Agenda Item #:______________________________

Staff Report
City of Manhattan Beach

TO: Honorable Mayor Fahey and Members of the City Council

THROUGH: Geoff Dolan, City Manager

FROM: Richard Thompson, Director of Community Development
Erik Zandvliet, City Traffic Engineer

DATE: September 6, 2005

SUBJECT: Consideration of a Council Work Plan Item to Review the Existing Traffic Mitigation Toolbox

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RECOMMENDATION:
Staff recommends that the City Council review the related materials and provide staff with direction for any changes to the NTMP Toolbox.

FISCAL IMPLICATION:
There are no fiscal implications associated with this review.

BACKGROUND:
In September 2001 the City Council initiated a comprehensive update of the City's General Plan. As part of this process the Neighborhood Traffic Committee (NTC) was appointed by the City Council to help develop, review and make recommendations on traffic related issues, including the Neighborhood Traffic Management Program. On August 22, 2002 the Parking and Public Improvements Commission (PPIC) reviewed the recommendations from the NTC on the Program, and recommended several revisions.

On October 1, 2002 and November 19, 2002, the City Council reviewed and approved the Citywide Neighborhood Traffic Management Program (NTMP). The NTMP is attached to this report. The Program and the associated "Toolbox" of traffic control measures were adopted separately from the General Plan to allow more flexibility in the future for amendments if needed.

The City Council's 2005-2006 Work Plan includes a task to review the NTMP Toolbox measures and consider the limited use of speed humps in school areas. Staff researched the criteria for each measure, reviewed the results of implementing certain measures in four NTMP areas and explored the feasibility of other possible measures including speed humps.

Since inception of this program, the City has undertaken two large NTMP areas covering over 3,400 homes in the Northeast and Southeast areas of the city, as well as two smaller preliminary study areas near Sand Dune Park area and Mira Costa/2nd Street area (Mira Costa East). These areas have provided a real-life example of how selected measures can be applied within neighborhoods.

NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM

The Citywide Neighborhood Traffic Management Program (NTMP) established a set of procedures to evaluate neighborhoods in an effort to improve livability of neighborhood streets. It created a consistent way for the City to evaluate traffic requests, so that a comprehensive process can be implemented that will minimize adverse impacts both before and after implementation of traffic calming measures. The process includes the following seven steps:

Step 1 Identify Candidate Streets/Neighborhoods
Step 2 Preliminary Screening and Evaluation
Step 3 Engineering Analysis/Preliminary Recommendations
Step 4 Neighborhood Meetings and Survey/Petitions
Step 5 Develop, Install, and Evaluate Test projects
Step 6 Determination of Permanent Project
Step 7 Monitoring

NTMP TOOLBOX

The NTMP contains a "Toolbox" of possible traffic calming measures that could be considered when preparing a comprehensive solution to the identified traffic impacts within a neighborhood. The existing toolbox measures and minimum implementation criteria for each are included in the NTMP attachments. The measures are aimed at reducing unusual non-local cut-through traffic volumes, high speeds, truck traffic intrusion, demonstrated accident history, and other related problems.

Each of the NTMP toolbox measures was evaluated for appropriateness and its ability to address typical concerns and findings. These measures and an evaluation of their appropriateness are listed below:

Level One Tools

Enhanced Police Enforcement

Applicability - This measure is effective in addressing speeding and stop sign violations during selected times throughout the neighborhood, especially at school dismissal. Although it has been implemented in both major NTMP areas, actual results are hard to track and verify.
Proposed Changes - None

Speed Monitoring Trailer

Applicability - This measure is useful on higher volume major local and collector streets such as Meadows Avenue, Peck Avenue, Redondo Avenue, Marine Avenue and Highland Avenue. It has been implemented in both major NTMP areas resulting in temporary but residual speed reductions if used regularly.
Proposed Changes - None

Neighborhood Watch Program

Applicability – While this program is better for enforcing other types of neighborhood violations, this measure can be used to educate and notify residents of local traffic issues. While it has not been implemented in previous NTMP areas, it would be applicable for local streets with evidence of moving violations or speeding by residents.
Proposed Changes - None

Higher Visibility Crosswalks

Applicability - This measure is effective at locations with high pedestrian volumes and exposure to motorists. It is well documented that drivers have difficulty seeing two painted crosswalk lines, but awareness increases dramatically with larger profiles or warning signs. It has been implemented in certain school areas and along Highland Avenue and Manhattan Avenue on a case-by-case basis.
Proposed Changes - None

Pedestrian Crossing Paddle-Style Signs –

Applicability - This measure has limited but targeted use at crossings that have high pedestrian volumes and/or collision history, but are hard to sign or mark with other high visibility devices. It should not be used on narrow streets or locations where there are high turning movement volumes. It has been used on Highland Avenue and Manhattan Beach Boulevard with some success, however, the signs placed on the centerlines quickly become damaged and require regular maintenance. Excessive use of this measure could reduce the visual impact and effectiveness at all locations. A similar device that can be used is red reflective warning strips. They can be installed on stop sign poles to enhance visibility of the stop sign.
Proposed Changes – This measure should be limited to crossings with minimum pedestrian volume of 100 pedestrians per day in addition to the minimum vehicle volume or at locations that have restricted sight visibility. Reflective warning strips should also be added to the toolbox.

Electronic or Larger Speed Limit Signs –

Applicability – This measure can be effective on higher volume major local and collector streets that are experiencing above normal speeds. Its proximity to residences should be considered, however, several models have dimming, retro-reflective and/or time-of-day features to minimize adverse impact to residents.
Proposed Changes - This measure could also include newly approved blinking warning signs with LED lights along the borders. (See attached example.) This measure can become a Level Two tool if a new tool "Warning Signs and Markings" is added at Level One to be used prior to this measure.

Level Two Tools

Traffic Signal Timing

Applicability - This measure covers several types of timing methods to enhance neighborhood traffic calming. The methods include timing adjustments to discourage certain directions that are used by cut-through traffic, signal coordination on major streets, or restricting certain movements at signalized intersections. This measure has been used on Marine Avenue with good results to discourage cut-through traffic to/from the south and at Aviation Blvd. at 2nd Street before the NTMP was approved.

Proposed Changes - None

Turn Restrictions via Signage

Applicability - This measure is useful at locations where significant cut-through traffic has been found to enter or exit a neighborhood. It has been implemented on Rosecrans Avenue to prohibit left turns during peak hours, and recently on northbound Aviation Boulevard at 10th Street to prohibit left turns during peak hours. It has also been recommended out of the Manhattan Beach Middle School driveway. In before/after studies at Aviation Boulevard/10th Street, it was found that turn violations were common, even with periodic enforcement. This could be primarily attributed to the proximity of a preschool and several businesses whose patrons and employees would have been diverted much greater distances. However, this measure has been effective at other intersections, where the use of major streets are encouraged instead of local streets.

Proposed Changes - None

Rumble Strips / Dots

Applicability - These measures are only recommended in areas without nearby residences, because of road noise when vehicles travel over such devices.

Proposed Changes - None

Crosswalk Warning Light System

Applicability - This measure can be useful in areas that have high pedestrian volumes and insufficient gaps for crossing or high exposure to vehicles. No locations in prior NTMP areas have been recommended for crosswalk warning systems at this time, however, it could be appropriate if Level One tools are ineffective in improving pedestrian safety at selected locations, especially near the beach.

Proposed Changes – Critical speed may not be a contributing factor on many streets in the City, while inadequate gaps in traffic are a contributing factor in pedestrian safety. Therefore, the critical speed requirement should be removed, and a new criteria added to consider a minimum number of adequate gaps to cross in the peak hours.

Raised Median Island

Applicability – This measure could be considered on certain streets with cut–through and/or speeding. It should be noted that parking would have to be removed on narrower streets. No locations have been identified within prior NTMP neighborhoods that are good candidates for this measure due to the relative narrowness of most streets.

Proposed Changes - None

Neighborhood Entry Island

Applicability – This measure could be considered on certain streets with cut–through and/or speeding. No locations have been considered for this measure prior NTMP neighborhoods at this time, however, it could be appropriate if Level One measures are not effective on certain major local streets such as Meadows Avenue, Peck Avenue or Redondo Avenue.

Proposed Changes - None

Mid-block Narrowing

Applicability - This measure could be implemented on wider streets, however, curb parking might have to be removed at the narrowed section of street. For example, 19th Street adjacent to the water reservoir east of Peck Avenue might be a candidate to create a large landscaping area to screen the water tank from residents' view and reduce the apparent width of the street to discourage speeding.

Proposed Changes - None

Chokers at Intersections

Applicability – This measure could be implemented at high volume or high speed locations. It discourages cut-through traffic by reducing the relative convenience and increasing overall travel time through the neighborhood. No prior NTMP neighborhood locations have been identified with a collision history or resident concern for implementation of this measure, however, it has been used in the downtown at crosswalk locations with good results.

Proposed Changes - None

Lane Reduction/Narrowing/Restriping

Applicability - This measure often reduces speeding and discourages some cut-through traffic by limiting the amount of street available for drivers. This can be accomplished by several methods; centerlines, parking edgelines, bicycle lanes, etc. Due to the narrow rights-of-way on most streets within prior NTMP neighborhoods, few locations would be appropriate for this measure, however, streets with curves and wider streets are good candidates.

Proposed Changes - None

Stop Sign as Neighborhood Traffic Control Measure

Applicability - While stop signs should be installed in accordance with established guidelines, special conditions in a neighborhood may justify stop signs in certain directions to discourage non-resident traffic and speeding by virtue of their location. Several intersections have been recommended for multi-way stop signs in prior NTMP neighborhoods. These intersections meet the guidelines for stop signs in all directions due to physical obstructions and vertical curves that reduce sight distance.

Proposed Changes - None

Parking Restrictions

Applicability - Time-limit parking restrictions or prohibitions during certain hours can be be effective in eliminating non-resident parking in neighborhoods. Several areas have been identified in prior NTMP areas as candidates for parking restrictions. In all cases, it was recommended that no restrictions be implemented unless there was significant support from the affected residents. City Council also recently approved the Mira Costa Staggered Parking Program with resident override in the highly impacted high school area on a trial basis. This particular area is unique in that the high school provides sufficient parking for students, but they choose to park in the surrounding neighborhood instead.

Proposed Changes – None

<u>Level Three Tools</u>

<u>Raised Crosswalks</u>

Applicability – This measure could be useful near schools or other high pedestrian activity centers if lower level tools are found to be ineffective. It could complement other future street or city beautification efforts. No locations have been identified for this measure at this time.

Proposed Changes – None

<u>Raised Intersections</u>

Applicability – This measure could be useful at problem intersections with speeding or cut-through traffic if lower level tools are found to be ineffective. It could complement other future street or city beautification efforts. No locations have been identified for this measure at this time.

Proposed Changes – None

<u>Traffic Circles</u>

Applicability – This measure could be useful on streets with speeding or cut-through traffic if lower level tools are found to be ineffective. Additional right-of-way might be required at narrow intersections. No locations have been identified for this measure at this time.

Proposed Changes – None

<u>Restricted Movement Barriers</u>

Applicability – This measure could be useful where lower level tools are found to be ineffective at locations with restricted turns. The physical barrier would be more effective than signs or striping, but also more expensive. No locations have been identified for this measure at this time.

Proposed Changes – None

<u>Entrance and Half Street Barriers</u>

Applicability – This measure could be useful where lower level tools are found to be ineffective at reducing cut-through traffic or undesirable turns at neighborhood entrances. The physical barrier would be more effective than signs or striping, but also more expensive. This measure may also affect neighborhood access to residents and cause

undesirable diversion to other streets. No locations have been identified for this measure at this time.
Proposed Changes – None

Diagonal Diverters

Applicability – This measure could be useful where lower level tools are found to be ineffective at reducing cut-through traffic in the interior of a neighborhood. The physical barrier would be more effective than signs or striping, but also more expensive. This measure should only be used at locations where the intersecting streets are appropriate for potential diverted traffic circulation. It may also affect neighborhood access to residents and cause undesirable diversion to other streets. No locations have been identified for this measure at this time.
Proposed Changes – None

OTHER POSSIBLE MEASURES

Warning Signs and Markings

Applicability – New or larger warning signs and markings are a traditional first step in raising driver awareness of traffic safety on public streets. This should be included in the Toolbox as a Level One measure, especially if the warning sign or marking has not been used before to address a particular traffic calming objective. Often, certain roadside or pedestrian conditions are not readily apparent to unfamiliar drivers, and lower speeds would result. All signs should be installed pursuant to State and Federal guidelines.
Proposed Changes – Add this measure to the "Level One" Toolbox.

Speed Humps

There was an extensive discussion of speed humps during the General Plan Update in 2002. While it was decided to omit speed humps from the Toolbox at that time, it was acknowledged that the NTMP would be a dynamic document, subject to future revisions and updates. Speed humps are used in many communities in southern California, and have proven effective when installed under controlled conditions and in selected locations. Many years of trial-and-error have resulted in more universal practice and criteria that have been adopted both nationally and locally. The speed hump design has become standardized and has been tested both physically and legally. A summary of various local agency criteria and industry standards is attached to this report. The only speed humps currently in use in Manhattan Beach are in the El Porto area. There are two on Ocean Drive that were installed as part of a traffic study done in the early 1990s. Their effectiveness has been somewhat limited as they were not constructed to any specific standards and are likely too gradual in shape. As part of a subsequent study in late 1990s two humps were installed in the El Porto Parking Lot. They have been generally effective in reducing speeds through the parking lot.

Speed humps are not a cure-all for speeding or cut-through traffic. There are many advantages and disadvantages, some of which are listed below:

PROS:

- Vehicle speeds typically decrease in the vicinity of the speed hump to approximately 24 miles per hour.
- Speed humps reduce speeds 24 hours a day, 7 days a week.
- Speed humps may decrease traffic volume by discouraging non-resident traffic.
- Speed humps may help calm traffic in areas where signs or other measures have not worked.

CONS:

- Speed humps increase the emergency response time for fire and police vehicles. Speed humps may disturb or injure patients riding in ambulances.
- Passing over a speed hump can potentially cause damage to emergency vehicle.
- Traffic may be diverted to an adjacent street to avoid the speed humps.
- Drivers tend to speed up between humps or may drive in the gutter to make up for lost time.
- Speed humps can be hazards to bicyclists, motorcyclists and pedestrians. Pedestrians can confuse speed humps for crosswalks.
- Signs and striping associated with speed humps can be unsightly to the neighborhood.
- Vehicle noise increases in the vicinity of speed humps due to braking and suspensions.
- People with disabilities may experience discomfort going over speed humps.

The Police and Fire Departments have consistently opposed speed humps on the basis that it impairs their response in an emergency, can potentially damage vehicles and injure passengers, and introduces unexpected obstructions on the street. Memos from both departments are attached. The Fire Chief will also present video materials illustrating adverse impacts on fire operations.

Most streets in the City would not be candidates for speed humps, based on one or more criteria. For example all “major local”, “collector” and “arterial” streets would be disqualified because of their classification. Many other local streets are key emergency routes since there are few arterial streets in the City. Still others are too short, too steep or have horizontal curves. Narrower streets, such as those less than 30 feet wide, tend to have lower prevailing speeds already and would not meet the minimum speed requirement. Lastly, many candidate street segments fail because the minimum number of residents would not sign a petition. If added to the Toolbox, it is estimated that less than 10% of the residential streets would qualify for them, and even fewer would meet the petition requirement.

Speed humps near schools were considered as a possible qualifying criteria. School areas, by their nature, experience congestion during short time periods in the morning and afternoon. As a result, speeding does not occur during the critical times. During the rest of the day, on weekends and during the summer, children are rarely present. If speed humps were placed for school safety, their effectiveness would be reduced because speeds are already reduced. Also, the speed humps would be in place all day, while the purpose for them may only exist during short times during each school day. The better reason for speed humps is to reduce speeding or cut-through traffic that occurs all the time on a residential local street. Other traffic calming measures may be more appropriate near schools, and especially near school crosswalks.

Speed Cushions

Speed cushions are similar to speed humps, except that the hump is divided into segments such that a wide tracked vehicle, such as a fire engine, could pass without traversing the hump. Narrower wheeled vehicles would still have to drive over at least one cushion, effectively slowing speeding drivers. However, drivers often cross the center of the road or drive in the gutter to avoid the cushions and align at least one set of wheels with the gap. This can increase the risk of a collision at the speed cushion.

CONCLUSION:

It is recommended that the City Council review the related materials and provide staff with direction for any changes to the Toolbox.

Attachments:
A. Memo from Police Department
B. Memo from Fire Department
C. NTMP toolbox
D. NTMP flowchart
E. Speed Hump Criteria Summary
F. Speed Hump Detail
G. Speed Humps Article
H. Lighted Signs Brochure

MANHATTAN BEACH POLICE DEPARTMENT
MEMORANDUM

July 14, 2005

To: Rob Osborne, Management Analyst

From: Derrick Abell, Police Lieutenant

Subject: Proposal for Speed Humps on Public Streets in the City of Manhattan Beach

In December of 1999, The City submitted a proposal to Council, which did not support the installation of speed humps in the City of Manhattan Beach. The concept of using speed humps to alleviate speeding problems in the City of Manhattan Beach has been raised on a number of occasions by residents and groups.

Although the Police Department is in favor of alternatives that would help to reduce the speeding concerns in the community, we also have a strong opposition to the installation of speed humps on the streets of Manhattan Beach.

The installation of speed humps will have an adverse impact on our ability to respond quickly to emergency calls in the city of Manhattan Beach. Officers are often tasked with handling various types of emergency calls that require a quick and immediate response. By installing speed humps on our City streets, this will limit our ability to provide the best service possible.

We continue to encourage the residents and other concerned groups to suggest other traffic calming devices that would assist the City and Police Department in an effort to reduce the speeding problems in the City of Manhattan Beach. We are hopeful that these efforts will support our ability to respond to emergency calls and provide our residents with the best service possible.

TO: Rob Osborne, Management Analyst

THROUGH: Richard Thompson, Community Development Director

FROM: Dennis Groat, Fire Chief

SUBJECT: **TRAFFIC CALMING MEASURES**

DATE: September 6, 2005

Rob,

The Fire Department is fully supportive of having safe streets in our community. Speeding vehicles create many hazards, and we are supportive of all reasonable measures to keeping vehicle speeds at safe levels. In recent years, some communities have implemented wide-ranging programs to "calm" traffic. In 2002, our City formed an ad hoc Neighborhood Traffic Committee (NTC) to identify areas that may need a Traffic Control Plan and to develop a recommended list ("tool box") of possible Traffic Control Measures for these areas. The Fire Department played an active role throughout this process. In this study, many types of traffic management devices were analyzed for overall usefulness, and ultimately, a "tool box" of traffic control measures was presented to the Mayor and Council for possible use in our community. The "tool box" developed by the NTC contains an assortment of measures that can be implemented in an escalating, sequential manner to mitigate traffic problems, including excessive traffic speeds. In the final analysis, for a variety of reasons, Council chose not to include speed humps and speed bumps on the adopted list of mitigating measures.

Speed bumps and speed humps present significant obstacles to the delivery of Fire Department services. These obstacles include:

- Increases in emergency response times. Fire Engines must slow down significantly to pass over these obstacles, and impacts from multiple bumps or humps are substantial.
- Increased times for emergency medical transportation. Paramedic vans must slow to a near-stop when crossing them while transporting patients to the hospital
- Stress and damage to our heavy Fire Engines from crossing these obstacles
- Noise impacts to adjoining neighbors from slowing and acceleration of large vehicles, plus the noise created traversing the bumps and humps
- These impediments to emergency response are in place every day at all times, regardless of traffic conditions. This is especially frustrating during low- and no-traffic periods

Many studies have been conducted on the impacts of speed humps and speed bumps to the delivery of Fire and Emergency Medical services. Excerpts from these studies reinforce our concerns for active measures such as speed bumps and humps.

“Perhaps more important, the four test vehicles averages slightly less than 20 mph across the speed hump test route, about half the response cruising speed of 35-40 mph typically attained by fire vehicles on unimpeded roads.” (Firehouse, March 1998)

“The fire truck response more than DOUBLED (109%) from an average of 39.75 seconds to an average of 81.0 seconds in only three tenths of a mile. If this time span were to be projected to a full mile, … the time delay difference…could very well be the deciding factor in a life or death situation.

The Paramedic van response was approximately again another one half times greater (79%) from approximately 42 seconds to 75 seconds in only three tenths of a mile.” (Sergeant Hal Brothheim, The Journal of Law Enforcement).

“When communities lack a good traffic calming program, residents often ask for speed humps, since they are the only tool they know… Once speed humps are in place, it is often difficult to work with residents to get more appropriate tools in place… Large aerial ladder trucks with widely spaced axles take the longest to cross. There is also some evidence that humps stress equipment and create unnecessary wear.” (Local Government Commission Center for Livable Communities, 2001)

“Calming devices inflict permanent 24-hour delays to emergency response, unlike traffic congestion, which occurs only periodically. In addition, a study conducted by the Fire Department of Austin, Texas showed an increase in travel time of up to 100% by ambulances traveling over humps while transporting injured victims.” (Kathleen Cologne, Problems associated with Traffic Calming Devices, 1999)

“When asked to make decisions about traffic management programs, elected officials must clearly understand the tradeoffs that will occur in emergency response times and capabilities. Citizens will inevitably complain when response times are slowed and elected officials will have to support their city’s emergency services against these complaints… Solutions that may seem obvious often have hidden problems that aren’t discovered until the programs have been implemented… Planners should try passive strategies first and phase in more active strategies only if necessary.” (NFPA Journal, January/February 1997)

The Fire Department would prefer that speed bumps, speed humps, and speed tables not be added to our adopted list of traffic control measures. Should the existing measures in the traffic control “tool box” prove inadequate for a particular situation, we request that the Mayor and Council look to “active” traffic control measures with less negative effect on emergency response and services such as the recently developed “speed pillows”, rather than speed bumps, humps, and tables. Information on the most recent designs for speed pillows is available, should the need arise.

Please contact me if you require any additional clarification on this issue.

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NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM TOOLBOX APPLICATION CRITERIA –NOVEMBER 19, 2002

TRAFFIC MANAGEMENT MEASURE	PROBLEMS TARGETED	STREET TYPE (1)	MINIMUM CRITERIA				
			VOLUME	SPEED	DIVERSION TO ADJACENT STREETS	GRADE	OTHER CRITERIA
LEVEL ONE TOOLS							
Enhanced Police Enforcement	Moving Vehicle Violations Running Stop Signs	All	(2)	(3)	None expected	N/A	None
Speed Monitoring Trailer	High Speeds	All	(2)	(3)	None expected	N/A	None
Neighborhood Traffic Watch Program	Moving Vehicle Violations Running Stop Signs	All	(2)	(3)	None expected	N/A	Requires willing participants/volunteers
Higher Visibility Crosswalk	Moving Vehicle Violations Pedestrian Safety Running Stop Signs	All	>500 ADT	(3)	None expected	N/A	- At current crosswalk location - Near pedestrian generating land use
Pedestrian Crossing Signs	Moving Vehicle Violations Pedestrian Safety Running Stop Signs	All	> 500 ADT	(3)	None expected	N/A	- At current crosswalk location - Near pedestrian generating land use

NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM TOOLBOX APPLICATION CRITERIA –NOVEMBER 19, 2002

TRAFFIC MANAGEMENT MEASURE	PROBLEMS TARGETED	STREET TYPE (1)	MINIMUM CRITERIA				
			VOLUME	SPEED	DIVERSION TO ADJACENT STREETS	GRADE	OTHER CRITERIA
Electronic Speed Limit Signs/Larger Static Speed Limit Signs	High Speeds	All	> 500 ADT	Critical speed is > 7 mph over posted limit	None expected	N/A	Conditions not readily apparent to driver such as topography, vegetation, etc.
LEVEL TWO TOOLS							
Traffic Signal Adjustments to Discourage Cut-Through Traffic	Cut-Through Traffic	All	>15% of peak hour volume is cut-through traffic	(3)	Must meet diversion chart criteria	N/A	- Must have identified cut-through traffic - Must have traffic signal adjacent to residential neighborhood
Turn Restrictions Via Signage	Cut-Through Traffic	All	> 15% of peak hour volume is cut-through traffic	(3)	Must meet diversion chart guidelines	N/A	- Must have identified cut-through traffic
Rumble Strips/Dots	High Speeds	All	(2)	(3)	None expected	Less than 5 %	None
Crosswalk Warning System	High Speeds, Pedestrian Safety	All	> 500 ADT	Critical speed is > 7 mph over posted speed	None expected	N/A	None

NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM TOOLBOX APPLICATION CRITERIA –NOVEMBER 19, 2002

TRAFFIC MANAGEMENT MEASURE	PROBLEMS TARGETED	STREET TYPE (1)	MINIMUM CRITERIA				
			VOLUME	SPEED	DIVERSION TO ADJACENT STREETS	GRADE	OTHER CRITERIA
Raised Median Island	High Speeds, Cut Through Traffic	All	> 15% of peak hour volume is cut-through traffic	Critical speed is > 7 mph over posted speed	None expected	less than 10%	- Must not significantly impede emergency vehicle access - Must meet drainage requirements
Entry Island (Neighborhood Identification Island)	High Speeds, Cut Through Traffic	All	> 15% of peak hour volume is cut-through traffic	Critical speed is > 7 mph over posted speed	None expected	less than 10%	- Must not significantly impede emergency vehicle access - Must meet drainage requirements
Mid-Block Narrowing	High Speeds, Cut-through Traffic	All	> 15% of peak hour volume is cut-through traffic (between 500 and 2,000 total ADT on the street)	Critical speed is > 7 mph over posted speed	None expected	less than 10%	- Must not significantly impede emergency vehicle access
Chokers at Intersections	High Speeds, Cut-through Traffic	L, ML, RC (ALL IF NO RC)	> 15% of peak hour volume is cut-through traffic (between 500 and 2,000 total ADT on the street)	Critical speed is > 7 mph over posted speed	None expected	less than 10%	- Must not significantly impede emergency vehicle access
Lane Reduction/Lane Narrowing/ Restriping	High Speeds, Cut-through Traffic	All	> 15% of peak hour volume is cut-through traffic (between 500 and 2,000 total ADT on the street)	Critical speed is > 7 mph over posted speed	Must meet diversion chart criteria	N/A	- Must not create significant parking impact due to loss of parking

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NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM TOOLBOX APPLICATION CRITERIA –NOVEMBER 19, 2002

TRAFFIC MANAGEMENT MEASURE	PROBLEMS TARGETED	STREET TYPE (1)	MINIMUM CRITERIA				
			VOLUME	SPEED	DIVERSION TO ADJACENT STREETS	GRADE	OTHER CRITERIA
Stop Sign as Neighborhood Traffic Control Measure	High Speeds, Cut-through Traffic	L, ML, RC (ALL IF NO RC)	> 15% of peak hour volume is cut-through traffic (between 500 and 2,000 total ADT on the street)	(3)	Must meet diversion chart criteria	N/A	Requires review by City Traffic Engineer and City Council approval
Parking Restrictions	Non-Residential Parking Intrusion	All	N/A	N/A	Review impacts to Surrounding Streets	N/A	Parking Study
LEVEL THREE TOOLS							
Raised Crosswalk	High Speeds, Pedestrian Safety	L, ML, RC (ALL IF NO RC)	(2)	Critical speed > 7 mph over posted speed	None expected	less than 10%	- Must meet drainage requirements - Must not significantly impede emergency vehicle access > 25 pedestrians during peak hour, near pedestrian generator

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NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM TOOLBOX APPLICATION CRITERIA –NOVEMBER 19, 2002

TRAFFIC MANAGEMENT MEASURE	PROBLEMS TARGETED	STREET TYPE (1)	MINIMUM CRITERIA				
			VOLUME	SPEED	DIVERSION TO ADJACENT STREETS	GRADE	OTHER CRITERIA
Raised Intersection	High Speeds, Pedestrian Safety,	L, ML, RC (ALL IF NO RC)	(2)	Critical speed > 7 mph over posted speed	Must meet diversion chart criteria	less than 10%	- Must meet drainage requirements - Must not significantly impede emergency vehicle access > 25 pedestrians during peak hour, near pedestrian generator
Traffic Circle	High Speeds, Accident History, Vehicle Conflicts	L, ML, RC (ALL IF NO RC)	from 500 to 5,000 ADT	Critical speed > 7 mph over posted speed	Must meet diversion chart criteria	less than 10%	- Intersecting roadways must be of sufficient width - Loss of parking must be assessed
Restricted Movement Barrier	Cut-trough traffic, Vehicle conflicts	L, ML	> 15% of peak hour volume is cut-through traffic	(3)	Must meet diversion chart criteria	N/A	- Must meet drainage requirements - Must not significantly impede emergency vehicle access
Entrance Barrier-Half Closure	Cut-through Traffic, Vehicle Conflicts	L, ML	> 15% of peak hour volume is cut-through traffic	(3)	Must meet diversion chart criteria	N/A	Must not significantly impede emergency vehicle access
Diagonal Diverter	Cut-through Traffic, Vehicle Conflicts	L, ML	> 15% of peak hour volume is cut-through traffic	(3)	Must meet diversion chart criteria	N/A	- If full diverter, cannot be truck or transit route, - Must not significantly impede emergency vehicle access

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NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM TOOLBOX APPLICATION CRITERIA –NOVEMBER 19, 2002

TRAFFIC MANAGEMENT MEASURE	PROBLEMS TARGETED	STREET TYPE (1)	MINIMUM CRITERIA				
			VOLUME	SPEED	DIVERSION TO ADJACENT STREETS	GRADE	OTHER CRITERIA

Notes:

1) Street Type key: L – Local, ML – Major Local, RC – Residential Collector, C- Collector, All – All Residential Streets, excludes arterials

2) Specific volume (ADT) criteria may not be appropriate for this tool, it may be applied over a range of volume

3) Specific speed criteria may not be appropriate for this tool, it may be applied over a range of observed speeds at the discretion of the City Traffic Engineer or the Police Department

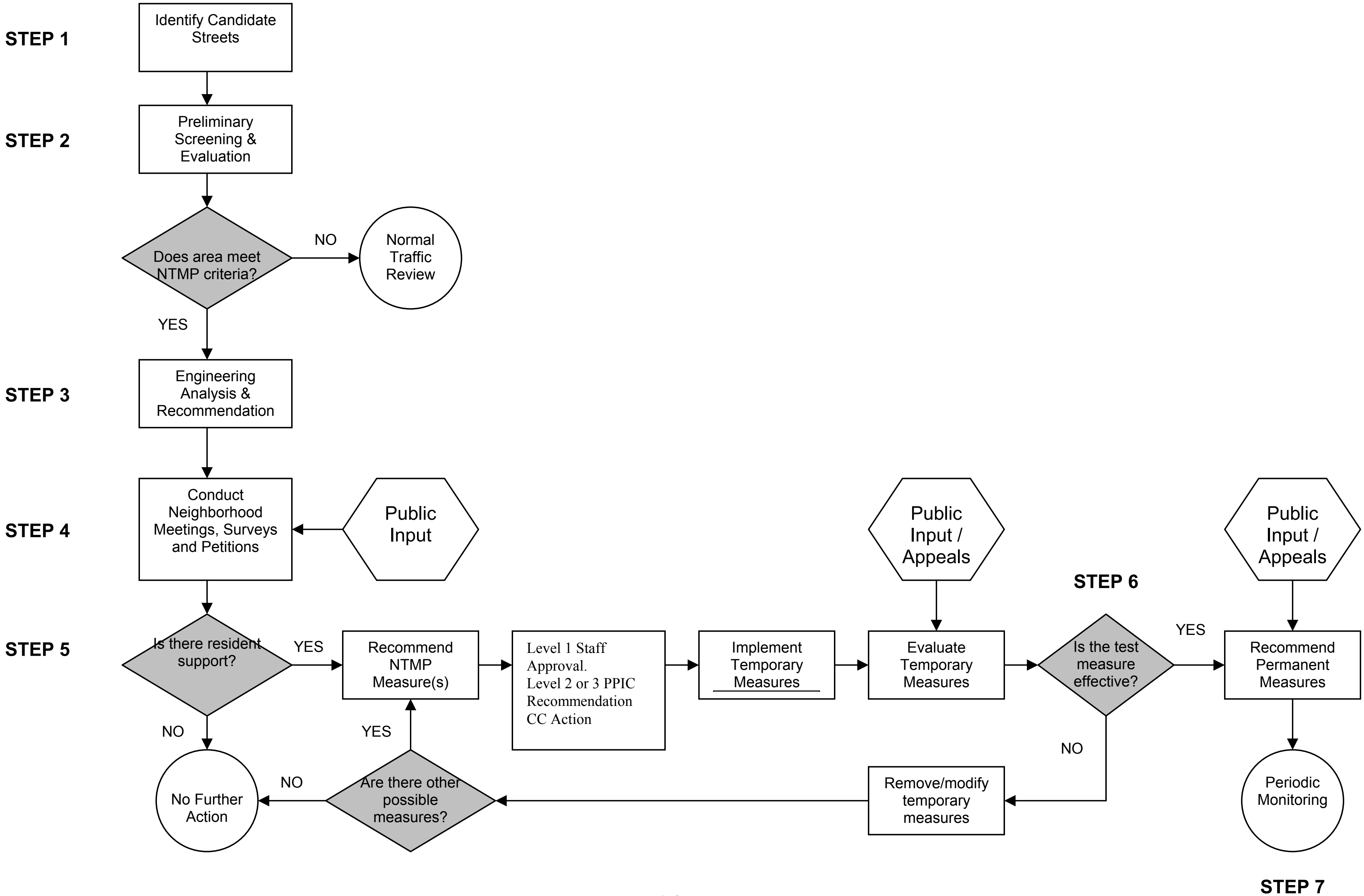
General Notes:

- final determination of certain control application based on review by City staff

- subject to modification by City Council on a case-by-case basis

H:\General Plan\Toolbox Criteria Table to CC 11-19-02.doc

CITY OF MANHATTAN BEACH
NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM PROCESS
EXHIBIT B



ELIGIBILITY CRITERIA FOR THE INSTALLATION OF SPEED HUMPS

CRITERIA	INSTITUTE OF TRANSP. ENGRS.	CITY OF PASADENA	CITY OF LA CANADA FLINTRIDGE
Type of Street	Residential	Residential	Local or residential street
Street Length	n/a	Minimum 800 feet Do not install on cul-de-sac	Full block length
Street Width	No greater than 40 feet	n/a	40 feet or less
Number of Lanes	No more than 2 travel lanes	No more than 2 travel lanes	no more that two travel lanes
Street Grade	8 percent or less	5 percent or less	8% or less
Horizontal/Vertical Alignment	Avoid within horizontal curves of less than 300 feet centerline radius and on vertical curves with less than the minimum safe stopping sight distance.	Street must have adequate vertical and horizontal alignment and sight distance	Roadway should not have a substantial horizontal or vertical curvature.
Sight Distance	Minimum safe stopping sight distance	Adequate sight distance	n/a
Traffic Speeds	Prima facie speed limit is 30mph or less. Carefully consider for street where the majority of the vehicles travel at relatively fast speeds (45 mph or greater)	25 mph or less	Posted 30 mph or less with prevailing speeds greater than 35 mph.
Traffic Volumes	Less than 3000 vehicles per day. When considering streets with higher volumes, should give special evaluation and justification for their use.	Less than 3000 vehicles per day. Determination on a case by case basis	500 - 2000 vehicles per day
Traffic Safety	Determination that such an installation will not introduce increased accidents.	n/a	n/a
Vehicle Mix	Do not install on street with more than 5 percent of long wheel-base vehicles unless there is a reasonable alternative route.	Do not install on truck routes.	n/a
Emergency Vehicle Access	Do not install on emergency routes.	Do not install on emergency routes	n/a
Transit Routes	Do not install on transit routes	Do not install on transit routes	Not on a public transit roadway
Citizen Support	Majority of the residents along the affected portion of street should ideally support their installation.	67 percent of residents along affected portion of subject street must support their installation	80% of properties in favor of installation.
Other	Give special consideration to motorcycles, bicycles and other type of special vehicles that use the street.		The proposal must be reviewed by LA County Fire and Sheriff's departments

ELIGIBILITY CRITERIA FOR THE INSTALLATION OF SPEED HUMPS

CRITERIA	LA COUNTY PUBLIC WORKS	CITY OF PALO ALTO	CITY OF BURBANK
Type of Street	Local residential street	Local residential streets	Residential
Street Length	No minimum - humps shall be spaced up to 600 feet.	No minimum requirements provided that there can be at least 250 feet between a hump and a stop sign.	n/a
Street Width	Not over 40 feet	n/a	No greater than 40 feet
Number of Lanes	1 lane each direction	n/a	No more than 2 travel lanes
Street Grade	5% of less	not to exceed 5%	Less than 5 percent
Horizontal/Vertical Alignment	Do not install on street that have curbs.	Not to be installed within 100 feet of the beginning or end of a curb of less than 300 feet centerline radius.	300 feet or more horizontal center line radius
Sight Distance	n/a	stopping sight distance	n/a
Traffic Speeds	30 mph or less	Minimum of 32 mph	Prevailing speeds of 30 mph or more
Traffic Volumes	500 - 2000 vehicles per day	500 - 4000 ADT	Minimum daily traffic volumes over 500 cars per day
Traffic Safety	Shall not be located on a thoroughfare which impacts an area servicing more than 75 homes or resident units.	n/a	n/a
Vehicle Mix	n/a	Do not install on truck or transit routes	n/a
Emergency Vehicle Access	Do not install on primary route for fire and ambulance or 25 feet of either side of fire hydrants	Do not install on primary or routine access route for emergency vehicles	Do not install on designated emergency vehicle access routes.
Transit Routes	Do not install on bus routes	Do not install on transit routes	Do not install on transit routes
Citizen Support	75% of the residents fronting the roadway must support the installation.	66% of all dwelling units with addresses on affected streets	67 percent of owners/residents on the impacted street and at least 80 80 percent of residents must be contacted and noted on petition
Other	Installation is approved by the Fire Prevention Unit.	At least 6 reported speed related traffic accidents in the last 3 years.	

ELIGIBILITY CRITERIA FOR THE INSTALLATION OF SPEED HUMPS

CRITERIA	CITY OF CAMARILLO	CITY OF SANTA BARBARA	CITY OF WESTLAKE VILLAGE
Type of Street	Residential or Local road	Local or Collector roadways	Residential street
Street Length	n/a	n/a	At least 1/4 mile long
Street Width	No greater than 40 feet	n/a	40 feet or less
Number of Lanes	No more than 2 traffic lanes	n/a	one lane each direction
Street Grade	n/a	6% or less	5% or less
Horizontal/Vertical Alignment	n/a	n/a	n/a
Sight Distance	n/a	n/a	n/a
Traffic Speeds	87 percent of the surveyed motorists exceeds a speed of 25 mph	no more than 30 mph	67% of the motorists exceed the 25 mph speed limit
Traffic Volumes	exceeds 2500 vehicles in a 24 hour period.	must be greater than 1000 but no more than 4000 vehicles in a 24 hour period	Greater than 2000 ADT
Traffic Safety	n/a	A speed survey must show that more than 25 percent of the motorist traveling exceed the posted speed by 5 mile or more	n/a
Vehicle Mix	n/a	n/a	n/a
Emergency Vehicle Access	City to notify Fire, Sheriff and Ambulance services on new installations of speed humps	Shall not be constructed on streets that are designated as primary emergency response w/o fire approval	n/a
Transit Routes	n/a	n/a	n/a
Citizen Support	60 percent of the residents, excluding churches and apartments, that face the street within 75 feet from the curb.	A three-quarter (75%) majority must agree that speed humps are desired	At least 60% of the property owners that abut the proposed speed hump.
Other			City will publish notice of a public hearing to all property owners within 300 feet of the street segment

ELIGIBILITY CRITERIA FOR THE INSTALLATION OF SPEED HUMPS

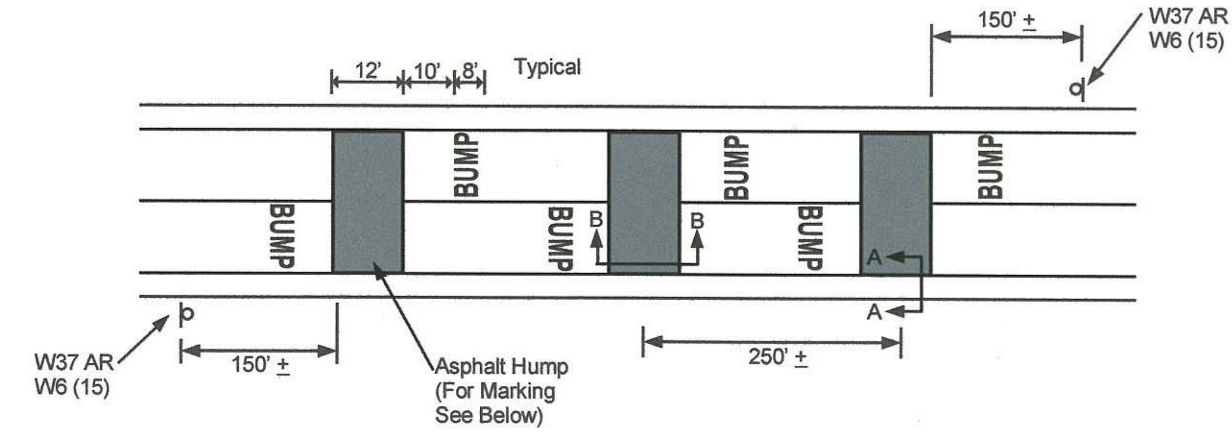
CRITERIA	CITY OF GLENDALE	CITY OF THOUSAND OAKS	CITY OF CALABASAS
Type of Street	Street must be located in "residence district" as defined in CVC, and designated local/collector in Gen Pln	Residential road	Residential road
Street Length	Minimum block length of 500 feet	Minimum 1/4 of a mile	n/a
Street Width	No greater than 40 feet	No more than 40 feet	n/a
Number of Lanes	No more than 2 travel lanes	No more than 2 traffic lanes	n/a
Street Grade	10 percent or less	n/a	5% or less
Horizontal/Vertical Alignment	Adequate vertical and horizontal alignment	n/a	n/a
Sight Distance	Shall provide a min. of 200 feet clear visibility on approach to hump	n/a	n/a
Traffic Speeds	Speed limit shall be no greater than 25 mph as determined in accordance with state law. The measured 85th percentile speed of traffic shall be equal to or greater than 30 mph.	25 mph	25 mph
Traffic Volumes	Between 1500 and 5000 vehicles on local residential streets, between 3000 and 5000 on residential collector streets, total in both directions, in 24 hr period avg wkdy	must exceed 2500 vehicles in a 24 hour period	Under traffic calming guidelines
Traffic Safety	n/a	More that 87 percent of the surveyed motorists exceed a speed of 25 mph	n/a
Vehicle Mix	Do not install on truck routes	n/a	n/a
Emergency Vehicle Access	Do not install on emergency routes	n/a	n/a
Transit Routes	Do not install on transit routes	n/a	n/a
Citizen Support	75 percent in support of installation	60 percent of the residents that face the street	75 percent of the residents fronting the roadway in question
Other			Speed humps shall not be installed within 100 feet of any intersection

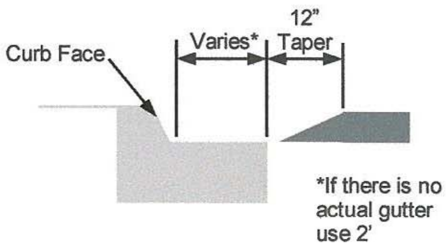
ELIGIBILITY CRITERIA FOR THE INSTALLATION OF SPEED HUMPS

CRITERIA	CITY OF CULVER CITY	CITY OF AGOURA HILLS	COUNTY OF VENTURA
Type of Street	Local residential streets only	Residential streets	Residential road or local road
Street Length	Approx. 1/4 mile for streets w/ intersections at both ends. At least 800 feet on cul-de-sac streets.	Minimum of 1/4 mile and conform to the definition of "Residential District" in the California vehicle code.	Definition of "Residential District" in the California vehicle code.
Street Width	No greater than 40 feet	n/a	40 feet or less
Number of Lanes	No more than 2 travel lanes	n/a	no more than two traffic lanes
Street Grade	6 percent or less	6% exceptions for steeper grades	n/a
Horizontal/Vertical Alignment	Shall not be installed where street curvature has a radius of 300 feet or less.	may be allowed. Care should be taken with respect to visibility over crest vertical curves.	Can not be installed due to severe horizontal and vertical curves and excessive street down grade.
Sight Distance	n/a	n/a	Inadequate sight distance
Traffic Speeds	Legal speed limit of 25 mph or less. At least 66.7% of traffic observed during non-peak hrs exceeding posted or legal speed limit.	60% of the vehicles on the street are exceeding the 25 mph speed limit	67% of the motorists exceed the 25 mph speed limit
Traffic Volumes	Between 2500 and 7500 vehicles per day.	Minimum daily volume of 2000 vehicles or 200 during any peak hour. Amend the minimum volume criteria when the prevailing speed exceeds 40 mph to 1400 per dayor 140 per hour.	Greater than 1000 vehicles per day.
Traffic Safety	n/a	n/a	n/a
Vehicle Mix	n/a	n/a	n/a
Emergency Vehicle Access	Do not install on primary emergency vehicle access routes.	n/a	Notify P.D. and Fire of new speed humps.
Transit Routes	Do not install on transit routes	n/a	n/a
Citizen Support		At least 60% of the affected residents	At least 67% of the property owners.
Other		Humps should be installed at approximately 400 feetspacing. The minimum number of humps on any street should be three.	Speed humps shall not be installed on streets where the traffic will be diverted to a nearby residential or local street

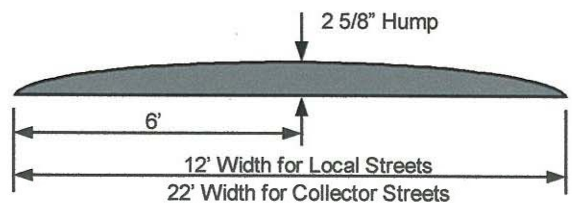
ELIGIBILITY CRITERIA FOR THE INSTALLATION OF SPEED HUMPS

CRITERIA	CITY OF PLACENTIA	CITY OF MISSION VIEJO	CITY OF SIMI VALLEY
Type of Street	Local residential streets only	Residential streets	Residential road or local road
Street Length	Minimum of 1,500 feet between stop signs or traffic signals.	Minimum of 1/4 mile and conform to the definition of "Residential District" in the California Vehicle Code. Not on very short blocks or cul-de-sacs	Minimum of 1/4 mile and conform to the definition of "Residential District" in the California Vehicle Code. Not on cul-de-sacs.
Street Width	n/a	40 feet or less	40 feet or less
Number of Lanes	No more than 2 travel lanes	no more than two traffic lanes	no more than two traffic lanes
Street Grade	n/a	5% or less	n/a
Horizontal/Vertical Alignment	n/a	Only on roads with adequate horizontal and vertical alignment as determined by City Engineer	n/a
Sight Distance	n/a	Not on roads with inadequate sight distance	Inadequate sight distance
Traffic Speeds	Legal speed limit of 25 mph or less. Prevailing speeds must exceed 30 mph	15% of the vehicles on the street must exceed the 32 mph critical speed Legal speed limit of 25 mph.	85% of the motorists exceed the 25 mph speed limit
Traffic Volumes	Greater than 3,000 vehicles per day	Minimum daily volume of 2000 vehicles per day	Average daily volume greater than 2,000 vehicles per day
Traffic Safety	n/a	Collision history considered.	n/a
Vehicle Mix	n/a	n/a	n/a
Emergency Vehicle Access	Do not install on priority emergency vehicle access routes.	n/a	Police Dept. must concur that it will not adversely affect access.
Transit Routes	Do not install on transit routes	n/a	n/a
Citizen Support	At least 65% of homes on street as well as 65% of homes on adjacent parallel streets, as determined by City Engineer.	At least 67% of the households with addresses on the street segment	At least 67% of the residents fronting the street. Includes apartment residents.
Other	Notify w/in 300' of subject street. Staff, Traffic Commission and Council review. Priority List, annual funding limits	Review by emergency service agencies. City Council approval.	Notice posted in local newspaper, on street, at intersections, and on parallel streets.

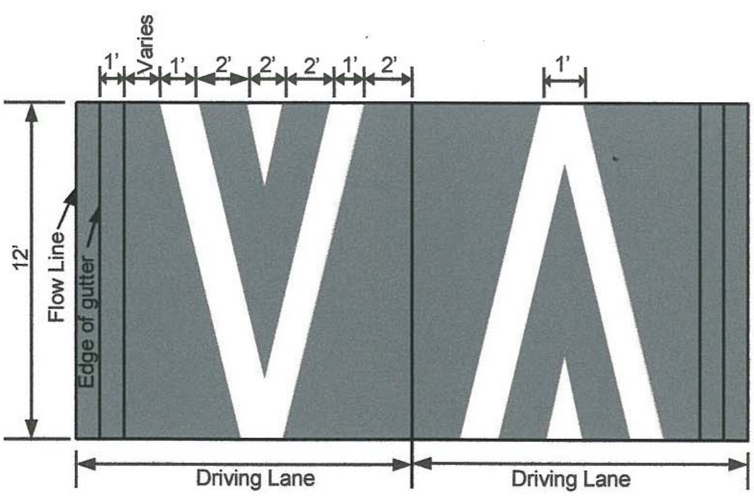




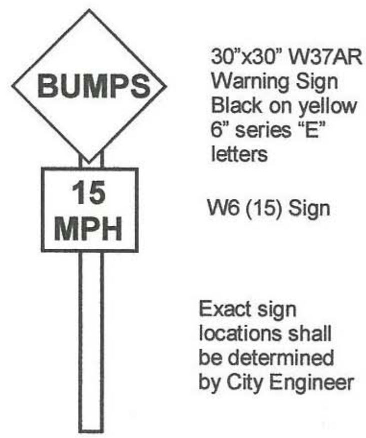
SECTION A-A



SECTION B-B



SPEED HUMP MARKING



ADVANCE SIGNING

NOTES:
1) Speed humps may only be installed on streets with grades less than 5%, unless otherwise approved by the Traffic and Safety Committee.
2) Speed humps shall only be installed on street surfaces in good condition.
3) Proximity to existing driveways, bus stops, utility vaults, boxes, and manholes shall be minimized.
4) Speed humps shall be placed adjacent to property lines, and not mid-lot, to the extent possible.

SPEED HUMP STANDARD

TC-01

CITY OF ROLLING HILLS ESTATES TRAFFIC CALMING TECHNIQUE

A Matched Case–Control Study Evaluating the Effectiveness of Speed Humps in Reducing Child Pedestrian Injuries

June M. Tester, MD, MPH, George W. Rutherford, MD, Zachary Wald, MCP, and Mary W. Rutherford, MD

Objectives. We evaluated the protective effectiveness of speed humps in reducing child pedestrian injuries in residential neighborhoods.

Methods. We conducted a matched case–control study over a 5-year period among children seen in a pediatric emergency department after being struck by an automobile.

Results. A multivariate conditional logistic regression analysis showed that speed humps were associated with lower odds of children being injured within their neighborhood (adjusted odds ratio [OR]=0.47) and being struck in front of their home (adjusted OR=0.40). Ethnicity (but not socioeconomic status) was independently associated with child pedestrian injuries and was adjusted for in the regression model.

Conclusions. Our findings suggest that speed humps make children's living environments safer. (*Am J Public Health.* 2004;94:646–650)

Pedestrian injuries caused by automobile collisions are a leading cause of death among children aged 5 to 14 years.[1] The demographic characteristics of children injured by automobiles have remained the same over the past 20 years, with boys, children between the ages of 5 and 9 years, and children living in neighborhoods of low socioeconomic status (SES) at highest risk.[2–4]

Children en route to school or at play in front of their homes are exposed to roads and street traffic. Modifying traffic patterns is a passive and sustainable public health intervention that may make children's living environments safer.[5] Traffic patterns can be modified with a number of engineering strategies that fall under the rubric of "traffic calming." Distinct from speed limit signs or stop signs, traffic calming measures such as speed humps, street closures, median barriers, and traffic circles are successful in providing long-term safety for pedestrians and motorists because they are physical structures with designs that are self-enforcing rather than requiring police enforcement.[6–8]

For years, European countries such as Denmark, the Netherlands, and Great Britain, as well as Australia and New Zealand, have implemented and tested the effects of traffic calming.[6] A report published in British Columbia summarized 43 international studies that demonstrated reductions in collision frequency rates ranging from 8% to 100% after implementation of traffic calming measures.[6] A Danish study showed that, in comparison with control streets, 72% fewer injuries occurred on experimental streets incorporating a variety of traffic calming measures in addition to new speed zoning requirements.[9]

As a result of the successful efforts in other countries, there is developing interest in traffic calming in the United States, and the Federal Highway Administration, in cooperation with the Institute of Transportation Engineers, has initiated a national traffic calming technical assistance project.[6] However, the majority of safety studies focusing on traffic calming measures have assessed accident statistics before and after installation, and there is no available hospital-based information on the specific effects of these interventions on childhood pedestrian injury.

Oakland has historically been one of the most dangerous cities in California in which to be a pedestrian, exhibiting, for example, the highest rate of pedestrian fatalities among the state's cities in 1995.[10] In that year, after a series of child pedestrian deaths, the Oakland Pedestrian Safety Project was formed. This multidisciplinary alliance addressed child and senior pedestrian injuries occurring in the city of Oakland and advocated for installation of speed humps. Over the 5-year period 1995 to 2000, Oakland installed about 1600 speed humps on residential streets. In this study, we examined the effect of residing on a street with speed humps on the odds of child pedestrian injuries in Oakland.

METHODS

We conducted a matched case–control study among Oakland residents younger than 15 years over the 5-year period March 1, 1995, to March 1, 2000. Case patients were children who were seen in the emergency department at Children's Hospital Oakland after having been struck and injured by an automobile on a residential street. Since this hospital receives all pediatric ambulance trauma transports (including deaths on the scene) from the city of Oakland, it was considered an appropriate choice to target child pedestrians injured in Oakland. Case patients were each compared with 2 respective controls matched in regard to age and gender. The purpose of the study was to determine whether these children who had been struck by automobiles were any less likely to live near a speed hump than their peers who lived in the same city boundaries but visited the emergency room that day for a reason other than being hit by a car.

We identified case patients retrospectively from a trauma database using *International Classification of Diseases* (9th Revision)[11] E-code E814.7 (motor vehicle traffic accident involving collision with a pedestrian). Cases were limited to those involving children younger than 15 years who were residents of the city of Oakland and who were injured or died as a result of the collision. We reviewed charts and emergency medical service data sheets to eliminate parking lot injuries, injuries involving bicyclists who had been misclassified as pedestrians, and injuries suffered by children in driveway rollover collisions. In addition, we reviewed traffic report data from the Oakland Police Department, primarily to confirm locations of collisions. When necessary, we reviewed original traffic reports for further clarification.

We also restricted our analysis to children injured or killed within 0.25 mi (0.4 km) of home and used a street atlas[12] to determine whether the injury occurred on the street block of the child's residence (defined by Mueller et al.[2] as the "index street"), within a 0.25-mi radius (about 5 blocks, considered the "surrounding neighborhood"[2]), or at a more distant location within Oakland. The type of street on which a child lived was classified with the street atlas as well.[12] Only children residing on minor roads (residential streets) were eligible for the study, because speed humps are installed only on such roads.

Living on a street with a speed hump, or within 1 block of a speed hump, was our principal predictor variable. We used data from the Department of Traffic Engineering in Oakland to determine the exact locations and dates of installation of speed humps (Department of Traffic Engineering, unpublished data, 1995–2000). Speed humps that were located on the other sides of primary or secondary roads (arteries) or were installed after the date of the injury were not considered.

As mentioned, we matched each case patient, according to age, gender, and date of emergency department visit, with 2 controls seen in the emergency department that same day for a reason other than being struck by a car. We identified all eligible controls of the same sex and with the same year of birth as the case patient from the daily log and randomly selected 2 such individuals. In situations in which there were fewer than 2 control patients born in the same year as the case patient, we made a random decision to search the 1 year above or below the age of the case patient, and then 2 years above or below and so on, until a suitable control was identified. Ninety-three percent of all controls were within 2 years of age of their respective case patients.

Controls were restricted to Oakland residents living on residential streets. We collected information on ethnicity and insurance status (classified as private, public, or self-pay) from medical records. In addition, we categorized the SES of patient and control households, using 1990 census data on median household income within the case patient or control's census tract, as low ($0–$15 736), medium ($15 737–$30 115), or high (more than $30 115).[13] Finally, we examined the records of case patients and controls to ascertain the presence of certain preexisting diagnoses, such as cerebral palsy, mental retardation, paraplegia, and developmental delay, that would have affected their walking ability and, thus, their potential to be exposed as pedestrians to automobile traffic.

Statistical analyses were performed with Stata software (Stata Corp, College Station, Tex). We used McNemar matched pairs analyses in examining the 200 case–control pairs (100 case patients each matched to 2 controls). When a factor is truly protective against disease, there are more case–control pairs in which the case lacks (and the control has) this protective factor than the converse. Separate univariate analyses focused on ethnicity, census tract household income, and insurance status to determine whether they were independent predictors of child pedestrian injuries. Once significant ($P<.05$) variables were determined, we constructed a multivariate conditional logistic regression model that included only these variables.

RESULTS

We identified 236 individuals who had been seen in the emergency department during the study period and had been assigned an E-code of E814.7. We eliminated 52 potential case patients because they (1) were not Oakland residents at the time of admission, (2) were injured outside Oakland, (3) were more than 14 years of age, (4) were bicyclists who had been misclassified as pedestrians, or (5) had been injured by an automobile backing up within a driveway or parking lot. We eliminated an additional 84 potential patients because they either lived on an artery street or had been injured outside of their neighborhood, yielding a final study sample of 100 case patients.

Case patients and controls were similar in terms of age, gender, insurance status, median household income, and proportion with an underlying premorbid neurodevelopmental disease (Table 1). Case patients were more likely to be Asian or of Hispanic ethnicity. The odds of Asian children having been involved as a pedestrian in an accident were 5.8 times as high as those for White children ($P=.018$), and the odds of Latino children having been involved were 4.3 times as high ($P=.038$). Admitting diagnoses of controls are available on request from the authors.

Unadjusted odds ratios (ORs) derived from a matched pairs analysis showed a protective effect of speed humps. In comparison with children living more than a block from a speed hump, those living within a block of a speed hump were significantly less likely to be injured as pedestrians within their neighborhood (14% vs 23%; OR=0.50; 95% confidence interval [CI]=0.27, 0.89) (Table 2). Among the 100 case patients, 49 were actually hit on the block in front of their home (index street). As a subset, these children were even less likely to have a nearby speed hump than their controls (12% vs 24%; OR=0.38; 95% CI=0.15, 0.90) (Table 2).

We performed multivariate logistic regression analyses using both predictor variables and included race and ethnicity in the model. After control for race and ethnicity, speed humps were associated with significantly lower odds of children being injured in their neighborhood (adjusted OR=0.47; 95% CI=0.24, 0.95) and being struck on the block immediately in front of their home (adjusted OR=0.40; 95% CI=0.15, 1.06) (Table 2).

DISCUSSION

In our observational study, we found that children who lived within a block of a speed hump had significantly lower odds of being struck and injured by an automobile in their neighborhood. Living within a block of a speed hump was associated with a roughly 2-fold reduction in the odds of injury within one's neighborhood (adjusted OR=0.47). This protective effect was even more pronounced among the subset of children who were injured on the block immediately in front of their house (index street). Children living within a block of a speed hump exhibited a 2.5-fold reduction in the odds of being injured on their street (adjusted OR=0.4). These results highlight the effectiveness of speed humps in reducing child pedestrian injuries.

TABLE 1—Demographic Characteristics of Case Patients and Controls

	Case Patients (n = 100)	Controls (n = 200)	Odds Ratio	P^a
Male, No. (%)	68 (68)	136 (68)	. . .	. . .
Age, y, mean (SD)	6.8 (3.5)	6.6 (3.7)	. . .	.63
Ethnicity, %				
White	3 (3)	16 (8)	Reference	
Black	49 (49)	117 (58.5)	2.4	.187
Native American/other	11 (11)	21 (10.5)	3.2	.115
Hispanic	22 (22)	31 (15.5)	4.3	.038
Asian	15 (15)	15 (7.5)	5.8	.018
Insurance status				
Private insurance	17 (17)	43 (21.5)	Reference	
Public insurance	78 (78)	147 (73.5)	1.3	.366
Self-pay	5 (5)	10 (5)	1.3	.717
Household income, $ (census tract)				
High (> 30 115)	12 (12)	39 (19.5)	Reference	
Medium (15 737–30 115)	75 (75)	136 (68)	1.8	.105
Low (0–15 736)	13 (13)	25 (12.5)	1.7	.265
Premorbid diagnosis[b]				
Mild mental retardation	1 (1)	1 (0.5)	. . .	
Developmental delay	0 (0)	3 (1.5)	. . .	

Note. A univariate analysis of age, ethnicity, insurance status, household income, and presence of a premorbid diagnosis showed that only ethnicity was independently associated with child pedestrian injury.

[a]All *P* values were obtained from conditional logistic regression analyses, except for age, which was obtained with a 2-tailed test of means.

[b]Case patients and controls were screened for the presence of any of the following premorbid diagnoses: cerebral palsy, mental retardation, quadriplegia, paraplegia, and developmental delay.

Exposure to Traffic

Increased exposure to traffic (especially traffic at high volume and speed) is a known risk factor for child pedestrian injury. Stevenson and colleagues showed that an increase in volume of 100 vehicles per hour is associated with an incremental increase of about 2.0 in the odds of pedestrian injury.[14] Average speeds traveled on streets are also associated with risk of injury, and at least 2 studies have demonstrated that a higher proportion of vehicles exceeding the posted speed limit is associated with higher odds of child pedestrian injuries.[14,15] In addition to the type of street, the number of streets that children cross on their way to school seems to affect their risk.[16]

Need for Passive Environment Modification

Given the relationship between exposure to traffic and risk of child pedestrian injuries, we have essentially 2 prevention strategies at our disposal: we can protect children from fast-moving traffic by modification of either their behavior or their traffic environment. There have been multiple attempts to modify children's behavior, including school training programs,[17] "traffic clubs" designed to educate parents and children about safe behavior on streets,[18] simulation games,[19] and community-level interventions.[20] For the most part, however, these educational efforts have been unable to exert meaningful changes in the long-term behavior of children, largely owing to the developmental limitations of preschool-aged children.[20] As a result, a great deal of attention has shifted to environment modification and the promise it holds for affecting child pedestrian injury rates.

Focus on Neighborhood Injury

The deliberate focus of our study was on pedestrian injuries occurring in a child's own neighborhood (defined here as within a 0.25-mi radius of the child's home) as opposed to all injuries, including those occurring at more distant sites. We focused on such injuries because although children leave their neighborhoods with adults (and often in automobiles), most of their unsupervised time is likely to be near home. In addition, the traffic calming methods we examined can be applied only to residential streets. One 8-year study that examined fatal head injuries revealed that injuries to pedestrians were the most common cause of fatal head injuries and that 53% of those injured were playing in the street at the time of the injury. Of the 135 accidents that fell into this category, only 1 involved a child who had been under adult supervision at the time of the accident (the remaining children had been supervised by siblings or other children).

The same study showed that 80% of fatal pedestrian injuries had taken place within 1 mi (1.6 km) of the child's home.[21] Among the 184 children we initially identified for this study, 125 (68%) were eligible for the study because their injury occurred within 0.25 mi of home (the other children were eliminated because they lived on arterial streets). Therefore, our data suggests that roughly two thirds of injuries occur within the 0.25 mi surrounding a child's home. Passive interventions that

TABLE 2—Odds of Pedestrian Injury Within a Child's Neighborhood and Odds of Injury on a Child's Index Street of Residence When Child's Home Is Within 1 Block of a Speed Hump: Multivariate Model

	Case Patients (n = 100), No. (%)	Control Subjects (n = 200), No. (%)	OR (95% CI)[a]	Adjusted OR (95% CI)[b]
Neighborhood injury	14 (14)	46 (23)	0.50 (0.27, 0.89)	0.47 (0.24, 0.95)
Index street injury	6 (12)	24 (24)	0.38 (0.15, 0.90)	0.40 (0.15, 1.06)

Note. OR = odds ratio; CI = confidence interval.

[a]Calculated from McNemar matched pairs analysis.

[b]Calculated from multivariate model including ethnicity.

reduce child pedestrian injuries are likely to be of greater benefit in areas where children are prone to spend time without adults.

In our study, SES was not a significant independent predictor of child pedestrian injury. Mueller and colleagues found that living in a census tract with a median household income level below $20 000 was associated with 7.0-fold higher odds of injury than living in a census tract with a median income level above $30 000.[2] Other research points toward an association between increasing rates of pedestrian injury and lower SES, as approximated by census tract of residence,[4] spatial modeling of census tract and other data with a geographic information system,[22] and more indirect indicators of lower SES such as living near a convenience store, gas station, or fast food store.[15]

It is possible that, in our population, "overmatching" was the reason SES was not found to be an independent risk factor. Case patients were not matched with controls on SES, but if lower SES is associated with both increased odds of injury[2] and increased odds of an emergency department visit,[23] choosing controls from the emergency department may have resulted in overmatching in terms of SES.

Limitations

Our study involves potential methodological limitations. For example, limiting measurement to speed humps on a child's street ignores the potential protective effect of speed humps around the corner from a child's house. Thus, by measuring speed humps lateral to an index street (rather than in a 1-block radius), we may have underestimated the relevant rate of exposure to this intervention, which would have affected our estimation of the intervention's protective impact.

There are also limitations involved with our study sample. While relying on emergency department visits ensured that we incorporated higher severity injuries (including deaths), injuries that were not reported to the emergency medical services (and for which children may have been taken by their family to their regular doctor) would have been missed. This would mean that our sample underrepresented lower acuity injuries. It is also possible that our sample underrepresented younger children, in that children younger than 5 years are more likely to be hit in their driveway (often by a backing automobile)[24,25]; we excluded children in this age group from our study because such injuries are not related to the flow of street traffic.

Finally, it is possible that significant confounding factors were not addressed in this study. Some research suggests that the presence of sidewalks is not a significant contributor to odds of injury,[2,15] and other research suggests that the presence of sidewalks is a strong risk factor, with an odds ratio of 11.0.[14] We would have liked to control for the presence of sidewalks, but there were no reliable retrospective data on sidewalk or curb presence available to do so. Also, since much of the earlier literature points to lower SES as a risk factor for child pedestrian injury, the reason for our inability to reproduce this relationship may have been that the factors we used to approximate SES—census tract household income and medical insurance status—are inappropriate proxies for SES.

CONCLUSIONS

We found that speed humps were associated with a 53% to 60% reduction in the odds of injury or death among children struck by an automobile in their neighborhood. These findings invite additional research on the protective effects of traffic calming interventions and offer a framework for studying pedestrian injuries in relation to physical interventions implemented within a localized geographic region. Further confirmation of the protective effects of speed humps would be useful and could be augmented by additional information on stop signs or other factors that would affect slowing distances on either side of a speed hump. Our study provides direct observational evidence that speed humps are associated with a reduction in the odds of childhood pedestrian injuries and supports the installation of speed humps by traffic engineering departments. ■

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Contributors

J.M. Tester conceived the study, performed all analyses, and led the writing of the article. G.W. Rutherford assisted in data analyses, interpretation of findings, and revisions of the article. Z. Wald contributed to conceptualization of ideas as well as reviews of the article. M.W. Rutherford contributed to the study design and interpretation of the findings.

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Human Participant Protection

This study was reviewed and approved by the institutional review board of Children's Hospital and Research Center at Oakland. Informed consent was not required by the review board because patients did not need to be contacted for this retrospective data analysis.

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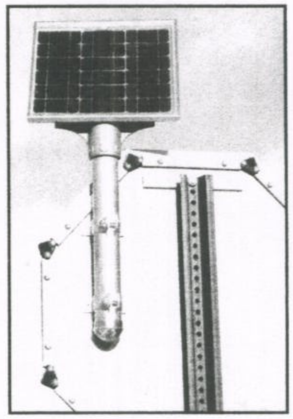

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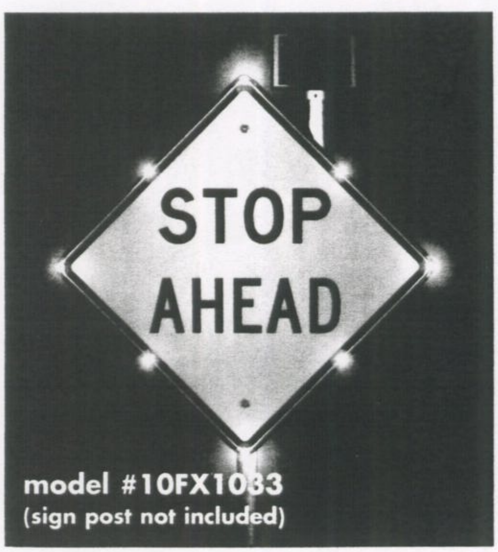

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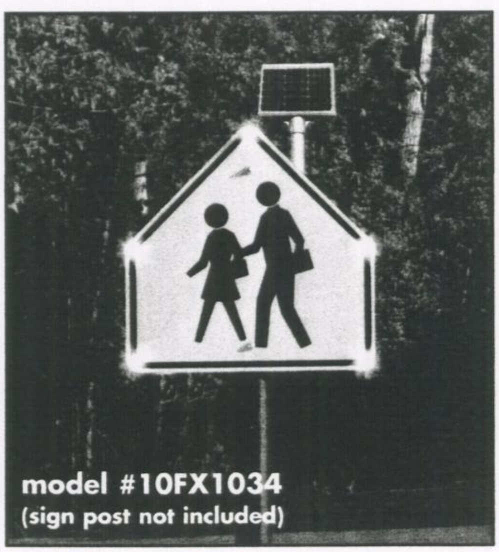

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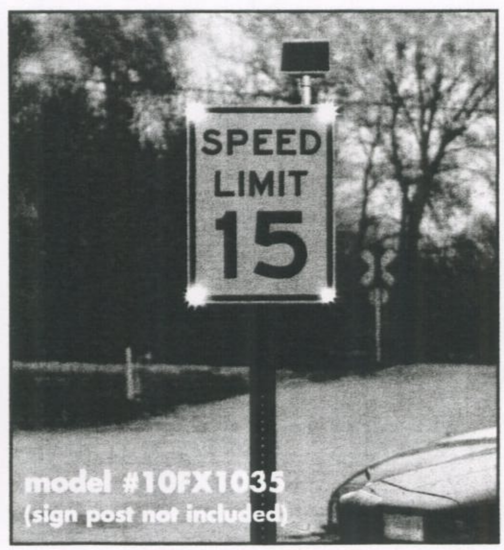

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