City of Rancho Cordova Neighborhood Traffic Management Program (NTMP) Manual

February 2006

Prepared for:
City of Rancho Cordova

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1. INTRODUCTION

The NTMP provides the framework and guidelines for systematically selecting and prioritizing streets and neighborhood areas for treatment, selection and application of traffic calming devices, and design of new neighborhoods to minimize the future need for traffic calming. All residents living on two-lane residential streets are eligible to participate in the NTMP. Higher-order streets with more than two-lanes are not eligible for traffic calming devices due to safety implications associated with the higher traffic speeds and volumes. Traffic calming devices on these streets pose the potential to divert traffic back onto two-lane residential streets in order to avoid the traffic management devices.

Being guidelines, the contents are not intended as rigid requirements; rather, they are a tool for use by City staff, citizens, developers, and other interested parties to help develop effective traffic calming plans.

The guidelines are primarily intended for use by City staff and neighborhood residents developing a traffic calming plan, and developers concerned with avoiding future traffic-related concerns in new neighborhoods. This document may also be helpful to members of the general public who are interested in finding out how the City of Rancho Cordova implements traffic calming.

HOW TO USE THIS DOCUMENT

If you are a Resident, you should focus on the following chapters:

Chapter II, NTMP Process, to find out how to request treatment and how a traffic calming plan is developed

Chapter III, Evaluation and Ranking System, to find out how requests are ranked for selection

Chapter IV, Process for Removal, identifies the necessary steps to request removal of implemented traffic calming devices

Chapter V, NTMP Toolbox of Traffic Calming Measures, to discover what particular devices are available and the advantages and disadvantages of each device

If you are a Developer, Planning for a New Neighborhood, you should focus on the following chapters:

Chapter V, NTMP Toolbox, to discover what devices can be incorporated into your development

Chapter VI, Toolbox Application Guidelines, to understand where and when specific traffic calming measures can be used.

Chapter VII, Planning Process for New Neighborhoods, for proposed design standards and techniques to minimize the potential for future speeding and traffic-related concerns

If you are a City staff member, you should focus on the above Chapters as well as the following appendices:

Appendix A – Design Guidelines, provides recommended design features to minimize design issues once implemented

Appendix B – Standard Neighborhood Traffic Calming Device Designs, provides standard designs that can be easily modified to fit specific roadways

1.1 DEFINITION OF TRAFFIC CALMING

Traffic calming, as defined by the Institute of Traffic Engineers (ITE), is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users. Descriptions of typical traffic calming measures are provided in Chapter 6: *Toolbox*. Related strategies, such as enforcement and safety education, are also important to reducing the effects of neighborhood motor vehicle traffic though not included as part of this document.

1.2 GOALS AND OBJECTIVES

City staff frequently receives requests from residents to install traffic calming measures to slow or divert traffic, generally in response to neighbor's concerns about speeding or cut-through traffic on particular streets, or as concerns are generated by "in-fill" development.

This document creates a process for neighborhoods to take the lead in working with City staff to study a particular traffic issue, identify potential solutions, and develop neighborhood consensus on desired measures. Funding for the development and construction of traffic calming devices in existing neighborhoods will be borne by the City of Rancho Cordova.

The City's traffic calming program targets 2-lane residential and collector streets. Its objectives include:

- 85th percentile travel speeds (the speed at which 85 percent of vehicles travel at or below on a particular street) within 5 mph of the appropriate speed limit
- Reduced cut-through traffic where existing levels are inappropriate and where the remedy will not create a problem on other streets
- Reduced collisions for motor vehicles and pedestrians
- Adequate access for emergency vehicles

These objectives are met through a combination of parallel strategies, known collectively as the "Three E's":

Education – Information-sharing and awareness raising, targeting drivers, pedestrians, and cyclists about the safest, best ways to share the road.

Engineering – Physical measures constructed to lower speeds, improve safety, or otherwise reduce the impacts of automobiles.

Enforcement – Targeted police enforcement that supports neighborhood goals.

This document primarily focuses on the engineering aspects of traffic calming, though education and enforcement play an important role in any engineering strategy. Programs to educate neighborhood residents and the public regarding neighborhood traffic safety are discussed in section 3.1.3. The City of Rancho Cordova Police Department provides neighborhood enforcement of traffic speeds and rules of the road. While police enforcement cannot be conducted 24 hours a day, traffic calming measures are a viable alternative that is self-enforcing 24 hours a day.

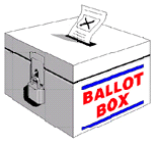
1.3 PLANNING PROCESS

These guidelines establish a neighborhood-driven process for initiating a request for traffic calming measures on a particular street or neighborhood wide. Residents will take the lead by filling out and submitting a NTMP petition form identifying the types of traffic-related concerns on their street or neighborhood. Two separate processes have been established to treat neighborhood traffic related concerns. The first process is specific to traffic concerns that can be isolated to a single street or intersection. The second process focuses on traffic concerns on multiple streets within a neighborhood area.

Each process is separated into four key components focusing on specific tasks towards consideration of a traffic calming plan (i.e. a set of traffic calming solutions). The four components of the process are briefly described below and are discussed later in the manual in greater detail.

-  **Plan Initiation** – Residents submit a petition to City Staff to investigate specific traffic. Staff prepares an initial evaluation and requests are ranked based on relevant traffic data. City Council selects priorities for staff action.

-  **Plan Development** – City staff and a Neighborhood Traffic Committee (NTC) develop a plan to treat traffic-related issues.

- 

Plan Approval – Ballots are distributed to local neighborhood residents to determine level of support for the proposed plan. A minimum level of neighborhood support is necessary before City Council can consider the proposed plan for approval.

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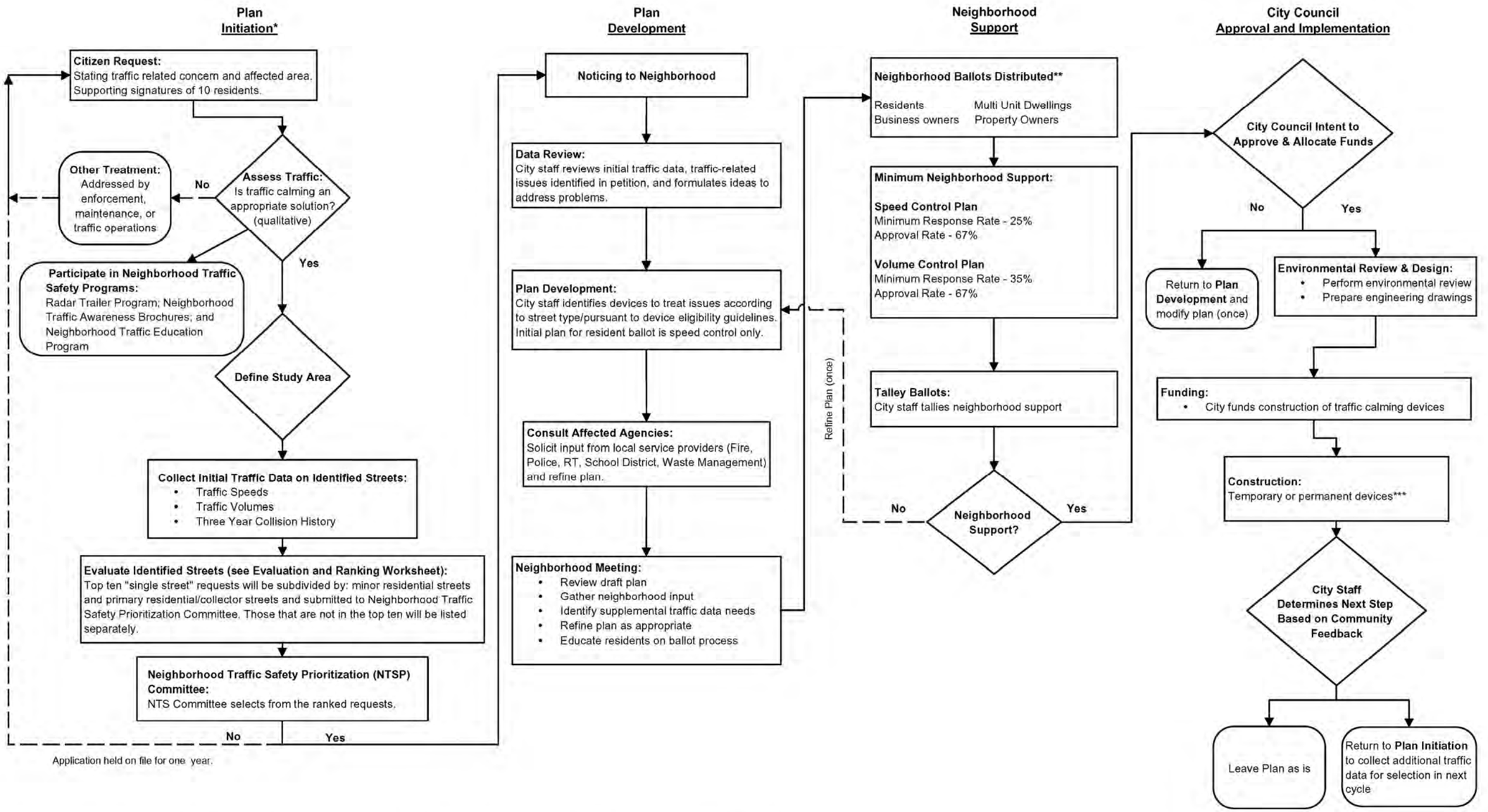
Plan Implementation – If local neighborhood residents support the proposed plan, City Council can allocate funds to construct the proposed traffic calming plan.

This document also presents the evaluation and ranking system to prioritize traffic calming petitions received. The evaluation system is based upon traffic data collected by City staff and assigns points for vehicle speeds in excess of the speed limit, number of vehicles on the roadway per day, and number of reported collisions. The evaluation system also collects other important information regarding the neighborhood that cannot be determined from the traffic data collection, such as: schools, parks, bus routes, bike lanes, etc. This information is not assigned a point value but is intended to assist City Council members when selecting individual neighborhoods for treatment.

Additionally, as part of the development review process, the City of Rancho Cordova will work with developers to ensure that new development or redevelopment projects are properly designed, in order to avoid the types of problems that frequently result in requests for traffic calming measures.

The City of Rancho Cordova's NTMP Single Street and Multiple Street Processes are summarized on the following pages.

Figure 1- City of Rancho Cordova Single Street NTMP Process

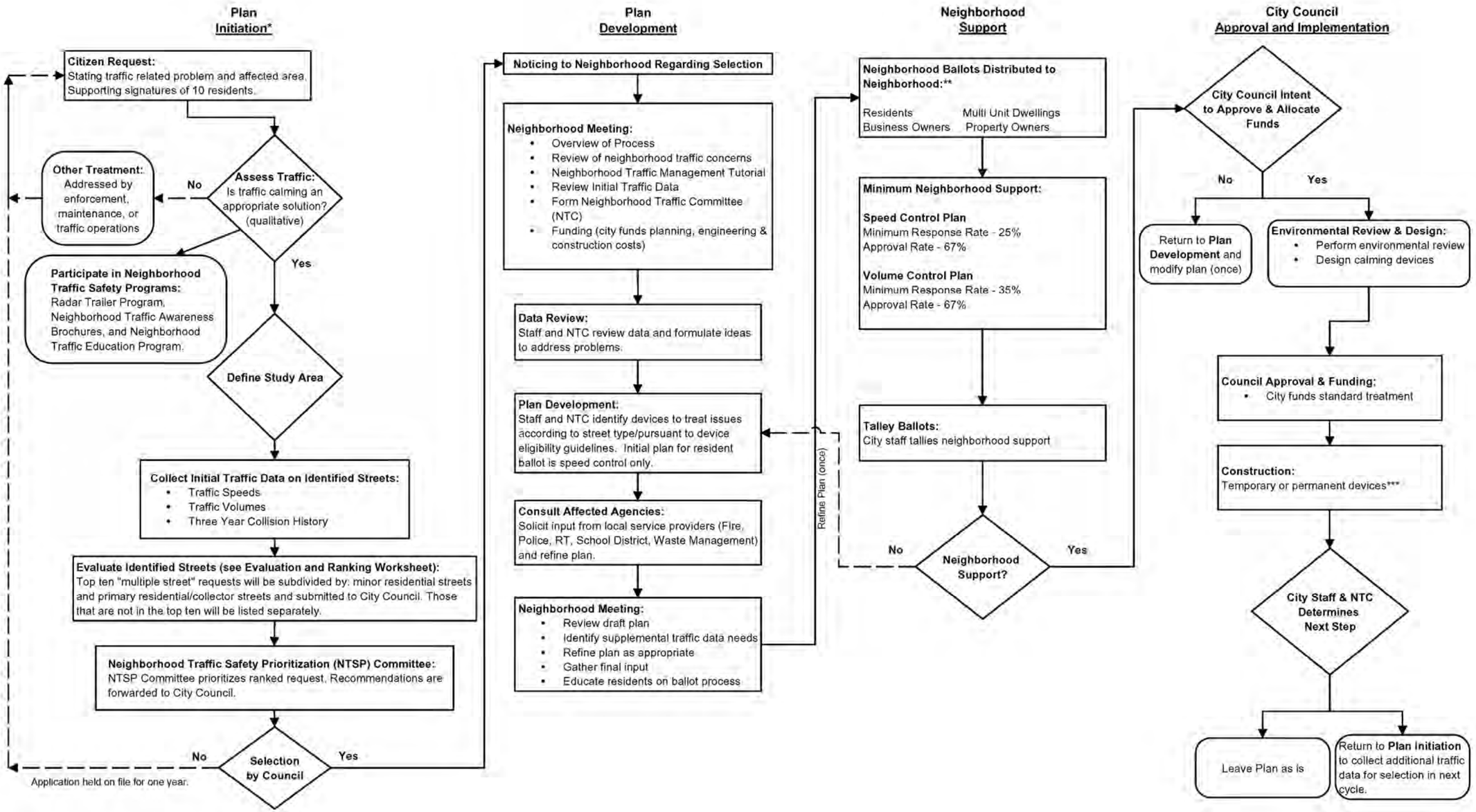


*Assumes quarterly selection for single street plans. Single street is defined as a street with a solution limited to the street in question and that would not result in diversion of traffic.

**Ballots distributed to eligible voters along treated street. Those streets having primary access to the treated street will also receive ballots and will be presented as supplemental information. Multi Unit Dwellings' vote does not count toward the minimum response rate. Ballots include two questions: (1) Would you support the proposed plan? (2) Would you oppose a traffic calming device adjacent to your property?

***Temporary devices are constructed at Staff discretion based on previous experience.

Figure 2 - City of Rancho Cordova Multiple Street NTMP Process



*Assumes annual selection for multiple street plans.
**Ballots distributed to eligible voters along treated street and those streets having significantly affected to access to treated street. Multi Unit Dwellings' vote does not count toward the minimum response rate. Ballots include two questions: (1) Would you support the proposed plan? (2) Would you oppose a traffic calming device adjacent to your property?
***Temporary devices are constructed at Staff discretion based on previous experience.

2. NTMP PROCESS

2.1 PLAN INITIATION

The first component of the process is the plan initiation. This component describes how the NTMP is initiated and how decisions are made to determine the order in which neighborhoods are prioritized and considered for treatment.

2.1.1 Citizen Petition Form

The process is initiated when residents submit a Neighborhood Traffic Management Plan petition (see next page for petition) requesting City staff to investigate speeding, traffic volumes, or traffic-related safety issues within their neighborhood. The purpose of this petition is to help staff understand the traffic-related issues within the neighborhood and confirm that residents are in support of pursuing the development of a traffic calming plan.

The petition must include the following information before it is considered complete:

- What type of traffic-related issue is occurring
- What street(s) and/or intersection(s) are affected
- When the problem occurs (i.e. time of day)
- Supporting signatures from ten (10) separate households (minimum 18 years of age)
- Name, address, and contact information of residents who signed the petition

Once City staff receives the petition, a letter will be sent to individuals who signed the petition acknowledging and staff's plan to investigate the issues.

2.1.2 Assess Issues

City staff will review the petition and determine whether traffic calming may be an appropriate remedy. Not all traffic-related issues will require traffic calming devices to solve the problem. For instance, certain issues could be addressed through maintenance (trees blocking a stop sign), targeted police enforcement, or traffic operation improvements (signal re-timing).

City of Rancho Cordova
NTMP Request Form

Name of Person Submitting Request form: _____
Date:_____

Phone Number: _____

Address: _____

1. Please indicate the type(s) of traffic-related concerns that are present in your neighborhood.

Speeding ____ Collisions ___ Non-compliance with stop signs ___

Excessive traffic volumes ___ Pedestrian/Bicycle safety ____ Other ___

If you selected other, please describe the concern below.

_____

_____

_____

2. Please describe the limits of your neighborhood and location(s) on the given street(s) in which these traffic-related concerns occur.

_____

_____

_____

3. Please list the time of day and whether the traffic-related concern primarily occurs during the week or weekend.

_____

_____

_____

4. Please provide the names, signatures, and contact information for at least 10 residents and/or property owners 18 years and older (from separate households) who are requesting that this neighborhood be considered for selection in the next NTMP cycle.

	Printed Name	Signature	Address	Phone No.
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

2.1.3 Neighborhood Traffic Education Programs

All residents submitting petitions will be advised of the opportunity to participate in Neighborhood Traffic Education programs provided by the City. These programs focus on increasing driver behavior and neighborhood awareness.

- Neighborhood Radar Trailer Program (NRTP) – Uses radar trailers to make drivers aware of their speeds and surroundings. The goals are to increase traffic safety awareness and voluntary compliance with residential speed limits.
- Neighborhood Traffic Safety Awareness Program (NTSAP) –Traffic safety flyers (available at City Hall) can be used to educate community residents on what can be done to reduce concerns associated with speeding vehicles and excessive traffic volumes and thereby improving pedestrian and bicycle safety.

2.1.4 Define Study Area

The initial study area will be defined by City staff by reviewing the petition and the surrounding street network to determine streets that may be affected by a traffic calming plan. The study area can later be refined with additional resident input. City staff will also determine whether the traffic-related issue affects a single street or multiple streets. Determining the affected area is necessary to understand where initial traffic data should be collected (discussed in the next step) or if development of a plan would potentially affect other nearby streets.

A single street plan will be developed by City staff based on the traffic-related issues stated in the petition. Typically the traffic-related issues of single street plans are much simpler to address and typically involve fewer traffic calming devices than a larger multiple street plan. The City staff will present the proposed plan to the neighborhood at-large for input prior to determining neighborhood support and construction of devices.

Multiple street plans include more than one affected street and will consequently require greater resources to implement and have the potential to affect a greater number of residents. A Neighborhood Traffic Committee (NTC) made up of neighborhood residents will assist City staff in understanding the traffic-related issues in the larger neighborhood area. City staff and the NTC will develop solutions to treat the neighborhood streets and ultimately present the proposed plan to the neighborhood at-large for input prior to determining neighborhood support and construction of devices.

2.1.5 Collect Initial Traffic Data

City staff will collect initial traffic data for the study area street(s) focusing on issues identified in the petition. Traffic data collection may include the following:

- traffic speeds

- traffic volumes
- three-year collision history

City staff will initially collect traffic data based on the locations specified in the petition. Subsequent traffic data collection locations will be determined by City Staff and the Neighborhood Traffic Committee.

2.1.6 Evaluate Identified Streets

City staff will use the traffic data to evaluate the magnitude of each neighborhood's traffic-related issues and rank the petitions among all other petitions as discussed in evaluation and ranking section. The evaluation system will allocate points based upon the following roadway characteristics:

- traffic speeds in excess of the posted speed limit
- number of vehicles on the roadway per day
- number of collisions in the past three years

Once the points are calculated for each petition, they will be organized by type of petition (single or multiple street), street type, and ranked according to the total points assigned. Figure 1 illustrates how each petition will be organized.

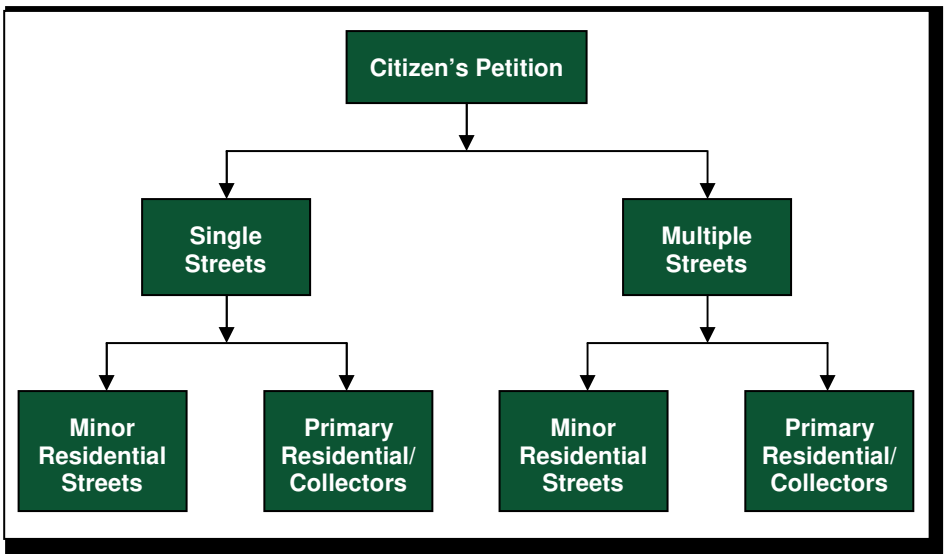


Figure 1 – Organization Chart for Neighborhood Traffic Management Petitions

Since single street traffic calming plans are initiated quarterly, while multiple street petitions are initiated yearly. The petitions are further subdivided by street type. Minor residential streets typically exhibit a different magnitude of traffic issues than primary residential and collector streets, and consequently would rank lower. Because street types are not easily discernable, City staff will be able to inform petition applicants of their street type.

2.1.7 Prioritization by Neighborhood Traffic Safety Committee

The City understands that each street or neighborhood area is unique and data collection alone cannot fully describe the traffic-related impacts on the surrounding neighborhood. For this reason, a standing Neighborhood Traffic Safety Prioritization (NTSP) Committee will be formed to assist in the review and selection process. The NTSP Committee will select the single street petitions for the next cycle of treatment.

For multiple street petitions, the NTSP Committee will prioritize all ranked petitions based on their understanding of neighborhood traffic-related concerns and input from residents. The prioritized list of multiple street petitions will be presented to City Council for selection.

2.1.8 Selection of Projects by City Council

City staff will present the ranked list of multiple street neighborhood petitions to City Council for selection. The ranked list will include the following information:

- number of points assigned
- traffic speed
- traffic volume
- number of accidents
- the characteristics of the area, such as: school, parks, etc.

Those streets/neighborhoods selected by the City Council will begin development of a traffic calming plan.

2.2 SINGLE STREET PLAN DEVELOPMENT

The single street plan development component of the process describes the steps in which the traffic calming plan is developed. City staff will review all traffic data and develop a plan to treat the traffic related concerns indicated on the petition.

2.2.1 Data Review

City staff will review the traffic-related concerns stated in the petition to determine the types of issues occurring, locations, and times of occurrences. City staff will also review initial traffic speeds, traffic volumes, collision history, and determine if additional traffic data should be collected. Data regarding the traffic related concerns and traffic data will be compared to the Toolbox Guidelines (see Toolbox Guidelines 6.1) to determine which devices may be most appropriate.

2.2.2 Plan Development

The initial plan development will rely on the following speed control devices to treat the traffic related concerns (see Toolbox Chapter 5 for more information):

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

Because volume control 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 control devices should be reserved until all other options have proven ineffective at reducing the traffic-related impacts.

Based on the traffic data review, the City staff will select devices that will most appropriately treat the traffic concern based on the location and roadway type (see Toolbox Guidelines 6.1). City staff will ultimately present the proposed plan to the neighborhood at-large for review and comment.

2.2.3 Consult Affected Agencies

Once City staff has developed a plan they feel appropriately addresses the traffic-related issues, City staff will schedule a meeting with other agencies that may be potentially affected by the plan. The intent of this meeting is to identify concerns and potential modifications to the plan. The following agencies would be contacted.

- Sacramento Metropolitan Fire District
- City of Rancho Cordova Police Department
- Regional Transit
- Folsom Cordova Unified School District
- Sacramento City Unified School District

City staff will revise the plan accordingly.

2.2.4 Neighborhood Meeting to Present Proposed Plan

A neighborhood meeting will be arranged to present the proposed plan to the neighborhood at-large to gather input prior to the approval process. At this meeting the proposed plan will be discussed describing the types and locations of devices proposed. Based on neighborhood feedback, changes to the proposed plan can be made as necessary.

Residents will also be informed of the approval process and ballots they will receive once the proposed plan is refined.

2.3 MULTIPLE STREET PLAN DEVELOPMENT

The multiple street plan development component of the process describes the steps in which the traffic calming plan is developed. Because multiple street requests involve numerous streets and have the potential to affect a greater number of residents, a Neighborhood Traffic Committee consisting of local neighborhood residents will be formed to assist City Staff in developing a plan. The NTC provides valuable first hand information on where and when the traffic related concerns occur. In addition, the NTC assists in the selection and placement of neighborhood devices.

2.3.1 Neighborhood Meeting

City staff will invite all study area residents to a neighborhood meeting to learn more about the selection of their neighborhood to participate in the NTMP. Staff will provide an overview of the NTMP and the process to develop, approve, and implement a traffic calming plan. At this meeting, staff will also accomplish the following.

- Review traffic-related issues – Discuss the type of issue(s), location(s), and time of occurrences. Collect any additional information regarding traffic-related issues.
- Refine Study area (if necessary) – City staff will refine the study area based on street(s) affected by the traffic-related issues or that may be affected by development of a traffic calming plan.
- Review traffic data – Review the initial data collected and determine if additional data collection is necessary.
- Neighborhood Traffic Calming Tutorial – Presentation of available traffic calming devices.
- Set goals – Identify goals to measure success of the plan. Goals may be measured by resident perception or numerically. Examples of such goals may be to improved driver behavior and awareness for the area or reduce average to speeds within five miles per hour of the posted speed limit.

- Discuss Funding – City will fund the development and implementation of the traffic calming plan[1].

At this meeting, City staff will provide interested residents the opportunity to volunteer and participate on the NTC. The NTC will meet with City staff to develop a plan for their neighborhood. Although all residents have the opportunity to provide input and receive updates as the plan develops, the NTC is more actively involved, committing the time and effort necessary to develop a plan.

2.3.2 City Staff and NTC Review Data and Develop Plan

City staff and the NTC will schedule meetings to formulate solutions to treat the traffic-related issues within the neighborhood.

During the initial plan development, only speed control devices will be available for use. Speed Control devices include the following (see Toolbox chapter for more information):

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

Because volume control 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 control devices should be reserved until all other options have proven ineffective at reducing the traffic-related impacts.

2.3.3 Consult Affected Agencies

Once City staff and NTC have developed a plan they feel appropriately addresses the traffic-related issues, City staff will schedule a meeting with other agencies that may be potentially affected by the plan. The intent of this meeting is to identify concerns and potential modifications to the plan. The following agencies would be contacted.

- Sacramento Metropolitan Fire District
- City of Rancho Cordova Police Department
- Regional Transit

[1] Pre-defined budget by neighborhood with opportunity for Council to supplement.

- Folsom Cordova Unified School District
- Sacramento City Unified School District

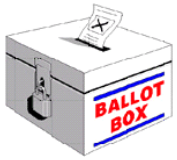
City staff will share the input from these agencies with the NTC and revise the plan accordingly.

2.3.4 Neighborhood Meeting to Present Proposed Plan

A neighborhood meeting will be arranged to present the proposed plan to the neighborhood at-large to gather input prior to the approval process. At this meeting, the NTC will present the proposed plan, describing the types and locations of devices proposed based on community input, aesthetic upgrades, and estimated cost to construct the proposed plan. At this time, residents can also determine what type (if any) aesthetic improvements are desired. Changes to the proposed plan will be made as necessary.

Residents will also be informed of the approval process and ballots they will receive once the proposed plan is refined.

2.4 NEIGHBORHOOD SUPPORT



The amount of neighborhood support for the proposed plan will be in the form of mail-in ballots. Prior to mailing the ballots to neighborhood area residents, City staff will inform residents of the ballot process through the most appropriate means. This could include public notices, mailers, and/or neighborhood association newsletters.

2.4.1 Distribute Ballots to Local Residents

Ballots will be distributed to all residents, property owners, apartment units, and businesses within the affected area to determine the level of support for the proposed plan. The ballots will include a description and map of the proposed plan indicating the type and location of devices being proposed. The ballot will also include a mail back postcard with two questions for residents to respond to. Those questions are:

1. Do you support the proposed plan?
2. Would you oppose a traffic calming device adjacent to your property?

The mail back postcard will also provide a space for residents to write comments regarding the proposed plan.

2.4.2 Determine Neighborhood Support

Once the mail back postcards are received by the City, a minimum response rate and approval rate must be met before the plan is forwarded to the City Council. For implementation of speed control devices, a minimum of 25 percent of all ballots must be returned with a 67 percent in favor of the

plan. For example, if 100 ballots are mailed out, at least 25 must be returned with 17 in favor of the proposed plan. If the plan includes volume control measures, a minimum of 35 percent of ballots must be returned with 67 percent of residents in favor.

Apartments present a unique situation because residents may be less likely to respond. For this reason, ballots from apartment units are not counted toward the minimum response rate, but will be counted in favor or against the proposed plan. Furthermore, if the minimum number of ballots is not received, the City staff can assist the NTC in reminding neighborhood residents to submit their mail back postcards in order to meet the minimum response rate.

On the other hand, if the minimum response rate is met, but 67 percent of residents are not in favor of the proposed plan, the NTC has one opportunity to revise the plan. This would require modifying the plan to address the aspects of the plan that were not favored by the neighborhood 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 affected area.

2.5 CITY COUNCIL APPROVAL AND IMPLEMENTATION

2.5.1 City Council Intent to Approve and Allocate Funds

Upon confirmation of favorable support by the neighborhood residents, staff will present the proposed plan and results of the balloting process to the City Council for consideration to approve and allocate funds. City Council can tentatively approve the proposed plan subject to completion of the following:

- Environmental review to identify potential impacts to surrounding roadway network
- Engineering drawings for each traffic management device

If the Council does not tentatively approve the proposed plan, the NTC has one opportunity to refine the plan. This would require modifying the plan to address the aspects of the plan that were not favored, consulting with the affected agencies, holding a public meeting to present the revised plan, and redistributing ballots to the affected area.

2.5.2 Environmental Review and Design Hearing

Upon completion of the environmental review and engineering drawings, City Staff will present this information for City Council's approval of the plan.

2.5.3 Construction of Proposed Plan

At this time, residents can fund aesthetic upgrades if desired. The traffic management devices are then constructed and a monitoring period of six months begins. Temporary devices can be constructed at staff's discretion based on previous experience with the device. Temporary devices can be converted to a permanent device after six months of acceptable operations.

2.5.4 City Staff and NTC Determines Next Step

At the end of the monitoring period, the City staff and NTC will evaluate the performance of the plan. The City and NTC will compare the previously defined goals and results of the plan. If the plan meets the goals and objectives set forth, any temporary devices will be converted to permanent devices and the plan will be considered a success.

If the plan does not meet the goals and objectives, the NTC has one opportunity to refine the plan by adding additional speed control devices. If it is determined that speed control devices will not adequately address the problem, City staff can pursue the use of Volume Control Measures to treat the traffic-related issues. Revising the plan would require modifying the plan to address the aspects of the plan that did not meet the goals and objectives, consulting the affected agencies, holding a public meeting to present the revised plan, and redistributing ballots to the affected area.

3. EVALUATION AND RANKING SYSTEM

3.1 EVALUATION AND RANKING SYSTEM

The evaluation and ranking system is a two-step method for the City to evaluate and rank the multiple neighborhood petitions received. The evaluation system assigns points to the neighborhood street(s) specified in the traffic calming petition and identifies other important neighborhood characteristics that cannot easily be assigned a point value.

The first step of the evaluation system is based on traffic data collected by the City. Traffic speeds, volumes, and collision data for the past three years are collected for the street(s) in question. The traffic data will be assigned a point value based on the methodology below.

- Two points are assigned for every 85th percentile mile per hour in excess of the posted speed limit
- One point is assigned for every 500 vehicles on the roadway per day
- Two points are assigned for every reported collision in the past three years

For example, if a street had an average speed of 34 miles per hour with a posted speed limit of 25 mile per hour, 1,500 vehicles per day traveling the street, and 3 reported collisions at an intersection along the street, the total points would be calculated as follows.

- 34 mph – 25 mph = 9 mph over the posted speed limit * 2 pts = 18 pts
- 1,500 vehicles per day ÷ 500 vehicles per day = 3 * 1 pt = 3 pts
- 3 reported collisions * 2 pts = 6 pts
- Total pts = 27 pts

If more than one street is identified in the petition, each street will be scored and the street with the higher score will be ranked amongst scores from other petitions.

The second step of the evaluation system does not assign a point value as in step one, but is intended to assist the City Council member in better understanding the surrounding neighborhood. The City will collect information pertaining to the location of schools, pedestrian destinations (i.e. parks, libraries, or community centers), bus stops, bicycle routes, types of collisions and other identifiable characteristics within a quarter of a mile of the given street.

An example of the evaluation and scoring system worksheet is presented on the following page.

Evaluation and Ranking Worksheet

This worksheet will be completed by City of Rancho Cordova Public Works Department staff as identified in the City's Neighborhood Traffic Management Program. This worksheet will be used to evaluate the magnitude of traffic issues within the study area. If multiple streets are identified to have potential issues, the street with the highest score in the neighborhood will be recorded. Petitions will be separated by multiple streets and single street issues and further subdivided by minor residential streets and primary residential/collector streets (for a total of 4 categories). The top ten scores for each category will be identified neighborhood scores will be submitted to City Council for consideration during selection of the areas to be treated in the next cycle. Projects for the upcoming cycle will be selected annually for multiple streets and quarterly for single streets.

Date: _____

Study Area/Street Name: _____

Prepared by: _____

Criteria	Point Assignment	Points
Average Speed	2 points for every Average mph in excess of the posted speed limit	
Traffic Volume	1 point for every 500 vehicles per day	
Three Year Collision History	2 points for every collision	
	Total Score	

Other Neighborhood Characteristics	Circle One
Schools	
Is there an Elementary, Middle, or High School within study area (circle one)?	Yes or No
Is there a school bus route/stop within study area? [1]	Yes or No
Other Pedestrian Generators	
Is there a library, community center, park, etc. within study area? [1]	Yes or No
Bicycle Routes	
Is there a designated bikeway within study area? [1]	Yes or No
Collisions	
Has there been a bike/pedestrian related collision in prior 3 years?	Yes or No
Has there been a property or injury related collision in prior 3 years?	Yes or No
Miscellaneous	
Is there a Regional Transit route/stop within study area? [1]	Yes or No
Is there a Fire Station within study area? [1]	Yes or No
Is there street lighting within study area?	Yes or No
Are there horizontal or vertical curves within the study area?	Yes or No
Other:_____	Yes or No
Note: [1] Within ¼ mile of street in question.	

4. PROCESS FOR REMOVAL

4.1 PLAN INITIATION

The City recognizes that after devices are approved and implemented, residents on rare occasions may wish to remove these devices. As the NTMP provides guidance to City staff and neighborhood residents for the installation of traffic calming devices, it also provides guidance on the process for removal of these devices.

Similar to the process for implementing traffic calming devices, the removal process is resident driven. The process requires that the same affected area be involved in the decision to remove the devices. Greater neighborhood support is also required to verify that the neighborhood truly wants the devices removed.

The removal process is described below and a flowchart outlining the removal process is provided on page 16.

4.2 CITIZEN REQUEST

To initiate the removal process, a petition must be submitted by a resident living in the neighborhood in which the removal of a device(s) would occur. The petition can be submitted within one-year of the finalized plan (i.e. not subject to further modifications). Similar to the petition to initiate the plan implementation, signatures of ten supporting neighborhood residents must be included on the petition. The petition must also state the locations of devices for removal.

Once City staff receives the petition, a letter stating that the petition has been received and that the City will organize and distribute ballots for the removal process will be sent to the individuals on the petition form.

4.3 DISTRIBUTE BALLOTS TO LOCAL RESIDENTS

Ballots will be distributed to the same affected area involved in the implementation of the devices. Although tenants or property owners in the area may have changed, the same addresses will be provided the opportunity to participate in the process. The ballots will contain description and map of devices and locations proposed for removal. The ballot will also include a mail back postcard residents can use to indicate their support for or against the proposed removal. The ballot will also provide a space for residents to write any comments regarding the removal.

4.4 DETERMINE NEIGHBORHOOD SUPPORT

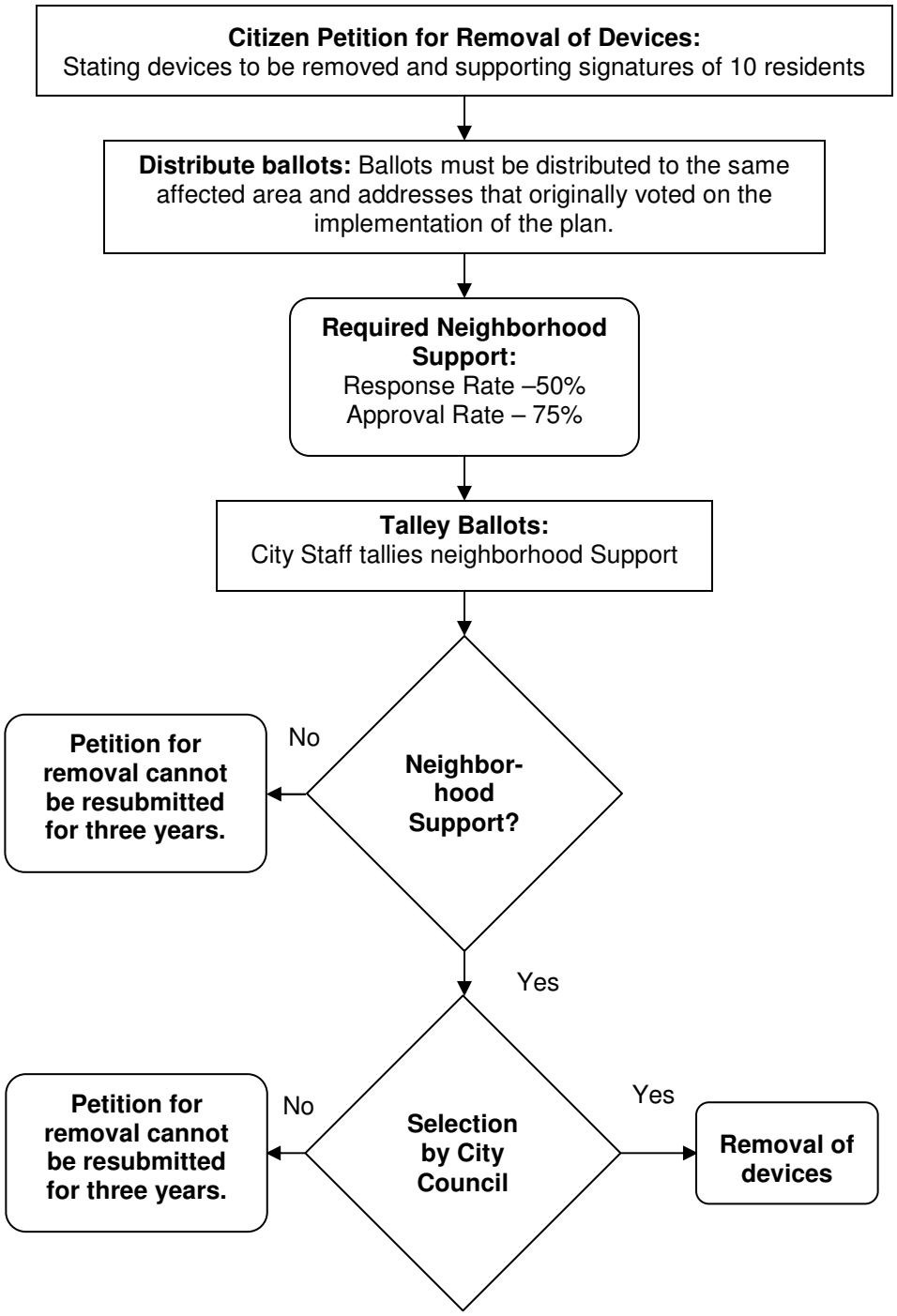
Once the postcards are received by the City, a minimum response rate and approval rate must be met at a higher level than the implementation process. For removal of traffic calming devices, a

minimum of 50 percent of all ballots must be returned with at least 75 percent of all ballots in favor of removal. Apartment units do not count toward the minimum response rate. If the minimum response or approval rates are not met, the petition can not be resubmitted for three years.

4.5 CITY COUNCIL SELECTION

If the neighborhood support meets the minimum response and approval rates, the recommendation and estimated removal cost will be presented to the City Council at the next annual meeting for selection of treatment areas. City staff will present this information in parallel with the petitions for treatment. Due to limited funding, the removal of devices will contend for funds that would otherwise be allocated to the treatment of other areas.

NTMP Process for Removal



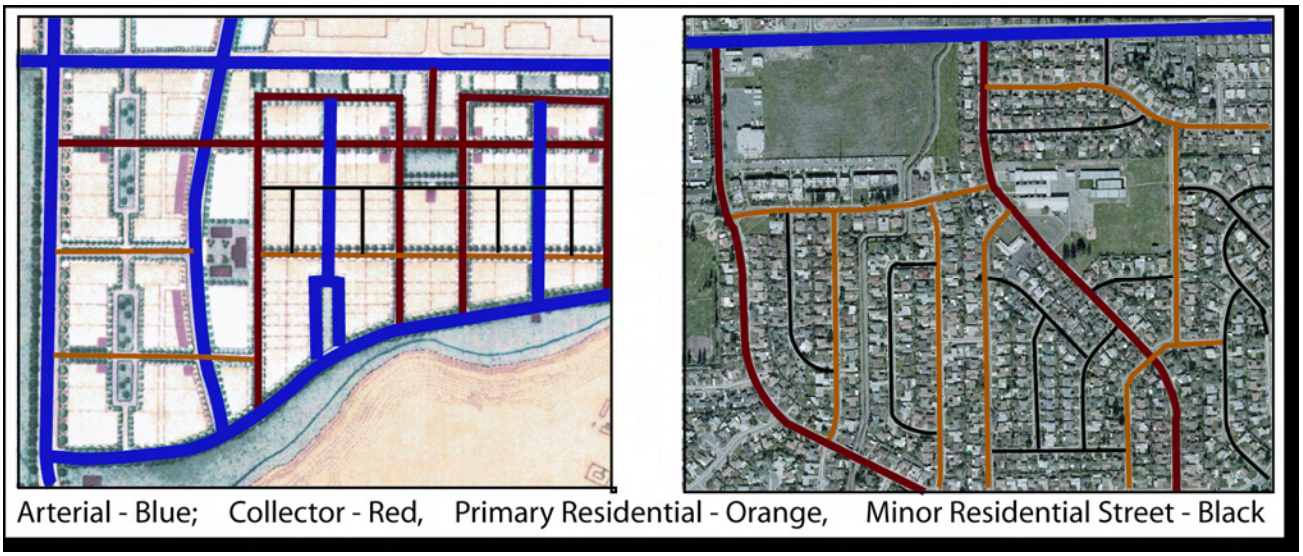
5. TOOLBOX OF TRAFFIC CALMING DEVICES

This chapter of the Neighborhood Traffic Management Program (NTMP) manual summarizes the "toolbox" of devices that are available to the City of Rancho Cordova and community members when developing traffic calming plans. The "toolbox" contains 33 different devices that address neighborhood traffic related concerns such as speeding vehicles, high traffic volumes, cut-through traffic, or collisions at neighborhood intersections. The devices vary in their ability to treat various traffic related concerns. For this reason the "toolbox" also provides guidance on selecting the most appropriate devices given the type of specific traffic related-concerns and street being treated.

The Neighborhood Traffic Management Program (NTMP) has identified the following two-lane neighborhood residential street types available for treatment.

- Minor Residential Street
- Primary Residential Street
- Collector Street
- Non-Residential Collector Streets

The technical definition of each of these streets are based upon right-of-way width (i.e. area including paved and unpaved surfaces) and types of land uses adjacent to the street. A simplified way to think about these street types is in a system of hierarchy. Minor Residential streets serve traffic from nearby residential homes which are directed to Primary Residential streets that also serve nearby residential or neighborhood commercial land uses. Collector streets serve to accommodate traffic from Minor and Primary Residential streets and provide greater connectivity to other areas within the City. The diagram on the following page illustrates the street hierarchy system and the aerial photo to further illustrate this concept.



The City's NTMP is limited to two-lane streets with primarily residential uses. Speed management and/or traffic safety issues on higher-order streets (non-residential or 4+ lanes) are not appropriate for arterial streets since the purpose of those streets is to accommodate traffic flow from other streets and reduce the likelihood of traffic diverting back to residential streets.

The remainder of the "toolbox" is divided into the following sections.

- 5.1 Description of traffic calming measures
- 5.2 Level 1 – Non-Physical devices
- 5.3 Level 2 – Narrowing devices
- 5.4 Level 2 – Horizontal devices
- 5.5 Level 2 – Vertical devices
- 5.6 Level 3 – Diversion measures

5.1 DESCRIPTION OF TRAFFIC CALMING DEVICES

The "toolbox" of traffic calming devices is structured into a three tier system of increasingly effective yet intrusive devices. The three tiers are listed below and described in further detail on the following pages.

1. Level 1 – The first solutions to consider should be Non-Physical Measures, such as signs and markings, since these devices can increase driver awareness and are relatively inexpensive.

2. Level 2 – Level 1 measures effectiveness can be increased when combined with Level 2 devices. Level 2 devices create vertical deflection, narrowing, and horizontal deflection to reduce driver speeds. Level 2 measures also increase emergency response travel times and are not allowed on Emergency Response Routes.

    - *Narrowing Measures* – Narrowing devices, such as bulbouts or center island medians, are less obtrusive than other devices and can be more aesthetically appealing if residents opt to fund upgraded landscaping.

    - *Horizontal Measures* – Horizontal deflection devices, such as chicanes and traffic circles, are more intrusive but also more effective than narrowings because they force vehicles to navigate horizontally around physical objects. These can also be combined with landscaping.

    - *Vertical Measures* – The use of vertical deflection devices, such as speed tables, have the greatest effect on speed reduction. Use of these devices should be carefully considered especially to limit any potential impact on emergency vehicles or transit access.

3. Level 3 – If Level 1 and 2 measures fail to achieve the desired results, diversion may be considered. Diversion measures restrict both local and non-local traffic from one street to another by restricting specific movements or by completely closing the street. Level 3 measures are not allowed on Emergency Response Routes and are constructed to accommodate emergency response vehicles on all other streets.

For each device in the "toolbox", the following discussions are provided.

- Description of the measure
- Photograph and/or schematic
- List of advantages and disadvantages
- Data sheet indicating speed, volume, or collision reduction potential

5.2 LEVEL 1 - NON-PHYSICAL MEASURES

5.2.3 Description

Non-physical devices include any measure that does not require physical changes to the roadway. Non-physical devices are intended to increase drivers' awareness of surroundings and influence driver behavior without physical devices. This category includes signing and striping modifications, as well as temporary use of certain enforcement strategies.

- Targeted Speed Enforcement
- Radar Trailers
- Speed Feedback Sign
- Centerline/Edgeline Lane Striping
- Optical Speed Bars
- Signage
- Speed Legend
- Centerline Botts Dots
- Textured Pavement
- High Visibility Crosswalk
- Angled Parking

TARGETED SPEED ENFORCEMENT

City staff or NTC identifies locations for temporary targeted enforcement, based on personal observations and survey comments. A request can be submitted to the Rancho Cordova Police Department for the desired enforcement. Because of limited Police resources, the targeted enforcement may be limited in duration. Targeted enforcement may also be used in conjunction with new traffic calming devices to help drivers become aware of the new restrictions.

Advantages

- Inexpensive if used temporarily
- Does not physically slow emergency vehicles or buses
- Quick implementation

Disadvantages

- Expensive to maintain an increased level of enforcement
- Effectiveness may be temporary

RADAR TRAILER

A radar trailer is a device that measures each approaching vehicle's speed and displays it next to the legal speed limit in clear view of the driver. They can be easily placed on a street for a limited amount of time then relocated to another street, allowing a single device to be effective in many locations.

Advantages

- Portable
- Does not physically slow emergency vehicles or buses
- Quick implementation

Disadvantages

- Effectiveness may be temporary
- Drivers may divert to alternate streets due to uncertainty of devices implications
- Subject to vandalism

SPEED FEEDBACK SIGNS

Speed feedback signs perform the same functions as radar trailers but are permanent. Real-time speeds are relayed to drivers and flash when speeds exceed the limit. Speed feedback signs are typically mounted on or near speed limit signs and can also be mobile units.

Advantages

- Real-time speed feedback
- Does not physically slow emergency vehicles or buses
- Permanent installation

Disadvantages

- May requires power source
- Only effective for one direction of travel
- Long-term effectiveness uncertain

CENTERLINE/EDGLINE LANE STRIPING

Lane striping can be used to create formal bicycle lanes, parking lanes, or edge lines. As a traffic calming measure, they are used to narrow the travel lanes for vehicles, thereby inducing drivers to lower their speeds. The past evidence on speed reductions is, however, inconclusive.

Advantages

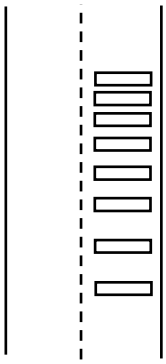
- Inexpensive
- Can be used to create bicycle lanes or delineate on-street parking
- Does not slow emergency vehicles

Disadvantages

- Long term effectiveness is unknown.
- Requires regular maintenance

OPTICAL SPEED BARS

Optical speed bars are a series of pavement markings spaced at decreasing distances. They have typically been used in construction areas to provide drivers with the impression of increased speed. Provides an added benefit when used with other Level 2 Vertical devices.



Advantages

- Inexpensive
- Does not physically slow emergency vehicles or buses

Disadvantages

- Long-term affects in residential area unknown
- Increases regular maintenance

SIGNAGE

Signage that can be used as a traffic calming measure include:

- Truck Restriction Signs; and
- "Cross Traffic Does Not Stop" Signs.

Note that speed limit signs, to be eligible for radar enforcement, must be set using an appropriate engineering and speed study.

Advantages

- Inexpensive
- Truck restrictions can reduce through truck traffic
- Does not slow emergency vehicles or buses

Disadvantages

- Speed limit signs do not necessarily change driver behavior. If speed limit is set unreasonably low, drivers are more likely to exceed it
- Requires regular maintenance

SPEED LEGEND

Speed legends are numerals painted on the roadway indicating the current speed limit in miles per hour. They are usually placed near speed limit signposts. Speed legends can be useful in reinforcing a reduction in speed limit between one segment of a roadway and another segment. They may also be placed at major entry points into a residential area.

Advantages

- Inexpensive
- Helps reinforce a change in speed limit
- Does not slow emergency vehicles

Disadvantages

- Has not been shown to significantly reduce travel speeds
- Requires regular maintenance

CENTERLINE BOTTS DOTS

Botts dots, or "raised pavement markers," are small bumps lining the centerline or edgeline of a roadway. They are often used on curves where vehicles have a tendency to deviate outside of the proper lane, risking collision. Raised reflectors improve the nighttime visibility of the roadway edges.

Advantages

- Inexpensive
- Does not physically slow emergency vehicles or buses
- Can help keep drivers in the appropriate travel lane on curves and under low-visibility conditions

Disadvantages

- Noise caused by Botts Dots
- Requires regular maintenance
- Has not been shown to significantly reduce travel speeds

TEXTURED PAVEMENT

Textured colored pavement includes the use of stamped pavement (asphalt) or alternate paving materials to create an uneven surface for vehicles to traverse. They may be used to emphasize either an intersection or a pedestrian crossing.

Advantages

- Increased visibility of crosswalk
- Focus crossing pedestrians at a single location

Disadvantages

- May give pedestrians a false sense of security, causing them to pay less attention to traffic
- Require more maintenance than normal crosswalks

HIGH VISIBILITY CROSSWALKS

High-visibility crosswalks use special marking patterns and raised reflectors to increase the visibility of a crosswalk at night. A "triple-four" marking pattern is created by painting two rows of four-foot wide rectangles, separated by four feet of unpainted space across the roadway. Raised reflectors are placed at the approach edges of these rectangles. The unpainted space along the center of the crosswalk allows wheelchairs and foot traffic an unobstructed path when crossing in the rain (markings may become slippery when wet).

Advantages

- Can reduce vehicle speeds
- Aesthetic upgrades can have positive aesthetic value
- Placed at an intersection, it can slow two streets at once

Disadvantages

- Expensive, varying by materials used
- Can be uncomfortable for bicyclists or handicapped.
- Textured pavement can increased noise to adjacent properties

ANGLED PARKING

Angled parking reorients on-street parking spaces to a 45-degree angle, increasing the number of parking spaces and reducing the width of the roadway available for travel lanes. Angled parking is also easier for vehicles to maneuver into and out of than parallel parking. Consequently, it works well in locations with high parking demand, such as multi-family residences, and high turnover rates, such as commercial and mixed-use areas. Angled parking should not be used on streets with on-street bikeways.

Advantages

- Reduces speeds by narrowing the travel lanes;
- Increases the number of parking spaces
- Makes parking maneuvers easier and takes less time than with parallel parking
- Favored by businesses and multi-family residences

Disadvantages

- Precludes the use of bike lanes (unless roadway is wider than 58 feet)
- Ineffective on streets with frequent driveways
- Potential for collisions when backing out

5.3 LEVEL 2 - NARROWING DEVICES

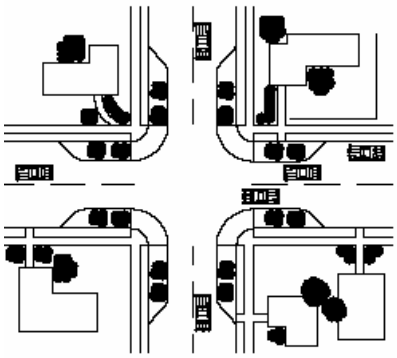
5.3.1 Description

Narrowing devices use raised islands and curb extensions to narrow the travel lane for motorists. The narrowing devices in the toolbox include.

- Neckdown/Bulbout
- Center Island Narrowing
- Two-Lane Choker
- One-Lane Choker

NECKDOWN/BULBOUT

Neckdowns/bulbouts are raised curb extensions that narrow the travel lane at intersections or midblock locations. Neckdowns/bulbouts "pedestrianize" intersections by shortening the crossing distance and decreasing the curb radii, thus reducing turning vehicle speeds. Both of these effects increase pedestrian comfort and safety at the intersection.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-7%**
Volume Reduction	**Reduction in Vehicles per Day**	**-10%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.

RETROFIT WITH COBBLESTONE TREATMENT

NEW CONSTRUCTION

Advantages

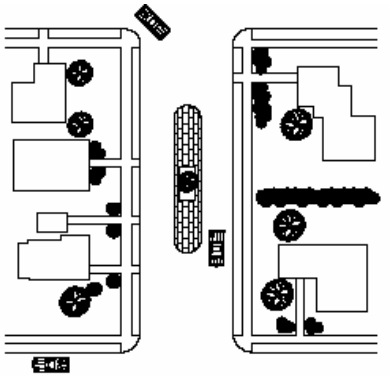
- Reduces pedestrian crossing distance and exposure to vehicles
- Through and left-turn movements are easily negotiable by large vehicles
- Creates protected on-street parking bays
- Reduces speeds (especially right-turning vehicles) and traffic volumes

Disadvantages

- Effectiveness is limited by the absence of vertical or horizontal deflection
- May slow right-turning emergency vehicles
- Potential loss of on-street parking
- May require bicyclists to briefly merge with vehicular traffic

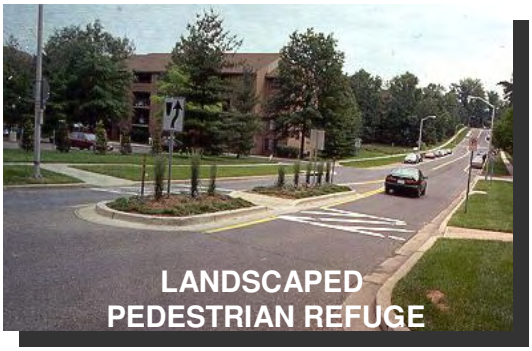
CENTER ISLAND NARROWING

Center island narrowings are raised islands located along the centerline of a street that narrow the travel lanes at that location. Placed at the entrance to a neighborhood, and often combined with textured pavement, they are often called “gateways". Fitted with a gap to allow pedestrians to walk through at a crosswalk, they are often called “pedestrian refuges”. They can also be landscaped to increase visual aesthetics.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-7%**
Volume Reduction	**Reduction in Vehicles per Day**	**-10%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.



LANDSCAPED PEDESTRIAN REFUGE

Advantages

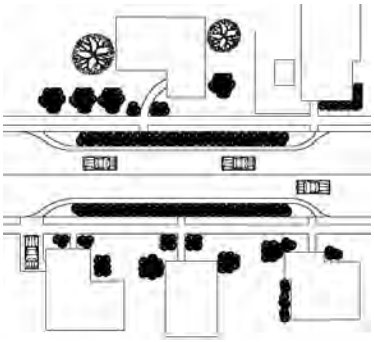
- Can increase pedestrian safety
- Aesthetic upgrades can have positive aesthetic value
- Reduces traffic volumes if alternative routes are available

Disadvantages

- Effect on vehicle speeds is limited by the absence of any vertical or horizontal deflection
- Potential loss of on-street parking

TWO-LANE CHOKER

Chokers are curb extensions at midblock that narrow a street. Chokers leave the street cross section with two lanes that are narrower than the normal cross section.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-7%**
Volume Reduction	**Reduction in Vehicles per Day**	**-10%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.

RETROFIT WITH LANDSCAPING (COMBINED WITH HUMP)

NEW CONSTRUCTION

Advantages

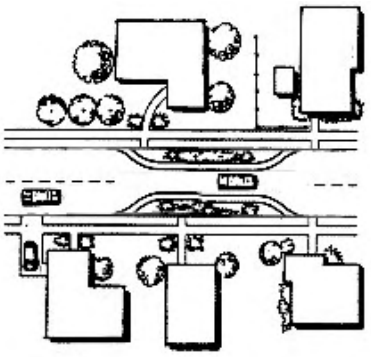
- Easily negotiable by emergency vehicles and buses
- Can have positive aesthetic value
- Reduces both speeds and volumes

Disadvantages

- Effect on vehicle speeds is limited by the absence of any vertical or horizontal deflection
- May require bicyclists to briefly merge with vehicular traffic
- Loss of on-street parking
- Build up of debris in gutter

ONE-LANE CHOKER

One-lane chokers narrow the roadway width such that there is only enough width to allow travel in one direction at a time. They operate similarly to one-lane bridges, where cars approaching on one side must wait until all traffic in the other direction has cleared before proceeding.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-14%**
Volume Reduction	**Reduction in Vehicles per Day**	**-20%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.

Advantages

- Maintains two-way vehicle access, except at choker
- Very effective in reducing speeds and traffic volumes

Disadvantages

- Perceived as unsafe because opposing traffic is vying for space in a single lane
- Can only be used on low-volume, low speed roads
- Loss of on-street parking

5.4 LEVEL 2 – HORIZONTAL DEVICES

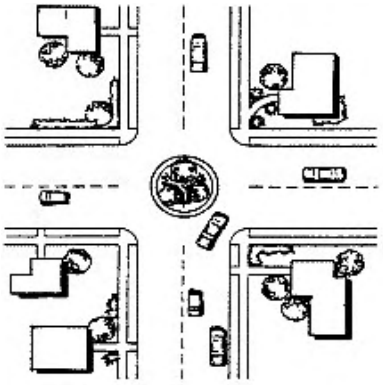
5.4.1 Description

Horizontal deflection devices use raised islands and curb extensions to eliminate straight-line paths along roadways and through intersections. The horizontal deflection devices in the toolbox include:

- Traffic Circle
- Roundabout (Single-Lane)
- Chicane
- Lateral Shift
- Realigned Intersection

TRAFFIC CIRCLE

Traffic circles are raised islands, placed in intersections, around which traffic circulates. Stop signs or yield signs can be used as traffic controls at the approaches of the traffic circle. Circles prevent drivers from speeding through intersections by impeding the straight-through movement and forcing drivers to slow down to yield. Depending upon the size of the intersection and circle, trucks may be permitted to turn left in front of the circle.



Measured Effectiveness		
Speed Impacts	**Reduction in 85th Percentile Speeds between Slow Points**	**-11%**
Volume Impacts	**Reduction in Vehicles per Day**	**-5%**
Safety Impacts	**Reduction in Average Annual Number of Collisions**	**-71%**
Source: Traffic Calming: State of the Practice, 2000.		

Advantages

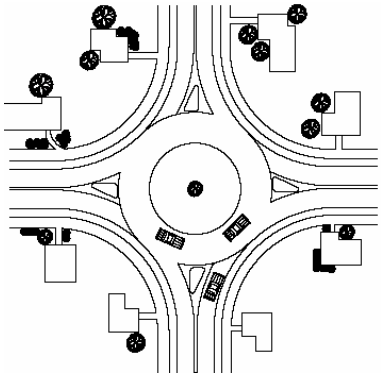
- Very effective in moderating speeds and improving safety
- Can have positive aesthetic value

Disadvantages

- If not designed properly, difficult for emergency vehicles or large trucks to travel around
- Must be designed so that the circulating traffic does not encroach on crosswalks
- Potential loss of on-street parking

ROUNDABOUT (SINGLE-LANE)

Like traffic circles, roundabouts require traffic to circulate counterclockwise around a center island. But unlike circles, roundabouts are used on higher volume streets to allocate right-of-way among competing movements. They are found primarily on collector streets, often substituting for traffic signals. They are larger than neighborhood traffic circles, have raised splitter islands to channel approaching traffic to the right, and do not have stop signs.



Measured Effectiveness		
Speed Impacts	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D**
Volume Impacts	**Reduction in Vehicles per Day**	**I/D**
Safety Impacts	**Reduction in Average Annual Number of Collisions**	**-15% to -33%**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Roundabouts: An Informational Guide, 2000.

Advantages

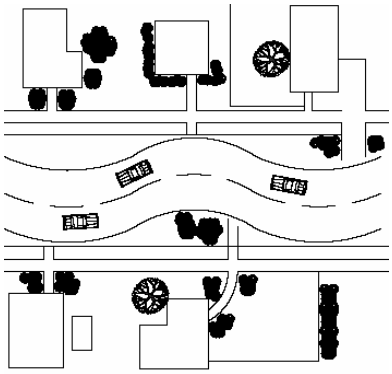
- Enhanced safety compared to a traffic signal or stop sign
- Minimizes queuing at approaches to the intersection
- Less expensive to operate than traffic signals
- Can have positive aesthetic value
- Shorter pedestrian crossing distance

Disadvantages

- May require major reconstruction of an existing intersection
- Loss of on-street parking
- Continuous flow of traffic limits opportunity for pedestrians to cross (compared to signal)

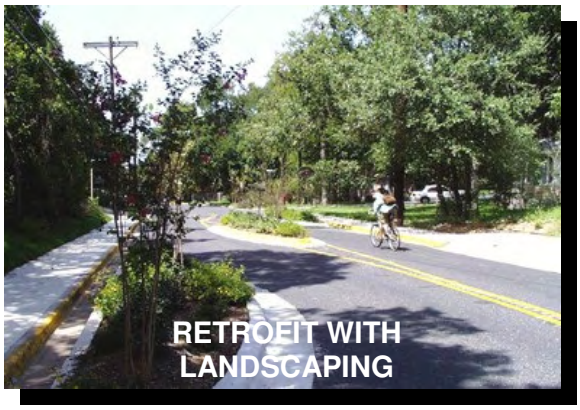
CHICANE

Chicanes are curb extensions that alternate from one side of the street to the other, forming S-shaped curves. Chicanes can also be created by alternating on-street parking between one side of the road and the other. Each parking bay can be created either by re-striping the roadway or by installing raised center islands at each end, creating a protected parking area.



Measured Effectiveness		
Speed Impacts	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D**
Volume Impacts	**Reduction in Vehicles per Day**	**I/D**
Safety Impacts	**Reduction in Average Annual Number of Collisions**	**I/D**
Note: I/D = Insufficient data to predict reduction effect.		

RETROFIT COBBLESTONE TREATMENT



RETROEIT WITH LANDSCAPING

Advantages

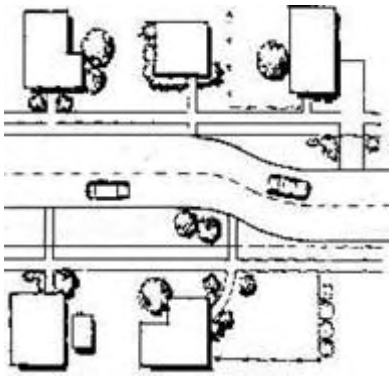
- Discourages high speeds by forcing horizontal deflection
- Easily negotiable by emergency vehicles and buses

Disadvantages

- Must be designed carefully to discourage drivers from deviating out of the appropriate lane
- Curb realignment and landscaping can be costly, especially if there are drainage issues
- Loss of on-street parking

LATERAL SHIFT

Lateral shifts are curb extensions on otherwise straight streets that cause a shift in the travel. Lateral shifts, with just the right degree of deflection, are effective in reducing speeds without compromising safety.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D**
Volume Reduction	**Reduction in Vehicles per Day**	**I/D**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**
Note: I/D = Insufficient Data to predict reduction effect.		

Advantages

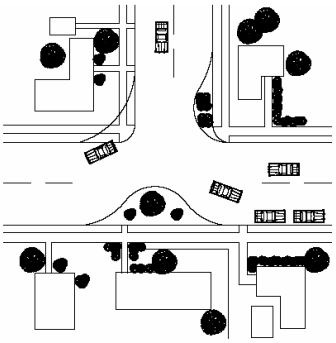
- Can accommodate higher traffic volumes than many other traffic calming measures
- Easily negotiable by large emergency vehicles and buses

Disadvantages

- Modest effect on speeds
- Loss of on-street parking
- Must be designed carefully to discourage drivers from deviating out of the appropriate lane

REALIGNED INTERSECTION

Realigned intersections provide deflection on an otherwise straight approach of a T- intersection. By providing deflection in the form of a curb extension or realignment, drivers are required to slow through the intersection or come to a stop prior to turning.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D**
Volume Reduction	**Reduction in Vehicles per Day**	**I/D**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**
Note: I/D = Insufficient Data to predict reduction effect.		

Advantages

- Can be effective at reducing speeds at T-intersections
- Can be affective in increasing safety at T intersections

Disadvantages

- Modifying curb or drainage can be costly
- Acquiring additional right-of way can be costly

5.5 LEVEL 2 – VERTICAL DEVICES

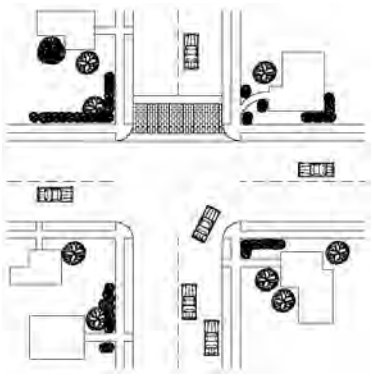
5.5.1 Description

Vertical deflection devices use variations in pavement height and alternative paving materials to physically reduce travel speeds. These devices are designed for travel speeds over the device of approximately 15 to 20 mph depending on the device. The vertical deflection devices in the toolbox include:

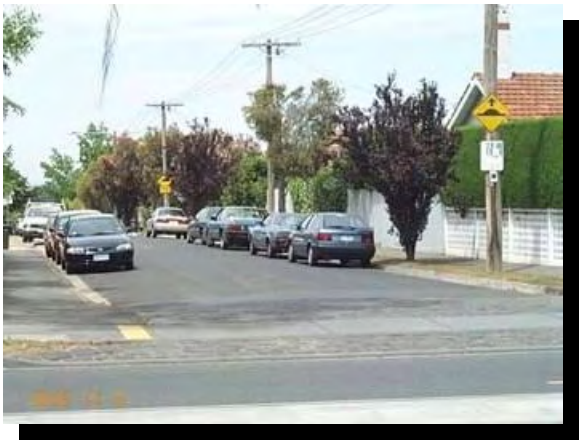
- Entry Feature
- Speed Hump
- Speed Lump
- Speed Cushion
- Split Speed Hump
- Speed Table
- Raised Crosswalk
- Raised Intersection

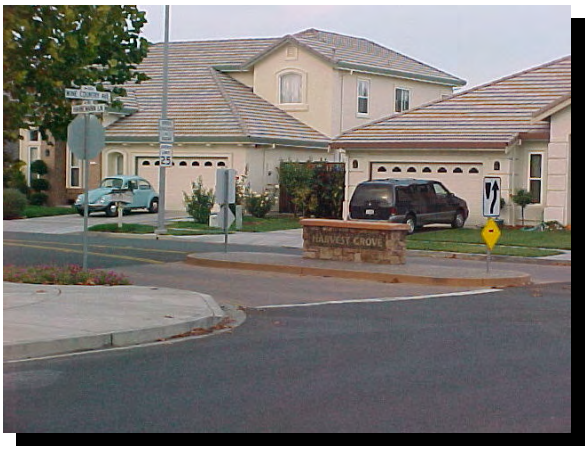
ENTRY FEATURE

An entry feature is an elevated portion of a roadway where a minor street provides access to and from a collector or arterial street signifying the entrance to a neighborhood area. It may be combined with a center median island splitting inbound and outbound traffic. The center median island can be constructed with stamp brick work or landscaping.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D**
Volume Reduction	**Reduction in Average Daily Traffic**	**I/D**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**
Note: I/D = Insufficient Data to predict reduction effect.		





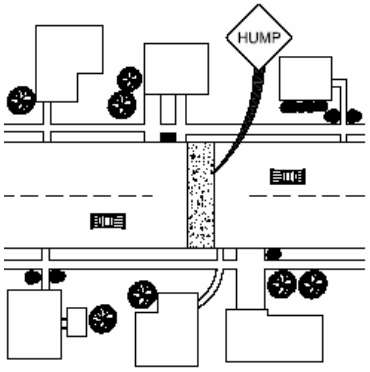
Advantages

- Alerts drivers that they are entering a neighborhood area
- Aesthetics may be pleasing

Disadvantages

- Cost, depending on material used
- Slows emergency vehicles and buses

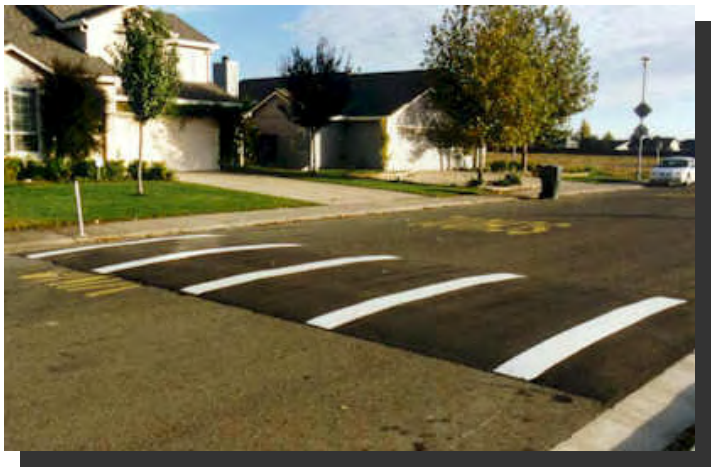
SPEED HUMP



Speed humps are rounded raised areas placed across the road. They are generally 12 feet long (in the direction of travel), 3 ¼ to 3 ¾ inches high, and parabolic in shape, and have a design speed of 15 to 20 mph. They are usually constructed with a taper on each side to allow unimpeded drainage between the hump and curb. When placed on a street with rolled curbs or no curbs, bollards are placed at the ends of the speed hump to discourage vehicles from veering outside of the travel lane to avoid the device.

The magnitude of reduction in speed is dependant of the spacing of speed humps between points that require drivers to slow (see page 65). On average, speed humps achieve a 22% reduction in speeds.

Measured Effectiveness		
Speed Impacts	**Reduction in 85th Percentile Speeds between Slow Points**	**-22%**
Volume Impacts	**Reduction in Average Daily Traffic**	**-18%**
Safety Impacts	**Reduction in Average Annual Number of Collisions**	**-13%**
Source: Traffic Calming: State of the Practice, 2000.		



Advantages

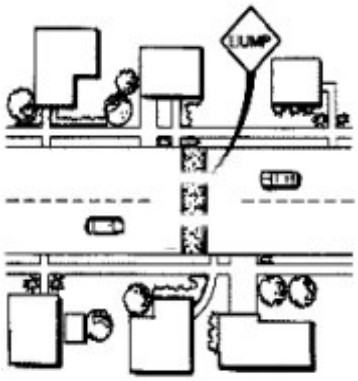
- Relatively inexpensive;
- Relatively easy for bicyclists to cross
- Very effective in slowing travel speeds.

Disadvantages

- Causes a "rough ride" for all drivers, and can discomfort people with certain skeletal disabilities;
- Slows emergency vehicles and buses
- Aesthetics
- Signs may be unwelcome by adjacent residents

SPEED LUMP

The speed lump is a variation on the speed hump, adding two wheel cut-outs designed to allow large vehicles, such as emergency vehicles and buses, to pass with minimal slowing. The design limits passenger cars and mid-size SUVs from fully passing through the cut-outs, but allows one set of wheels to pass through the cut-out while the other set is required to travel over the lump.



The magnitude of reduction in speed is dependant of the spacing of speed lumps between points that require drivers to slow (see page 65). Speed lumps have a similar reduction in speeds when compared to speed humps.

Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**Comparable to speed humps, but I/D**
Volume Reduction	**Reduction in Average Daily Traffic**	
Safety Reduction	**Reduction in Average Annual Number of Collisions**	
Note: Insufficient Data to predict reduction effect.		

Advantages

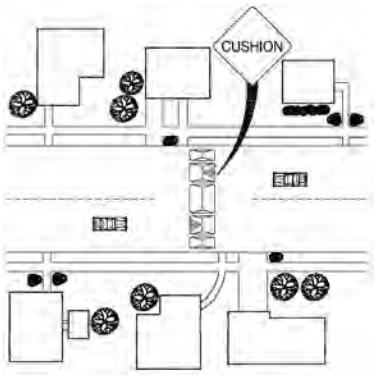
- Effective in reducing speeds
- Maintains rapid emergency response times
- Relatively easy for bicyclists to cross

Disadvantages

- Vehicles with wide wheel base can pass through the lump using the wheel cut-outs
- Increased noise
- Aesthetics
- Signs may be unwelcome by adjacent residents

SPEED CUSHION

Speed cushions are a variation of the speed lump that is constructed from durable recycled rubber. These prefabricated devices consistently have a more uniform shape than asphalt humps. Speed cushions provide wheel gaps for emergency vehicles and buses, and can be arranged to fit any street width.



The magnitude of reduction in speed is dependant of the spacing of speed cushions between points that require drivers to slow (see page 65). On average, speed cushions achieve a 14% reduction in speeds.

Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-14%**
Volume Reduction	**Reduction in Average Daily Traffic**	**Comparable to Speed Lumps but I/D**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	

Notes: I/D = Insufficient Data to predict reduction effect.
Source: City of Portland, Rubber Speed Bump Research, 1995.

Advantages

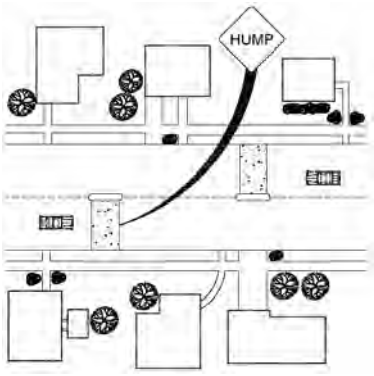
- Provides a more consistent ride than asphalt humps
- Can be used as a temporary device during a testing phase
- Reduces impacts to emergency vehicles due to cut-outs
- Easily accommodates street resurfacing

Disadvantages

- Increased noise
- Aesthetics (but may be better than lumps)
- Signs may be unwelcome by adjacent residents

SPLIT SPEED HUMP

Split speed humps are a variation of the speed hump. Each approach of the speed hump is separated by approximately 50 feet. The approach island at each lump discourages drivers from maneuvering around the lumps while the distance between the two lumps is adequate for emergency response vehicles to cross the centerline and bypass the speed hump. A split speed hump can be used in place of a speed lump or speed cushion



The magnitude of reduction in speed is dependant of the spacing of speed humps between points that require drivers to slow (see page 65). On average, split speed humps achieve 14% reduction in speeds.

Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-14%**
Volume Reduction	**Reduction in Average Daily Traffic**	**Comparable to Speed humps but I/D**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	

Notes: I/D = Insufficient Data to predict reduction effect.
Source: City of Portland, Split Speed Bump Research, 1998.

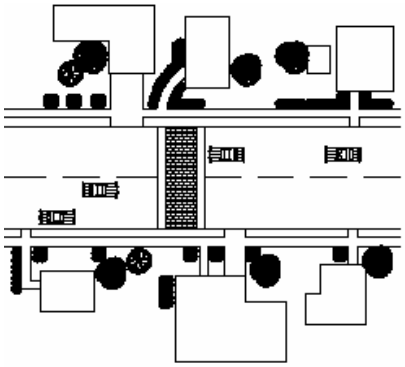
Advantages

- Effective at reducing speeds;
- Less of an impedance on emergency response vehicles compared to speed lump

Disadvantages

- May require the removal of on-street parking within the limits of the device.
- Increased noise
- Aesthetics
- Signs may be unwelcome by adjacent residents

SPEED TABLE



Speed tables are flat-topped speed humps approximately 22 feet long, which is typically long enough for the entire wheelbase of a passenger car to rest on top. Their long flat fields, plus ramps that are more gently sloped than speed humps, give speed tables higher design speeds than humps and thus may be more appropriate for streets with higher ambient speeds. Brick or other textured materials improve the appearance of speed tables, draw attention to them, and may enhance safety and speed reduction.

The magnitude of reduction in speed is dependant of the spacing of speed tables between points that require drivers to slow (see page 65). On average speed tables achieve an 18% reduction in speeds.

Measured Effectiveness		
Speed Impacts	**Reduction in 85th Percentile Speeds between Slow Points**	**-18%**
Volume Impacts	**Reduction in Vehicles per Day**	**-12%**
Safety Impacts	**Reduction in Average Annual Number of Collisions**	**-45%**

Source: Traffic Calming: State of the Practice, 2000.

STANDARD TREATMENT

UPGRADED AESTHETICS

Advantages

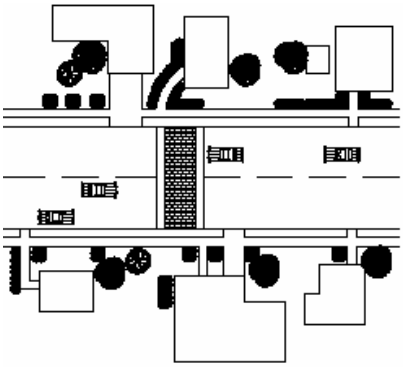
- Smoother on large vehicles (such as fire trucks) than speed humps
- Effective in reducing speeds, though not to the extent of speed humps

Disadvantages

- Aesthetics of device
- Increased noise
- Textured materials, if used, can be expensive
- Signs may be unwelcome by adjacent residents

RAISED CROSSWALK

Raised Crosswalks are speed tables striped with crosswalk markings and signage to channelize pedestrian crossings, providing pedestrians with a level street crossing. Also, by raising the level of the crossing, pedestrians are more visible to approaching motorists.



Measured Effectiveness		
Speed Impacts	**Reduction in 85th Percentile Speeds between Slow Points**	**-18%**
Volume Impacts	**Reduction in Vehicles per Day**	**-12%**
Safety Impacts	**Reduction in Average Annual Number of Collisions**	**-45%**
Source: Traffic Calming: State of the Practice, 2000.		

Advantages

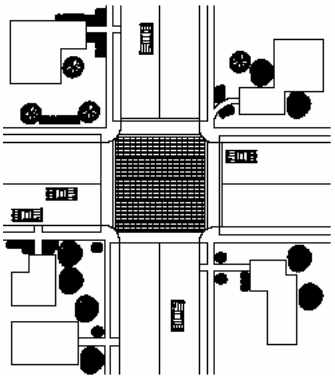
- Improve safety for both vehicles and pedestrians
- Aesthetic upgrades can have positive aesthetic value
- Effective in reducing speeds, though not to the extent of speed humps

Disadvantages

- Textured materials, if used, can be expensive
- Impact to drainage needs to be considered
- Textured pavement can increased noise to adjacent residences
- Signs may be unwelcome by adjacent residents

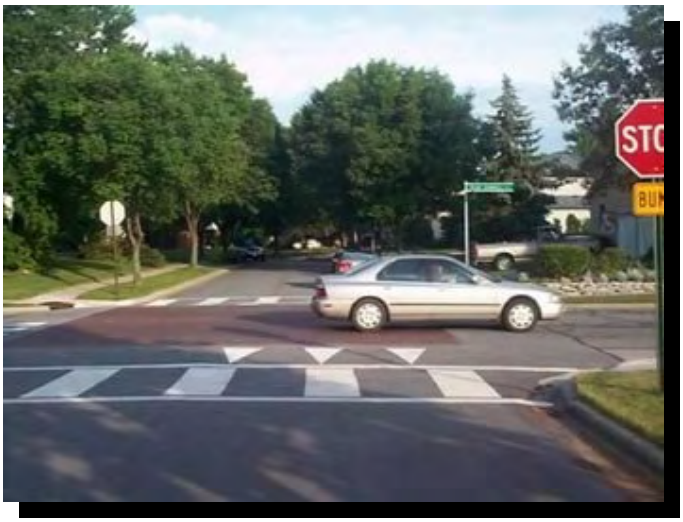
RAISED INTERSECTION

Raised intersections are flat raised areas covering entire intersections, with ramps on all approaches. They usually rise to sidewalk level, or slightly below to provide a "lip" for the visually impaired. By modifying the level of the intersection, the crosswalks are more readily perceived by motorists to be a pedestrian area. They are particularly useful in where loss of on-street parking associated with other traffic calming measures is considered unacceptable.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-1%**
Volume Reduction	**Reduction in Average Daily Traffic**	**I/D**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.



Advantages

- Can improve safety for pedestrians and motorists
- Aesthetic upgrades can have positive aesthetic value
- Can slow two streets at once

Disadvantages

- Less effective in reducing vehicle speeds than speed humps and speed tables
- Expensive, particularly as a retrofit
- Textured pavement can increased noise to adjacent residences

5.6 LEVEL 3 - DIVERSION MEASURES

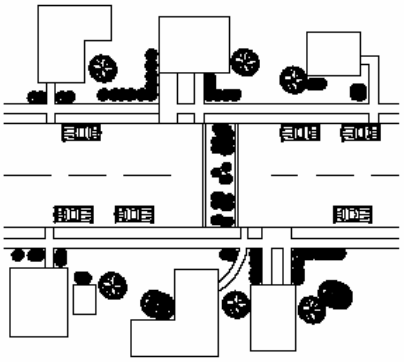
5.6.1 Description

Diversion devices use raised islands and curb extensions to preclude particular vehicle movements, such as left-turn or through movements, usually at an intersection. These devices can only be considered after all other devices have been attempted and failed to resolve the traffic problem. The diversion devices in the toolbox include:

- Full Closure
- Partial Closure
- Diagonal Diverter
- Median Barrier
- Forced Turn Island

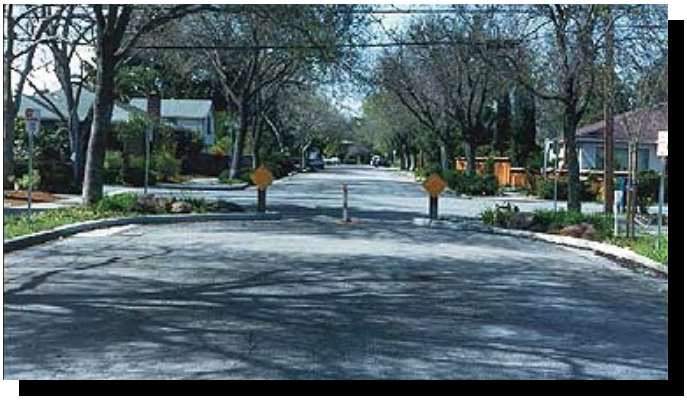
FULL CLOSURE

Full street closures are barriers placed across a street to close the street completely to through traffic, usually leaving only sidewalks or bicycle paths open. The barriers may consist of landscaped islands, walls, gates, side-by-side bollards, or any other obstructions that leave an opening smaller than the width of a passenger car. Emergency vehicles are accommodated via removable bollards or similar devices.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D**
Volume Reduction	**Reduction in Vehicles per Day**	**-44%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.



Advantages

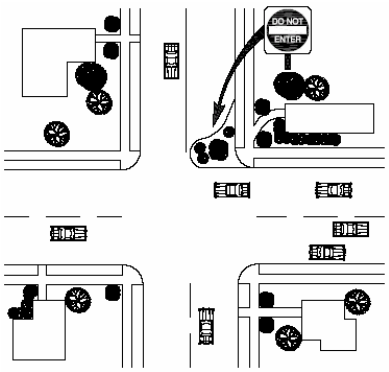
- Very effective in reducing cut-through traffic volumes
- Able to maintain pedestrian and bicycle connectivity

Disadvantages

- Requires statutory actions for public street closures
- Causes circuitous routes for local residents
- Diverts traffic to another street
- Delays for emergency services unless through access is provided for
- May limit access to businesses
- Cost

PARTIAL CLOSURE

Half street closures are barriers that block travel in one direction for a short distance on otherwise two-way streets. Half closures are the most common volume control measure after full street closures. Half closures are often used in sets to make travel through neighborhoods with gridded streets circuitous rather than direct.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-19%**
Volume Reduction	**Reduction in Vehicles per Day**	**-42%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.

STANDARD TREATMENT

Advantages

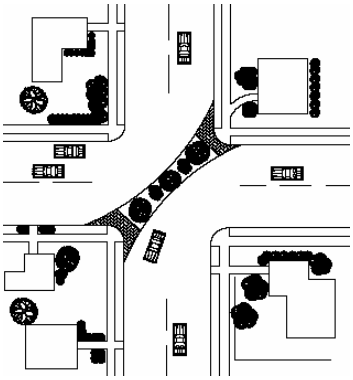
- Able to maintain two-way bicycle access
- Effective in reducing traffic volumes

Disadvantages

- Causes circuitous routes for local residents
- May limit access to businesses
- Drivers can bypass the barrier

DIAGONAL DIVERTER

Diagonal diverters are barriers placed diagonally across an intersection, blocking through movement. Like half closures, diagonal diverters are usually staggered to create circuitous routes through neighborhoods.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**-4%**
Volume Reduction	**Reduction in Vehicles per Day**	**-35%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.

Advantages

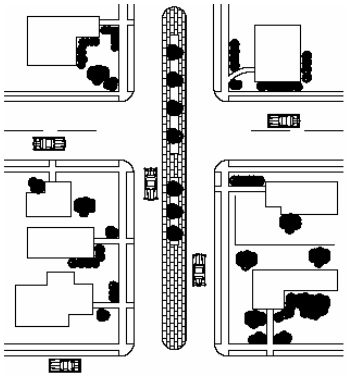
- Able to maintain full pedestrian and bicycle access
- Reduces traffic volumes

Disadvantages

- Causes circuitous routes for local residents
- Delays for emergency services
- May be expensive
- May require reconstruction of corner curbs

MEDIAN BARRIER

Median barriers are raised islands that are located along the centerline of a street and continue through an intersection so as to block through movement at a cross street.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D%**
Volume Reduction	**Reduction in Vehicles per Day**	**-31%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.

Advantages

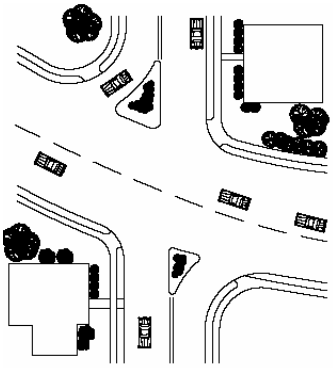
- Can improve safety at an intersection of a local street and a major street by prohibiting critical through movements
- Can reduce traffic volumes on a cut-through route that crosses a major street

Disadvantages

- Requires available street width on the major street
- Limits turns to and from the side street or driveway for local residents and emergency services

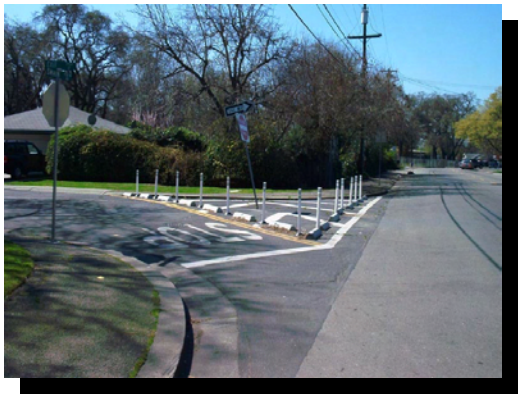
FORCED-TURN ISLAND

Forced turn islands are raised islands that prohibit certain movements on approaches to an intersection.



Measured Effectiveness		
Speed Reduction	**Reduction in 85th Percentile Speeds between Slow Points**	**I/D%**
Volume Reduction	**Reduction in Vehicles per Day**	**-31%**
Safety Reduction	**Reduction in Average Annual Number of Collisions**	**I/D**

Note: I/D = Insufficient Data to predict reduction effect.
Source: Traffic Calming: State of the Practice, 2000.



Advantages

- Can improve safety at an intersection by prohibiting critical turning movements
- Reduces traffic volumes

Disadvantages

- If designed improperly, drivers can maneuver around the island to make an illegal movement
- May divert a traffic problem to a different street

6. TOOLBOX GUIDELINES

6.1 GUIDELINES

This section provides guidance on selecting the most appropriate traffic calming measure for a specific problem. This includes narrowing the toolbox of traffic calming measures to those that will: most closely target the key traffic issue, are appropriate for the type of location concerned, and are compatible with the traffic volumes, geometrics, and adjacent land uses at that location. When the list has been narrowed, devices should be considered that balance effectiveness and likelihood of consensus among affected residents. Finally, the selected devices need to be placed in a manner that will produce the desired results.

6.1.1 Identify Traffic Related Issue

The first task when selecting the most appropriate traffic calming device is to narrow the field of devices to those that address the primary traffic issue. The most common traffic related concerns are:

- Speeding – motor vehicle speeds are too high
- Traffic Volumes – motor vehicle usage levels (all trips or non-local trips only) are too high
- Vehicle Safety – motor vehicle speeds or volumes create an inordinate level of risk
- Pedestrian Safety – motor vehicle drivers are often unaware of pedestrians and cause an inordinate level of risk
- Noise/Vibration/Air Pollution – motor vehicles cause excessive levels of these environmental effects

Each device in the toolbox is appropriate to a different subset of the above traffic related concern. The appropriateness of each device is summarized in Table 1.

6.1.2 Location Type

The appropriate device for a given problem is a function of the location (midblock or at an intersection). Special consideration must be given when considering measures on collector streets, which are the first street of choice by the Fire Department when responding to emergencies.

Table 2 indicates the location(s) where each type of traffic calming measure is applicable.

Table 1
Applicability of Devices by Traffic Related Issue

Type of Measure		Type of Issue				
		Speeding	Traffic Volume	Vehicle Collisions	Pedestrian Safety	Noise
Level 1 Non-Physical Measures						
	Targeted Speed Enforcement	●	○	◒	◒	◒
	Speed Radar Trailer	●	○	○	○	◒
	Speed Feedback Sign	●	○	○	○	◒
	Centerline/Edgeline Lane Striping	●	○	○	○	○
	Optical Speed Bars	◒	○	○	○	○
	Signage	●	◒	◒	○	○
	Speed Legend	●	○	○	○	○
	Centerline Botts Dots	○	○	●	◒	○
	Textured Pavement	◒	○	○	◒	×
	High Visibility Crosswalks	◒	○	○	●	○
	Angled Parking	●	◒	○	○	○
Level 2 Narrowing Measures						
	Neckdown/Bulbout	●	◒	○	●	○
	Center Island Narrowing/ Pedestrian Refuge	●	◒	◒	●	○
	Two-Lane Choker	●	◒	○	○	○
	One-Lane Choker	●	◒	○	○	○
Level 2 Horizontal Measures						
	Traffic Circle	●	◒	●	◒	○
	Roundabout (Single-Lane)	◒	◒	●	○	●
	Chicane	●	◒	○	○	○
	Lateral Shift	◒	◒	○	○	○
	Realigned Intersection	◒	◒	●	○	○
Level 2 Vertical Measures						
	Entry Feature	●	◒	○	◒	×
	Speed Hump	●	●	◒	◒	×
	Speed Lump	●	●	◒	◒	×
	Speed Cushion	●	●	◒	◒	×
	Split Speed Hump	●	●	◒	◒	×
	Speed Table	●	◒	◒	◒	×
	Raised Crosswalk	●	◒	◒	●	×
	Raised Intersection	●	◒	◒	●	×
Level 3 Diversion Measures						
	Full Closure	●	●	○	○	○
	Partial Closure	●	●	○	○	○
	Diagonal Diverter	●	●	○	○	○
	Median Barrier	○	●	◒	○	○
	Forced Turn Island	○	●	◒	○	○
Key:	● = Strongly Appropriate		× = Inappropriate/Counterproductive			
	◒ = Moderately Appropriate		○ = Indifferent			

Table 2
Applicability of Treatment by Location

Type of Measure		Residential		Non-Residential		Study Perimeter	Collectors*	Transit Route
		Mid-block	Intersection	Mid-block	Intersection			
Level 1 Non-Physical Measures								
	Targeted Speed Enforcement	●	●	●	●	●	●	●
	Radar Trailer	●	●	●	●	●	●	●
	Speed Feedback Sign	●	●	●	●	●	●	●
	Centerline/Edgeline Lane Striping	●	×	●	×	×	●	●
	Optical Speed Bars	●	×	●	×	×	●	●
	Signage	●	●	●	●	●	●	●
	Speed Legend	●	●	●	●	●	●	●
	Centerline Botts Dots	**On Curves**	×	●	×	×	●	●
	Textured Pavement	●	●	●	●	●	●	●
	High Visibility Crosswalks	●	**Unsignalized Intersections**	●	**Unsignalized Intersections**	**Unsignalized Intersections**	●	●
	Angled Parking	●	×	●	×	×	●	○
Level 2 Narrowing Measures								
	Neckdown/Bulbout	×	●	×	●	●	●	●
	Center Island Narrowing/ Pedestrian Refuge	●	●	●	●	●	●	●
	Two-Lane Choker	●	×	●	×	×	○	●
	One-Lane Choker	●	×	●	×	×	×	×
Level 2 Horizontal Measures								
	Traffic Circle	×	●	×	○	○	●	●
	Roundabout (Single-Lane)	×	○	×	●	○	●	●
	Chicane	●	×	●	×	×	●	●
	Lateral Shift	●	×	●	×	×	●	●
	Realigned Intersection	×	**Unsignalized Intersections**	×	**Unsignalized Intersections**	**Unsignalized Intersections**	●	●
Level 2 Vertical Measures								
	Entry Feature	×	○	×	○	●	○	○
	Speed Hump	●	×	×	×	×	×	×
	Speed Lump	●	×	○	×	●	○	●
	Speed Cushion	●	×	○	×	●	○	●
	Split Speed Hump	●	×	×	×	×	×	○
	Speed Table	●	×	○	×	×	●	○
	Raised Crosswalk	●	○	○	×	○	●	○
	Raised Intersection	×	●	×	●	●	●	○
Level 3 Diversion Measures								
	Full Closure	×	●	×	×	●	×	×
	Partial Closure	×	●	×	×	●	●	●
	Diagonal Diverter	×	●	×	×	×	×	×
	Median Barrier	×	○	×	×	●	×	×
	Forced Turn Island	×	○	×	●	●	○	○

Key: × = Never applicable. ○ = Seldom, except in some cases. ● = Generally applicable.
* Due to Emergency Response Concerns

6.1.3 Street Classification, Location and Other Constraints

The third step in determining the most appropriate device is to consider how each device is compatible with the street classification, traffic volumes, posted speeds, and special roadway users. Table 3 illustrates where each device is appropriate given the designated street type and roadway conditions.

Table 3
Applicability of Treatments by Location Type

<table>
<tr><th colspan="2" rowspan="2">Types of Measures</th><th colspan="4">Street Types</th><th rowspan="2">Bus or Emergency Response Route[2]</th></tr>
<tr><th>Minor Residential</th><th>Primary Residential</th><th>Collector</th><th>Non-Residential Collector</th></tr>
<tr><td colspan="7">Level 1 Non-Physical Measures[1]</td></tr>
<tr><td rowspan="10"></td><td>Targeted Speed Enforcement</td><td colspan="4" rowspan="8">No Limitations with respect to ADT or Speed</td><td rowspan="8">Yes</td></tr>
<tr><td>Radar Trailer</td></tr>
<tr><td>Speed Feedback Sign</td></tr>
<tr><td>Centerline/Edgeline Lane Striping</td></tr>
<tr><td>Optical Speed Bars</td></tr>
<tr><td>Signage</td></tr>
<tr><td>Speed Legend</td></tr>
<tr><td>Centerline Botts Dots</td></tr>
<tr><td>Textured Pavement</td><td>No</td><td>No</td><td colspan="2"></td><td rowspan="2">Yes</td></tr>
<tr><td>High Visibility Crosswalks</td><td colspan="4"></td></tr>
<tr><td>Angled Parking[3]</td><td colspan="4">ADT < 4,000; Width ≥ 48 feet; Speed Limit ≤ 30 mph</td><td>No</td></tr>
<tr><td colspan="7">Level 2 Narrowing Measures[1]</td></tr>
<tr><td rowspan="4"></td><td>Neckdown/Bulbout</td><td colspan="4" rowspan="3">ADT ≤ 20,000; Speed Limit ≤ 35</td><td rowspan="3">Yes</td></tr>
<tr><td>Center Island Narrowing</td></tr>
<tr><td>Two-Lane Choker</td></tr>
<tr><td>One-Lane Choker</td><td>ADT ≤ 3,000; Speed Limit ≤ 30</td><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td colspan="7">Level 2 Horizontal Measures[1]</td></tr>
<tr><td rowspan="5"></td><td>Traffic Circle</td><td colspan="3">Daily Entering Volume <10,000; Speed Limit ≤ 35 mph</td><td rowspan="2">Must be able to accommodate RT & Fire vehicles</td></tr>
<tr><td>Roundabout (Single-Lane)</td><td>No</td><td colspan="3">Daily Entering Volume <16,000; Speed Limit ≤ 45 mph</td></tr>
<tr><td>Chicane</td><td>No</td><td colspan="3">ADT ≤ 5,000; Speed Limit ≤ 35</td><td rowspan="3">Yes</td></tr>
<tr><td>Lateral Shift</td><td colspan="4">ADT ≤ 20,000; Speed Limit ≤ 35</td></tr>
<tr><td>Realigned Intersection</td><td colspan="4">Daily Entering Volume <5,000; Speed Limit ≤ 35 mph</td></tr>
<tr><td colspan="7">Notes:
1. Traffic calming devices are suitable for existing and new streets.
2. For Emergency Response Route contact Sacramento Metropolitan Fire District.
3. Angled parking is permitted on one side of the street with the opposite side retaining parallel parking.</td></tr>
</table>

Table 3 (continued)
Applicability of Treatments by Location Type

Types of Measures		Street Types				Bus or Emergency Response Route[2]
		Minor Residential	Primary Residential	Collector	Non-Residential Collector	
Level 2 Vertical Measures[1]						
	Entry Feature	ADT<3,000; Speed Limit ≤ 30mph				Yes
	Speed Hump			No	No	No
	Speed Lump					Yes
	Speed Cushion					
	Split Speed Hump			No	No	
	Speed Table	No	ADT<7,500: Speed Limit ≤ 35 mph			
	Raised Crosswalk	No				
	Raised Intersection	No				
Level 3 Diversion Measures[3]						
	Full Closure	Proper evaluation should be conducted to determine amount of diverted traffic to alternate routes.		No	No	No
	Partial Closure					RT & Fire must review
	Diagonal Diverter	No				No
	Median Barrier					
	Forced Turn Island					

Notes:
1. Traffic calming devices are suitable for existing and new streets.
2. For Emergency Response Route contact Sacramento Metropolitan Fire District.
3. Only if other measures fail to meet desired outcome. Not to be used on new streets.

6.2 EFFECTIVENESS COMPARISON

When more than one traffic calming device is available, it is helpful to understand the levels of effectiveness for each device to better determine which device will have the greatest effect in meeting the specified objective (s). Table 4 summarizes the effectiveness data that has been compiled for each of the traffic calming measures in the toolbox. These data are averages and the actual effectiveness will vary based on site-specific circumstances, such as proximity to major roads and the availability of alternate routes. For devices with no data or limited data samples, the effectiveness is not listed. This factor may be a deciding factor when between two devices.

Table 4
Quantitative Impacts of Traffic Calming Measures

Types of Measures		Effectiveness									
		85th Percentile Change				Vehicles Per Day		Average Annual Collisions			
		Before	After	Change	Percent Change	Change	Percent Change	Before	After	Change	Percent Change
Level 1 Non-Physical Measures											
		I/D				I/D		I/D			
Level 2 Narrowing Measures											
	Neckdown/Bulbout	34.9	32.3	-2.6	-7%	-293	-10%	I/D			
	Center Island Narrowing										
	Two-Lane Choker										
	One-Lane Choker	I/D			-14%	I/D	-20%				
Level 2 Horizontal Measures											
	Traffic Circle	34.2	30.3	-3.9	-11%	-293	-5%	2.19	0.64	-1.55	-71%
	Roundabout (Single-Lane)	Insignificant Speed Effects				Insignificant Volume Effects		Not Recorded			-15% to -33%
	Chicane	I/D				I/D		I/D			
	Lateral Shift										
	Realigned Intersection										
Level 2 Vertical Measures											
	Entry Feature	I/D				I/D		I/D			
	Speed Hump	35.0	27.4	-7.6	-22%	-355	-18%	2.62	2.29	-0.33	-13%
	Speed Lump	Comparable to speed hump but I/D									
	Speed Cushion[1]	Comparable to speed hump but I/D			-14%	Comparable to speed hump but I/D					
	Split Speed Hump	37	32	-5	-14%	Comparable to speed hump but I/D					
	Speed Table	36.7	30.1	-6.6	-18%	-415	-12%	6.71	3.66	-3.05	-45%
	Raised Crosswalk										
	Raised Intersection	34.6	34.3	-0.3	-1%	I/D		I/D			
Level 3 Diversion Measures											
	Full Closure	I/D	I/D	I/D	I/D	-671	-44%	I/D			
	Partial Closure	32.3	26.3	-6.0	-19%	-1,611	-42%	I/D			
	Diagonal Diverter	29.3	27.9	-1.4	-4%	-501	-35%	I/D			
	Median Barrier	I/D				I/D		I/D			
	Forced Turn Island										

Notes: I/D = Insufficient Data
Source: Traffic Calming State-of-the Practice (Ewing, 1999)
[1]City of Portland, Rubber Speed Bump Research, 1995

6.3 PLACING THE TRAFFIC CALMING MEASURES

Strategies for the specific placement of devices differ depending on whether the concern is speed-control, volume-control, or safety related. The placement of devices is described below.

6.3.1 Placing Level 2 Measures

Where feasible, traffic calming measures should be spaced in such a way that the following two design speeds are achieved:

- **Slow-Point 85th Percentile Design Speed:** the speed that exactly 85% of vehicles are going less than, when they are *crossing* a traffic calming device; the target slow-point speed is defined as 5 mph *below* the posted speed limit;

- **Midpoint 85th Percentile Design Speed:** the speed that exactly 85% of vehicles are going less than, when they are *halfway between* a traffic calming device or other roadway feature that requires significant slowing (i.e. stop sign or curve). The target midpoint speed is defined as 5 mph *above* the posted speed limit.

Figure 3 on the following page provides details how to estimate the midpoint speed.

The spacing of traffic calming measures directly affects the Midpoint speeds: the farther apart they are, the higher the Midpoint speed. In general, speed control measures placed 350 to 750 feet from another slow-point can result in speed reductions similar to those indicated in Table 4. Measures placed at intervals of less that 350 feet can become a nuisance to drivers and measures placed greater than 750 feet decrease the ability to slow speeds to the target midpoint speed. In addition, vertical measures should be placed a minimum of 250 feet from an adjacent intersection.

6.3.2 Placing Diversion Level 3 Diversion Measures

Traffic calming devices intended to control traffic volumes can be placed either at entrances to a neighborhood or internally to the neighborhood.

- ***Gateway Measures –*** Volume-control measures placed at entrances or gateways to the neighborhood can be more immediately effective in reducing volumes because all traffic is made aware even before entering the neighborhood that passing through is not a desirable option, causing them to choose to take other routes. However, these measures can also cause local traffic to take more circuitous paths than internal measures would.

- ***Internal Measures –*** When placed internal to a neighborhood, measures have a less direct effect on non-local traffic. First-time attempts to cross the neighborhood will occur more frequently, especially soon after the devices are constructed. However, this type of placement can cause less of an inconvenience to local traffic.

6.3.3 Placing Safety Measures

The placement of safety-oriented traffic calming devices is dependent on the particulars of the traffic related concern and of the characteristics of the selected traffic calming device. For example, if the traffic related concern involves pedestrian safety, then the solution—a raised crosswalk, for example—should be placed at a location where it is likely to be heavily used by pedestrians.

Figure 3
Estimating Midpoint Speeds

In mathematical terms, the relationship between midpoint speed and spacing of slow points is given by an exponential function:

$$85^{th}_{\text{midpoint (mph)}} = 85^{th}_{\text{slow point (mph)}} + (85^{th}_{\text{street (mph)}} - 85^{th}_{\text{slow point (mph)}}) * 0.56 * (1 - e^{-0.004 * \text{spacing (ft.)}})$$

where,

$85^{th}_{\text{midpoint}}$ = resulting 85^{th} percentile speed at midpoint after treatment;
$85^{th}_{\text{slow point}}$ = estimated 85^{th} percentile speed at the slow point after treatment;
85^{th}_{street} = 85^{th} percentile speed of street before treatment;
spacing = distance in feet between two devices.

When placing speed-control measures, the above formula should be used to test proposed spacing to determine whether the estimated midpoint speeds would be meet the targeted midpoint speed.

Example (speed humps on street with starting speed of 32 mph):

Where spacing is 350 feet:

$$85^{th}_{\text{midpoint (mph)}} = 15 \text{ mph} + ((32 \text{ mph} - 15 \text{ mph}) * 0.56 * (1 - e^{-0.004 * 350 \text{ feet}}))$$

$$85^{th}_{\text{midpoint (mph)}} = \underline{22 \text{ mph}}$$

Where spacing is 750 feet:

$$85^{th}_{\text{midpoint (mph)}} = 15 \text{ mph} + ((32 \text{ mph} - 15 \text{ mph}) * 0.56 * (1 - e^{-0.004 * 750 \text{ feet}}))$$

$$85^{th}_{\text{midpoint (mph)}} = \underline{24 \text{ mph}}$$

7. PLANNING PROCESS FOR NEW NEIGHBORHOODS

New neighborhoods and new development in the planning stage can benefit from traffic calming. Traffic problems can often be anticipated and prevented by reviewing street and lot plans for a neighborhood and prescribing refinements to the plan or identifying traffic calming measures that can be constructed concurrent with street construction. This section provides the concepts and proposed design standards to avoid the need for traffic claming in the future.

7.1 DEVELOPMENT REVIEW PROCESS

As part of the City's development review process, City staff may consider whether proposed developments would generate impacts that could ultimately require traffic calming measures. This may include impacts within the proposed development site, or off-site impacts (such as traffic that would travel to and from the proposed development).

New development and redevelopment projects may be conditioned to design, build and maintain traffic calming features as part of the development project through the subdivision improvement agreement, development agreement, homeowners' association and other development-related mechanisms. Recommended development review practices are described later in this section.

7.2 RELEVANT CITY POLICIES

This section will be updated as relevant neighborhood traffic policies, standard designs, etc. are developed and/or updated.

7.3 STREET DESIGN CONCEPTS

Traffic calming measures have traditionally been installed as retrofit measures in existing neighborhoods, in response to a particular traffic problem or concern. This section discusses residential street design concepts to reduce the likelihood of future traffic problems arising that would require costly retrofits. Section 7.4 expands on these concepts and presents the proposed street design standards for two-lane residential and non-residential streets.

7.3.1 Designing for Appropriate Speeds

The following paragraph from *Residential Streets* (ASCE/NAHB/ULI, 1990) provides a useful summary of the task of designing residential streets to minimize speeding problems:

> "The selection of appropriate pavement widths must account for probable peak traffic volume, parking needs and controls, likely vehicle speeds, and limitations imposed by sight distances, climate, terrain, and maintenance requirements. Designers should select the *minimum* width that will reasonably satisfy all realistic needs, thereby minimizing construction and average annual maintenance costs. The tendency of many communities to equate wider streets with better streets and to design traffic and parking lanes as though the street were a "microfreeway" is a highly questionable practice. Certainly the provision of 11- or 12-foot clear traffic lanes is an open invitation to increased traffic speeds."

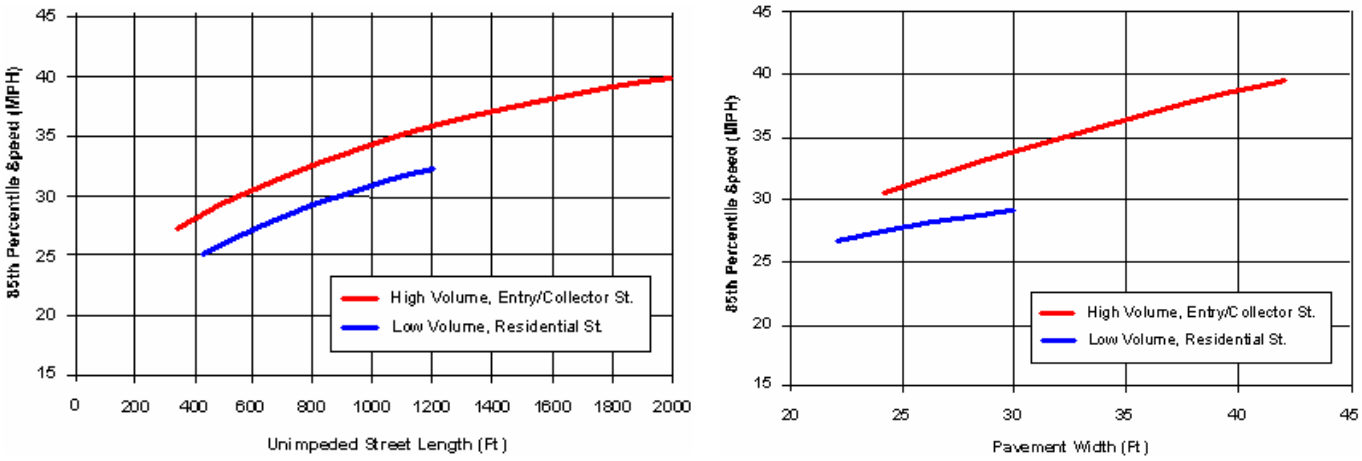
Residential Streets goes on to recommend pavement widths for access streets, subcollectors, and collector streets. In addition to wide streets, long, straight, and uninterrupted stretches of residential roadways can also induce drivers to accelerate to unsafe speeds, increasing noise and risk of collisions with pedestrians and other vehicles. It is important to understand that the lanes widths discussed in *Residential Streets* apply only to residential type streets and do not include provisions for on-street parking. The following attributes should be considered when designing residential streets.

- ***Travel Lane Width –*** Travel lanes are often designed with excessive widths. To minimize drivers' propensity to speed, residential travel lanes on local streets should be designed to be no more than 10 feet wide. If excess width is provided in anticipation of a future need for traffic capacity, then in the short-term this width could be occupied by appropriately spaced chokers or other traffic calming measures. To determine the actual street width, add the appropriate dimensions for on-street parking and curb and gutter.

- ***Parking Lanes –*** Excessive width is sometimes provided for on-street parking in places where adjacent land uses generate little parking demand, leaving long gaps of unused space adjacent to the travel lane. This can often be the case along residential collector streets with few front-on houses. If parking demand can be accommodated elsewhere, the parking lanes should be eliminated and the street width reduced accordingly.

- ***Block Length –*** Some street networks leave excessively long blocks without interrupting intersections. Drivers that travel a long distance (600 feet or greater) without being required to slow or stop by traffic control or traffic calming devices tend to travel at speeds higher than the limit. To minimize this effect, the street network can be designed such that street blocks are interrupted by streets of sufficient traffic volumes to warrant a traffic control device (e.g. a traffic circle or stop sign) on the street of concern. Shorter block lengths also facilitate pedestrian movement throughout the neighborhood.

Correlation Between Width, Unimpeded Block Length and Speed



7.3.2 Designing for Local Traffic

If designed improperly, 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 interrupt the parallel collector route sufficiently that the travel time by collector is greater than the travel time by arterial.

7.3.3 Pedestrian and Bicycle Amenities

Pedestrian and bicycle amenities can be facilitated through the creation of shorter blocks, enhanced crossing, and increased connectivity within neighborhoods. Pedestrian safety can be enhanced through reduced travel speeds, detached sidewalks, and specific traffic calming design elements such as bulbouts and center median islands.

Similarly, recreational and commuter bicyclists can benefit from such design elements in addition to separate bicycle paths (Class I bicycle path), which can also accommodate pedestrian travel. These facilities are usually 10 – 12 feet wide (minimum 8 feet) and are commonly placed adjacent to underutilized land uses or open space. American Association of State Highway and Transportation Officials (AASHTO) guidelines recommend that sidewalk bicycle paths be limited to high-speed or heavily traveled roadways having inadequate space for bicyclists and uninterrupted by driveways and intersections for long distances. Caltrans standards for placement of a “Class I” bicycle path along a roadway require a raised barrier or at least five feet of separation between the path and roadway.

The proposed street design standards require wider sidewalks to accommodate bicycle travel along new collector streets. Special concerns may arise on streets with frequent intersections or driveways, or high volumes of pedestrians. Special design treatments would be recommended at intersections because motorists are often not accustomed to bicyclists traveling through crosswalks and bicyclists are often less visible to motorists when traveling on an off-street path. Bicycle lanes may be required on arterial roadways in lieu of sidewalk bicycle paths at the discretion of the Public Works Director.

Additional design elements that would not be required but are included within the NTMP should be considered on a case-by-case basis to benefit pedestrians and bicyclists.

7.3.4 Pedestrian/Vehicle Conflict Areas

Some elements of residential areas, such as schools and parks, have particularly high potential for vehicle and pedestrian conflicts because of the pedestrian activity they generate. 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. For both schools and parks, entrances tend to focus on 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 speeding or high traffic volumes are unavoidable, then traffic calming measures should be selected that incorporate pedestrian accommodations. For example, at an intersection, bulbouts or center island narrowings should be given some preference over other measures, such as intersection realignment. Midblock locations can benefit from such treatments as chokers or chicanes.

7.4 PROPOSED STREET DESIGN GUIDELINES

The proposed street design guidelines are based on the design concepts and principles discussed above and in *Residential Streets.* The proposed street design guidelines are intended to accomplish the following:

- Improve the function and appearance of new streets
- Encourage pedestrian and bicycle travel
- Reduce the potential for speeding and other traffic-related concerns associated with wider streets, which frequently results in requests for "traffic calming" measures in existing neighborhoods

7.4.1 What Other Cities are Doing

Many cities have revised their street design standards in recent years to include many of the design concepts discussed on the preceding pages.

Sacramento

The City of Sacramento updated it streets design standards in 1998. The update was in response to a consistent message from residents that previous standards did not result in livable neighborhoods, protests from the development community that the previous standards were too rigid, and City staff's desire to improve the clarity of the design standards.

Many neighborhood groups had complained that residential traffic volumes and speeds had contributed to a decline in quality-of-life. In response, the City initiated an aggressive program of traffic calming to reduce travel speeds on existing streets with identified problems. However, the City recognized that this program required substantial resources and could only address the existing street system.

The development of new street standards arose from a desire to improve the design of streets at the outset. Additionally, it was felt by many that the "best" streets in Sacramento included elements such as detached sidewalks and landscaped medians that were no longer allowed in the standards.

In developing the new standards, City staff adopted certain guidelines for the development of the new street standards, with regard to right-of-way width, width of parking spaces, sidewalk design, Fire Code requirements and tree planter specifications. Some trade-offs were necessary; for example, may residents and developers wanted narrower streets while the fire department wanted wider streets. Residents wanted vertical curbs while developers wanted rolled curbs. Others advocated for wider landscaped strips and bicycle lanes, while developers desired to limit the width of the overall right-of-way.

Following the development of draft standards and a public participation process, the City of Sacramento developed new standards that included:

- The minimum width of local residential streets was reduced from 36 feet to 30 feet
- Flexibility in the design of new streets was introduced by providing options. For example, sidewalk and planter strips were designated as minimums and can be increased at the request of the developer
- For collector streets, landscaped medians are required if the projected traffic volume exceeds a specific threshold
- Parking will be included based on the adjacent land use and requires an additional 7 feet per direction
- Bicycle lanes are required on arterial streets
- Planter strips are required on all streets, with minimum widths designated that can be increased by the developer

- Traffic calming devices such as bulbouts or traffic circles are encouraged to enhance the pedestrian environment

Eugene, Oregon

The City of Eugene adopted a Local Street Plan in 1996 that responded to desires for narrower streets, shorter blocks, greater street connectivity and a desire for the reintroduction of elements such as planter strips, detached sidewalks and alleys, commonly found in older neighborhoods, into new subdivisions.

The new street standards included a reduction in the maximum block length for a residential street from 1,200 feet to 600 feet. The new standard was based on the existing grid pattern found in Eugene's older neighborhoods, which contained blocks measuring 400 feet by 600 feet.

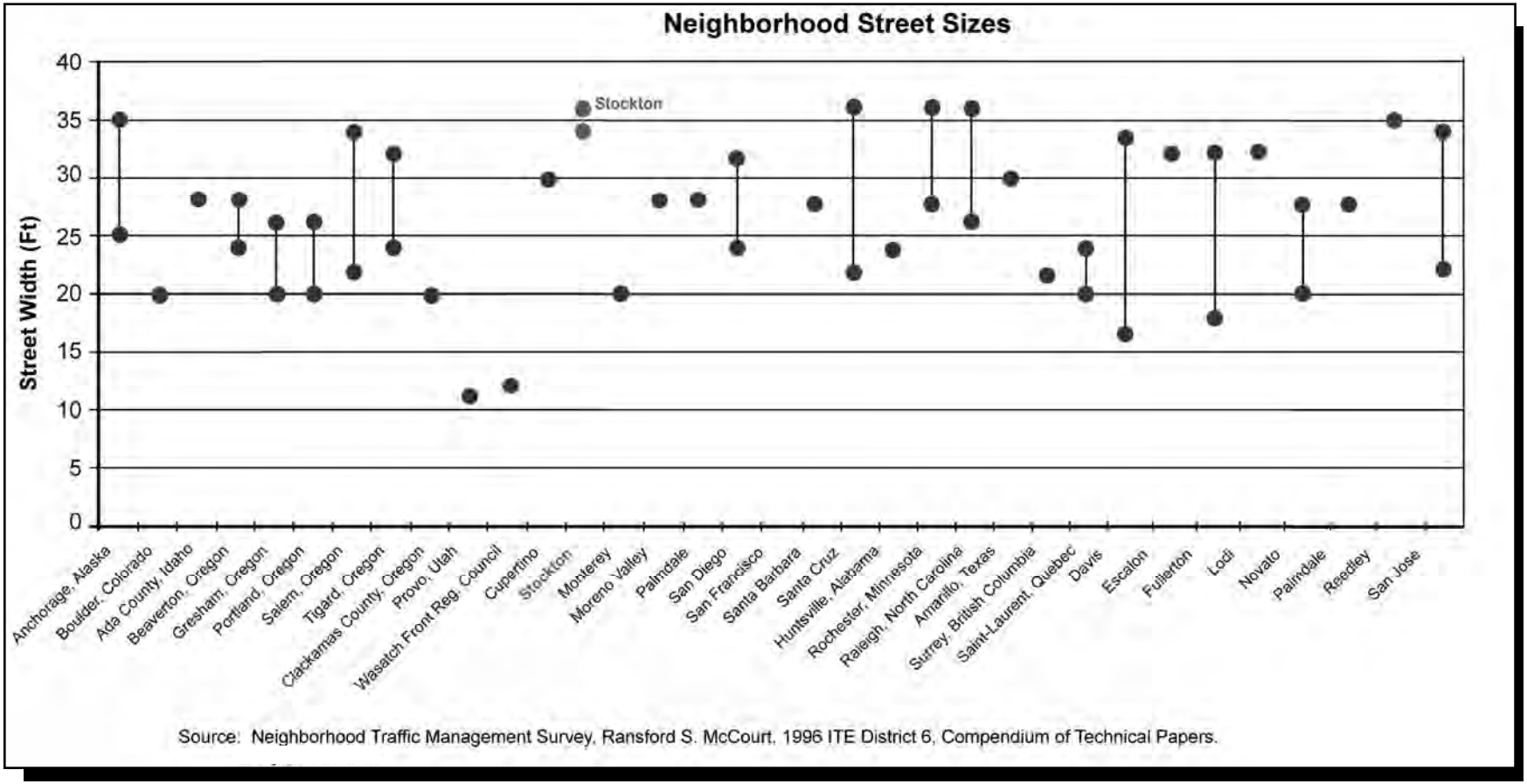
Other key elements of the new standards for local streets included:

- A range of local street classifications, based on expected traffic volume that included minimum widths varying from 21 feet for an "access lane", carrying less than 250 average daily traffic (ADT), to 34 feet for a medium-volume residential street carrying up to 750 ADT. Residential alleys were permitted with a width of 12 feet for one-way traffic or 16 feet for two-way traffic

- Local commercial and industrial streets would have a width of 30 to 44 feet

- Street connectivity was required and cul-de-sacs were discouraged unless necessitated by topographic or other physical barriers; if cul-de-sacs were necessary, then bicycle and pedestrian connections were required, wherever possible, to connect the ends of cul-de-sacs

The chart on the following page summarizes other jurisdictions residential street width.


Neighborhood Street Sizes
Street Width (Ft)
40
35
30
25
20
15
10
5
0
Stockton
Anchorage, Alaska
Boulder, Colorado
Ada County, Idaho
Beaverton, Oregon
Gresham, Oregon
Portland, Oregon
Salem, Oregon
Tigard, Oregon
Clackamas County, Oregon
Provo, Utah
Wasatch Front Reg. Council
Cupertino
Stockton
Monterey
Moreno Valley
Palmdale
San Diego
San Francisco
Santa Barbara
Santa Cruz
Huntsville, Alabama
Rochester, Minnesota
Raleigh, North Carolina
Amarillo, Texas
Surrey, British Columbia
Saint-Laurent, Quebec
Davis
Escalon
Fullerton
Lodi
Novato
Palmdale
Reedley
San Jose
Source: Neighborhood Traffic Management Survey, Ransford S. McCourt, 1996 ITE District 6, Compendium of Technical Papers.

7.4.2 Street Design Guidelines

The proposed street design guidelines will accomplish the goals of 7.4 through the following actions:

- Reduced roadway widths
- Set limitations on maximum block length
- Introduce landscaped strips between the curb and sidewalk
- Create wider sidewalks to accommodate bicyclists

Table 5 below summarizes the proposed street design guidelines.

Table 5
Proposed Street Design Guidelines

Item	Local				Collector	
	Low-Volume Residential	**Medium-Volume Residential**	**Commercial**	**Industrial**	**Residential (Back-up)***	**Non-Residential**
Average Daily Traffic	0 - 750	750 – 1,500	<5,000	<5,000	1,500 – 3,000	<13,000
Street Characteristics						
Number of Travel Lanes	2	2	2	2	2	2
Travel Lane Width (feet)	9-10	9-10	10-11	12	13	11
Parking Lane Width (feet)	7	7	7	8	None	8
Width (feet)	30	32	34	40	28-30	48
Left-turn lane Width (feet)	None	None	None	None	None	10
Raised Median (feet)	None	None	None	None	None	None
Block Length (feet)	600	800	800	800	1,000	1,000
Sidewalk Width (feet)	4	4	4 (detached) / 4.5 (attached)		8 (min.)	8 (min.)
Sidewalk Bike Path (feet)	No	No	No	No	Yes	Yes
Detached Sidewalk	Yes	Yes	Optional	Optional	Yes	Yes
Landscape Strip Width (feet)	6	6	6 (detached) / 5.5 (attached)		Including Sidewalk	
Note: * Homes do not face onto or have driveways on to street						

7.5 RECOMMENDED DEVELOPMENT REVIEW PRACTICES

As part of the City's development review process, City staff may consider the need for traffic calming measures in and adjacent to proposed developments. Where appropriate, developers should be encouraged to incorporate traffic calming measures into their development plan before submitting their application to the City. The process for reviewing street and lot plans for new developments and prescribing refinements may include the following, at the discretion of City staff:

- **Traffic Volumes:** Project average daily traffic (ADT) on adjacent internal roadways surrounding the proposed project. If traffic is projected to be less than 1,500 with the proposed development, street livability may not be affected, and traffic calming measures based on traffic volumes unnecessary. For projected volumes of above 1,500 vpd, traffic calming measures may be considered. In addition, driveway treatments that do not require vehicles to back out of driveways, such as loop driveways may also be considered.

- **Traffic Speeds:** Identify potential speeding concerns on new streets and adjacent existing streets. Potential problem areas may include:

  Where there is a distance of greater than 600 feet between traffic control or traffic calming devices, or as determined by City staff

  Where roadway grades may increase the potential for speeding, as determined by City staff

  Potential pedestrian/vehicle conflict areas such as nearby schools and parks

  Design speed attributes that encourage speeding, such as travel lane width, parking lanes, and block lengths

- **Street Layout:** Street design and layout modifications may be proposed by the City if an area is likely to experience cut-through traffic.

- **Nearby Neighborhoods:** Where traffic calming measures have been implemented in nearby neighborhoods, consideration may be given to their inclusion in new developments, as determined by City staff.

- **Traffic Calming Plan:** Based on the size and nature of the proposed development, the City will determine if a traffic calming plan is necessary. As described above, a traffic calming plan should be developed when the proposed street layout cannot be modified in such a way that will eliminate all potential traffic problems.

7.5.1 Developing a Traffic Calming Plan for New Development

When a proposed street layout cannot be modified in such a way that will eliminate all potential traffic problems, a traffic calming plan should be developed.

- For potential volume-related problems, traffic volume data will only be available in the form of traffic forecasts, and these will typically be limited to the major roads. Some manual traffic volume estimates may be required using land use quantities and trip generation rates for the proposed development.

- For speed-related problems, existing travel speed data will not be available. Consequently, a response to anticipated speeding problems would need to rely on roadway geometry. For example, if a block length is greater than 600 feet, then traffic calming measures could be used to break up the block into segments that are each shorter than 600 feet.

- Anticipated safety problems will likely revolve around land uses that generate pedestrian activity, such as schools, parks, and community centers. The placement of traffic calming devices that include pedestrian crossings should take into consideration the planned locations of walkways, gates, and building entrances for these land uses.

- For some traffic calming measures, particularly those involving modified roadway curbs, significant cost-savings can be achieved by constructing them concurrent with roadway construction. Consequently, when selecting a type of traffic calming measure, some additional preference should be given to measures that take advantage of these cost-savings.

APPENDIX A – TOOLBOX DESIGN GUIDELINES

This section identifies various physical design considerations and constraints associated with the traffic calming measures discussed in the Toolbox. Engineering designs for the standard traffic calming measures in NTMP toolbox are contained in Appendix D. These designs were developed based on recommended designs published in *Traffic Calming State-of-the Practice*[2], *Canadian Guide to Traffic Calming*[3], and conform to the following considerations expressed by the Technical Advisory Committee (TAC).

EMERGENCY RESPONSE ROUTES

Traffic calming measures have been developed to better respond to emergency response concerns. Such measures have become common tools in many agencies toolboxes, such as the speed lump and split speed hump. The City recognizes every situation is different, such variations on the standard traffic calming devices may be appropriate in many cases. The NTMP promotes the consideration of existing measures and the exploration of new measures through continuous dialogue between the City Staff, Sacramento Metropolitan Fire District, and community members. The development of official "Emergency Response Routes" may aid City staff and NTC members in selecting devices that would least likely impact emergency response times.

SPEED CONTROL - 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 humps) should use *parabolic* profiles on the approach and departure ramps to the device on roadways without designated on-street bicycle facilities. For streets with designated on-street bicycle facilities, *sinusoidal* profiles should be used to better accommodate bicyclists. 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 2 shows three commonly used profiles and a description of each follows below.

---

[2] Ewing, R. (1999). *Traffic Calming: State of the Practice*. Washington, DC: Institute of Transportation Engineers/Federal Highway Administration

[3] *Canadian Guide to Neighbourhood Traffic Calming,* (1998) Ottawa, Canada: Transportation Association of Canada.

- *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 has 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.

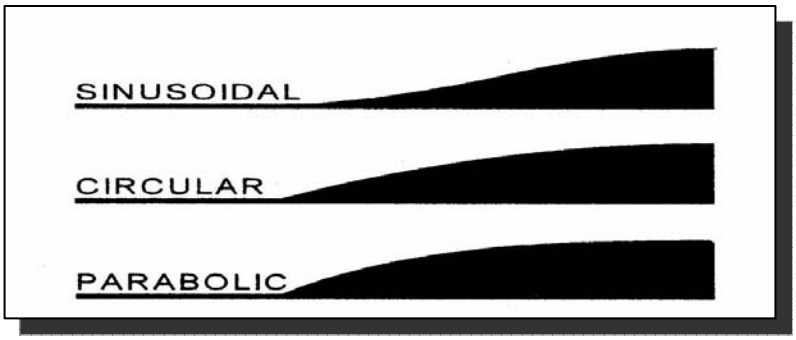


Figure 2 Vertical Measure Ramp Profiles

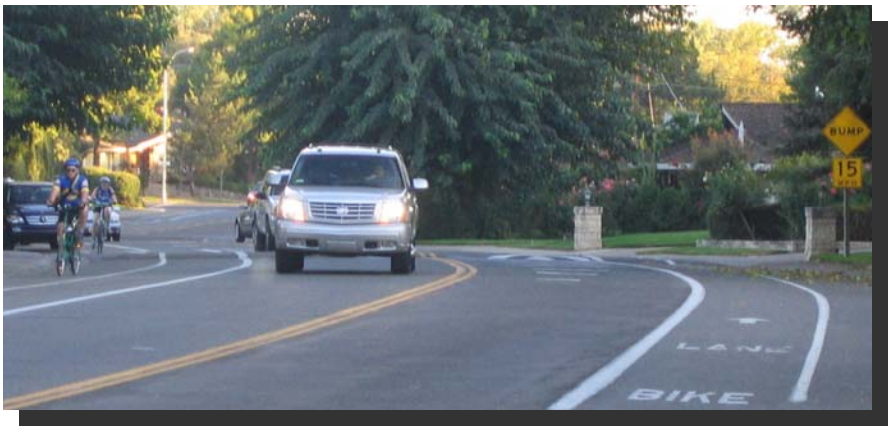
Edge Tapers

The 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 humps 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) can be placed on either end 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 plat to indicate the entrance to the crosswalk from the sidewalk. Raised crosswalks are not appropriate where curbs do not exist.

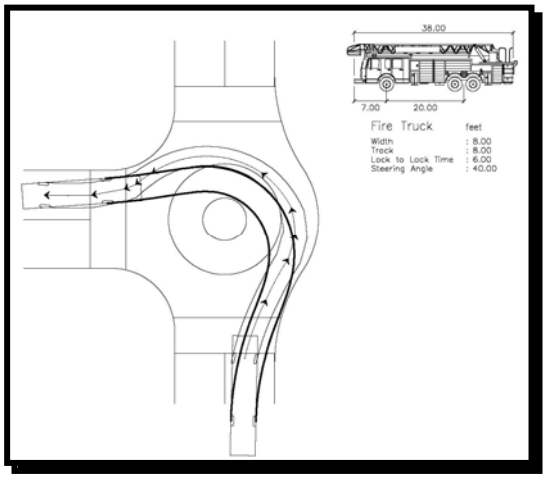
HORIZONTAL DEFLECTION MEASURES

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 trucks and buses in some cases if geometric constraints require it. If a specific intersection has a high proportion of trucks and/or bus traffic, alternative treatments may provide similar results without the impact to trucks or busses. All traffic circles should be designed using Autocad/AutoTurn softwares 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 neighborhood. 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 neighborhood 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).

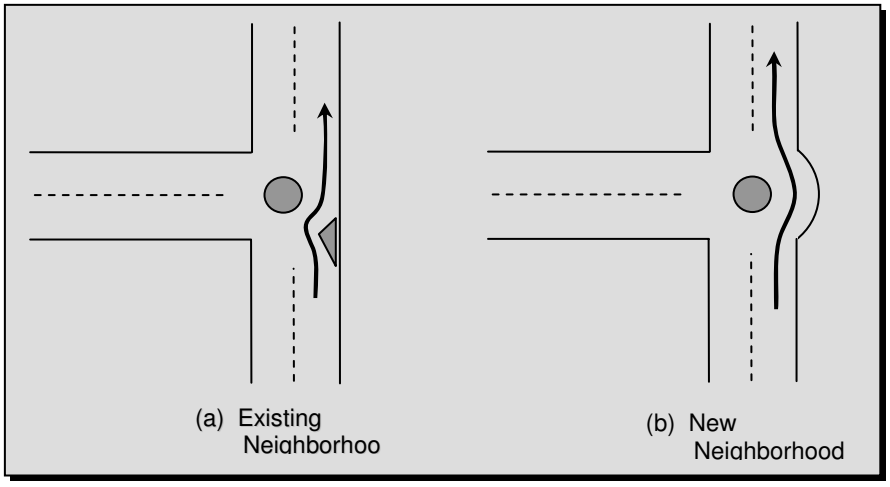


Figure 2. Traffic circles at T-Intersections

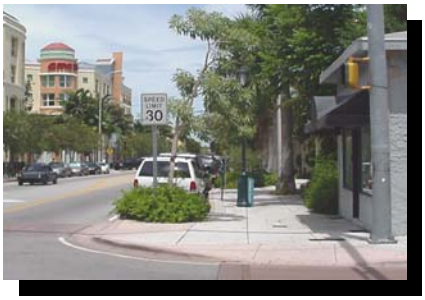
NARROWING MEASURES

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.

Neckdowns/Bulbouts

Narrowing measures, such as neckdown 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 could present potential safety issues to other drivers.



LANDSCAPING

The standard treatment for all traffic calming devices will be hardscape (i.e. grouted cobblestone). Residents will have the option to fund upgraded aesthetic features of traffic calming devices such as landscaping or stamped and colored concrete (i.e. simulated brick work). Aesthetics upgrades not only improve the aesthetic quality of the device but 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 & MARKING

Concurrent with the installation of traffic calming devices, device-specific symbol-based signs will be installed (see Appendix B Figure B-20) adjacent to each device. Traffic circle center islands will include signage symbolically indicating the permitted travel paths around the center island (see Appendix B Figure B-12).

Vertical traffic calming measures shall include advanced warning markings on the approach ramps (see Appendix B Figure B-1). 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 environments.

Special signing for bicyclists can be provided at the discretion of City 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 are a unique traffic control device that may be useful in a variety of situations. They are often used in lieu of all-way stop control or traffic signals as a means of increasing the capacity of the intersection and improving its safety. However, roundabouts require a considerably more rigorous design process than the other traffic calming devices in the toolbox. Because of their complex design features, no generic design is included in this document. However, 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 is presented here. *Roundabouts: An Information Guide*[4] provides reference on the design of roundabouts. Also, the following examples illustrate cases where a roundabout may be appropriate:

[4] Robinson, B.W. et al (2000). *Roundabouts: An Informational Guide.* Washington, DC Federal Highway Administration

- ***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 Control –*** 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.

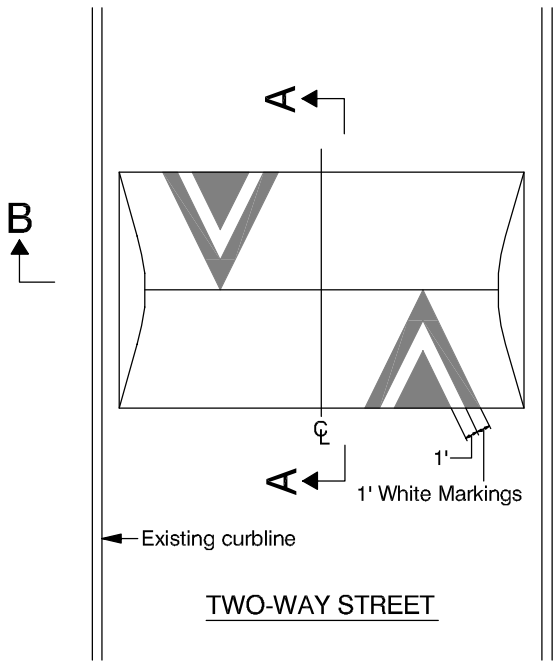
- ***Abundant Right-of-Way –*** Finally, an intersection that already includes abundant right-of-way may be a good candidate for a roundabout simply because the operations and safety improvements would then outweigh the minimal costs of acquiring additional right-of-way and expanding the intersection.

COMBINED MEASURES

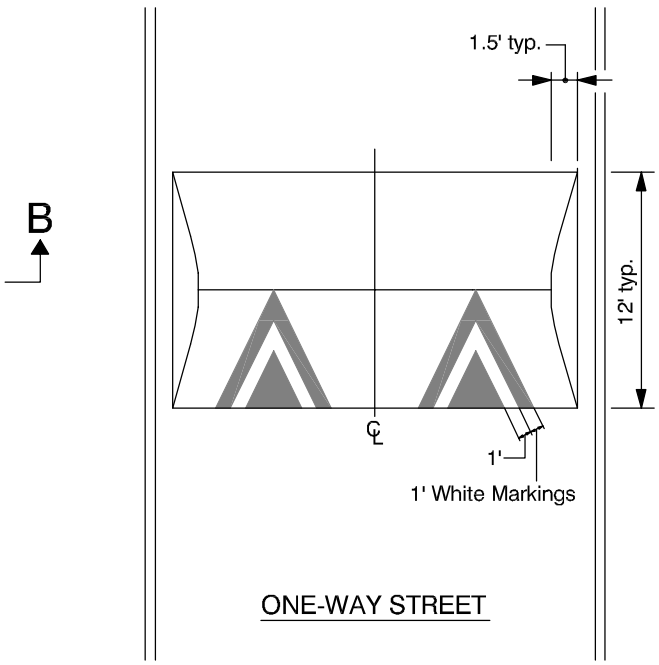
Some measures from the toolbox can be combined to increase the combined effect on traffic volumes and speeds. For example, a raised crosswalk may be combined with neckdowns, the effect being a crosswalk that is both shortened and raised above the level of the roadway. Motorists must then react to both a vertical deflection and a narrowing. In assessing the suitability of a proposed combined measure, the guidelines in Tables 1, 2, and 3 for both of the component devices should be applied.

APPENDIX B – STANDARD TRAFFIC CALMING DEVICE DESIGNS

Standard traffic calming device designs are provided for the following measures. Measures that do not have standard designs should be designed according to each situation specific to the roadway and traffic conditions.

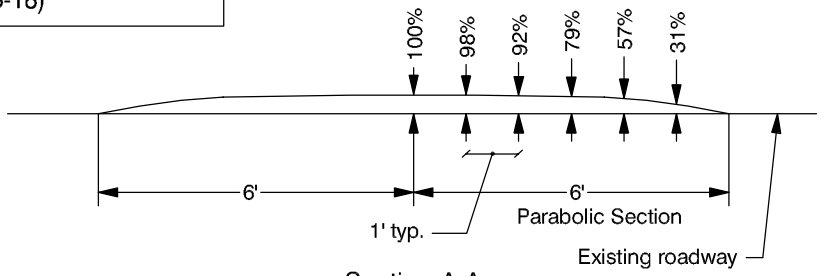


TWO-WAY STREET

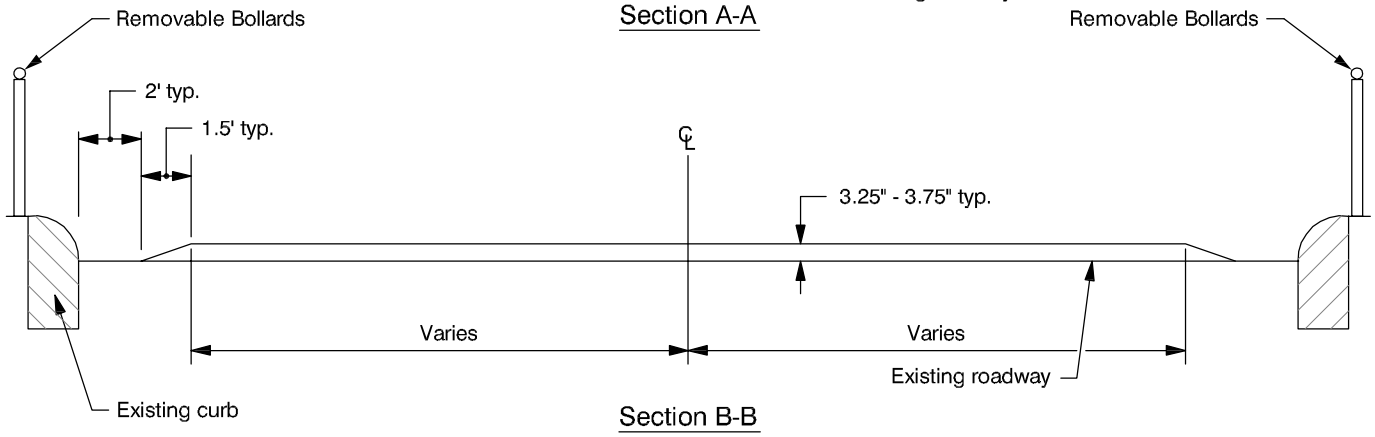


ONE-WAY STREET

Install speed hump warning signs (see Figure B-18)



Section A-A



Section B-B

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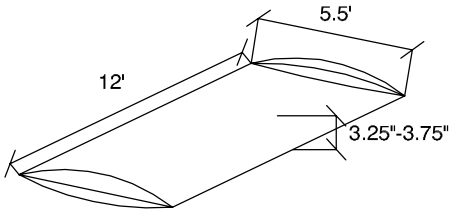
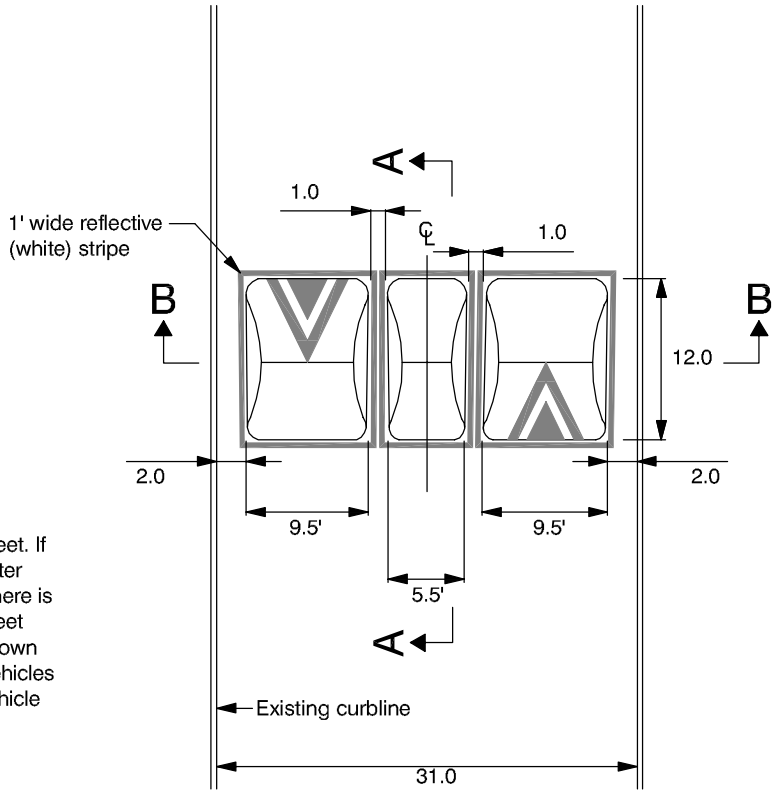
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-1_speed_hump.dwg

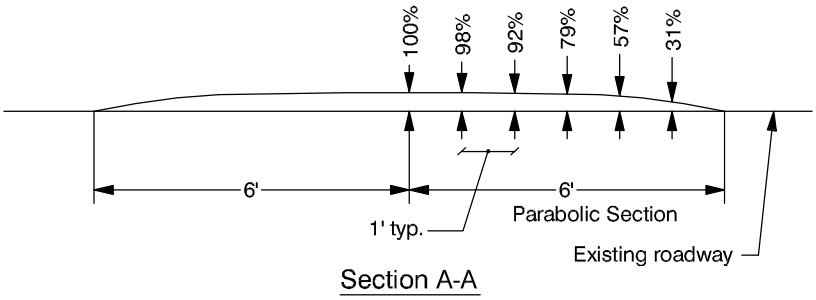
SPEED HUMP

FIGURE B-1

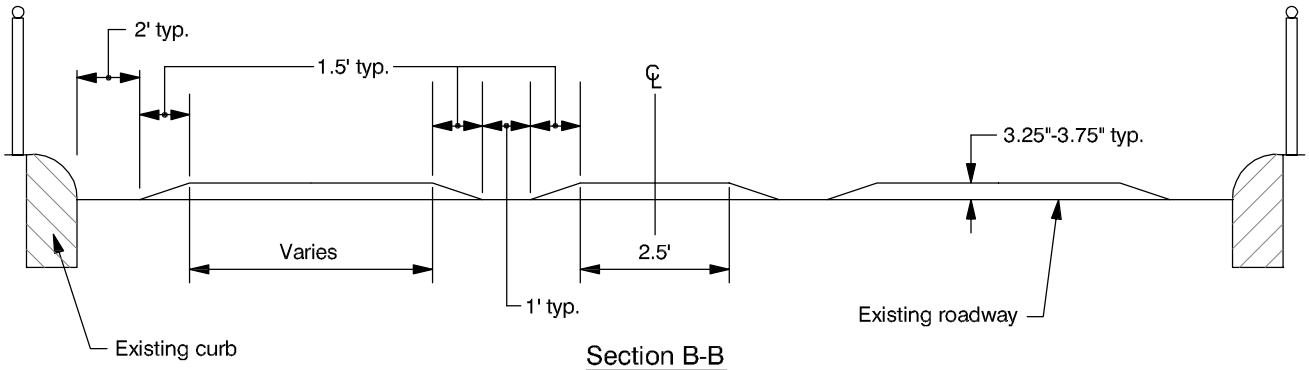




The speed-lump drawing shown is for a 31-foot wide street. If a street is wider, another lump may be added. Each center lump (only one shown) is 12 feet deep, 5 ½ feet wide, there is 1 foot between outer lumps and the center lump with 2 feet from curb to drainage. This would require cars to slow down substantially in order to pass. It may be necessary for vehicles to pull to the right and allow an opposing emergency vehicle to pass.



Section A-A



Section B-B

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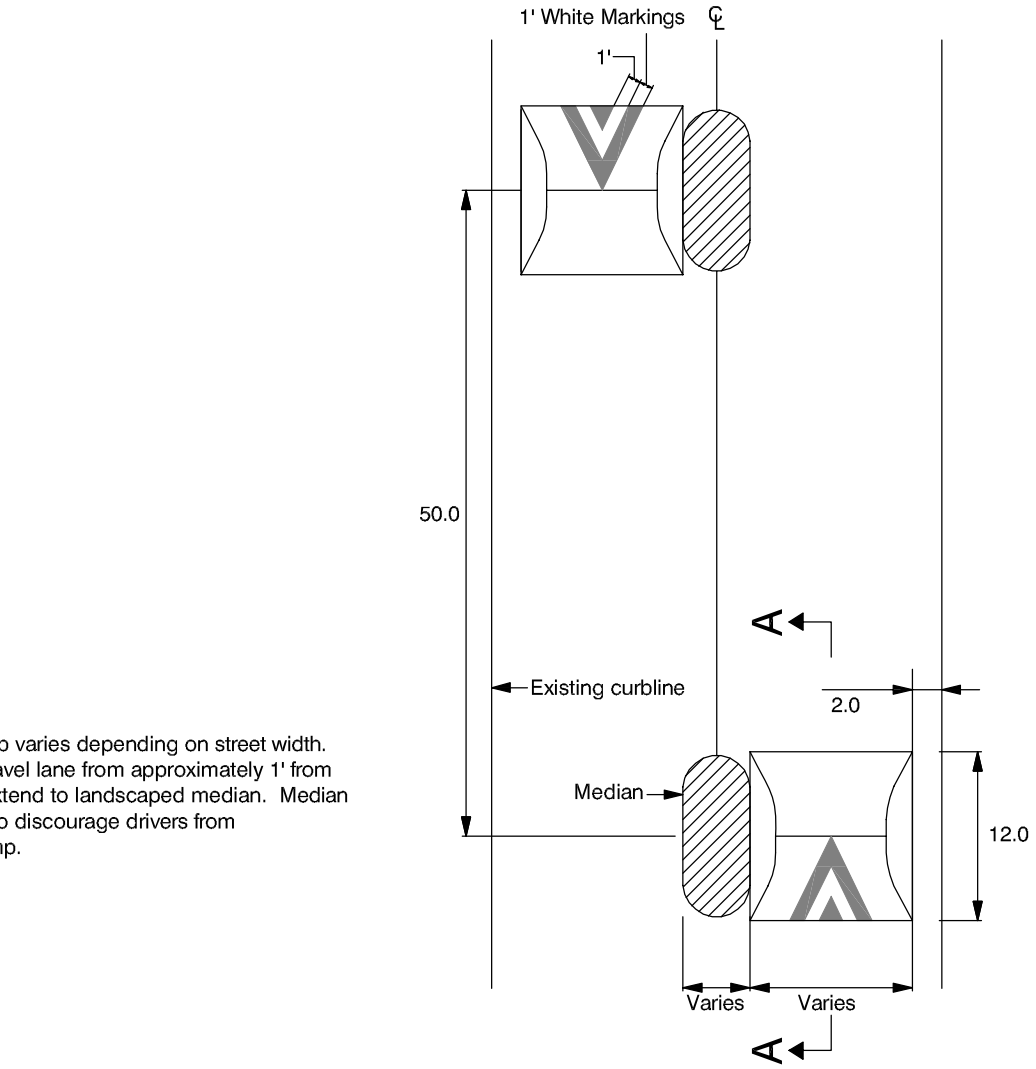
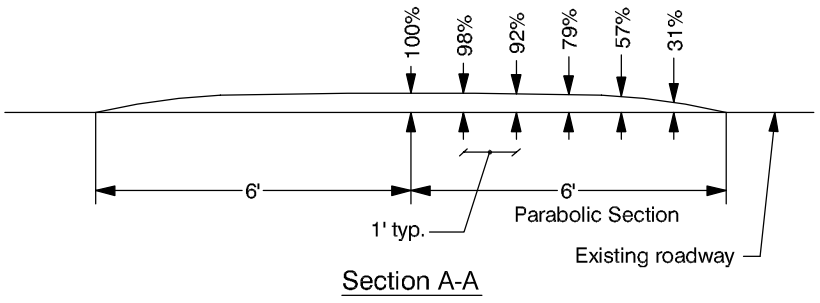
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-2_speed_lump.dwg

SPEED LUMP OR SPEED CUSHION

FIGURE B-2



Width of split speed hump varies depending on street width. Humps should occupy travel lane from approximately 1' from curb and drainage and extend to landscaped median. Median should be wide enough to discourage drivers from maneuvering around hump.



Section A-A

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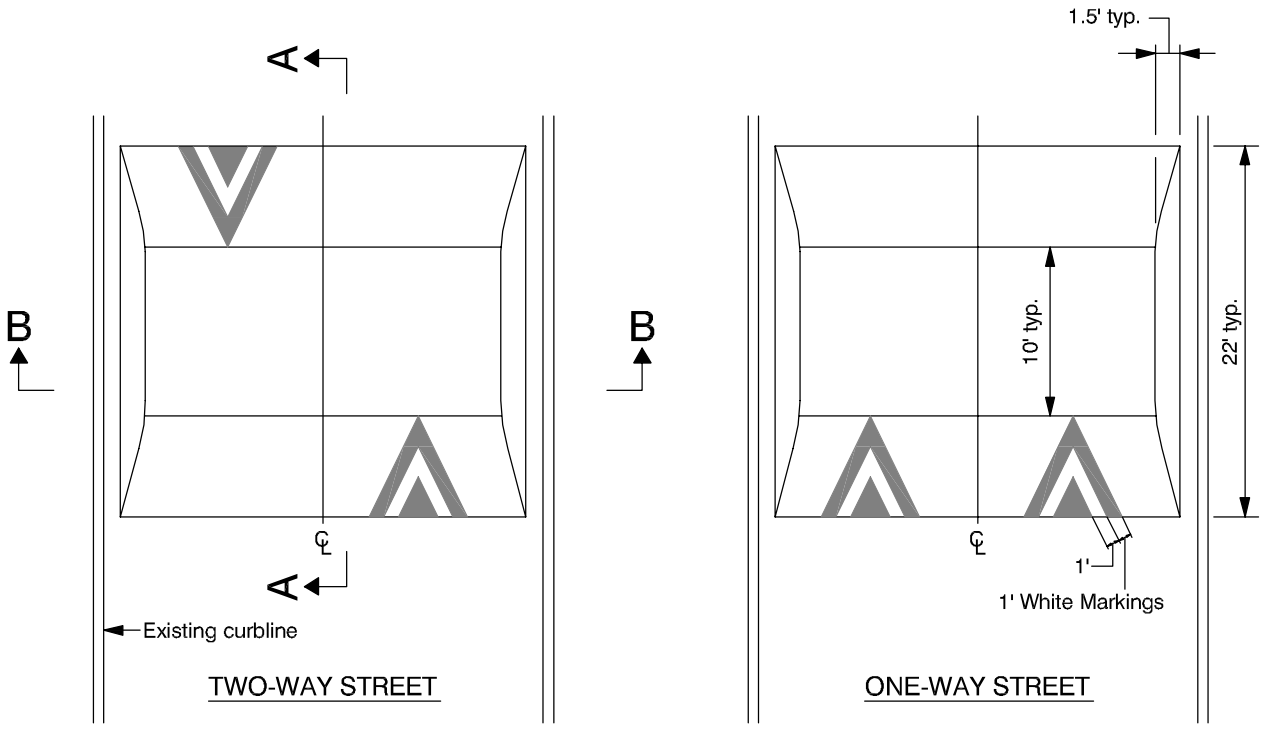
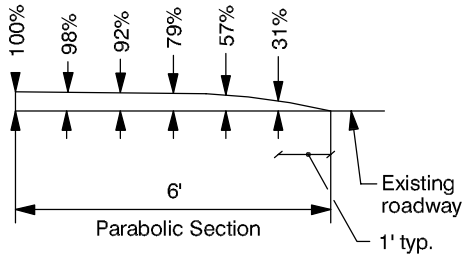
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-3_split_speed_hump.dwg

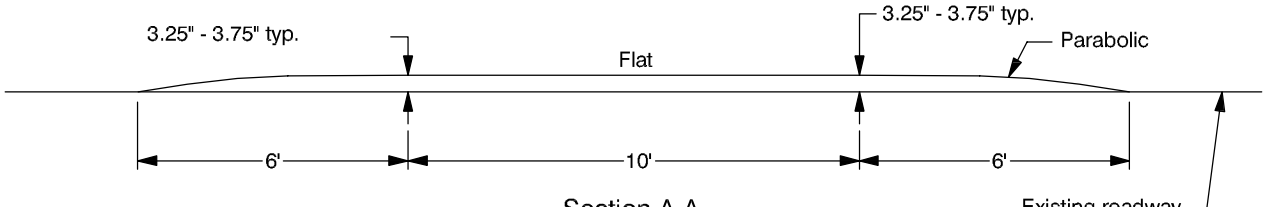
SPLIT SPEED HUMP

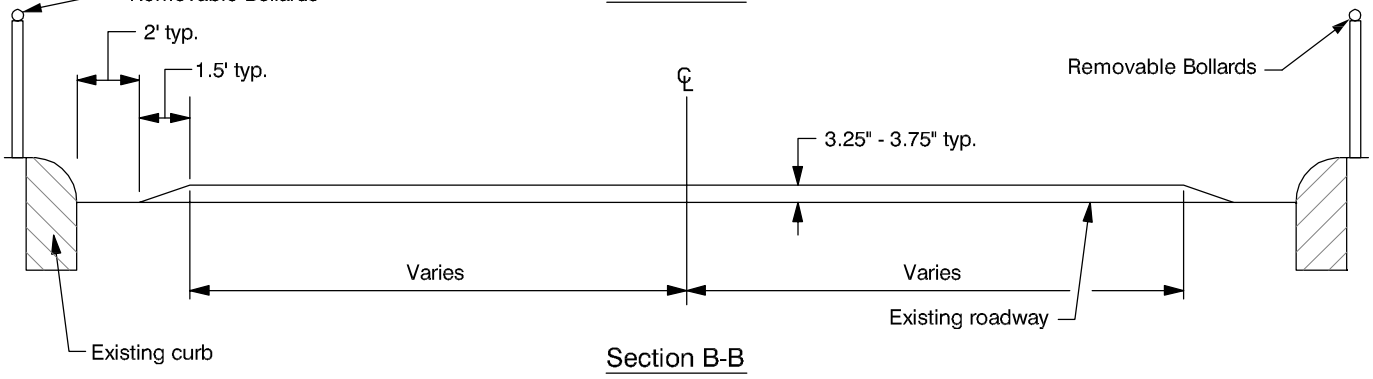
FIGURE B-3



Install speed table warning signs (See Figure B-18)







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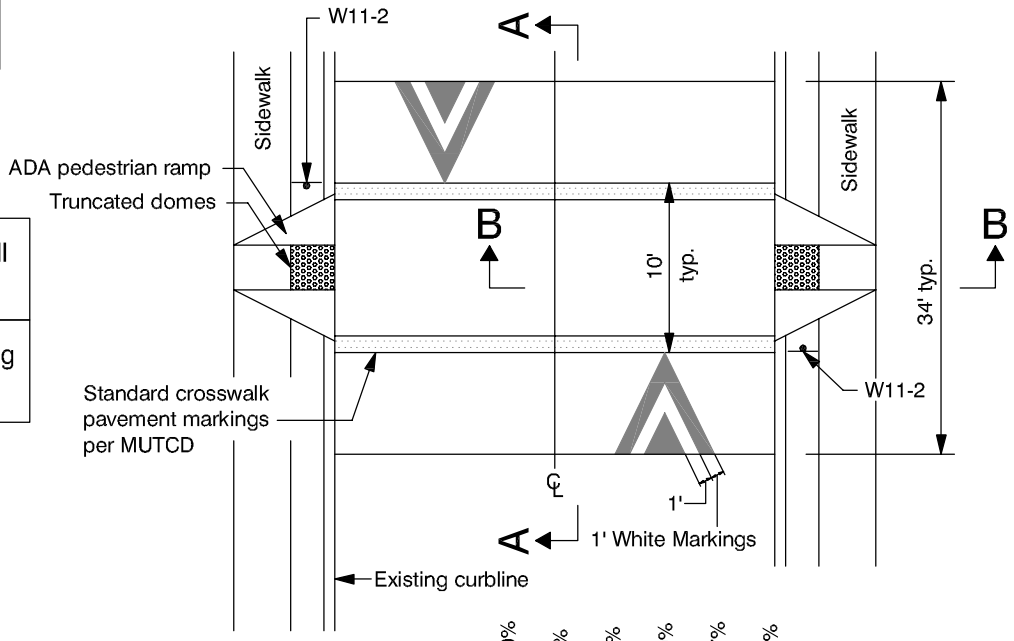
SPEED TABLE

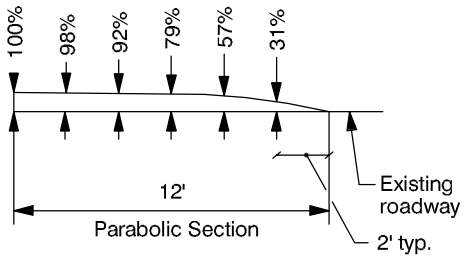
FIGURE B-4

Sign Description
W11-2 Pedestrian Crossing

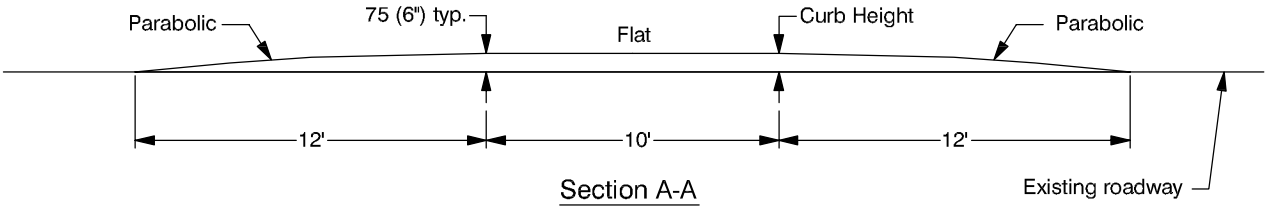
Inlets are required on the uphill side of a raised crosswalk
Install raised crosswalk warning signs (Shown below)

RAISED CROSSWALK

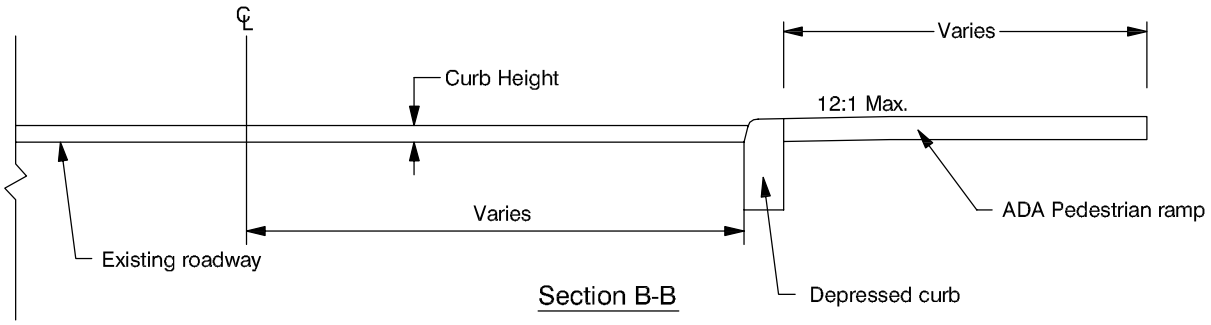




Sign Dimensions	Color Code		
	Background	Message	Border
30" x 30"	Flourescent Yellow or Yellow-Green	Black	Black



Section A-A



Section B-B

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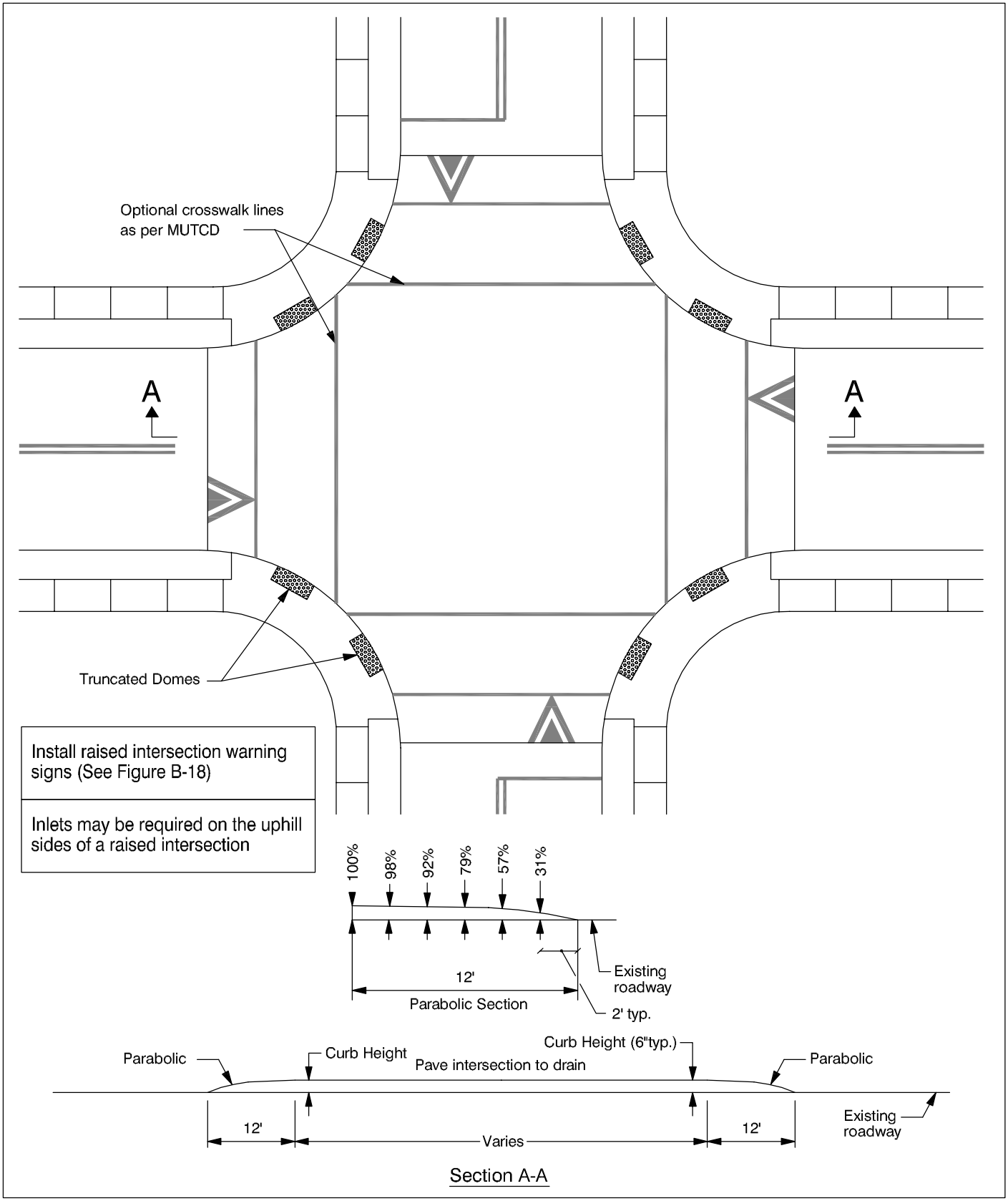
RAISED CROSSWALK

FIGURE B-5



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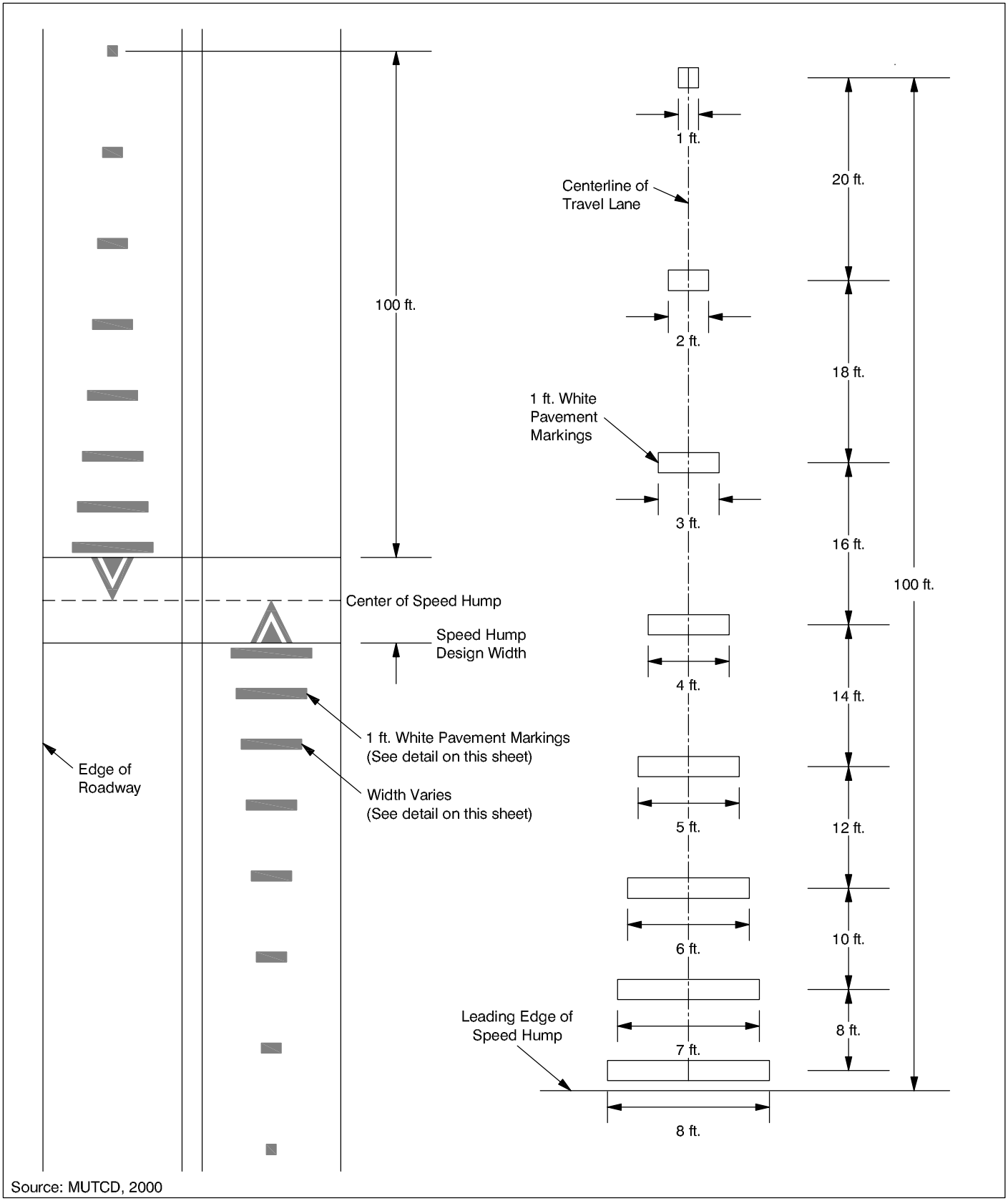
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-6_raised_intersection.dwg

RAISED INTERSECTION

FIGURE B-6



Source: MUTCD, 2000

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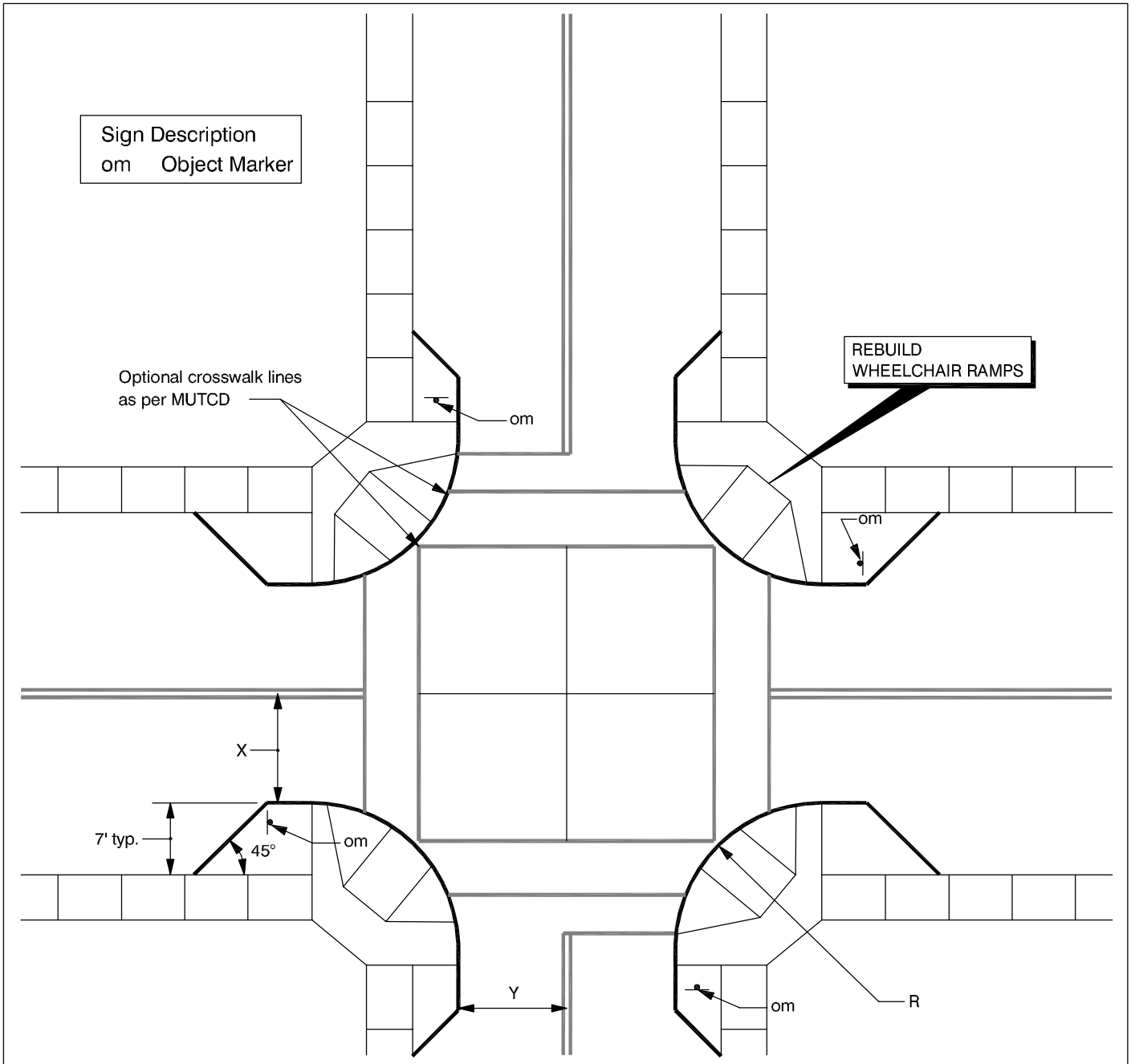
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-7_advance_warning.dwg

VERTICAL DEVICE - ADVANCE WARNING MARKINGS

FIGURE B-7



For The Street Widths:		Use This Curb Radius:
X	Y	R
12'	12'	40'
12'	14'	32'
12'	16'	26'
14'	12'	37'
14'	14'	35'
14'	16'	24'

NOTES: 1. Distance X is referenced from the center of the roadway to the lip of gutter.

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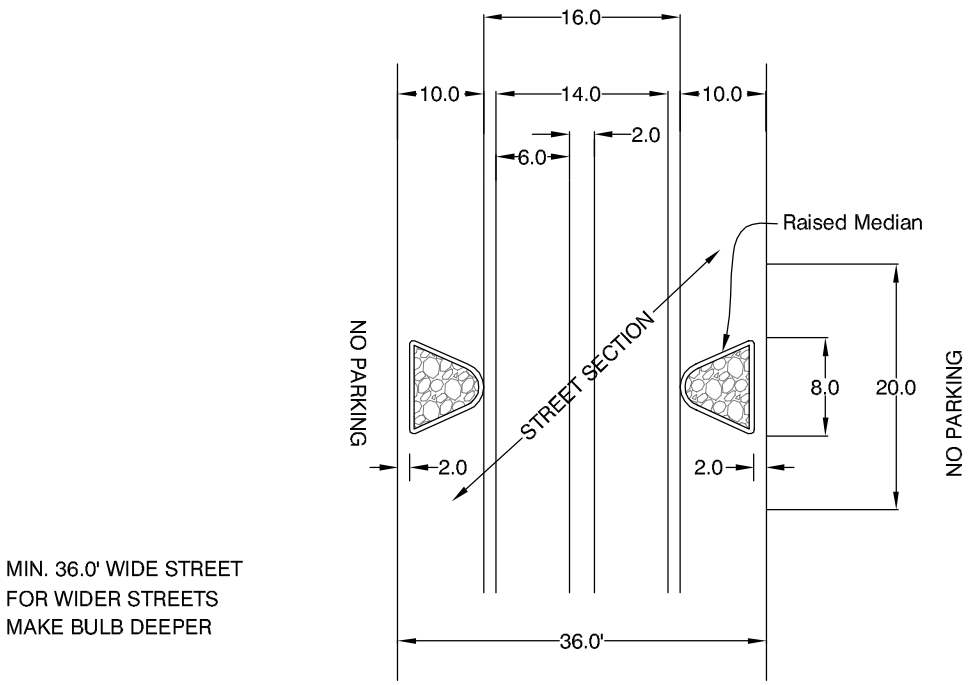
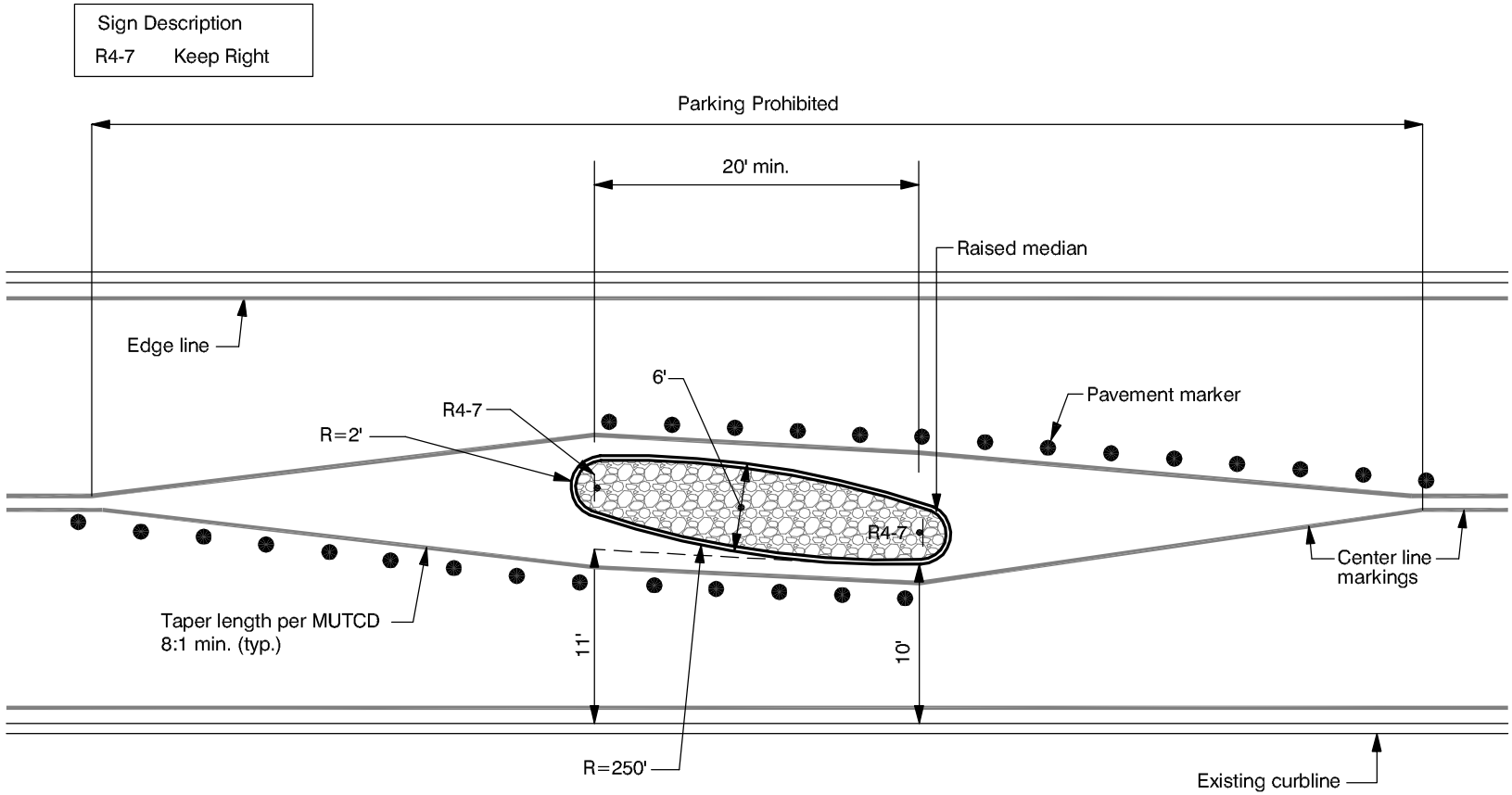
NECKDOWNS/BULBOUT (INTERSECTION)

FIGURE B-8



MIN. 36.0' WIDE STREET
FOR WIDER STREETS
MAKE BULB DEEPER

THE BULB-OUT DRAWING SHOWN IS FOR A 36 FOOT WIDE STREET. IF A STREET IS WIDER, THE BULB WOULD BE DEEPER; EACH BULB SHOWN IS EIGHT FEET DEEP SET TWO FEET FROM CURB. FOR CLASS "C" ROADWAY, BULB WOULD BE SEVEN FEET FROM EDGE OF CURB. THE WIDTH BETWEEN BULBS SHOULD BE 16 FEET, WHICH ALLOWS FOR ONE FOOT BETWEEN BULB AND CAR, SIX FEET PER CAR AND TWO FEET BETWEEN CARS. THIS WOULD REQUIRE CARS TO SLOW DOWN SUBSTANTIALLY IN ORDER TO PASS. THE BULB WOULD RESTRICT PARKING FOR APPROXIMATELY 20 FEET (ONE CAR LENGTH FOR PARKING PURPOSES) IN ORDER FOR THE BULB TO BE VISIBLE, ALLOW WIDER VEHICLES TO PULL TO THE RIGHT AND ALLOW AN OPPOSING VEHICLE TO PASS.



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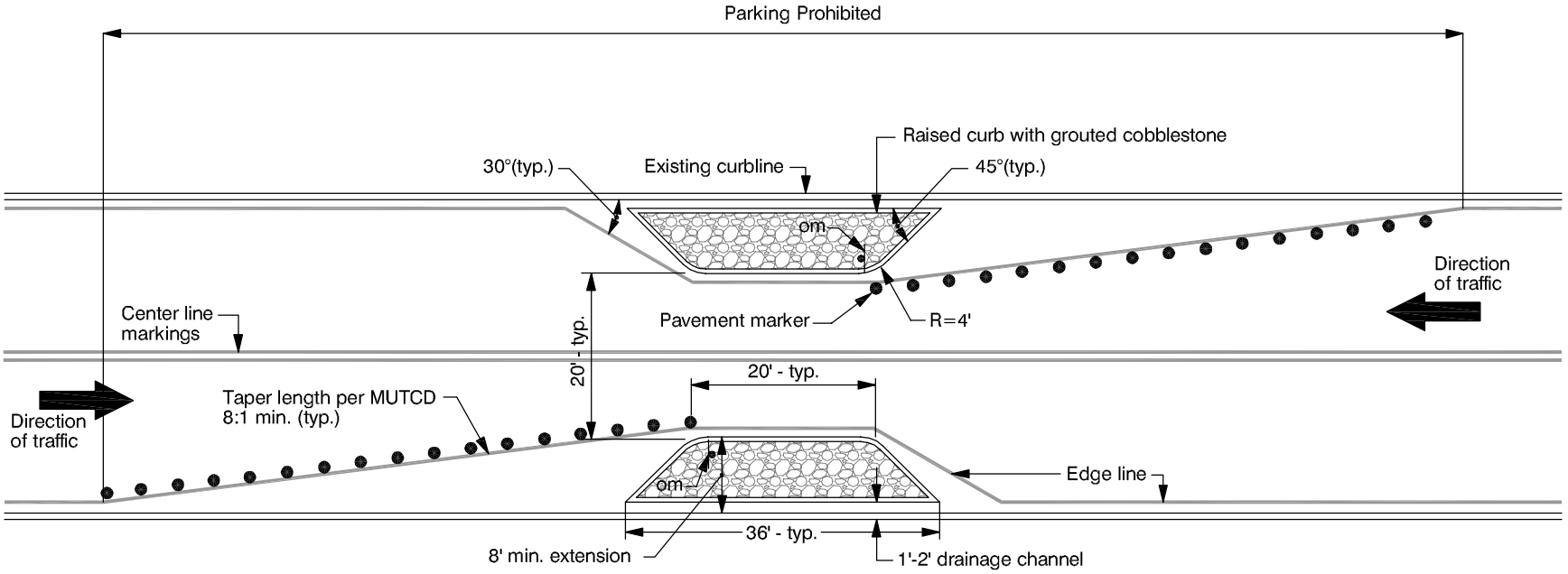
CENTER ISLAND NARROWING

FIGURE B-10



Sign Descriptions	
om	Object Marker

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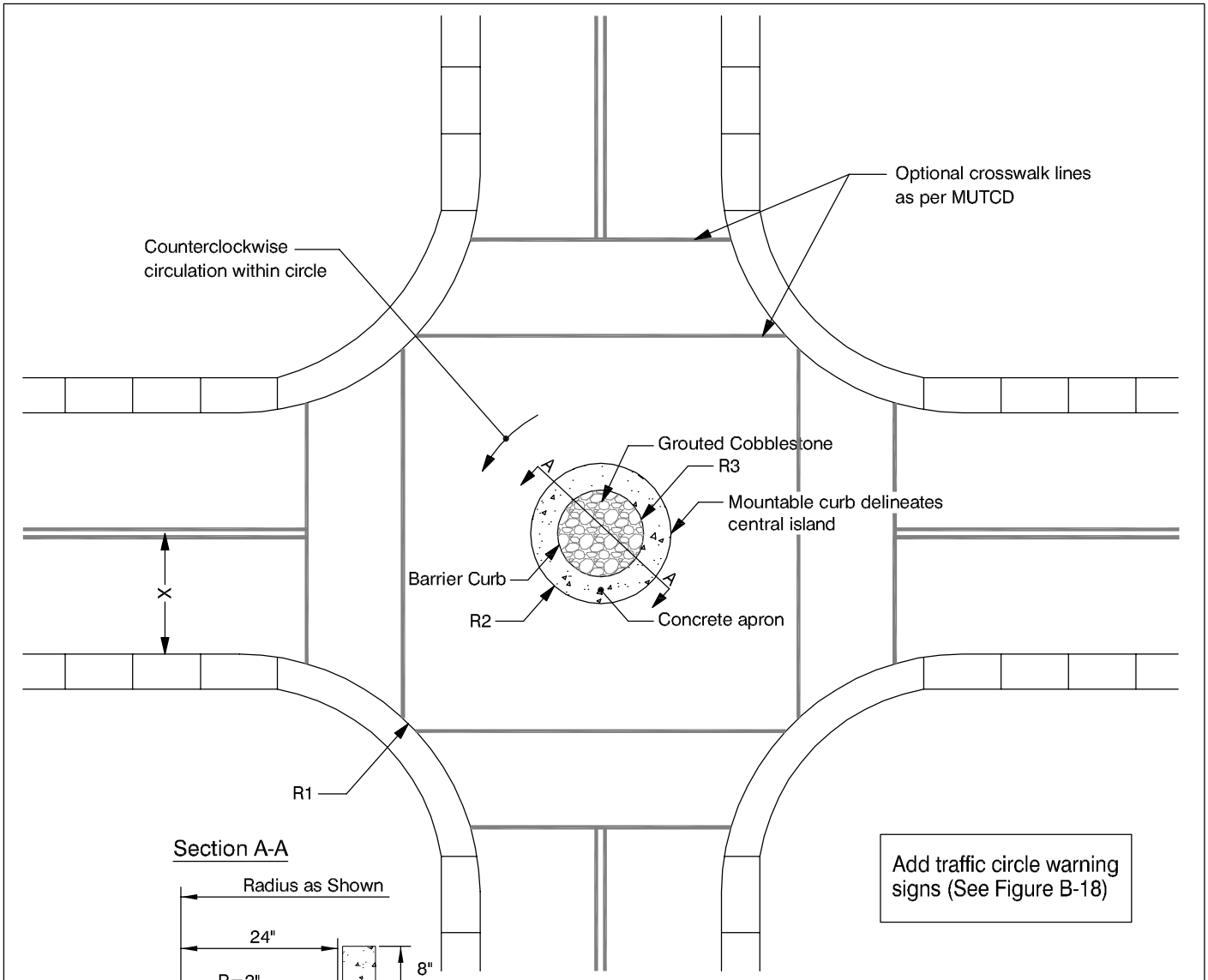
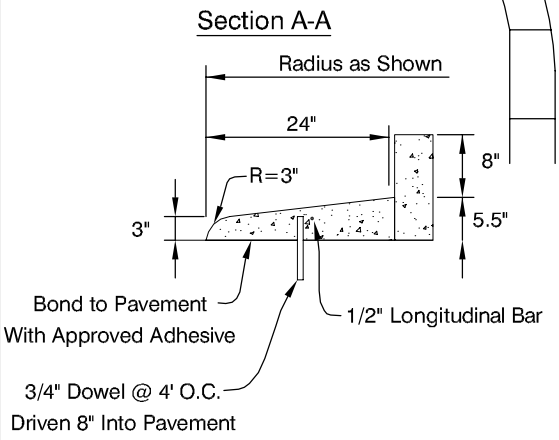
TWO-LANE CHOKER

FIGURE B-11





For This Street Width[2]:	Use These Curb Radii:		
X	R1	R2	R3
16'	15'	12'	7'
	20'	18'	7'
	25'	20'	7'
14'	15'	10'	5'
	20'	11'	5'
	25'	12'	5'
12'	15'	6'	3'
	20'	8'	3'
	25'	9'	3'

NOTES:
1. Distance X is referenced from the center of the roadway to the lip of gutter.
2. Assumes equal street widths; For unequal street widths, use truck turning template (AASHTO) to ensure adequate turning radii for the desired design vehicle.

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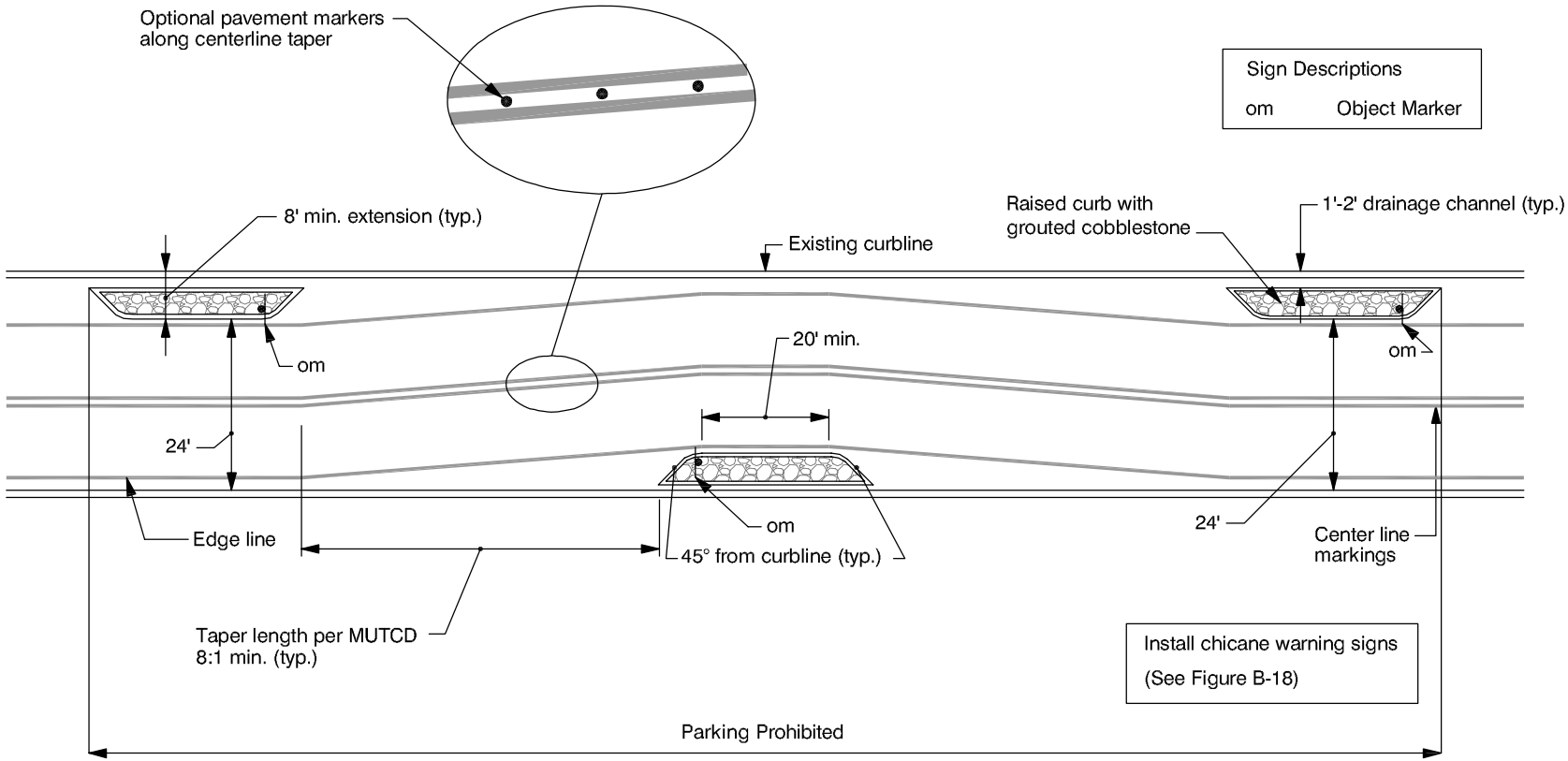
TRAFFIC CIRCLE

FIGURE B-12



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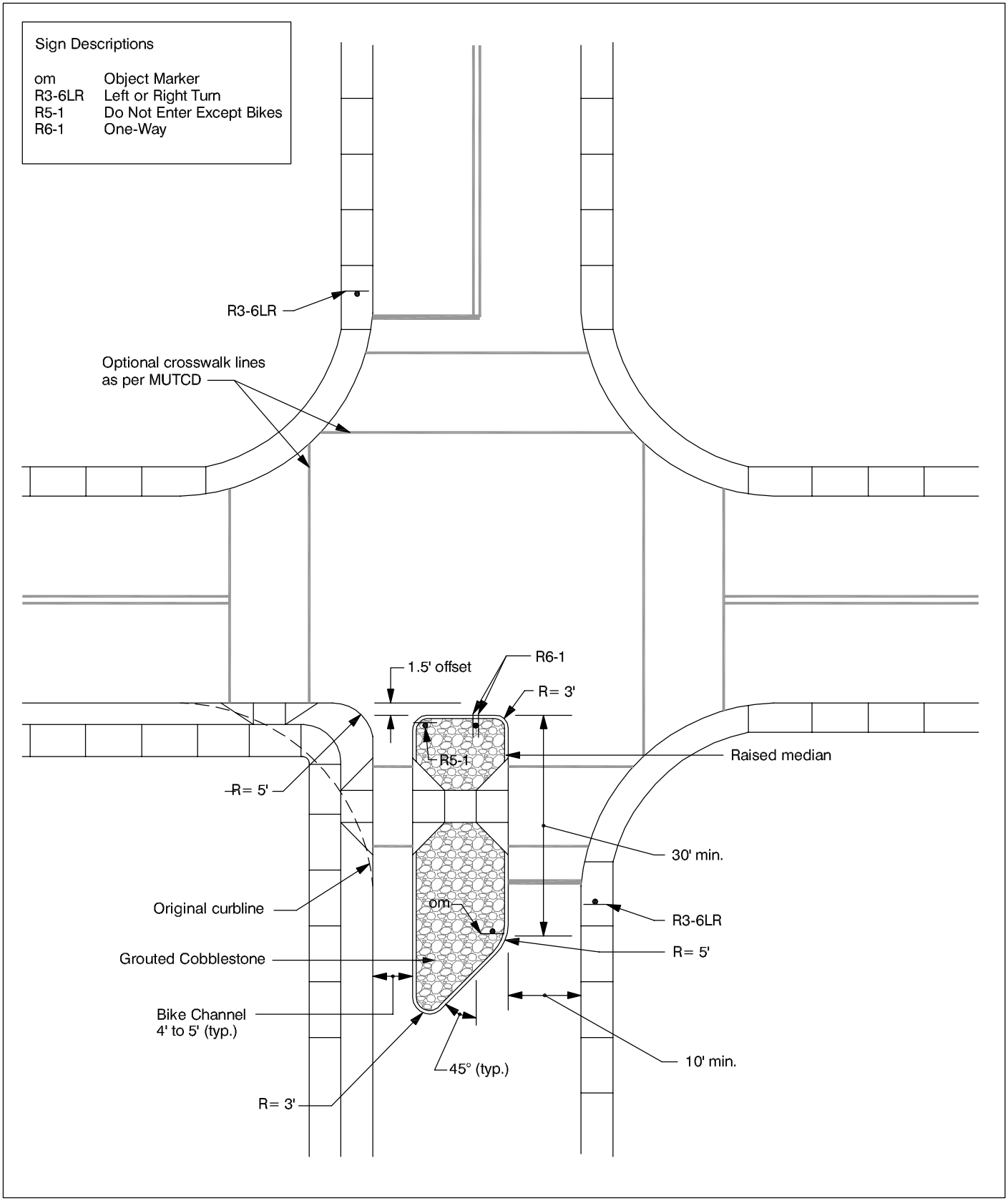
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-13_chicane.dwg

CHICANE

FIGURE B-13



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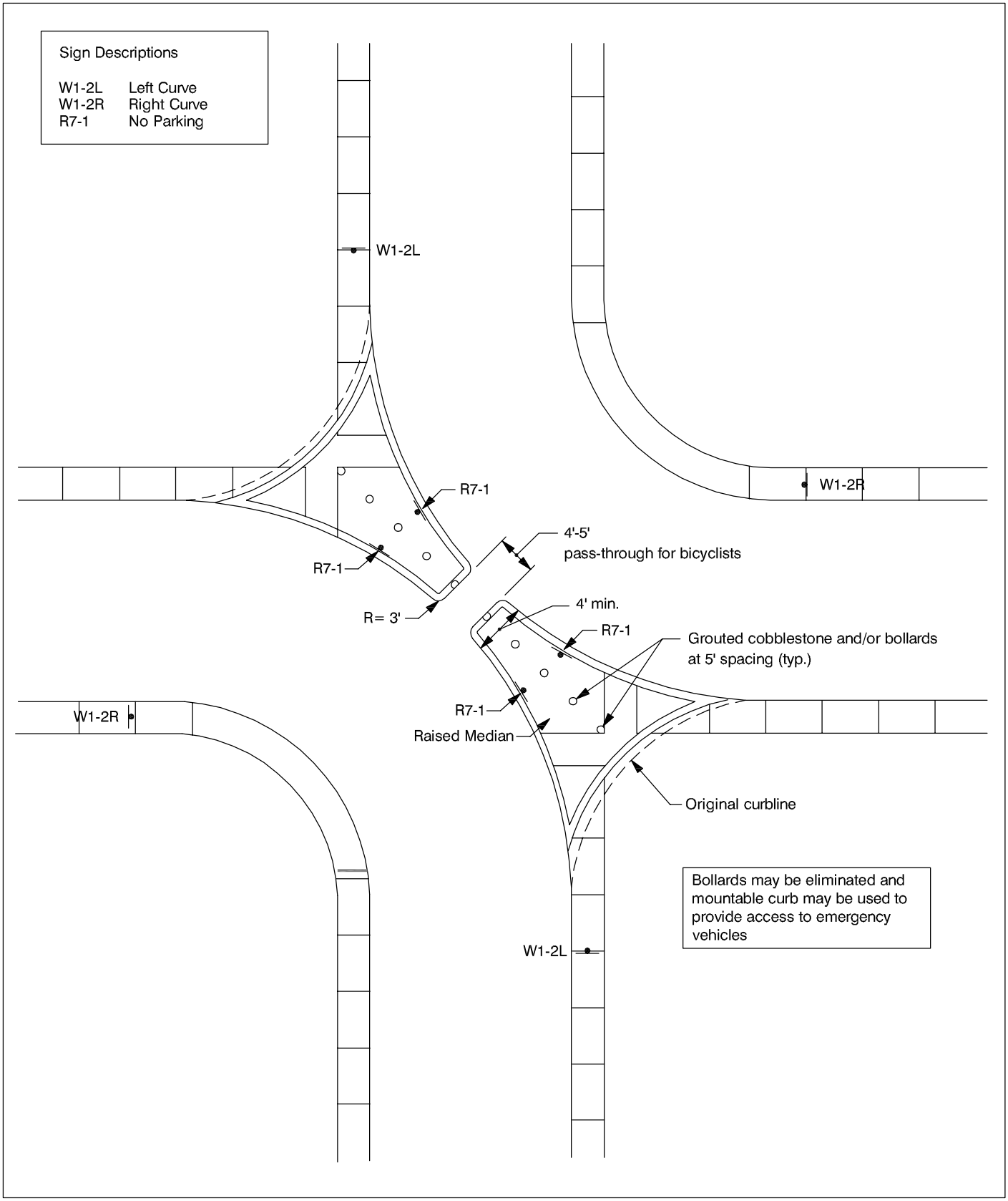
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-14_partial_closure.dwg

PARTIAL CLOSURE

FIGURE B-14



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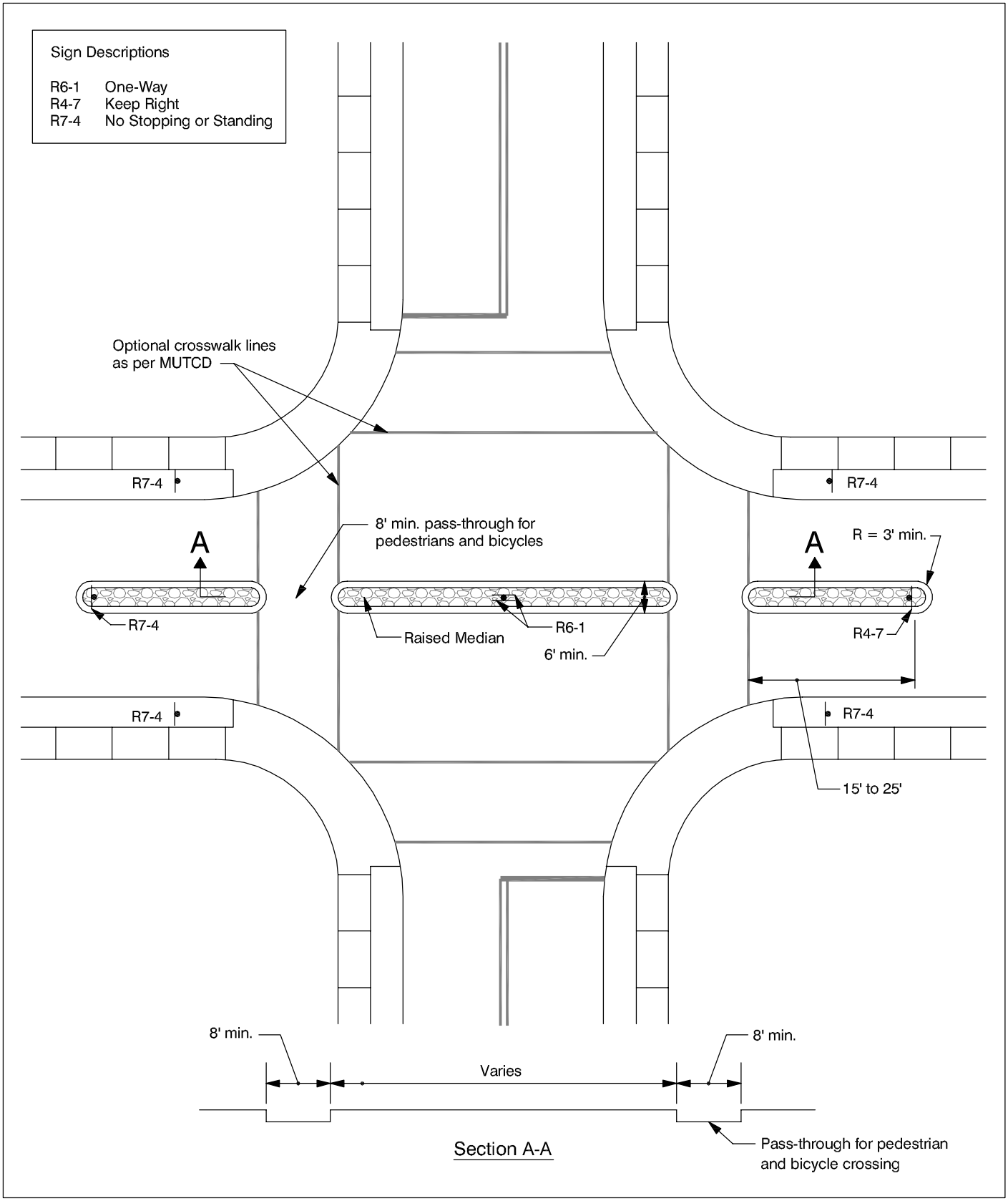
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-15_diagonal_diverter.dwg

DIAGONAL DIVERTER

FIGURE B-15



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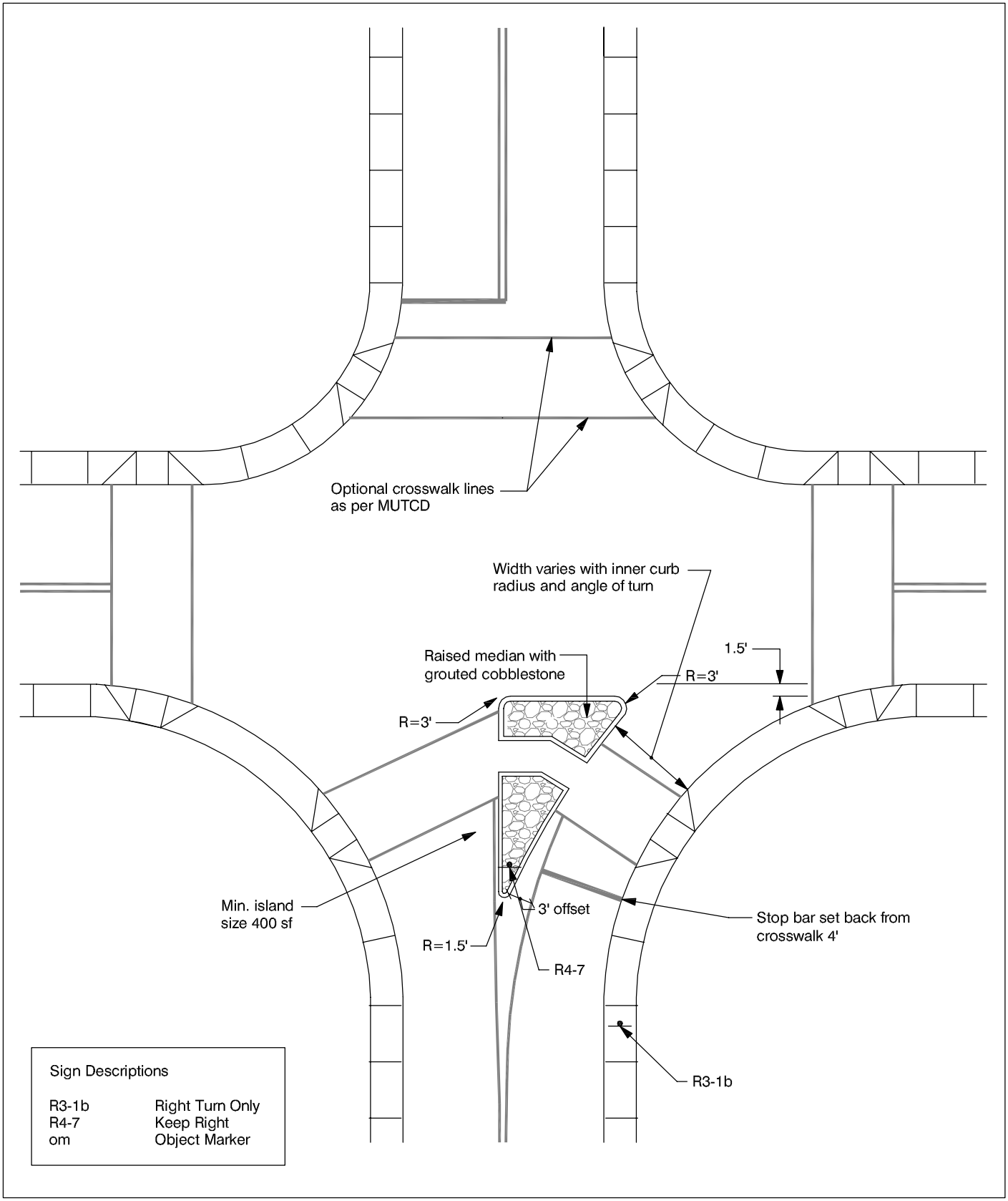
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-16_median_barrier.dwg

MEDIAN BARRIER

FIGURE B-16



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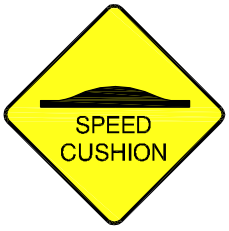
N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-17_forced_turn_island.dwg

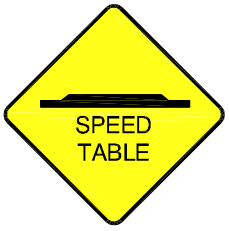
FORCED TURN ISLAND

FIGURE B-17

Sign Dimensions	Color Code		
	Background	Message	Border
30" x 30"	Flourescent Yellow or Yellow-Green	Black	Black

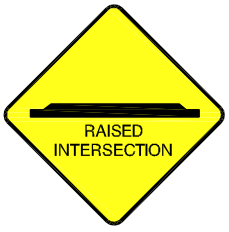


SPEED CUSHION

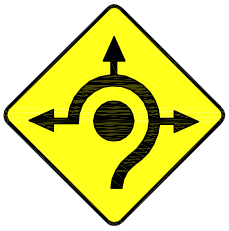


SPEED TABLE

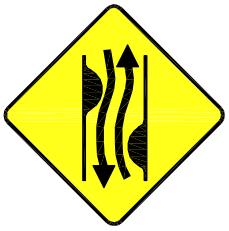
RAISED CROSSWALK



RAISED INTERSECTION



TRAFFIC CIRCLE OR ROUNDABOUT



CHICANE

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N:\PROJECTS\1042\1922\Graphics\Standard Designs\figB-18_warning_signs.dwg

COMMON WARNING SIGNS

FIGURE B-18

APPENDIX C –COST ESTIMATE WORKSHEET

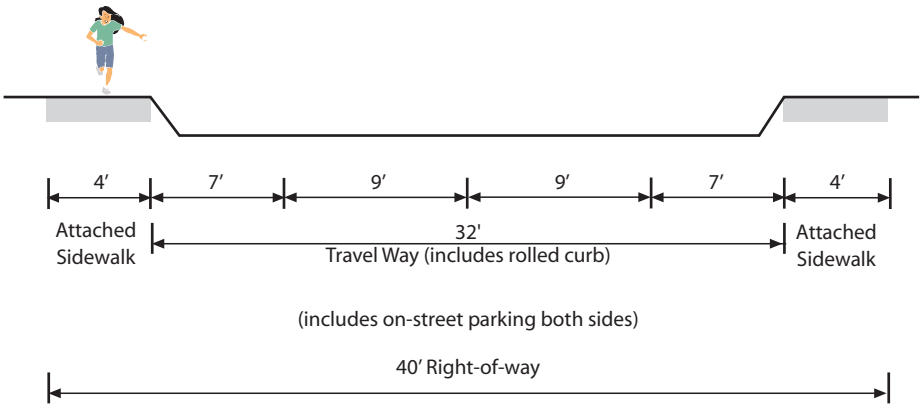
Table C-1 summarizes the approximate costs of the Toolbox of traffic calming devices. The approximate cost for each device has been gathered from a number of municipal sources and published articles. The actual cost per device is dependent on a number of factors including but not limited to individual contractor costs, number of devices to be constructed, materials. This worksheet will aid City staff and NTC members in developing a preliminary cost estimate for each traffic calming plan.

This worksheet will be updated periodically to stay current with construction costs.

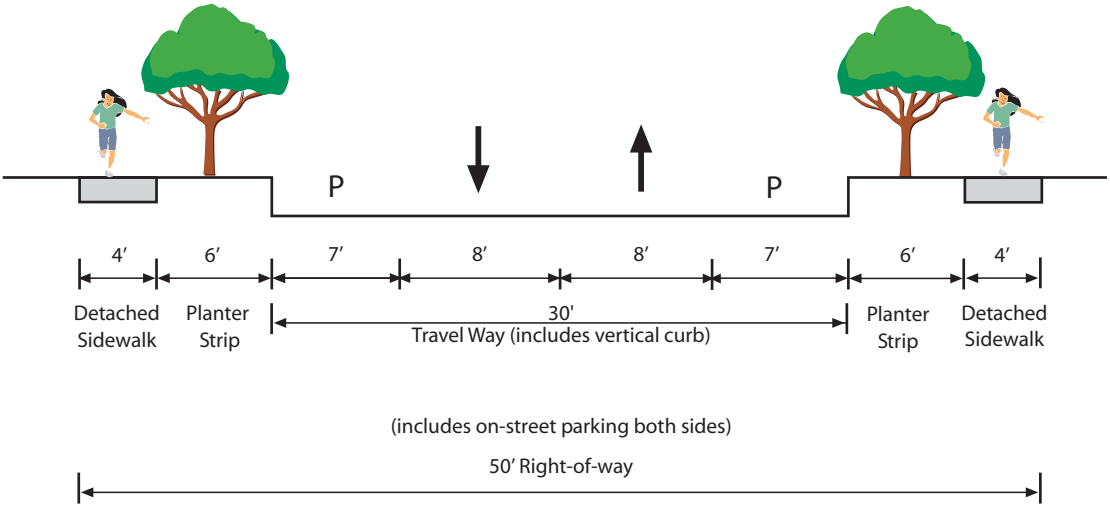
Table C-1 Cost Estimate Worksheet						
Type of Measure	**Quantity**	**Construction Cost**	**Unit**	**Design Cost (15%)**	**Contingency (15%)**	**Total**
Level 1 Non-Physical Measures						
Targeted Speed Enforcement		No Direct Cost				
Radar Trailer		No Direct Cost				
Speed Feedback Sign		$4,500	per sign			
Centerline/Edgeline Lane Striping		$2.00	linear foot			
Optical Speed Bars		$1.00	linear foot			
Signage		$150	per sign			
Speed Legend		$75	p.l.			
Centerline Botts Dots		$4.50	per marker			
Level 2 Narrowing Measures						
Neckdown/Bulbout		$40,000	p.l.			
Center Island Narrowing		$7,500	p.l.			
Two-Lane Choker		$7,500	p.l.			
One-Lane Choker		$8,500	p.l.			
Level 2Horizontal Measures						
Traffic Circle		$12,000	p.l.			
Roundabout (Single-Lane)		$150,000	p.l.			
Chicane		$12,000	p.l.			
Lateral Shift		$15,000	p.l.			
Realigned Intersection		$15,000	p.l.			
Level 2 Vertical Measures						
Entry Feature		$15,000				
Speed Hump		$2,500	p.l.			
Speed Lump		$3,500	p.l.			
Speed Cushion		$2,000	per cushion			
Split Speed Hump		$5,000	p.l.			
Speed Table		$4,500	p.l.			
Raised Crosswalk		$5,000	p.l.			
Raised Intersection		$50,000	p.l.			
Rumble Strips		$4.50	per marker			
Textured Pavement		$8.00	per sq.ft.			
Level 3 Diversion Measures						
Full Closure		$30,000	p.l.			
Partial Closure		$6,500	p.l.			
Diagonal Diverter		$25,000	p.l.			
Median Barrier		$15,000	p.l.			
Forced Turn Island		$4,500	p.l.			
Turn-Movement Restrictions		$150	per sign			
Total Estimated Cost						
Notes: p.l. = per location						

APPENDIX D – PROPOSED STREET DESIGN CROSS SECTION DIAGRAMS

Existing Minor Residential Street



Proposed Local Street -
Low Volume Residential



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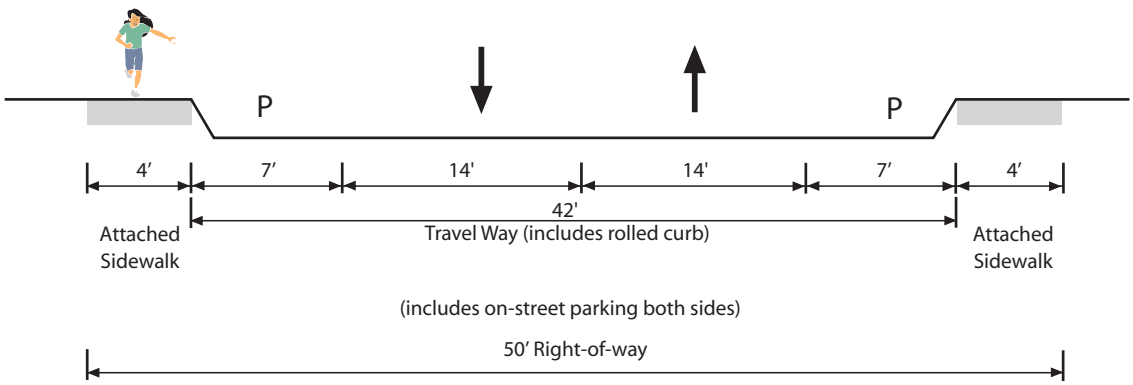
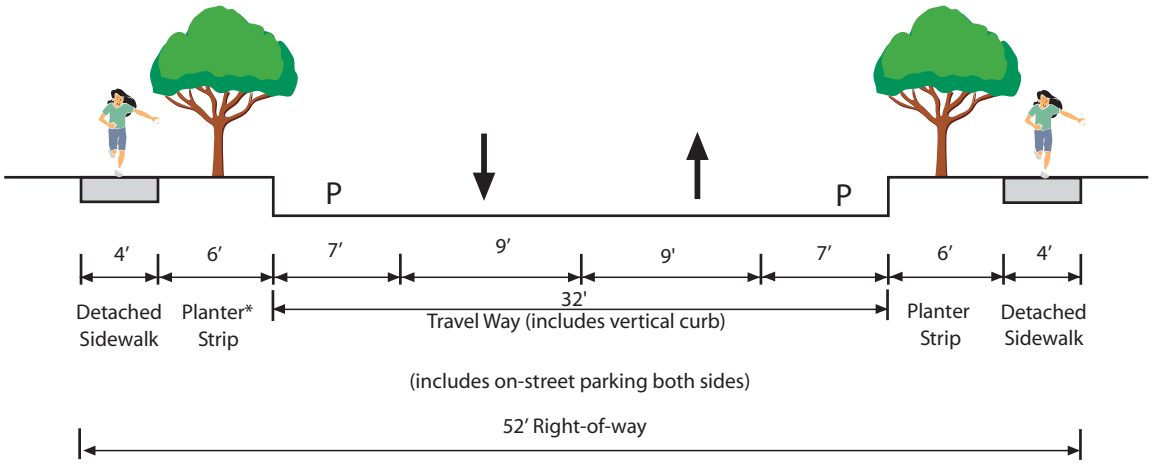
DRAFT STREET STANDARDS -
LOW VOLUME RESIDENTIAL

FIGURE A

Existing Primary Residential Street

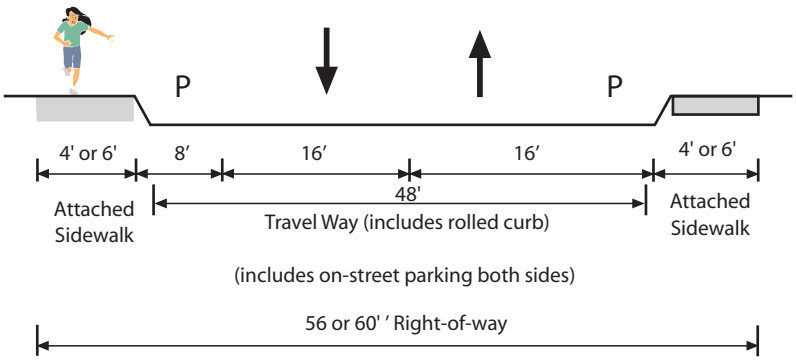


Proposed Local Street - Medium Volume Residential

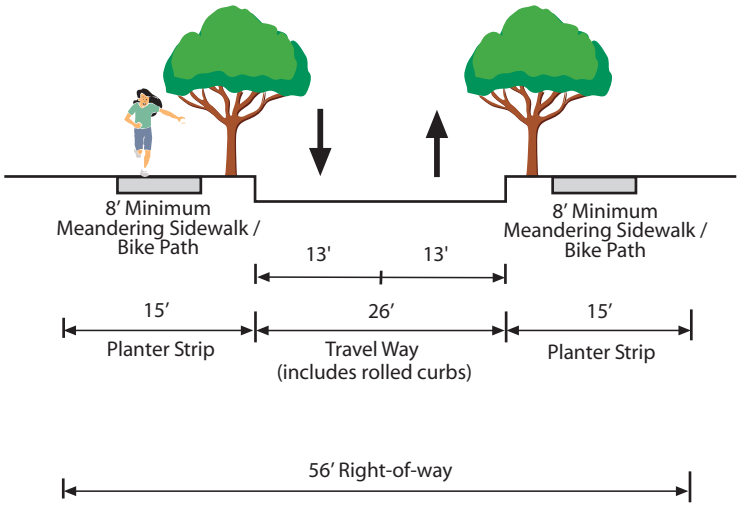


*Width includes vertical

Existing Collector
(With or without front-on residential)



Proposed Residential Collector
(No front-on residential)



Width includes vertical curb.

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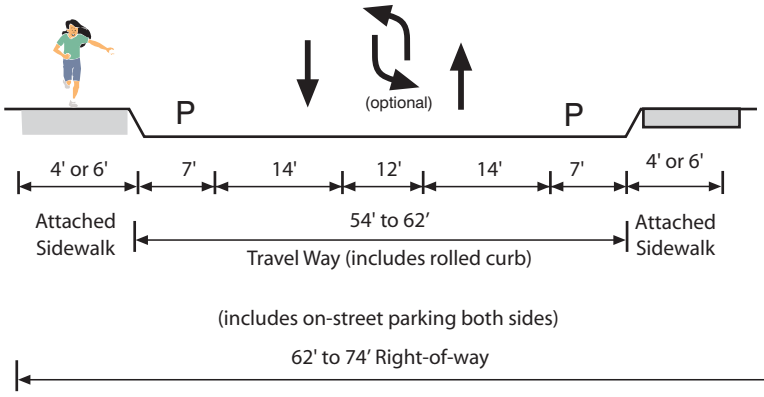
DRAFT STREET STANDARDS
RESIDENTIAL COLLECTOR
FIGURE C

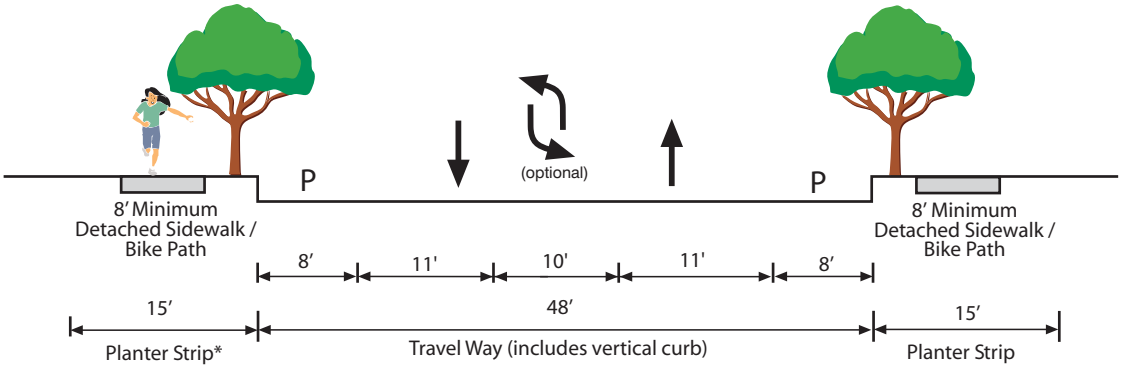
Existing



(includes on-street parking both sides)

62' to 74' Right-of-way

Propose



(includes on-street parking both sides)

78' Right-of-way **

* Width includes vertical curb.

** NOTE: Intersections to be flared for left-turn lanes

P = Parking

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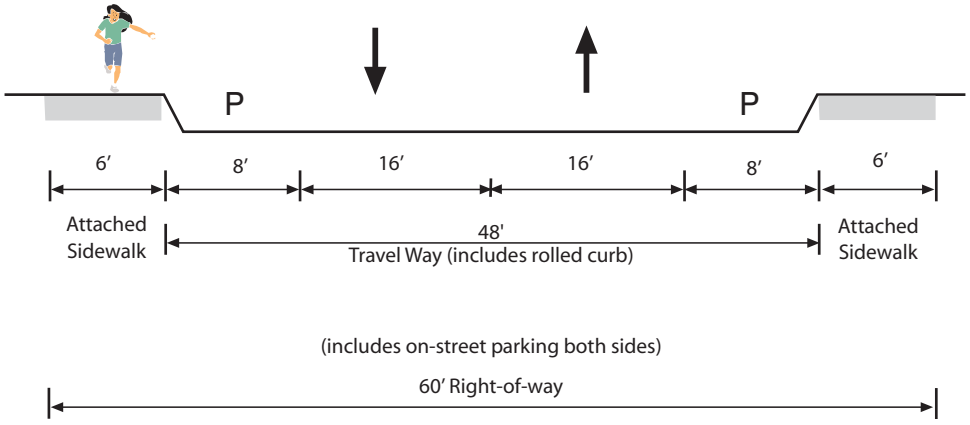
DRAFT STREET STANDARDS
NON-RESIDENTIAL COLLECTOR
FIGURE D

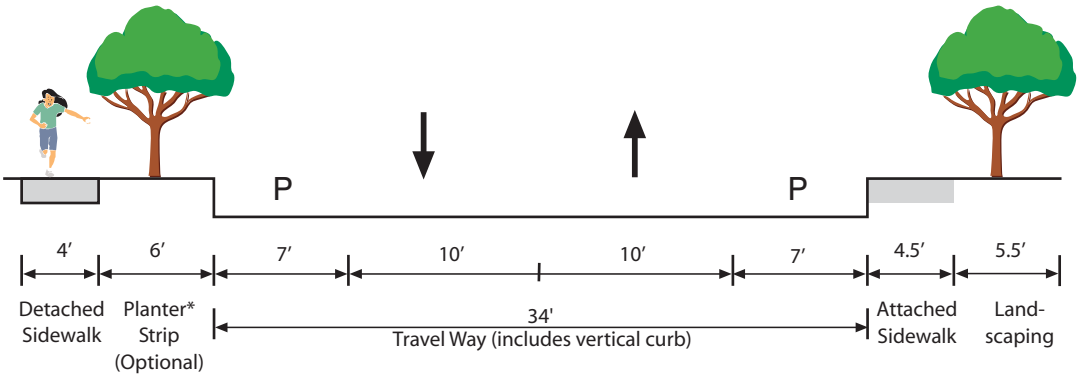
Existing Commercial Street



(includes on-street parking both sides)

60′ Right-of-way

Proposed Local Street - Commercial



(includes on-street parking both sides)

54′ Right-of-way

* Width includes vertical curb.

P = Parking

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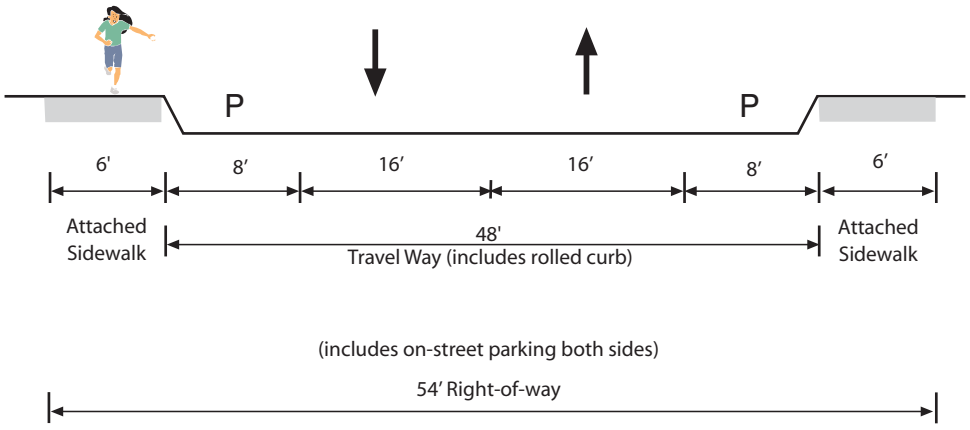
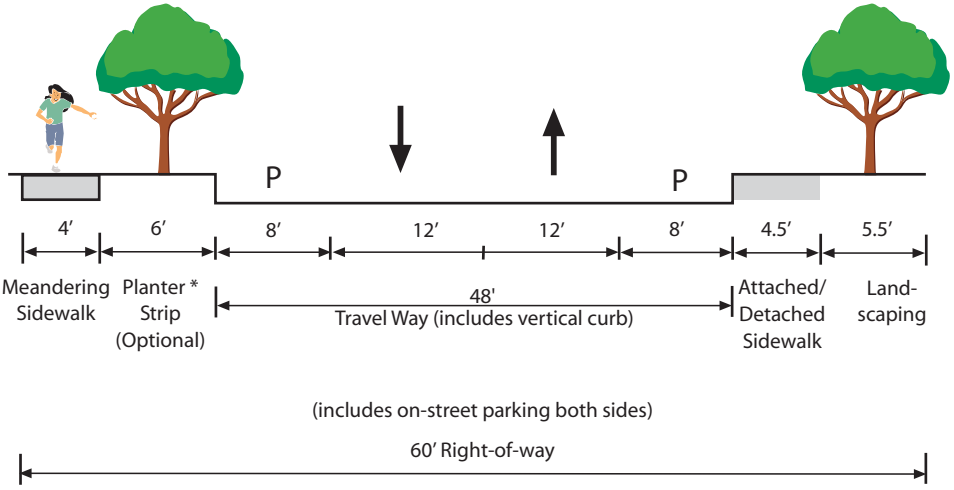
DRAFT STREET STANDARDS
LOCAL STREET COMMERCIAL
FIGURE E

Existing Industrial Street



Proposed Local Street - Industrial



* Width includes vertical curb.

P = Parking

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DRAFT STREET STANDARDS
LOCAL STREET INDUSTRIAL
FIGURE F