HIGHLAND TRAFFIC CALMING AND PEDESTRIAN SAFETY MANUAL

Adopted:
September 19, 2023

WALL CONSULTANT GROUP

HIGHLAND CITY

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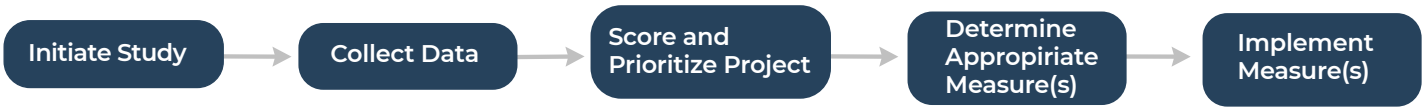
EXECUTIVE SUMMARY

The Highland Traffic Calming and Pedestrian Safety Manual serves to define the objectives of traffic calming measures and outlines potential implementations for Highland City. Passive, active, and temporary measures are discussed. The manual covers the factors that determine the most suitable traffic calming measure, including roadway classification, sight triangles, access management, and design standards. A process for implementing traffic calming is established, as outlined below.



Initiate study

- Neighborhood residents request traffic calming
- City Identifies area where traffic calming is needed

Collect Data

- Collect data to identify, confirm, and quantify issues

Score and Prioritize Project

- Evaluate data to determine project urgency

Determine Appropriate Measure(s)

- Determine which measure or combination of measures is appropriate

Implement Measure(s)

- Install traffic calming measure(s)

> While traffic calming measures can bring many positive benefits to communities, they can also have some negative impacts such as causing inconvenience or frustration for drivers.

INTRODUCTION

The Institute of Transportation Engineers (ITE) describes traffic calming as "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."[1] Traffic calming measures are designed to reduce vehicle speeds in residential and other areas where pedestrians, cyclists, and turning/parking vehicles interact.

While traffic calming measures can bring many positive benefits to communities, they can also have some negative impacts such as causing inconvenience or frustration for drivers. For example, increased delay to the driver's journey can be a negative impact. The installation of traffic calming measures can lead to increased traffic on alternative routes, potentially causing congestion and safety problems in those areas. Some traffic calming devices can also increase noise pollution.

[1] Lockwood, Ian. ITE Traffic Calming Definition. ITE Journal, July 1997, pg. 22.

Goals for Traffic Calming Manual

The objective of the Highland City Traffic Calming is to provide guidance on when traffic calming is recommended and assist in determining which traffic calming measure should be used. This document establishes a procedure that allows for a consistent approach for traffic calming projects. The measures discussed align with both emergency response considerations and the city's long-term maintenance plan, and are consistent with American Association of Highway and Transportation Officials (AASHTO), National Association of City Transportation Officials (NACTO), and Manual on Uniform Traffic Control Device (MUTCD) standards.

Goals for Pedestrian Safety Manual

The goal of the Pedestrian Safety Manual is to provide guidance on when pedestrian safety measures are recommended and assist in determining which measure should be used. Similar to traffic calming, the objective of pedestrian safety measures is to make walking and other forms of non-motorized travel safer and more enjoyable for people of all ages and to reduce the number of pedestrian fatalities and injuries caused by crashes involving motor vehicles.

From 2018 – 2022 there were 22 pedestrian and bicycle related crashes. 3 of these crashes resulted in serious injury, and the crash in 2020 resulted in a fatality. A summary table of this data can be shown in Table 1. The measures outlined in the Pedestrian and Bicycle Safety section of this Manual aim to reduce the number of crashes by making pedestrians are more visible to drivers, reducing the length of roadway a pedestrian must cross.

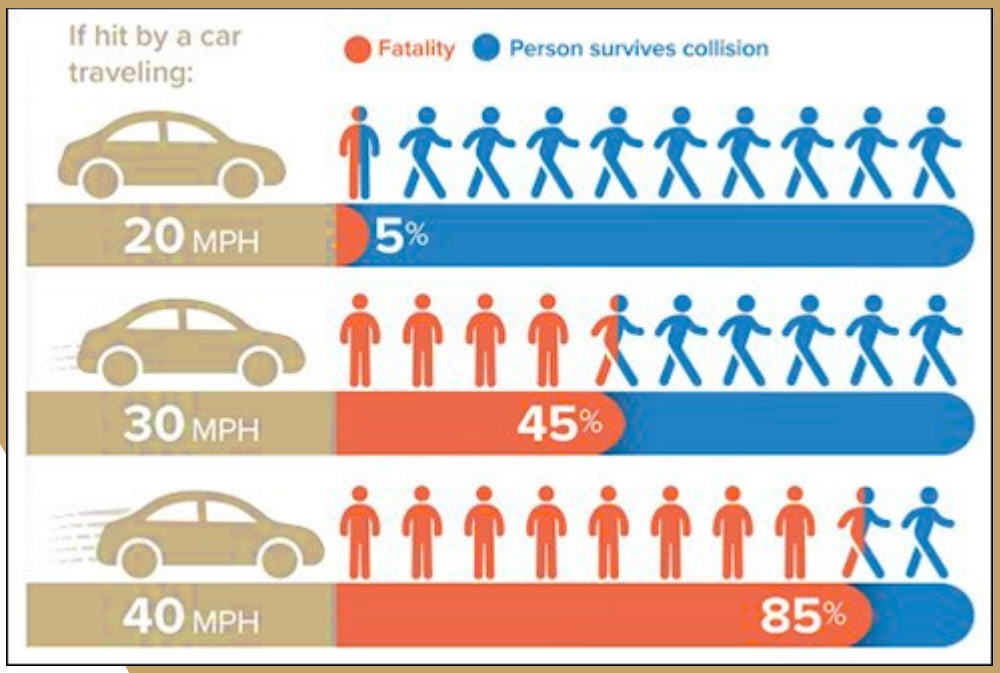
Table 1: Active Transportation Crash Data Summary

Year	Total Active Transportation Related Crashes	Severe Active Transportation Related Crashes (Fatal / Serious Injury)
2018	4	1
2019	4	1
2020	4	1
2021	4	0
2022	6	1
Total	22	4

Data via AASHTOWARE (Numetric)

In addition to this document, Highland City has an Active Transportation Plan (ATP). The ATP shows both current and proposed walking and bike paths in Highland City, as well as measures that can be used to improve the safety and walkability of those paths. The pedestrian safety measures presented in this document may be used to complement those suggested in the ATP.

Reducing Vehicle Speed Saves Lives



Reducing Speeding-Related CrashesInvolving Passenger Vehicles, National Traffic Safety Board , 2017

> "It's important to carefully evaluate the location and the specific needs of the community before selecting and implementing traffic calming measures."

Finding the Right Solution

Implementing the correct traffic calming and pedestrian safety measures is crucial because it can have a significant impact on the safety and livability of a community. The wrong measures can have unintended consequences and may even make the situation worse.

The correct measures should be implemented for the following reasons:

Safety: The primary goal of traffic calming measures is to reduce the speed of traffic, which in turn can reduce the number and severity of crashes involving pedestrians, cyclists, and motor vehicles. However, the wrong measures can create new hazards or exacerbate existing ones.

Cost-effectiveness: Implementing the wrong traffic calming measures can be costly in terms of both money and time. Beyond just initial costs, the wrong traffic calming measure can increase long-term maintenance costs for

the city. By selecting the right measures, it's possible to achieve the desired results while minimizing costs.

Community Acceptance: The wrong traffic calming measures can cause frustration and anger among residents, which can undermine community support for traffic calming efforts.

Environmental Impact: Some traffic calming measures can increase noise pollution and air pollution from idling vehicles. It's important to consider the environmental impact of any traffic calming measures and to select those that minimize negative effects on the environment.

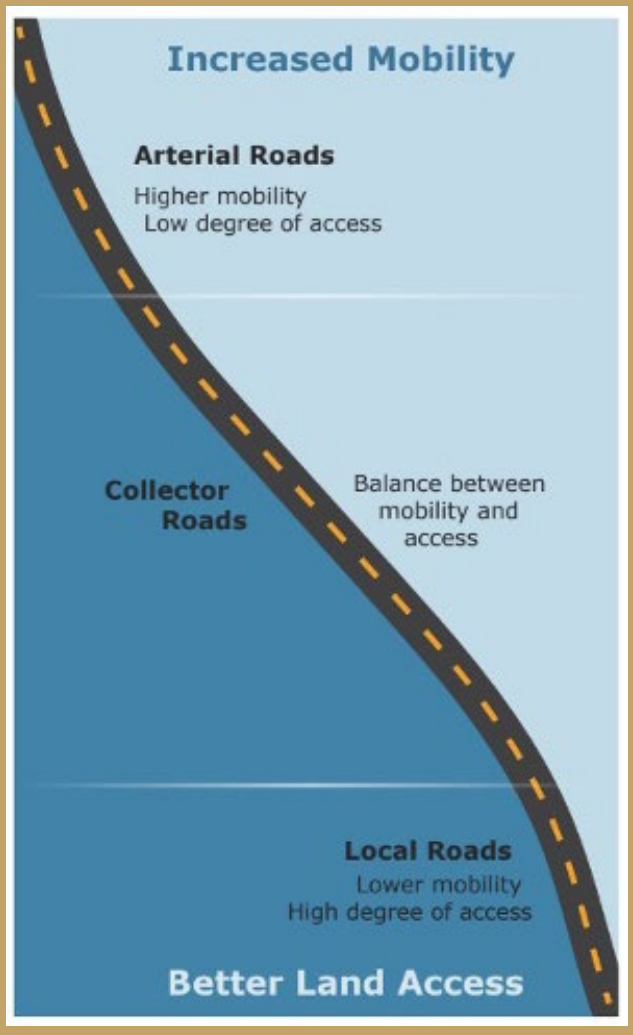
Implementing the correct traffic calming measures is essential for improving safety, cost-effectiveness, community acceptance, and minimizing negative environmental impact. It's important to carefully evaluate the location and the specific needs of the community before selecting and implementing traffic calming measures.

Roadway Classification

The roadway system is hierarchical, with different classifications based on attributes like speed, access, and mobility. Functional classification indicates a road's role within the transportation system.

The classifications of Highland City roadways used in this Manual are arterials, major collectors, minor collectors, neighborhood collectors, and local streets:

- **Arterial**–An arterial roadway has high mobility and little access. Arterials typically have between five to seven travel lanes. Arterial roadways have no on-street parking. The target speed limit for arterial roadways is 45 MPH or greater.
- **Major Collector**–A collector roadway provides both mobility and access. Major collectors connect local, minor collectors and neighborhood collectors with arterial roadways. Major Collectors typically have three lanes. Parking is discouraged on major collectors. The target speed limit for major collectors is between 35 and 40 MPH.
- **Minor Collector**–A collector roadway provides both mobility and access. Minor collectors connect local and neighborhood collector roadways with major collectors and arterial roadways.



Minor Collectors typically have two lanes with additional lanes at high capacity intersections. Parking is discouraged on minor collectors. The target speed limit for minor collectors is between 30 and 35 MPH.

- **Neighborhood Collector**–A collector roadway provides both mobility and access. Neighborhood collectors connect local roadways with major and minor collectors, as well as arterial roadways. Neighborhood Collectors typically have two lanes with parking on each side. The target speed limit for major collectors is between 25 and 30 MPH.
- **Local**– A local roadway provides full access to adjacent land uses but allows for little mobility. Local roads typically have two lanes with parking on each side. The target speed limit for local roadways is 25 MPH.

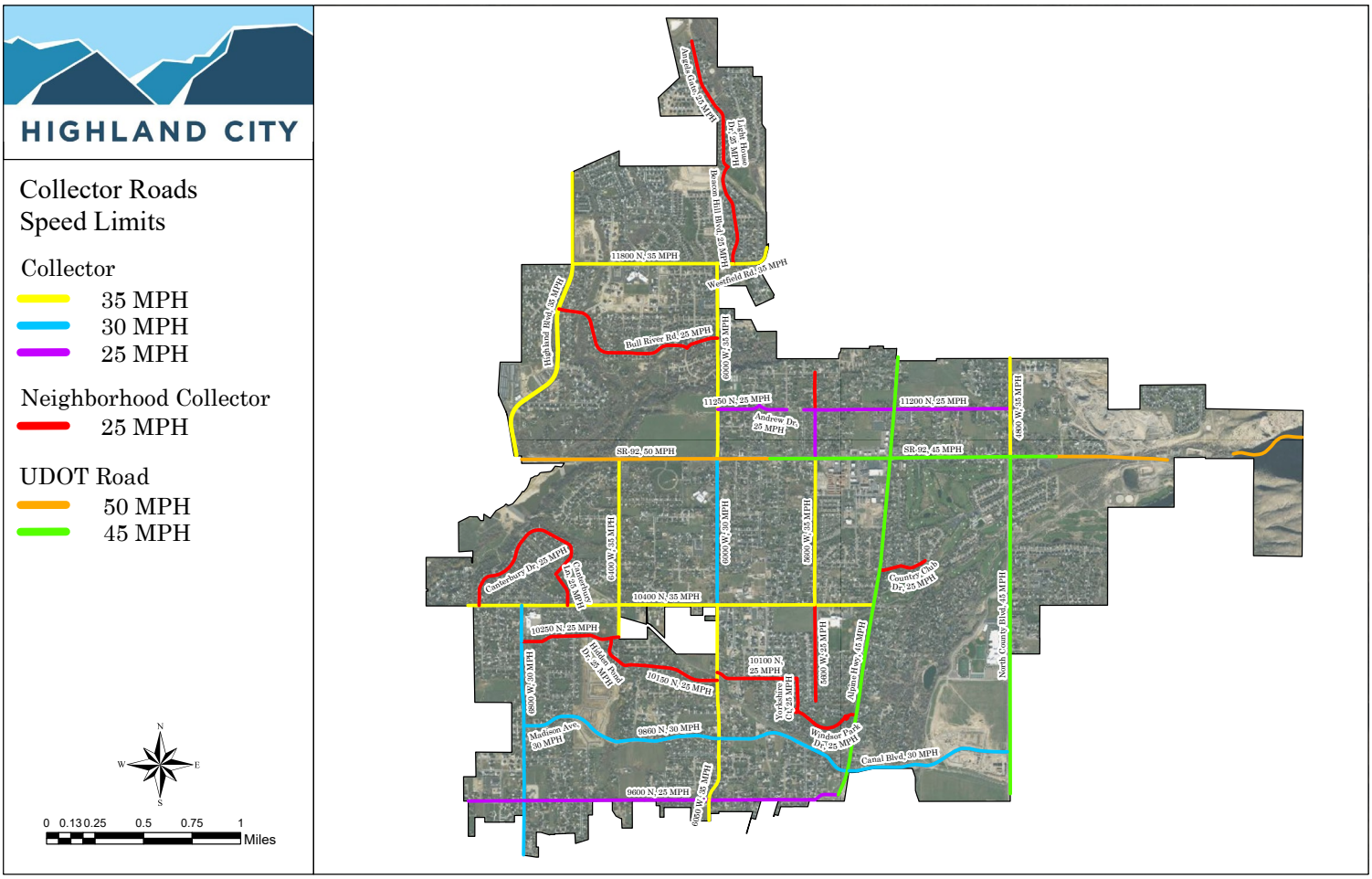


Figure 1—Map of collector speed limits in Highland City

Figure 1 shows a map of current Highland City and the speed limits of the roadways. The speed limit on unmarked local roadways within Highland is 25 MPH.

TRAFFIC CALMING MEASURES

This section outlines traffic calming measures Highland City has determined appropriate to implement within city limits. Traffic calming measures should only be implemented when recommended by an engineering study.

When implementing traffic calming measures, it is important to note that often one single measure will not result in reduced speeds. Combining multiple traffic calming measures creates a cumulative effect on speed reduction. Individual traffic calming measures may have limitations or be less effective on their own. By using multiple measures, any potential weaknesses of one measure can be compensated for by the strengths of others. This comprehensive approach increases the chances of achieving the desired speed reduction goals.

Passive Measures

Passive traffic calming measures aim to reduce speed by changing driver behavior through visual cues such as roadway striping and signage. There are no physical changes to the roadway. Passive measures can be installed on any roadway and in combination with active measures. They are less expensive and can provide cost-effective solutions to increasing safety. Listed below are passive measures that Highland City has determined are acceptable to use. Details regarding these passive measures can be found in **Appendix A**.

- Radar Speed Sign
- Pavement speed limit marking
- Optical speed bars
- Additional speed limit signs
- Striping narrower lanes
- Landscaping
- Crosswalks
  (also meets pedestrian criteria)
- Enforcement
- Education

Active Measures

Active traffic calming measures require a change in driver speed due to physical changes in the roadway. The driver must actively engage when interacting with the traffic calming measure. Active measures are more expensive to implement but can be more effective in reducing

“When implementing traffic calming measures, it is important to note that often one single measure will not result in reduced speeds. Combining multiple traffic calming measures creates a cumulative effect on speed reduction.”

vehicle speeds. Below are active calming measures Highland City has determined are acceptable to use. Details regarding these active measures can be found in **Appendix A**.

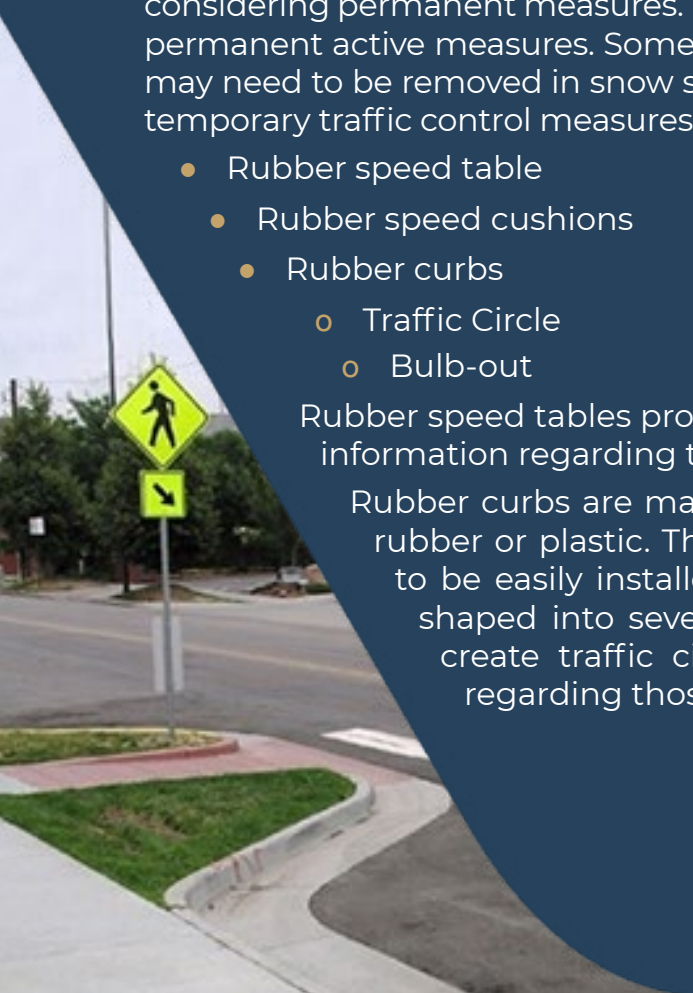
- Roadway design (curves, shoulders, side treatments)
- Curb extensions (bulb-outs)
- Medians
- Road Diet
- Raised crosswalk
- Roundabouts
- Traffic circles
- Neckdowns
- On-street parking
- Raised intersection
- Chicanes
- Speed Cushions
- Speed Tables

> Collector roads often have higher posted speed limits. While speed tables may be employed on these roads, driving over them at higher speeds can lead to passenger discomfort and potential vehicle damage.

Temporary Traffic Calming Measures

Temporary speed reduction measures act as substitutes for permanent active traffic calming measures. These options can be more cost-effective and offer the flexibility to be moved when necessary. They require less construction time and provide a quick response to urgent issues, allowing the city to assess their effectiveness before considering permanent measures. However, they may not be as durable or effective as permanent active measures. Some temporary measures such as rubber speed tables may need to be removed in snow seasons so has to not hinder snowplows. Below are temporary traffic control measures that can be implemented in Highland City.

- Rubber speed table
- Rubber speed cushions
- Rubber curbs
  - Traffic Circle
  - Bulb-out



Rubber speed tables provide similar results to traditional speed tables. For information regarding this traffic calming measure, see **Appendix A**.

Rubber curbs are made of durable, flexible materials such as recycled rubber or plastic. They are usually modular in design, allowing them to be easily installed or removed as needed. Rubber curbs can be shaped into several configurations, allowing them to be used to create traffic circles, bulb-outs, and chicanes. For information regarding those traffic calming measures, see **Appendix A**.

> Rubber curbs can be shaped into several configurations, allowing them to be used to create traffic circles, bulb-outs, and chicanes.

Inappropriate Measures for Highland City

Highland City staff has determined the following traffic calming measures are inappropriate for traffic calming within the city:

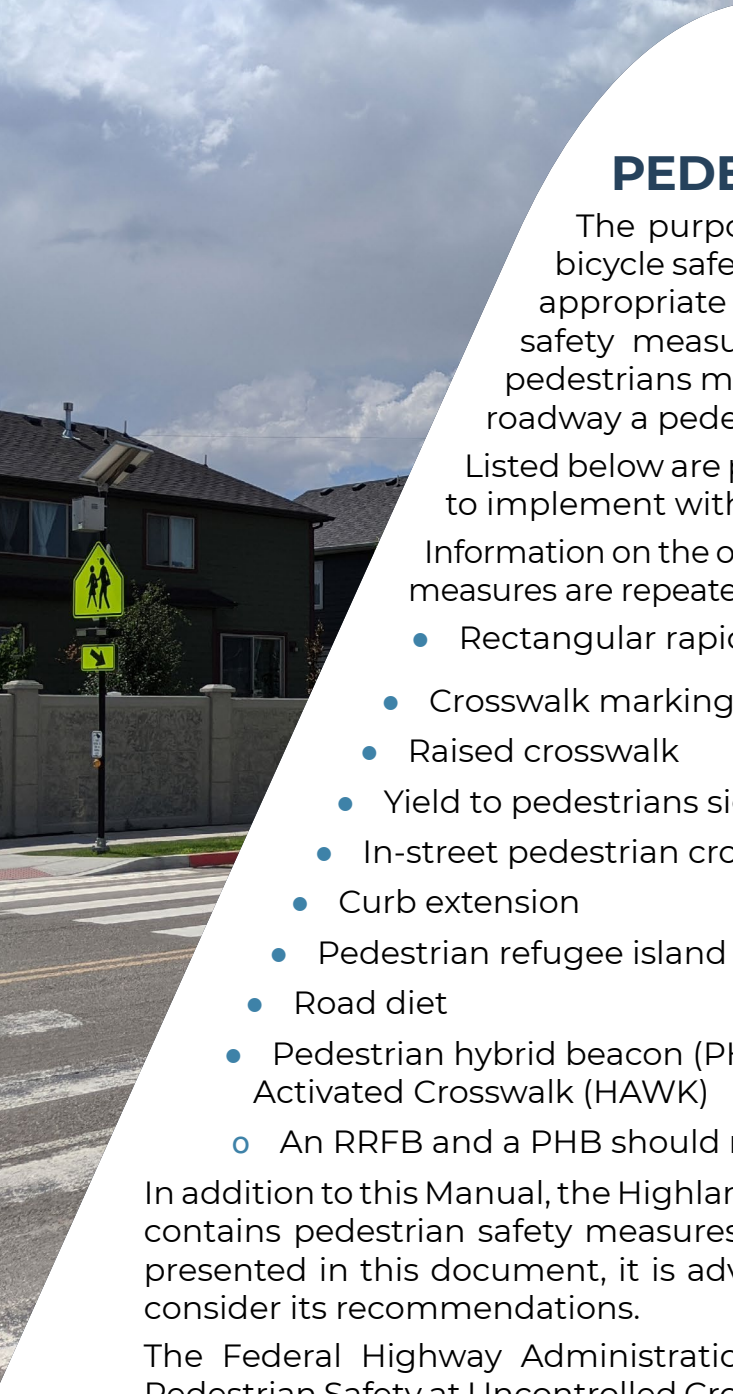
- Diagonal divertors
- Rumble strips
- Speed bumps/humps

Rumble strips are inappropriate due to the damage that can be done to the vehicles and difficulties with plowing/roadway maintenance. Diagonal divertors have been deemed inappropriate due to the restricted access that occurs when they are installed. Although these measures may be suitable for implementation in other regions, they do not meet the goals for traffic calming in Highland City. Collector roads often have higher posted speed limits. While speed tables may be employed on these roads, driving over them at higher speeds can lead to passenger discomfort and potential vehicle damage.

Stop Signs Should Not be Used for Speed Reduction

In addition to the measures listed above, stop signs are inappropriate for speed control. Stop signs should never be used for traffic calming because they are designed for a specific purpose, which is to assign the right-of-way at an intersection. **The MUTCD states that "stop signs should not be used for speed control" (MUTCD 2003).** Using stop signs for traffic calming purposes can have unintended consequences. Research by the Ohio Department of Transportation[2] has found that installing a stop sign when it is not warranted results in decreased pedestrian safety, increased speeds between intersections, and an increased rate of collisions. ITE found similar results, as well as an increase in noise pollution and fuel consumption.[3]

[2]Intersection Safety: Myth Versus Reality, Ohio Department of Transportation, July 2013
[3]Chadda, H., & Carter, E., Multi-Way Stop Signs- Have We Gone Too Far? ITE Journal, May 1983, pg. 21



PEDESTRIAN AND BICYCLE SAFETY

The purpose of this section is to outline pedestrian and bicycle safety measures that Highland City has determined appropriate to implement within city limits. Pedestrian safety measures make crosswalks safer by either making pedestrians more visible to drivers, or reducing the amount of roadway a pedestrian has to cross.

Listed below are pedestrian safety measures that are appropriate to implement within Highland City.

Information on the other measures can be found in **Appendix A**. Some measures are repeated from the passive and active measures list.

- Rectangular rapid-flashing beacon (RRFB)
- Crosswalk markings (striping)
- Raised crosswalk
- Yield to pedestrians sign and stop line
- In-street pedestrian crossing sign
- Curb extension
- Pedestrian refugee island
- Road diet
- Pedestrian hybrid beacon (PHB), also known as a High-Intensity Activated Crosswalk (HAWK)
  - An RRFB and a PHB should not be installed at the same location

In addition to this Manual, the Highland City Active Transportation Plan also contains pedestrian safety measures. In conjunction with the measures presented in this document, it is advisable to also refer to the ATP and consider its recommendations.

The Federal Highway Administration (FHWA) Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations[4] features a table titled "Application of pedestrian crash countermeasures by roadway feature," which offers countermeasure options for a range of roadway conditions. This table is shown in Figure 2. Each matrix cell of this table suggests potential pedestrian safety measures that may be suitable for specific pedestrian crossings.

All trail crossings should include a marked crosswalk, pedestrian crossing signs, and where appropriate, higher level measures may be implemented, such as RRFBs or Pedestrian Hybrid Beacons.

[4]Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, FHWA, July 2018.

The UDOT policy on marked pedestrian crosswalks[5] states that all trail crossings should have a marked crosswalk. At non-trail crossings, UDOT policy is to implement a crosswalk if more than 20 pedestrians are observed crossing during the peak hour. On smaller city roads, 20 pedestrians crossing in one hour is very unlikely. Therefore, Highland City has adopted a different scoring system to determine if a crosswalk should be installed. This scoring system can be found in the **Appendix C**.

> In addition to this Manual, the Highland City Active Transportation Plan also contains multiple pedestrian safety measures. In conjunction with the measures presented in this document, it is advisable to also refer to the ATP and consider its recommendations.

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	❼ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 8 ❾
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	❼ ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 8 ❾

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)**

Figure 2—Application of pedestrian crash countermeasures by roadway feature from FHWA
** a RRFB and a PHB should not be installed at the same crossing location

[5] Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, FHWA, July 2018.

ROADWAY CRITERIA

Emergency Routes

Speed tables and raised crosswalks or raised intersections **are not allowed** on streets designated as emergency response routes by Highland City Police and Fire Departments. This is to avoid impacting emergency vehicle operations. Faster response times are crucial for saving lives and minimizing property damage during emergencies. These measures on emergency routes can hinder response times, reducing the chances of saving lives. Figure 3 displays the specific emergency routes where these measures are not allowed.

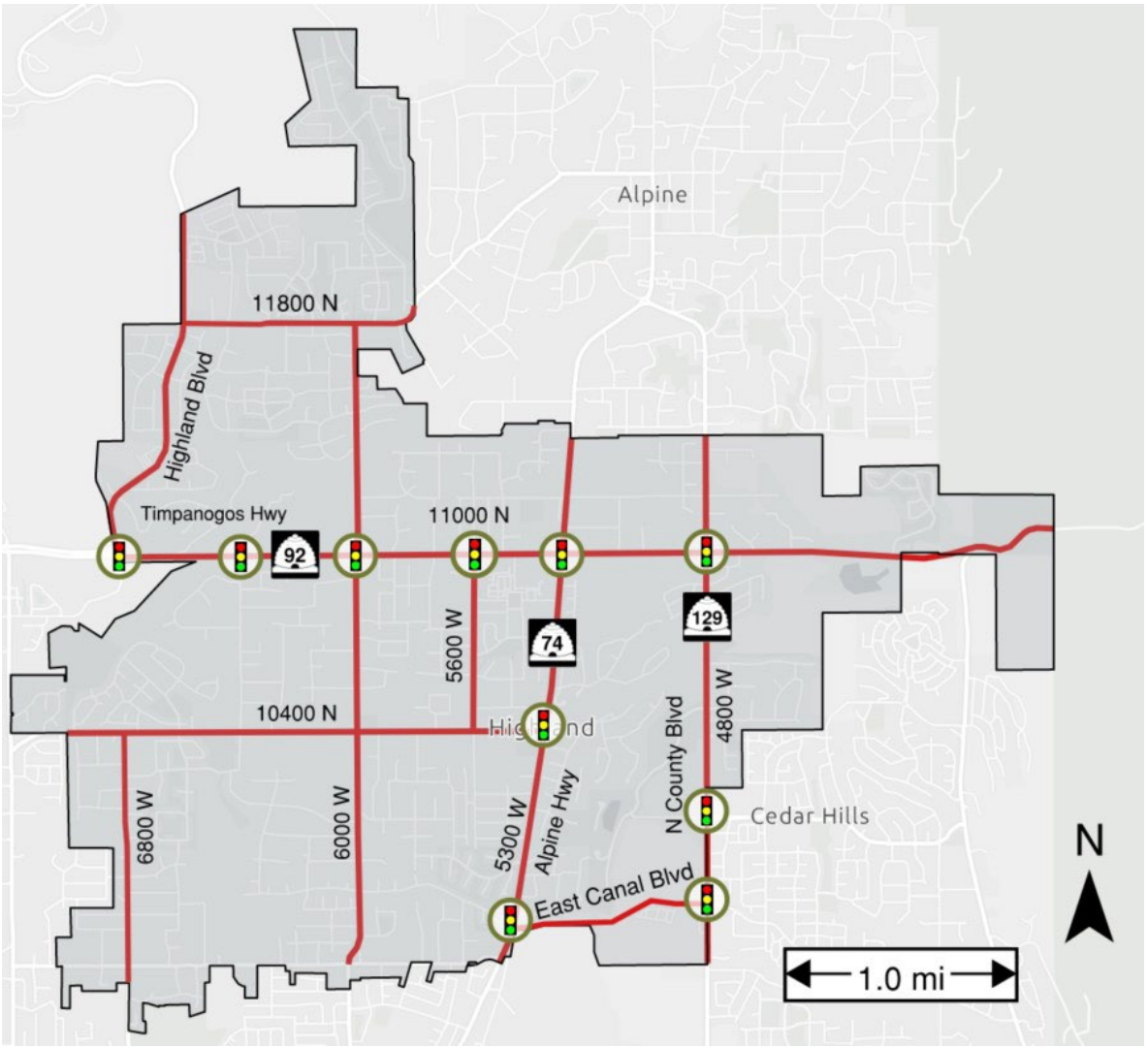


Figure 3—Emergency routes in Highland City

Roadway Jurisdiction

Highland City can only install traffic calming measures on roadways over which it has jurisdiction. The city is responsible for maintaining and managing the public streets within its boundaries. They have the authority to regulate the use of their roads and ensure the safety of all road users.

Highland City contains roads within its boundaries that fall outside their jurisdiction and are under the control of other governing bodies, such as UDOT. UDOT has jurisdiction over Timpanogos Highway (SR-92), Alpine Highway (SR-74), and North County Blvd (SR-129) within Highland. These roadways are shown in Figure 4. UDOT has its own regulations and procedures for installing traffic calming measures, and it is not within the authority of Highland City to make decisions or changes to these roads without permission or cooperation from UDOT.

Highland has limited resources and budgets for implementing traffic calming measures, and the city prioritizes areas with the highest need. Focusing efforts and resources on areas within their jurisdiction ensures the most effective use of resources and provides the greatest benefit to Highland City neighborhoods.

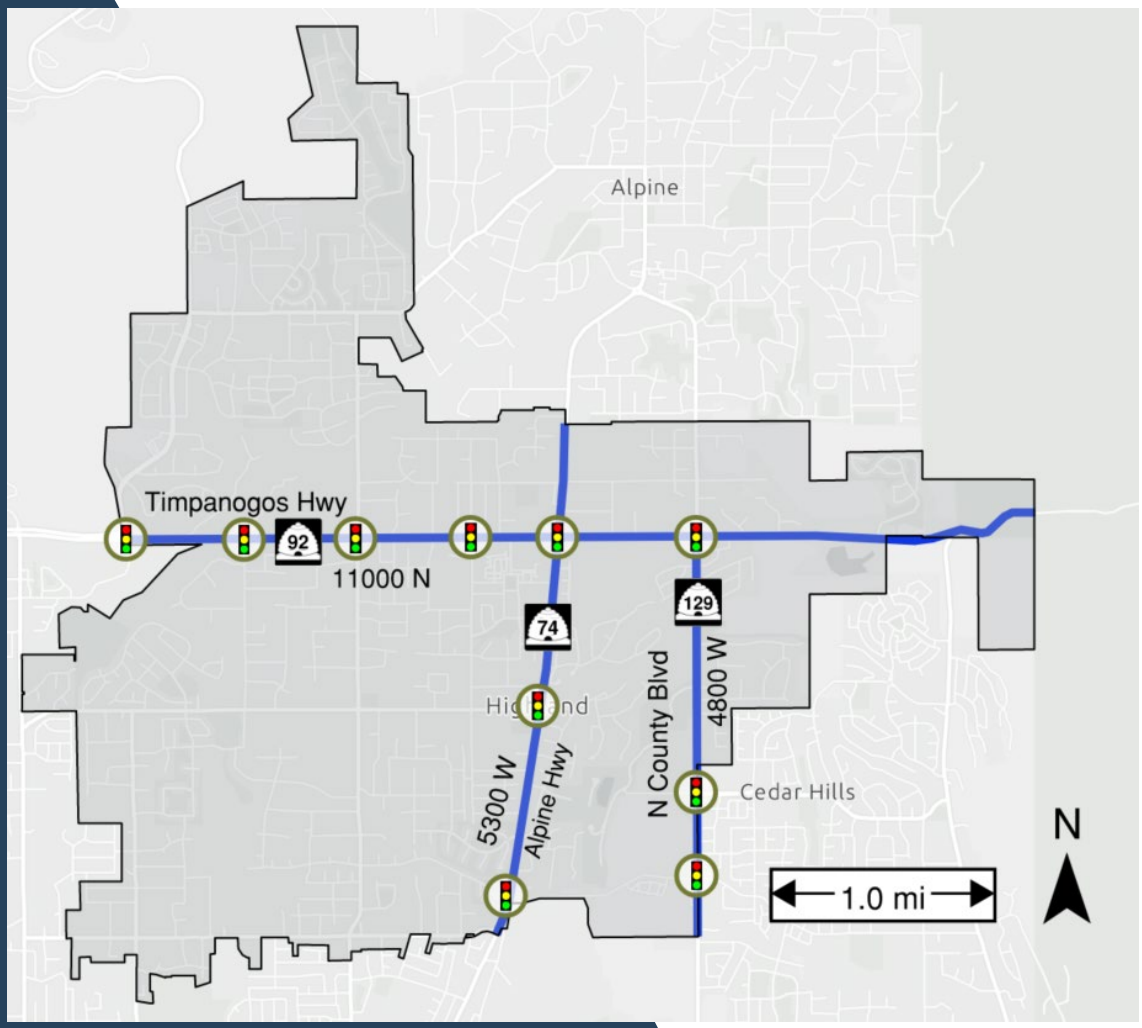


Figure 4—UDOT-owned roads in Highland City

PROCESS

The process for traffic calming and pedestrian safety projects in Highland City is outlined in Figure 5.

The aim is to establish a fair and consistent approach for all submitted projects, prioritizing urgent locations.

The process is an administrative process implemented by the Highland City staff. The Highland City council, as a legislative entity, does not participate in this process unless an appeal is submitted. In the event of an appeal, the council will determine if an exception will be made which will subsequently be executed by the city staff. Highland City staff will keep the city council informed of the progress of traffic calming requests and when measures are decided upon.

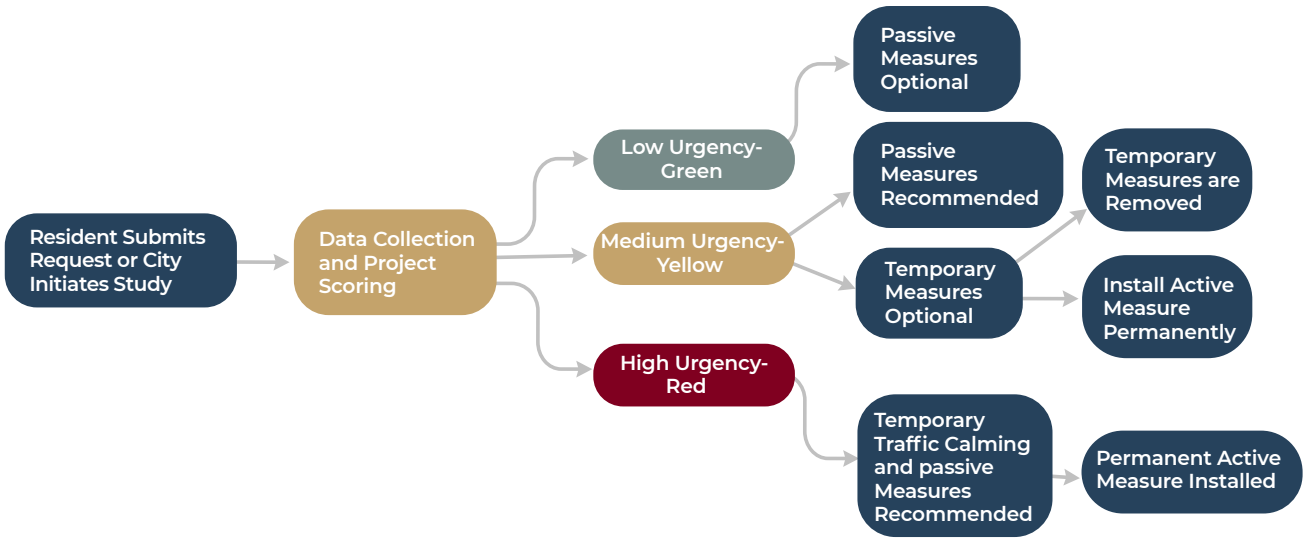


Figure 5: Process for traffic calming implementation in Highland City

Application Submittal

Any resident of Highland City may request a traffic calming study for a location on their street of residence. This should be done by completing a "Request for Traffic Calming" form included in **Appendix B**. The following information is required:

- Applicant information
- Study location
- Description of issue
  - What times the issue is most prominent
  - What is the main concern
- Names and signatures of at least five other residents who reside on the same street
- A $25 fee

Highland City staff can also initiate traffic calming requests for suitable locations. Areas evaluated within the past two years are ineligible, except in cases of recent crashes or significant changes in development, such as new neighborhoods, roadway configurations, or speed limits. The application and signatures should be submitted to the Highland City Public Works Department for review, either online through highlandcity.org or in-person drop-off.

Data Collection and Project Scoring

After receiving a traffic calming request form, the city will collect the following data from the requested site:

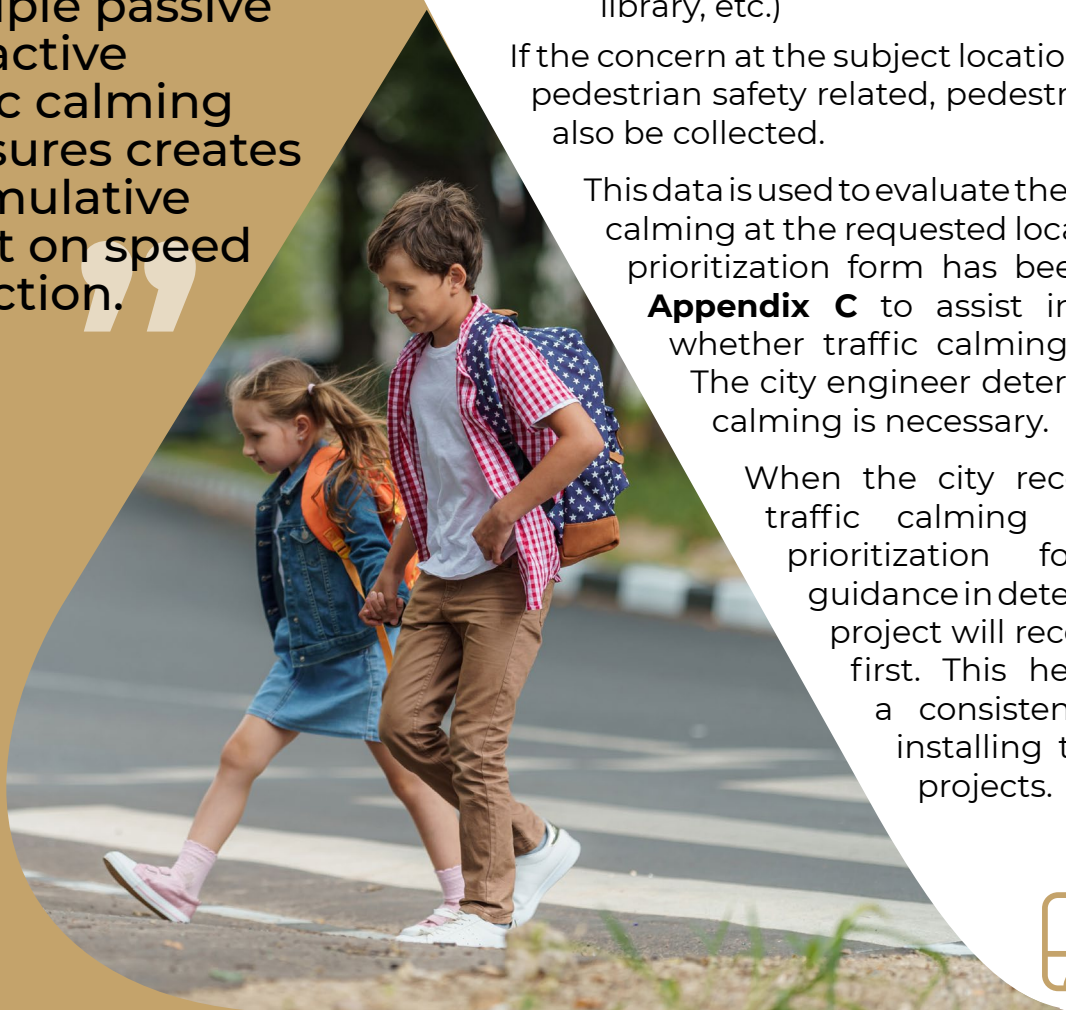
- **Speed data**–two weeks of data will be collected to obtain a representative sample.
  - 85th percentile
  - Percent of drivers driving 10 MPH over speed limit
- **Vehicle counts**–two weeks of data will be collected to obtain a representative sample.
  - 24-hour count to determine the daily traffic
- **Historic crash data**
  - Last five years
- **Sight distance**
  - Stopping sight distance at study location
- **Roadway context**
  - Bus routes
  - Bike lanes present
  - Crosswalks or trail crossings present
  - Nearby schools
  - Nearby pedestrian generators (public park, library, etc.)

If the concern at the subject location is specifically pedestrian safety related, pedestrian counts will also be collected.

This data is used to evaluate the need for traffic calming at the requested location. A project prioritization form has been included in **Appendix C** to assist in determining whether traffic calming is warranted. The city engineer determines if traffic calming is necessary.

When the city receives multiple traffic calming requests, the prioritization form provides guidance in determining which project will receive treatment first. This helps to ensure a consistent process for installing traffic calming projects.

> "It is important to note that often one single measure will not result in reduced speeds. Combining multiple passive and active traffic calming measures creates a cumulative effect on speed reduction."



Project is Low Urgency (Green)

A project that scores less than 40 points is considered “Green” (low urgency). No traffic calming measures are required at this location. Passives measures may be installed if the city engineer feels it is appropriate. If residents want a passive measure and City does not find one is required, residents can pay for the device and City will install it. Residents may only pay to install passive measures such as a radar speed sign. Residents cannot pay to install an active measure if the City finds that one is not required. This helps to ensure traffic control measures are appropriate and effective.

Project is Medium Urgency (Yellow)

A project that scores between 40 and 79 points is considered “Yellow” (medium urgency). Passive measures are recommended at this location. Temporary measures may be installed if the city engineer feels it is appropriate. If the response to the temporary measures is positive, then permanent active measures may be installed. If not, they may be removed.

Project is High Urgency (Red)

A project that scores 80 or more points is considered “Red” (high urgency). Both passive and temporary measures are recommended at this location. The temporary measures should eventually be replaced with permanent active measures if proven effective, well received by citizens, and budgets are sufficient.

Traffic Calming Measure Flowcharts

While all speed reduction measures are valuable, not all measures are suitable in every scenario. The following flowcharts provide guidance to help the community

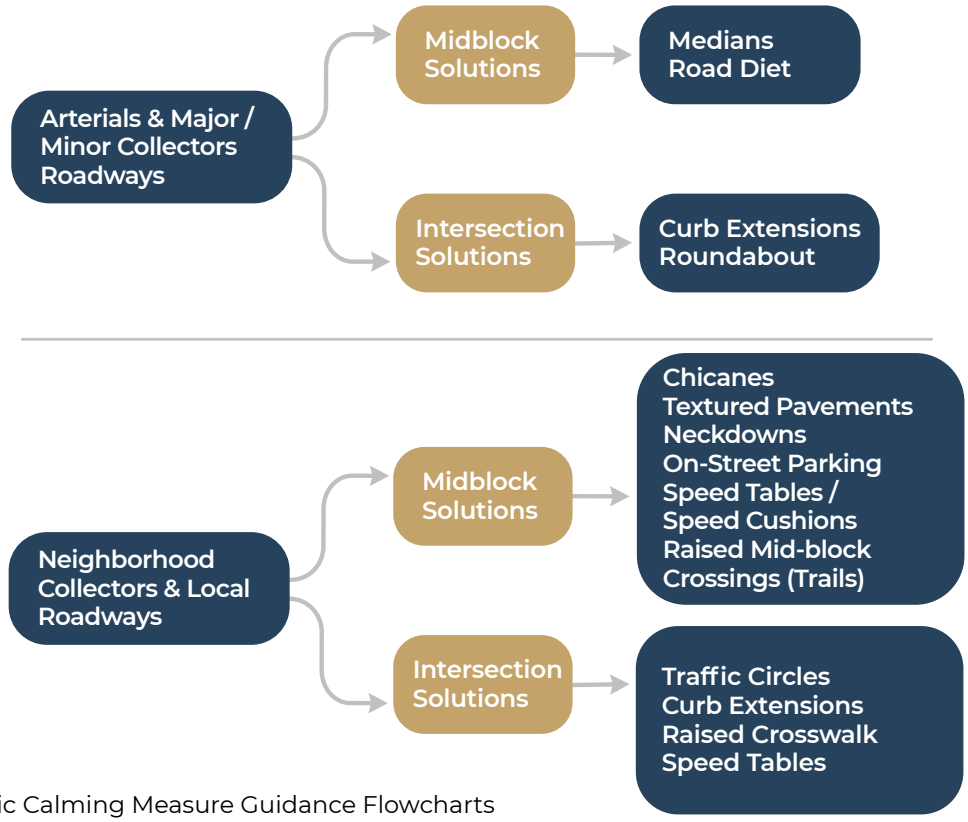


Figure 6: Traffic Calming Measure Guidance Flowcharts

implement a proper traffic calming measure based on the roadway classification outlined in earlier sections of this manual.

Passive measures can be implemented on any roadway. Rubber curbs can be used to create temporary roundabouts, bulb-outs, or chicanes on roadways where those measures are suggested. More than one measure may be required to reduce vehicle speeds.

FUNDING AND POLICY

Funding for traffic calming projects is obtained through the city budget. Other sources besides Highland City funds could be available for traffic calming projects as well, including:

- **The Utah Department of Transportation (UDOT) Safe Routes to School (SRTS) Program:** The goal of the SRTS Program is to assist and encourage students living within 1.5 to 2 miles of school to walk or bike. Funding can be used for non-infrastructure and infrastructure-type projects (i.e., physical improvements—primarily new sidewalks, but also school pavement markings, signage, bicycle parking, etc.). The deadline each year is in October.
- **UDOT Transportation Alternatives (TAP):** eligible projects include Bike facilities (on- and off-road), trails, sidewalks (off-state routes), vehicle-caused wildlife mortality reductions, and other qualifying transportation alternative projects. Region Three will consider contributing up to 60 percent of the project cost, with a maximum department-paid cost of $300,000. The deadline each year is in March.
- **UDOT Active Transportation Investment Fund (ATIF):**To be used for the planning, design, construction, maintenance, reconstruction, or renovation of paved pedestrian or paved non-motorized trail projects that are prioritized through the Utah Transportation Commission. The use of the funds is also required to serve a regional purpose and must be part of an active transportation investment plan. The deadline each year is in March.
- **UDOT TTIF First and Last Mile:** Eligible project must be a pedestrian or nonmotorized transportation project that provides connection to a public transit system and is maintained by the local government or district. The deadline each year is in March
- **Mountainland Association of Governments Transportation Improvement Program (MAG TIP):** MAG TIP, administered by Mountainland Association of Governments, provides funding for local governments. MAG TIP funds support bicycle and pedestrian facilities, including construction, planning, design, traffic calming, lighting, and ADA accessibility projects. The application deadline is every other year.

ACCESS MANAGEMENT

Access management is a process of controlling the location and number access to and from roadways, driveways, and other transportation facilities to improve safety, mobility, and efficiency of the transportation network. Benefits of access management include:

Improved safety: Access management can help reduce the number of crashes on roadways by limiting the number of points where vehicles can enter or exit a roadway. This can also help reduce conflicts between vehicles and pedestrians, thereby increasing safety.

Improved mobility: By managing access points to a roadway, traffic flow can be improved, reducing delays and travel times for motorists. This can also help reduce congestion and improve the overall capacity of the transportation network.

Improved aesthetics: Access management can also help improve the appearance of roadways by reducing the number of curb cuts and other access points, resulting in a more attractive and inviting environment.

Table 2 outlines the access management standards. The distances in the table are from curb to curb. When determining the appropriate access management, the highest functional classification governs (arterials, followed by collectors, then local roads).

Table 2: Access Management Standards

Roadway Classification	Minimum signal spacing	Street spacing	Driveway spacing	Corner distance
Arterial	2,640 ft	660 ft	350 ft	350 ft
Major Collector	1,320 ft	330 ft	150 ft	150 ft
Minor Collector	1,320 ft	330 ft	150 ft	150 ft
Neighborhood Collector	1,320 ft	330 ft	150 ft	150 ft
Local	N/A	150 ft	Residential: NA Commercial: 100 ft	30 ft

Figure 7—Access management standards

SIGHT TRIANGLES

Sight triangles are clear, unobstructed areas required at intersections or driveways for drivers' visibility. They help drivers make safe decisions while navigating these areas, reducing the risk of crashes. Figure 7 is a figure from the Highland City Design Criteria[6] that shows the sight triangles for a right-turning and left-turning vehicle. Sight distance triangles are calculated based on the stopping sight distance of the road being intersected. The following roadway classifications have the design stopping sight distance:

- Arterial – 425 feet
- Major, minor, and neighborhood collectors – 300 feet
- Local roadways – 200 feet

[6]Design Criteria for Public Improvements, Highland City, 2021

According to the Highland City Standard Drawings[7], a sight distance of 40 feet is required and shall not be obstructed by fencing or landscaping. In design, the greater site distance value between the Highland City Standard Drawings and the Highland City Design Criteria shall be used.

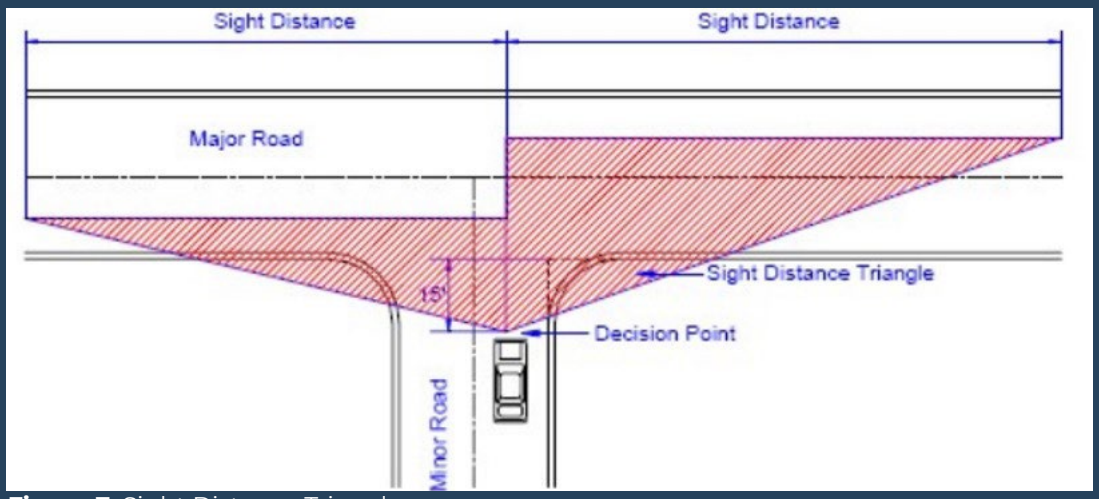


Figure 7: Sight Distance Triangle

DESIGN STANDARDS

Design consistency is crucial in traffic engineering to ensure uniformity and predictability in traffic calming and pedestrian safety measures. Consistent designs meeting driver expectations enhance road safety by reducing confusion and minimizing the risk of crashes. Designs for traffic calming and pedestrian safety measures shall be consistent with the standards presented in American Association of Highway and Transportation Officials (AASHTO), the Manual on Uniform Traffic Control Devices (MUTCD), the Federal Highway administration (FHWA), and the National Association of City Transportation Officials (NACTO). By designing according to these standards, Highland City takes measures to absolve itself from any liability associated with the utilization of these designs.

7 Highand City Standard Drawings, ST-05, Highland City, 2021

APPENDICES

Appendix A:

Approved Traffic Calming Measures for Highland City

- Passive Measures
- Active Measures
- Pedestrain Safety Measures

Appendix B:

Highland City Traffic Calming and Pedestrian Safety Request Form

Appendix C:

Highland City Traffic Calming and Pedestrian Safety Prioritization Form

APPENDIX A:

Approved Traffic Calming Measures for Highland City

The costs presented are a general estimate and should be viewed as approximate figures. It is important to recognize that these costs can vary significantly based on various factors, including but not limited to the manufacturer, geographic location, market conditions, and inflation rates.

SPEED MANAGEMENT STUDIES

WHAT ARE SPEED MANAGEMENT STUDIES?

Speed Management Studies are an alternative to typical speed studies. These studies may indicate that the 85th percentile speed is much greater than the posted speed limit, but instead of raising the speed limit, speed management should be considered to instead lower the 85th percentile speed.

HOW DO I REQUEST A SPEED MANAGEMENT STUDY?

Speed Management Studies are performed through the UDOT traffic studies process in the same manner as traditional speed studies, signal warrants, left-turn studies, and many other common study types. Request are generally initiated at the regional or community level then are submitted through Workflow Manager by UDOT Region traffic engineers.

WHERE TO UTILIZE SPEED MANAGEMENT STUDIES?

Speed Management Studies should be utilized when there is a disconnect between vehicle speeds and the roadway context or when 85th percentile speeds are higher than recommended for safety. This includes situations when non-motorists are commonly present, when adjacent land uses are not consistent with roadway character, or when the roadway design does not match the traveling speed.

SPEED MANAGEMENT ≠ ARTIFICIALLY LOWERING SPEED LIMITS

Speed management is a holistic approach to dealing with speed. Research has shown that artificially lowering speed limits generally does not lead to lower vehicle speeds. Speed limits should be lowered in conjunction with speed management measures.

SPEED MANAGEMENT MAY MEAN "ENGINEERING UP"

When there is a disconnect between vehicle speeds and roadway design the solution may not always be to slow traffic. Sometimes on key connectors carrying significant traffic the solution may be to design the roadway to better accommodate the speeds in which users want to travel. This could mean wider shoulders, median barrier, consolidated accesses, improved alignment, etc.

Source: UDOT Speed info management sheets, March 2022

Speed Management is considered within the framework of the ***Safe System Approach***[1], which means designing a roadway in which impacts on the human body are kept at tolerable levels. Examples of this are as follows:

1. If a roadway has frequent pedestrian or bicycle users, then speeds should be managed so that an impact is less likely to be fatal. If speeds can't be reduced, vulnerable roadway users need to be separated from vehicular traffic.
2. If there is a high likelihood of centerline crossing crashes, then speeds should be managed so that a head-on crash is less likely to be fatal. If speeds can't be reduced, centerline crossing can be mitigated via median barrier.

This guide focuses specifically on measures to slow traffic. Design improvements to accommodate higher speeds could be an outcome of a speed management study, but specific recommendations would not be provided.

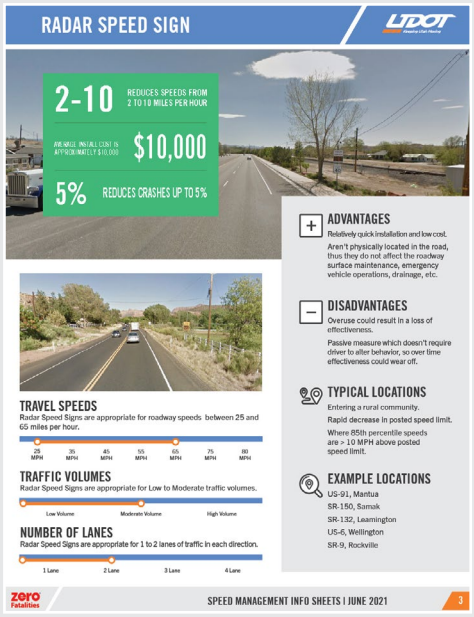
INFO SHEETS

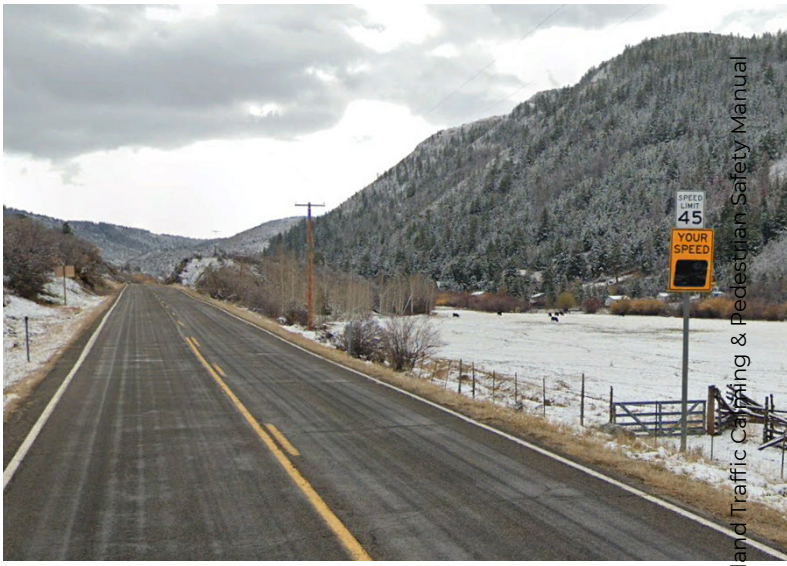
Information sheets on a range of speed management measures are provided to help guide the study engineer when selecting appropriate treatments.

These info sheets highlight key aspects of each speed management measure including advantages, disadvantages, costs, implementation considerations, and example/typical locations.

- Radar Speed Sign
- Pavement Speed Limit Marking
- Optical Speed Bars
- Road Diet
- Median Island
- Roundabout
- Roadway Narrowing (bike lanes, lane narrowing, on-street parking, etc.)
- Curb Extensions (bulb-outs)
- Roadside Gateway Features (street trees, lighting, signage, banners, public art, etc.)

For guidance on roadway safety improvements outside of speed management please consult the Safety Countermeasure Fact Sheets.



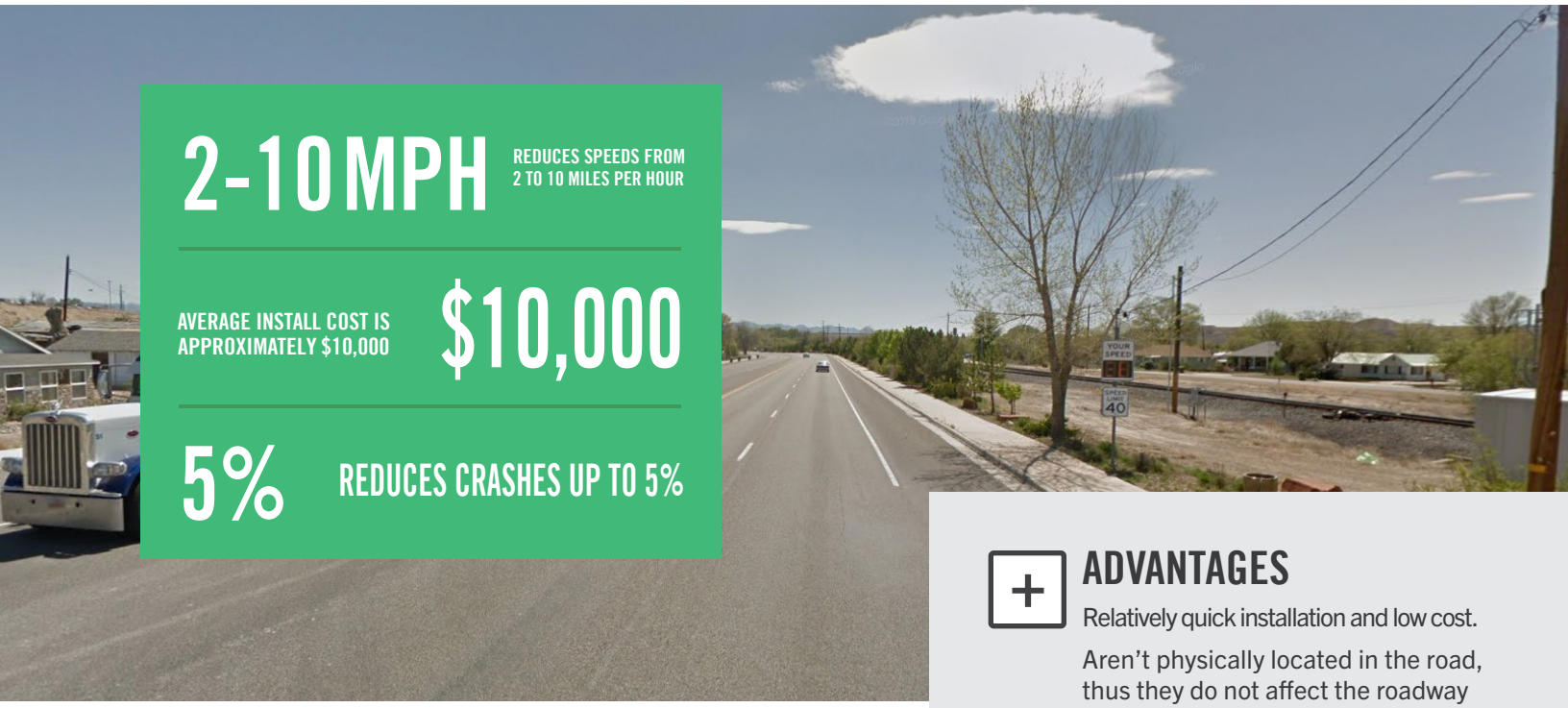


[1] https://safety.fhwa.dot.gov/zerodeaths/docs/FHWA_SafeSystem_Brochure_V9_508_200717.pdf

Source: UDOT Speed info management sheets, March 2022

PASSIVE MEASURES

RADAR SPEED SIGN



2-10 MPH REDUCES SPEEDS FROM 2 TO 10 MILES PER HOUR

AVERAGE INSTALL COST IS APPROXIMATELY $10,000 **$10,000**

5% REDUCES CRASHES UP TO 5%

TRAVEL SPEEDS

Radar Speed Signs are appropriate for roadway speeds between 25 and 65 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Radar Speed Signs are appropriate for Low to Moderate traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Radar Speed Signs are appropriate for 1 to 2 lanes of traffic in each direction.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Relatively quick installation and low cost.

Aren't physically located in the road, thus they do not affect the roadway surface maintenance, emergency vehicle operations, drainage, etc.

DISADVANTAGES

Overuse could result in a loss of effectiveness.

Passive measure which doesn't require driver to alter behavior, so over time effectiveness could wear off.

TYPICAL LOCATIONS

Entering a rural community.

Rapid decrease in posted speed limit.

Where 85th percentile speeds are > 10 MPH above posted speed limit.

EXAMPLE LOCATIONS

US-91, Mantua

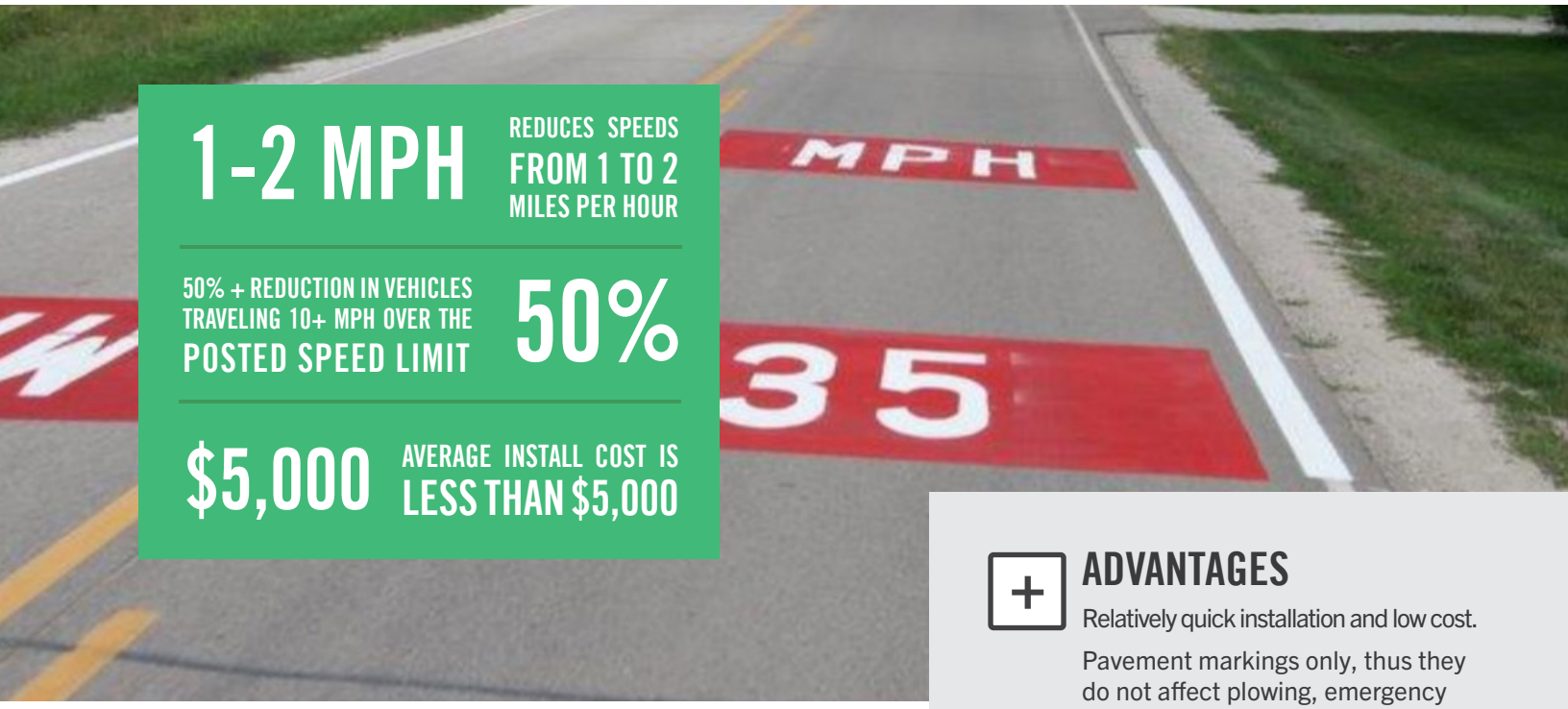
S.R. 150, Samak

S.R. 132, Leamington

US-6, Wellington

S.R. 9, Rockville

PAVEMENT SPEED LIMIT MARKING



1-2 MPH REDUCES SPEEDS FROM 1 TO 2 MILES PER HOUR

50% + REDUCTION IN VEHICLES TRAVELING 10+ MPH OVER THE POSTED SPEED LIMIT **50%**

$5,000 AVERAGE INSTALL COST IS LESS THAN $5,000

TRAVEL SPEEDS

Pavement Speed Limit Markings are appropriate for ALL roadway speeds.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Pavement Speed Limit Markings are appropriate for ALL traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Pavement Speed Limit Markings are appropriate for ALL lanes of traffic.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Relatively quick installation and low cost.

Pavement markings only, thus they do not affect plowing, emergency vehicle operations, drainage, etc.

DISADVANTAGES

Passive measure which doesn't require driver to alter behavior, so over time effectiveness could wear off.

In the traveled way, thus wear off over time.

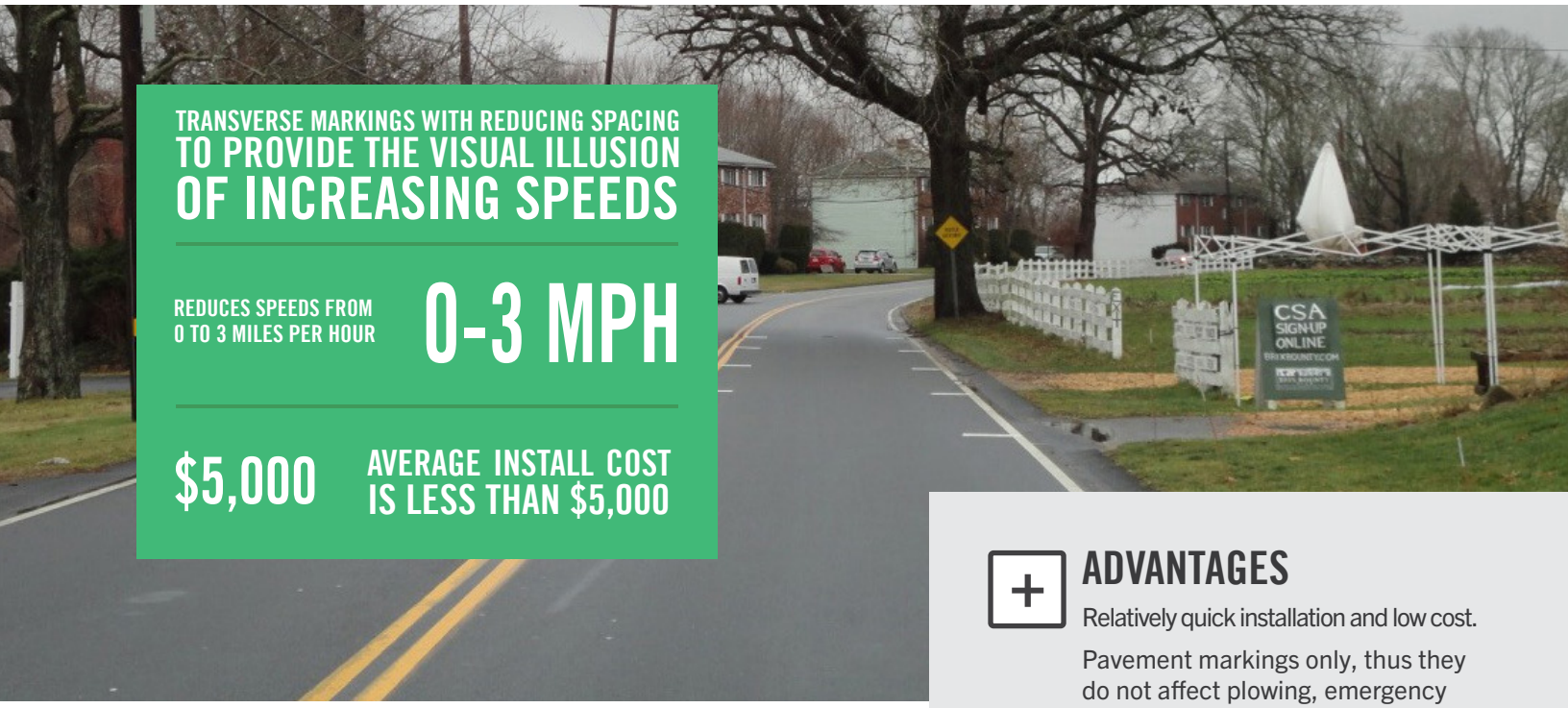
TYPICAL LOCATIONS

Any location where additional emphasis is needed. (curves, entering developed areas, reduction in posted speed limit).

EXAMPLE LOCATIONS

I-80 Eastbound at I-15, SLC

OPTICAL SPEED BARS



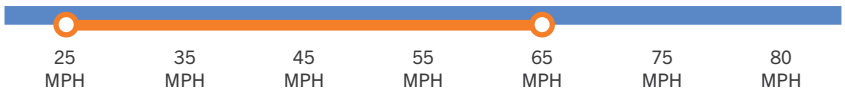
TRANSVERSE MARKINGS WITH REDUCING SPACING TO PROVIDE THE VISUAL ILLUSION OF INCREASING SPEEDS

REDUCES SPEEDS FROM 0 TO 3 MILES PER HOUR **0-3 MPH**

$5,000 AVERAGE INSTALL COST IS LESS THAN $5,000

TRAVEL SPEEDS

Optical Speed Bars are appropriate for roadway speeds between 25 and 65 miles per hour.



TRAFFIC VOLUMES

Optical Speed Bars are appropriate for Low to Moderate traffic volumes.

NUMBER OF LANES

Optical Speed Bars are appropriate for 1 to 2 lanes of traffic in each direction.

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Relatively quick installation and low cost.

Pavement markings only, thus they do not affect plowing, emergency vehicle operations, drainage, etc.

DISADVANTAGES

Passive measure which doesn't require driver to alter behavior, so over time effectiveness could wear off.

In the traveled way, thus wear off over time.

TYPICAL LOCATIONS

Curves and entering rural communities.

EXAMPLE LOCATIONS

None within Utah

ROADWAY NARROWING

STARTING AT $20,000 PER MILE (STRIPING ONLY)

0-3 MPH MINOR (0 TO 3 MILES PER HOUR) EFFECT ON VEHICLE SPEED WITHOUT OTHER CHANGES

PROVIDES SPACE FOR BIKE LANES OR PARKING

TRAVEL SPEEDS

Roadway Narrowing is appropriate for roadway speeds between 25 and 40 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Roadway Narrowing is appropriate for Low to Moderate traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Roadway Narrowing is appropriate for 1 to 3 lanes of traffic in each direction.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Potentially improved bike facilities or increased on-street parking.

Low cost.

DISADVANTAGES

Without other changes has not been shown to drastically vehicle speeds.

TYPICAL LOCATIONS

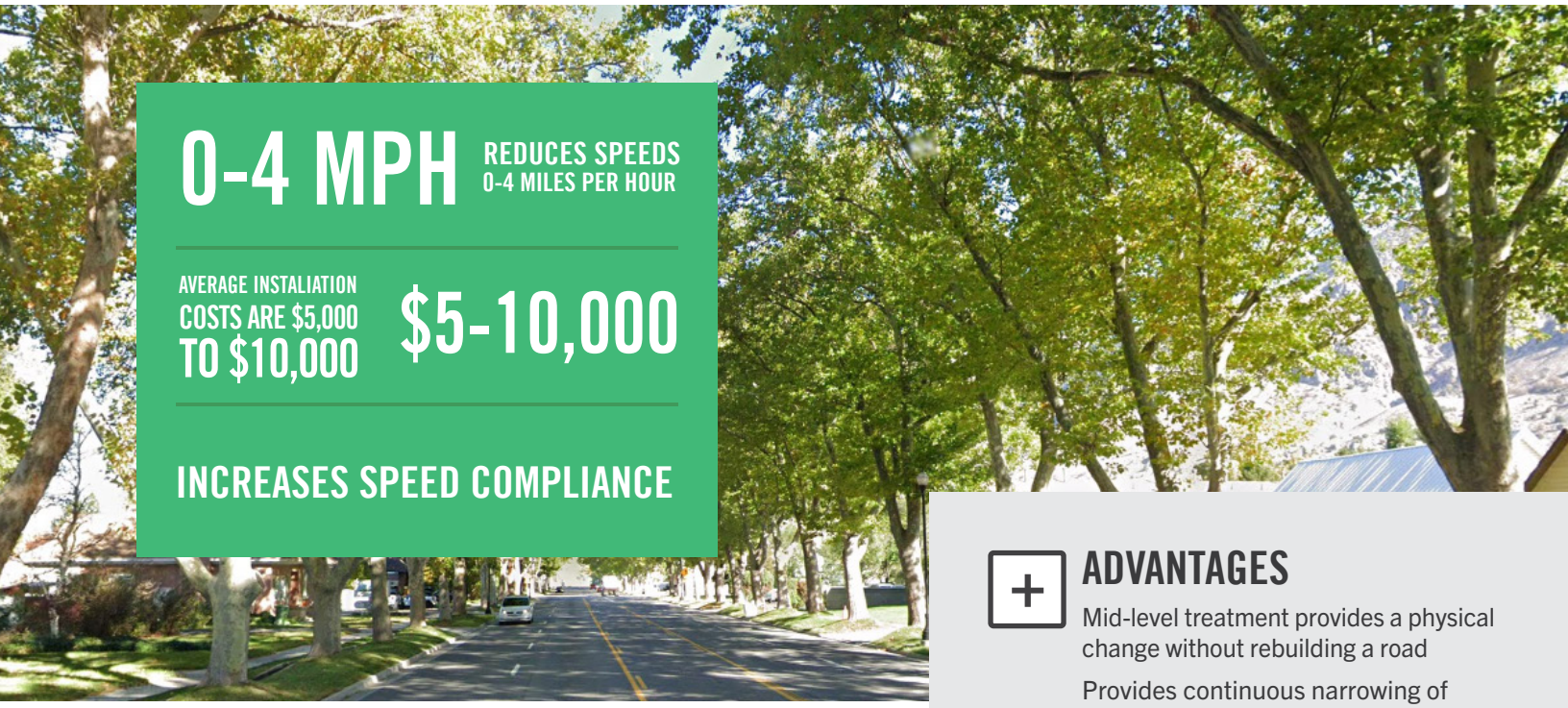
Combined with other treatments. Where treatments are needed for bicycle activity, high demand for parking, etc. and not just lowering vehicle speeds.

Roadways with wider pavement section than needed.

EXAMPLE LOCATIONS

200 South @ 800 East, SLC

Daybreak Parkway, South Jordan



0-4 MPH REDUCES SPEEDS 0-4 MILES PER HOUR

AVERAGE INSTALIATION COSTS ARE $5,000 TO $10,000 **$5-10,000**

INCREASES SPEED COMPLIANCE

TRAVEL SPEEDS

Landscaping is appropriate for roadway speeds between 25 and 65 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Landscaping is appropriate for LOW to HIGH traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Landscaping is appropriate for 1 to 4 lanes of traffic in each direction.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

- Mid-level treatment provides a physical change without rebuilding a road
- Provides continuous narrowing of perceived width
- Improves streetscape aesthetics and reduces heat-island effect
- Works well in conjunction with other treatments

DISADVANTAGES

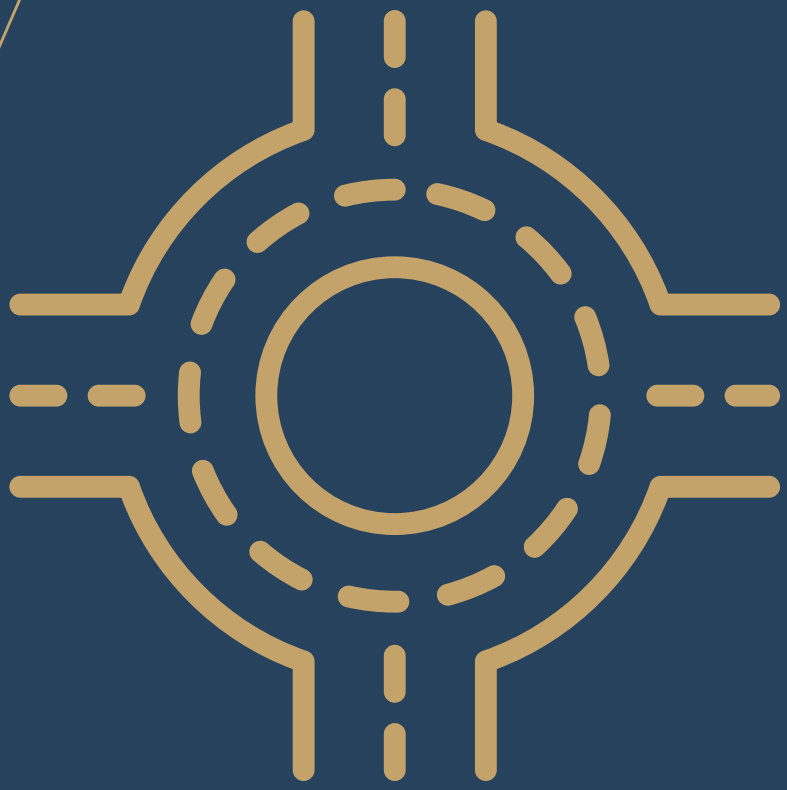
- Must be designed to avoid creating sight distance triangle obstructions
- Often requires maintenance
- May be challenging in a dry climate

TYPICAL LOCATIONS

- Along transition zones
- At gateways
- Within developed areas

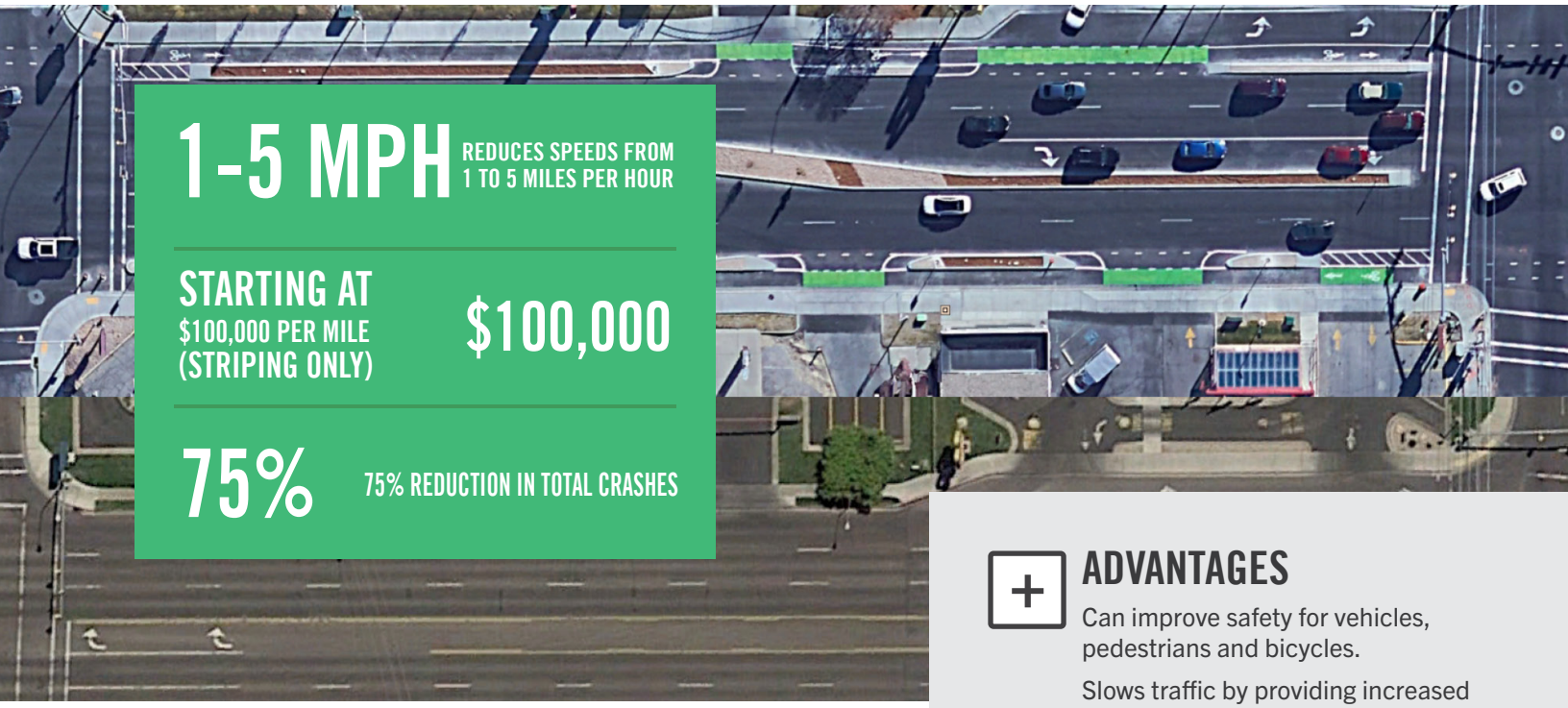
EXAMPLE LOCATIONS

- St George S.R. 34
- Hurricane S.R. 9
- Brigham City S.R. 13
- Park City S.R. 248
- Farmington S.R.106



ACTIVE MEASURES

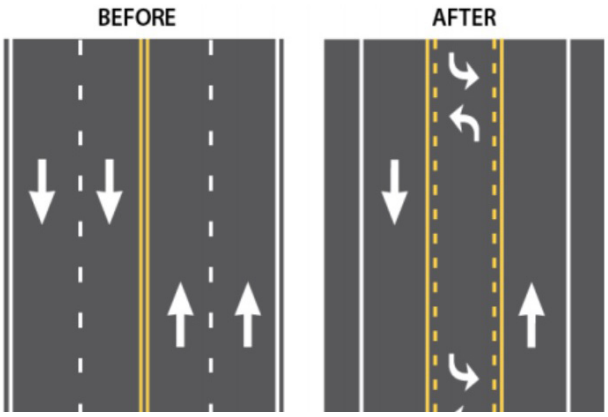
ROAD DIET



1-5 MPH REDUCES SPEEDS FROM 1 TO 5 MILES PER HOUR

STARTING AT $100,000 PER MILE (STRIPING ONLY) **$100,000**

75% 75% REDUCTION IN TOTAL CRASHES



TRAVEL SPEEDS

Road Diets are appropriate for roadway speeds between 25 and 50 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Road Diets are appropriate for Low to Moderate traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Road Diets are appropriate for 2 to 4 lanes of traffic in each direction.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Can improve safety for vehicles, pedestrians and bicycles.

Slows traffic by providing increased friction.

DISADVANTAGES

Could impact roadway capacity, and emergency services/evacuation times.

TYPICAL LOCATIONS

Roadways with frequent curb cuts and with traffic volumes that are lower than roadway capacity.

EXAMPLE LOCATIONS

S.R. 258, Elsinore

S.R. 118, Richfield

Cougar Blvd, Provo

200 West, SLC

California Ave
(east of Redwood Rd), SLC

LANDSCAPE MEDIAN ISLAND

1-5 MPH REDUCES SPEEDS FROM 1 TO 5 MILES PER HOUR

$0.5 TO 1 MILLION PER MILE

71% REDUCES CRASHES UP TO 71%

Treatment also includes curb extensions

TRAVEL SPEEDS

Median Islands are appropriate for roadway speeds between 25 and 65 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Median Islands are appropriate for ALL traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Median Islands are appropriate for All lanes of traffic.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Physical treatment so effectiveness does not wear off with time.

Provides improved pedestrian crossing.

Landscaped medians improve aesthetics as well as reduce travel speeds.

DISADVANTAGES

Increased maintenance. Could require additional right-of-way.

Back to back curb medians without landscaping have not been shown to reduce travel speeds.

TYPICAL LOCATIONS

Roadways with two-way left-turn lanes and where u-turns, alternate access, or median openings can be accommodated. Existing and potential pedestrian crossing locations.

EXAMPLE LOCATIONS

US-89, downtown Ogden

US-89 @ 50 North, SLC

S.R. 68 @ 5500 South, Taylorsville

S.R. 34, St. George

CURB EXTENSIONS

LIKELY REDUCTION IN VEHICLE SPEEDS
DEPENDING ON DESIGN

APPROXIMATELY $100,000 OR GREATER
$100,000

UP TO 30% REDUCTION IN PEDESTRIAN CRASHES

TRAVEL SPEEDS

Curb Extensions are appropriate for roadway speeds between 25 and 40 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Curb Extensions are appropriate for Low to Moderate traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Curb Extensions are appropriate for 1 to 2 lanes of traffic in each direction.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Physical treatment so effectiveness does not wear off with time.

Provides improves pedestrian crossing.

DISADVANTAGES

Increased maintenance. Could interfere with large vehicle movements.

TYPICAL LOCATIONS

Corridors with on-street parking. Intersections with pedestrian activity and a small number of turning heavy vehicles.

EXAMPLE LOCATIONS

US-89, downtown Ogden
US-89 & 500 N, SLC
US-40, downtown Ogden
S.R. 120, Richfield
US-89, Gunnison
S.R. 12, Triopic

RAISED CROSSWALK

HIGHLAND CITY

Safe Transportation For Every Pedestrian

A Counter Measure Tech Sheet

Local and collector roads with high speeds pose a significant challenge for pedestrians crossing the roadway.

A raised crosswalk can reduce vehicle speeds and enhance the pedestrian crossing environment.

45% REDUCES PEDESTRIAN CRASHES BY 45%

AVERAGE INSTALLATION COSTS FROM

$8,000 - $32,000

Raised crosswalks are ramped speed tables spanning the entire width of the roadway, often placed at midblock crossing locations. The crosswalk is demarcated with paint and/or special paving materials. These crosswalks act as traffic-calming measures that allow the pedestrian to cross at grade with the sidewalk.

In addition to their use on local and collector streets, raised crosswalks can be installed in campus settings, shopping centers, and pick-up/drop-off zones (e.g., airports, schools, transit centers).

Raised crosswalks are flush with the height of the sidewalk. The crosswalk table is typically at least 10 feet wide and designed to allow the front and rear wheels of a passenger vehicle to be on top of the table at the same time. Detectable warnings (truncated domes) and curb ramps are installed at the street edge for pedestrians with impaired vision.

FEATURES:

- Elevated crossing makes the pedestrian more prominent in the driver's field of vision, and allows pedestrians to cross at grade with the sidewalk
- Approach ramps may reduce vehicle speeds and improve motorist yielding

OFTEN USED WITH:

- Crosswalk visibility enhancements

Source: FHWA Raised Crosswalk Tech Sheet June 2018

Boston, MA. Photo: Peter Furth / nacto.org

CONSIDERATIONS

Raised crosswalks are typically installed on 2-lane or 3-lane roads with speed limits of 30 mph or less and annual average daily traffic (AADT) below about 9,000. Raised crossings should generally be avoided on truck routes, emergency routes, and arterial streets.

Drainage can be an issue. Raised crosswalks may be installed with curb extensions where parking exists. They may also be used at intersections, particularly at the entrance of the minor street.

Since this countermeasure can cause discomfort and noise (especially with larger vehicles), it may be appropriate to get public buy-in. Raised crosswalks may not be appropriate for bus transit routes or primary emergency vehicle routes. For States that experience regular snowfall, snowplowing can be a concern.

COST

The cost associated with a raised crosswalk ranges from $7,110 to $30,880 each, with the average cost estimated at $8,170.

References

Federal Highway Administration. (2013). "Raised Pedestrian Crossings" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. Available: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=7

Thomas, L., Thirsk, N. J., & Zegeer, C. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington D.C.

Bushell, M., Poole, B., Zegeer, C., & Rodriguez, D. (2013). Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public. Pedestrian and Bicycle Information Center.

Elvik, R., Christensen, P., and Amundsen, A. (2004). "Speed and Road Accidents An Evaluation of the Power Model." Transportokonomisk Institutt, Oslo, Norway.

Source: https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm

HIGHLAND CITY

SIGNIFICANT SPEED REDUCTIONS

AVERAGE INSTALL COST OF 1-3 MILLION

$1-3 MILLION

88%

REDUCE FATAL AND SERIOUS INJURY CRASHES BY UP TO 88%

TRAVEL SPEEDS

Roundabouts are appropriate for roadway speeds between 25 and 65 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Roundabouts are appropriate for Low to Moderate traffic volumes.
**High volume roadways may be possible with additional review / design.*

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Roundabouts are appropriate for 1 to 2 lanes of traffic in each direction.
**3 lane roadways may be possible with additional review / design.*

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Alters vehicle path thus necessitates major reductions in speed.

Major safety improvements.

Can handle a wide range of mainline and turning traffic.

Pedestrian safety improved due to lower speeds.

DISADVANTAGES

Relatively expensive. May require additional right-of-way.

TYPICAL LOCATIONS

Intersections with available right-of-way. Where speeds, safety, and congestion are all concerns.

EXAMPLE LOCATIONS

I-80 interchange, Jeremy Ranch Park City

S.R.63, Oljato-Monument Valley

S.R. 12 & S.R. 63, Bryce Canyon

S.R. 130, Enoch

SPEED CUSHION

Description:

- Two or more raised areas placed laterally across a roadway with gaps between raised areas
- Height and length similar to a speed hump; spacing of gaps allow emergency vehicles to pass through at higher speeds
- Often placed in a series (typically spaced 260 to 500 feet apart)
- Sometimes called speed lump, speed slot, and speed pillow

Applications:

- Appropriate on local and collector streets
- Appropriate at mid-block locations only
- Not appropriate on grades greater than 8 percent

(Source: James Barrera, Horrocks, New Mexico)

20-25% REDUCES SPEED BY 20-25%

AVERAGE INSTALLATION COSTS FROM **$3,000 - $4,000**

13% REDUCES PEDESTRIAN CRASHES BY 13%

Design/Installation Issues:

- Two or more cushions at each location
- Typically 12 to 14 feet in length and 7 feet in width
- Cushion heights range between 3 and 4 inches, with trend toward 3 - 3 ½ inches maximum
- Speed cushion shapes include parabolic, circular, and sinusoidal
- Material can be asphalt or rubber
- Often have associated signing (advance-warning sign before first cushion at each cushion)
- Typically have pavement markings (zigzag, shark's tooth, chevron, zebra)
- Some have speed advisories

Potential Impacts:

- Limited-to-no impact on non-emergency access
- Speeds determined by height and spacing; speed reductions between cushions have been observed averaging 20 and 25 percent
- Speeds typically increase by 0.5 mph midway between cushions for each 100 feet of separation
- Studies indicate that average traffic volumes have reduced by 20 percent depending on alternative routes available
- Average collision rates have been reduced by 13 percent on treated streets

Emergency Response Issues:

- Speed cushions have minimal impact on emergency response times, with less than a 1 second delay experienced by most emergency vehicles

Typical Cost (2017 dollars):

- Cost ranges between $3,000 and $4,000 for a set of rubber cushions

Source: ITE Traffic Calming Fact Sheets, May 2018

Description:

- Long, raised speed humps with a flat section in the middle and ramps on the ends; sometimes constructed with brick or other textured materials on the flat section
- If placed at a pedestrian crossing, it is referred to as a raised crosswalk
- If placed only in one direction on a road, it is called an offset speed table

Applications:

- Appropriate for local and collector streets; mid-block or at intersections, with/without crosswalks
- Can be used on a one-lane one-way or two-lane two-way street
- Not appropriate for roads with 85th percentile speeds of 45 mph or more
- Typically long enough for the entire wheelbase of a passenger car to rest on top or within limits of ramps
- Work well in combination with textured crosswalks, curb extensions, and curb radius reductions
- Can be applied both with and without sidewalks or dedicated bicycle facilities
- Typically installed along closed-section roads (i.e. curb and gutter) but feasible on open section

(Source: Google Maps, Boulder, Colorado)

0.5 - 1 MPH REDUCES SPEED BY 0.5-1 MPH

AVERAGE INSTALLATION COSTS FROM **$2,500 - $8,000**

45% REDUCES PEDESTRIAN CRASHES BY 45%

Design/Installation Issues:

- ITE recommended practice – "Guidelines for the Design and Application of Speed Humps"
- Most common height is between 3 and 4 inches (reported as high as 6 inches)
- Ramps are typically 6 feet long (reported up to 10 feet long) and are either parabolic or linear
- Careful design is needed for drainage
- Posted speed typically 30 mph or less

Potential Impacts:

- No impact on non-emergency access
- Speeds reductions typically less than for speed humps (typical traversing speeds between 25 and 27 miles per hour)
- Speeds typically decline approximately 0.5 to 1 mph midway between tables for each 100 feet beyond the 200-foot approach and exit points of consecutive speed tables
- Average traffic volumes diversions of 20 percent when a series of speed tables are implemented
- Average crash rate reduction of 45 percent on treated streets
- Increase pedestrian visibility and likelihood of driver yield compliance
- Generally not appropriate for BRT bus routes

Emergency Response Issues:

- Typically preferred by fire departments over speed humps, but not appropriate for primary emergency vehicle routes; typically less than 3 seconds of delay per table for fire trucks

Typical Cost (2017 dollars):

- Cost ranges between $2,500 and $8,000 for asphalt tables; higher for brickwork, stamped asphalt, concrete ramps, and other enhancements sometimes used at pedestrian crossings

Source: ITE Traffic Calming Fact Sheets, May 2018

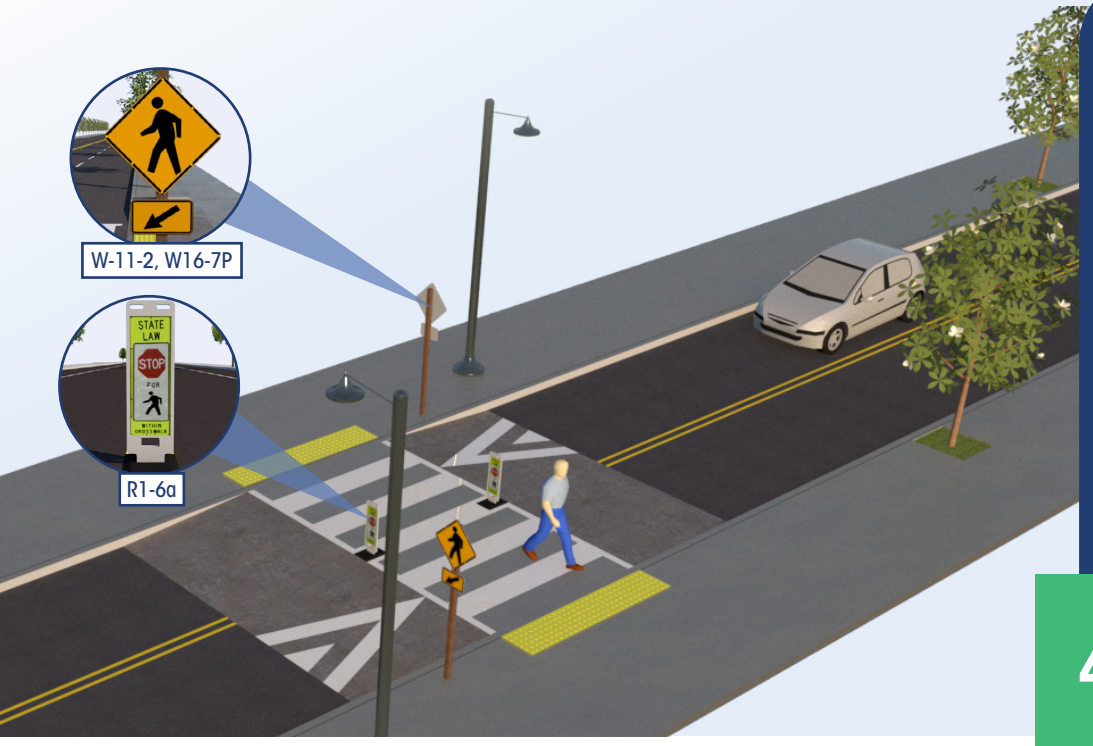
PEDESTRIAN SAFETY MEASURES

RAISED CROSSWALK

HIGHLAND CITY

Safe Transportation For Every Pedestrian

A Counter Measure Tech Sheet



Local and collector roads with high speeds pose a significant challenge for pedestrians crossing the roadway.

A raised crosswalk can reduce vehicle speeds and enhance the pedestrian crossing environment.

45% REDUCES PEDESTRIAN CRASHES BY 45%

AVERAGE INSTALLATION COSTS FROM

$8,000 - $32,000

Raised crosswalks are ramped speed tables spanning the entire width of the roadway, often placed at midblock crossing locations. The crosswalk is demarcated with paint and/or special paving materials. These crosswalks act as traffic-calming measures that allow the pedestrian to cross at grade with the sidewalk.

In addition to their use on local and collector streets, raised crosswalks can be installed in campus settings, shopping centers, and pick-up/drop-off zones (e.g., airports, schools, transit centers).

Raised crosswalks are flush with the height of the sidewalk. The crosswalk table is typically at least 10 feet wide and designed to allow the front and rear wheels of a passenger vehicle to be on top of the table at the same time. Detectable warnings (truncated domes) and curb ramps are installed at the street edge for pedestrians with impaired vision.

FEATURES:

- Elevated crossing makes the pedestrian more prominent in the driver's field of vision, and allows pedestrians to cross at grade with the sidewalk
- Approach ramps may reduce vehicle speeds and improve motorist yielding

OFTEN USED WITH:

- Crosswalk visibility enhancements

Source: FHWA Raised Crosswalk Tech Sheet June 2018

Boston, MA. Photo: Peter Furth / nacto.org

CONSIDERATIONS

Raised crosswalks are typically installed on 2-lane or 3-lane roads with speed limits of 30 mph or less and annual average daily traffic (AADT) below about 9,000. Raised crossings should generally be avoided on truck routes, emergency routes, and arterial streets.

Drainage can be an issue. Raised crosswalks may be installed with curb extensions where parking exists. They may also be used at intersections, particularly at the entrance of the minor street.

Since this countermeasure can cause discomfort and noise (especially with larger vehicles), it may be appropriate to get public buy-in. Raised crosswalks may not be appropriate for bus transit routes or primary emergency vehicle routes. For States that experience regular snowfall, snowplowing can be a concern.

COST

The cost associated with a raised crosswalk ranges from $7,110 to $30,880 each, with the average cost estimated at $8,170.

References

Federal Highway Administration. (2013). "Raised Pedestrian Crossings" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. Available: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=7

Thomas, L., Thirsk, N. J., & Zegeer, C. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington D.C.

Bushell, M., Poole, B., Zegeer, C., & Rodriguez, D. (2013). Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public. Pedestrian and Bicycle Information Center.

Elvik, R., Christensen, P., and Amundsen, A. (2004). "Speed and Road Accidents An Evaluation of the Power Model." Transportokonomisk Institutt, Oslo, Norway.

Source: https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm

CROSSWALK VISIBILITY ENHANCEMENTS

This example combines curb extensions, high-visibility markings, overhead lighting, and in-street signs on a two-lane roadway.

Poor lighting conditions, obstructions such as parked cars, and horizontal or vertical roadway curvature can reduce visibility at crosswalks, contributing to higher crash rates.

Crosswalk visibility enhancements help make crosswalks and/or pedestrians more visible and can help pedestrians decide where to cross.

23-48% REDUCES PEDESTRIAN CRASHES BY 23-48%

AVERAGE INSTALLATION COSTS FROM
$300 - $22,000

This group of countermeasures includes improved lighting, advance or in-street warning signage, pavement markings, and geometric design elements. Such features may be used in combination to indicate optimal or preferred locations for people to cross and to help reinforce the driver requirement to yield the right-of-way to pedestrians at crossing locations.

For multi-lane roadway crossings where vehicle AADTs are in excess of 10,000, a marked crosswalk alone is typically not sufficient (Zegeer, 2005). Under such conditions, more substantial crossing improvements are also needed to prevent an increase in pedestrian crash potential. Examples of more substantial treatments include the refuge island, PHB, and RRFB.

FEATURES:

- High visibility marking improves visibility of the crosswalk compared to the standard parallel lines.
- Parking restriction on the crosswalk approach improves the sightlines for motorists and pedestrians.
- Advance STOP or YIELD markings & signs reduce the risk of a multiple threat crash.
- Curb extension improves sight distance between drivers and pedestrians and narrows crossing distance.
- In street STOP or YIELD signs may improve driver yielding rates.

June 2018, Updated | *FHWA-SA-18-061*

Source: FHWA Crosswalk Visibility Enhancements Tech Sheet June 2018
"ITE Traffic Calming Fact Sheets, May 2018

High-visibility crosswalk marking. High-visibility crosswalks are preferred over parallel line crosswalks and should be provided at all established midblock pedestrian crossings. They should also be considered at uncontrolled intersections.

Parking restriction on the crosswalk approach. Parking restriction can include the removal of parking space markings, installation of new "parking prohibition" pavement markings or curb paint, and signs. The minimum setback is 20 feet in advance of the crosswalk where speeds are 25 mph or less, and 30 feet where speeds are between 26 and 35 mph.

Advance YIELD or STOP markings and signs.[1] The stop bar or "sharks teeth" yield markings are placed 20 to 50 feet in advance of a marked crosswalk to indicate where vehicles are required to stop or yield in compliance with the accompanying "STOP Here for Pedestrians" or "YIELD Here to Pedestrians" sign.

Curb extension. This treatment, also referred to as bulb-outs, extends the sidewalk or curb line out into the parking lane, which reduces the effective street width. Curb extensions must not extend into travel lanes and should not extend across bicycle lanes.

Improved nighttime lighting. Consideration should be given to placing lights in advance of midblock and intersection crosswalks on both approaches to illuminate the front of the pedestrian and avoid creating a silhouette.

In-street STOP or YIELD to pedestrian sign.[2] These signs serve to remind road users of laws regarding right-of-way, and they may be appropriate on 2-lane or 3-lane roads where speeds limits are 30 mph or less. The sign can be placed in between travel lanes or in a median.

COST

Countermeasure	Range	Average
High visibility crosswalk marking	$600-5,700 each	$2,540 each
Lighting	*Varies based on fixture type and utility service agreement*	
Parking restriction	*Varies based on the required signs and pavement markings*	
Curb extension	$2,000-20,000	$13,000 each
Advance STOP/YIELD sign	N/A	$300 each
Advance STOP/YIELD line	N/A	$320 each
In-street STOP/YIELD sign	N/A	$240 each

[1]MUTCD section 2B.12 In-Street and Overhead Pedestrian Crossing Signs (R1-6, R1-6a, R1-9, and R1-9a)

[2]MUTCD reference:Section 2B.11 Yield Here To Pedestrians Signs and Stop Here For Pedestrians Signs (R1-5 Series)

References

Harkey, D.L., R. Srinivasan, J. Baek, F. Council, K. Eccles, N. Lefler, F. Gross, B. Persaud, C. Lyon, E. Hauer, and J. Bonneson. (2008). NCHRP Report 617: Crash Reduction Factors for Traffic Engineering and ITS Improvements. Transportation Research Board, Washington, D.C.

Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.

Gibbons, R. B., Edwards, C., Williams, B., & Andersen, C. K. (2008). Informational Report on Lighting Design for Midblock Crosswalks. Report No. FHWA-HRT-08-053. Federal Highway Administration.

Bushell, M., Poole, B., Zegeer, C., & Rodriguez, D. (2013). Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public. Pedestrian and Bicycle Information Center.

Federal Highway Administration. (2013). Multiple webpages in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System:

- Marked Crosswalks and Enhancements: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=4
- Lighting and Illumination: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=8
- Parking Restrictions: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=9
- Curb Extensions: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=5
- Advance Stop/Yield Lines: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=13

Source: FHWA Crosswalk Visibility Enhancements Tech Sheet June 2018

CURB EXTENSIONS

LIKELY REDUCTION IN VEHICLE SPEEDS
DEPENDING ON DESIGN

APPROXIMATELY $100,000 OR GREATER
$100,000

UP TO 30% REDUCTION IN PEDESTRIAN CRASHES

TRAVEL SPEEDS

Curb Extensions are appropriate for roadway speeds between 25 and 40 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Curb Extensions are appropriate for Low to Moderate traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Curb Extensions are appropriate for 1 to 2 lanes of traffic in each direction.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Physical treatment so effectiveness does not wear off with time.

Provides improves pedestrian crossing.

DISADVANTAGES

Increased maintenance. Could interfere with large vehicle movements.

TYPICAL LOCATIONS

Corridors with on-street parking. Intersections with pedestrian activity and a small number of turning heavy vehicles.

EXAMPLE LOCATIONS

US-89, downtown Ogden
US-89 & 500 N, SLC
US-40, downtown Ogden
S.R. 120, Richfield
US-89, Gunnison
S.R. 12, Triopic

PEDESTRIAN REFUGE ISLAND

HIGHLAND CITY

Safe Transportation For Every Pedestrian

A Counter Measure Tech Sheet

The combination of a long crossing distance and multiple lanes of oncoming traffic can create an unsafe pedestrian environment.

A pedestrian refuge island can improve safety and comfort by providing pedestrians with the option of waiting in the median area before beginning the next stage of the crossing.

32% REDUCES PEDESTRIAN CRASHES BY 32%

AVERAGE INSTALLATION COSTS FROM

$5,000 - $45,000

A pedestrian refuge island is a median with a refuge area that is intended to help protect pedestrians who are crossing a multilane road. This countermeasure is sometimes referred to as a crossing island, refuge island, or pedestrian island. The presence of a pedestrian refuge island at a midblock location or intersection allows pedestrians to focus on one direction of traffic at a time as they cross, and gives them a place to wait for an adequate gap in oncoming traffic before finishing the second phase of a crossing.

Refuge islands are highly desirable for midblock pedestrian crossings on roads with four or more travel lanes, especially where speed limits are 35 mph or greater and/or where annual average daily traffic (AADT) is 9,000 or higher. They are also a candidate treatment option for uncontrolled pedestrian crossings on 3-lane or 2-lane roads that have high vehicle speeds or volumes. When installed at a midblock crossing, the island should be supplemented with a marked high-visibility crosswalk.

FEATURES:

- Median can enhance visibility of the crossing and reduce speed of approaching vehicles.
- Refuge area provides a place to rest and reduces the amount of time a pedestrian is in the roadway.

OFTEN USED WITH:

- Crosswalk visibility enhancements
- Curb extensions (where road width allows)

Source: FHWA Raised Crosswalk Tech Sheet June 2018

Asheville, NC. Photo: Lyubov Zuyeva, pedbikeimages.org

CONSIDERATIONS

The design must accommodate pedestrians with disabilities. Islands should be at least 4 feet wide (preferably 8 feet) and of adequate length to allow the anticipated number of pedestrians to stand and wait for gaps in traffic before crossing. The cut-through must include detectable warnings if island width is at least 6 feet.

Islands should be illuminated or highlighted with street lights, signs, and/or reflectors to ensure that they are visible to motorists. They can be constructed so that crossing pedestrians are directed to the right, so they can more easily view oncoming traffic after they are halfway through the crossing. If applicable, evaluate the impact of the island on bicycle facility design.

COST

The cost of a median island depends on its size and construction materials. The costs range from $2,140 to $41,170 per island, depending on the length of the island, with an average cost of $13,520. The average cost per square foot is approximately $10. Costs will be higher for concrete islands versus asphalt islands, though the lifespan of concrete is longer compared to the lifespan of asphalt. Cost reductions may be realized if the refuge island can be incorporated into planned roadway improvements or utility work.

References

Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.

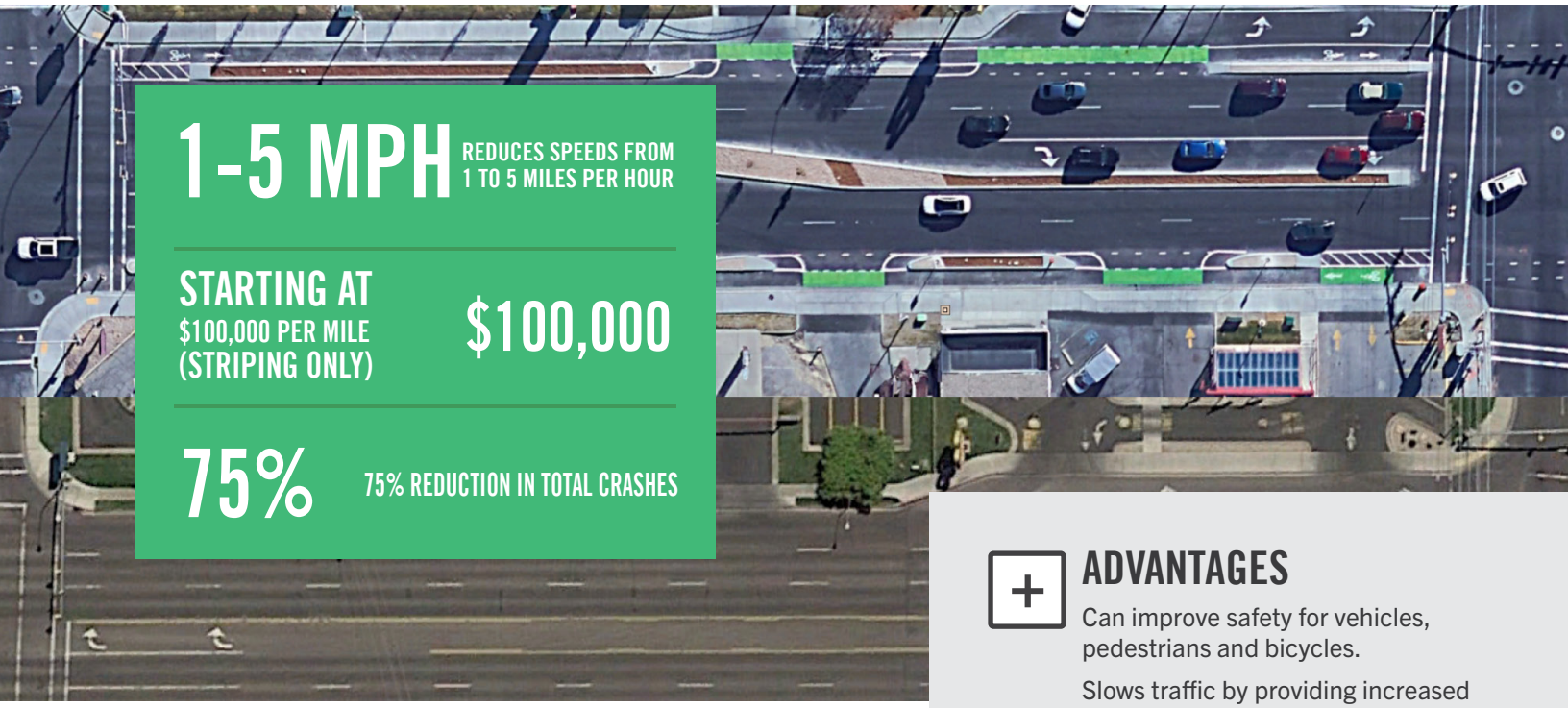
Federal Highway Administration. (2013). "Crossing Islands" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. Available: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=6

Federal Highway Administration. "Medians and Pedestrian Crossing Islands in Urban and Suburban Areas." Proven Safety Countermeasures. Available: https://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.cfm

Bushell, M., Poole, B., Zegeer, C., & Rodriguez, D. (2013). Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public. Pedestrian and Bicycle Information Center.

Source: FHWA Crosswalk Visibility Enhancements Tech Sheet June 2018
https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm

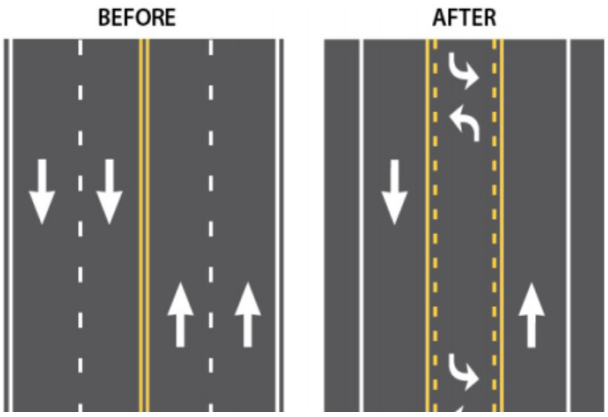
ROAD DIET



1-5 MPH REDUCES SPEEDS FROM 1 TO 5 MILES PER HOUR

STARTING AT $100,000 PER MILE (STRIPING ONLY) **$100,000**

75% 75% REDUCTION IN TOTAL CRASHES



TRAVEL SPEEDS

Road Diets are appropriate for roadway speeds between 25 and 50 miles per hour.

25 MPH | 35 MPH | 45 MPH | 55 MPH | 65 MPH | 75 MPH | 80 MPH

TRAFFIC VOLUMES

Road Diets are appropriate for Low to Moderate traffic volumes.

Low Volume | Moderate Volume | High Volume

NUMBER OF LANES

Road Diets are appropriate for 2 to 4 lanes of traffic in each direction.

1 Lane | 2 Lane | 3 Lane | 4 Lane

Source: UDOT Speed Info Management Sheets, March 2022

ADVANTAGES

Can improve safety for vehicles, pedestrians and bicycles.

Slows traffic by providing increased friction.

DISADVANTAGES

Could impact roadway capacity, and emergency services/evacuation times.

TYPICAL LOCATIONS

Roadways with frequent curb cuts and with traffic volumes that are lower than roadway capacity.

EXAMPLE LOCATIONS

S.R. 258, Elsinore

S.R. 118, Richfield

Cougar Blvd, Provo

200 West, SLC

California Ave
(east of Redwood Rd), SLC

RECTANGULAR RAPID FLASHING BEACON (RRFB)

HIGHLAND CITY

Multiple lanes of traffic create challenges for pedestrians crossing at unsignalized locations.

RRFBs can make crosswalks and/or pedestrians more visible at a marked crosswalk.

47% REDUCES PEDESTRIAN CRASHES BY 47%

AVERAGE INSTALLATION COSTS FROM
$5,000 - $55,000

RRFBs are pedestrian-actuated conspicuity enhancements used in combination with a pedestrian, school, or trail crossing warning sign to improve safety at uncontrolled, marked crosswalks. The device includes two rectangular-shaped yellow indications, each with an LED-array-based light source, that flash with high frequency when activated.

The RRFB is a treatment option at many types of established pedestrian crossings. Research indicates RRFBs can result in motorist yielding rates as high as 98 percent at marked crosswalks. However, yielding rates as low as 19 percent have also been noted. Compliance rates varied most per the city location, posted speed limit, crossing distance, and whether the road was one- or two-way. RRFBs are particularly effective at multilane crossings with speed limits less than 40 mph. Consider the Pedestrian Hybrid Beacon (PHB) instead for roadways with higher speeds. FHWA's *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* (HSA-17-072) provides specific conditions where practitioners should strongly consider the PHB instead of the RRFB.

FEATURES:

- Enhanced warning improves motorist yielding

OFTEN USED WITH:

- Crosswalk visibility enhancements
- Pedestrian refuge island
- Advance STOP or YIELD markings and signs

Source: FHWA Rectangular-Rapid Flashing Beacon (RRFB) Tech Sheet June 2018
https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm

Princeton, NJ. Photo: VHB

CONSIDERATIONS

FHWA has issued interim approval for the use of the RRFB (IA-21). State and local agencies must request and receive permission to use this interim approval before they can use the RRFB. IA-21 does not provide guidance or criteria based on number of lanes, speed, or traffic volumes.

RRFBs are placed on both ends of a crosswalk. If the crosswalk contains a pedestrian refuge island or other type of median, an RRFB should be placed to the right of the crosswalk and on the median (instead of the left side of the crosswalk).

RRFBs typically draw power from standalone solar panel units, but may also be wired to a traditional power source. IA-21 provides conditions for the use of accessible pedestrian features with the RRFB assembly. When RRFBs are not in common use in a community, consider conducting an outreach effort to educate the public and law enforcement officers on their purpose and use.

COST

The cost associated with RRFB installation ranges from $4,500 to $52,000 each, with the average cost estimated at $22,250. These costs include the complete system installation with labor and materials.

References

MUTCD section 2B.12 In-Street and Overhead Pedestrian Crossing Signs (R1-6, R1-6a, R1-9, and R1-9a).

Fitzpatrick, K., M. Brewer, R. Avelar, and T. Lindheimer. "Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon." Report No. TTI-CTS-0010. Texas A&M Transportation Institute, College Station, Texas. June 2016. https://static.tti.tamu.edu/tti.tamu.edu/documents/TTI-CTS-0010.pdf

Federal Highway Administration. (2018). MUTCD – Interim Approval for Optional Use of Pedestrian-Actuated Rectangular Rapid-Flashing Beacons at Uncontrolled Marked Crosswalks (IA-21). U.S. Department of Transportation, Washington, DC.

Federal Highway Administration. (2013). "Rectangular Rapid Flash Beacon" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. Available: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=54

Bushell, M., Poole, B., Zegeer, C., & Rodriguez, D. (2013). Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public. Pedestrian and Bicycle Information Center.

Source: FHWA Rectangular-Rapid Flashing Beacon (RRFB) Tech Sheet June 2018
https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm

PEDESTRIAN HYBRID BEACON (PHB)

PHB or High-Intensity Activated Crosswalk (HAWK)

A Pedestrian Hybrid Beacon head consists of two red lenses above a single yellow lens. Unlike a traffic signal, the PHB rests in dark until a pedestrian activates it via pushbutton or other form of detection. When activated, the beacon displays a sequence of flashing and solid lights that indicate the pedestrian walk interval and when it is safe for drivers to proceed (see figure on back page).

The PHB is often considered for installation at locations where pedestrians need to cross and vehicle speeds or volumes are high, but traffic signal warrants are not met. These devices have been successfully used at school crossings, parks, senior centers, and other pedestrian crossings on multilane streets. PHBs are typically installed at the side of the road or on mast arms over midblock pedestrian crossings.

Source: FHWA Pedestrian Hybrid Beacon (PHB) Tech Sheet June 2018
https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm

High speeds and multiple lanes of traffic create challenges for pedestrians crossing at unsignalized locations.

PHBs can warn and control traffic at unsignalized locations and assist pedestrians in crossing a street or highway at a marked crosswalk.

55% **REDUCES PEDESTRIAN CRASHES BY 55%**

AVERAGE INSTALLATION COSTS FROM
$25,000 - $130,000

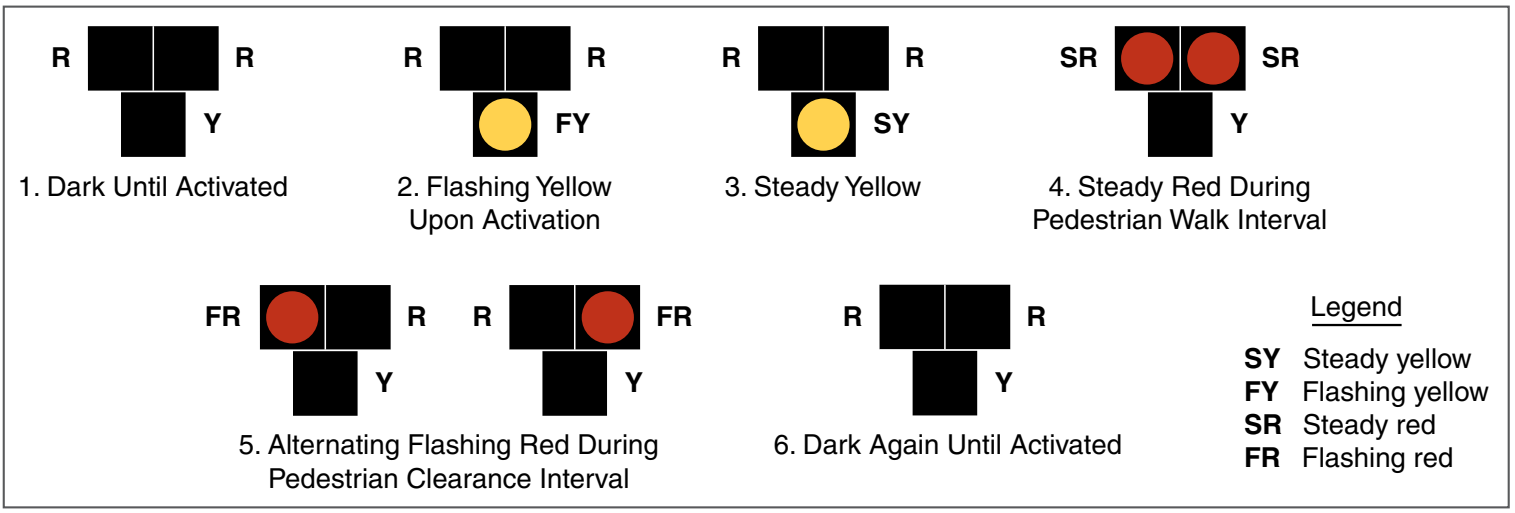
FEATURES:

- Beacons stop all lanes of traffic, which can reduce pedestrian crashes.

OFTEN USED WITH:

- High-visibility crosswalk markings
- Raised islands
- Advance STOP or YIELD signs and markings

Figure 4F-3. Sequence for a Pedestrian Hybrid Beacon from FHWA's *Manual on Uniform Traffic Control Devices*, 2009 Edition, p. 511



When a pedestrian activates a PHB, a flashing yellow light is followed by a solid yellow light, alerting drivers to slow. A solid red light requires drivers to stop while pedestrians have the right-of-way to cross the street. When the pedestrian signals display a flashing DON'T WALK indication, the overhead beacon flashes red, and drivers may proceed if the crosswalk is clear.

CONSIDERATIONS

PHBs are a candidate treatment for roads with three or more lanes that generally have annual average daily traffic (AADT) above 9,000. PHBs should be strongly considered for all midblock and intersection crossings where the roadway speed limits are equal to or greater than 40 miles per hour (mph). The PHB should meet the application guidelines provided in the Manual on Uniform Traffic Control Devices for existing or projected pedestrian volumes.

PHBs are intended for installation at midblock locations, but can be installed at intersections. They should only be installed in conjunction with marked crosswalks and pedestrian countdown signals.

When PHBs are not in common use in a community, consider conducting an outreach effort to educate the public and law enforcement officers on the PHBs' purpose and use.

COST

The PHB is often less expensive than a full traffic signal installation. The costs range from $21,000 to $128,000, with an average per unit cost of $57,680.

References

Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.

Federal Highway Administration. (2013). "Pedestrian Hybrid Beacon" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. Available: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=53

Bushell, M., Poole, B., Zegeer, C., & Rodriguez, D. (2013). Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public. Pedestrian and Bicycle Information Center.

Source: FHWA Pedestrian Hybrid Beacon (PHB) Tech Sheet June 2018

APPENDIX B:

Highland City Traffic Calming and Pedestrian Safety Request Form

Highland City Traffic Calming & Pedestrian Safety Request Form

Applicant Information

Applicant Name: _____

Applicant Address: _____

Applicant Phone Number: _____

Applicant Email: _____

Study Location Information

Street Name: _____

Beginning address or cross street: _____

Ending address or cross street: _____

Locations that have been evaluated less than 2 years ago are not viable for consideration **UNLESS** a recent crash has happened, or development has changed (new neighborhood, roadway lane configuration, change in speed limit).

Description of Issue

What is the concern at this location? When is the issue the worst (dates, times)? Is this a speed, pedestrian safety, or volume concern?

_____

_____

_____

_____

_____

_____

_____

_____

Supporting Signatures

Supporting signatures must be residents on the same street as the request for traffic calming. Only one signature is allowed per household.

	Name	Address	Signature	Phone Number
1				
2				
3				
4				
5				

Fee

The required application fee is $25.

Please attach any relevant documents or photographs to this request form.

APPENDIX C:

Highland City Traffic Calming and Pedestrian Safety Prioritization Form

Highland City Traffic Calming Prioritization Form

Project information

Project Location: _____ Project Number: _____

Date of Evaluation: _____

Date of Data collection: _____

History

Locations that have been evaluated less than 2 years ago are not viable for consideration **UNLESS** a recent crash has happened, or development has changed (new neighborhood, roadway lane configuration, change in speed limit).

Date of Previous Evaluation (if applicable): _____

85th Percentile speed

Posted speed limit_____

Recorded 85th Percentile speed_____

85th percentile speed less than 5 mph over the speed limit?		0 points
85th percentile speed 5-10 mph over the speed limit?		5 points
85th percentile speed 11-15 mph over the speed limit?		10 points
85th percentile speed 16+ mph over the speed limit?		15 points

Points from 85th percentile speed: _____

Percent Drivers 10 mph over limit

Posted speed limit_____

Percent of drivers that are 10 mph over posted speed limit _____

Less than 10% drivers 10 mph over speed limit?		0 points
10%-15% drivers 10 mph over speed limit?		5 points
16%-20% drivers 10 mph over speed limit?		10 points
20% or more drivers 10 mph over speed limit?		15 points

Points from percent speeders: _____

If any of the above factors receive a score of 15 points individually, then traffic calming should be considered at this location.

Daily Traffic Volumes

Two directional daily vehicle volume_____

Less than 500 vehicles		0 points
Between 500 and 749 vehicles		5 points
Between 750 and 999 vehicles		10 points
Between 999 and 1,249 vehicles		15 points
Greater than 1,250 vehicles		20 points

Points from volume: _____

Stopping Sight Distance

85th Percentile speed: _____

Required stopping sight distance for 85th Percentile speed: _____

Available sight distance: _____

Adequate stopping sight distance?		0 points
Inadequate stopping sight distance?		15 points

Points from stopping sight distance: _____

Crash History (5-year Period)

Number of crashes: _____

Are there any speed related crashes?		15 points
Are there any severe (fatal/suspected serious injury) crashes?		30 points
Do any of the crashes involve ped/bike?		30 points

Points from crash history: _____

Roadway Context

Shared Roadway

If more than 1 of the following applies, choose the value with the most points.

Bus route		10 points
Bike lanes		15 points
Pedestrian crossing		15 points
Trail crossing		20 points
School crossing		25 points

Points from Shared Roadway: _____

Schools

If more than 1 of the following applies, choose the value with the most points.

School within ½ mile of study location		
Elementary		20 points
Middle School		15 points
High school		10 points

Points from Schools: _____

Pedestrian Generator

Pedestrian generator includes facilities with high pedestrian volumes (public park, library, splash pad, etc.)

Pedestrian generator within ¼ mile		15 points

Points from Pedestrian Generator: _____

Active Transportation (bike, pedestrian, scooter, etc.) Volumes (**ONLY FOR PEDESTRIAN SAFETY STUDY**)

Peak hour pedestrian crossing volume_____

Less than 5 pedestrian per hour		0 points
Between 5 and 10		10 points
Greater than 10		20 points
Greater than 20		40 points

Points from volume: _____

Total points_____

If the 85th Percentile speed or percentage drivers 10 mph over speed limit reaches 15 points independently, traffic calming should be considered at this location.

GREEN–LOW URGENCY
Projects scoring under 40 points

Traffic Calming not required, passive measures may be installed.

YELLOW–MEDIUM URGENCY
Projects scoring between 40 and 79 points

Passive measures recommended at this location. Temporary measures may be installed.

RED–HIGH URGENCY
Projects scoring 80 or more points

Both passive and temporary measures recommended at this location. Temporary measures should eventually be reaplaced with permanent active measures.