SLOW POINTS are created by constructing triangular medians on either side of the road. This creates a narrow travel path between the medians that is directed at a different angle than the approaching lanes. This tool can either be two-lane or single lane. On a two-lane slow point, a short median is constructed between the travel lanes. To negotiate this device, drivers must slow to maneuver through the curve created by the islands. For single-lane angled slow points, drivers must yield to oncoming traffic.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

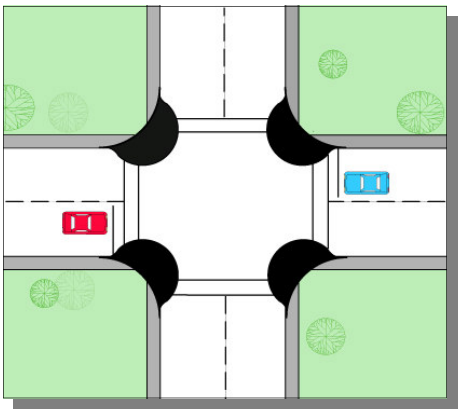
ADVANTAGES

- Speed reduction
- Possible opportunity for landscaping

DISADVANTAGES

- Loss of on-street parking in vicinity of treatment
- Increased maintenance
- More difficult access for larger vehicles
- Requires Bicyclists to merge with vehicles

BULBOUT/POP-OUT/CURB EXTENSION



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

VOLUME REDUCTION

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **HIGH**

($40,000 to $80,000 per intersection; 4 bulbouts total)

BULBOUTS, also know as Pop-Outs and Curb Extensions, narrow the width of a street at intersection locations by extending the curb into the parking lanes. This creates a shorter crossing distance, decreasing a pedestrian's exposure time to oncoming vehicles. Bulbouts also may slow vehicles making right turns, as the potential turning radius is greatly reduced. By placing the pedestrian at the edge of the travel lane, both the pedestrian and driver have a better view of each other. Bulbouts are best used in locations with high pedestrian volumes, such as downtown areas and near schools.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	-7%
Volume Reduction[2]	-10%
Collision Reduction[3]	I/D[4]

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

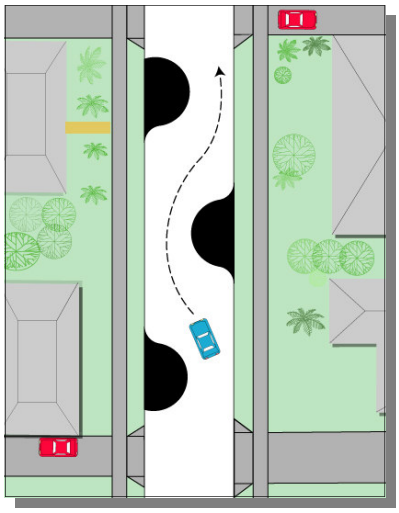
ADVANTAGES

- Increase the visibility of pedestrians to drivers
- Speed reduction for through traffic
- Speed reduction for right turning vehicles

DISADVANTAGES

- Difficult for emergency vehicles and larger vehicles to turn
- May force bicyclists into travel lanes

CHICANE



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

VOLUME REDUCTION

COLLISION REDUCTION

Cost: **MEDIUM**

($30,000 to $50,000 per series of 3)

CHICANES are created by installing a series of two or more curb extensions, alternating from one side of the roadway to the other. This creates an S-shaped path for vehicles. To reduce speeds, chicanes rely on a curvilinear path and potential conflict between opposing traffic. Chicanes can be either one or two lanes. One lane chicanes should only be used on roads with low traffic volumes. This tool is best used on long, straight streets with low volumes due to the single lane of travel through the chicane. Careful consideration must go into the design to make sure that drivers are not able to drive directly down the center without any horizontal deflection. This tool should be avoided on roads that have significant horizontal and/or vertical curves.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**-8% to -17%**

Source: Harmony Road Project, Newark, DE, 2002
[1]Reduction in 85th Percentile Speeds between slow points

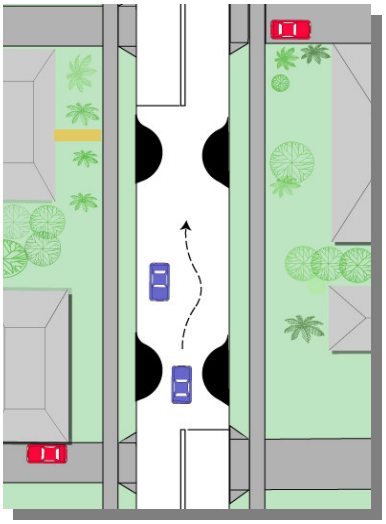
ADVANTAGES

- Speed reduction
- Possible opportunity for landscaping

DISADVANTAGES

- Loss of on-street parking in vicinity of treatment
- Increased maintenance
- Requires Bicyclists to merge with vehicles

CHOKER



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

VOLUME REDUCTION

COLLISION REDUCTION

Cost: **LOW**

($8,000 to $9,000 per location)

CHOKERS are created by installing curb extensions at locations on opposite sides of a roadway. This narrows the road, but still maintains two-way traffic. This form of traffic management works best at mid-block locations that have sufficient enough volumes so that opposing traffic would be passing the choker at or near the same point in time. This discourages drivers from traveling down the center of the roadway to avoid any impacts of the chokers. There should be enough roadway width maintained between the chokers to accommodate bicycle and vehicle traffic.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**-14%**
Volume Reduction[2]	**-20%**
Collision Reduction[3]	**I/D[4]**

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

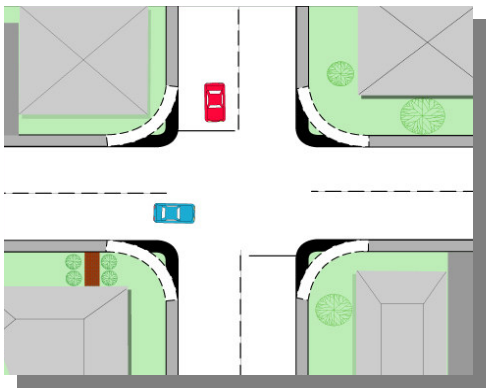
ADVANTAGES

- Speed reduction
- Possible opportunity for landscaping
- Potential mid-block crossing location if combined with pedestrian crossing features

DISADVANTAGES

- Loss of some on-street parking in vicinity of treatment
- Possible increased maintenance

CURB RADIUS REDUCTION



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **MEDIUM**

($24,000 to $32,000 per Intersection; 4 reductions total)

CURB RADIUS REDUCTIONS provide tighter corner radii at intersections. This treatment may reduce the right-turn speed of vehicles. By reducing right-turn speeds, some drivers may be discouraged from cutting through the neighborhood. It also will increase the visibility of pedestrians to drivers and shorten the crossing distance for pedestrians.

This treatment may cause difficultly for larger vehicles. Some larger vehicles may not be able to make the turn without crossing into the opposing travel lane. This treatment may not be appropriate in areas that experience high volumes of large vehicles.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

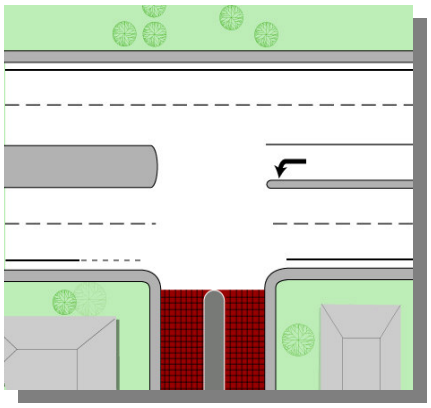
ADVANTAGES

- Slows right turn speeds
- May discourage cut-through traffic
- Increases the visibility of pedestrian to drivers
- Shortens pedestrian crossing distance

DISADVANTAGES

- Difficult for large vehicles to make right-turn

GATEWAY/ENTRANCE FEATURE



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

PEDESTRIAN SAFETY

Cost: **MEDIUM**

($20,000 to $50,000)

GATEWAY/ENTRANCE FEATURES are used on local streets at the intersection with a collector or major arterial. The purpose of a gateway/ entrance feature is to alert the driver that they have left the arterial roadway and have entered a residential neighborhood. An example of a gateway treatment is a median with a specimen tree or neighborhood sign and textured roadway pavement. The use of textured pavement may affect bicyclists, but can be designed in order to take bike safety into account.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

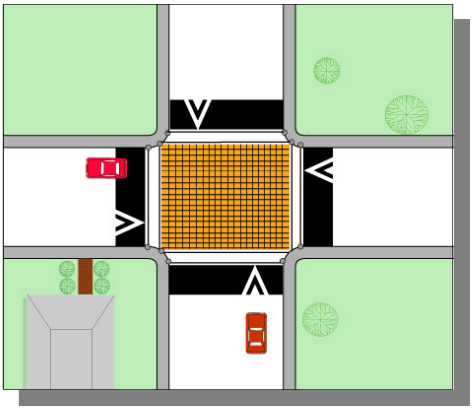
ADVANTAGES

- May cause a reduction in speeds
- May discourage cut-through traffic
- May provide a pedestrian crossing refuge
- Strengthens neighborhood identity
- Changes driving environment (e.g. major to residential)

DISADVANTAGES

- May cause difficulty for large vehicles to make right turns

INTERSECTION TABLE/RAISED INTERSECTION



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

VOLUME REDUCTION

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **HIGH**

($75,000 to $125,000)

INTERSECTION TABLES/RAISED INTERSECTIONS are created by raising the intersection to be level with the sidewalk. Similar to a speed table, this device has ramped edges on all approaches and exits and can incorporate textured paving materials on the flat intersection portion. The use of textured pavement may affect bicyclists, but can be designed in order to take bike safety into account. Intersection tables force drivers to slow down upon entry and exit of the intersection. To distinguish between the road and sidewalk, bollards can be used to outline the sidewalk. This will serve to protect pedestrians by prohibiting vehicles from traveling on the sidewalk.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	-1%
Volume Reduction[2]	I/D[4]
Collision Reduction[3]	I/D[4]

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

ADVANTAGES

- Speed reduction
- Creates a pedestrian friendly atmosphere
- Self-enforcing
- Improves visibility of pedestrian crossings and intersections

DISADVANTAGES

- Increase in EMS/ Fire response time
- Creates more noise from decelerating and accelerating
- May cause bicycle safety if non-standard pavement treatments are used

PERMANENT SPEED FEEDBACK SIGN

Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

VOLUME REDUCTION

Cost: **MEDIUM**

($10,000 to $15,000 per installation)

PERMANENT SPEED FEEDBACK SIGNS are used to educate drivers of their speed, especially as they travel on residential streets. Speed Feedback Signs can be setup permanently for a more lasting effect when compared with a radar speed trailer. This tool can be a first attempt at getting drivers to reduce their speeds. The driver's behavior may change when the feedback sign is first introduced; it will not necessarily modify driving behavior permanently.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**-5% to -12%**
Volume Reduction[2]	**I/D[4]**
Collision Reduction[3]	**I/D[4]**

Source: City of San Diego
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

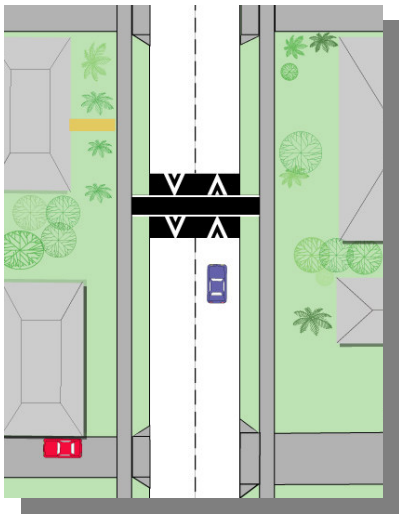
ADVANTAGES

- Speed reduction
- Inexpensive attempt at traffic calming
- No increase in EMS/ Fire response time

DISADVANTAGES

- Changes in driver behavior are only temporary

RAISED CROSSWALK



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

VOLUME REDUCTION

PEDESTRIAN SAFETY

Cost: **MEDIUM**

($25,000 to $35,000)

RAISED CROSSWALKS are similar to speed tables; however, they provide a marked pedestrian crossing. This device can be used at intersections or mid-block locations. Raised crosswalks are highly effective in areas with large volumes of pedestrian traffic, such as schools or downtown business districts.

Raised crosswalks can be combined with bulbouts or chokers to decrease the distance a pedestrian is in the vehicle travel way.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**-18%**
Volume Reduction[2]	**-12%**
Collision Reduction[3]	**-45%**

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions

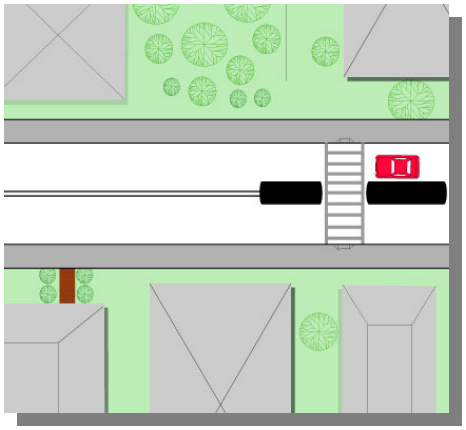
ADVANTAGES

- Speed reduction
- Improves visibility of pedestrians and crossings
- Can provide pedestrian mid-block crossing

DISADVANTAGES

- Loss of parking
- EMS/ Fire vehicles forced to almost stop at ramp
- Creates more noise from decelerating and accelerating

RAISED MEDIAN/PEDESTRIAN REFUGE



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

COLLISION REDUCTION

PEDESTRIAN SAFETY

Cost: **MEDIUM**

($12,000 to $15,000 per location)

RAISED MEDIANS/PEDESTRIAN REFUGES are used on wide streets to shorten a pedestrian's crossing distance and provide pedestrians with a refuge. To provide refuge, the median should have a minimum width of 6'. This also allows the pedestrian to cross one direction of traffic at a time. After a pedestrian crosses one lane of traffic, they may wait in the median area before crossing the other lane of traffic. These medians can be landscaped to break up the sight line of the driver and enhance the aesthetics of the neighborhood. Landscaping also increases the visibility of the tool.

MEASURED EFFECTIVENESS	
Pedestrian Safety[1]	Increased pedestrian use of crosswalk. No significant difference in motorists yielding to pedestrians.

[1]Source: Huang & Cynecki, 2001

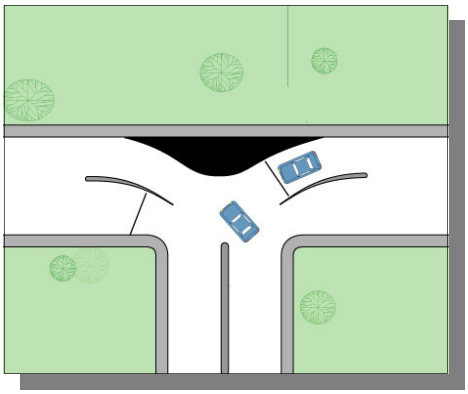
ADVANTAGES

- Provides ability for a safer pedestrian crossing
- Possible opportunity for landscaping

DISADVANTAGES

- Potential loss of parking
- May restrict access to driveways in vicinity of device

REALIGNED T-INTERSECTION



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

VOLUME REDUCTION

COLLISION REDUCTION

Cost: **MEDIUM**

($15,000 to $30,000)

REALIGNED T-INTERSECTIONS modify the existing alignment, forcing the once straight through movement to follow a slower, curvilinear travel route. A bulbout is constructed on the major road in the intersection. Medians can also be installed on the major approach legs to guide the traffic through the intersection.

To further slow the traffic on the through street, stop signs can be installed on the through street rather than the side street. This would allow the side street movement the right-of-way while stopping the through street.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

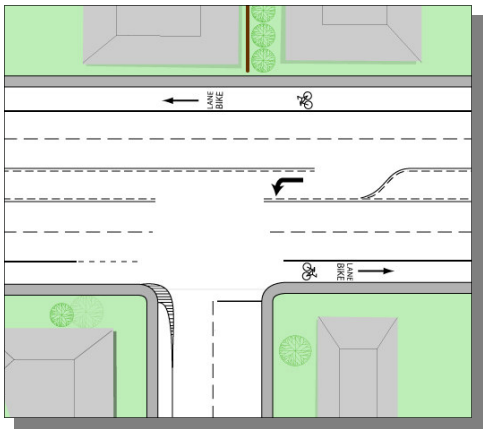
ADVANTAGES

- Reduce overall intersection speeds
- Provides an opportunity for additional landscaping

DISADVANTAGES

- May be more difficult for large vehicles to make right-turn
- May reduce available parking

ROADWAY STRIPING



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

None Identified

Cost: **Low**

($2.00 per Linear Foot)

ROADWAY STRIPING can change the appearance of the roadway, encouraging drivers to remain in designated lanes or drawing their attention to bike lanes. Adding lane striping to a residential road without lane markings or a bike lane may change the behavior of some drivers. By adding striping, the vehicle travel lanes are narrowed which will encourage slower speeds. In general, vehicles will not travel in a designated bike lane. This can have a positive impact on both driver and bicycle safety.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

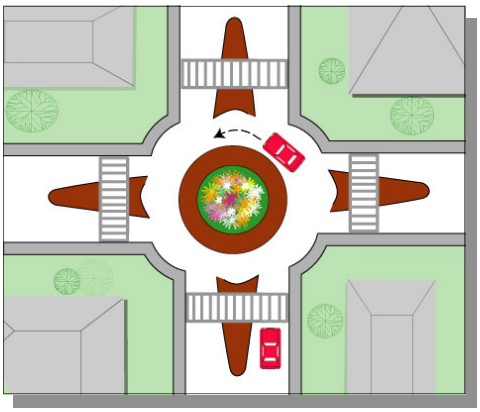
ADVANTAGES

- Speed reduction
- Increase the visibility of bikes to drivers

DISADVANTAGES

- Possible loss of parking

ROUNDABOUT



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

VOLUME REDUCTION

COLLISION REDUCTION

Cost: **HIGH**

($200,000 to $500,000 per location)

ROUNDABOUTS are large circular medians placed in the center of an intersection. Traffic flows around the median counter-clockwise through the intersection. Drivers yield to vehicles already circulating within the intersection. Due to the horizontal deflection, vehicles must slow to maneuver around the intersection. Speeds can be reduced from multiple directions. The circular median and splitter islands can both be landscaped to help beautify the neighborhood.

In general, roundabouts are more expensive than traffic circles due to larger right-of-way requirements. However, roundabouts are typically more cost effective for an intersection compared with traditional traffic signals.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**I/D[4]**
Volume Reduction[2]	**I/D[4]**
Collision Reduction[3]	**-15% to 33%**

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

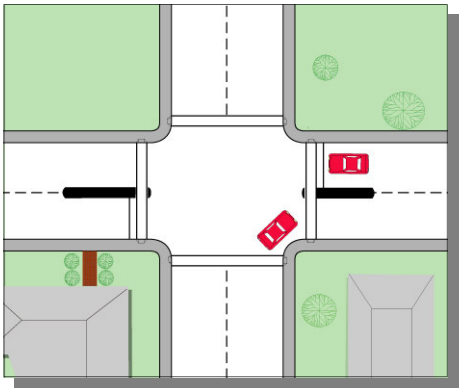
ADVANTAGES

- Speed reduction
- Possible opportunity for landscaping
- Easier for large vehicles to navigate relative to traffic circles
- Typically more cost effective than traditional signals

DISADVANTAGES

- Potential loss of parking
- Greater expense relative to traffic circles
- Increased EMS/ Fire response
- Potentially difficult for disabled pedestrians to navigate

SHORT INTERSECTION MEDIAN/MEDIAN SLOW POINT



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **MEDIUM**

($15,000 to $30,000)

SHORT INTERSECTION MEDIANS/MEDIAN SLOW POINTS can be installed on any leg of an intersection to slow fast-turning vehicles. The median forces vehicles to make a turn along a smaller radius, rather than making a higher speed turn on a larger radius, thereby slowing traffic. This device may also be installed at mid-block locations to achieve the same effect by forcing traffic to shift its path to travel safely around the median. However, this tool may block access to some driveways. Also, it may require removing some parking. The medians may restrict some larger vehicles, such as fire trucks, buses or moving vans, from making left turns at the intersection.

MEASURED EFFECTIVENESS
Insufficient Data to predict reduction effect

ADVANTAGES

- Potential for reduction of left-turn speeds
- Possible opportunity for landscaping
- Refuge for pedestrians

DISADVANTAGES

- Potential loss of parking
- May restrict access to driveways in vicinity of device
- May restrict turning movements by larger vehicles

SIGNAGE

Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

PEDESTRIAN SAFETY

Cost: **Low**

($500 per sign)

SIGNAGE comes in various forms. Depending on the given circumstances, these signs may make drivers aware of their surroundings. Upon leaving a major arterial, many people do not recognize when they enter a residential neighborhood. Installing speed limit signs can notify drivers that they have entered residential neighborhood. "School Zone" signs are installed at appropriate locations to remind drivers that there is a school and there are children in the vicinity.

MEASURED EFFECTIVENESS
Insufficient Data to predict reduction effect

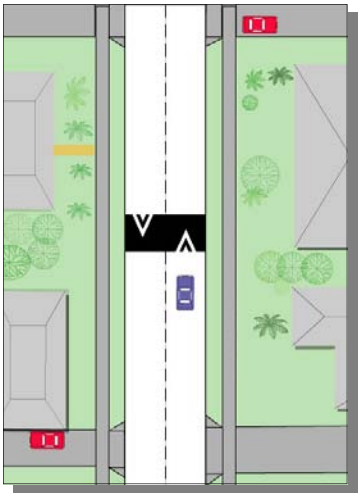
ADVANTAGES

- Speed reduction
- May discourage cut-through traffic
- Raise driver awareness

DISADVANTAGES

- Effect is often temporary
- Drivers may not obey the device without enforcement

SPEED HUMP



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector*

Other Potential Results:

VOLUME REDUCTION

COLLISION REDUCTION

Cost: **LOW**

($2,500 PER HUMP)

SPEED HUMPS are devised to encourage drivers to travel at lower speeds over the device. They are approximately 3 1/2" inches high, have a parabolic-shape surface, and span the width of the road. The height causes the driver to be jolted if traveling at too high of a speed. However, due to the advance in vehicle suspension systems, this device may not affect all drivers. It must be cautioned that these devices do have a severe impact on emergency response services and can create an uncomfortable situation for all passengers including those in ambulances.

*May only be used on low ADT two-lane collectors that do not have two-way left-turn lanes or dedicated left-turn pockets.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**-22%**
Volume Reduction[2]	**-18%**
Collision Reduction[3]	**-13%**

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions

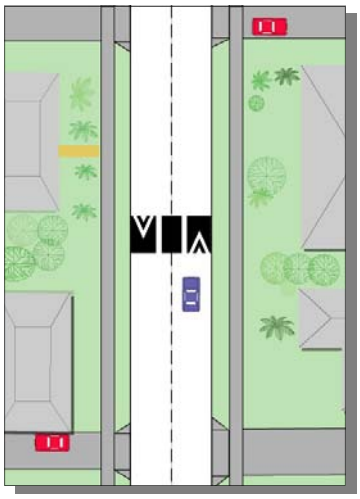
ADVANTAGES

- Speed reduction
- May discourage cut-through traffic

DISADVANTAGES

- Uncomfortable for bicyclists and vehicle passengers
- Creates noise
- EMS/Fire vehicles forced to almost stop at ramp

SPEED LUMP



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector*

Other Potential Results:

VOLUME REDUCTION

COLLISION REDUCTION

Cost: **LOW**

($3,000 PER LUMP)

SPEED LUMPS are similar to speed humps except that there are two tire cut-outs set far enough apart to allow for an emergency vehicle's tire pathway to pass between each lump. The pathway is set based on the axle width of a fire apparatus allowing emergency vehicles to pass through virtually unimpeded. Vehicles with a narrower wheel base would be forced to travel over the lumps.

MEASURED EFFECTIVENESS	
Speed Reduction	**-27%**
Source: Survey of 16 Sacramento, CA locations (Fehr and Peers)	

*May only be used on low ADT two-lane collectors that do not have two-way left-turn lanes or dedicated left-turn pockets.

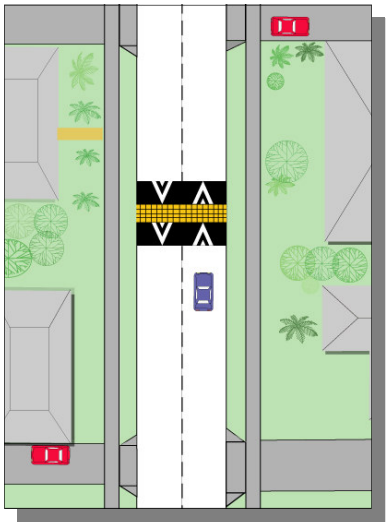
ADVANTAGES

- Speed reduction
- May discourage cut-through traffic
- Will not impede EMS/ Fire response as much as traditional speed humps

DISADVANTAGES

- Does not affect all vehicles
- Creates noise

SPEED TABLE



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector*

Other Potential Results:

VOLUME REDUCTION

COLLISION REDUCTION

Cost: **MEDIUM**

($22,000 to $33,000)

SPEED TABLES provide vertical deflection. Instead of having a rounded surface, speed tables have ramps on either side leading to a flat "table". The effectiveness of the speed table can be varied by changing the shape of the ramps and/or texture of the table. Steeper ramps will cause a greater reduction in vehicular speeds. Similarly, texturing the table will also cause a greater reduction in speeds. Textured pavement may affect bicyclists, but can be designed to take bike safety into account.

Speed tables can be used in conjunction with a mid-block pedestrian crossing. The speed table may increase the visibility of pedestrians at mid-block locations (see raised crosswalk).

*May only be used on low ADT two-lane collectors that do not have two-way left-turn lanes or dedicated left-turn pockets.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**-18%**
Volume Reduction[2]	**-12%**
Collision Reduction[3]	**-45%**

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions

ADVANTAGES

- Speed reduction

DISADVANTAGES

- EMS/ Fire vehicles forced to almost stop at ramp
- Creates more noise from decelerating and accelerating
- May cause bicycle safety issues if non-standard pavement treatments are used

TEMPORARY RADAR SPEED TRAILER

Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

VOLUME REDUCTION

Cost: **MEDIUM**

$250 per day

TEMPORARY RADAR SPEED TRAILERS are used to educate drivers of their speed, especially as they travel on residential streets. Radar speed trailers are mobile and can be used for a temporary warning device. This type of tool can be a first attempt at getting drivers to reduce their speeds. The driver's behavior may change when the radar speed trailer is first introduced; it will not necessarily modify driving behavior permanently.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

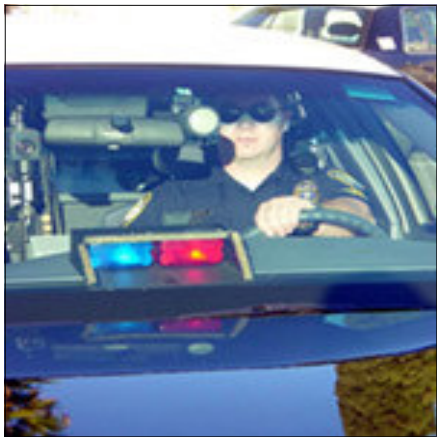
ADVANTAGES

- Speed reduction
- Inexpensive and temporary attempt at traffic calming
- No increase in EMS/ Fire response time
- Raises driver awareness

DISADVANTAGES

- Changes in behavior are only temporary

TEMPORARY ENFORCEMENT



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector, Major

Other Potential Results:

VOLUME REDUCTION

Cost: **High**

($2,400 per week for three AM and three PM peak hours)

TEMPORARY ENFORCEMENT requires the presence of officers to monitor and enforce speeds and restrictions. Enforcement is usually used as a first attempt at reducing speeds and changing driver behavior. However, the influence of the police usually lasts as long as the officers are present. Based on the cost versus benefit, physical measures may have greater effect and could be more cost effective in the long run.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

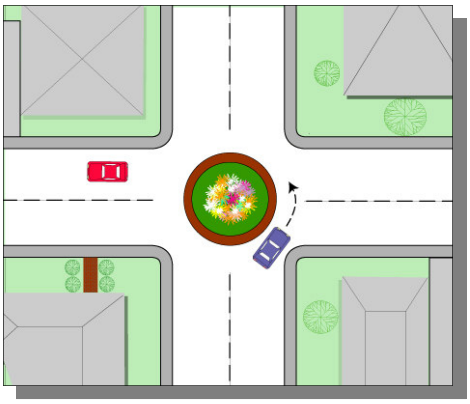
ADVANTAGES

- Speed reduction
- No permanent roadway changes

DISADVANTAGES

- Changes in behavior are only temporary

TRAFFIC CIRCLE



Primary Purpose:

SPEED REDUCTION

On: Residential

Other Potential Results:

VOLUME REDUCTION

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **MEDIUM**

($10,000 to $50,000 per location)

TRAFFIC CIRCLES are circular medians placed in the center of an intersection. Traffic flows around the median counter-clockwise through the intersection. Drivers yield to vehicles already circulating within the intersection. These devices may reduce speeds through neighborhoods. Due to the horizontal deflection, vehicles must slow to maneuver around the device. The circular median can be landscaped to help beautify the neighborhood.

Depending on right-of-way and budget constraints, either a traffic circle or roundabout can be installed. Unlike roundabouts, traffic circles do not have splitter islands on each approach to help guide traffic around the roundabout due to their smaller size. Large emergency vehicles like fire trucks are permitted to turn left in front of circle.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	**-11%**
Volume Reduction[2]	**-5%**
Collision Reduction[3]	**-71%**

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions

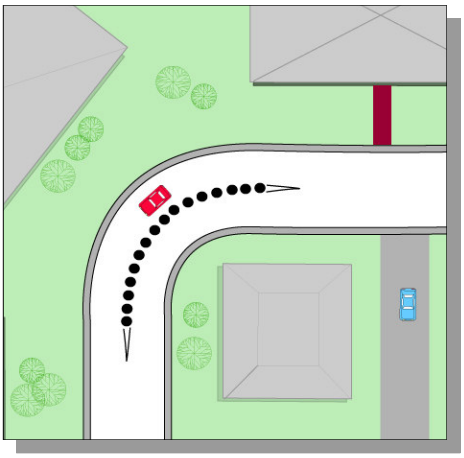
ADVANTAGES

- Speed reduction
- Possible opportunity for landscaping
- Possible decrease in intersection accidents compared with stop-controlled intersections

DISADVANTAGES

- Potential loss of parking
- Restricts turning movements by larger vehicles
- Increased EMS/ Fire response

TREATMENT ON CURVE



Primary Purpose:

SPEED REDUCTION

On: Residential, Collector

Other Potential Results:

COLLISION REDUCTION

Cost: **LOW**

($2,000 to $5,000)

TREATMENT ON CURVES intends to prevent vehicles from drifting into the opposing lane while traveling around a sharp curve. By eliminating the ability to travel into the opposing lane, speeds are generally reduced around the curve. Raised pavement markers (Botts dots) can be installed. Also, medians can be installed if there is sufficient roadway width. However, median installation has the potential to block driveway access. Openings may be cut in the median or the median may be mountable, to accommodate this situation.

MEASURED EFFECTIVENESS
Insufficient Data to predict reduction effect

ADVANTAGES

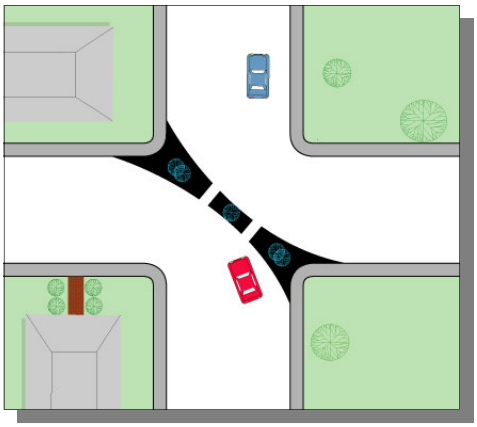
- Speed Reduction

DISADVANTAGES

- Potential loss of parking
- May restrict access to driveways in vicinity of device
- May create noise

VOLUME REDUCTION TOOLS

DIAGONAL DIVERTER



Primary Purpose:

VOLUME REDUCTION

On: Residential

Other Potential Results:

SPEED REDUCTION

COLLISION REDUCTION

Cost: **MEDIUM**

($15,000 to $40,000)

DIAGONAL DIVERTERS are barriers constructed diagonally across a four legged intersection blocking the through movements. Diagonal diverters can create circuitous routes for those accessing adjacent properties, including emergency services. Some neighborhood roads may experience an increase in traffic, while others experience a decrease due to the change in traffic circulation. Design features of the diverter could allow for pedestrian, bicycle, and EMS/ Fire access.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	-4%
Volume Reduction[2]	-35%
Collision Reduction[3]	I/D[4]

Source: Traffic Calming: State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

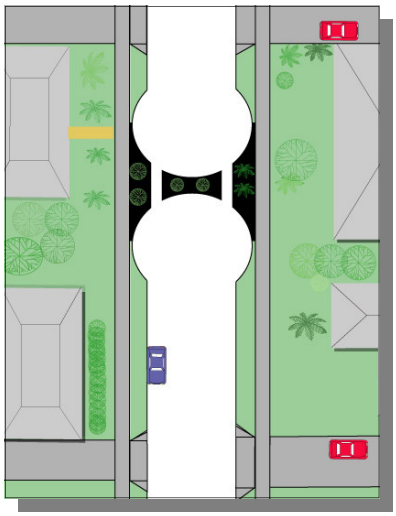
ADVANTAGES

- Eliminate cut-through traffic
- Potential landscaping opportunity

DISADVANTAGES

- Will change neighborhood traffic patterns
- Will increase trip length for some residents
- Will increase traffic on adjacent roadways
- Emergency response routes may lengthen

FULL STREET CLOSURE/CUL-DE-SAC



Primary Purpose:

VOLUME REDUCTION

On: Residential

Other Potential Results:

SPEED REDUCTION

COLLISION REDUCTION

Cost: **MEDIUM**

($30,000 to $50,000)

FULL STREET CLOSURES/CUL-DE-SACS are created by constructing a barrier across the entire street, closing the street to all through traffic. This measure will have a drastic effect on local traffic circulation. They are used to force changes in travel patterns - such as preventing cut-through traffic in residential neighborhoods or to eliminate dangerous or problematic intersections. Adjacent roadways will experience an increase in traffic due to the closure and local residents will have longer travel routes.
Full street closures should be constructed in a manner which maintains pedestrian, bicycle and emergency vehicle access.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	I/D[4]
Volume Reduction[2]	-44%
Collision Reduction[3]	I/D[4]

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

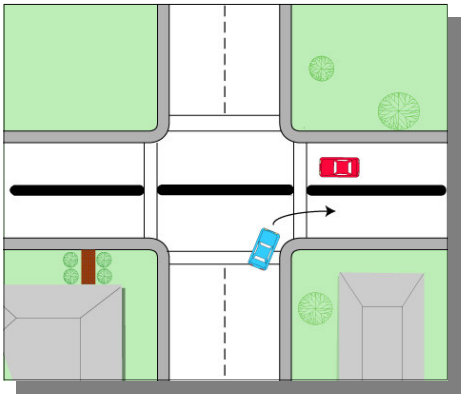
ADVANTAGES

- Eliminate cut-through traffic
- Potential landscaping opportunity

DISADVANTAGES

- Will change neighborhood traffic patterns
- Will increase trip length for many residents
- Will increase traffic on adjacent roadways
- Emergency response routes may lengthen

MEDIAN BARRIER/ CHANNELIZATION



Primary Purpose:

VOLUME REDUCTION

On: Residential, Collector

Other Potential Results:

SPEED REDUCTION

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **MEDIUM**

($10,000 to $50,000)

MEDIAN BARRIERS/CHANNELIZATION help prevent cut-through traffic in residential neighborhoods. The raised median is used on the major street, restricting traffic from continuing from one residential neighborhood to the next. The median barrier also restricts left-turns from the major street into the residential neighborhoods. Typically, right-in and right-out are the only turn movements allowed to and from the minor street. However, a variation on the median barrier is an "S" Median which allows for left turn movements from the major street onto the minor street but still prevents through traffic from crossing.

Median barriers can also help improve traffic flow along the major street. Stacking caused by vehicles waiting for a gap to make a left turn will be eliminated. Median barriers can also help improve intersection safety due to a decrease in conflicting intersection turn movements. Pedestrians may also use the median barrier as a refuge while crossing the major street, given a minimum median width of 6'. Pedestrians would only have to be concerned with one direction of traffic at a time.

Median barriers can help reduce cut-through on residential streets. However, they inevitably result in changes to travel patterns which can shift problems elsewhere. They also may cause inconvenience to residents and delays to emergency response vehicles.

MEASURED EFFECTIVENESS

Speed Reduction[1]	**I/D[4]**
Volume Reduction[2]	**-35%**
Collision Reduction[3]	**I/D[4]**

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

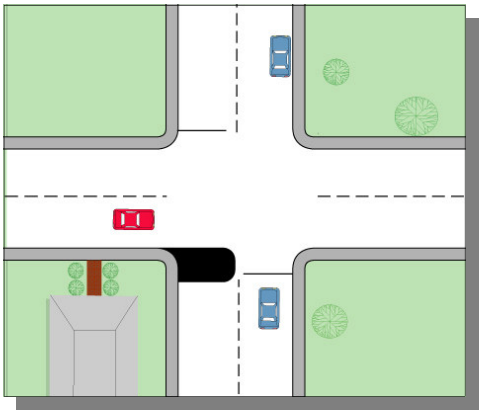
ADVANTAGES

- Effective in reducing cut through traffic
- Possible opportunity for landscaping
- Can reduce traffic volumes on residential streets

DISADVANTAGES

- May shift problem to neighboring roads
- Restricts access to neighborhood
- Restricts EMS/ Fire access
- May cause difficulty in mapping routes to a location due to roadway change

PARTIAL STREET CLOSURE/SEMI-DIVERTER



Primary Purpose:

VOLUME REDUCTION

On: Residential

Other Potential Results:

SPEED REDUCTION

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **MEDIUM**

($10,000 to $30,000)

PARTIAL STREET CLOSURES/SEMI-DIVERTERS are barriers that block one direction of travel. This device can be used to block entering or exiting traffic, depending on the specific neighborhood problem. They are used to prevent drivers from making certain turn movements at an intersection. Partial street closures can effectively reduce traffic volumes on a street although the diverted traffic may impact adjacent streets.

Careful consideration must be given when installing a partial street closure. Pedestrian and bicycle access should be maintained when using this device. Any road closure can create circuitous travel routes for residents in the affected neighborhood. Closures will also increase traffic volumes on adjacent roadways due to the changes in residents' travel patterns.

MEASURED EFFECTIVENESS	
Speed Reduction[1]	-19%
Volume Reduction[2]	-42%
Collision Reduction[3]	I/D[4]

Source: Traffic Calming - State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

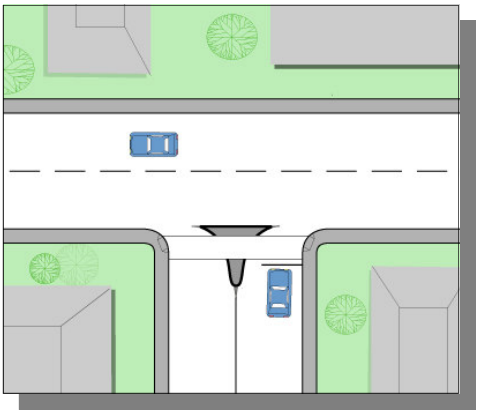
ADVANTAGES

- Elimination of cut-through traffic in one direction
- Potential landscaping opportunity
- Maintains emergency response access

DISADVANTAGES

- Will change neighborhood traffic patterns
- Will increase trip length for many residents
- Will increase traffic on adjacent roadways
- Drivers can bypass device

RIGHT-IN/RIGHT-OUT ISLAND



Primary Purpose:

VOLUME REDUCTION

On: Residential, Collector

Other Potential Results:

SPEED REDUCTION

PEDESTRIAN SAFETY

COLLISION REDUCTION

Cost: **LOW**

($5,000 to $10,000)

RIGHT-IN/RIGHT-OUT ISLANDS , also known as pork-chops, restrict left-turns into and out of a particular street. Rather than relying on a sign to discourage drivers from turning left, right-in/right-out islands force drivers to make the desired movement using a raised median.

The right-in/right-out island can be constructed to restrict a single left-turn. For example, the left-turn out may be restricted, but the left-turn in may be maintained.

This device may be particularly effective at locations where local streets intersect with uncontrolled collector streets. If a left turn in or out of a particular street is difficult due to speed and/or sight distance, the installation of a right-in/right-out island may be very beneficial. However, on low volume roadways, the device may be ineffective as drivers may still be able to make left turns, thereby bypassing the device.

MEASURED EFFECTIVENESS

Speed Reduction[1]	**I/D[4]**
Volume Reduction[2]	**-31%**
Collision Reduction[3]	**I/D[4]**

Source: Traffic Calming: State of the Practice 2000
[1]Reduction in 85th Percentile Speeds between slow points
[2]Reduction in Vehicles per Day
[3]Reduction in Average Annual Collisions
[4]I/D=Insufficient Data to predict reduction effect

ADVANTAGES

- Slows right turn speeds
- May discourage cut-through traffic
- May provide pedestrian refuge

DISADVANTAGES

- Difficult for large vehicles to make right-turn
- May shift traffic to adjacent streets

TURN RESTRICTION

Primary Purpose:

VOLUME REDUCTION

On: Residential, Collector, Major

Other Potential Results:

SPEED REDUCTION

Cost: **LOW**

($500 per sign)

TURN RESTRICTIONS can help reduce cut-through traffic or eliminate turn movements. Turn restrictions, such as "No Right-Turns 6AM-9AM" may help reduce traffic from cutting through a residential neighborhood to avoid a congested arterial. This type of treatment, however, relies on enforcement to make sure drivers are abiding by the restriction.

MEASURED EFFECTIVENESS

Insufficient Data to predict reduction effect

ADVANTAGES

- May discourage cut-through traffic
- Maintains emergency response access

DISADVANTAGES

- May increase trip length for many residents
- May increase traffic on adjacent roadways
- Drivers can bypass device

DESIGN GUIDELINES FOR NEW DEVELOPMENTS

6.0 Design Guidelines for New Developments

Proposed developments can benefit from neighborhood traffic management strategies. Traffic concerns related to speeding and traffic volumes can often be anticipated and prevented through proper review of street designs. New development and infill (redevelopment) projects can be designed to either incorporate traffic calming devices or avoid the need for traffic calming devices altogether.

During the development review process the following factors are most crucial in determining the need for traffic calming devices or layout redesign:

- Traffic volumes
- Traffic speeds
- Street layout
- Vehicle/pedestrian conflict areas

Through the City's development review process, if staff is able to determine that the proposed layout is problematic based on the above factors, then staff can request a redesign of the layout to reduce or avoid future traffic related problems.

6.1 Traffic Volumes

The average daily traffic (ADT) on residential streets should be minimal, not exceeding 1,500 vehicles. High traffic volumes on residential streets would be a reason to include traffic calming measures. According to the City's *Street Design Manual* (2002), the design ADT of a residential street is 1,500 vehicles. During development review, if a residential street were estimated to carry more than 1,500 vehicles then the street layout would require redesign. This would help to reduce speeds on higher volume residential streets.

6.2 Traffic Speeds

The potential for speeding on new streets and adjacent existing streets needs to be evaluated. Potential problem areas may include:

- Where there is a distance of greater than 600 feet between traffic control or traffic calming devices
- Where roadway grades may increase the potential for speeding
- Where the effective travel width is large due to a lack of on-street parking or lightly used bike lanes

Each street type in the *City of San Diego Street Design Manual (2002)* has a specific design speed. Features such as roadway widths, maximum grades, and parking lanes are all specific to the designed roadway.

6.3 Street Layout

Some residential collector streets can become cut-through routes, or routes used by non-local motorists as a means of bypassing congested or circuitous arterial roads. In these cases, the residential collector should be modified in one of two ways.

- The collector can be designed with a deviating path so that the overall distance by collector is greater than the distance by arterial.
- The residential roadway network can be designed such that traffic-controlled intersections result in a travel time by collector that is greater than the travel time by arterial.

For detailed information on street design and layout, the following City of San Diego documents are recommended:

- Street Design Manual, City of San Diego, November 2002
- Transit-Oriented Development Design Guidelines, City of San Diego, August 1992

The following documents are recommended supplemental readings on the subject of designing residential streets:

- Residential Street Design and Traffic Control, Homburger, Deakin, Bosselmann, Smith, and Beukers (Institute of Transportation Engineers), 1989
- Residential Streets, 3rd Edition, American Society of Civil Engineers, Institute of Transportation Engineers, National Association of Home Builders, and the Urban Land Institute, 2001
- Traditional Neighborhood Development: Street Design Guidelines, Institute of Transportation Engineers, 1999

6.4 Vehicle/Pedestrian Conflict Areas

Schools, parks, community centers, or other high pedestrian generators have particularly high potential for vehicle and pedestrian conflicts. The major pedestrian routes to school should be identified and traffic controls should be structured so that the number of crossings at uncontrolled cross-streets is minimized and pedestrians are directed to the most appropriate crossing locations. For both schools and parks, entrances tend to focus pedestrian street crossings at particular locations. These entrances can be made safer by combining them with roadway intersections so that the intersection's traffic control can also allocate right-of-way to pedestrians.

If a pedestrian-oriented land use is located in an area where high speed or high traffic volumes are unavoidable, then neighborhood traffic management measures should be selected that benefit pedestrians. For example, at an intersection or at mid-block locations, bulbouts, raised crosswalks or center island narrowings should be given some preference over other measures, such as intersection realignment or speed humps.

APPENDIX A – DESIGN FEATURES

Design Features

This section describes the design features to be used when implementing traffic management devices.

Speed Reduction – Vertical Measures

Ramp Profiles

Ramp profile describes the angle or approach of the vertical measure that a vehicle would traverse. Vertical measures (e.g., speed lumps) should use parabolic profiles on the approach and departure ramps to the device. Parabolic profiles have consistently been used in other programs around the nation and are a recommended design according to Institute of Transportation Engineers: *Guidelines for the Design & Application of Speed Humps* (ITE 1993). Figure 1 shows three commonly used profiles and a description of each follows below.

- *Sinusoidal* profiles have slightly less reduction effects on speed than circular and parabolic profiles but higher comfort levels for vehicles and bicyclists and are typically more difficult and expensive to construct due to the slope of the profile.
- *Circular* profiles have moderate reduction effects on speeds (compared to the two other profiles) and comfort levels for vehicles and bicyclists.
- *Parabolic* profiles have the greatest reduction effects on speeds but have the lowest comfort levels for vehicles and bicyclists due to the greater rise in the slope of the profile.

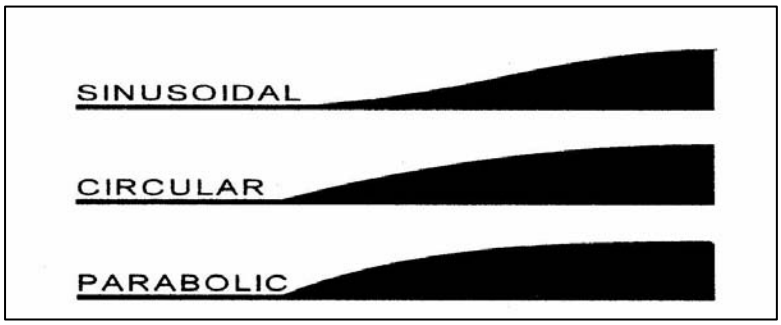


Figure 1. Vertical Measure Ramp Profiles

Edge Tapers

Edge taper refers to the transition area between a vertical measure at its full height and the edge of the device. Edge tapers on vertical measures (e.g., speed lumps and excluding raised crosswalks) should extend to the edge of the pavement (i.e., not into the gutter) to prevent blocking the gutter drainage.

On streets without vertical curbs, the edge taper should extend the full length

of the pavement width to discourage drivers from straddling or driving around the vertical measure. In addition, an advisory sign (or other barrier) should be placed on either approach of the vertical device to prevent drivers from driving around the device.

Edge Tapers – Parking and Bikeways

Vertical devices should extend across any parking or bike lane to prevent drivers from veering into the bike lane. Consequently, bicyclists will traverse the even section (as opposed to the tapered portion) of the device. In addition, vehicles parking on the street will have the option to park on a portion of the device or avoid the device entirely.

Raised Crosswalk Tapers

Raised crosswalks should always be designed to a height equal to the curb height, but not fully extend to the curb, as this will impede drainage. To bridge the gap between the sidewalk and raised crosswalk, a metal connector plate shall be used as shown in the image to the right. The device should also include truncated domes to indicate the entrance to the crosswalk from the sidewalk. Raised crosswalks are not appropriate where curbs do not exist.

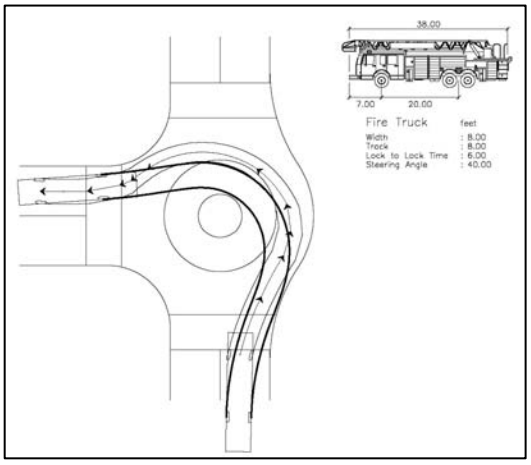
Horizontal Deflection Measures

Traffic Circle Center Island Profile

Traffic circles should be designed with both a vertical inner curb and a mountable apron. The vertical inner curb prevents vehicles from driving over the circle. The apron is a shallow-sloped curb extending out from the bottom of a vertical curb; the apron has a low lip at its pavement-side edge. This apron effectively reduces the diameter of the center island for large vehicles, facilitating easier turns. The lip at the apron's edge discourages vehicles from using it unnecessarily.

Traffic Circle Turn Operations

All vehicles should circulate around the center island on left-turns. However, an exception can be made for large vehicles (i.e., trucks and buses) in some cases if geometric constraints require it. If a specific intersection has a high proportion of truck and/or bus traffic, alternative treatments may provide similar results without the impact to trucks or buses. All traffic circles should be designed using AutoCAD/AutoTurn software or using appropriate truck turning templates as specified in *A Policy on Geometric Design of Highways and Streets* (FHWA, 2001) to identify whether emergency response vehicles and buses can turn left around the circle.



Traffic Circles at T-Intersections

Traffic circles should have deflection on all approaches if implemented at a T-intersection. This can be implemented in both existing neighborhoods in retrofit situations and in new neighborhoods. First, a raised island can be placed at the right side of the un-deflected approach to the traffic circle to artificially introduce deflection, as shown in Figure 2 (a). In new neighborhoods the street curbs can be modified to allow the center island to be located at the center of the intersection, as shown in Figure 2 (b).

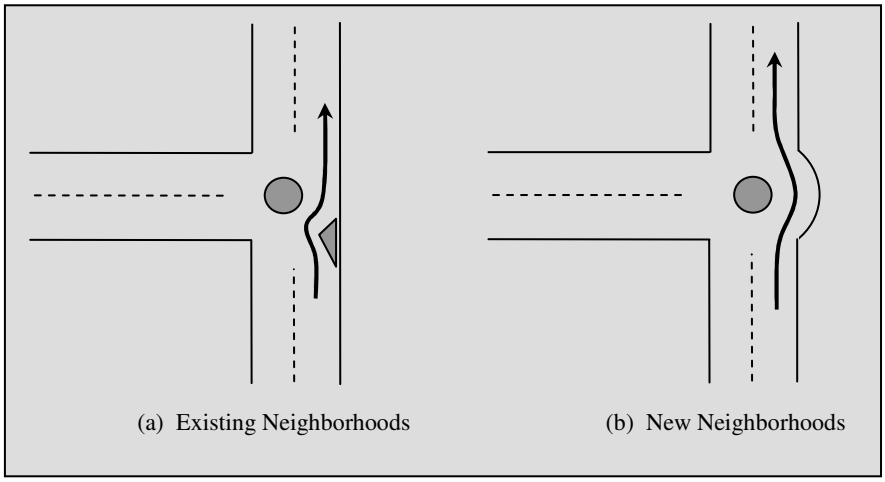


Figure 2. Traffic Circles at T-Intersections

Narrowing Measures

Drainage

Narrowing measures, such as chokers, should be constructed to minimize or avoid blocking the flow of the gutter as illustrated in the photo. Modifying the drainage can be cost prohibitive and could require regular maintenance to clear debris from the modified gutter.

Bulbouts/ Chokers

Narrowing measures, such as bulbouts or chokers, should not be constructed wider than the approximate width of a parked vehicle. Extension of these devices any further than the width of a parked vehicle (or the length of a vehicle in the case of diagonal parking) could present potential safety issues to other drivers.

Landscaping

Aesthetic upgrades not only improve the aesthetic quality of the device but also increase the visual presence by extending the device's vertical size and introducing more varied colors. Landscaping should be low laying shrubs and plants. Trees planted on center islands must allow adequate sight distances for motorists.

Signing and Marking

Concurrent with the installation of neighborhood traffic management devices, device-specific symbol-based signs should be installed next to each device. Traffic circle center islands will include signage symbolically indicating the permitted travel paths around the center island.

Vertical traffic calming measures shall include advanced warning markings on the approach ramps. Raised crosswalks and raised intersections with crosswalks should always have pavement markings due to concerns about visibility of pedestrians to drivers. In certain situations vertical devices may be unmarked, such as revitalization or beautification plans in a given area. In such cases, the device must be designed to provide a clear contrast between the surrounding environment.

Special signing for bicyclists can be provided at the discretion of staff. For example, the approaches to narrowing devices that do not include a bypass lane for bicyclists could include signage warning motorists to watch for merging bicyclists.

Roundabouts

Roundabouts require a considerably more rigorous design process than the other neighborhood traffic management devices in the toolbox. Roundabouts should generally have the following characteristics:

- A circular travel lane operating counter-clockwise for collecting and distributing traffic
- A raised center island
- Mountable apron
- Channelized approaches
- Yield control at all approaches
- Tapered approaches to encourage entering vehicles to travel in the correct direction through the circular travel lane

The use of roundabouts is primarily constrained by traffic volumes and by geometrics. Detailed designs should be developed using detailed traffic and geometric information and procedures beyond what are presented here. *Roundabouts: An Information Guide* (FHWA 2000) provides reference on the design of roundabouts. Also, the following examples illustrate cases where a roundabout may be appropriate:

- *History of Accidents* – Roundabouts may be placed at intersections with a history of accidents, especially head-on collisions and right-angle collisions. A roundabout can help improve safety by substantially reducing the number of conflict points and by simplifying interactions between vehicles.
- *Minimizing Queues* – A roundabout can allocate right-of-way while minimizing the queues on the approach stemming from another intersection.
- *Handling Irregular Approach Geometry* – An intersection with greater than four approaches or with approaches that meet the intersection at irregular angles may be a candidate for a roundabout
- *Inexpensive Traffic Reduction* – In some cases, traffic volumes at an intersection may be too high to allow acceptable operations with all-way stop control. Roundabouts are typically less expensive to construct and operate than traffic signals and if ample right-of-way is readily available, a roundabout may be an appropriate alternative to a traffic signal.
- *High Proportion of U-Turns* – If an intersection is situated where U-turns are frequent, a roundabout can facilitate those U-turns without adversely affecting the operations of the intersection as a whole.
- *Pedestrian Accommodation* – Crossing distances are generally shorter than a signalized intersection and are broken by a pedestrian refuge. However, they can

be inconvenient for pedestrians because the crosswalks are set back farther from the intersection, and they lack a "protected" phase created by a signal.

- *Abundant Right-of-Way* – Finally, an intersection that already includes abundant right-of-way may be a good candidate for a roundabout simply because the operations and safety improvements would then outweigh the minimal costs of acquiring additional right-of-way and expanding the intersection.

Combined Measures

Some measures from the toolbox can be combined to increase the combined effect on traffic volumes and speeds. For example, a raised crosswalk may be combined with bulbouts, the effect being a crosswalk that is both shortened and raised above the level of the roadway. Motorists must then react to both a vertical deflection and a narrowing. The suitability of a combined measure needs to be assessed.

APPENDIX B – DESIGN DRAWINGS

APPENDIX C – CITY OF SAN DIEGO ROADWAY CLASSIFICATIONS

A. Local Street: A street that provides, primarily, direct access to abutting property. It carries low vehicular movement, low-to-heavy pedestrian movement, and low-to-moderate bicycle movement. It has on-street parking, street trees, traffic safety street lighting, and sidewalks. It may include landscaping, pedestrian-scale lighting, and underground utilities.

B. Collector Street: A street that primarily provides movement between local/collector streets and streets of higher classification and, secondarily, provides access to abutting property. It carries low-to-moderate vehicular movement, low-to-heavy pedestrian movement, moderate-to-heavy bicycle movement, and low to-moderate transit movement. It has on-street parking, street trees, traffic safety street lighting, and sidewalks. It may also include landscaping, pedestrian-scale lighting, and underground utilities.

C. Major Street: A street that primarily provides a network connecting vehicles and transit to other major streets and primary arterials, and to the freeway system and secondarily providing access to abutting commercial and industrial property. It carries moderate-to-heavy vehicular movement, low-to-high pedestrian and bicycle movements, and moderate-to-high transit movement. It has a raised center median, street trees, traffic safety street lighting, and sidewalks, and may include landscaping, pedestrian-scale lighting, underground utilities, on-street parking, and/or bike lanes.

D. Primary Arterial: A street that primarily provides a network connecting vehicles and transit to other primary arterials and to the freeway system. It carries heavy vehicular movement while providing low pedestrian movement and moderate bicycle and transit movements. It has a raised center median, bicycle lanes, street trees, traffic safety street lighting, sidewalks, and no access from abutting property. It may include underground utilities.

E. Rural Local Road: A road in agricultural, natural open space, and large lot (greater than 2.5 acres) residential areas that primarily provides direct access to abutting property. It carries low vehicular movement, low pedestrian movement, and low bicycle movement. It may include traffic safety street lighting and underground utilities. It typically does not have sidewalks or landscaping.

F. Rural Collector Road: A road in agricultural, natural open space, and large lot (greater than 2.5 acres) residential areas that primarily provides movement between local and collector roads and roads or streets of higher classification and secondarily provides access to abutting property. It carries low-to-moderate vehicular movement, low pedestrian movement, low-to-moderate bicycle movement, and low transit movement. It may include traffic safety street lighting and underground utilities. It typically does not have sidewalks or landscaping.

APPENDIX D – EXISTING LOCAL TRAFFIC CALMING EXAMPLES

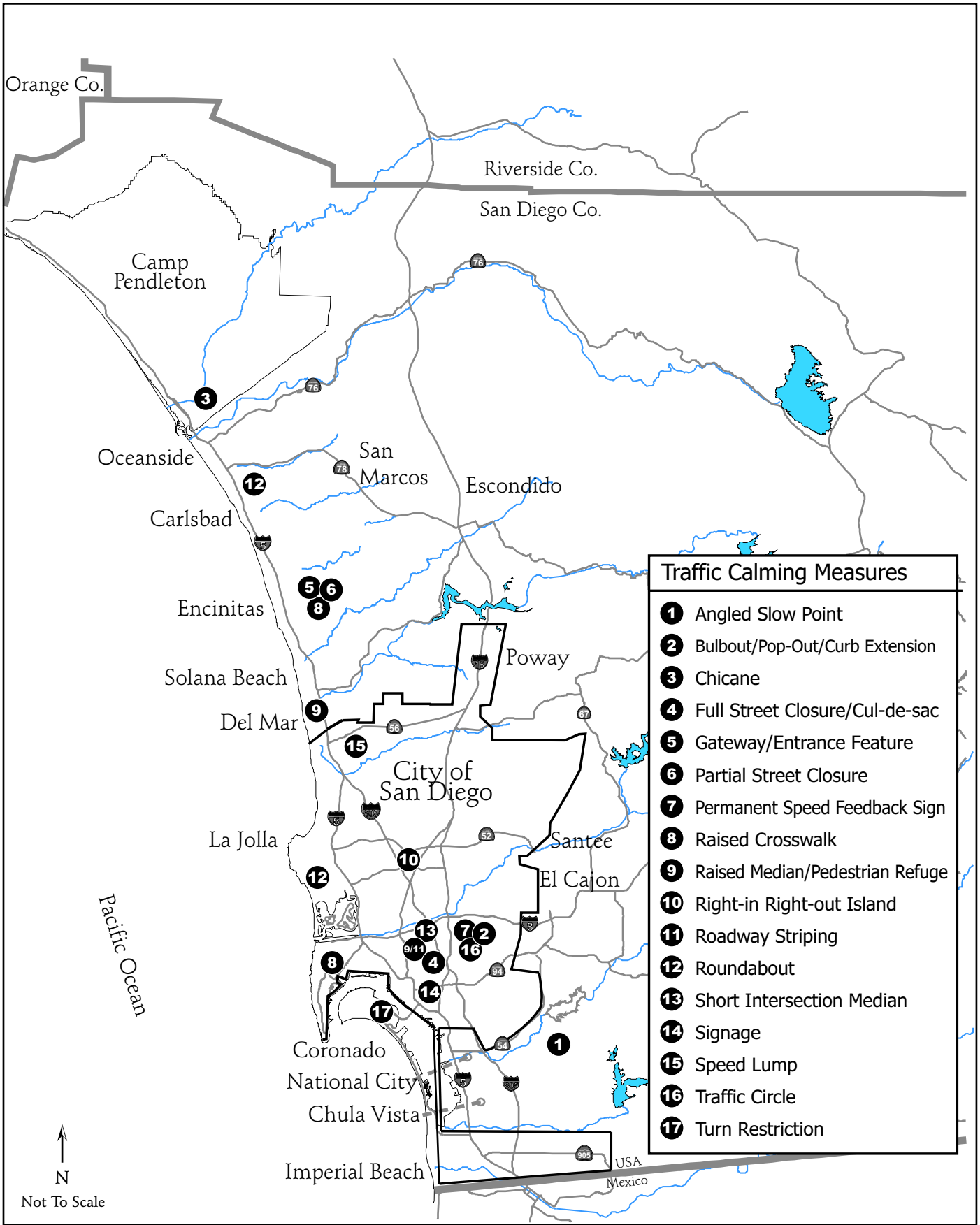


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Figure A

Existing Traffic Calming Measures

Katz, Okitsu & Associates
Traffic Engineers and Transportation Planners

San Diego Region - Traffic Calming Examples

#	Tool	Location	Thomas Brothers Guide Page
1	Angled Slow Points	Corral Canyon Road* - County of San Diego	1311 A2
2	Bulbouts/Curb Extensions	Menlo Ave. & Orange Ave. - San Diego, CA; Hawley Blvd. & School St. - San Diego, CA	1269 J4; 1269 F3
3	Chicane	Capistrano Drive &Santa Paula Street- Oceanside, CA	1086 A5
4	Full Street Closure/Cul-De-Sac	Pershing Dr. at Upas St - San Diego, CA	1269 D6
5	Gateway/Entrance Treatment	Paseo De Las Flores** - Encinitas, CA	1147 E4
6	Partial Street Closure	Avenida La Posta at Village View - Encinitas, CA	1147 H4
7	Permanent Speed Feedback Sign	Collwood Dr. - San Diego, CA	1270 A2
8	Raised Crosswalk	Paseo De La Flores** - Encinitas, CA; Truxton Rd. - San Diego, CA	1187 F1; 1248 D7
9	Raised Median/Pedestrian Refuge	Camino Del Mar & 12th st. - Del Mar, CA; Adams Ave. & Florida St. - San Diego, CA	1167 F5; 1187 F3
10	Right-In/Right Out Island	Convoy St. & Opportunity Road - San Diego, CA	1249 B2
11	Roadway Striping	Adams Ave. at Park Blvd. - San Diego, CA	1269 C3
12	Roundabout	La Jolla Blvd. & Colima St.& Midway St. - San Diego, CA; Lego Drive - Carlsbad, CA	1227 G4; 1126 J2
13	Short Intersection Median	Suncrest Dr. & Kansas St. - San Diego, CA	1269 E3
14	Signage	33rd St. at C St. - San Diego, CA	1289 F2
15	Speed Lump	Del Mar Mesa Road - San Diego, CA	1188 D7
16	Traffic Circle	49th St. & Adams Ave. - San Diego, CA	1270 A3
17	Turn Restriction	Third St. & B Ave. - Coronado, CA	1288 J6

* Corral Canyon Road has a series of traffic calming features besides the angled slow point. Various median and striping techniques are used.

** Paseo De Las Flores also uses a series of traffic calming features. There is a raised crosswalk for golfers/golfcarts and a gateway/entrance treatment. This road leads into a relatively new housing development that installed traffic calming features when it was built. There are bulb-outs and textured pavement at many of the intersections.

APPENDIX E – TOOLBOX PHOTO REFERENCE LIST

	Feature	Location	Source
SPEED REDUCTION TOOLS			
1	Angled Parking	Garnet Ave., San Diego, CA	Katz, Okitsu & Associates
2	Angled Slow Point	Corral Canyon Rd., San Diego County, CA	Katz, Okitsu & Associates
3	Bulbout/Pop-Out/ Curb Extension	Hawley Blvd. and School St., San Diego, CA	Katz, Okitsu & Associates
4	Chicane	Capistrano Dr. and Santa Paula St., Oceanside, CA	Katz, Okitsu & Associates
5	Choker	Sarasota, FL	www.trafficcalming.org
6	Curb Radius Reduction	Unknown	www.pedbikeimages.org/ Peter Lagerwey
7	Gateway/ Entrance Feature	Carmel Ridge Rd. & Tivoli Park Row, City of San Diego, CA	Robert Mross
8	Intersection Table/ Raised Intersection	Columbus, OH	linden.morpc.org
9	Permanent Speed Feedback Sign	Collwood Blvd., San Diego, CA	Katz, Okitsu & Associates
10	Raised Crosswalk	Paseo de las Flores, Encinitas, CA	Katz, Okitsu & Associates
11	Raised Median/ Pedestrian Refuge	Adams Ave. and Florida St., San Diego, CA	City of San Diego
12	Realigned T-Intersection	Crest Rd. at Hoska Dr., San Diego, CA	Andy Hamilton
13	Roadway Striping	Adams Ave. and Park Blvd., San Diego, CA	Katz, Okitsu & Associates
14	Roundabout	La Jolla Blvd. and Midway St., San Diego, CA	Katz, Okitsu & Associates
15	Short Intersection Median	Kansas St. and Suncrest Dr., San Diego, CA	City of San Diego
16	Signage	(Speed Limit) Palo Alto, CA (School Xing) 33rd St. and C St., San Diego, CA	www.cityofpaloalto.org; Katz, Okitsu & Associates
17	Speed Hump	Unknown	www.co.bay.fl.us/traffic
18	Speed Lump	Del Mar Mesa Rd., San Diego, CA	Crystal Cliame, City of San Diego
19	Speed Table	Columbus, OH	linden.morpc.org
20	Temporary Radar Speed Trailer	Unknown	www.informationdisplay.com
21	Traditional Enforcement	Unknown	City of San Diego
22	Traffic Circle	Louisiana St. and Dwight St., San Diego, CA	Andy Hamilton
23	Treatment on Curve	Davis, CA	*Traffic Management, Parking and Traffic Calming Master Plan for Bird Rock, City of San Diego, August 2002* Dan Burden, City of San Diego
VOLUME REDUCTION TOOLS			
24	Diagonal Diverter	Ft. Lauderdale, FL	www.trafficcalming.org
25	Full Street Closure/ Cul-de-Sac	Pershing Dr. and Upas St., San Diego, CA	Katz, Okitsu & Associates
26	Median Barrier	Culver City, CA	Katz, Okitsu & Associates
27	Partial Street Closure	Culver City, CA	Katz, Okitsu & Associates
28	Right-In/ Right-Out Island	Convoy St. and Opportunity Rd., San Diego, CA	Katz, Okitsu & Associates
29	Turn Restrictions	(No Right Turn) Sacramento, CA (No Right Turn – Arrow) Unknown	geography.about.com www.dps.state.mn.us