

Chapter 4 – The Expert System

BIKESAFE: Background - Mozilla Firefox

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http://www.bicyclinginfo.org/bikesafe/background.cfm

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BIKESAFE Bicycle Countermeasure Selection System


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Background

Bicycling is one of the oldest forms of human transportation, yet the modern-day cyclist faces problems related to suburban living and motor vehicle speed and traffic volume, among others. The various kinds of facilities needed to maintain bicycling as a viable transportation mode have been frequently overlooked in the building of modern transportation systems. This situation has been changing in recent years, and now people want more ways to get around their communities and elsewhere via bicycle. And they want to be able to make these bicycling trips in a safe and enjoyable manner.



The bicyclist is a vulnerable road user, and creating a safer bicycling environment involves more than striping a bike lane or re-striping motor vehicle travel lanes to accommodate a wide curb lane or even building a separated path. A truly viable bicycling network involves both the big picture and the smallest details – from how a community is built and connected, to the maps that indicate safe bicycling routes, to the surface materials on the bike path. Bicycling facilities should be accessible to various types of users, and information should be provided about the level of skill necessary on a

Page Contents:

- [Land Use and Bicycling](#)
- [Assume That People Will Bicycle](#)
- [Transit and Bicycling](#)
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How to Use BIKESAFE

Selection Tool

Interactive Matrices

Countermeasures

Case Studies

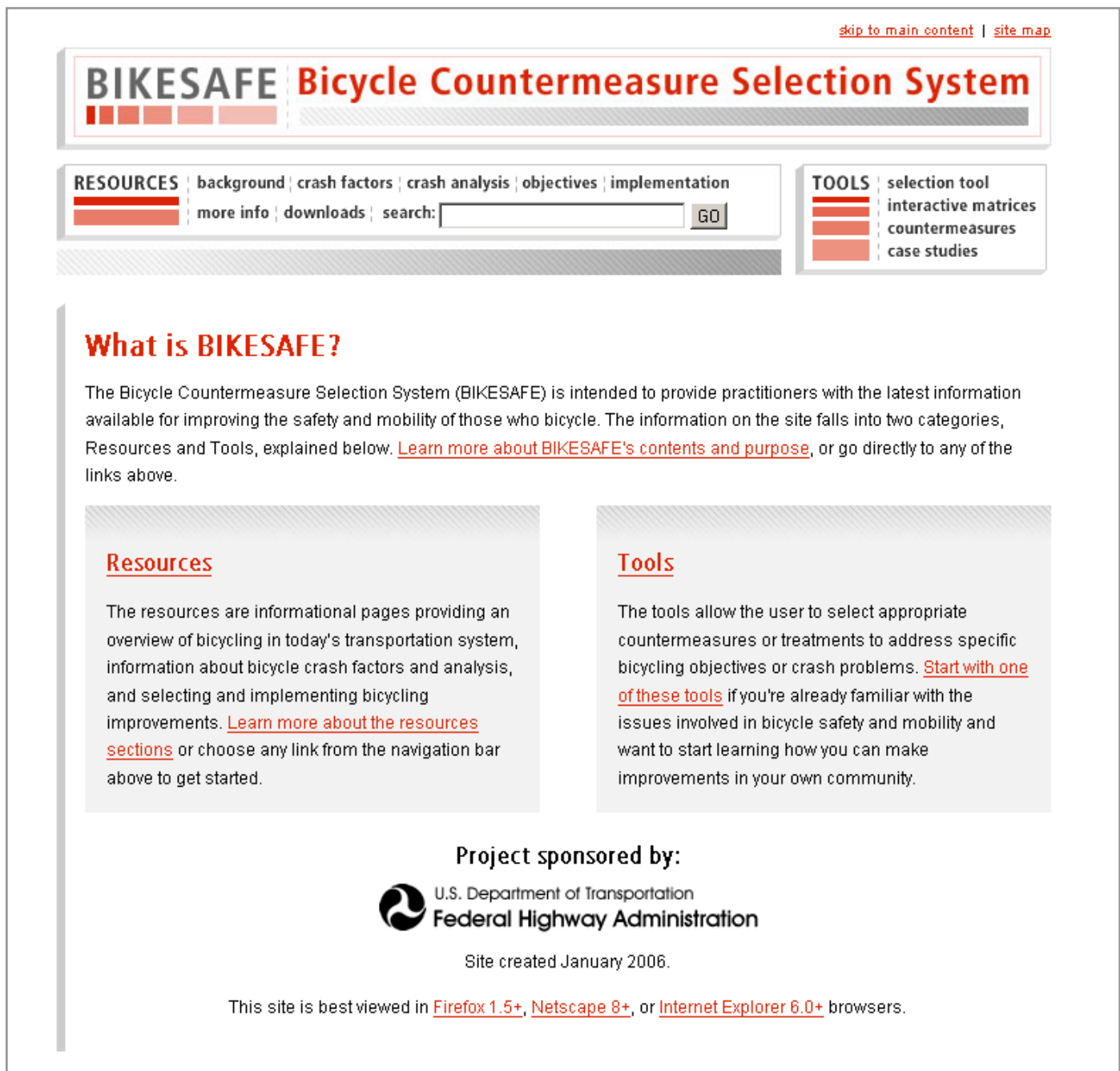
The BIKESAFE expert system is provided on the enclosed CD-ROM and is available online at <http://safety.fhwa.dot.gov/bikesafe> and at <http://www.bicyclinginfo.org/bikesafe>. This chapter provides an overview of the application and specific instructions on how to access and use the tools available. The application is designed to:

- Provide information on the countermeasures available to prevent bicycle crashes and improve motorist and bicyclist behavior.
- Highlight the purpose, considerations and cost estimates associated with each countermeasure.
- Provide a decision process to select the most applicable

countermeasures for a specific location.

- Provide links to case studies showing the various treatments and programs implemented in communities around the U.S.
- Provide easy access to resources such as statistics, implementation guidance, and reference materials.

The expert system combines the resources provided in this document with online tools (see home page below) to enable practitioners to effectively select engineering, education, or enforcement treatments to mitigate a known crash problem or achieve a specific performance objective.



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BIKESAFE Bicycle Countermeasure Selection System

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What is BIKESAFE?


The Bicycle Countermeasure Selection System (BIKESAFE) is intended to provide practitioners with the latest information available for improving the safety and mobility of those who bicycle. The information on the site falls into two categories, Resources and Tools, explained below. [Learn more about BIKESAFE's contents and purpose](#), or go directly to any of the links above.

Resources

The resources are informational pages providing an overview of bicycling in today's transportation system, information about bicycle crash factors and analysis, and selecting and implementing bicycling improvements. [Learn more about the resources sections](#) or choose any link from the navigation bar above to get started.

Tools

The tools allow the user to select appropriate countermeasures or treatments to address specific bicycling objectives or crash problems. [Start with one of these tools](#) if you're already familiar with the issues involved in bicycle safety and mobility and want to start learning how you can make improvements in your own community.

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 U.S. Department of Transportation
Federal Highway Administration

Site created January 2006.

This site is best viewed in [Firefox 1.5+](#), [Netscape 8+](#), or [Internet Explorer 6.0+](#) browsers.

The home page of the BIKESAFE Web application introduces the site and highlights the Resources and Tools sections.

The resource materials included in the Web/CD-ROM application are related to this document as follows:

WEB/CD-ROM	PRINT DOCUMENT*
Background	Chapter 1: The Big Picture
Crash Factors	Chapter 2: Bicyclist Crash Factors
Crash Analysis Objectives	Chapter 3: Selecting Improvements for Bicyclists
Implementation Publications	Chapter 7: Implementation and Resources

*Chapters 5 and 6 include the countermeasures and case studies, which are available as Tools on the Web/CD-ROM application.

HOW TO USE BIKESAFE

The opening page gives a brief explanation of BIKE-SAFE and then highlights the “Resources” and “Tools” sections. The “Resources” section provides an overview of bicycling in today’s transportation system, information about bicycle crash statistics and analysis, and selecting and implementing bicycling improvements. “Tools” allows the user to select appropriate countermeasures or treatments to address specific objectives, such as the need to make intersections safer for bicyclists, or crash problems, such as overtaking motorists striking bicyclists from the rear on a busy corridor with inadequate space. This section also includes a large number of case studies to illustrate

treatments implemented in communities throughout the United States.

The rest of this chapter focuses on the four tools available on the Web/CD-ROM application. Each can be used to enter the system, as described below:

- Selection Tool – This interactive tool allows the user to develop a list of possible countermeasures on the basis of site characteristics, such as geometric features and operating conditions, and the type of safety problem or desired behavioral change. The decision logic used to determine when specific treatments are and are not applicable is based on input from an expert panel of practitioners.
- Interactive Matrices – This tool shows the relationship between the countermeasures and the performance objectives or crash types and can be used to display applicable countermeasures.
- Countermeasures – Details of 50 engineering, education, enforcement, and other treatments or programs for improving bicycle safety and mobility are provided in the categories of shared roadway treatments; on-road bicycle facilities; intersection treatments; traffic calming applications; trails/shared-use paths; markings, signs, and signals; education and enforcement; and support facilities and programs.
- Case Studies – More than 50 real-world examples illustrate various treatments or programs as implemented in a state or municipality.

BIKESAFE is designed to allow the tools and information to be accessed from multiple points of entry. Links are provided to allow users to easily navigate between the tools and to quickly access the resource materials. Provided below are four examples of how a user may choose to enter the system and access the tools.



Resources page.



Tools page.

1) Selection Tool – The user may have information available about geometrics and operating conditions of a particular location and either has a specific type of crash problem or desires to change motorist/bicyclist behavior at the site. Known location information may be entered by answering a series of questions. The system will then display the countermeasure options to be considered.

2) Interactive Matrices – The user has a specific type of crash problem or desires to change motorist/bicyclist behavior but does not have specific information about the characteristics of the site. The matrices can be used to view and access the types of countermeasures available for further consideration.

3) Countermeasures – The user is interested in acquiring information about a particular treatment or program. The countermeasures page can be directly accessed and displays the nine categories of treatments included. Detailed descriptions of the 50 countermeasures can be accessed from this point. Links to relevant case studies can then be accessed from the description pages.

4) Case Studies – The user wishes to see specific examples of treatments that have been installed. The case studies page provides a list of all case studies assembled, as well as the option of selecting a specific implementation example by type of treatment or by location (state and municipality). From there, the user can access the countermeasure description pages that are relevant to a particular example.

Each of these tools is described in more detail in the remainder of the chapter.

SELECTION TOOL

The interactive selection tool allows the user to refine their selection of countermeasures on the basis of specific site characteristics and/or the type of safety problem or desired behavioral change. One begins by choosing selection tool from the Tools menu. A screen will appear with specific instructions on how to use the tool (see next page), and then allows the user to click on “Start the Selection Tool.” This leads to a simple three-step process:

Step 1: Choose the Location—A text box is provided for the user to describe the location of interest (e.g., “Route 1 between Spring Ave. and Summer Ave.” for a roadway segment, or “Intersection of Route 1 and Spring Ave.” for an intersection). This is entirely for the benefit of the user and allows other descriptive information to be entered

as well. This information will be stored and displayed as typed with the results so the project can be identified. In the figure on the next page, a specific intersection location—Main Street and Broadway Avenue—has been entered.

Step 2: Select the Goal of the Treatment—The user must then choose a particular type of crash problem to be mitigated or a performance objective to be achieved. As shown in the figure on page 42, there are seven performance objectives and 13 crash groups. Only one can be selected. As the user proceeds through the steps, the previous input is shown on the right side of the screen (in this example, the roadway location from Step 1).

Step 3: Describe the Site—Finally, the user is asked to provide input about the characteristics of the site. As shown in the figure on page 43, there are nine questions that are asked in reference to the general location, geometric features, and operating conditions. The default value is “Not Applicable/Unknown” for each question. The answers to these questions are used to narrow the list of appropriate countermeasures for a specific goal or crash type. For example, if the location of interest was a roadway segment (midblock location), then the treatments associated with intersection improvements would not be applicable and would not be included in the results as applicable countermeasures.

The field investigation form included in Appendix A can be used for site visits to obtain the information asked for in this last step. For any question where the information is not known, an entry of “Not Applicable/Unknown” will simply retain all countermeasures relevant to the question, and the choice of treatments will not be reduced.

After completing these three steps, the user clicks Get Results. The information entered is used to develop a list of applicable countermeasures, which are presented as shown on page 44. The user can then read more about a specific countermeasure by selecting it, which takes the user to the countermeasure description page. The user is advised to carefully read the countermeasure description page, especially if some of the suggested treatments seem “inappropriate.” The description of the countermeasure, along with the “Considerations” section, hopefully will clear up questions. As an example, “Reduce Lane Width” is displayed for the crash type of motorist overtaking bicyclist on a shared roadway. While this may seem counterintuitive, reducing lane width is one way to reduce motor vehicle speed. If speed is reduced, then some overtaking crashes may be averted (e.g., on curves with poor sight distance).

Selection Tool

How the Tool Works

The selection tool is designed to receive input on several variables from the user in three steps.

1

Choose the Location

First, enter the location of the site in question. This allows the user to create reports for several different sites and keep the results separated by location. It is used for reporting purposes only and is not stored permanently by the operators of this web site.

2

Select the Goal of the Treatment

Second, one must decide on the goal of the treatment. It may either be to achieve a specific performance objective, such as reduce traffic volumes, or to mitigate a specific type of bicyclist-motor vehicle collision.

3

Describe the Site

Once a specific goal has been selected, the third step is to provide answers to a series of questions related to the geometric and operational characteristics of the site in question. The answers to these questions are used to narrow the list of appropriate countermeasures for a specific goal. For example, if the location of interest were a segment of roadway, or midblock location, then the treatments associated with intersection improvements would not be applicable and thus, would not be included in the results as possible countermeasures.

For any question where the information is not known, an entry of "unknown" will simply retain the countermeasures relevant to the question, and the range of treatments will not be reduced.

[Start the Selection Tool](#)

The Selection Tool includes three simple steps that are described on its opening page.

Selection Tool

Step One: Choose the Location

For the roadway location being addressed, please enter a description.

Location:

Main Street and Broadway Avenue

Proceed to Step 2

The user may enter any combination of text and numbers to describe the location of interest.

Selection Tool

Step Two: Select the Goal of the Treatment

For the roadway location being addressed, the goal of the bicycling treatment is intended to improve bicyclist safety and access by either achieving one of the following performance objectives OR mitigating one of the following crash types.

Therefore, you must choose one of the following to begin:

Performance Objectives

- Provide safe on-street facilities/space for bicyclists
- Provide off-road paths or trails for bicyclists
- Provide and maintain quality surfaces for bicyclists
- Provide safe intersections for bicyclists
- Improve motorist behavior/compliance with traffic laws
- Improve bicyclist behavior/compliance with traffic laws
- Encourage and promote bicycling

Crash Types

- Motorist failed to yield - signalized intersection
- Motorist failed to yield - non-signalized intersection
- Bicyclist failed to yield - signalized intersection
- Bicyclist failed to yield - non-signalized intersection
- Motorist drove out - midblock
- Bicyclist rode out - midblock
- Motorist turned or merged left into path of bicyclist
- Motorist turned or merged right into path of bicyclist
- Bicyclist turned or merged left into path of motorist
- Bicyclist turned or merged right into path of motorist
- Motorist overtaking bicyclist
- Bicyclist overtaking motorist
- Non-motor vehicle crashes

Your Input:

Roadway Location:
test

Next Steps:

[Proceed to Step 3](#)

A specific performance objective or crash type to be mitigated must be selected in step two.

Selection Tool

Step Three: Describe the Site

Please answer the following questions.

1. Is the problem location on an off-road multi-use path (not at an intersection with a roadway) or on a roadway (or roadway/path intersection)?

- Roadway
- Path
- Not Applicable/Unknown

2. In what type of area is the roadway located?

- Urban CBD
- Urban - Other
- Suburban
- Rural
- Not Applicable/Unknown

3. What is the functional class of the roadway?

- Local
- Collector & Minor Arterial
- Principal Arterial
- Not Applicable/Unknown

4. Is the problem location at an intersection or midblock?

- Intersection
- Midblock
- Not Applicable/Unknown

5. Is vehicle volume low, medium, or high?

- Low (<10,000 ADT)
- Medium (10 - 25,000 ADT)
- High (>25,000 ADT)
- Not Applicable/Unknown

6. Is vehicle prevailing speed low, medium, or high?

- Low (<= 30 mph)
- Med (31 - 44 mph)
- High (>45mph)
- Not Applicable/Unknown

7. What is the number of through lanes?

- <=2
- 3 or 4
- 5 or more
- Not Applicable/Unknown

8. Is a traffic signal present, being considered, or not an option?

- Present (removal not an option)
- Present (removal could be an option)
- Not present (installation is not an option)
- Not present (installation possible)
- Not Applicable/Unknown

9. What are the existing on-road bicycle facilities?

- Bike Lane
- Wide Curb Lane
- Paved Shoulder
- None or Other
- Not Applicable/Unknown

Your Input:

Roadway Location:

Main Street and Broadway Avenue

Your Performance Objective:

**Provide safe on-street facilities/
space for bicyclists.**

Next Steps:

Edit:

[Change Your Performance
Objective](#)

[Start Over](#)

[Get Results](#)

The characteristics of the location are provided in step three by answering nine questions.

In addition to the applicable countermeasures, the results page also provides the user with a list of the inputs made in the three steps. Options are provided for changing these inputs for the location of interest, exporting the results to Microsoft Excel, or starting over with a new location.

[Home](#) > [Selection Tool](#) > [Step One: Choose the Location](#) > [Step Two: Select the Goal of the Treatment](#) > [Step Three: Describe the Site](#) > [Applicable Countermeasures](#)

Applicable Countermeasures

Based upon your input, the following countermeasures were found:

- Shared Roadway
 - [Roadway Surface Improvements](#)
 - [Bridge and Overpass Access](#)
 - [Tunnel and Underpass Access](#)
 - [Lighting Improvements](#)
 - [Parking Treatments](#)
 - [Median/Crossing Island](#)
 - [Driveway Improvements](#)
 - [Access Management](#)
 - [Reduce Lane Number](#)
 - [Reduce Lane Width](#)
- On-Road Bike Facilities
 - [Bike Lanes](#)
 - [Wide Curb Lanes](#)
 - [Paved Shoulders](#)
 - [Combination Lanes](#)
 - [Contraflow Bike Lanes](#)
- Maintenance
 - [Repetitive/Short-Term Maintenance](#)
 - [Major Maintenance](#)
 - [Hazard Identification Program](#)
- Traffic Calming
 - [Speed Tables/Humps/Cushions](#)
 - [Visual Narrowing](#)
- Markings, Signs, Signals
 - [Sign Improvements](#)
 - [Pavement Marking Improvements](#)
 - [School Zone Improvements](#)
- Education and Enforcement
 - [Practitioner Education](#)
- Support Facilities and Programs
 - [Wayfinding](#)
 - [Aesthetics/Landscaping](#)

Your Input:

Roadway Location:

Main Street and Broadway Avenue

Your Performance Objective:

**Provide safe on-street facilities/
space for bicyclists.**

Your answers to the previous questions:

Roadway or Path: Roadway

Location: Suburban

Functional Class: Not Applicable

Intersection or Midblock:

Midblock

**Volume: Medium (10 - 25,000
ADT)**

Speed: Med (31 - 44 mph)

Lanes: 3 or 4

Signal: Not Applicable

Bike Facilities: None or Other

Next Steps:

Edit:

[Change Your Performance
Objective](#)

[Change Your Answers to Site
Description](#)

Save:

[Output Results to Microsoft Excel](#)

[Start Over](#)

The results produced from the Selection Tool provide a list of applicable countermeasures and present the user with options to edit the responses, save the results, or start over..

INTERACTIVE MATRICES

Also included in the Web/CD-ROM application are two matrices that may be accessed by selecting “interactive matrices” from the Tools menu. The objectives matrix (shown below) provides the user with a quick view of the relationship between the seven performance objectives and the nine countermeasure groups. The crash analysis matrix (shown on the following page) allows the user to see the relationship between the 13 crash type groups and the nine countermeasure groups. In either matrix, a filled cell indicates that there is a specific countermeasure within the countermeasure group (shown in the columns) that is applicable to the crash group or performance objective listed in each row. The user can click on the bullet in any filled cell to obtain a drop-down list of the specific applicable countermeasures. From there, the user can select a countermeasure and be linked to the countermeasure description page or select another cell within the matrix.

[Home](#) > [Interactive Matrices](#) > Objectives Matrix

Objectives Matrix

Select an Objective and Countermeasure Group from the matrix below by clicking on one of the dots, or [view the text-only version](#).

Objective	Countermeasure Group								
	Shared Roadway	On-Road Bike Facilities	Intersection Treatments	Traffic Calming	Trails/Shared-Use Paths	Markings, Signs, Signals	Education and Enforcement	Support Facilities and Programs	
1. Provide safe on-street facilities/space for bicyclists.	•	•	•	•	•	•	•	•	•
2. Provide off-road paths or trails for bicyclists.			•		•	•	•	•	
3. Provide and maintain quality surfaces for bicyclists.	•		•			•	•		
4. Provide safe intersections for bicyclists.	•		•	•	•	•	•		
5. Improve motorist behavior/compliance with traffic laws.	•		•	•	•	•	•	•	
6. Improve bicyclist behavior/compliance with traffic laws.	•	•	•	•	•	•	•	•	•
7. Encourage and promote bicycling.	•	•	•		•	•	•	•	•

Cells with a bullet indicate there are one or more countermeasures within a countermeasure group that are applicable to a specific performance objective.

Crash Matrix

Select a Crash Group and Countermeasure Group from the matrix below by clicking on one of the dots, or [view the text-only version](#).

Crash Group	Countermeasure Group							
	Shared Roadway	On-Road Bike Facilities	Intersection Treatments	Maintenance	Traffic Calming	Trails/Shared-Use Paths	Markings, Signs, Signals	Education and Enforcement
1. Motorist failed to yield – signalized intersection	•		•		•	•	•	•
2. Motorist failed to yield – non-signalized intersection	•		•		•	•	•	•
3. Bicyclist failed to yield – signalized intersection	•		•		•	•	•	•
4. Bicyclist failed to yield – non-signalized intersection	•		•		•	•	•	•
5. Motorist drove out – midblock	•					•	•	•
6. Bicyclist rode out – midblock	•				•	•	•	•
7. Motorist turned or merged left into path of bicyclist	•	•	•		•	•	•	•
8. Motorist turned or merged right into path of bicyclist	•	•	•		•	•	•	•
9. Bicyclist turned or merged left into path of motorist	•		•	•	•	•	•	•
10. Bicyclist turned or merged right into path of motorist	•	•	•	•	•	•	•	•
11. Motorist overtaking bicyclist	•	•		•	•	•	•	•
12. Bicyclist overtaking motorist	•	•		•		•	•	•
13. Non-motor vehicle crashes	•			•		•	•	•

Cells with a bullet indicate there are one or more countermeasures within a countermeasure group that are applicable to a specific crash group.

COUNTERMEASURES

Each of the 50 engineering, education, and enforcement countermeasures described in Chapter 5 are included in the Web/CD-ROM application. After selecting “countermeasures” within the Tools menu, the user may select one of the following nine categories of treatments:

- Shared Roadway
- On-Road Bike Facilities
- Intersection Treatments
- Maintenance
- Traffic Calming
- Trails/Shared-Use Paths
- Markings, Signs, Signals
- Education and Enforcement
- Support Facilities and Programs

A specific countermeasure may then be selected from those listed for each category. Each countermeasure includes a description of the treatment or program, purpose(s), considerations of which one should be aware, and cost estimates. Finally, there are links to specific case studies (if available) where the particular countermeasure has been implemented. An example countermeasure description page is shown on the following page for Bike Lanes.

[Home](#) > Countermeasures

Countermeasures

A total of 50 engineering, education, and enforcement countermeasures are discussed in this section. The treatments and programs selected for inclusion in this application are those that have been in place for an extended period of time and/or have been proven effective at the time the material for this product was being compiled. Since that time, new countermeasures continue to be developed, implemented, and evaluated. Thus, practitioners should not necessarily limit their choices to those included here; this material is a starting point. More information on the latest treatments and programs can be found through many of the Web sites and resources included in this section and the [More Info](#) section.



Shared Roadway:

The goal of an appropriately designed roadway should be to safely and efficiently accommodate all modes of travel, from bicyclists to pedestrians to motorists.



Trails/Shared-Use Paths:

Bike paths or shared-use trails are complementary to the road network and serve recreational, child, and even commuter bicyclists.



On-Road Bike Facilities:

Various kinds of on-road facilities, such as bike lanes, paved shoulders, and wide curb lanes, make bicyclists more comfortable.



Markings, Signs, Signals:

Traffic engineers have an arsenal of pavement markings, signs, and signals that can be used to inform, regulate, and warn both motorists and bicyclists.



Intersection Treatments:

Nearly half of all bicycle-motor vehicle crashes occur at intersections or other junctions.



Education and Enforcement:

Education and enforcement are key strategies in increasing bicyclist and motorist awareness and behavior.



Maintenance:

Maintenance of all kinds of bicycle facilities must be planned for and done routinely.



Support Facilities and Programs:

The simple promotion of bicycling is a way to increase the amount of riding in a community.



Traffic Calming:

Traffic calming is a way to design streets, using physical measures, to encourage people to drive more slowly.

The 50 countermeasures are divided among the nine categories of improvements shown here.

CASE STUDIES

The case studies described in Chapter 6 are included in the Web/CD-ROM application. The user can access the implementation examples by selecting “case studies” within the Tools menu. As shown on the following page, the user then has the option of selecting a case study on the basis of location or type of countermeasure. The figure on the following page provides an example of selection by countermeasure. The selection of the On-Road Bike Facilities countermeasure group produces a list of the five treatments included in the application. The selection of Bike Lanes produces a list of 16 case studies in which a bike lane was a component of the treatments implemented. Accessing each of these case studies provides information about the specific problem that was addressed, the solution implemented and the results achieved.

Home > Countermeasures > On-Road Bike Facilities > Bike Lanes

Bike Lanes:

[View Other On-Road Bike Facilities Treatments](#)

Bike lanes indicate a preferential or exclusive lane for bicycle travel along a street. Bike lanes are typically 4.2 to 4.8 m (14 to 16 ft) in width and are designated by striping and/or signs. Colored pavement (for example, blue or red bike lanes) or a different paving material has also been used in certain situations to distinguish bike lanes from the motor vehicle lanes. Use of colored bike lanes is being considered but is not an accepted MUTCD standard. Bike lanes are usually marked along the right side of the roadway and should be designated to the left of parking or right-turn lanes. Sometimes bike lanes are marked on the left side of a one-way street.

Adaptations to bike lanes have been used to solve local problems. An innovative bike lane transit stop treatment in Portland, OR, is used to reduce conflicts between bicycles and electric transit stop users adjacent to a bike lane (see [case study #13](#)). Adaptation for this treatment should be possible for a shared roadway situation. Some communities also employ combination bike and bus lanes, a single lane nearest the curb that is shared by the two modes. This is generally workable unless there is incompatible bike and bus traffic.

Bike lanes have been found to provide more consistent separation between bicycles and passing motorists than shared bike lanes. The presence of the bike lane stripe has also been shown from research to result in fewer erratic motor vehicle driver maneuvers, more predictable bicyclist riding behavior, and enhanced comfort levels for both motorists and bicyclists. The extra space created for bicyclists to also a benefit on congested roadways where motorists may be unable to pass motor vehicles on the right.

Purpose

- Create on-street, separated travel facilities for bicycles.
- Provide separate operational space for safe motorist overtaking of bicyclists.
- Reduce or prevent the problems associated with bicyclists overtaking motor vehicles in narrow, congested areas.
- Narrow the roadway or roadway motor vehicle traffic lanes to encourage lower motor vehicle speeds.

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Considerations

- Where bike lanes are to be considered, the road or street should be evaluated to determine if this facility is appropriate.
- Provide adequate bike lane width.
- Provide a smoothly paved surface and keep the bike lane free of debris.
- Provide adequate space between the bike lane and parked cars so that open doors do not create a hazard for bicyclists.
- Avoid termination of bike lanes where bicyclists are left in a vulnerable situation.
- Determine if special signs or markings are necessary for situations such as a high-volume of bike left turns on a busy roadway.

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Estimated Cost

The cost of installing a bike lane is approximately \$3,100 to \$11,000 per kilometer (\$5,000 to \$18,000 per mile), depending on the condition of the pavement, the need to remove and repave the lane itself, the need to adjust signage, and other factors. It is most cost-efficient to create bike lanes during street reconstruction, street resurfacing, or at the time of original construction.

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Case Studies

- #1 - A Tale of Portland Bridges - Portland, OR
- #2 - Valencia Street Road Diet - Creating Space for Cyclists - San Francisco, CA
- #3 - Charlotte Park Expansion Project - Provision of Route and Pedestrian Encouragements - Santa Barbara, CA
- #4 - Blue Lane Effect Evaluation - Chicago, IL
- #5 - Establishing Bike Lanes - Chicago's Streets for Cyclists Plan - Chicago, IL
- #6 - How Hampshire Street Pavement Markings Influence Bicycle and Motor Vehicle Flow Behavior - Cambridge, MA
- #7 - Based Bicycle Lanes and Other Traffic Calming Treatments on Avenues Road - Eugene, OR
- #8 - Creating Bike Lanes in Conjunction with Parkette Paving - San Francisco, CA
- #9 - Incorporating a Bicycle Lane through a Streetcar Platform - Portland, OR
- #10 - Preferential Transit Bicycle Right-Turn Lanes on Broadway Boulevard - Jackson, MS
- #11 - Fanning the Urban Aerial - Washouk, WA
- #12 - Converting Bicycle Lanes on Urban Streets - Cambridge, MA
- #13 - Left Side Bike Lanes on One-Way Streets - Minneapolis, MN
- #14 - Converting Bicycle Lane/Right-Turn Lane - Portland, OR
- #15 - Blue Bike Lane at Interchange Opening from - Portland, OR
- #16 - Converting an Aerial at Interchange Opening from - Portland, OR
- #17 - Converting an Aerial at Interchange Opening from - Portland, OR
- #18 - Converting an Aerial at Interchange Opening from - Portland, OR
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- #35 - Converting an Aerial at Interchange Opening from - Portland, OR
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Each countermeasure includes a description, purpose, considerations, estimated cost, and links to case studies where the treatment or program has been implemented.

Choose a Case Study

The 50 engineering, education, enforcement and promotional countermeasures are described in the [Countermeasures](#) section. Included in this section are case studies that illustrate these treatments or programs as implemented in a state or municipality. Examples are included from many States.

Each case study includes a description of the problem that was addressed, relevant background information, a description of the implemented solution, and any quantitative results from evaluation studies or qualitative assessments.

Many communities find it difficult to conduct formal evaluations of projects due to staff and budget limitations, but assessing whether a treatment has helped toward the intended objectives and not caused unexpected adverse impacts is critical to long-term improvement. We tend to think that some evaluation is better than none but occasionally may be misled by short-term or single-event types of assessments. In these cases, the judgment of experienced practitioners may help to fill in the gaps in knowledge or interpret results that seem "too good to be true." By far, longer-term evaluations (bicyclist/traffic counts, speed studies, etc.) are preferable to short-term project assessments. Multiple short-term studies of the same types of facilities do, however, build on each other and help to provide a more complete picture of the effectiveness of bicycling countermeasures. These cautions should be borne in mind when reviewing the case studies that follow.

Included for each study is a point of contact in the event that further information is desired. Please note that in some cases the specific individual listed may have left the position or agency. There should still be someone at the municipal or state agency who is familiar with the project and can provide any supplemental information.

Not all traffic control devices (TCDs) in the case studies comply with the *Manual on Uniform Traffic Control Devices* (MUTCD). The Federal Highway Administration (FHWA) does not endorse the use of non-compliant TCDs except under experimentation, which must be approved by the FHWA Office of Transportation Operations.

All Case Studies

- [#1 – Minimizing Roadway Surface Hazards for Bikes, Seattle, Washington](#)
- [#2 – A Tale of Portland Bridges, Portland, Oregon](#)
- [#3 – Lighting and Advance Warning of Bicyclists in the Knapps Hill Tunnel, State of Washington](#)
- [#4 – Back-in Diagonal Parking with Bike Lanes, Vancouver, Washington](#)
- [#5 – Valencia Street Road Diet — Creating Space for Cyclists,](#)

By Location

- [Inside the United States](#)
- [Outside the United States](#)

By Countermeasure Group

- [Shared Roadway](#)
- [On-Road Bike Facilities](#)
- [Intersection Treatments](#)
- [Maintenance](#)

By Countermeasure Group

- [Shared Roadway](#)
- [On-Road Bike Facilities](#)
 - [Bike Lanes](#)
 - [Wide Curb Lanes](#)
 - [Paved Shoulders](#)
 - [Combination Lanes](#)
 - [Contraflow Bike Lanes](#)
- [Intersection Treatments](#)
- [Maintenance](#)
- [Traffic Calming](#)
- [Trails/Shared-Use Paths](#)
- [Markings, Signs, Signals](#)
- [Education and Enforcement](#)
- [Support Facilities and Programs](#)

Bike Lanes

- [#10 – How Hampshire Street Pavement Markings Influence Bicycle and Motor Vehicle](#)
- [#11 – Raised Bicycle Lanes and Other Traffic Calming Treatments on Ayres Road](#)
- [#12 – Floating Bike Lanes in Conjunction with Part-time Parking](#)
- [#13 – Incorporating a Bicycle Lane through a Streetcar Platform](#)
- [#16 – Preferential Transit-Bicycle-Right Turn Lanes on Broadway Boulevard](#)
- [#17 – Taming the Urban Arterial](#)
- [#18 – Contraflow Bicycle Lanes on Urban Streets](#)
- [#19 – Left Side Bike Lanes on One-Way Streets](#)
- [#2 – A Tale of Portland Bridges](#)
- [#21 – Combined Bicycle Lane/Right-Turn Lane](#)
- [#22 – Blue Bike Lanes at Intersection Weaving Areas](#)
- [#23 – Crossing an Arterial through an Offset Intersection: Bicycle-Only Center-Turn](#)
- [#25 – Grandview Drive Roundabout and Corridor Improvements](#)
- [#5 – Valencia Street Road Diet — Creating Space for Cyclists](#)
- [#6 – Shoreline Park Expansion Project — Provision of Bicycle and Pedestrian](#)
- [#8 – Bike Lane Safety Evaluation](#)
- [#9 – Establishing Bike Lanes — Chicago's Streets for Cycling Plan](#)

The case studies may be selected by location or countermeasure. Opening a countermeasure group folder reveals the list of countermeasures included. Selecting a specific countermeasure reveals the case studies in which that treatment/program was a component.

