MULTI-MODAL TRANSPORTATION BOARD
THURSDAY, MARCH 1, 2018
6:00 PM
CITY COMMISSION ROOM
151 MARTIN STREET, BIRMINGHAM

1. Roll Call
2. Introductions
3. Review of the Agenda
4. Approval of Minutes, Meeting of **February 8, 2018**
5. **Residential Street Widths**
6. **Bicycle Rack Standard in Triangle District**
7. Meeting Open to the Public for items not on the Agenda
8. Miscellaneous Communications – **Training Survey**
9. Next Meeting – **April 5, 2018**
10. Adjournment

Notice: Due to Building Security, public entrance during non-business hours is through the Police Department—Pierce St. Entrance only. Individuals with disabilities requiring assistance to enter the building should request aid via the intercom system at the parking lot entrance gate on Henrietta St.

Persons with disabilities that may require assistance for effective participation in this public meeting should contact the City Clerk's Office at the number (248) 530-1880, or (248) 644-5115 (for the hearing impaired) at least one day before the meeting to request help in mobility, visual, hearing, or other assistance.

Las personas con incapacidad que requieren algún tipo de ayuda para la participación en esta sesión pública deben ponerse en contacto con la oficina del escribano de la ciudad en el número (248) 530-1800 o al (248) 644-5115 (para enos un dia antes de la reunión para solicitar ayuda a la movilidad, visual, auditiva, o de otras asistencias. (Title VI of the Civil Rights Act of 1964).

CITY OF BIRMINGHAM
MULTI-MODAL TRANSPORTATION BOARD
THURSDAY, FEBRUARY 8, 2018
City Commission Room
151 Martin Street, Birmingham, Michigan

Minutes of the regular meeting of the City of Birmingham Multi-Modal Transportation Board held Thursday, February 8, 2018.

Board Member Johanna Slanga convened the meeting at 6:05 p.m.

1. ROLL CALL

Present: Board Members Lara Edwards, Johanna Slanga; Alternate Board Members Daniel Isaksen, Katie Schafer

Absent: Board Members Amy Folberg, Vice-Chairperson Andy Lawson, Daniel Rontal, Michael Surnow, Chair Vionna Adams

Administration: Lauren Chapman, Asst. Planner
Jana Ecker, Planning Director
Austin Fletcher, Asst. City Engineer
Scott Grewe, Police Dept. Commander
Paul O'Meara, City Engineer
Carole Salutes, Recording Secretary

Also Present: Julie Kroll from Fleis & Vandenbrink ("F&V"),Transportation Engineering Consultants

2. INTRODUCTIONS (none)

Since both the Chair and Vice-Chair were not present, the Board selected Johanna Slanga to serve as temporary Chair for this meeting.

3. REVIEW AGENDA (no change)

4. APPROVAL OF MINUTES, MMTB MEETING OF JANUARY 4, 2018

Mr. Isaksen requested the following change:

Page 1 - He was present, although he did not serve on the board. It was determined to list him in the Also Present section.

Motion by Ms. Edwards
Seconded by Mr. Isaksen to accept the MMTB Minutes of January 4, 2018 with the change as mentioned.

Motion carried, 7-0.

VOICE VOTE
Yeas: Edwards, Isaksen, Schafer, Slanga
Nays: None
Absent: Adams, Folberg, Lawson, Rontal, Surnow

5. S. ETON TEMPORARY STRIPING

Mr. O'Meara provided background. At the November 2, 2017 MMTB meeting the board passed a set of recommendations for the City Commission to approve on S. Eton Rd. In December the Commission passed a resolution that endorsed the ideas in theory. In addition the Commission endorsed staff's recommendation to attempt to secure outside funding for the work. They also suggested that this board look at a temporary concept where the majority of the proposed ideas could be tested out with paint and low cost methods while waiting to see if funding is available.

Therefore, staff has put together a temporary striping plan for the board to consider tonight. The two significant features being left out of this test are: the pedestrian island at the Maple Rd. crosswalk; and the off-road bike path from Lincoln Ave. to 14 Mile Rd. If this temporary plan is endorsed by this board it would go back to the Commission for their approval.

Maple Rd. to Yosemite Blvd.
The recommendation for the center island has not been endorsed by the Commission. More data will be collected for study in the Spring. The only other changes involve narrowing of the street on the west side, which is difficult to implement since the main benefit of this provision would be the widened sidewalk. Sharrows can be painted in the street that will help encourage bikes.

Yosemite Blvd. to Villa Rd.
The suggestion is to narrow the street in both directions by moving the curbs inward, and taking out the parking on the southbound side in favor of a 5 ft. bike lane with a 2 ft. buffer. Vertical separation elements such as turtles to separate the bike lane are not recommended here. The permanent plan is to have the bikes ride on the same road section as the cars.

Villa Rd. to Lincoln Ave.
Painted bumpouts at each intersection are proposed with 2 ft. high markers to encourage people to stay out of those areas as they make right turns. Due to the high cost of the green paint feature, just the sections where the bike lanes cross an intersection are proposed to feature green paint during the test period. Stop signs west of each intersection will warn people to watch for bikes in two directions.

Lincoln Ave. to 14 Mile Rd.
The off-road bike lane facility proposed on the recommended plan will have to be deleted during the test period due to cost. South of Lincoln Ave. there are no bike improvements because the road isn't wide enough. The double yellow line as well as the white line for a southbound parking lane could be installed. It was discussed that temporary sharrows could be installed to show that the bike lane doesn't just dead end. The test would allow the City to monitor if the changes help reduce average speeds, as well as encourage on-street parking.

Motion by Mr. Isaksen
Seconded by Ms. Schafer
WHEREAS, the City Commission has endorsed the majority of the Multi-Modal Transportation Board recommendations for S. Eton Rd. from Maple Rd. to 14 Mile Rd., and

WHEREAS, the City will be applying for a Transportation Alternatives Program (TAP) grant in the near future in an effort to obtain funding for this project, and

WHEREAS, the City Commission has directed staff to obtain additional truck and pedestrian traffic counts in the area of Maple Rd. and S. Eton in order to allow for further study of the recommended improvements at the Maple Rd. intersection,

THEREFORE, the Multi-Modal Transportation Board recommends that the City proceed with the installation of test features that will provide the majority of the transportation improvements being considered in a temporary mode, at a substantially reduced cost, as outlined below:

1. Installation of painted bumpouts with lane markers at each intersection, as well as pavement markings to improve each crosswalk in accordance with the recommended plan.
2. Installation of sharrows between Maple Rd. and Yosemite Blvd.
3. Removal of parking, and installation of buffered, marked bike lanes for northbound and southbound traffic between Yosemite Blvd. and Villa Rd.
4. Removal of parking on the west side of the street, to provide room for a marked, buffered, and separated two-way bike lane, as well as white lines demarcating the northbound parking lane between Villa Rd. and Lincoln Ave.

5. Installation of double yellow lines and white line to demarcate travel lanes from the southbound parking lane between Lincoln Ave. and 14 Mile Rd.

In addition, that we paint sharrows on the portion between Lincoln Ave. to 14 Mile Rd.

Motion carried, 4-0.

VOICE VOTE
Yeas: Isaksen, Schafer, Edwards, Slanga
Nays: None
Absent: Adams, Folberg, Lawson, Rontal, Surnow

6. SAXON/LATHAM INTERSECTION IMPROVEMENTS

Commander Grewe reported that staff has received complaints from residents on Saxon about the speed and volume of vehicles on Saxon. Staff has discussed these complaints numerous times over the last few years and explored multiple options. Currently the road is not scheduled to be replaced or repaired as it is in good condition. In the Fall of 2017 crosswalks and pavement markings were added at Latham and Saxon.

Since it appears that the majority of the homeowners are not interested in a large expenditure, any implemented ideas must be kept at low cost. The one low-cost idea that F&V suggests that has not been discussed with the residents is the idea of installing white edge lines on both sides to narrow the street.

Ms. Kroll indicated that previous studies with Beverly Hills found that the traffic there is not cut-through; it is really just local residents that drive fast.

Motion by Ms. Edwards
Seconded by Mr. Isaksen to direct Staff to meet with residents of Birmingham and Beverly Hills to review the potential of installing edge lines as depicted in the aeriel photo in the agenda.

Motion carried, 4-0.

VOICE VOTE
Yeas: Edwards, Isaksen, Schafer, Slanga
Nays: None
Absent: Adams, Folberg, Lawson, Rontal, Surnow

Mr. O'Meara explained that staff will make phone calls and invite the residents in to talk about the proposal.

7. DOWNTOWN SIGNAL TIMING FOR PEDESTRIANS

Mr. O'Meara recalled that several years ago, City Staff received several complaints from employees that regularly used the Chester St. Parking Structure, who needed to cross Maple Rd. at its intersection with Chester St. The issue was that due to the high number of right turns coming from southbound Chester St. on to Maple Rd., pedestrians did not always feel safe when crossing the west leg of the intersection.

After review of the issue with F&V, it was suggested that all four directions of traffic should remain red while the green light allows the pedestrians to get out into the intersection while everyone else is stopped. That seems to have helped remove their anxiety. Recently, an article about balancing pedestrian comfort and traffic impacts with an elongated Leading Pedestrian Interval ("LPI") was circulated among the City Commissioners. As a result, they asked that all of the downtown intersections be studied with the idea that the entire Downtown should be as pedestrian friendly as possible.

Accordingly, F&V has outlined the benefits of adding LPI intersections with high pedestrian volumes, a history of pedestrian-vehicle conflicts, permissive left turns, prohibited right turns on red, low vehicular demand, and long crossing lengths. F&V reviewed a total of 11 Downtown intersections for the addition of LPIs. In most cases at least a three second lead time can be given where the pedestrians get the green light before any cars do. That would give them a chance to get out into the crosswalk and be more visible before the turns start. F&V doesn't think that a three or four second delay for vehicles is substantial and it really won't change their level of service.

Discussion confirmed that the addition of crosswalk buttons would significantly increase costs.

Mr. 0'Meara indicated he has already started conversations with the MDOT Traffic Engineer to explore intersections along Woodward Ave. that can be accommodated without any impact to operations.

Motion by Ms. Edwards
Seconded by Ms. Schafer that the Multi-Modal Transportation Board recommends that the City Commission direct Staff to implement Leading Pedestrian Intervals at each of the intersections within the Central

Business District as listed in the letter and analysis prepared by F&V dated February 2, 2018.

Motion carried, 4-0.

VOICE VOTE
Yeas: Edwards, Schafer, Isaksen, Slanga
Nays: None
Absent: Adams, Folberg, Lawson, Rontal, Surnow

Chairperson Slanga suggested that before making a recommendation for the Central Business District relative to these LPIs we ask the City Commission to expand them to other places that are determined by City Staff.

8. **MEETING OPEN TO THE PUBLIC FOR ITEMS NOT ON THE AGENDA**
(no public left)

9. **MISCELLANEOUS COMMUNICATIONS** (none)

10. **NEXT MEETING MARCH 1, 2018 at 6 p.m.**

12. **ADJOURNMENT**

No further business being evident, the board members adjourned at 6:52 p.m.

Jana Ecker, Planning Director

Paul O'Meara, City Engineer

City of Birmingham
A Walkable Community

MEMORANDUM

Engineering Dept.
Planning Department
Police Dept.

DATE: **February 23, 2018**

TO: **Multi-Modal Transportation Board**

FROM: **Lauren Chapman, Assistant City Planner**
Scott Grewe, Police Dept.
Paul O'Meara, City Engineer

SUBJECT: **Street Widths- History**

The Multi-Modal Transportation Board (MMTB) recently reviewed conceptual designs for three local streets planned for reconstruction in 2018. A public hearing was held, and a final recommendation for the streets was passed on to the City Commission on a vote of 4-3. As you may recall, at the public hearing, several residents appeared before the Board asking that Bennaville Ave. not be reduced in width (as proposed). A smaller number of residents appeared asking that the block of Chapin Ave. east of Cummings St. also not be reduced in width.

When the City Commission reviewed the issue at their meeting of January 22, 2018 several residents again appeared on behalf of Bennaville Ave., and additional residents appeared on behalf of the one block of Chapin Ave. After much discussion, the City Commission endorsed the recommendations of the MMTB, also on a vote of 4-3. As a part of the discussion, the Commission expressed confusion as to what the City's policy is for determining the width of a new street. As a result, the MMTB was asked to study the issue in further detail, and send information and policy direction back to the Commission.

GOALS

The goals for identifying a standard road width, for residential roads are: functionality, consistency, accident reduction, traffic calming, expediency in planning and engineering, infrastructure costs. A standard does not mean that all streets will be uniform; a standard creates a basis for consideration.

HISTORY

The majority of the public rights-of-ways in Birmingham were created prior to World War II. In this era, cities accepted new public streets from developers with little investment. Streets were typically gravel, and often lacked drainage outlets. As subdivisions became more populated and expectations rose, residents looked to the City to get their street paved. As was standard practice then (as it is now), cities can

construct a localized improvement such as a new street pavement, and charge the adjacent property owners for some or all of the cost. Under this guideline, some streets were paved as early as the 1910's, while others have never been paved. In Birmingham, unpaved streets began being oiled and then chip sealed starting in the late 1940's, removing many of the problems generally experienced with gravel roads.

In order to get a road paved, residents petition the City and request the improvement. The improvement is generally not considered until a petition showing that over 50% of the owners are in favor of the idea can be presented. High costs today continue to keep the number of streets being paved relatively low. Recently, the City Commission has authorized the formation of an Unimproved Streets Study Committee that will be meeting to discuss the special assessment procedure in detail, and potentially considering alterations to that policy as well.

In Birmingham, once a street has been constructed with a permanent pavement, the City has promised to maintain it into the future, at no additional cost to the adjacent property owners. Since a local street typically has a service life of 60 to 90 years, discussions pertaining to the policy of the width for a new street have always pertained to the construction of new streets that have never had a pavement with curbs. The current policy, passed in 1997, also focused exclusively on the construction of new streets. Since reconstruction of existing streets had not been frequent, even at that time, the unwritten expectation has been that the road would be reconstructed to match the road as it was built the first time.

The following describes the standards passed for new street paving projects, as of 1977:

<u>1977</u>
In 1977, the City Commission adopted Engineering Design Standards relating to pavements and street widths. These standards were in existence prior to this date and formalized by the Commission at that time. The City was substantially consistent with the city design standards when recommending street improvements.

These standards note the width of roads in relation to the level of use it gets. It was divided into three categories: streets in commercial areas, streets in residential areas, and cul-du-sacs. The adopted standard was for a 36 foot street in commercial areas, and 28 foot width in residential area. Residential cul-du-sacs maintain a 24 foot width.

<u>1994</u>
During the public hearing for Henrietta Street the City Commission directed city staff to examine the existing policy pertaining to street improvements as it relates to street widths. Goals included letting the public know what the benefits are to the property owners for making these street improvements, what the design standards are, and what options may be available to them when requesting this improvement.

City Commissioners suggested that standards be set so these details need not be revisited each time a street is recommended for improvement. It was the Engineering Department's opinion there existed standards that the City has substantially followed when making recommendations throughout the years.

The City Commission reviewed which streets were fire routes and per the recommendation by the fire chief adopted a standard of 29 feet for residential streets.

1996

At the December 16, 1996 City Commission meeting three local streets were approved for permanent surface improvements. In conjunction with the discussion it was suggested the issue of residential street widths be placed on the agenda for the 1997 Long Range Planning Meeting.

Downtown 2016 Plan

The Downtown Birmingham 2016 Plan is a master plan that was created in 1996 and was intended for use for the next twenty years. Pages in the appendix of the plan recommended street widths based on type and rationale for the widths in the form of a decision tree and examples from AASHTO and the City of Portland. The recommended width for a "subcollector" road (similar to the typical Birmingham residential street) was 28 ft.

1997

The City Commission voted to reduce the residential street width standard by 2 feet to 26 feet, with parking on two sides and 20 feet with parking on one side.

2013

In 2013, the City Commission created a steering committee to oversee the creation of a Multi-Modal Transportation Master Plan. The consultant The Greenway Collaborative was hired to prepare the plan. During this process, the steering committee not only worked with the consultant, they also helped direct the final cross-sections for the important collector streets planned for 2014:

Lincoln Ave. – Southfield Rd. to Woodward Ave.
N. Eton Rd. – Derby Rd. to Yorkshire Rd.

The Multi-Modal Transportation Master Plan was adopted in 2014 as a long term guide to the City's transportation network. A new Multi-Modal Transportation Board was formed to help oversee the implementation of the new plan, as well as take over the duties of the former Traffic & Safety Board.

Since then, the new board has studied each of the City's upcoming street projects from a multi-modal perspective.

2018 Local Street Paving Program

This year the City will be reconstructing three streets first paved in the late 1940's (Bennaville Ave., Ruffner Ave., and Chapin Ave.). Staff approached this study with two objectives:

1. The Master Plan did not provide any recommendations on the three streets. Even so, a closer discussion with input from the Board may result in possible refinements to the current conditions.
2. While the unwritten policy of rebuilding streets at their current widths should be used as a starting point, staff had identified some potential issues with following this approach on these three streets:
   a) Bennaville Ave. was constructed at a width (32 ft.) much greater than current policy would dictate. The Board would provide an avenue to open the discussion about the benefits and/or drawbacks of reconstructing the street to match the current standard of 26 ft.
   b) Portions of Ruffner Ave. and Chapin Ave. were first constructed at 28 ft. These same sections also had several mature trees growing immediately adjacent to, or on top of, the old curb. Reconstruction of the streets at this width would mean automatically removing several mature trees. However, reducing the widths to 26 ft. (thereby matching the current standard), would give us the ability to attempt to save the majority of them.

As discussed above, both the MMTB and the City Commission struggled with the decisions as to whether to narrow the streets for the reasons listed above. The recommendations of the Board stirred up strong feelings among residents on two of the streets. As a result, split votes resulted both at the Board level, as well as at the City Commission level. The Board is now being asked to research national standards for residential road widths, the advantages and disadvantages of narrow and wide streets, determine what other cities are using as standards for constructing or reconstructing streets, and to consider detailed standards for use in the City of Birmingham. The City Commission also asked for some guidance on when (or if) to allow variance from these standards. The following is meant to be a draft outline that is intended to stimulate input from the Board. Once the input is received, staff will attempt to finalize a new policy statement on this issue for the future.

CURRENT POLICY REGARDING STREET WIDTHS

UNIMPROVED STREETS

From staff's perspective, the current standards for unimproved streets, now in place since 1997, have worked well.

As shown on the attached list at the end of this report, the current street width policy has been followed. Once a new street is constructed, very few, if any, complaints are

ever received from residents relative to the street width used for their new street. Residential sections have been consistently built at 26 ft., and commercial sections have been built at 36 ft., as directed in the policy. An option for a 20 ft. street also exists, which residents can consider if they so desire. Unique circumstances such as needing to accommodate a student drop off area at a parochial school (on Harmon St.) have also worked well.

Given the positive track record of the past 20 years, staff would recommend that the current policy concerning street widths for unimproved streets continue to be the starting point in the discussion. If future streets are subject to changes by the MMTB, it will be important to consider that creating a petition that shows that over 50% of the residents are in favor of a special assessment can be a difficult and time consuming process. If the MMTB were to enter the discussion after the petition has been created, this may result in some signers no longer supporting the project, which could then jeopardize the whole project. How and when the MMTB is involved in this process needs to be considered.

IMPROVED STREETS

The City is financially responsible for the reconstruction of improved street pavements that are nearing the end of their lifespan. Reconstruction offers the opportunity to review the current conditions in light of current standards, and consider if there is a potential need for change. Factors to consider in this discussion currently include, in alphabetical order:

1. MULTI-MODAL IMPROVEMENTS – A review of the Master Plan is required to be included with each street review. If ideas were provided in the Master Plan, the Board considers the recommendations in their totality to verify if they should be implemented as a part of the upcoming project. If there are no specific recommendations in the Master Plan, the Board will discuss improvements that can be included that would bring multi-modal improvements to the area.

2. NEIGHBORHOOD DENSITY – The board also considers the extent to which the land uses and density of uses on the street impact parking demand. The board reviews whether there are any unique conditions that would result in less or more than the usual parking demand. If parking demand is less than normal, should parking be limited to one side of the street, and if so, the board will consider which side of the street may be better for on-street parking

   OWNER PREFERENCE – The board holds a public hearing on all proposed road improvements to gather input from adjacent residents and property owners. While the City may have established guidelines and attempt to follow current best practices in the industry, the property owners living on the street often have preferences that are counter to the direction that the best practice standards would dictate.

3. RIGHT-OF-WAY – The board also considers the existing right-of-way for each street. Most local streets have an existing right-of-way between 50 and 60 ft., with which the current 26 ft. wide standard works well. If the right-of-way is less than 50 ft. however, the board may consider a narrower street in order to provide the required space for City sidewalks and street trees.

   TRAFFIC ISSUES – The board will conduct a review of the history of traffic issues on a street, which typically includes a review of speeding and cut-through traffic complaints. Staff can provide speed and traffic count data with each street being studied.

4. TREES – Finally, the board will consider the location and health of the existing tree canopy when considering the width for a reconstructed street. Streets with 50 ft. rights-of-way (or less) tend to have conditions where trees are given less than ideal conditions to grow, due to lack of space. If a street has mature trees that can be damaged or require removal during a street reconstruction project, these factors need to be considered.

Attached are two lists that indicate the history of street construction going back to 2000. The first list documents local streets that have been reconstructed. Comments are added in the right column if unique circumstances dictated that the street be rebuilt at a width different than what was done the first time. The second list documents all local streets built with a new pavement for the first time since 2000. Comments added on the right column describe conditions where the pavement was built at a width other than the standard, due to unique circumstances.

REVIEW OF BEST PRACTICES AND NATIONAL STANDARDS

Please find attached a letter from MKSK with attachments that summarize their research on national standards and best practices for residential street design. MKSK has reviewed numerous sources and compiled their findings for your review and discussion. In addition, MKSK has surveyed local peer communities to determine residential street standards for other Michigan communities.

As stated above, this is a topic that requires discussion and input from the Board before being finalized. The Board is encouraged to consider the factors above, as well as others that they may wish to introduce, to help finalize a final policy recommendation for the consideration of the City Commission.

(Previously Unpaved)						
Street Name	**From**	**To**	**Year Built**	**Width, Face to Face (Feet)**	**Previous Width**	**Comments**
Davis	Grant	Woodward Alley	2000	26	NA	
Davis	Woodward Alley	Woodward	2000	36	NA	Commercial Section
Willits	Greenwood	Chester	2000	26	NA	
Watkins	Brown	Lincoln	2001	20	NA	Width directed by Commission after resident survey was split 50/50
Stanley	Hanna	Wallace	2001	26	NA	
Henrietta	Frank	Lincoln	2001	26	NA	
Hazelwood	Oak	Vinewood	2003	26	NA	
Oak	Lakeview	Greenwood	2003	20	NA	40 Foot Right-of-Way
Knox	West End	Poppleton	2003	26	NA	
Humphrey	Grant	Woodward Alley	2004	26	NA	
Humphrey	Woodward Alley	Woodward	2004	36	NA	Commercial Section
S. Worth	Haynes	Alley	2005	36	NA	Commercial Section-Matches remainder of block
Harmon	Lakeside	West of Old Woodward	2005	26	NA	Except as noted on next two lines
Harmon	Greenwood	Woodland	2005	32	NA	Widened to accommodate bus loading area at Holy Name
Harmon	West of Old Woodward	Old Woodward	2005	36	NA	Adjacent Booth Park, contains metered parking
Washington	Lincoln	14 Mile	2005	26	NA	
Fairway	330 Ft. W. of Pleasant	Pleasant	2005	26	NA	
Northlawn	Stanley	Washington	2005	26	NA	
Greenwood	Harmon	Willits	2006	26	NA	
Wakefield	Southfield Alley	Southfield	2006	34	NA	Commercial section with head-in parking beyond
Greenwood	Oak	Harmon	2007	26	NA	
Baldwin	Harmon	Randall	2008	26	NA	
Baldwin	Randall	Maple	2008	20	NA	As requested by residents
Clark	George	Lincoln	2014	26	NA	

(Reconstruction)						
Street Name	**From**	**To**	**Year Built**	**Width, Face to Face (Feet)**	**Previous Width**	**Comments**
Ruffner	Adams	Torry	2001	26	26	
Humphrey	Woodward	Torry	2001	26	26	
Bennaville	Woodward	Torry	2001	26	26	
Emmons	Grant	Cummings	2001	26	26	
Daines	Purdy	Old Woodward	2002	26	26	
Melton	Eton	14 Mile	2003	28	28	
Holland	Adams	Eton	2004	29	29	
Shipman	Southlawn	14 Mile	2005	28	28	
Birmingham	Lincoln	14 Mile	2005	32	32	
Henrietta	Lincoln	Northlawn	2005	28	28	
Northlawn	Shipman	Birmingham	2005	32	32	
Northlawn	Birmingham	Stanley	2005	28	28	
Northlawn	Washington	Pierce	2005	28	28	
Southlawn	Southfield	Shipman	2005	28	28	
Southlawn	Birmingham	Stanley	2005	28	28	
Yorkshire	Adams	East End	2006	24	24	
Rugby	Yorkshire	Maple	2006	24	24	
Cambridge	Dorchester	Maple	2006	24	24	
Southlawn	Pierce	Grant	2006	28	28	
Edgewood	Southlawn	14 Mile	2006	28	28	
Grant	Emmons	Davis	2006	28	28	
Buckingham	Adams	Cambridge	2007	24	24	
Dorchester	Adams	East End	2007	24	24	
Rugby	Buckingham	Yorkshire	2007	24	24	
Cambridge	Buckingham	Dorchester	2007	24	24	
Aspen	Maple	Hawthorne	2008	16	18	Staff discussed with residents, determined old road was too narrow
Hawthorne	Maple	Linden	2008	16	18	Staff discussed with residents, determined

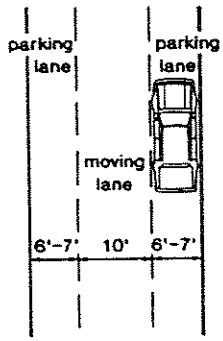
						old road was too narrow
Bowers	Adams	Hazel	2009	28	28	
Hazel	Bowers	Columbia	2009	28	28	
Pierce	Merrill	Brown	2009	40	40	
Townsend	Henrietta	Pierce	2009	32	32	
Bates	Martin	Brown	2010	36	36	
Henrietta	Martin	Brown	2010	32	32	
Townsend	Chester	Henrietta	2010	32	32	
George	Pierce	Old Woodward	2010	24	24	
St. Andrews	Pembroke	Maple	2011	28	28	
Graefield	Derby	Eton	2012	32	32	
Graefield Ct.	North End	Graefield	2012	26	26	
Pierce	Maple	Merrill	2013	40	40	
Merrill	Pierce	Old Woodward	2013	40	40	
Cole	Adams	Eton	2013	28	30	Narrowed in order to save large trees
Torry	Webster	Lincoln	2013	32	32	
Mohegan	Oxford	Adams	2014	24	24	
Kennesaw	Oxford	Adams	2014	24	24	
Oxford	Wimbleton	S. of Kennesaw	2014	24	24	
Poppleton	N. of Mohegan	S. of Kennesaw	2014	24	24	
Oak	Chesterfield	Lakepark	2015			

Residential STREETS

Second Edition

American Society of Civil Engineers
National Association of Home Builders
ULI—the Urban Land Institute

In 1986, the American Society of Civil Engineers (ASCE), the National Association of Home Builders (NAHB), and ULI-the Urban Land Institute (ULI) began discussing the need for a new book on residential streets to update and expand the general principles and design considerations outlined in the organizations' joint 1974 publication. Over the years, all three organizations have received inquiries into street design issues from developers, engineers, planners, and public officials. Agreeing on the need for a new book, ASCE, NAHB, and ULI established a task force composed of representatives of each organization. The task force members were charged with contributing material, reviewing and commenting upon drafts, and reaching consensus on the document. ASCE, NAHB, and ULI believe that their collaborative efforts will contribute to more appropriate residential street designs that balance considerations of safety and efficiency, cost effectiveness, livability, and community attractiveness.



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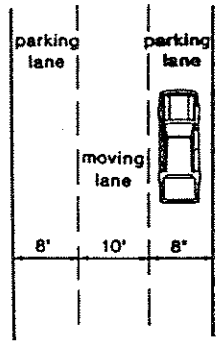

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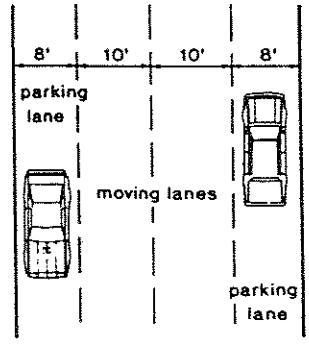


collector

EXCERPT FROM *RESIDENTIAL STREETS*

AASHTO—Geometric Design of Highways and Streets

Number of Lanes

On residential streets in areas where the primary function is to provide land service and foster a safe and pleasant environment, at least one unobstructed moving lane must be ensured even where parking occurs on both sides. The level of user inconvenience occasioned by the lack of two moving lanes is remarkably low in areas where single-family units prevail. Local residential street patterns are such that travel distances are less than 0.5 mi between trip origin and a collector street. In multifamily-unit residential areas a minimum of two moving traffic lanes to accommodate opposing traffic may be required. In many residential areas a 26-ft-wide roadway is typical. This curb-face-to-curb-face width provides for a 12-ft center travel lane and two 7-ft parking lanes. Opposing conflicting traffic will yield and pause on the parking lane area until there is sufficient width to pass.

In commercial areas where there will be several midblock left turns it may be advantageous to provide an additional continuous two-way left-turn lane in the center of the roadway.

Width of Roadway

Street lanes for moving traffic preferably should be at least 10 ft wide. Where feasible they should be 11 ft wide, and in industrial areas they should be 12 ft wide.

WHAT ARE SKINNY STREETS?

The City of Portland requires most newly constructed residential streets to be 20 or 26 feet wide, depending on neighborhood on-street parking needs. In the past, residential streets were required to be as wide as 32 feet. To achieve the benefits described below, the City reduced residential street widths.

Why create skinny streets in neighborhoods?

Allowing newly-paved residential streets to be narrower provides many benefits to area residents. Skinny streets help preserve neighborhood livability, while improving access to homes. Some benefits are:

Maintain neighborhood character.

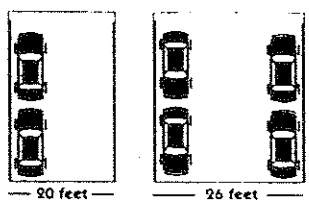
Construction of a wide paved street to replace a narrow unimproved road can change a neighborhood's atmosphere. Skinny streets reduce the impact on slopes and contours, on yards and on neighborhood self-image.

Lower construction costs.

Construction of narrower streets costs less. This means that residents who want to improve existing streets are able to do so for less money and developers can create new neighborhood streets less expensively.

Save vegetation & trees.

In existing neighborhoods, narrower paving widths reduce the need to cut trees and shrubs along the street.



Reduce stormwater runoff.

Paved streets are a major source of stormwater runoff. Pollutants from autos, as well as fertilizer, pesticides and other contaminants, are collected in stormwater, which flows into storm sewers. Eventually, this dirty water reaches area streams and rivers. Reducing pavement reduces stormwater runoff and allows more water to soak directly into the ground.

Encourage traffic safety.

Narrower streets discourages non-neighborhood traffic and force drivers to slow down.

Encourage better land-use.

As stewards of our natural resources, we know that streets aren't the best use of existing undeveloped land. With skinny streets, in new developments we have more room to house our growing population while reducing the amount of land reserved for traffic use.

Who decides on a street's width?

If you live on an unimproved street, you may be considering forming a Local Improvement District (LID) to complete your street. With an LID, you and the other property owners on your street would pay for improvements, and the City would be responsible for future maintenance.

In that case, you and other participating property owners can help design what your street will look like. Collectively, you can decide if you want parking on one or both sides of the street. This will determine how wide the street will be.

In new neighborhoods, developers will select the street width they believe to be most appropriate within the city guidelines.

Can emergency vehicles reach my home?

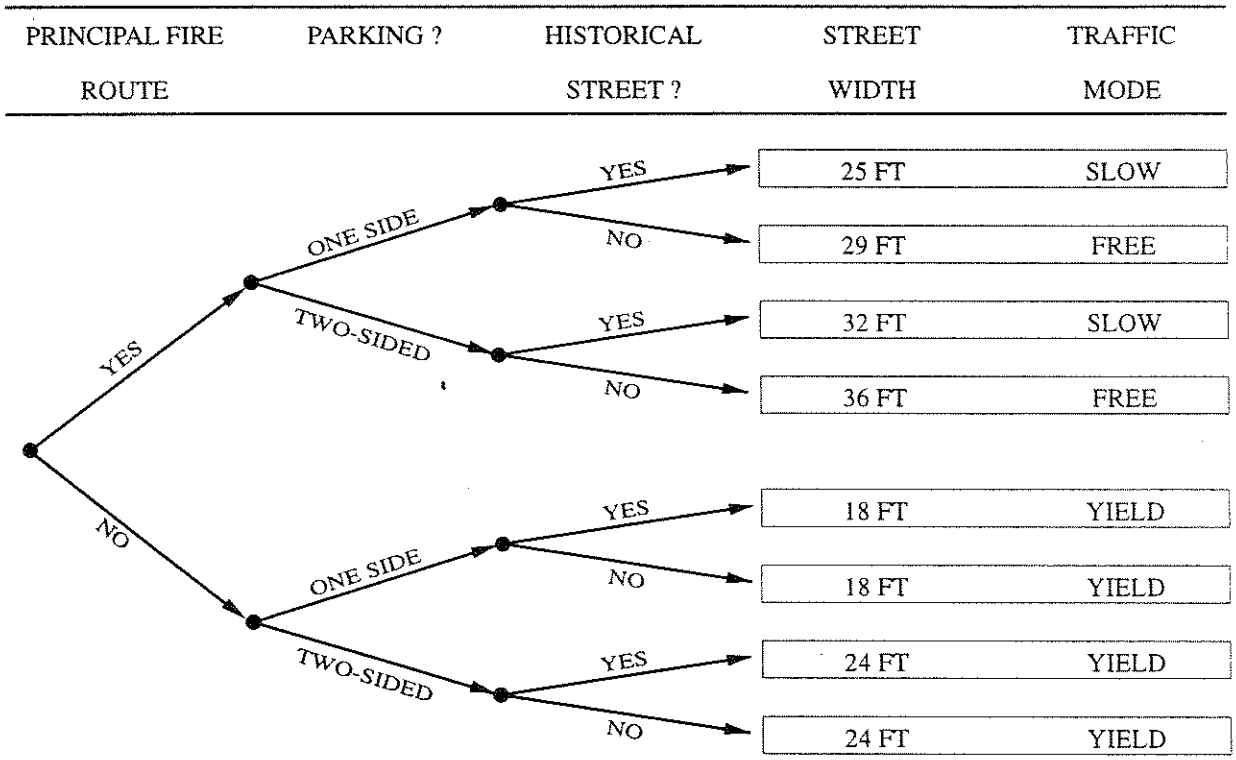
The Fire Bureau participated in exercises in older neighborhoods with narrow streets. The Bureau found that street widths based on skinny street guidelines will provide adequate access for emergency vehicles.

How Can I Learn More About SKINNY STREETS?

The City of Portland's Office of Transportation has set up the Local Streets Outreach Program. If you would like more information, or if you're interested in a presentation about skinny streets, please contact

(503) 823-7046

EXCERPTS FROM *THE AASHTO MANUAL* AND *SKINNY STREETS*



STREET WIDTH DECISION TREE

Legend

Right_of_Way

<all other values>

Right of Way

Non-Local

20 ft

30 ft

40 ft

50 ft

60 ft

66 ft

70 ft

75 ft

80 ft

86 ft

Alley

Private

Legend

Curb_Face

- <all other values>

Face To Face Widths

- Unimproved Streets
- 16 ft
- 18 ft
- 20 ft
- 22 ft
- 24 ft
- 26 ft
- 28 ft
- 30 ft
- 32 ft
- 34 ft
- 36 ft
- 38 ft
- 40 ft
- 44 ft
- Not Paved

To: City of Birmingham, City Commission
From: Brad Strader, PTP, MKSK
Date: February 22nd, 2016

MKSK
4219 Woodward Avenue
Suite 305
Detroit, MI 48201
313.652.1101

RE: Street Widths on Residential Streets

This memo is in response to a request by the City Commission to have the Multi-Modal Board research standards for curb-to-curb widths on residential streets. Specifically the request was for precedents and implications for different street width from.

We have begun research on this topic. This serves as an interim report on the information found thus far. There is limited data on street widths at this level of detail. Most information published is in regards to collector and arterial streets, not residential streets.

This packet of information includes:

1. Information we have found to-date from peer cities

2. Published recommendations for residential street width from national organizations

3. Background information and street width data for the City of Birmingham prepared by City Staff (under separate cover)

One of the questions asked was evidence of the safety related to various street widths, incrementally from 24 to 32 feet. Thus far we have not found that level of research in our review of published manuals, articles and contacts with organizations sources such as the Transportation Research Board, Institute of Transportation Engineers, Urban Land Institute and NACTO. The minimum residential street widths used by similar cities in Michigan varies, but the 26-foot standard used in Birmingham since 1996 seems to be the most common. Notably, a number of cities have recently or are currently evaluating their standards. We should be able to share some of their findings with you soon.

In summary, from our research this far, these are the general findings:

1. Generally traffic speeds are higher when the lane widths are higher (ULI, ITE, CNU). But other factors also influence the speed at least as much as the width.

2. Streets with on-street parking have lower speeds (Sources: TRB, ITE, ULI).

3. Streets with on-street parking have higher rates of collisions but those collisions are usually minor (source ITE).

4. Streets with trees and short setbacks tend to have lower speeds than those with fewer or no trees and deeper setbacks.

5. Some of the Michigan cities that allow the most narrow streets have significantly less snow than Birmingham.

6. The 26-foot width used by the City of Birmingham is pretty standard in comparable Michigan cities. Some cities allow and maintain 24-foot width, especially in historic neighborhoods where that width was long ago established. A 26-foot width seems to be the most common. Some cities, especially those in high snow zones, have a minimum of 30-32 foot width for new residential streets.

7. Most cities with a width standard have many streets that are wider or more narrow. Those cities tend to reconstruct streets to the new standard, but make modifications in specific situations (trees, block length, use of on-street parking, residential density, observed problems, and neighborhood preferences)

8. Some fire departments, like Grand Rapids, have established a minimum open lane width of 16 feet to be able to provide emergency response.

9. For on-street lane parking lane width along residential streets the most common dimension used is minimum 7-foot width, with 8-foot widths along transit or bike routes.

These findings and our continued research will be presented on Thursday, March 1st at the Multi-Modal Board meeting.

Sincerely,

Brad Strader, Principal

bstrader@mkskstudios.com

Comparison to Standards of Comparable Michigan Cities

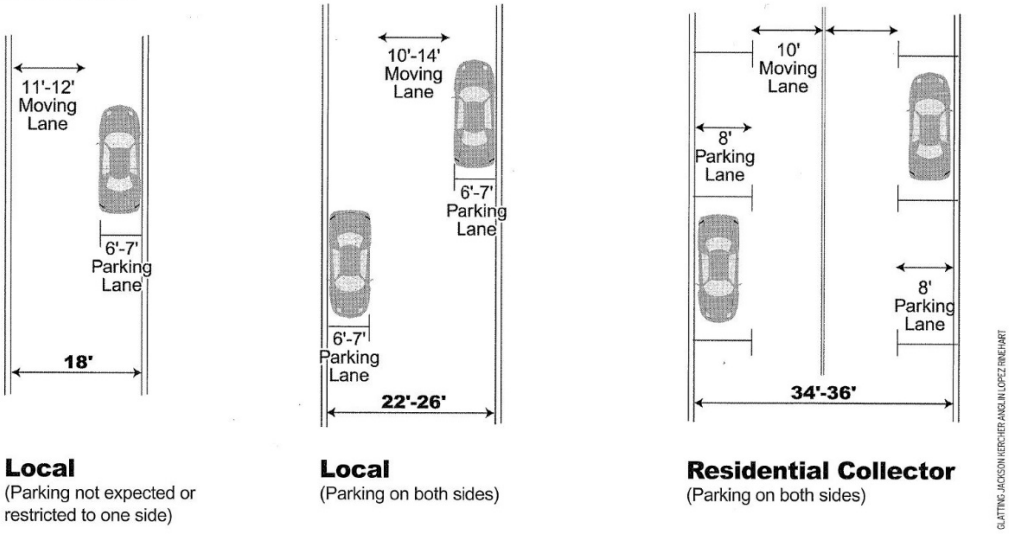
City	Minimum Street Width For Residential Streets	Average Snow Fall Per Year*
Birmingham	20-foot wide curb-to-curb for parking on one side of the street; 26-foot wide for parking on two sides.	36 inches
Royal Oak	27-foot wide (back of curb to back of curb) on local streets. Typical parking lane width: 8ft	33 inches
Pleasant Ridge	27-foot wide for parking on one side of the street; parking on both sides of streets being considered to slow traffic. Parking lane width: 7-9ft	32 inches
Ann Arbor	32-foot wide for streets with metered parking; 24-26 foot wide streets are also common. Travel lanes: 10-foot travel lanes in downtown, 9-foot lanes on very low volume residential streets. Parking lane width: 8ft (preferred), some are 7ft	53 inches
Grand Rapids	26-foot wide preferred, 24-foot wide minimum (e.g. in a historical district). Travel lanes: Typical had been 12-foot travel lanes, 10-foot travel lanes are now preferred; 16-foot minimum clear zone for emergency vehicles, low volume yield streets with parking on both sides. Parking lane width: 7-8ft (8ft preferred, especially when adj. to transit or bike lane) including the gutter pan.	68 inches
East Lansing	Travel lanes: 10-foot wide lanes, 11-foot preferred, especially adjacent to parking or bike lanes. Parking lane width: 7-8ft (8ft preferred)	45 inches
Traverse City	Minimum 27-foot width face-to-face parking on both sides, but only one side allowed in winter. 30-foot widths required for year-round parking	110 inches

*Snowfall noted because it was cited as a factor in the Commissioner's request. Source: Google

Comparison to National Standards

The Institute of Transportation Engineers' (ITE's) 2001 publication, "Residential Streets, Third Edition," recommends an 18-foot pavement width for local streets with no parking expected, 22-24 foot pavement width for local streets with low or restricted parking, 24-26 foot pavement width for local streets with normal residential parking, and 32-36 foot pavement width for residential collector streets (See Figure 2-15 and Table 2-4). For local streets, the 18-foot width allows for a 6-7 foot on-street parking lane on one side and an 11-12 foot travel lane. The 22-26 foot pavement width allows for 6-7 foot parking lanes on both sides of the street with a 10-14 foot travel lane. The 34-36 foot pavement width of the residential collector street allows for two 8-foot on-street parking lanes with two 10-foot travel lanes.

FIGURE 2-15
Street and lane widths.



Local
(Parking not expected or restricted to one side)

Local
(Parking on both sides)

Residential Collector
(Parking on both sides)

TABLE 2-4

RECOMMENDED PAVEMENT WIDTHS

	Pavement Width
Local Streets	
• No Parking Expected	18 feet
• Low or Restricted Parking	22-24 feet
• Normal Residential Parking	24-26 feet
Residential Collector	32-36 feet

ITE's 2003 "Neighborhood Street Design Guidelines" offers more specific recommendations for residential street curb-to-curb pavement widths based on neighborhood character, dwelling units per gross acre, and number of on-street parking lanes (refer to Table 3-1). For Low-Density Residential streets with 2.0 and fewer dwelling units per gross acre, ITE recommends 2 channels for traffic and parking, an 18-foot minimum curb-to-curb pavement width if parking is permitted on only one side, and a 20-22 foot curb-to-curb pavement width if parking is permitted on both sides. For Medium-Density Residential streets, defined as having between 2.1 and 6.0 dwelling units per gross acre, ITE recommends 3 channels for traffic and parking with a minimum of 24 feet of curb-to-curb pavement if parking is on one side, and 26-28 feet of curb-to-curb pavement width if parking is permitted on both sides of the street. For High-Density Residential streets with 6.1 to 10.0 dwelling units per gross acre, 4 channels for traffic and parking are recommended, with a minimum pavement width of 28 feet for parking on one side, or 30-32 feet of pavement width if parking is desired on both sides of the street. In Very High-Density Residential areas, ITE recommends 4 channels for traffic and parking with minimum 32 feet of pavement width for parking on one side and 34-38 feet of width for parking on both sides. The recommendation for Mixed-Use/Commercial districts is also 4 channels for traffic and parking with a minimum curb-to-curb pavement width of 32 feet for one-sided parking and at least 34 feet of width for parking on both sides.

Table 3–1
Guidelines for Neighborhood Street Curb-to-Curb Pavement Width[1]

Neighborhood Character	Dwelling Units per Gross Acre[2]	Recommended Number of Channels for Traffic and Parking	Recommended Curb-to-Curb Width of Pavement with Parking Permitted on Either Side[3]	Minimum Curb-to-Curb Width of Pavement with Parking Permitted on One Side Only[4]
Low-Density Residential	2.0 and fewer	2	20–22 ft.[5]	18 ft.
Medium-Density Residential	Between 2.1 and 6.0	3	26–28 ft.[5]	24 ft.
High-Density Residential	Between 6.1 and 10.0	4	30–32 ft.	28 ft.
Very High-Density Residential	10.1 and higher	4	34–38 ft.	32 ft.
Mixed-Use/ Commercial	Not applicable	4	At least 34 ft.	32 ft.

The National Association of City Transportation Officials (NACTO) Urban Street Design Guide (2013) refers to a study that estimated "each additional foot of lane width related to a 2.9 mph increase in driver speed." NACTO recommends travel lane width of 10 feet for urban areas because they provide adequate safety while minimizing speeding behavior. For designated truck and transit routes, with the addition of one travel lane of 11 feet in each direction for. They also note that in some cases, narrower 9-9.5 foot lanes can be used in conjunction with a turning lane. NACTO also recommends parking lane width of 7-9 feet in urban areas.

The AASHTO's "A Policy on Geometric Design of Highways and Streets" recommends that travel lanes be at least 10 feet wide, and where feasible, 11 feet wide. AASHTO describes a 26-foot wide pavement as a typical curb-to-curb dimension for residential streets that allows for two 7-foot parking lanes and a central 12-foot travel lane. The level of inconvenience caused by having only one travel lane and yielding traffic is minimal in most single-family residential areas.

The city of Portland, Oregon's "Skinny Streets" policy calls for residential pavement width of 20 feet with one on-street parking lane or 26 feet with on-street parking on both sides.

Additional Graphics:

LANE WIDTH & SPEED

2017 CITY OF WYOMING MASTER PLAN

Wider travel lanes are correlated with higher vehicle speeds.

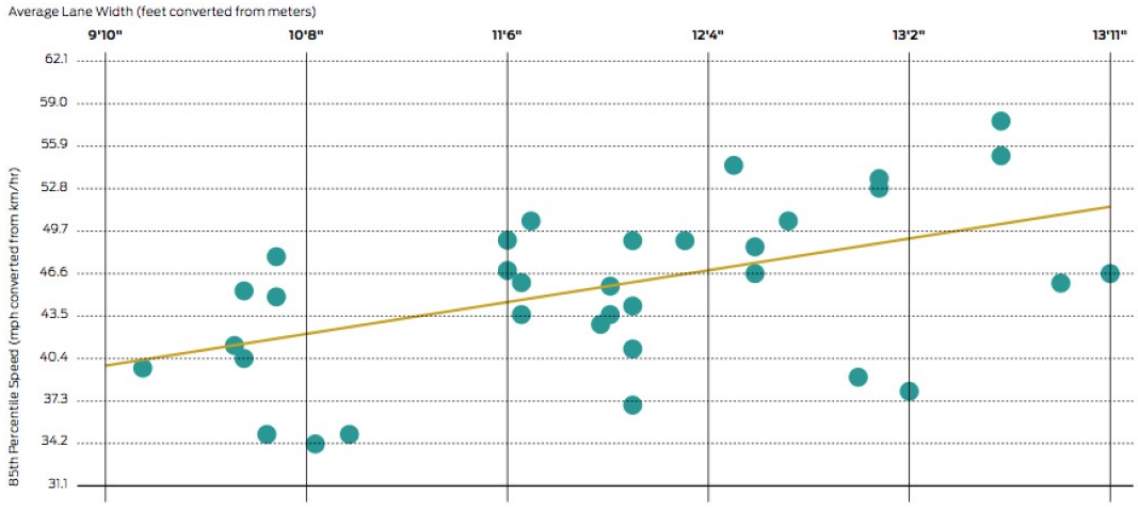


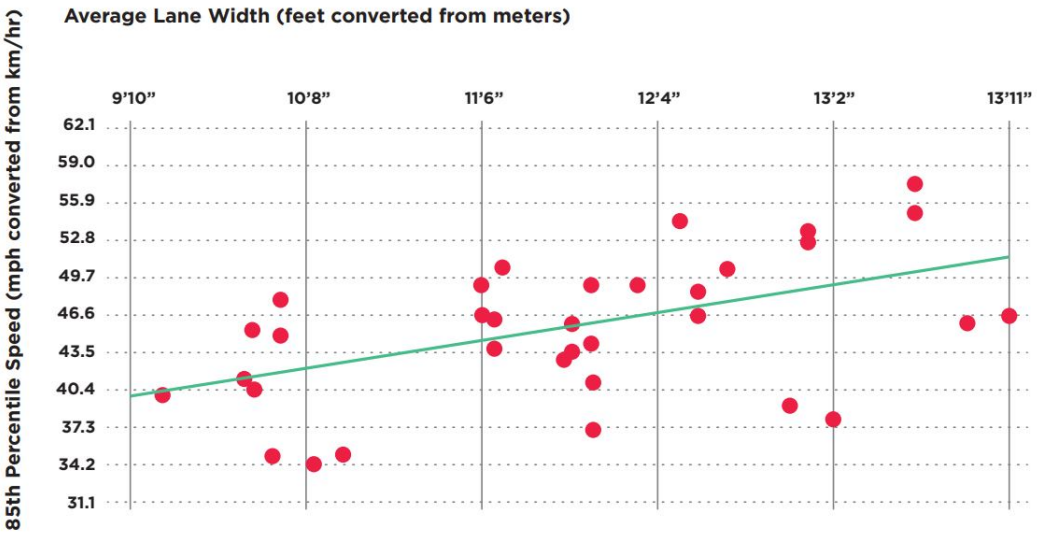
Chart source: Fitzpatrick, Kay, Paul Carlson, Marcus Brewer, and Mark Wooldridge. 2000. "Design Factors That Affect Driver Speed on Suburban Streets." *Transportation Research Record* 1751: 18–25.

"Lanes greater than 11 ft should not be used as they may cause unintended speeding and assume valuable right of way at the expense of other modes. This includes the use of wide outside lanes for bicyclist accommodation. Wide outside lanes are not an effective means of accommodating bicyclists in urban areas."

- *Urban Street Design Guide* - NACTO (National Association of City Transportation Officials)

4

FIGURE 5 WIDE TRAVEL LANES ARE CORRELATED WITH HIGHER VEHICLE SPEEDS



As the width of the lane increased, the speed on the roadway increased...When lane widths are 1 m (3.3 ft) greater, speeds are predicted to be 15 km/h (9.4 mph) faster.

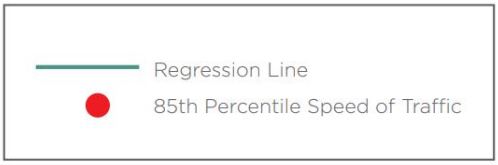


Chart source: Fitzpatrick, Kay, Paul Carlson, Marcus Brewer, and Mark Wooldridge, 2000. "Design Factors That Affect Driver Speed on Suburban Streets." Transportation Research Record 1751:18-25.

Engineering judgment must be used to determine if lane widths should be expanded or narrowed from the recommended widths below.

RECOMMENDED LANE OR TRAVELWAY WIDTHS IN THE CITY OF GRAND RAPIDS.

TRAVEL LANE / TRAVELWAY USE	RECOMMENDED WIDTH
Yield street (exclusive of on street parking generally required on at least one side)	16'
Travel lane directly adjacent to the curb	11'
Typical general purpose travel lane	10'
Turn lane	10'
Bicycle Facility	6'
Frequent transit bus lane or lane with high volume of heavy vehicles (>8%)	11'

City of Birmingham
A Walkable Community

MEMORANDUM

Planning Department

DATE: **February 23, 2018**

TO: **Multi-Modal Transportation Board**

FROM: **Lauren Chapman, Assistant City Planner**

APPROVED BY: **Jana L. Ecker, Planning Director**

SUBJECT: **Triangle District Streetscape- Bike Racks**

On July 14, 2008, the City Commission approved the streetscape furnishings for the Triangle District from Landscape Forms as the standard. The City Commission wanted options that were more contemporary than the streetscape elements that were Downtown. The Planning Board came up with elements for the Triangle District that would frame and shape the district:

- Standards do not need to conform to existing style; they can stand alone;
- Contemporary; and
- Metallic finish rather than a painted finish.

The Commission decided to choose "Pi" style bike racks with a silver metallic finish provided by Landscape Forms. Several "Pi" racks were installed in the Triangle District; six racks are at Walgreens on Woodward, two are at 700 S Adams, and three are at 735 Forest on Elm Street. Landscape Forms no longer manufactures the "Pi" style bike rack.

The City Commission has allocated $15,000 for bicycle parking. City staff identified thirty-six locations for new bike racks, nine of the locations are within the Triangle District. City Staff recommends bike racks be embedded into the surface rather than mounted onto the surface. Embedded racks tend to be more secure and more stable than surface mounted racks.

The Association of Pedestrian and Bicycle and Professionals (APBP) recommend that bike racks do the following:

- Support bike upright without putting stress on wheels
    - The rack should provide two points of contact with the frame—at least 6" apart horizontally.
    - If a rack cradles a bicycle's wheel, it must also support the frame securely at one point or more.
    - The rack's high point should be at least 32".
- Accommodate a variety of bicycles and attachments

    - Avoid designs and spacing that restrict the length, height, or width of bicycles, attachments, or wheels.
- Allow locking of frame and at least one wheel with a U-lock
    - A closed loop of the rack should allow a single U-lock to capture one wheel and a closed section of the bike frame.
    - Rack tubes with a cross section larger than 2" can complicate the use of smaller U-locks.
- Provide security and longevity features appropriate for the intended location
    - Use tamper-resistant mounting hardware in vulnerable locations.
    - Rack finish must be appropriate to the location.
- Rack use is intuitive
    - First-time users should recognize the rack as bicycle parking and should be able to use it as intended without the need for written instructions.

Included in this memo is information on various bike rack models that are sold by the two Michigan based bike rack manufacturers, Landscape Forms and CycleSafe, that the City has worked with in the past.

Landscape Forms

Landscape Forms provides high-design site furniture and advanced LED lighting. Landscape Forms solutions include a wide range of elements from seating to bike racks and trash receptacles. Founded in 1969, the company headquarters are in Kalamazoo. Landscape Forms has worked with a variety of clients including: municipalities, transit centers, corporate, college and health care campuses; and familiar brand leaders such as Boeing, Disney, Sprint, American Airlines, and Nike. All Landscape Forms bike racks meet guidelines established by the APBP.

Landscape Forms standard finish options are as follows:

- Metallic
    - Bronze
    - Silver
    - Steel
    - Stone
    - Titanium
    - Mercury
- Powder Coat
    - Black: Black and Matte Black
    - Blue: Blue Bell and Ocean
    - Buttercup
    - Cranberry
    - Flambé Orange
    - Green: Grass and Ivy
    - Stormcloud
    - White

Bicilinea

Curved arms mounted on a rectilinear rail provide support for multiple bicycles. The Bicilinea is available in 10’ and 20’ lengths. 10' accommodates up to eight bicycles, and 20' holds up to sixteen bicycles The Bicilinea only has one finish option: polished stainless steel. The rack must be embedded and requires assembly.

The estimated cost of this product is $3890 - $6900 per rack.

Bola

Bola bike racks are made of stainless steel tubing, with a satin electropolish finish on bare stainless steel. Bola is also available in the standard finish options. Bola must be embedded. Bola can secure two bicycles parked parallel to the rack. The rack provides two-point contact to prevent the bicycle from tipping over. A standard U-lock can secure both a wheel and the frame to the rack.

The estimated cost of this product is $330 per rack.

Emerson

The Emerson bike rack is tapered from top to bottom with crisp edges and beveled detail; it has concealed hardware and pre-installed stainless steel leveling guides. It is manufactured of cast aluminum and finished with durable polyester powdercoat.

The Emerson was designed, developed and manufactured with sustainability in mind. Aluminum and steel parts contain recycled content material and are fully recyclable. All metal parts are finished with Landscape Forms lead–free Pangard II polyester powdercoat. The Emerson is built for the long term to withstand years of weather and wear.

The estimated cost of this product is $375 per rack.

FGP

The FGP bike rack has a visually intriguing shape that echoes the form of a bicycle frame, lending it fresh appeal. The rack is affixed to the ground at a single base. The cast aluminum frame has a durable anodized finish. Parts for the bike racks come together in carefully articulated connections with minimized or hidden fasteners. The only finish option for the FGP is anodized aluminum.

The estimated cost of this product is $360 per rack.

Flo

The Flo is an artful solution for bicycle storage and security. The rack is made of stainless steel tubing. Flo is available in the standard colors as well as satin electropolish finish. Nylon glides cushion the two intermediate loops. Flowing design secures up to three bicycles parked parallel to the rack. A standard U-lock can secure both a wheel and the frame. Flo may be surface mounted or embedded. The bicycles must alternate directions, so access is required from both ends. If access is limited to one direction, the capacity is reduced to two bicycles. The rack provides two-point contact to prevent the bicycles from tipping over.

The estimated cost of this product is $660- $745 per rack.

Key

The Key bike rack has a cast aluminum base and steel loop frame finished in integral-colored high-density polyurethane foam. Recipient of a Red Dot Award in 2008 and an IDEA Bronze in 2007, this simple and lighthearted bike rack updates an essential urban element with new spirit. Key is offered in yellow, red, and anthracite grey.

The rack is made of polyurethane plastic molded over galvanized finish on internal steel tubing. Aluminum base comes standard in silver powdercoat. Key must be embedded, and ships fully assembled. Supports bike upright by its frame in two places, and holds two bicycles. Standard U-lock can be placed to secure both a wheel and the frame.

The estimated cost of this product is $520 per rack.

Loop

The Loop bike rack is a simple, sweeping circle with a twist. Both functional and sculptural, it is a welcome addition to the 35 Collection of integrated site elements created to encourage social activity in outdoor space. Cyclists can loop and lock up to two bikes around its shape-shifting cast aluminum ribbon frame. Like all products in the 35 Collection, it is finished with Landscape Forms standard colors.

The “Sit” style bench and the “Pitch” style litter receptacle ,that the City Commison chose for the Triangle District are part of the 35 Collection as well.

700 Adams- “Pitch” Litter Receptacle, “Pi” Bike Rack, “Sit” Bench

The estimated cost of this product is $345 per rack.

MultipliCITY

MultipliCITY is a collection of outdoor public furniture elements that gives new meaning to the term “global design.” MultipliCITY addresses multiple scales, applications and creative expressions. The distinctive profile of its cast aluminum sculptural forms attracts at a distance, while subtle transitions from flat to convex surfaces become visible at closer proximity, creating a rich 360-degree experience. Bike racks have a handy wood shelf that provides a place for phone or keys while riders secure the bike. MultipliCITY may be surface mounted or embedded.

MultipliCITY bike racks at Little Caesars Arena- Detroit

In addition to the standard finish options, MultipliCITY can also be finished in anodized aluminum or black polyethylene. The wood shelf comes in ipe or jarrah. The woods weather to a warm, pewter gray; no finish is applied so no maintenance is required.

The estimated cost of this product is $385 per rack.

Reeder

The elliptical-shaped bike rack with optional LED down light sports a vinyl decal when used for its named purpose. Cast and extruded aluminum elements are powdercoat finished in all standard color palette options. Reeder may be surface mounted or embedded.

The estimated cost of this product is $410 per rack.

Ride

The Ride rack is made of cast aluminum. Ride can be surface mount or embedded, and ships fully assembled. The rack provides bicycle support with capability for attachment at two points and holds two bicycles. A cover plate over bike rack base provides seamless appearance. Aluminum casting finished with powdercoat, offered in the standard selection of colors. Ride racks can secure up to two bicycles parked parallel to the rack. Four stainless steel leveling glides within the base are provided for fine adjustment from top side of base.

The estimated cost of this product is $440 per rack.

Ring

Ring bike racks are made of stainless steel tubing, with a satin electropolish finish on bare stainless steel. Ring is also available in powdercoated steel. The rack must be embedded. Ring can secure up to two bicycles parked parallel to the rack. The rack provides two-point contact to prevent the bicycle from tipping over. A standard U-lock can secure both a wheel and the frame. Ring is available in the standard colors and satin electropolish finish.

The estimated cost of this product is $405 per rack.

CycleSafe

Founded in 1980, CycleSafe has set the standard for secure bike parking products. The company's headquarters are in Grand Rapids. Their eco-minded products are designed to encourage cycling and livable communities worldwide. CycleSafe offers a line of secure bicycle storage solutions to meet ever-changing needs of the cycling community. All of CycleSafe's racks accommodate two bikes per rack and can be in-ground, surface, or rail mounted.

CycleSafe bike racks have several finish options:

- Black Plastisol
- Stainless Steel
- Powder Coat
    - Traffic Black
    - Federal Green
    - Traffic Red
    - Bronze
    - Signal White
    - Sapphire Blue
    - Metallic Silver
    - Custom

Classic U Rack

Classic U Racks by CycleSafe are manufactured of heavy-gauge steel pipe and coated with 1/8" thick, black plastisol rubberized coating for scratch resistance and rust protection. This rack design is the recommended standard by the APBP. Classic inverted U bike racks offer multiple positions to attach a lock to secure both the wheel and frame.

The Classic Bike U Rack is currently the City's Standard Bike Rack. On April 9, 2012, the City Commission approved the use of black plastisol finished "Classic Bike U Racks".

The base cost of this product is $153 per rack.

Classic U Rack with Crossbar

CycleSafe U bicycle racks provide leading-edge coating technology and offer a solution for short term bicycle parking. The one-bend 2” diameter round steel pipe rack is coated with a 1/8” thick, black plastisol rubberized coating. This classic inverted U rack is widely regarded as the standard for space efficiency and bicycle protection to maintain stability and improve pedestrian access. CycleSafe recommends U bike racks with a crossbar for added security. The crossbar deters a theft by not allowing a lock to be slipped to the ground and removed with bolt cutters leveraged against the ground.

The base cost of this product is $244 per rack.

Circle Rack

The Circle Rack offers a sleek, stylish design to enhance a community’s image with security to lock both the bike wheel and frame. This rack is based on the design principals of the Bike U Rack with Crossbar.

This design accommodates a variety of bikes, including children’s bikes with the lower circle to maintain stability and provide a means to secure a lock. The lower circle also deters the ability to slide and cut a lock from the rack.

Logos or graphic images can be inserted within the circle for project or community identification.

The base cost of this product is $456 per rack.

Custom Bike U Racks

Custom Racks are bike U racks with designs to enhance a community’s image. These bike racks are based on the proven design principles of the Bike U Rack with Crossbar. The custom bike racks offer unique wayfinding or signage systems that also serve the facility and cyclists with form and function to enhance community image and promote cycling with short-term bike parking.

Bike racks can be customized by duplicating, silk screening, or creating an adhesive label with logos and images.

Cost estimates depend on the design specifications.

Cycle Park

Cycle Park bike racks communicate to cyclists that bike parking is available, with a laser-cut bike parking symbol that promotes “bikes belong here”. Cycle Park bike racks offer the security of two-point locking, protecting both the bike wheel and frame. Each rack accommodates bikes in a sturdy, upright fashion that maintains clear access aisles for pedestrian traffic per rack.

The base cost of this product is $312 per rack.

Modern Bike Racks

Modern Racks incorporate the functional design features of the Classic U Rack with Crossbar with a contemporary flair. Designed to blend in with modern streetscapes or accent traditional environments, Modern Racks complement streetscapes as decorative urban art to encourage eco-friendly transportation. There are nine design SKUs available for the Modern.

The base cost of this product is $312 per rack.

Staple Bike Rack

CycleSafe Staple Bike Racks are the recommended standard for high-vandal areas, as the 2″ square tubing/crossbar provides additional security and allows a bike to be secured by both wheel and frame. The design has been approved by the APBP.

Standard includes 2″ square steel tubing with cross bar for additional security coated with powder coat finish for maximum corrosion resistance. Custom powder coat finishes are available upon request.

No cost estimates were provided for this model.

Vintage Bike Racks

Vintage Racks combine the unmatched reliability of the U rack with the charm of years past. Facility managers and cyclists appreciate the design features that provide a solid bike rack that holds the bike steady from knocking handlebars or toppling into pedestrian aisles. Vintage Bike Racks complement historic streetscapes, providing short-term bicycle parking for various locations. There are eleven design SKUs available for the Vintage Bike Rack.

Vintage bike racks in Grosse Pointe Farms

The base cost of this product is $312 per rack.

Conclusion and Analysis

	Model	Estimated cost per rack	Number of bikes per rack	Cost per bikes parked
Landscape Forms	Bicilinea	$3890/ $6900	8/16	$486.25/ $431.25
	Bola	$330	2	$115
	Emerson	$375	2	$187.50
	FGP	$360	2	$180
	Flo	$660-$745	3	$220-$248.33
	Key	$520	2	$260
	Loop	$345	2	$172.50
	MultipliCITY	$385	2	$192.50
	Reeder	$410/$660	2	$205/$330
	Ride	$440	2	$220
	Ring	$405	2	$202.50
Cycle Safe	Classic U	$153	2	$76.50
	Classic U with Crossbar	$244	2	$122
	Circle Rack	$456	2	$228
	Cycle Park	$312	2	$156
	Custom Bike U	-	2	-
	Modern	$312	2	$156
	Staple	-	2	-
	Vintage	$312	2	$156

The least expensive option is the City's current standard rack, the Classic U provided by Cycle Safe ($153 / $76.50 per bike parked). The average cost of models provided is $664.25. The previously approved "Pi" model cost $270 per rack. Most of the racks provide parking for a maximum of two bikes. The average cost per bike parked is $199.12. The most expensive option, in total cost and cost per bike parked, is the Bicilinea ($3890/ $6900 total and $486.25/$431.25 per bike parked)

Suggested Recommendation

To recommend to the City Commission that the _____ model bike rack, embedded and with a _____ finish, produced by _____ be the new standard bike rack for the Triangle District.

Birmingham Multimodal Transportation Board Survey

Name: _____

MKSK Studios and Fleis & Vandenbrink are offering topical training for Birmingham's Multimodal Transportation Board Members on relevant transportation-related topics. The purpose of this survey is to gauge the Multimodal Board's interest and narrow down the topics for inclusion in future training sessions.

1. Please select the top 3-5 transportation topics that you would be most interested in learning more about:
   - ☐ Best practices in pedestrian design
   - ☐ Traffic operations and level of service
   - ☐ Complete streets
   - ☐ How speed limits are set
   - ☐ Traffic calming
   - ☐ An overall "Transportation 101"
   - ☐ What peer cities are doing
   - ☐ Safety, such as "Vision Zero"
   - ☐ Traffic impact study best practices
   - ☐ Transit systems in Birmingham
   - ☐ Residential street design standards
   - ☐ Transportation demand management
   - ☐ Access management
   - ☐ Bike facilities and design
   - ☐ Road diets (repurposing traffic lanes to another use)
   - ☐ Smart cities
   - ☐ Other, please describe: _____

2. Which types of transportation-related plans would you like to see?

3. What transportation aspects does Birmingham already do well?

4. What is one transportation topic or issue that Birmingham could improve upon?

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America WALKS

SIGNALIZED INTERSECTION ENHANCEMENTS THAT BENEFIT PEDESTRIANS

Making America a Great Place To Walk

Table of Contents

Prepared for America Walks by

FEHR & PEERS

America WALKS

Making America a Great Place To Walk

WELCOME

America Walks is a national resource which fosters walkable communities by engaging, educating, and connecting.

Walking is a healthy, environmentally friendly, and socially equitable form of transportation. Improvements to the safety and convenience of walking are critical to maximizing the number of people who walk.

According to *Bicycling and Walking in the United States – 2010 Benchmarking Report* (Alliance for Biking & Walking, 2010), pedestrians account for 11.3% of all traffic fatalities nationwide and 25% of all traffic fatalities in major U.S. cities. Signalized intersections are an inherent element of the roadway network in cities; they are a common point of convergence for pedestrians and vehicles and many pedestrian traffic fatalities occur at signalized intersections. Improving safety at signalized intersections is therefore critical to reducing the number of pedestrian traffic fatalities.

The purpose of this resource is to educate decision makers, planners, engineers, and citizens on signalized intersection enhancements that can improve pedestrian safety and convenience. This resource is intended to summarize a wide array of potential treatments for a variety of signalized intersections; not all of the treatments summarized in this resource are appropriate for every signalized intersection.

This resource categorizes signalized intersection enhancements into three types:

- Geometric treatments
- Signal hardware
- Operational measures

America WALKS

Making America a Great Place To Walk

GEOMETRIC DESIGN TREATMENTS

Geometric design treatments are those that relate to an intersection's physical attributes: it's dimensions, pavement or concrete layout, and striping pattern.

Fewer Travel Lanes

Fewer travel lanes decrease roadway width and crosswalk length. It takes an average pedestrian almost four seconds to cross each additional travel lane. Therefore, reducing the number of travel lanes minimizes the amount of time that pedestrians are in the crosswalk. More travel lanes than necessary can also increase vehicle travel speeds; research has shown that the severity of pedestrian collisions increases sharply with increased vehicle speed.

Narrower Travel Lanes

Travel lanes are typically designed to be 12 feet wide. Where fewer travel lanes are not possible, research shows travel lanes can be safely narrowed to as little as nine feet, especially left- and right-turn pockets. Narrower travel lanes decrease roadway width and crosswalk length, thereby minimizing the amount of time that pedestrians are in the crosswalk.

Median Pedestrian Island

Median pedestrian islands provide a safe place for pedestrians to stand if they do not have sufficient time to cross a street. They can be enhanced with median pedestrian push buttons.

Corner Bulbouts

Corner bulbouts extend the curb and sidewalks further into the roadway, shortening the length of the crosswalk. They act as a traffic calming device by narrowing the effective width of the roadway. Because they extend into the roadway, often past parallel-parked vehicles, they improve visibility for pedestrians. Corner bulbouts can be constructed with reduced curb radii and to accommodate ADA improvements, such as directional curb ramps.

Reduced Curb Radius

Vehicles travel faster through turns with a large turn radius than turns with a small curb radius. Reducing the radius of a corner curb is an effective way of reducing vehicle speeds. In suburban

environments turn radii generally do not need to exceed 30 feet. In urban environments turn radii can be 10 feet or less, especially where the meeting of one-way streets prohibits turning movements. Where on-street parking is permitted on one or both streets, consideration for further reductions of radii should occur acknowledging that the effective radius is increased with on-street parking. Corner curb radii on multi-lane streets should acknowledge that trucks turning right can turn into two lanes.

Directional Curb Ramps (with Truncated Domes)

Curb ramps offer wheelchair access to/from the sidewalk and crosswalk. Truncated domes, which are often yellow, warn pedestrians with limited or no sight that they are about to enter a crosswalk. The best practice for curb ramps is to install two per corner so that each ramp points directly into the crosswalk and to the curb ramp at the other side of the street. Directional curb ramps help blind pedestrians by pointing them in the correct direction while crossing. Corner bulbouts can be used to increase the amount of space available for directional curb ramps. Flared sides may not be necessary when two ramps are provided per corner.

Raised Crosswalk

Raised crosswalks are speed tables (flat-topped speed humps) outfitted with crosswalk markings and signage, providing pedestrians with a level street crossing. By raising the level of the crossing, vehicles drive more slowly through the crosswalk and pedestrians are more visible to approaching motorists. At signalized intersections, they are most appropriate where "pork-chop" islands separate channelized right-turn lanes from the adjacent through lanes.

Improved Right-Turn Slip-Lane Design

Free right-turns allow vehicles to turn right on red without stopping. Since the vehicles are never controlled by the traffic signal, pedestrians must always treat crosswalks across a free right-turn lane as an uncontrolled crosswalk. Controlled right-turn movements are preferable for pedestrians because they require a vehicle to stop on red before turning right. Where "pork-chop" islands that channelize right-turns are necessary to provide acceptable turning radii, raised crosswalks are a pedestrian enhancement. The geometry of the free right-turn lane can enforce a safe turning speed.

Advanced Yield Lines

Advanced yield lines, often referred to as "sharks teeth", are placed in front of uncontrolled crosswalks to improve yield compliance. At signalized intersections, they can be used to remind free right-turning vehicles to yield to pedestrians.

Textured Pavement

Textured pavement can be used in crosswalks or in intersections as an aesthetic enhancement. Because of its texture, it also calms traffic by slowing vehicles before they cross an intersection. It can also make crosswalks more visible. Textured pavement can be made of brick or, alternatively, both concrete and asphalt can be stamped to look like brick or stone.

Anti-Skid Surfacing

Roadway paint, including the paint used to mark crosswalks, can become slippery when wet. Alternative pavement marking materials, such as tape and thermoplastic, are less slippery than paint when wet.

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Advanced Stop Bars

Advanced stop bars are placed in front of crosswalks. They keep vehicles from encroaching into the crosswalk when stopped at a red light. On multi-lane roads, advanced stop bars placed at least one car-length back from the crosswalk allow pedestrians to be seen by drivers in adjacent lanes.

Marked Crosswalks (on all approaches)

Marking a crosswalk across all approaches of an intersection improves pedestrian accessibility. At a four-way intersection, a missing crosswalk forces pedestrians to cross three times instead of once. Crosswalks on all approaches can often be accommodated without a significant impact to traffic signal operations.

High-Visibility Markings

Design policies should require different crosswalk markings for controlled and uncontrolled crosswalks. Standard crosswalks are generally acceptable across controlled approaches; however, high-visibility crosswalks are appropriate in areas with high pedestrian volumes. High-visibility crosswalks should also be used across uncontrolled locations including midblock and at free right-turns. Continental, zebra, ladder, or triple-four crosswalks are all examples of high-visibility crosswalks. High-visibility markings improve yield compliance. Having a uniform design policy for marked and unmarked crosswalks delivers a clear message to pedestrians when they are about to enter a crosswalk.

Colored Crosswalks / Intersections

Colored crosswalks improve crosswalk visibility for motorists. They can be designed to complement the colors of a city or school.

Proper Locations for Signal Controllers

Signal controller boxes should be located such that they do not present a barrier for pedestrians. The best placement for signal controller boxes is completely off of the sidewalk, but still accessible for maintenance.

SIGNAL HARDWARE

Signal hardware includes all of the physical elements of a traffic signal: signal heads, pedestrian signals, and push buttons.

Blank Out Turn Restriction LED Signs

The ubiquity of conventional turn restriction signs, usually for no right-turn on red, contributes to their disregard by motorists. Blank out turn restriction signs, usually for no right-turn on red, activate only when the specified movement is prohibited.

Protected Left-Turn Signals

The "Walk" signal at a crosswalk usually begins at the same time that through- and turning-vehicles in the same direction receive a green light. Where permitted left-turns are allowed, denoted by a "Left Turn Yield on Green" sign, left-turning vehicles can conflict with pedestrians in the crosswalk. By making the left-turn protected, so that it is allowed only with a green arrow, the "Walk" signal at a crosswalk occurs at the same time that through- and right-turning vehicles in the same direction receive a green light. This reduces the risk of left-turning vehicle conflicts with the opposing crosswalk; since left-turns typically occur at a higher speed than right-turns, collisions of increased severity can be avoided by protecting left-turns.

Pedestrian Signals

Pedestrian signal heads minimize vehicle-pedestrian conflicts by assisting pedestrians in deciding when to begin crossing the roadway. For best results, post pedestrian signal heads in the same general vicinity as vehicle heads for conflicting movements such that pedestrians know what to expect from traffic. This is especially important where permitted left-turns are allowed, denoted by a "Left Turn Yield on Green" sign.

Pedestrian heads should be located on the same post as the vehicle indications and on the intersection side of the crosswalk rather than at the back of the crosswalk. This reduces the likelihood of view obstruction by large vehicles.

Pedestrian Countdown Signals

Pedestrian countdown signals give pedestrians "Walk" and "Don't Walk" signals and inform them how long they have to cross the street. Research suggests that pedestrians are more likely to obey the "Don't Walk" signal when delivered using a countdown signal. The 2009 Manual on Uniform Traffic Control Devices requires that all new pedestrian signals be countdown signals.

Animated Eyes Pedestrian Signals

Animated eyes pedestrian signals feature eyes that look from side to side when a "Walk" signal is given. The signals remind pedestrians to look for turning vehicles before proceeding into the crosswalk. Research has indicated that animated eyes pedestrian signals reduce conflicts between vehicles and pedestrians.

Pedestrian Push buttons

To receive a "Walk" signal at a crosswalk, pedestrians are often required to use a push button. The location and design of buttons should comply with ADA guidelines.

Median Pedestrian Push buttons

Where median pedestrian islands exist, median pedestrian push buttons can be provided for pedestrians who become stranded mid-crossing. Occasionally, pedestrians who walk slowly, such as the elderly or children, are unable to cross the street in one cycle length. Providing a push button in the pedestrian median island allows them to receive a "Walk" signal for the next phase of their crossing. In general, the benefits of a median pedestrian push button are more pronounced when the total crossing distance is 60 feet or greater.

Passive Detection Devices

Passive detection of pedestrians, which can be accomplished using video or radar detection devices, register the presence of a pedestrian waiting to cross a street without the use of a push button. Additionally, they can track the location of a pedestrian as he crosses the street to determine if more crossing time is needed. Advances in video and infrared technology are improving the reliability of passive detection devices; in Santa Clara, CA, the City recently began using infrared technology at traffic signals to extend the crossing time when needed.

Accessible Pedestrian Signals

Accessible pedestrian signals and detectors provide information, such as "Walk" indications and direction of crossing, in non-visual formats to improve accessibility for blind pedestrians. Audible options for accessible pedestrian signals include audible tones and speech messages. Vibrotactile push-buttons are effective options that alleviate the impacts of noise created by audible pedestrian signals.

Braille Wayfinding

Braille characters can be added to the "Push Button for Walk Signal" plaques to provide basic information about the intersection.

Extended Push button

Some pedestrians may need extra time to safely cross a street. Traffic signals can be retrofitted to allow pedestrians to increase the crossing time by pressing the push button a bit longer.

OPERATIONAL MEASURES

Changes to a signalized intersection's operations can often be made inexpensively without making physical changes to the intersection.

Short Cycle Lengths

Long cycle lengths at signalized intersections result in long pedestrian wait times to cross a street. By shortening an intersections cycle length, pedestrians do not have to wait as long to cross after pushing the button to request a "Walk" signal.

Longer crossing times at crosswalks ensure that all pedestrians are safely able to cross the street within the allotted time. Previous to 2009, crossing time for crosswalks at signalized intersections was based on an average walking speed of 4.0 feet per second. Guidance in the 2009 Manual on Uniform Traffic Control Devices specifies that a walking speed of 3.5 feet per second should be assumed to determine crossing times. A speed slower than 3.5 feet per second can be used where slower pedestrians routinely use the crosswalk, such as locations near schools, hospitals, or senior centers. Additionally, where a crosswalk's concurrent green vehicle phase is greater than the minimum phase for pedestrians, the duration of the pedestrian phase can be increased to be the same as the concurrent vehicle phase.

Leading Pedestrian Interval

A leading pedestrian interval illuminates the "Walk" signal for a few seconds prior to stopped through-vehicles receiving a green light. Allowing pedestrians a head start into the intersection can reduce conflicts between pedestrians and turning vehicles and makes crossing pedestrians more visible. The Manual on Uniform Traffic Control Devices recommends that leading pedestrian intervals be at least three seconds in duration.

Pedestrian Scramble Phase

Pedestrians usually have to cross two roadways to get from one corner of an intersection to the opposite corner. A scramble phase allows pedestrians to cross in all directions, including diagonally. Right-turn on red for vehicles must be restricted during the walk phase to ensure pedestrian safety.

No Right-Turn on Red

When attempting to turn right on red, vehicles must look left to see if the road is clear; drivers often forget to look right before turning and may not see pedestrians to their right. Restricting right-turns on red can reduce conflicts between vehicles and pedestrians. Blank out turn restriction signs are more effective than conventional "No Right Turn on Red" signs. "No Right Turn on Red" signs that specify time-of-day restrictions or "When Pedestrians are Present" are confusing to motorists and are often disregarded.

Pedestrian Recall

Pedestrian recall gives pedestrians a "Walk" signal at every cycle. No push-button or detection is necessary since a "Walk" signal will always be given. Pedestrian recalls are useful in areas with high levels of pedestrian activity. They demonstrate that an intersection is meant to serve both vehicles and pedestrians. In general, pedestrian recall should be used if pedestrians actuate a "Walk" signal 75 percent of the time during three or more hours per day.

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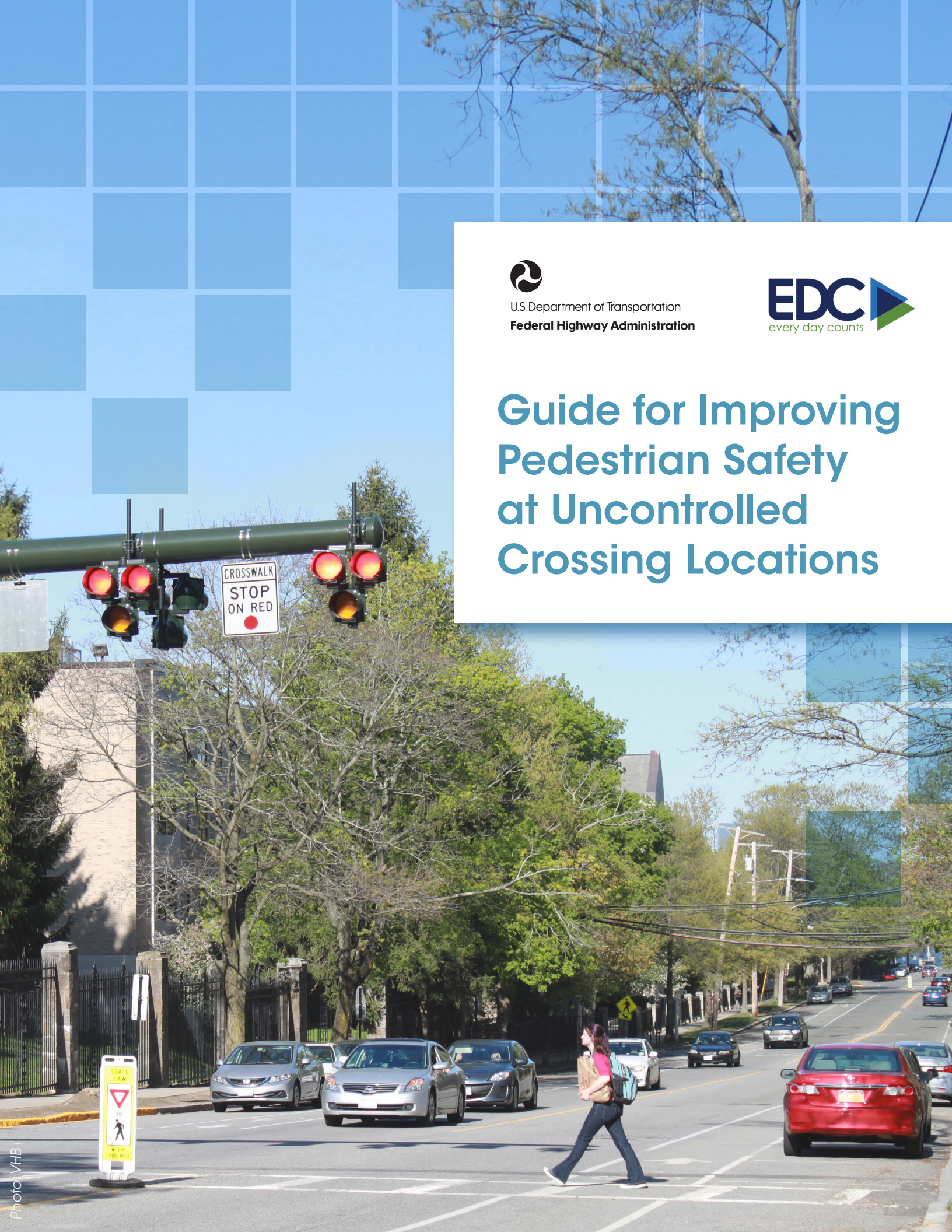
Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations



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U.S. Department of Transportation
Federal Highway Administration

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Investment in roadway safety saves lives

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16. ABSTRACT

This guide assists State or local transportation or traffic safety departments that are considering developing a policy or guide to support the installation of countermeasures at uncontrolled pedestrian crossing locations. This document provides guidance to agencies, including best practices for each step involved in selecting countermeasures. By focusing on uncontrolled crossing locations, agencies can address a significant national safety problem and improve quality of life for pedestrians of all ages and abilities. Agencies may use this guide to develop a customized policy or to supplement existing local decision-making guidelines.

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What is the *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*?

State or local transportation or traffic safety departments should consider developing a policy or guide to support the installation of countermeasures at uncontrolled pedestrian crossing locations. This document provides guidance to agencies, including best practices for each step involved in selecting countermeasures. Agencies may use this guide to develop a customized policy or to supplement existing local decision-making guidelines.

This document was produced by the Federal Highway Administration (FHWA) as part of the Safe Transportation for Every Pedestrian (STEP) program. STEP is part of the fourth round of Every Day Counts. STEP's purpose is to help transportation agencies address crashes by promoting countermeasures with known safety benefits at uncontrolled crossing locations.

Uncontrolled pedestrian crossing locations occur where sidewalks or designated walkways intersect a roadway at a location where no traffic control (i.e. traffic signal or STOP sign) is present. These common crossing types occur at intersections (where they may be marked or unmarked) and at non-intersection or midblock locations (where they must be marked as crossings). Overall, uncontrolled pedestrian crossing locations correspond to higher pedestrian crash rates, often due to inadequate pedestrian crossing accommodations.

By focusing on uncontrolled crossing locations, local and State agencies can address a significant national safety problem and improve quality of life for pedestrians of all ages and abilities. STEP promotes the following five effective and lower-cost countermeasures that communities can deploy based on their specific needs:

- Crosswalk visibility enhancements (i.e., high-visibility crosswalk markings, parking restriction on crosswalk approach, improved lighting, advance Yield Here To [Stop Here For] Pedestrians sign and yield [stop] line, In-Street Pedestrian Crossing sign, and curb extension).
- Raised crosswalk.
- Pedestrian refuge island.
- Pedestrian Hybrid Beacon (PHB).
- Road Diet.

These countermeasures and their safety benefits are described further in this guide. The guide also includes best practices for identifying locations and installing countermeasures at uncontrolled pedestrian crossing locations.

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List of Abbreviations

AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADT	average daily traffic
CMF	crash modification factor
CRF	crash reduction factor
EDC	Every Day Counts
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
GIS	geographic information system
HSIP	Highway Safety Improvement Program
HSP	Highway Safety Plan
MUTCD	Manual on Uniform Traffic Control Devices
NHTSA	National Highway Traffic Safety Administration
PHB	Pedestrian Hybrid Beacon
RSA	Road Safety Audit
SHSP	Strategic Highway Safety Plan
STBG	Surface Transportation Block Grant
STEP	Safe Transportation for Every Pedestrian
TZD	Toward Zero Deaths
VZ	Vision Zero

Introduction

Pedestrians are among the most vulnerable road users, accounting for approximately 16 percent of all roadway fatalities nationally in 2016, per the Fatality Analysis Reporting System (FARS).[1] Pedestrians are especially vulnerable at non-intersection locations, where 72 percent of pedestrian fatalities occur.[1]

This guide addresses safety issues at **uncontrolled pedestrian crossing locations**, which occur where sidewalks or designated walkways intersect a roadway at a location where no traffic control (i.e., traffic signal or STOP sign) is present. These common crossing types occur at intersections (where they may be marked or unmarked) and at non-intersection or midblock locations (where they must be marked as crossings). Overall, uncontrolled pedestrian crossing locations correspond to higher pedestrian crash rates than controlled locations, often due to inadequate pedestrian crossing accommodations.

How to Use this Guide

The guide includes steps to assist an agency in selecting appropriate countermeasures to help improve pedestrian safety, as illustrated in Figure 1. An agency that has an established process for identifying priority locations for pedestrian safety improvements should review the guidance in Steps 3 through 6. This information is most important for selecting pedestrian crossing countermeasures. An agency that is at the beginning stages of identifying priority locations should consult each of the steps described in this guide.

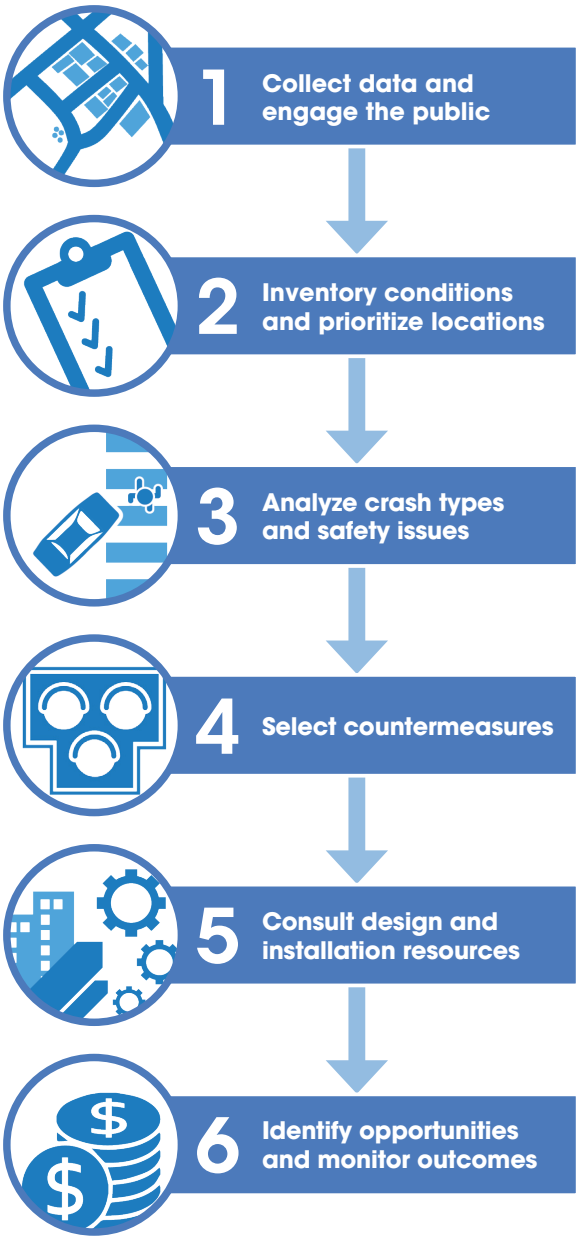

Figure 1. Process diagram for selecting countermeasures at uncontrolled pedestrian crossing locations.

[1]*NHSTA, "FARS Data Query: 2016 Data." Fatality Analysis Reporting System (FARS) Encyclopedia. (2017). https://www-fars.nhtsa.dot.gov//QueryTool/QuerySection/SelectYear.aspx*

Following the process in the guide results in possible countermeasure options based on road conditions, crash causes, and pedestrian safety issues. The guide provides two reference tables to help identify countermeasure options. Table 1 identifies countermeasures by roadway conditions such as vehicle speed limit, annual average daily traffic (AADT), and number of travel lanes. Table 2 helps further pinpoint the most appropriate countermeasures by common safety concerns such as failure to yield or excessive vehicle speeds. The guide does not include specific recommendations for countermeasures based on all criteria in design and reference manuals, such as actual speeds and pedestrian volumes. The agency should reference the Manual on Uniform Traffic Control Devices (MUTCD), American Association of State Highway and Transportation Officials (AASHTO) design guidelines, and State and local practices when selecting one or more specific countermeasures. The guide is followed by appendices including reference material for a local agency resolution and a summary of research cited for crash modification factors (CMFs).

The agency should note additional considerations for the application of this guide, such as costs to design, install, and maintain the treatments. The agency should apply engineering judgment and conduct field investigations to confirm data and observe driver and pedestrian behaviors when selecting countermeasures.

Building a safe and connected pedestrian network requires consideration of topics beyond what is included in this guide. This guide does not include methods for prioritizing sidewalk improvements, but agencies should consider giving special attention to connecting the pedestrian network with sidewalks, walkways, paved shoulders, and trails and paths. The ActiveTrans Priority Tool was created through the National Cooperative Highway Research Program and can provide agencies with automated resources to prioritize pedestrian and bicycle improvements.

Pedestrian crossings in or near school zones are not specifically addressed in this guide, as these crossings may be subject to other guidance or other considerations. Agencies may refer to the "Safe Routes to School Briefing Sheets: School Area Traffic Control" produced by the Institute of Transportation Engineers (ITE) for guidance on improving pedestrian crossings near schools.

This guide does not describe pedestrian crossing requirements per the Americans with Disabilities Act (ADA), although ADA requirements should be addressed as part of any pedestrian crossing improvements project. For more information about ADA accessibility requirements, the agency should consult the US Access Board's 1991 ADA Accessibility Guidelines (ADAAG), the 2010 Standards for Accessible Design, and the 2011 Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (proposed PROWAG).

1

Collect Data and Engage the Public

GUIDING PRINCIPLES

This section describes optional methods for describing existing pedestrian safety trends and engaging stakeholders. The following are important considerations for this step in the process of selecting countermeasures:

» Review existing plans for safety statistics and locations previously identified for safety improvements.

» Develop a resolution or policy statement in support of improving pedestrian safety at uncontrolled crossing locations.

» If a formal process is preferred, initiate a Pedestrian Safety Action Plan to engage the community and identify priority locations.

» If a less formal process is preferred, document public comments previously received or conduct a walkability audit to identify locations generally considered as less safe for pedestrians crossing.

Collect Pedestrian Crash and Safety Data

Crash reports completed by law enforcement agencies may include information about driver and pedestrian actions, as well as environmental conditions when and where the crash occurred. These data are helpful to understand safety issues in the area. Crash data may be geocoded and mapped. The agency can collect crash maps, request crash reports (as needed), and contact public health officials for other pedestrian injury data.

Review Existing Traffic Safety Plans

The Strategic Highway Safety Plan (SHSP) is a comprehensive interagency plan that the State updates and submits to FHWA every 5 years. The SHSP may include recommendations for improving pedestrian safety. The agency should review the SHSP for pedestrian crash statistics and recommendations for pedestrian safety improvements.

The SHSP informs the State's Highway Safety Improvement Program (HSIP). The HSIP describes how the State will allocate funding for a variety of roadway safety improvements. HSIP projects are selected through a data-driven approach and can

include pedestrian crash countermeasures and intersection improvements. The HSIP may set aside funding for pedestrian safety improvements, or the program may use a common scoring process to consider safety projects for all travel modes. The agency should identify and understand pedestrian safety projects in the current HSIP, and consider how pedestrian safety projects are identified for potential funding and implementation.

The SHSP is also linked to the State's Highway Safety Plan (HSP). The HSP is an annual strategy submitted by the State's Governor's Highway Safety Program to the National Highway Traffic Safety Administration (NHTSA). The HSP focuses on countermeasures that address driver and non-motorized behavior, and it provides an investment plan for activities such as law enforcement operations and public education programs. The HSP establishes performance measures. Pedestrian safety initiatives are eligible for funding through the HSP. The agency should research pedestrian safety programs recommended in the HSP and consider how pedestrian crossing treatments can support the performance standards described in the HSP.

Evaluate Pedestrian Accommodation and Traffic Safety Policies

The agency may have a policy or guidance for how pedestrian improvements are incorporated into other roadway projects, such as a Complete Streets policy. The policy explains the process for integrating sidewalks and crossing treatments into routine street maintenance activities and large-scale highway projects. The agency should examine the linkages between Complete Streets and pedestrian safety and consider improvements to the process to better integrate pedestrian crossing improvements into roadway projects.

The agency may have adopted a policy for eliminating traffic-related fatalities, such as a Vision Zero or Toward Zero Deaths initiative. The programs focus on eliminating or significantly reducing traffic fatalities and prioritize strategies for the most vulnerable roadway users, such as pedestrians. These programs may summarize how all agency departments can improve pedestrian and traffic safety, and may include metrics that establish the need for safety at uncontrolled pedestrian crossings.

Review Pedestrian Master Plans for Proposed Projects

Another approach to identify pedestrian issues is to review existing local or regional plans, particularly those with a focus on pedestrians, for potential locations for safety projects and to identify needed countermeasures. A State or local pedestrian master plan may include recommendations for pedestrian safety projects, identified infrastructure deficiencies, and/or documentation about safety concerns. This step leverages prior analyses and helps to identify countermeasures that that the agency is already considering.

Initiate a Pedestrian Safety Action Plan (PSAP)

Agency leaders and community stakeholders can begin a formal process to identify priority locations and key strategies for improving pedestrian safety. The agency may initiate a PSAP to increase community awareness and

support for improving pedestrian safety. A PSAP considers the input of stakeholders from multiple disciplines and uses data analysis to identify potential locations for safety improvement.

Document Informal Public Comments

The agency can identify locations of significance within a jurisdiction by collecting concerns and requests from community partners. Agencies should set up a process for receiving, tracking, and responding to input from residents and visitors. Many local governments respond with traffic calming request applications or online forms for residents with concerns about pedestrian safety on high-speed arterials or collector streets. Agencies may also consider forming a committee or work group devoted to considering pedestrian safety and mobility, such as a pedestrian advisory committee. This type of group can collect input from stakeholders and present their concerns to agency staff or decision-makers.

Conduct a Walkability Audit

Community leaders and neighbors can conduct a walkability audit at priority locations or corridors to identify deficiencies in the pedestrian network at a small area or neighborhood scale. This is an informal method for engaging stakeholders and raising awareness about pedestrian safety. Leaders can organize an event and ask participants to follow a simple checklist to assess neighborhood streets. Figure 2 shows an excerpt from a sample "walkability checklist" that agencies may use to conduct a walkability audit.

Take a walk and use this checklist to rate your neighborhood's walkability.

How walkable is your community?

Location of walk

Rating Scale: 1 awful; 2 many problems; 3 some problems; 4 good; 5 very good; 6 excellent

1. Did you have room to walk?

☐ Yes ☐ Some problems:
- ☐ Sidewalks or paths started and stopped
- ☐ Sidewalks were broken or cracked
- ☐ Sidewalks were blocked with poles, signs,shrubbery, dumpsters, etc.
- ☐ No sidewalks, paths, or shoulders
- ☐ Too much traffic
- ☐ Something else _____

Rating: (circle one) 1 2 3 4 5 6

Locations of problems: _____

4. Was it easy to follow safety rules? Could you and your child...

☐ Yes	☐ No	Cross at crosswalks or where you could see and be seen by drivers?
☐ Yes	☐ No	Stop and look left, right and then left again before crossing streets?
☐ Yes	☐ No	Walk on sidewalks or shoulders facing traffic where there were no sidewalks?
☐ Yes	☐ No	Cross with the light?

Rating: (circle one) 1 2 3 4 5 6

Locations of problems: _____

Figure 2. Excerpt from "Walkability Checklist."

Source: Pedestrian and Bicycle Information Center. Created in collaboration with FHWA, NHTSA, National Center for Safe Routes to School, and United States Environmental Protection Agency.

RESOURCES

NHTSA Pedestrian Safety Information

NHTSA publishes annual reports summarizing the latest pedestrian fatality statistics. These statistics are based on FARS and the reports describe pedestrian fatality trends per different socioeconomic groups and for each State.

Smart Growth America – National Complete Streets Coalition

Smart Growth America, a non-governmental advocacy organization, supports the National Complete Streets Coalition. This organization provides resources to support the development and implementation of Complete Streets policies. These policies encourage pedestrian mobility and safety by promoting street design that accommodates controlled and uncontrolled crossings. For example, the Massachusetts Department of Transportation Complete Streets program assists local governments developing Complete Streets policies and implementation plans.

FHWA State SHSP Resources

The FHWA Office of Safety posts a link to each State's current SHSP. This website also lists noteworthy practices. Many SHSP plans provide an emphasis on pedestrians and contain goals for reducing traffic fatalities and injuries.

The Ohio DOT 2015 SHSP has a pedestrian emphasis area that seeks to reduce fatalities and serious injuries through six strategies that include data collection, institutionalizing pedestrian accommodations, implementing proven countermeasures, and promoting law enforcement.

FHWA HSIP Resources

The HSIP includes the projects selected for implementation, an evaluation of past projects, and an annual status report. Projects can include pedestrian safety improvement programs and projects. For example, the 2016 Oregon HSIP Annual Report details how the its All Roads Transportation Safety Program sets aside funding to address systemic pedestrian crash locations.

State HSP Documents

NHTSA posts the States' current HSP outlining non-infrastructure strategies for improving roadway safety. A State HSP is likely to contain a pedestrian fatality and injury reduction goal, an associated performance measure, and describe non-infrastructure initiatives like enforcement and education programs. For example, Colorado DOT's 2017 HSP (called the 2017 Integrated Safety Plan) supports the Denver Police Department's "Decoy Pedestrian Program" to enforce driver yielding compliance at high-crash pedestrian crossings.

Vision Zero Network

This collaborative website posts case studies and tracks cities who are implementing Vision Zero plans or goals. The Vision Zero Network website also notes best practices by agencies who are working to eliminate traffic fatalities and serious injuries. Vision Zero goals are accompanied by policies, strategies, and target dates. For example, Columbia, Missouri's Vision Zero Action Plan contains an outreach campaign to educate pedestrians and drivers on new and potentially confusing infrastructure improvements like pedestrian hybrid beacons and enhanced pedestrian crosswalks.

FHWA How to Develop a Pedestrian and Bicycle Safety Action Plan (2017)

This document explains the process of developing pedestrian and bicycle safety action plans. The sources of data required for these plans may include police reports, roadway and intersection conditions, field visits of crash sites. For example, New Jersey's PSAP identified how its infrastructure prioritization programs could be revised to recognize locations with systemic pedestrian crash risk.

FHWA Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts (2016)

This resource focuses on flexibility and options for the design of pedestrian and bicycle networks designed to minimize crash conflicts, including case studies to illustrate various design treatments.

Walkability Checklist

This tool can be used by community leaders during a walkability audit to evaluate pedestrian infrastructure and traffic behavior.

2

Inventory Conditions and Prioritize Locations

GUIDING PRINCIPLES

This section describes how the agency can document field conditions (such as roadway characteristics) necessary for prioritizing locations and selecting countermeasures. The following are important considerations for this step:

» Create a worksheet or checklist of roadway characteristics to record in the field (see Figure 3).

» Document pedestrian volumes and driver behavior, especially where pedestrians are frequently expected such as at bus stop locations and near schools.

» Classify pedestrian crossings as either uncontrolled or controlled locations.

» Analyze data and create maps to show priority locations for pedestrian improvements.

Inventory Roadway Characteristics

The process of collecting roadway characteristics includes compiling geospatial data to create base maps for each of the priority sites. Roadway conditions are key criteria for selecting countermeasures. The agency may document and map the following roadway characteristics for priority sites (see Glossary for more information):

» Speeds, including posted speed limits and actual speeds (i.e., 85th percentile speeds).

» Number of travel lanes for each approach.

» Center turn lanes, medians, or refuge islands.

» Intersection turn lanes.

» Vehicle queue lengths at intersections.

» Width of roadway, from curb to curb.

» Traffic volumes (AADT or ADT).

» Large truck traffic volumes or large trucks as a percentage of total traffic.

» On-street parking, alignment, and marked or signed restrictions.

City of Boulder Pedestrian Crossing Treatment Installation Guidelines

Crossing Location Evaluation Worksheet

Rev. 11/2/11

STEP 1 - LOCATION DESCRIPTION

Major Street: _____ Crossing Location: _____

Is this a multi-use path crossing? ☐ Yes ☐ No Posted Speed Limit: _____ mph

Existing Traffic Control: ☐ Stop Sign ☐ Traffic Signal ☐ Uncontrolled

Existing Crossing Treatments (if any): _____

_____

Nearby Pedestrian Generators (School, transit stop, commercial, etc.): _____

_____

STEP 2 - PHYSICAL DATA

Roadway Configuration:
☐ 2-Lane
☐ 3-Lane w/Striped Median
☐ 3 Lane w/Raised Median
☐ 4 Lane
☐ 5 Lane w/Striped Median
☐ 5 Lane w/Raised Median
☐ 6 Lane
☐ Other: _____

Crossing Distance By Direction: _____ ft total _____ ft to median *(if applicable + note direction)* _____ ft to median *(if applicable + note direction)*

Nearest Marked or Protected Pedestrian Crossing: _____ Distance to: _____ft

(*For uncontrolled location only*) Stopping Sight Distance (SSD) = _____ ft _____ ft.

Is SSD ≥ 8x Speed Limit? ☐ Yes ☐ No If No, are improvements to SSD feasible? ☐ Yes ☐ No

Figure 3. Example crossing inventory worksheet.

Source: City of Boulder, Pedestrian Crossing Treatment Installation Guidelines (2011).

Inventory Pedestrian Crossings and Observed Traffic Behavior

The agency can also document pedestrian crossing conditions. Agency staff can visit the sites and record the following crossing site features:

- Crosswalk markings, presence, and types.
- Crosswalk distance (in feet) and crossing phase duration (in seconds).
- Signage, such as advance, crosswalk, and in-street.
- Traffic control devices and signals, such as pedestrian crossing signal, pedestrian signal detector, STOP sign, and PHB.
- Signal phasing and restrictions, such as Leading Pedestrian Interval, split or concurrent phasing type, and turn restrictions.
- Vertical elements, such as refuge island or raised crosswalk.
- Horizontal elements, such as curb extensions, narrowed curb radii, Road Diet, or lane reconfiguration.
- Accessibility features, such as curb ramps, truncated domes, and accessible signal push buttons.
- Lighting and visibility enhancements, such as overhead lighting.
- Pedestrian volumes, including transit boarding volumes from nearby stops.
- Pedestrian crossing behaviors near important activity centers such as transit stops, schools, and in downtown districts.
- Driver behaviors at crosswalks and intersections.
- Sight distance and visual clearance of crossing.

Classify Pedestrian Crossings as Controlled or Uncontrolled

In addition to collecting inventory information about the priority sites, it is important that the agency categorize each crossing as either controlled or uncontrolled. Uncontrolled pedestrian crossing locations occur where sidewalks or designated walkways intersect a roadway at a location where no traffic control (i.e., traffic signal or STOP sign) is present. These common crossing types occur at intersections (where they may be marked or unmarked) and at non-intersection or midblock locations (where they must be marked as crossings). This guide describes countermeasures applicable to uncontrolled crossings. Some of these countermeasures can also be used for controlled crossings, and the agency should consult other guidance for specific implementation criteria at those sites.

Screen the Network for High-Crash or High-Risk Locations

By following a data-driven approach, the agency can readily explain and defend how it selected priority sites for improvement. An agency can study, or screen, the safety conditions for the road network within its jurisdiction. The screening process uses geo-coded pedestrian crash data and other information to identify different types of locations. Network screening may take the form of spot safety or systemic safety analysis. Spot safety analysis is based on crash history at individual locations and identified high-crash locations. The systemic approach analyzes crash history on an aggregate basis to identify roadways that have high-crash experience, as well as high-risk characteristics at other sites before crashes occur, so countermeasures can be selected to address these characteristics.

Analyze "Hot Spots" or Crash Cluster Locations

Spot safety analysis involves mapping the individual locations of crashes over a time period, preferably at least 5 years for pedestrian crash data. Mapping these crashes on a geographic information system (GIS) helps to visually reveal clusters, or "hot spots," of pedestrian crashes. Similarly, using the spot analysis approach may also reveal corridors or areas where pedestrian crashes tend to cluster. Grouping the clusters of crashes identified in the spot location process can show areas of potential pedestrian improvements. These areas may be corridors, roadways that share roadway design features, and/or areas of a similar land use. Figure 4 shows a map of pedestrian crash locations in an area.

Develop a Systemic Analysis Approach

Many areas may have low pedestrian crash rates, but still have a high risk for pedestrian crashes. The agency can identify these sites based on roadway characteristics combined with land use features of the area. The agency may select countermeasures to address these high-risk factors before pedestrian crashes occur.

The systemic analysis can cover different geographies; an agency may choose to analyze for an area of interest or the entire jurisdiction. Systemic analysis considers factors such as inadequate roadway design and traffic control devices, lighting conditions, vehicle speeds, and nearby pedestrian destinations. Combinations of these factors help identify countermeasures to address and prevent pedestrian crashes.

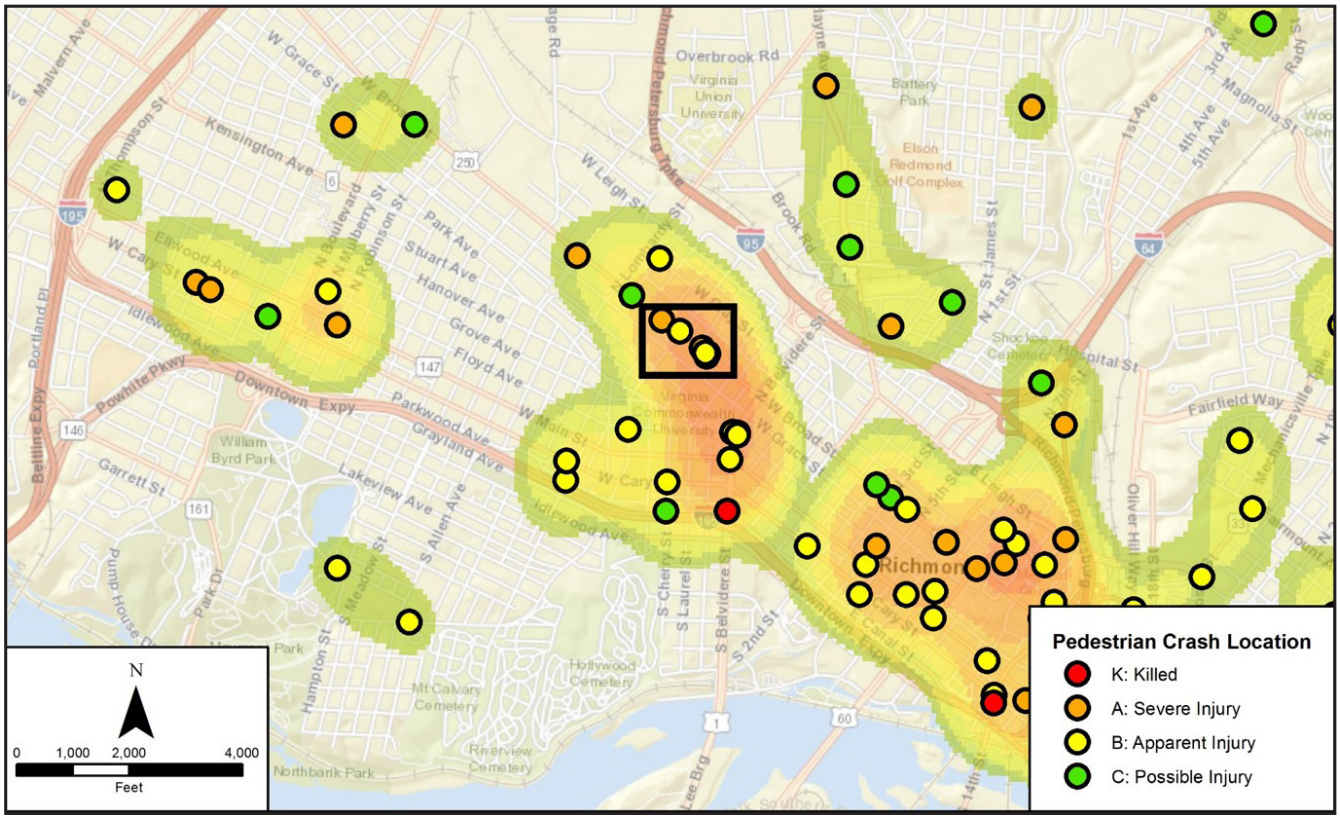

Figure 4. Crash cluster analysis map: Richmond, VA.

Source: Virginia Department of Transportation (2017).

3

Analyze Crash Types and Safety Issues

GUIDING PRINCIPLES

This section describes methods for summarizing pedestrian crash types and observed traffic safety issues. This information is important for selecting countermeasures. The following are important considerations for this step:

» Diagram crashes according to information included on crash reports (see Figure 5 for a sample diagram).

» Review the crash types described by the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE).

» Conduct a pedestrian Road Safety Audit (RSA) to formally engage representatives from various departments and interest groups.

» Lead an informal site visit to engage stakeholders and describe conditions observed in the field.

Diagram Crash Reports

Crash diagrams are created to graphically illustrate crash data associated with a given site. Each crash is plotted on a schematic of the site at the approximate location where the crash occurred. Icons are used to represent crash types so that patterns are identifiable. Spatial analysis tools like GIS can also enhance the analysis. Crash diagrams are sometimes plotted on aerial imagery and cross referenced with a tabular listing of the associated crash data so that agency staff can easily access key information. Crash diagrams are useful when there are many crashes associated with a site. An agency may not have sufficient pedestrian crash history to reveal crash patterns, but the absence of crash data does not necessarily mean a safety problem does not exist. In these cases, an agency should consider systemic analysis.

Identify Crash Factors

Whether an agency is assembling the crash diagrams or simply conducting an exercise to identify potential factors for pedestrian crashes in their jurisdiction, these factors can be considered:

» Vehicle speed.

» Compliance with regulations and traffic devices.

» Pedestrian crossing behaviors.

» Built environment or area type.

- Intersection presence and types of traffic control devices.
- Pedestrian crossing distance.
- Time of day/day of week/seasonal factors.
- Alcohol involvement by pedestrians or drivers.
- Demographics.
- Special populations, such as school-aged children, older adults, and persons with disabilities.
- Presence of transit stops.

Conduct a Road Safety Audit (RSA)

An RSA is the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. An RSA considers all users of the roadway and human factors and generates a formal report and response upon its conclusion. The agency can use the field conditions inventory and crash type summary during the RSA process. RSAs typically produce multiple planning-level countermeasure recommendations for the study corridor or area.

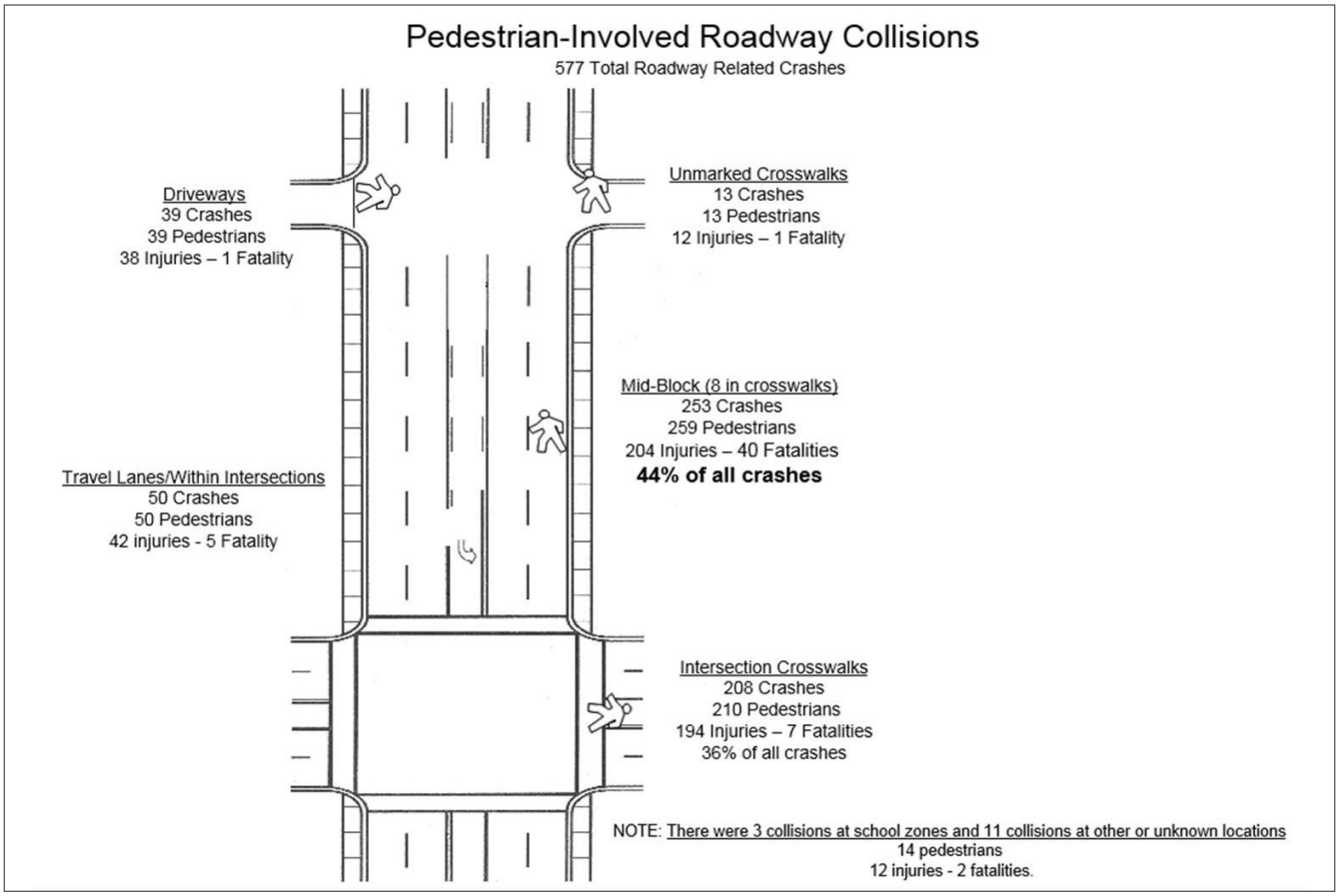

Figure 5. Pedestrian collision summary.

Source: City of Phoenix, AZ. 2015 Pedestrian Collision Summary (2015).

Like traditional RSAs, pedestrian RSAs are performed by a multidisciplinary team of experts or agency representatives, use structured prompt lists, and consider the surrounding socioeconomic and land use context. The materials for a pedestrian RSA provide more detail on pedestrian safety issues and examine elements such as signage, obstructions, signals, bus stop locations, drainage, and lighting. These tools can help identify possible deficiencies in the pedestrian network and potential locations for further investigation.

Lead an Informal Site Visit

An alternative to a formal RSA is an on-site evaluation of pedestrian conditions including representatives from multiple agency departments and stakeholder interest groups. An informal on-site evaluation can collect information about pedestrian crossings and traffic operations at the neighborhood or area-wide scale. Law enforcement, public health, community groups, neighborhood residents, street or transportation departments, planning, emergency response, schools, and public transportation agencies can be involved in the process. The findings from this informal evaluation should be documented and shared with participants.

RESOURCES

FHWA Model Road Safety Audit Policy (2014)

This resource outlines the steps typically taken to conduct an RSA and the roles of the stakeholders. Identifying safety issues is an element of the RSA that is accompanied by suggestions on how to enhance the specific road's safety.

Pedestrian RSA Guidelines and Prompt Lists (2007)

This resource complements practices for RSAs with additional guidance and a field manual for a pedestrian-focused RSA. An RSA team will use the knowledge of a diverse team, analysis of crash data, and a site visit to identify pedestrian safety issues.

Pedestrian RSA Case Studies (2009)

This website provides links to several examples of RSAs focused on identifying pedestrian safety risks and improvement strategies. For example, the City of Tucson, Arizona conducted an RSA of roadways with PHBs to improve the countermeasures' visibility and usability.

PEDSAFE: Pedestrian Crash Typing

PEDSAFE provides definitions for 12 key pedestrian crash types identified by the software package, the Pedestrian and Bicycle Crash Analysis Tool (PBCAT). PBCAT is still used by many agencies but may not be compatible with some current operating systems.

4

Select Countermeasure(s)

GUIDING PRINCIPLES

This section can help the agency select countermeasures based on information previously collected and assessed. The agency can use the following resources to select countermeasures:

» Reference Table 1 to compare roadway and vehicle speed characteristics to countermeasure options.

» Reference Table 2 to compare crash types and other observed safety issues to countermeasure options.

» Review Appendix B for more information about countermeasure CRFs and CMFs.

Application of Countermeasures by Roadway Feature

Table 1 includes a comprehensive matrix and list of STEP pedestrian crash countermeasures suggested for application at uncontrolled crossing locations per roadway and traffic features. The countermeasures are assigned to specific matrix cells based on safety research, best practices, and established national guidelines. When a pedestrian crossing is established, the agency should review the countermeasure options in the cells before selecting the optimal group of crossing treatments. The agency should consider the previously obtained characteristics such as pedestrian volume, operational speeds, land use context, and other site features when selecting countermeasures.

The agency should also reference the MUTCD and other national, State, and local guidelines when making the final selection of countermeasures.

For example, the agency may evaluate a 5-lane road with no raised median, an AADT of 12,000, and a 35 mph posted speed limit. The matrix recommends the agency strongly consider high-visibility crosswalks, adequate lighting, and parking restrictions on the approaches. In addition, the agency should strongly consider adding advance Yield Here To (Stop Here For) Pedestrians signs and yield (stop) lines, pedestrian refuge islands, and PHBs. Other candidate treatments include implementing a Road Diet along the corridor and adding curb extensions.

Table 1. Application of pedestrian crash countermeasures by roadway feature.

Roadway Configuration	Speed Limit								
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
2 lanes*	❶ 2 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼
3 lanes with raised median*	❶ 2 3 4 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ 3 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼
3 lanes w/o raised median†	❶ 2 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼	❶ ❸ 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼
4+ lanes with raised median‡	❶ ❸ 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼
4+ lanes w/o raised median‡	❶ ❸ 5 6 7 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8

*One lane in each direction †One lane in each direction with two-way left-turn lane ‡Two or more lanes in each direction

Given the set of conditions in a cell,

❶ 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 the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

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 restriction on crosswalk approach, adequate nighttime lighting levels
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 Pedestrian Hybrid Beacon
8 Road Diet

This table was developed using information from: Zegeer, C. V., Stewart, J. R., Huang, H. H., Lagerwey, P. A., Feaganes, J., & Campbell, B. J. (2005), Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines (No. FHWA-HRT-04-100); Manual on Uniform Traffic Control Devices, 2009 Edition, Chapter 4F. Pedestrian Hybrid Beacons; the Crash Modification Factors (CMF) Clearinghouse website (http://www.cmfclearinghouse.org/); and the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE) website (http://www.pedbikesafe.org/PEDSAFE/).

Safety Issues Addressed per Countermeasure

The results of the crash analysis, road safety audit, and/or stakeholder input provide the agency with a better understanding of the risk factors at uncontrolled crossing locations. The countermeasures listed in this guide can improve the visibility of crossing locations and reduce crashes, and they each address at least one additional safety concern associated with a higher risk of collision and/or severe injury. These additional safety issues include the following: excessive vehicle speed, inadequate conspicuity/visibility, drivers not yielding to pedestrians in crosswalks, and insufficient separation from traffic.

Table 2 shows the specific safety issues that each countermeasure may address. For example, the addition of PHBs has been consistently shown to improve motorist yielding by 90 percent or greater, when compared with no traffic control or warning type devices.

Table 2. Safety issues addressed per countermeasure.

	Safety Issue Addressed				
Pedestrian Crash Countermeasure for Uncontrolled Crossings	Conflicts at crossing locations	Excessive vehicle speed	Inadequate conspicuity/ visibility	Drivers not yielding to pedestrians in crosswalks	Insufficient separation from traffic
Crosswalk visibility enhancement	✓	✓	✓	✓	✓
High-visibility crosswalk markings*	✓		✓	✓	
Parking restriction on crosswalk approach*	✓		✓	✓	
Improved nighttime lighting*	✓		✓		
Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*	✓		✓	✓	✓
In-Street Pedestrian Crossing sign*	✓	✓	✓	✓	
Curb extension*	✓	✓	✓		✓
Raised crosswalk	✓	✓	✓	✓	
Pedestrian refuge island	✓	✓	✓		✓
Pedestrian Hybrid Beacon	✓			✓	
Road Diet	✓	✓	✓		✓

*These countermeasures make up the STEP countermeasure "crosswalk visibility enhancements." Multiple countermeasures may be implemented at a location as part of crosswalk visibility enhancements.

Countermeasure Descriptions

This subsection describes considerations for implementation of each of the countermeasures included in Tables 1 and 2. The agency can review other guidance—such as the MUTCD, the AASHTO Pedestrian Guide, and/or agency policies and practices—to identify and select countermeasures for implementation.

Crosswalk visibility enhancements

High-visibility crosswalks may include a variety of crosswalk striping designs, such as ladder, continental, or bar pairs. A high-visibility crosswalk is much easier for an approaching motorist to see than the traditional parallel lines. The agency should strongly consider providing high-visibility crosswalks at all established midblock pedestrian crossings. The high-visibility markings may be supplemented with the pedestrian crossing warning signs (sign W11-2 in the MUTCD) on each approach to the crosswalk. MUTCD Section 2C.50—*Non Vehicular Warning Signs* and Section 3B.18—*Crosswalk Markings* provide additional information.

The agency should also strongly consider implementing parking restrictions on the crosswalk approach at all established pedestrian crossings (both approaches) so there is adequate sight distance for motorists on the approaches to the crossings and ample sight distance for pedestrians attempting to cross. The minimum setback is 20 feet where speeds are 25 mph or less, and 30 feet between 26 mph and 35 mph. If this cannot be done, the curbs should be "bulbed out" to allow the pedestrian to see past the parked vehicle along the street. Adjacent bus stops should be placed downstream of the crosswalk and not on the crosswalk approach.

The agency should consider providing an appropriate level of lighting at all established pedestrian crossings. Consideration should be given to placing the lights 10 to 15 feet in advance of the crosswalk on both sides of the street and on both approaches to better light the front of the pedestrian and avoid silhouette lighting (where possible).

In-street Pedestrian Crossing sign

In-street signs are placed in the middle of the road at a crossing and are often used in conjunction with refuge islands. These signs may be appropriate on 2-lane or 3-lane roads with speed limits of 30 mph or less. On higher-speed, higher-volume, and/or multilane roads, this treatment may not be as visually prominent; therefore, it may be less effective (drivers may not notice the signs in time to stop in advance of the crosswalk). For such roadways, more robust treatments will be needed. When making the choice to use these signs, the agency should consider making a plan and securing a funding source for the maintenance and prompt replacement of damaged signs. MUTCD Section 2B.12—*In-Street and Overhead Pedestrian Crossing Signs* contains additional information about these signs.

Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line

Advance Yield Here To (Stop Here For) Pedestrians signs are placed between 30 and 50 feet in advance of the marked crosswalk along with the stop line or "shark's teeth" yield line. This is a candidate treatment for any uncontrolled pedestrian crossing, and should be strongly considered for any established pedestrian crossing on roads with four or more lanes and/or roads with speed limits of 35 mph or greater. Stop

Here For Pedestrians signs should only be used where the law specifically requires that a driver must stop for a pedestrian in a crosswalk. MUTCD Section 2B.11—*Yield Here To Pedestrians Signs and Stop Here For Pedestrians Signs* and Section 3B.16—*Stop and Yield Lines* contain additional information.

Curb extension

A curb extension or "bulbout" extends the sidewalk or curb line into the street or parking lane, thus reducing the street width and improving sight distance between the driver and pedestrian. A curb extension is a candidate treatment for any uncontrolled pedestrian crossing, particularly where parking lanes exist. Curb extensions should not extend into paths of travel for bicyclists.

Raised crosswalk

Raised crosswalks function as an extension of the sidewalk and allow a pedestrian to cross the street at a constant grade. A raised crosswalk is typically a candidate treatment on 2-lane or 3-lane roads with speed limits of 30 mph or less and AADTs below 9,000. Raised crossings are generally avoided on truck routes, emergency routes, and arterial streets. Drainage needs to be accommodated. See MUTCD Section 3B.25—*Speed Hump Markings* for additional information about markings that can be used alongside raised crosswalks.

Pedestrian refuge island

A pedestrian island is typically constructed in the middle of a 2-way street and provides a place for pedestrians to stand and wait for motorists to stop or yield. This countermeasure is highly desirable for midblock pedestrian crossings on roads with four or more lanes, and should be considered for undivided crossings of four or more lanes with speed limits of 35 mph or greater and/or AADTs of 9,000 or greater. Median islands may also be a candidate treatment for uncontrolled pedestrian crossings on 3-lane or 2-lane roads, especially where the street is wide and/or where vehicle speed or volumes are moderate to high. Consideration should be given to creating a two-stage crossing with the island to encourage pedestrians to cross one direction of traffic at a time and look towards oncoming traffic before completing the second part of the crossing. The minimum pedestrian refuge island width is approximately 6 feet. MUTCD Section 3B.10—*Approach Markings for Obstructions*, Section 3B.18—*Crosswalk Markings*, and Section 3B.23—*Curb Markings* provide additional information.

Pedestrian Hybrid Beacons (PHBs)

PHBs are a candidate treatment for roads with three or more lanes that generally have 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 mph. Refer to Table 1 for other conditions where PHBs should be strongly considered. Application guidelines for the PHB are provided in Figure 4F-1 (for speeds of 35 mph or less) and Figure 4F-2 (for speeds greater than 35 mph) of the MUTCD. Chapter 4F—*Pedestrian Hybrid Beacons* provides additional requirements and information about the use of this device. Figure 6 shows a rendering of a PHB.

Road Diet

A frequently-implemented Road Diet involves converting a 4-lane, undivided roadway into a 3-lane roadway with a center turn lane. This is a candidate treatment for any undivided road with wide travel lanes or multiple lanes that can be narrowed or repurposed to improve pedestrian crossing safety.

After conducting a traffic analysis to consider its feasibility, the agency may determine that a Road Diet is a good candidate for use on roads with four or more lanes and traffic volumes of approximately 20,000 or less. In some cases, agencies have successfully implemented Road Diets on roads with AADTs of up to 25,000. By reducing the width of the roadway, pedestrians benefit from shorter crossing distances and often bike lanes or streetscape features can be added. Road Diets are often effectively accomplished during pavement resurfacing.

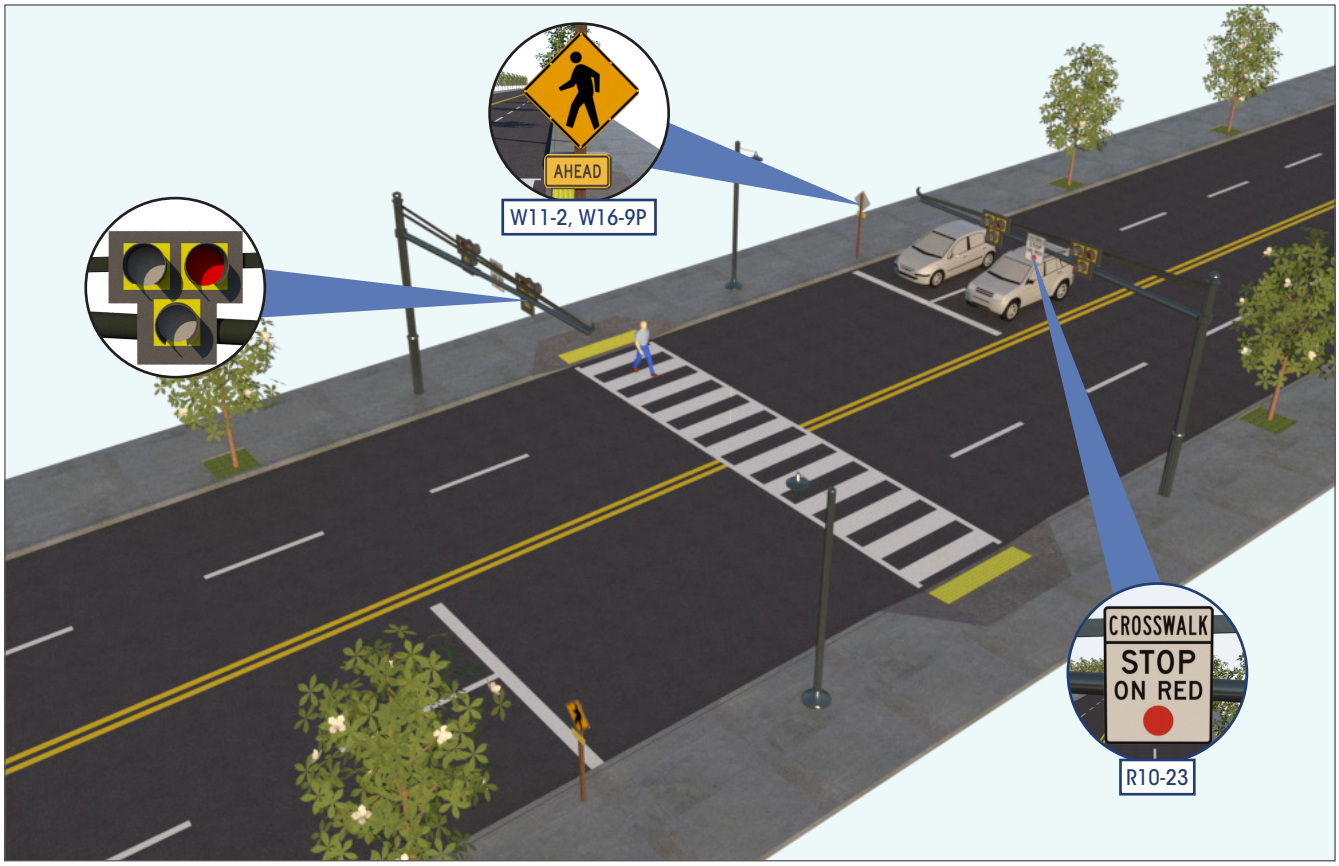

Figure 6. Rendering of a PHB.

Source: FHWA STEP Countermeasure Tech Sheets. (Note: Drawing not to scale.)

RESOURCES

PEDSAFE, Pedestrian Safety Guide and Countermeasure Selection System

This online tool includes links to research studies, crash reduction statistics, and case studies for nearly 70 pedestrian safety countermeasures. Its Countermeasure Selection Tool provides countermeasure recommendations for uncontrolled crossing locations based upon variables such as AADT, vehicle speed, and number of lanes.

Highway Safety Manual

This manual provides detailed guidance for the collection, analysis, and evaluation of roadway crash data, as well as related CMFs and treatment selection guidance.

Manual on Uniform Traffic Control Devices (MUTCD)

This manual provides transportation engineers and planners with detailed guidance for the design and application of traffic control devices, including signage, roadway markings, and intersection controls. Refer to the specific sections of the MUTCD listed in the countermeasure descriptions and consult State-level supplements for additional information.

FHWA Road Diet Desk Reference (2015)

This resource includes sample policy, case studies, and design guidance for agencies and decision-makers considering Road Diets. The benefits of Road Diets include reducing vehicle speeds, reducing number of lanes to cross, and allocating space for pedestrian refuge island.

FHWA Design Resource Index

This resource directs practitioners to the specific location of information about pedestrian and bicycle treatments or countermeasures, across various design guidelines published by organizations such as AASHTO, the Institute of Transportation Engineers, and National Association of City Transportation Officials.

TCRP REPORT 112/NCHRP REPORT 562: Improving Pedestrian Safety at Unsignalized Crossings (2006)

This document recommends treatments to improve safety for pedestrians crossing high-volume, high-speed roadways at unsignalized intersections, with particular focus on roadways served by public transportation.

NHTSA "A Primer for Highway Safety Professionals" (2016)

This resource outlines a comprehensive approach to improving safety for bicyclists and pedestrians and offers a summary of the most frequently used engineering, enforcement, and education safety measures. The resource identifies how certain treatments may be placed in relation to other treatments, such as the coordinated installation of a pedestrian refuge island and lighting.

CMF Clearinghouse

The CMF Clearinghouse is an online database of countermeasures and corresponding CMFs. The database describes the confidence of the study that produced the CMF with an assigned "star quality rating." The clearinghouse includes CMFs for most of the STEP countermeasures.

5

Consult Design and Installation Resources

GUIDING PRINCIPLES

This section identifies additional resources that refine countermeasure options for priority sites. The following are important considerations for this step:

» Consult the MUTCD for recommendations for signage and roadway markings for all countermeasures.

» Review the MUTCD (Part 4) for more considerations, including pedestrian volumes and vehicle operating speeds, for the installation of PHBs.

» Consult local and national design guidance for the preferred width and placement of these countermeasures.

Review Agency Design Guidelines

The agency can review and, if needed, enhance local guidance for traffic engineers and roadway designers to follow when installing countermeasures. The agency's roadway design manual can include details, such as design and installation guidance, for each of the countermeasure options. The agency may also consider creating additional warrant and threshold guidance for countermeasures such as the Road Diet, considering local conditions.

Consult the MUTCD

The agency may focus on three parts of the MUTCD for additional considerations when installing countermeasures:

» Part 2: Signs.

» Part 3: Markings.

» Part 4: Highway Traffic Signals (includes detailed guidance for installing Pedestrian Hybrid Beacons based on traffic speeds, traffic volumes, and pedestrian volumes).

RESOURCE

AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, 1st Edition (2004)

This guide provides recommendations for the planning, design, and operation of accommodations for pedestrians on public rights-of-way. This guide also discusses the impact of land use and site design on pedestrian safety and connectivity.

6

Identify Opportunities and Monitor Outcomes

GUIDING PRINCIPLES

This section describes possible options for funding and implementation of the countermeasures described in this guide. The following are important considerations for this step:

- Review the State's HSIP process for considering and funding pedestrian crossing countermeasures.
- Review local traffic calming and land development policies for opportunities to install pedestrian crossing countermeasures.
- Consider the costs to design, install, and maintain selected countermeasures.
- Collect usage and crash data for at least three years after countermeasures are installed at priority sites.
- Continue to monitor priority sites not funded for countermeasure installation.
- Provide information to the public about planned countermeasure projects. Information should address the safety benefits and possible impacts to traffic operations.

Consider Funding Options

A major consideration when selecting a safety project or program is identifying and securing the funding to design, construct, operate, and maintain the project or program. FHWA, NHTSA, and other Federal agencies distribute funding to States and other jurisdictions for transportation safety projects. If local funding is scarce, agencies may approach the State Departments of Transportation for safety improvement funding consideration. Some projects may require a local match to leverage State or Federal dollars. The agency may consider the following steps:

- Submit high-priority pedestrian crash locations as HSIP projects.
- Consider other State safety funding programs for low-cost pedestrian safety improvements.
- Address gaps in pedestrian accommodations through other State or Federal funding programs such as Transportation Alternatives Program, Congestion Mitigation and Air Quality, and Surface Transportation Block Grant (STBG).

Identify Opportunities for Successful Implementation

The agency can look beyond safety-focused funding programs to help implement countermeasures. By incorporating safety treatments into roadway maintenance or traffic operation projects, the agency can realize cost savings. For example, the agency should consider how resurfacing and operational projects may include countermeasures such as Road Diets and pedestrian crossing signal improvements.

The agency can also engage the community prior to programing the project. The treatments are likely to affect traffic operations, and the public may respond negatively to the change without sufficient notice and education. The agency can develop public education materials describing the benefits and costs of the countermeasures. Law enforcement, pedestrian safety advocates, public health officials, and other community partners may be able to help distribute the materials.

It is important for the agency to work with local partners to coordinate early in the process of designing or improving a roadway to identify opportunities for improved pedestrian crossing safety. If the agency has a Complete Streets policy in place, the policy describes how pedestrian crossing treatments and sidewalks are incorporated into roadway projects. Roadway project design should identify locations and countermeasure options for pedestrian crossings. Developing preliminary cost estimates early for these improvements will help local partners make decisions about funding for pedestrian crossing treatments.

The agency can also work with land developers to incorporate pedestrian crossing treatments into site plans and connecting roadways. Land development policies provide an opportunity to integrate pedestrian and multimodal improvements, connectivity, and accommodations into site plans and nearby roadways. The agency can examine development policies or ordinances for requirements to install sidewalks and pedestrian crossing treatments.

Construct Improvements

The public may have questions about the improvements as construction activities begin. The agency should post information about the improvements and a timeline for construction to a public-facing website and consider issuing a press release about the project. The agency should also provide detailed information to neighbors and business owners impacted by construction activities about the project. Pedestrians will maintain access through the work zone area by way of temporary walkways, curb ramps, and traffic control signage.

The agency may consider phasing in the improvements. For example, a refuge island can be implemented initially by pavement markings and flexible delineators in the center lane. The agency can later add a raised median and appropriate landscaping at the refuge island.

Monitor Results of Implementation

The agency should consider monitoring the impacts of countermeasures per defined performance measures. Specific performance measures can be outlined in plans, such as a PSAP. The PSAP may

also list priority locations and proposed countermeasures.

The first measure of success for a project or program is public support. States and local governments can prepare public information for countermeasures that are new to the community or may change traffic patterns. Public information about the projects may describe the crash history or risks noted at the site, as well as the benefits of the proposed countermeasure.

States and local government can also collect and analyze crash and traffic data related to countermeasure sites for at least 3 years following the installation of the project. This time allows for data to be collected to compare crash rates and severity with the same data collected before the installation. The agency should work with their State HSIP to evaluate projects by continuing to collect data, and it is essential that the treatment installation date be documented. In addition to the safety performance of the treatment, agency staff should consider assessing the durability and life cycle maintenance needs for in-service devices.

In addition to crash data, it is important to collect data on pedestrian volumes, traffic speeds, and interactions between pedestrians and drivers. Pedestrian volume data can help demonstrate the benefits of implementing safety countermeasures. Information about traffic speeds and behaviors also help confirm the effectiveness of installing these countermeasures. As more pedestrian crossing treatments are implemented, State and local agencies can use these data to research the effectiveness of countermeasures and best practices for installation. Evaluation also helps an agency demonstrate the value of the investment in countermeasures to community leaders and the public.

RESOURCES

FHWA Federal-aid Program Administration

This website includes links to guidance for local and State governments administering federally-funded projects, such as those funded by HSIP or STBG.

FHWA Pedestrian and Bicycle Funding Opportunities Summary (2016)

This resource includes a matrix comparing eligibility of various federal transportation funding programs for different types of bicycle and pedestrian projects.

FHWA Guidebook for Developing Pedestrian and Bicycle Performance Measures (2016)

This resource identifies a wide variety of potential metrics for setting goals, prioritizing projects and evaluating outcomes of bicycle and pedestrian plans, including plans for pedestrian safety improvements. Performance measures may include pedestrian levels of service or pedestrian fatality rates.

NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments (2017)

This report describes the safety benefits and CMFs for four types of pedestrian crossing treatments—rectangular rapid flashing beacons, PHBs, pedestrian refuge islands, and advance crosswalk signs and pavement markings.

NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways (2016)

This is a compilation of existing practices regarding the selection and implementation of pedestrian crossing improvements, as well as a literature review of research on more than 25 pedestrian crossing treatments.

NCHRP Report 803: Pedestrian and Bicycle Transportation Along Existing Roads—ActiveTrans Priority Tool Guidebook (2015)

This resource includes an interactive tool and guidance to help agencies prioritize pedestrian and bicycle improvements, including safety projects, either as standalone or incidental to a roadway project.

Glossary

Average Annual Daily Traffic (AADT)

The total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year.

Average Daily Traffic (ADT)

The average 24-hour volume of traffic passing a point or segment of a highway in both directions.

Complete Streets

Complete Streets are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. (Smart Growth America, National Complete Streets Coalition.)

Controlled pedestrian crossing

A pedestrian crossing where motorists are required to stop by either a STOP sign, traffic signal, or other traffic control device.

Crash modification factor (CMF)

A multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure. If available, calibrated or locally developed State estimates may provide a better estimate of effects for the State. (Crash Modification Factors Clearinghouse.)

Crash reduction factor (CRF)

The percentage crash reduction that might be expected after implementing a given countermeasure at a specific site.

Curb extensions

A roadway edge treatment where a curb line is bulbed out toward the middle of the roadway to narrow the width of the street. Curb extensions are sometimes called "neckdowns."

Highway Safety Improvement Program (HSIP)

A Federal-aid program with the purpose to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned roads and roads on tribal land. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads with a focus on performance. (FHWA.)

High visibility crosswalk

A pedestrian crossing location marked by patterns such as zebra, ladder, or continental markings as described by the MUTCD.

Marked crosswalk

A pedestrian crossing that is delineated by white crosswalk pavement markings.

Parking restriction

Parking restriction can include the removal of parking space markings, installation of new "parking prohibition" pavement markings or curb paint, and signs.

Pedestrian Hybrid Beacon (PHB)

A traffic control device with a face that 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.

Raised crosswalk

Raised crosswalks are ramped speed tables spanning the entire width of the roadway, often placed at midblock crossing locations.

Refuge island

A median with a refuge area that is intended to help protect pedestrians who are crossing the road. This countermeasure is sometimes referred to as a crossing island or pedestrian island.

Road Diet

A roadway reconfiguration resulting in a reduction in the number of travel lanes. The space gained by eliminating lanes is typically used for other uses and travel modes. (FHWA.)

Road Safety Audit (RSA)

A formal examination of an existing or future road or intersection by a multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. (FHWA.)

Toward Zero Deaths (TZD)

TZD is a traffic safety framework that seeks to eliminate highway fatalities by engaging diverse safety partners and technology to address traffic safety culture. (See also: Vision Zero.)

Uncontrolled pedestrian crossing

An established pedestrian crossing that does not include a traffic signal, beacon, or STOP sign to require that motor vehicles stop before entering the crosswalk.

Vehicle queue

A line of stopped vehicles in a single travel lane, commonly caused by traffic control at an intersection.

Vision Zero (VZ)

Similar to TZD, Vision Zero is a vision to eliminate traffic fatalities and serious injuries within the transportation system. VZ employs comprehensive strategies to address roadway design, traffic behavior, and law enforcement.

Appendix A: Framework for a Resolution Supporting Pedestrian Safety

Agency policies respond to a need or opportunity, such as pedestrian safety crash and fatality trends. A resolution may help decision-makers, including elected officials or appointed commissioners, better understand the need for pedestrian crash countermeasure policy or design guidance.

The following is a list of possible elements for a local or Statewide resolution in support of a pedestrian crossing policy. These elements may be developed into "Whereas" statements or be included as explanatory text introducing the policy. The list of resolution elements is presented as four categories covering a spectrum of pedestrian safety issues.

1. Example statistics that may raise awareness of pedestrian safety trends.

» Percent pedestrian fatalities of total traffic fatalities.

» Number of total pedestrian crashes/ fatalities per year.

» Percent of pedestrian crashes occurring outside the intersection.

SAMPLE LANGUAGE

"Whereas the number of pedestrian crashes per year and the percent of pedestrian fatalities out of all traffic fatalities in [*State*] demonstrate the need for improved pedestrian safety at roadway crossings…"

2. List of broad issues that agencies commonly consider when discussing pedestrian safety and crash countermeasures.

» Safety is a priority for all road users.

» Crossings are essential to a complete network for pedestrian mobility.

» Pedestrian safety is part of overall quality of life and improved public health.

» Improvements to pedestrian safety often improve safety for all road users.

» Pedestrian countermeasures are genreally lower-cost treatments.

» Many pedestrian crash countermeasures have been evaluated as highly effective.

SAMPLE LANGUAGE

"Whereas [*Agency/State*] recognizes that safety is a priority for all road users, and improvements to pedestrian safety often improve safety for all road users…"

3. List of example planning documents that frequently discuss Statewide pedestrian safety concerns and may include statistics or other compelling reasons for implementing pedestrian crossing treatments.

» State Strategic Highway Safety Plan includes pedestrian safety as an emphasis area.

» State Highway Safety Plan includes pedestrian safety programs or enforcement support.

» State Roadway Design Manual includes guidance for countermeasure design.

» Highway Safety Improvement Program includes safety performance targets for non-motorists.

SAMPLE LANGUAGE

"Whereas [*State*]'s Strategic Highway Safety Plan addresses pedestrian safety as an emphasis area…"

4. List of Statewide opportunities for promoting, planning, and funding the construction of pedestrian crossing treatments.

» Highway Safety Improvement Program includes specific focus or funding for pedestrian crash countermeasures.

» Complete Streets Policy directs the inclusion of pedestrian accommodations as part of other transportation projects.

» Vision Zero or Towards Zero Deaths initiative strives to reduce or eliminate all traffic-related fatalities, including pedestrians.

SAMPLE LANGUAGE

"Whereas [*Agency*]'s Highway Safety Improvement Program includes specific funding for pedestrian crash countermeasures…"

Appendix B: CRF and CMF Summary Table

Table 3. CRFs and CMFs by countermeasure.

Countermeasure	CRF	CMF	Basis	Reference
Crosswalk visibility enhancement[1]	—	—	—	—
Advance STOP/YIELD signs and markings	25%	0.75	Pedestrian crashes[2]	Zegeer, et. al. 2017
Add overhead lighting	23%	0.77	Total injury crashes	Harkey, et. al. 2008
High-visibility marking[3]	48%	0.52	Pedestrian crashes	Chen, et. al., 2012
High-visibility markings (school zone)[3]	37%	0.63	Pedestrian crashes	Feldman, et. al. 2010
Parking restriction on crosswalk approach	30%	0.70	Pedestrian crashes	Gan, et. al., 2005
In-street Pedestrian Crossing sign	UNK	UNK	N/A	N/A
Curb extension	UNK	UNK	N/A	N/A
Raised crosswalk (speed tables)	45%	0.55	Pedestrian crashes	Elvik, et. al., 2004
	30%	0.70	Vehicle crashes	
Pedestrian refuge island	32%	0.68	Pedestrian crashes	Zegeer, et. al., 2017
PHB	55%	0.45	Pedestrian crashes	Zegeer, et. al., 2017
Road Diet – Urban area	19%	0.81	Total crashes	Pawlovich, et. al., 2006
Road Diet – Suburban area	47%	0.53	Total crashes	Persaud, et. al., 2010

[1]This category of countermeasure includes treatments which may improve the visibility between the motorist and the crossing pedestrian.

[2]Refers to pedestrian street crossing crashes, and does not include pedestrians walking along the road crashes or "unusual" crash types.

[3]The effects of high-visibility pavement markings (e.g., ladder, continental crosswalk markings) in the "after" period is compared to pedestrian crashes with parallel line markings in the "before" period.

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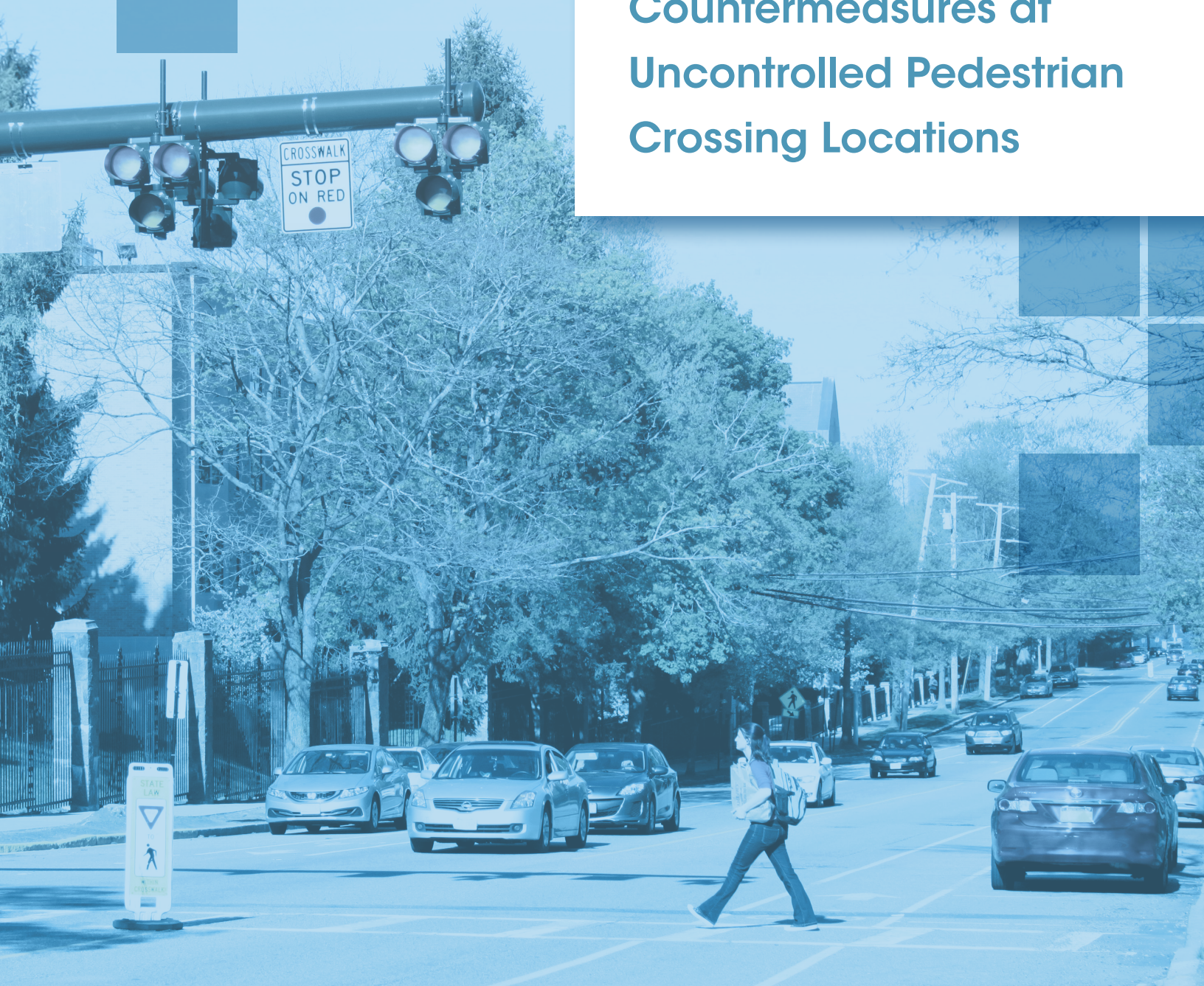
Field Guide for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations



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16. ABSTRACT

This field guide helps agencies select pedestrian crash countermeasures based on criteria established in published literature, best practices, and national guidance. This guide includes a form that the agency may use to document roadway characteristics and pedestrian safety issues. It also includes tables that relate these documented conditions to a specific set of countermeasure options. A series of descriptions lead the agency through additional installation considerations for each countermeasure.

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pedestrian crash countermeasures, uncrontrolled crossings, midblock crossings, Pedestrian Hybrid Beacon, Road Diet, crosswalk visibility enhancements	No restrictions.

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Table of Contents

Introduction

This field guide helps agencies select pedestrian crash countermeasures based on criteria established in published literature, best practices, and national guidance. This guide includes a form that the agency may use to document roadway characteristics and pedestrian safety issues. It also includes tables that relate these documented conditions to a specific set of countermeasure options. A series of descriptions lead the agency through additional installation considerations for each countermeasure.

Countermeasure Selection Tables

The information in this field guide relates to the information in the *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* (FHWA-SA-17-072). That guide describes a comprehensive decision-making process for the installation of pedestrian crossing countermeasures and leads the agency through the following steps in the process:

1. Collect Data and Engage the Public
2. Inventory Conditions and Prioritize Locations
3. Analyze Crash Types and Safety Issues
4. Select Countermeasure(s)
5. Consult Design and Installation Resources
6. Identify Opportunities and Monitor Outcomes

This field guide expands upon the fourth step, Select Countermeasures, for agencies who have an established process for identifying priority locations for countermeasure installation. This step presents two tables for the agency to review to identify potential countermeasures. Table 1, "Application of pedestrian crash countermeasures by roadway feature," compares roadway and vehicle speed characteristics to appropriate options. Table 2, "Safety issues addressed per countermeasure," compares crash types and other observed safety issues to the countermeasures. This field guide contains both tables and instructions for their use.

Countermeasure Descriptions

The field guide focuses on uncontrolled crossing types—where sidewalks or designated walkways intersect a roadway at a location where no traffic control (i.e., traffic signal or STOP sign) is present. The countermeasures described in the guide include the following:

- Crosswalk Visibility Enhancements, including:
  - High-visibility crosswalk markings
  - Parking restriction on crosswalk approach
  - Overhead lighting
  - Advance Yield Here To (Stop Here For) Pedestrians sign and stop or yield line
  - In-Street Pedestrian Crossing sign
  - Curb extension
- Raised crosswalk
- Pedestrian refuge island
- Pedestrian Hybrid Beacon (PHB)
- Road Diet

The field guide includes a description for each of the countermeasures. The descriptions present additional design and installation considerations, such as references to the Manual on Uniform Traffic Control Devices (MUTCD).

Sample Inventory Form

On this example inventory form, the agency records information about roadway conditions and safety issues important to selecting countermeasures for uncontrolled crossing locations. The information added to this form is applied in Tables 1 and 2. Some information, such as pedestrian volume data, is used when reviewing MUTCD guidance for countermeasures such as the PHB.

Roadway Conditions Inventory

Speed Limit

☐ ≤ 30 mph ☐ 35 mph ☐ ≥ 40 mph

Total Vehicles per Day

Annual Average Daily Traffic (AADT): _____

Approximate Vehicles per Hour (VPH): _____

☐ AADT < 9,000
☐ AADT 9,000–15,000
☐ AADT > 15,000

Travel Lane Configuration

☐ 2 lanes without raised median
☐ 3 lanes without raised median
☐ 3 lanes with raised median
☐ 4+ lanes without raised median
☐ 4+ lanes with raised median

Crosswalk Length (feet): _____

Approximate Total Pedestrians per Hour (PPH) Crossing the Roadway: _____

Pedestrian Safety Issues Inventory

Noted conflicts at crossing locations ☐ Yes ☐ No

» History of turning movement crashes
» Observed conflicts at permitted crossings

Excessive vehicle speed ☐ Yes ☐ No

» 85th percentile speeds, per speed study
» History of speed-related crashes

Inadequate conspicuity/visibility ☐ Yes ☐ No

» Dim or dark conditions for pedestrians in the crosswalk
» Limited visibility of crosswalk due to roadway curvature or topography
» Obstructions, such as on-street parking, vegetation, and signage

Drivers not yielding to pedestrians in crosswalks ☐ Yes ☐ No

» Crash history in marked crosswalks

Insufficient separation between pedestrians and traffic ☐ Yes ☐ No

» Long crossing distance
» No buffer (e.g., landscape buffer, on-street parking, bike lanes)

Table 1 Instructions

1 Select the column that represents the target location's speed limit and vehicle AADT.

2 Select the row that represents the target location's roadway configuration.

3 The cell at the intersection of the column from step 1 and the row from step 2 contains numbers representing countermeasures.

4 Refer to the table legend for a list of countermeasures. Numbers in dark circles represent countermeasures that should be considered at the location. Other numbers in the cell are candidates.

Roadway Configuration	Speed Limit								
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
2 lanes*	❶ 2 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼
3 lanes with raised median*	❶ 2 3 4 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ 3 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼
3 lanes w/o raised median†	❶ 2 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼	❶ ❸ 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼
4+ lanes with raised median‡	❶ ❸ 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼
4+ lanes w/o raised median‡	❶ ❸ 5 6 7 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8

*One lane in each direction †One lane in each direction with two-way left-turn lane ‡Two or more lanes in each direction

Given the set of conditions in a cell,

❶ 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 the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

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 restriction on crosswalk approach, adequate nighttime lighting levels
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 Pedestrian Hybrid Beacon
8 Road Diet

This table was developed using information from: Zegeer, C. V., Stewart, J. R., Huang, H. H., Lagerwey, P. A., Feaganes, J., & Campbell, B. J. (2005), Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines (No. FHWA-HRT-04-100); Manual on Uniform Traffic Control Devices, 2009 Edition, Chapter 4F. Pedestrian Hybrid Beacons; the Crash Modification Factors (CMF) Clearinghouse website (http://www.cmfclearinghouse.org/); and the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE) website (http://www.pedbikesafe.org/PEDSAFE/).

Table 1: Application of Pedestrian Crash Countermeasures by Roadway Feature

Table 1 identifies suggested countermeasures for uncontrolled crossing locations according to roadway and traffic features. Review the corresponding worksheets for countermeasures considered for the site. The worksheets describe additional design and installation considerations for the countermeasures.

Roadway Configuration	Speed Limit								
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
2 lanes*	❶ 2 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼
3 lanes with raised median*	❶ 2 3 4 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ 3 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼
3 lanes w/o raised median†	❶ 2 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼	❶ ❸ 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼
4+ lanes with raised median‡	❶ ❸ 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼
4+ lanes w/o raised median‡	❶ ❸ 5 6 7 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8

*One lane in each direction †One lane in each direction with two-way left-turn lane ‡Two or more lanes in each direction

Given the set of conditions in a cell,

❶ 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 the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

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 restriction on crosswalk approach, adequate nighttime lighting levels
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 Pedestrian Hybrid Beacon
8 Road Diet

This table was developed using information from: Zegeer, C. V., Stewart, J. R., Huang, H. H., Lagerwey, P. A., Feaganes, J., & Campbell, B. J. (2005), Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines (No. FHWA-HRT-04-100); Manual on Uniform Traffic Control Devices, 2009 Edition, Chapter 4F. Pedestrian Hybrid Beacons; the Crash Modification Factors (CMF) Clearinghouse website (http://www.cmfclearinghouse.org/); and the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE) website (http://www.pedbikesafe.org/PEDSAFE/).

Table 2 Instructions

1. Select the columns representing the priority safety issues at the location.

2. Use the rows to identify pedestrian crash countermeasures that address these safety issues at uncontrolled crossings.

Pedestrian Crash Countermeasure for Uncontrolled Crossings	Safety Issue Addressed				
	Conflicts at crossing locations	Excessive vehicle speed	Inadequate conspicuity/ visibility	Drivers not yielding to pedestrians in crosswalks	Insufficient separation from traffic
Crosswalk visibility enhancement	🚶	🚶	🚶	🚶	🚶
High-visibility crosswalk markings*	🚶		🚶	🚶	
Parking restriction on crosswalk approach*	🚶		🚶	🚶	
Improved nighttime lighting*	🚶		🚶		
Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*	🚶		🚶	🚶	🚶
In-Street Pedestrian Crossing sign*	🚶	🚶	🚶	🚶	
Curb extension*	🚶	🚶	🚶		🚶
Raised crosswalk	🚶	🚶	🚶	🚶	
Pedestrian refuge island	🚶	🚶	🚶		🚶
Pedestrian Hybrid Beacon	🚶			🚶	
Road Diet	🚶	🚶	🚶		🚶

*These countermeasures make up the STEP countermeasure "crosswalk visibility enhancements." Multiple countermeasures may be implemented at a location as part of crosswalk visibility enhancements.

Table 2: Safety Issues Addressed per Countermeasure

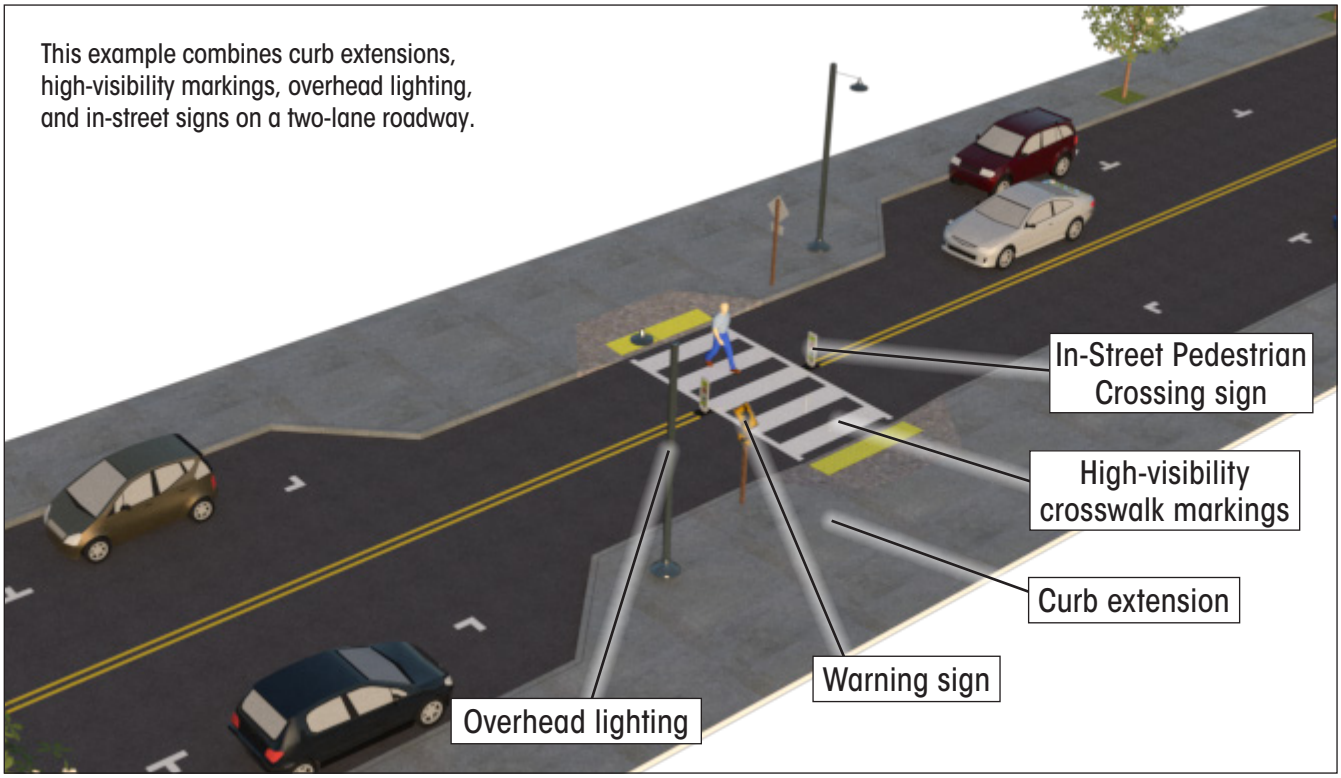
Table 2 identifies the safety issues that may be addressed by suggested countermeasures for uncontrolled crossing locations. Review the corresponding worksheets for countermeasures considered for the site. The worksheets describe additional design and installation considerations for the countermeasures.

	Safety Issue Addressed				
Pedestrian Crash Countermeasure for Uncontrolled Crossings	Conflicts at crossing locations	Excessive vehicle speed	Inadequate conspicuity/ visibility	Drivers not yielding to pedestrians in crosswalks	Insufficient separation from traffic
Crosswalk visibility enhancement	✓	✓	✓	✓	✓
High-visibility crosswalk markings*	✓		✓	✓	
Parking restriction on crosswalk approach*	✓		✓	✓	
Improved nighttime lighting*	✓		✓		
Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*	✓		✓	✓	✓
In-Street Pedestrian Crossing sign*	✓	✓	✓	✓	
Curb extension*	✓	✓	✓		✓
Raised crosswalk	✓	✓	✓	✓	
Pedestrian refuge island	✓	✓	✓		✓
Pedestrian Hybrid Beacon	✓			✓	
Road Diet	✓	✓	✓		✓

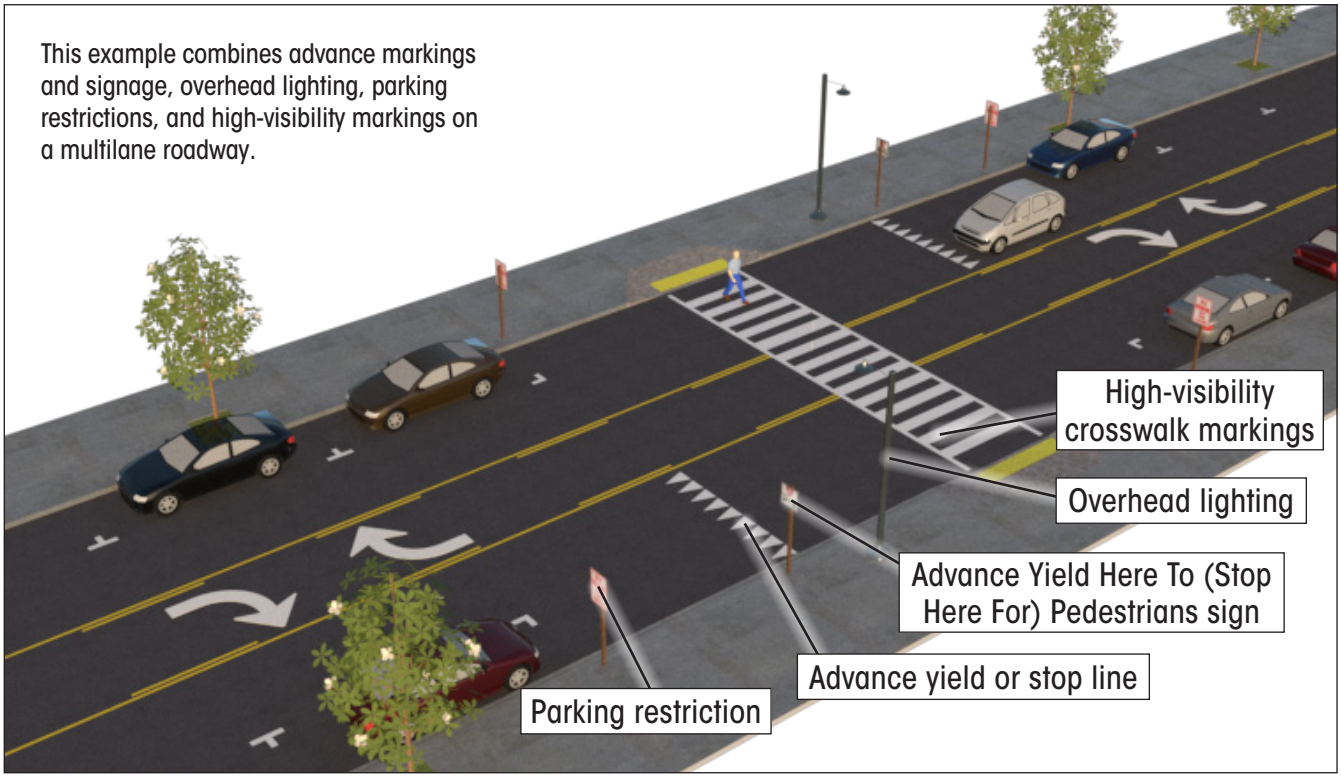
*These countermeasures make up the STEP countermeasure "crosswalk visibility enhancements." Multiple countermeasures may be implemented at a location as part of crosswalk visibility enhancements.

Countermeasure: Crosswalk Visibility Enhancements

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



This example combines advance markings and signage, overhead lighting, parking restrictions, and high-visibility markings on a multilane roadway.



Definition

This group of countermeasures includes high-visibility crosswalk markings, improved nighttime lighting, advance or in-street warning signage, curb extensions, and parking restrictions. These features may be used in combination to indicate preferred locations for people to cross, to increase visibility of the crossing location, and to help reinforce the driver requirement to yield the right-of-way to pedestrians at crossing locations. Refer to the Crosswalk Visibility Enhancements Tech Sheet for more information about this set of countermeasures.

Roadway and Site Information

Strongly consider the following countermeasures at all established midblock or intersection uncontrolled crossing locations:

- High-visibility crosswalk markings
- Overhead lighting
- On-street parking restrictions or curb extensions

  Note: On roadways with 4 or more lanes and more than 9,000 vehicles per day, the risk for pedestrian crashes could increase if marked crosswalks are not combined with other treatments, such as refuge islands or Pedestrian Hybrid Beacons.

Strongly consider adding advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line if the roadway(s) are described by one of the following sets of conditions:

- ☐ Any AADT + 4 or more lanes (with or without a raised median) + any speed limit
- ☐ Any AADT + any number of lanes + ≥ 35 mph speed limit

Safety Issues and Behaviors

This countermeasure may help address most traffic behaviors or safety issues but are most needed when the following are observed at the site:

- ☐ Drivers not yielding to pedestrians in crosswalks
- ☐ Inadequate conspicuity/visibility of the crosswalk and pedestrian
- ☐ Noted conflicts at crossing locations

Additional Installation and Design Guidelines

Crosswalk Markings

- High-visibility crosswalks may include a variety of crosswalk striping designs, such as ladder, continental, or bar pairs.
- High-visibility markings may be supplemented with the pedestrian crossing warning signs (sign W11-2 in the MUTCD) on each approach to the crosswalk.
- See MUTCD Section 2C.50 for more information about Non-Vehicular Warning Signs and Section 3B.18 for more information about crosswalk markings.
- Adjacent bus stops should be placed downstream of the crosswalk and not on the crosswalk approach.

Overhead Lighting

- Overhead lights placed in advance of uncontrolled crossings on both approaches illuminate the front of the pedestrian and avoid creating a silhouette.
- Consider placing the light fixtures 10 to 15 feet in advance of the crosswalk on both sides of the street.

Parking Restrictions and Curb Extensions

- Parking restrictions can include the removal of parking space markings or the installation of "no parking" signs or pavement markings.
- The minimum setback for parking restrictions is 20 feet in advance of the crosswalk where speeds are 25 mph or less, and 30 feet in advance of the crosswalk where speeds are between 26 and 35 mph.
- Curb extensions must not extend into travel lanes and should not block bicycle lanes.

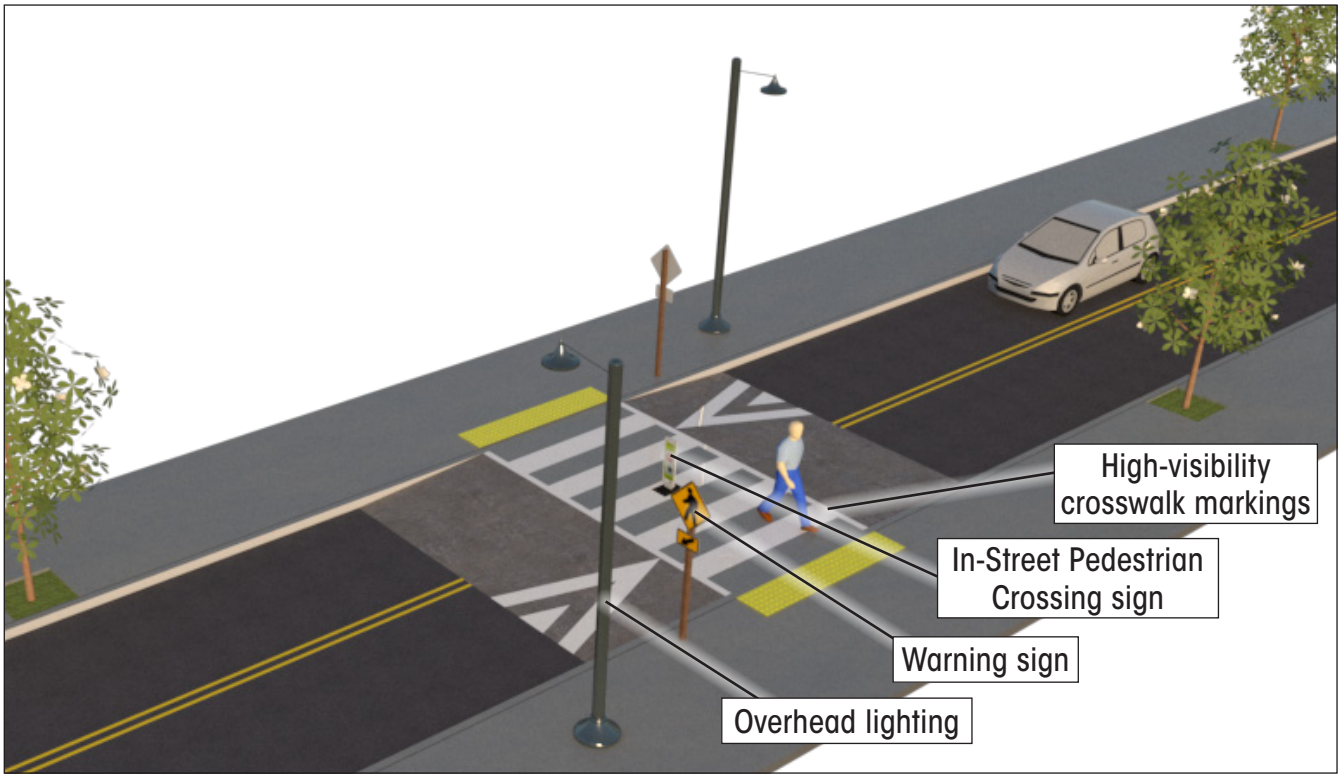
Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line

- The stop line or "shark's teeth" yield line is 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 Yield Here To (Stop Here For) Pedestrians sign.
- Stop Here for Pedestrians signs should only be used where the law specifically requires that a driver must stop for a pedestrian in a crosswalk. Otherwise, Yield Here for Pedestrians signs should be used with shark's teeth pavement markings.
- See MUTCD Section 2B.11 for more information about Yield Here To (Stop Here For) Pedestrians signs and Section 3B.16 for more information about stop and yield lines.

In-Street Pedestrian Crossing Sign

- The In-Street Pedestrian Crossing sign can be placed in between travel lanes or in conjunction with a refuge island or raised median.
- Consider maintenance and prompt replacement of damaged in-street (and all other) signs.
- See MUTCD Section 2B.12 for more information about In-Street Pedestrian Crossing signs.

Countermeasure: Raised Crosswalk



Definition

Raised crosswalks are ramped speed tables spanning the entire width of the roadway, often placed at midblock crossing locations. Refer to the Raised Crosswalks Tech Sheet for more information about this countermeasure.

Roadway and Site Information

Consider this countermeasure for 2 or 3 lane roadways also described by the following conditions:

- ☐ AADT less than 9,000 + ≤ 30 mph speed limit

Safety Issues and Behaviors

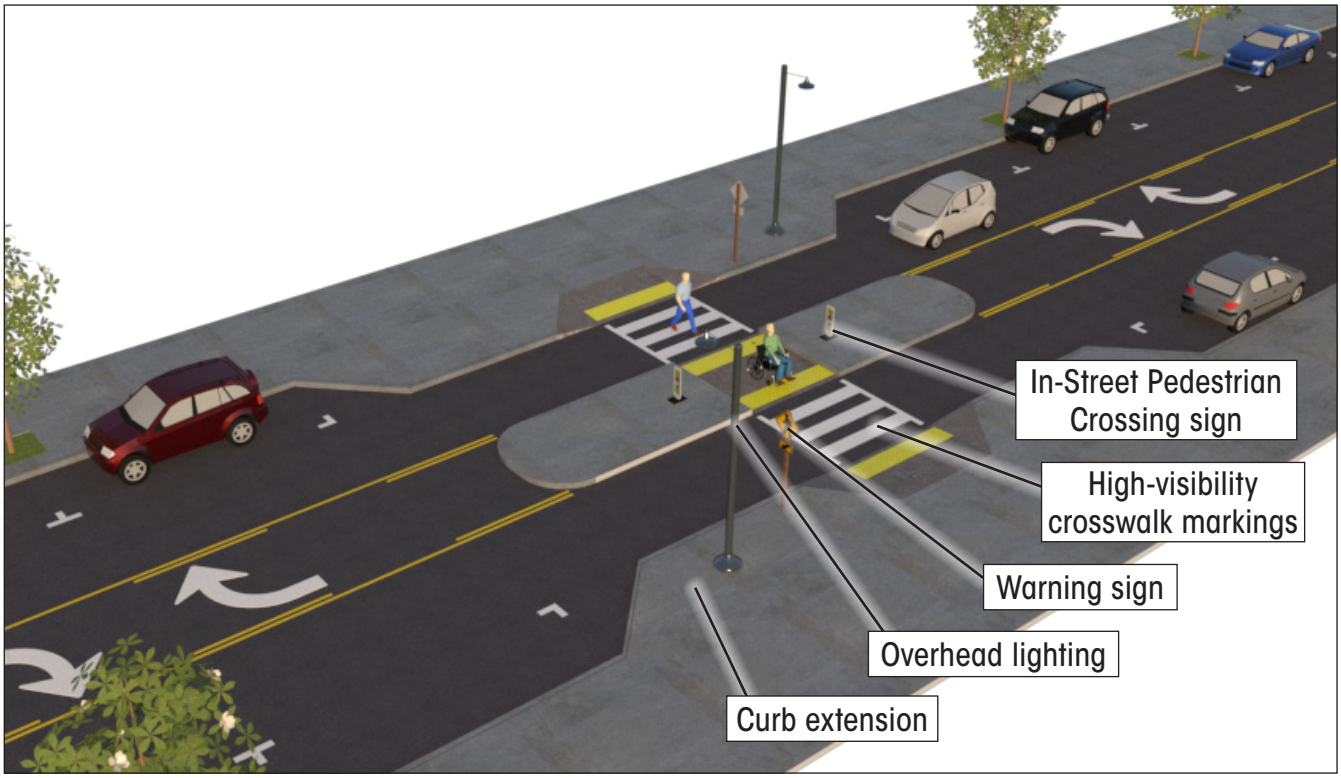
This countermeasure may help address the following traffic behaviors or safety issues observed at the site:

- ☐ Inadequate conspicuity/visibility
- ☐ Excessive vehicle speed

Installation and Design Guidelines

- Raised crosswalks may be installed with curb extensions and on-street parking.
- Raised crosswalks may also be used at intersections, particularly at the entrance of the minor street.
- Raised crosswalks should be 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 should be installed at the street edge for pedestrians with impaired vision.
- Raised crossings are generally avoided on arterial streets and primary routes for heavy trucks, bus transit, and emergency response vehicles.
- Consider storm water drainage and snowplowing in the design of the raised crosswalk.
- See MUTCD Section 3B.25 for information about Speed Hump Markings and other markings that can be used with raised crosswalks.

Countermeasure: Pedestrian Refuge Island



Definition

A pedestrian refuge island is a median with a refuge area that is intended to help protect pedestrians who are crossing the road. This countermeasure is sometimes referred to as a crossing island or pedestrian island. Refer to the Pedestrian Refuge Island Tech Sheet for more information about this countermeasure.

Roadway and Site Information

Consider this countermeasure for established pedestrian crossings at all 2 or 3 lane roadways without a raised median.

Strongly consider this countermeasure if the roadway(s) are described by one of the following sets of conditions:

- ☐ AADT of at least 9,000 + 4 or more lanes without a raised median + any speed limit
- ☐ Any AADT + 4 or more lanes without a raised median + ≥ 35 mph speed limit

Safety Issues and Behaviors

This countermeasure may help address all traffic behaviors or safety issues but is most effective where the following are observed at the site:

- ☐ Inadequate conspicuity/visibility
- ☐ Excessive vehicle speed
- ☐ Insufficient pedstrian separation from traffic

Installation and Design Guidelines

» Consideration should be given to creating a two-stage crossing. The island can encourage pedestrians to cross one direction of traffic at a time and look towards oncoming traffic before completing the second part of the crossing.

» Pedestrian refuge 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 of the island must include detectable warnings if island width is at least 6 feet.

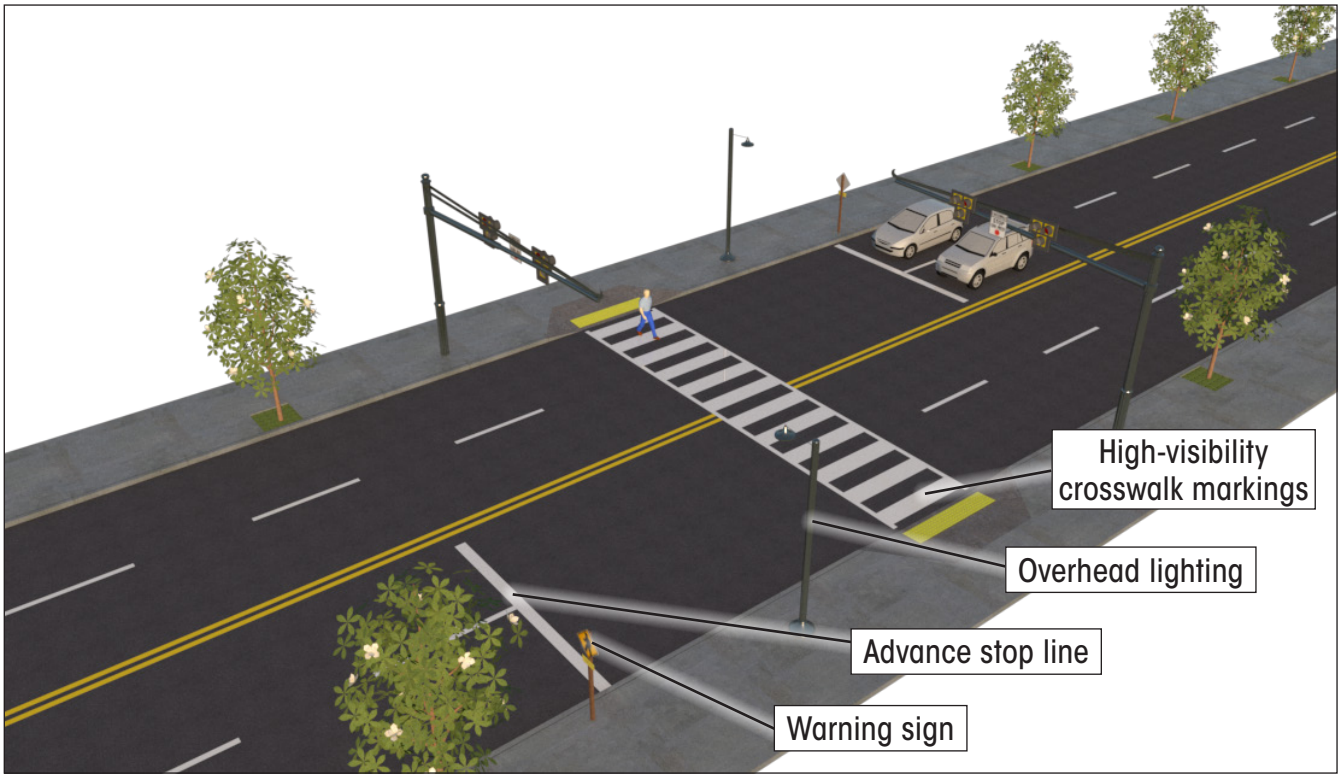
» Refuge islands should be illuminated or highlighted with street lights, signs, and/or reflectors to ensure that they are visible to motorists.

» See MUTCD Section 3B for more information about the following for refuge islands:

- Section 3B.10 - Approach Markings for Obstructions
- Section 3B.18 - Crosswalk Markings
- Section 3B.23 - Curb Markings

» If applicable, evaluate the impact of the island on bicycle facility design.

Countermeasure: Pedestrian Hybrid Beacon (PHB)



Definition

A PHB is a hybrid beacon used to control traffic and 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 when pedestrians should cross and when it is safe for drivers to proceed. Refer to the PHB Tech Sheet for more information about this countermeasure.

Roadway and Site Information

Strongly consider this countermeasure if the roadway(s) are described by one of the following sets of conditions:

- ☐ AADT of at least 15,000 + 4 or more lanes + any speed limit
- ☐ AADT of at least 9,000 + 3 or more lanes (with or without median) + ≥ 35 mph speed limit
- ☐ Any AADT + any number of lanes + ≥ 40 mph speed limit

Safety Issues and Behaviors

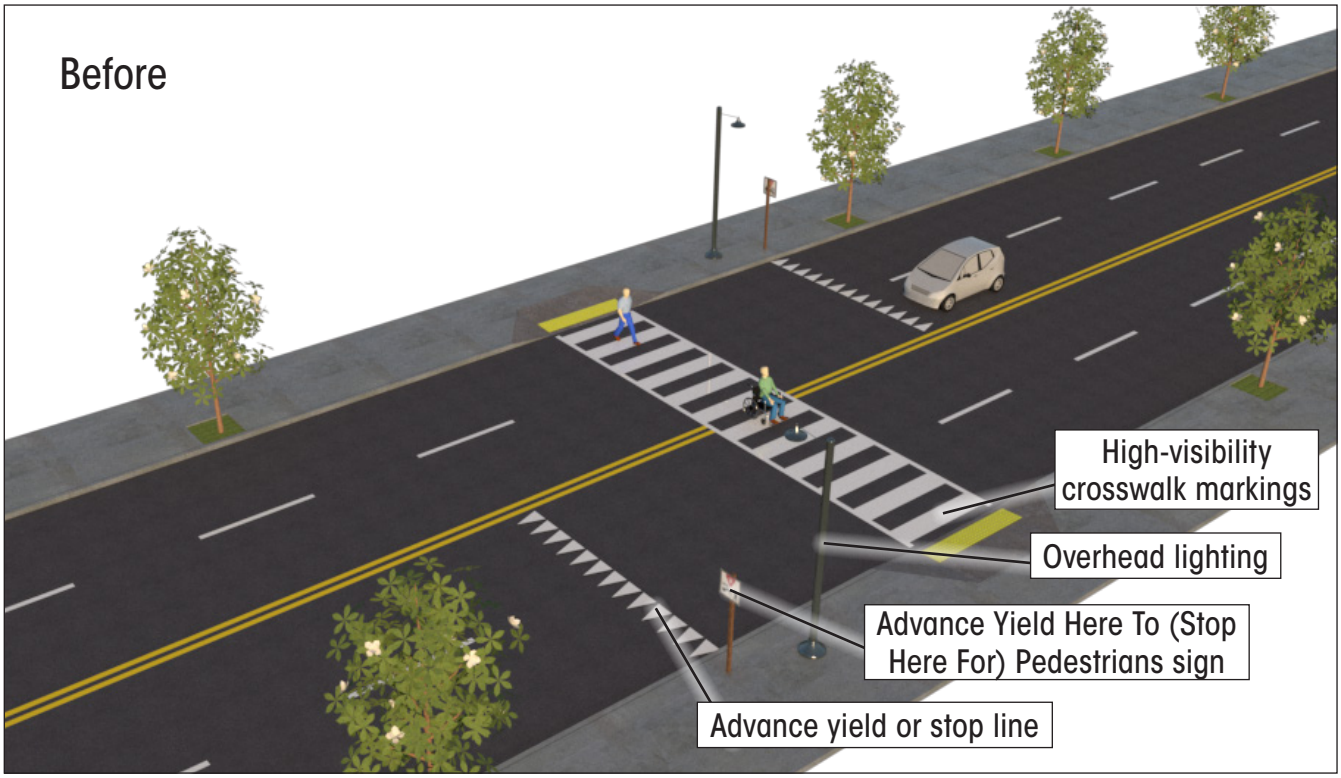
This countermeasure may help address the following traffic behaviors or safety issues observed at the site:

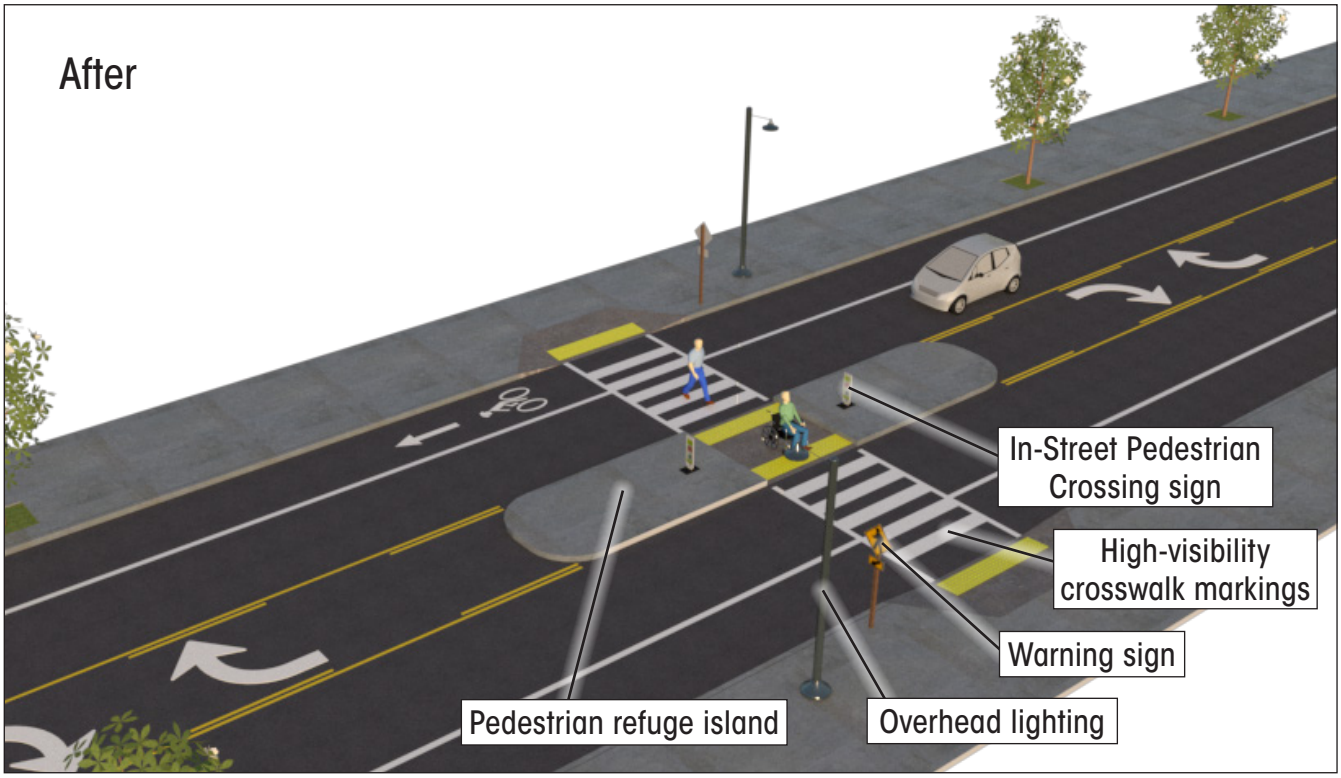
- ☐ Drivers not yielding to pedestrians in crosswalks
- ☐ Noted conflicts at crossing locations

Additional Installation and Design Guidelines

- Use in conjunction with signs and pavement markings at locations where pedestrians enter or cross the roadway.
- Only install a PHB at a marked crosswalk.
- For roadways with speeds of 35 mph or less, see *MUTCD Figure 4F-1*. For roadways speeds greater than 35 mph, see *MUTCD Figure 4F-2*. These charts compare crosswalk length, approximate vehicles per hour (VPH, including both approaches), and pedestrians per hour (PPH). The MUTCD recommends installation of a PHB where these conditions meet minimum criteria.
- The PHB should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs.
- Parking should be prohibited and other sight obstructions should be removed at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk and PHB.
- The PHB should be coordinated if within a signal system.
- Review the MUTCD Part 4F for more information about the design and operation of the beacon face and the installation of optional signage.

Countermeasure: Road Diet





Definition

A Road Diet is a roadway reconfiguration resulting in a reduction in the number of travel lanes, which is usually achieved by converting a four-lane undivided road to three lanes. The space gained by eliminating lanes is typically used for other uses and travel modes. Refer to the Road Diet Tech Sheet for more information about this countermeasure.

Roadway and Site Information

Consider this countermeasure for all roadways with four or more lanes without a raised median.

Typically, Road Diets are considered for roadways with current and future average daily traffic (ADT) equal to or less than about 20,000.

Safety Issues and Behaviors

This countermeasure may help address the following traffic behaviors or safety issues observed at the site:

- ☐ Conflicts at crossing locations
- ☐ Excessive vehicle speeds
- ☐ Insufficient pedestrian separation from traffic

Additional Installation and Design Guidelines

Refer to the FHWA's Road Diet Informational Guide for a range of additional design considerations, including:

- » Vehicle speed
- » Level of Service (LOS)
- » Quality of Service
- » Operation and volume of pedestrians, bicyclists, transit, and freight
- » Peak hour and peak direction traffic flow
- » Vehicle turning volumes and patterns
- » Frequency of stopping and slow-moving vehicles
- » Presence of parallel roadways

FHWA-SA-18-018

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Process for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations

This process follows the steps outlined in the *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* (FHWA-SA-17-072). Each numbered step includes multiple options and components below for agencies to consider; these options are not necessarily sequential, and the agency does not need to complete all activities within each step. Underlined text in the flowchart indicates a hyperlink to an online resource containing additional information.

1 Collect data and engage the public

- **Collect pedestrian crash and safety data**
  - Location and conditions
  - Crash maps
  - Crash reports
- **Review existing traffic safety plans**
  - SHSP
  - HSIP
  - HSP
- **Evaluate pedestrian accommodation and traffic safety policies**
  - Complete Streets
  - Vision Zero
- **Initiate a PSAP**
- **Review pedestrian master plans for proposed projects**
- **Document informal public comments**
- **Conduct a walkability audit**

2 Inventory conditions and prioritize locations

- **Inventory pedestrian crossings and observed traffic behavior**
- **Classify pedestrian crossings**
  - Controlled
  - Uncontrolled
- **Inventory roadway characteristics**
- **Screen the network for high-crash or high-risk locations**
  - Analyze "hot spots" or crash cluster locations
  - Develop a systemic analysis approach

3 Analyze crash types and safety issues

- **Diagram crash reports**
- **Identify crash factors**
- **Conduct an RSA**
- **Lead an informal site visit**

4 Select countermeasures

- **Review Table 1 (roadway features)**
  - AADT
  - Number of lanes
  - Median presence
  - Speed limit
- **Review Table 2 (safety issues)**
  - Conflicts at crossings
  - Excessive speed
  - Visibility issues
  - Other

5 Consult design and installation resources

- **MUTCD**
  - Part 2: Signs
  - Part 3: Markings
  - Part 4: Highway Traffic Signals
- **AASHTO Guide for the Design of Pedestrian Facilities**
- **Local design guidance and selection criteria**
  - PEDSAFE
  - Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

6 Identify opportunities and monitor outcomes

- **Identify implementation opportunities**
  - Routine maintenance activities
  - STIP
- **Consider funding options**
  - HSIP
  - Other (TAP, CMAQ, STBG)
- **Construct improvements**
  - Review design considerations
  - Conduct public outreach
- **Monitor results of implementation**
  - Track performance measures
  - Obtain public feedback
  - Analyze crash data

Abbreviations:

AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
CMAQ	Congestion Mitigation and Air Quality
HSIP	Highway Safety Improvement Program
HSP	Highway Safety Plan
MUTCD	*Manual on Uniform Traffic Control Devices*
PSAP	Pedestrian Safety Action Plan
RSA	Road Safety Audit
SHSP	Strategic Highway Safety Plan
STBG	Surface Transportation Block Grant
STIP	State Transportation Improvement Program
TAP	Transportation Alternatives Program

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Safe Roads for a Safer Future
Investment in roadway safety saves lives

EDC every day counts

EDC-4 Safe Transportation for Every Pedestrian: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

every day counts
An Innovation Partnership with States

Safe Transportation for Every Pedestrian (STEP)




Cost-effective countermeasures with known safety benefits can help reduce pedestrian fatalities at uncontrolled crossing locations and un-signalized intersections.

Pedestrians account for over 17.5 percent of all fatalities in motor vehicle traffic crashes, and the majority of these deaths occur at uncontrolled crossing locations such as mid-block or un-signalized intersections. These are among the most common locations for pedestrian fatalities generally because of inadequate pedestrian crossing facilities and insufficient or inconvenient crossing opportunities, all of which create barriers to safe, convenient, and complete pedestrian networks.

Expecting pedestrians to travel significantly out of their way to cross a roadway to reach their destination is unrealistic and counterproductive to encouraging healthier transportation options. By focusing on uncontrolled locations, agencies can address a significant national safety problem and improve quality of life for pedestrians of all ages and abilities.

Knowing how to determine good crossing locations and which countermeasures to use enables highway agencies and other organizations to increase pedestrian safety.

PEDESTRIAN SAFETY COUNTERMEASURES

FHWA is promoting the following pedestrian safety countermeasures through the fourth round of Every Day Counts (EDC-4):

- **Road Diets** can reduce vehicle speeds and the number of lanes pedestrians cross, and they can create space to add new pedestrian facilities.
- **Pedestrian hybrid beacons (PHBs)** are a beneficial intermediate option between enhanced pedestrian signage and a full pedestrian signal. They provide positive stop control at locations with the high pedestrian traffic volumes.
- **Pedestrian refuge islands** allow pedestrians a safe place to stop at the midpoint of the roadway before crossing the remaining distance. This is particularly helpful for older pedestrians or others with limited mobility.
- **Raised crosswalks** can reduce vehicle speeds.
- **Crosswalk visibility enhancements**, such as crosswalk lighting and enhanced signing and marking, help drivers detect pedestrians—particularly at night.

STATE OF THE PRACTICE

Road Diets, pedestrian refuge islands, and PHBs are all considered Proven Safety Countermeasures by the Federal Highway Administration (FHWA). The FHWA is also promoting Road Diets through EDC-3.

Communities benefitting from their use include Austin, Texas, where at least 39 PHBs are already installed and residents can request additional sites for them. In Michigan, the Department of Transportation (DOT) developed a Road Diets checklist to ensure smooth administrative procedures.

Safe Transportation for Every Pedestrian (STEP)

Countermeasures such as crosswalk lighting and raised crosswalks are being promoted through FHWA's PEDSAFE, a tool that helps transportation agencies diagnose and treat pedestrian safety issues. PEDSAFE includes numerous case studies that describe how communities across the country have implemented these safety improvements.

This EDC-4 effort will help more communities deploy these pedestrian safety improvements based on their specific roadway contexts and needs. It also aligns with U.S. DOT's Safer People, Safer Streets initiative and with other U.S. DOT efforts such as Ladders of Opportunity, which aims to provide people with safe, reliable and affordable connections to employment, education, healthcare and other essential services. STEP is also an important action in FHWA's *Strategic Agenda for Pedestrian and Bicycle Transportation*, which is a collaborative framework for pedestrian and bicycle planning, design, and research efforts being developed over the next five years.

BENEFITS

- **Improved Safety.** Countermeasures are available that offer proven solutions for reducing pedestrian fatalities at uncontrolled crossing locations.
- **Targeted Investment.** By focusing on uncontrolled locations, agencies can address a significant national pedestrian safety problem.
- **Enhanced Quality of Life.** Improving crossing opportunities boosts quality of life for pedestrians of all ages and abilities.

RESOURCES

EDC-4 STEP: *https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm*

FHWA Proven Safety Countermeasures: *http://safety.fhwa.dot.gov/provencountermeasures/*

Pedestrian and Bicycle Information Center: *http://www.pedbikeinfo.org*

EDC-4 Summit Breakout Session: Fall 2016 *https://www.youtube.com/watch?v=xSN9JqjGmow*

For additional information, please contact:

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Peter Eun
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Peter.Eun@dot.gov

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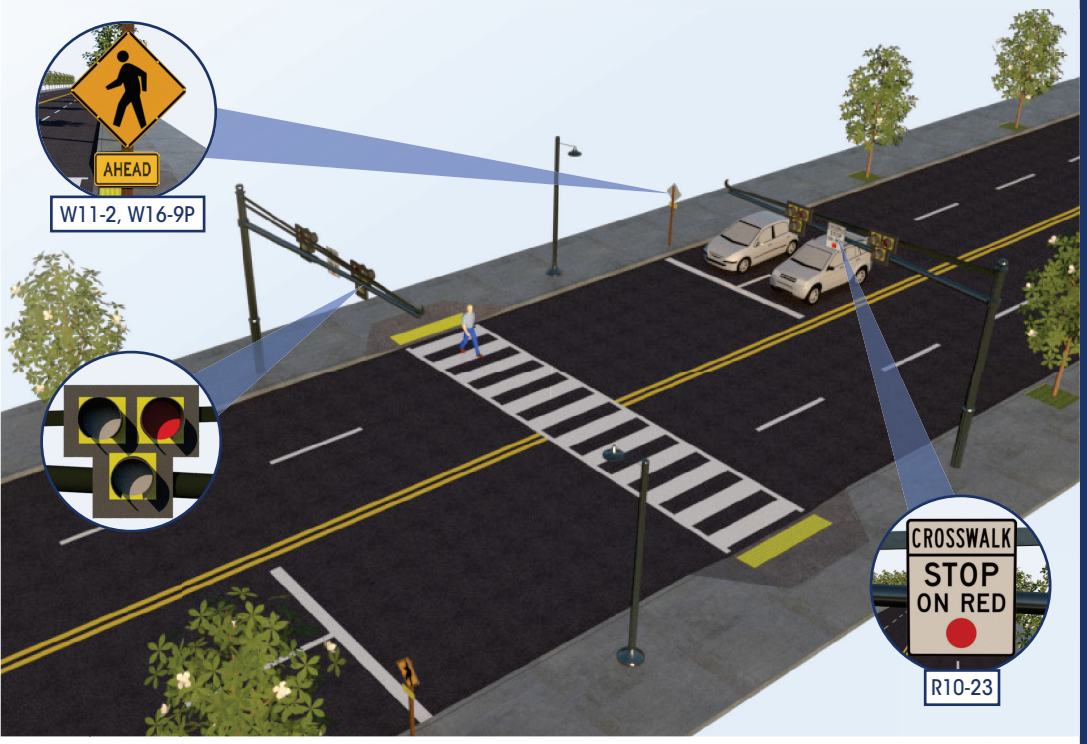
Every Day Counts (EDC), a State-based initiative of FHWA's *Center for Accelerating Innovation*, works with State, local and private sector partners to encourage the adoption of proven technologies and innovations aimed at shortening and enhancing project delivery.

Pedestrian Hybrid Beacon (PHB)

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN

COUNTERMEASURE TECH SHEET



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.

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.

PHBs can reduce pedestrian crashes by **55%**

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

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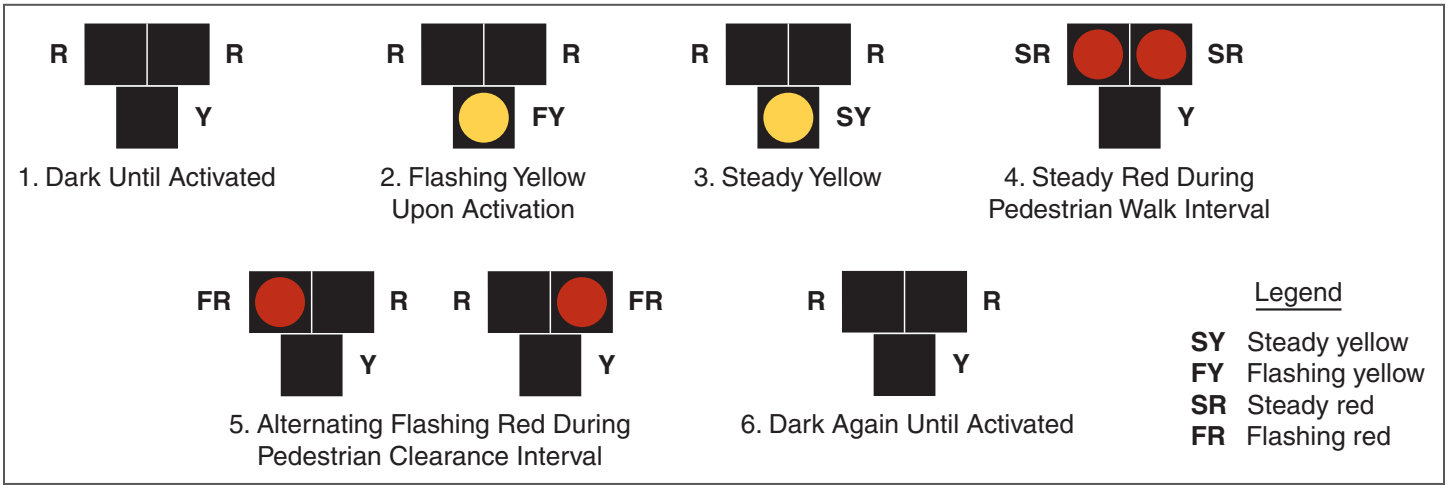
Safe Roads for a Safer Future
Investment in roadway safety saves lives

EDC
every day counts

Pedestrian Hybrid Beacon (PHB)

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

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.

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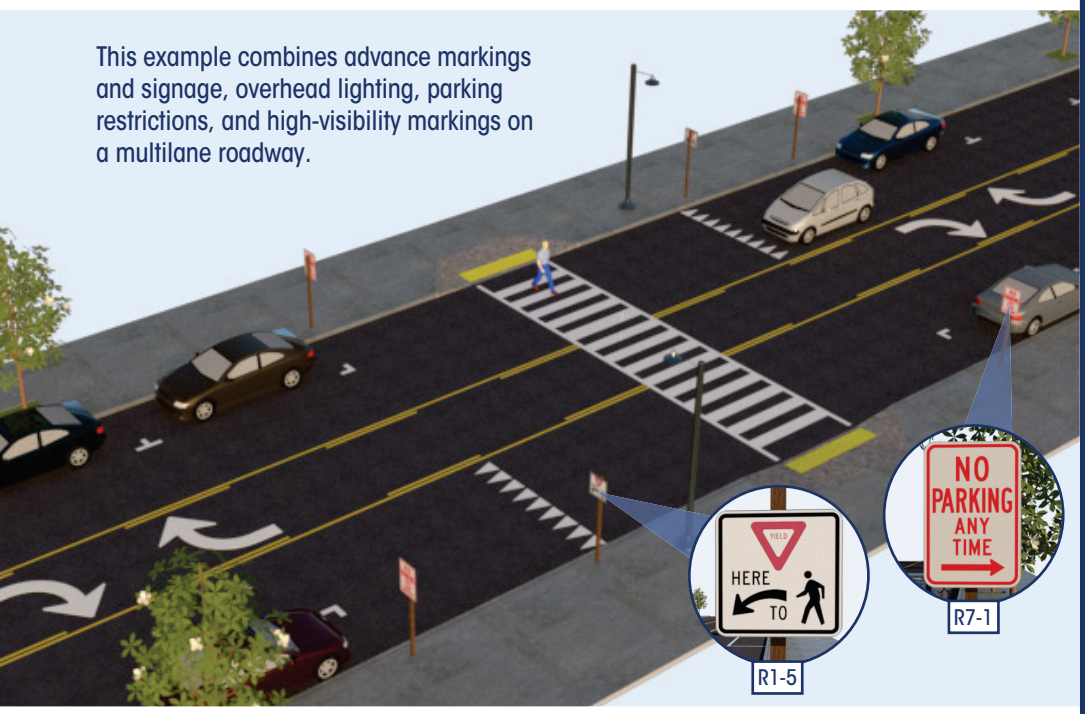
Crosswalk Visibility Enhancements

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN

COUNTERMEASURE TECH SHEET

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

This example combines advance markings and signage, overhead lighting, parking restrictions, and high-visibility markings on a multilane 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.

Crosswalk visibility enhancements can reduce crashes by

23–48%

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.

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Crosswalk Visibility Enhancements

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

CONSIDERATIONS

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.

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.

[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)

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 speed 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

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- 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

Pedestrian Refuge Island

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COUNTERMEASURE TECH SHEET

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.

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.

Pedestrian refuge islands can reduce pedestrian crashes by

32%

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)

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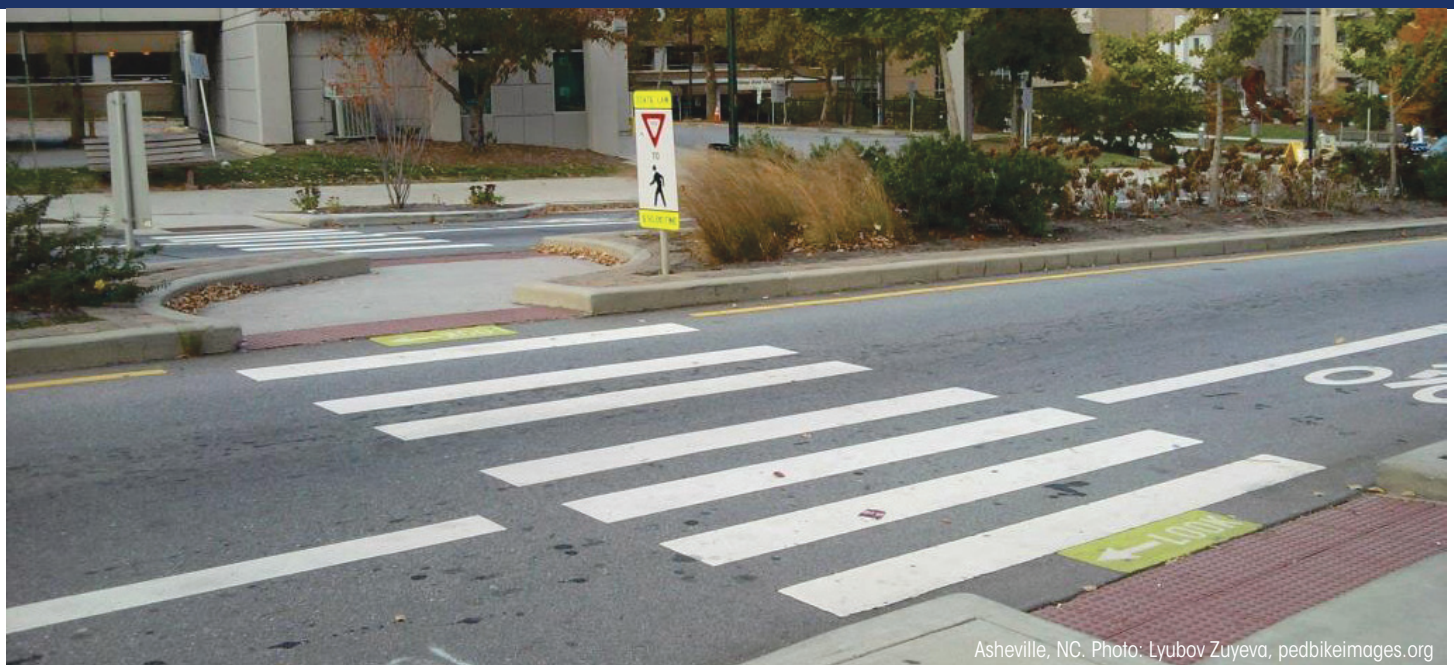
EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm



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.

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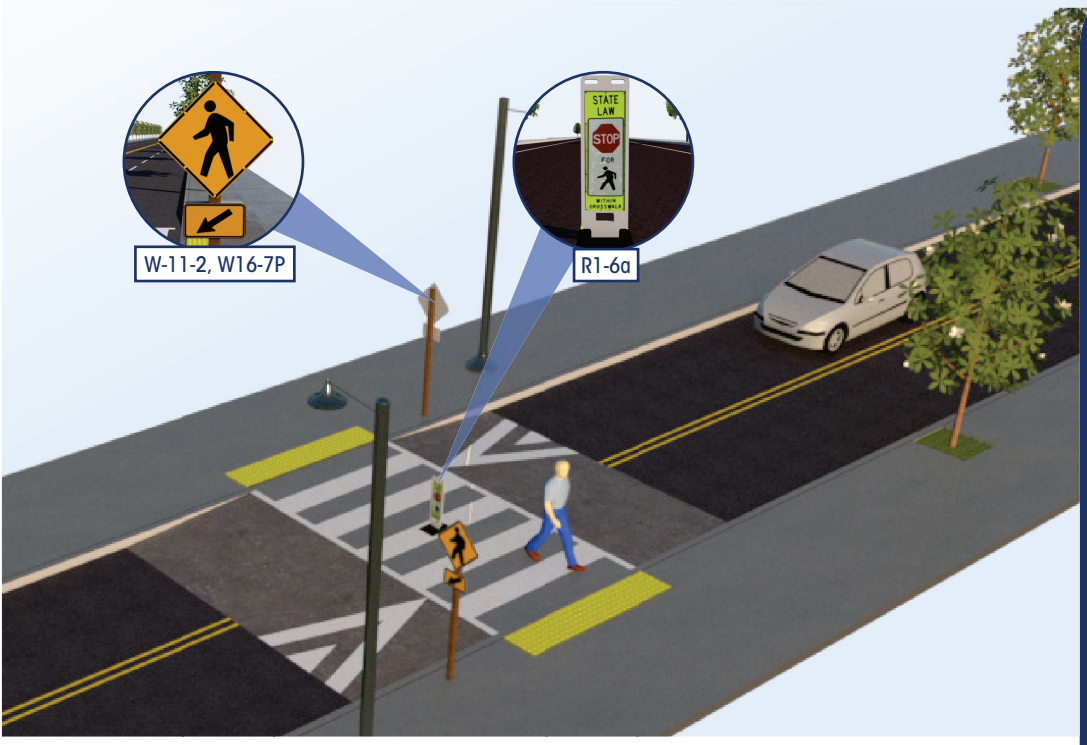
Raised Crosswalk

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN

COUNTERMEASURE TECH SHEET



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.

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.

Raised crosswalks can reduce pedestrian crashes by

45%

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**

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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.

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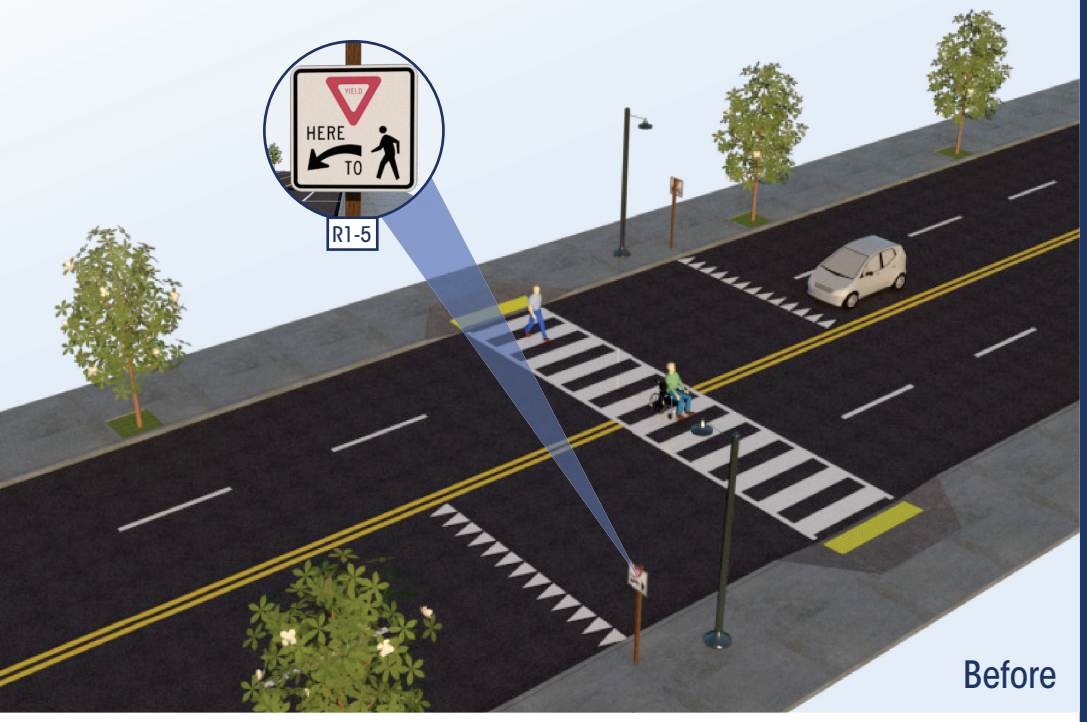
Road Diet

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN

COUNTERMEASURE TECH SHEET



Before

After

Multilane roads can take longer to cross and vehicle speeds may be high.

Road Diets can decrease the lane crossing distance and reduce vehicle speeds.

Road Diets can reduce total crashes by

19–47%*

*19% in urban areas, 47% in suburban areas.

FEATURES:

- Reduced crossing distance and exposure.
- Reduced vehicle speeds.
- Promote Complete Streets.
- Provide space for installing curb extensions and widening sidewalks.
- Create space for bicycle, transit, and/or parking lanes.

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Road Diet

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

A typical Road Diet converts an existing four-lane, undivided roadway to two through lanes and a center, two-way left turn lane. This design allows left-turning drivers to exit the traffic stream while waiting for a gap to complete their turn and frees up space that can be reallocated to other uses, including:

- Pedestrian refuge island
- Crosswalk visibility enhancements, such as curb extensions
- On-street parking, with parking restrictions on crosswalk approaches
- Widened sidewalks and landscaped buffers
- Bicycle lane and/or transit lanes

A Road Diet can be a relatively low-cost safety solution, particularly where only pavement marking modifications are required to implement the reconfigured roadway design. When planning in conjunction with reconstruction or overlay projects, the change in cross section may be completed without any additional cost.

CONSIDERATIONS

While Road Diets are effective countermeasures for midblock collisions, they are not recommended for all multilane roadways. Typically, a suitable roadway has a current and future average daily traffic (ADT) equal to or less than about 20,000. In some instances, Road Diets have been successfully used on roads with ADTs as high as 25,000.

FHWA's Road Diet Informational Guide provides a closer look at the safety and operational benefits of Road Diets to help agencies determine if this countermeasure may suit their needs. Communities will need to consider a range of factors, including:

- Vehicle speed
- Level of Service (LOS)
- Quality of Service
- Vehicle volume (ADT)
- The operation and volume of pedestrians, bicyclists, transit, and freight
- Peak hour and peak direction traffic flow
- Vehicle turning volumes and patterns
- Frequency of stopping and slow moving vehicles
- Presence of parallel roadways

Since Road Diets may be new or uncommon in a community, consider conducting an outreach effort to educate the public on the purpose and potential benefits.

COST

The cost associated with a Road Diet can vary widely. Restriping costs for the three lanes plus bicycle lanes are estimated at $25,000 to $40,000 per mile, depending on the amount of lane lines that need to be repainted. When a Road Diet involves geometric features like extended sidewalks, curb extensions, a raised median or refuge island, the costs can increase to $100,000 or more per mile.

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