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The three primary objectives of this project were to: (1) conduct research on existing bicycle and pedestrian safety programs and guidelines in the U.S. and internationally, (2) obtain and analyze existing data related to pedestrian and bicycle safety in California, and (3) assist in developing methodologies for producing safety action plans, identifying and selecting projects, conducting education campaigns, and targeting enforcement campaigns. To meet these objectives, SafeTREC developed a set of resources and tools for use in California. These resources make information and data on pedestrian injuries and fatalities in CA accessible to practitioners, researchers, and anyone else interested in obtaining information and improving conditions for pedestrians. The deliverables are individually summarized and included as appendices. These resources should be further developed and maintained to remain useful and appropriate.

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CALIFORNIA PATH PROGRAM
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Evaluate the Causes of Pedestrian and Bicyclist Traffic Fatalities and Injuries, and Establish Appropriate Countermeasures for Use in California

Lindsay S. Arnold* , David R. Ragland* , Harry Yip* , Doug Cooper* Kara MacLeod* , Daniel Hennessey* , Meghan Mitman , Brooke DuBose****

California PATH Research Report
UCB-ITS-PRR-2010-33

*UC Berkeley SafeTREC, **Fehr & Peers

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation, and the United States Department of Transportation, Federal Highway Administration.

Final Report for Task Order 6221

May 2010

UC Berkeley Safe Transportation Research & Education Center
University of California, Berkeley

Task Order 6221

Evaluate the Causes of Pedestrian and Bicyclist Traffic Fatalities and Injuries, and Establish Appropriate Countermeasures for Use in California

FINAL REPORT

Prepared by
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STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
Division of Research & Innovation

May 2010

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**Fehr & Peers

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Acknowledgments

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Abstract

The three primary objectives of this project were to: (1) conduct research on existing bicycle and pedestrian safety programs and guidelines in the U.S. and internationally, (2) obtain and analyze existing data related to pedestrian and bicycle safety in California, and (3) assist in developing methodologies for producing safety action plans, identifying and selecting projects, conducting education campaigns, and targeting enforcement campaigns.

To meet these objectives, SafeTREC developed a set of resources and tools for use in California. These resources make information and data on pedestrian injuries and fatalities in CA accessible to practitioners, researchers, and anyone else interested in obtaining information and improving conditions for pedestrians.

The deliverables are individually summarized and included as appendices. These resources should be further developed and maintained to remain useful and appropriate.

Executive Summary

This document summarizes the deliverables produced by the UC Berkeley Safe Transportation Research & Education Center (SafeTREC) for the California Department of Transportation Task Order 6221: *Evaluate the Causes of Pedestrian and Bicyclist Traffic Fatalities and Injuries, and Establish Appropriate Countermeasures for Use in California.* The three primary objectives of this project were to:

(1) Conduct research on existing bicycle and pedestrian safety programs and guidelines in the U.S. and internationally

(2) Obtain and analyze existing data related to pedestrian and bicycle safety in California

(3) Assist in developing methodologies for producing safety action plans, identifying and selecting projects, conducting education campaigns, and targeting enforcement campaigns

To meet these objectives, SafeTREC developed a set of resources and tools for use in California. These resources make information and data on pedestrian injuries and fatalities in CA accessible to practitioners, researchers, and anyone else interested in obtaining information and improving conditions for pedestrians. The literature reviews (I, II, III) bring together reports and peer-reviewed literature on specific topics. The pedestrian and bicyclist brochures (IV) provide injury and fatality statistics at a glance in a simple format that can be distributing at events such as community pedestrian trainings. The websites (V, VI) are interactive tools to help users identify locations for pedestrian safety improvements, and the Pilot Safety Index for Pedestrian & Bicycle Funding (VII) is an application for selecting and prioritizing countermeasures with accompanying documentation. The Survey Report (VIII) highlights institutional challenges faced in CA and the Guidelines Report (IX) makes recommendations to minimize these challenges and maximize opportunities for improving pedestrian safety. Deliverables I, II, III and IV were presented in the T.O. 6221 Interim Report in July 2008, while this report encompasses the complete list of tasks and deliverables under this task order. These deliverables are listed below and described in the following summary.

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Tables

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Deliverables

I. Literature Review: Existing Bicyclist and Pedestrian Safety Programs and Guidelines

To help California develop pedestrian and bicycle safety program and guidelines, this paper reviews the existing and pedestrian safety programs and guidelines across the country. More specifically, this paper reviews local, regional, state and national guidelines for safety program aspects such as: data analysis, problem identification, countermeasure design, safety message marketing, and best-practices policies.

After a search on online databases for existing bicycle and pedestrian plans, we have found:

- 6 Local Plans
- 1 Regional Plan
- 7 State Plans
- 3 National Plans

Breaking the plans down by user type, we have:

- 9 Pedestrian Plans
- 5 Bicycle Plans
- 3 Combined Bicycle and Pedestrian Plans

Reviewing these safety plans will help California develop methodologies for producing safety action plans, identifying and selecting projects, and conducting education and enforcement campaigns. The plans are described individually and summarized in Table A 1 on page 37.

II. Literature Review: Pedestrian and Bicyclist Countermeasures

Accurate information on the ability of countermeasures to address these problems is essential in order to effectively target investment in pedestrian and bicyclist safety measures. Previous research suggests that a significant number of traditional countermeasures do not have the effect believed, and that some new technology or under-utilized items carry more effect. This literature review looks at different studies concerning the accuracy and availability of data with respect to countermeasures for pedestrian and bicyclist crashes.

A major problem concerning research in this area is a lack of quality data for the countermeasures. There are several good sources, however, highlighted by the Pedestrian and Bicycle Crash Analysis Tool (PBCAT), Bicycle Countermeasure Selection System (BikeSAFE), and Pedestrian Safety Guide and Countermeasure

Selection System (PedSAFE). These sources provide countermeasures for different crash types, approximate costs, ease of implementation, approximate effects, and case studies for each countermeasure. These are by far the most thorough practical resources for countermeasures in the area of pedestrian and bicycle crashes.

Throughout this review, the most common theme was that researchers had conjectures about countermeasures and no tangible or practical way to measure it. There is much theorizing about which countermeasures might help which crash types in different circumstances, but some of the new ideas (and old ideas, for that matter) are difficult to implement in measurable situations, and the data can be difficult to both quantify and use in an appropriate manner.

The report contains an annotated bibliography listing some of the best sources in this area, a bibliography with some sources that could be helpful in certain situations or with more detail/data, and a bibliography with sources that came up in this process that were of little help or were not particular to this situation, and a numbered list of the sources. Table B 1 contains a list of the countermeasures found, a very coarse gauge of their cost, ease of implementation, and effects on pedestrian and bicycle safety, and which resources mentioned these countermeasures.

III. Literature Review: Underreporting of Pedestrian and Bicyclist Collisions

Previous research suggests that a significant number of roadway collisions are not reported to the police and are therefore not reflected in the state or national databases. This literature review looks at different studies concerning the underreporting of collisions involving pedestrians and bicyclists.

Throughout the studies, the following table summarizes the most common finding pertaining to the general level of underreporting.

Fatal	90-100%
Serious	60-75%
Slight	40-60%
All	50-70%

The numbers for pedestrian collisions are also higher than the percentage of bicycle collisions reported. Typical pedestrian crashes reported percentages range from 55-70% while typical bicycle crashes reported percentages range from 40-60%.

Certain factors have been found to affect the probability of a pedestrian-motor or bicycle-motor crash being reported. After moving past the severity of injury, African-Americans

are less likely than white people to have a police report filed, and women are more likely than men to have a police report filed.

The current reporting system is oriented toward crashes involving moving motor vehicles on public roads. Within the state of California, there are several possible methods for improving the reporting of pedestrian and bicycle collisions. The studies that have been completed have basically done this; they have used other data sources to complement the base record and compare the collisions recorded within each system. Utilizing these methods on a continuous basis, instead of for the small sample of a study, would give more realistic results for the true number of bicyclist and pedestrian collisions.

There are several recording systems in place that could be used to more completely record pedestrian and bicycle collisions, including the Fatality Analysis Reporting System (FARS) and the Statewide Integrated Traffic Records System (SWITRS) Comparing these two systems is just one level of a system to check and organize these collisions. Another way would be to include public health data such as vital statistics, hospital discharges, and ER data. Lastly, these data could be supplemented with surveys to people throughout the region in question regarding recent pedestrian and/or bicyclist collisions.

IV. Pedestrian Brochures

The data for these analyses were obtained from the California Statewide Integrated Traffic Records System (SWITRS) for years 1998-2007 and 2005-2007.

The purpose of this document is to assist in understanding pedestrian injury collisions in California in the context of overall injury and fatality characteristics and trends.

Data were obtained from the California Statewide Integrated Traffic Record System (SWITRS). SWITRS is an electronic database of police-reported crashes operated by the California Highway Patrol (CHP). CHP and all local law enforcement agencies in the state are required by law to submit data on all police-reported injury collisions.

The trend analysis used SWITRS victim data from 1998-2007. Data for estimated vehicle miles traveled for years 1998-2007 were obtained from the SWITRS Annual Reports (California Highway Patrol). Population estimates were obtained from the California Department of Finance.

Records were queried from the SWITRS collision tables by constructing a table of all injury collisions from years 2005-2007, and then identifying pedestrian records.

V. Location Analysis Website

The Location Analysis website, also known as the UC Berkeley SafeTREC Data Library, was developed in coordination with a project funded by the California Office of Traffic Safety. The SafeTREC Data Library has been established to provide data and analysis tools for traffic safety related research, policy and planning. Over time, the website will continue to expand the available resources on the site and provide updates to current tools. The tools can be used to analyze all severe injury and fatal crashes reported in SWITRS. The letter report details how the website can be used to analyze pedestrian crashes in particular.

VI. Pilot California Pedestrian Safety Data Source Website

SafeTREC has created the California Pedestrian Safety Data Source to meet this need by providing researchers, practitioners, stakeholders, and other interested parties access to up-to-date information and data related to pedestrian safety. This pilot website was created to demonstrate the potential utility of a web-based resource for pedestrian safety information. The site is organized into five main sections: Data, Laws & Regulations, News &Events, Special Programs, and Useful Links.

VII. Pilot Safety Index for Pedestrian Safety Funding Report

This deliverable is a pilot demonstration of an application for identification and prioritization of pedestrian countermeasures. A parallel application could be developed for bicycle countermeasures. The application, run in Microsoft Excel, is illustrated in the following screenshots. This report describes the application and documents its use. The application produces a quantitative estimate of the expected effect of a given countermeasure or combination of countermeasures at a specific location, based on the collision history of the location and Crash Reduction Factors (CRFs) from the Federal Highway Administration's (FHWA) *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes.*

The application was developed in association with the Caltrans-funded project *Evaluation of Safety Index Calculations*.

VIII. Caltrans Pedestrian/Bicycle Collision Causes and Countermeasures Study: Needs Assessment

Increasingly, communities throughout California are expressing a desire for safer and more accommodating walking and bicycling facilities. To meet this rising demand and in-line with a national paradigm shift toward more "Complete Streets," local jurisdictions are developing plans and seeking funds to implement pedestrian and bicycle projects.

However, with limited funding and resources, some communities are having greater success than others.

At the same time, Caltrans is increasingly focusing on the implementation of the agency's Complete Streets Deputy Directive 64 (revised). In addition to improving multimodal access and safety on state facilities, Caltrans has the opportunity to take the lead in revising policies and funding mechanisms which largely shape decision-making and funding availability at the local level.

This report documents an existing conditions baseline for pedestrian and bicycle safety programs, policies, and practices at both the local and state level in California. In reviewing the existing conditions, opportunities for adjustments and new initiatives are identified.

To gauge the level of resources and technical assistance for pedestrian and bicycle safety available to local agencies in California, as well as current practices within Caltrans itself, SafeTREC collaborated with Fehr & Peers and Caltrans to conduct surveys and interviews as a component of the overall project. This report summarizes the findings from the surveys and interviews and provides insight on the current successes and constraints experienced. The report also presents specific recommendations for programs, practices, policies, and funding allocations to enhance pedestrian and bicycle safety across the State.

IX. The Road To Great Walking & Bicycling Communities: Resources For Pedestrian & Bicycle Safety Programs

The Road To Great Walking & Bicycling Communities: Resources For Pedestrian & Bicycle Safety Programs summarizes the findings and recommendations gleaned in the Needs Assessment in a succinct and graphical manner. It is a deployable companion to the detailed Needs Assessment that can be printed and distributed.

The major recommendations in the report are:

- Allocate additional funding to pedestrian and bicycle projects
- Make grant applications more flexible and streamline the process
- Enhance the Pedestrian and Bicycle sections of the Caltrans website; Provide regular updates on funding cycles and deadlines on the Caltrans website
- Provide training to local agencies on how to fund and manage pedestrian and bicycle projects
- Enhance Local Assistance Offices' communication and collaboration with local jurisdictions
- Implement Deputy Directive 64 at all staff levels

Conclusion

Major barriers to implementing pedestrian and bicyclist safety countermeasures include lack of data, incomplete and non-reporting of collisions, and insufficient funding. SafeTREC created several pilot resources to address some of these barriers and made recommendations to address others at an institutional level. Each stand-alone resource requires maintenance and updates in order to remain useful.

Recommendations

- Improve countermeasure selection methods by increasing data collection and analysis
- Improve reporting of pedestrian and bicyclist collisions by expanding collisions reportable to SWITRS to include all non-traffic collisions, improve data collected by CHP, and compare SWITRS, FARS, and public health data (EMS, vital statistics, etc.)
- Supply local jurisdictions and Caltrans with user-friendly data analysis tools
- Supply local jurisdictions and Caltrans with timely and appropriate resources on pedestrian and bicyclist safety
- Enable local jurisdictions by streamlining grant applications and providing project management training and technical assistance
- Implement Deputy Directive 64 at all staff levels
- Allocate additional funding to pedestrian and bicycle projects

Appendices

The appendices contain the following deliverables in their entirety:

A. Literature Review: Existing Bicyclist and Pedestrian Safety Programs and Guidelines
B. Literature Review: Pedestrian and Bicyclist Countermeasures
C. Literature Review: Underreporting of Pedestrian and Bicyclist Collisions
D. Pedestrian Brochures
E. Location Analysis Website
F. Pilot California Pedestrian Safety Data Source Website
G. Pilot Safety Index for Pedestrian Safety Funding Report
H. Caltrans Pedestrian/Bicycle Collision Causes and Countermeasures Study: Needs Assessment
I. The Road to Great Walking and Bicycling Communities: Resources for Pedestrian and Bicycle Safety Programs

Appendix A

Literature Review: Existing Bicyclist and Pedestrian Safety Programs and Guidelines

Prepared by:

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UC Berkeley Safe Transportation Research & Education Center

July 2008

Contents

Introduction

With the increase of walking and bicycling as modes of transportation in California, pedestrians and bicyclists are requiring more protection on the road. Therefore, there is a need to develop and deploy safety programs to reduce the risk of injuries and fatalities for pedestrians and bicyclists. California is currently undergoing extensive planning to promote safe walking and bicycling.

To help California develop pedestrian and bicycle safety program and guidelines, this paper will review the existing and pedestrian safety programs and guidelines across the country. More specifically, this paper will review local, regional, state and national guidelines for safety program aspects such as: **data analysis, problem identification, countermeasure design, safety message marketing, and best-practices policies.**

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1. Local Guidelines

Boston: Pedestrian Safety Guidelines for Residential Streets

Boston Transportation Department (2001). Pedestrian Safety Guidelines for Residential Streets, Boston Transportation Department.

RESEARCH NOTES

The safety guidelines in this report focused on pedestrian safety in residential neighborhoods. It provides a policy framework and design guidelines. It begins with the community's role. Identification of a problem and a need for a project will come from a citizen's group. After the request, the Boston Transportation Department will evaluate the road to see if it meets BTD's criteria for improvement. If its criteria is acceptable, then the BTD will conduct a "before" study that will collect data which can be used as a baseline to measure the effectiveness of the project. After all data collection is complete, project alternatives will be proposed and evaluated. As for selection of projects, the guide gives priority to the schools, hospitals, community centers, parks and playgrounds, and senior centers.

The countermeasures featured in this guide to make residential streets safer were divided into two stages. In the first stage, the BTD will consider and implement low cost countermeasures such as, signage, turn restrictions, pavement markings, traffic signal adjustments, etc. After that the BTD will conduct an "after" study to evaluate the effectiveness of the changes. If the changes are deemed effective, the project is complete, otherwise, the project moves to stage two. In stage two, the BTD will consider physical changes to the roadways such as curb extensions, textured pavements, street lighting, etc.

URL

http://www.cityofboston.gov/transportation/accessboston/pdfs/pedestrian_safety_guidelines.pdf

Cambridge Pedestrian Plan

Cambridge, Cambridge Pedestrian Committee, et al. (2000). Cambridge Pedestrian Plan. Cambridge, Mass., City of Cambridge.

RESEARCH NOTES

In terms of data and analysis, the plan analyzes the percentage of the population that commutes by walking, pedestrian walking speeds. The guide also has an extensive collection of pedestrian facilities design guidelines and addresses traffic issues with regard to pedestrian safety. To identify problem spots, Cambridge encourages people to report places and situations that are difficult for pedestrians. Meanwhile, Cambridge has a pedestrian committee that reviews and compiles a list of problem spots for pedestrians that will be sent to city staff.

In addition, the guide also mentions the importance of public education programs. They believe that many pedestrians and motorists do not know basic safety rules. They plan to spread this information through schools, police, elder services, driver education classes, taxi companies and public service announcements. Another approach they suggest is incorporating the collection of pedestrian and bicycle data to the state public health system. Lastly, the guide suggests working with the DMV to ensure material on pedestrian safety is emphasized in manuals and tests.

The guide also endorsed the use of enforcement to create a safer environment for pedestrians. The guide suggests increased enforcement of traffic laws, investing in devices like traffic cameras. They also looked into rewriting traffic laws to make motorists stop for pedestrians instead of just yielding for them.

URL

http://www.cambridgema.gov/CDD/et/ped/pedplan/ped_plan_all.pdf
.

Davis Bicycling Plan

City of Davis (2001). City of Davis Comprehensive Bicycle Plan. Davis, CA, City of Davis.

RESEARCH NOTES

Because of the presence of UC Davis, bicycling has always been the mode of choice of many students, faculty and staff. Therefore, bicycle planning has been of great importance to the City of Davis and their guide should be one of the better examples. The guide uses the 4 E's: education, enforcement, engineering and encouragement.

For education, collision data analysis has shown that most of the accidents are attributed to the improper behavior of the bicyclist and/or motorist, therefore, an education program is required to correct the behavior. They plan to enhance programs that promote safe driving techniques, investigating other safety program to be taught to school children. Also, there is the development and promotion of "riding tips" clinic for new riders. The guide also suggests distributing bicycle maps and literature containing safety tips, laws etc.

For enforcement, the guide recommends increased training for officers to increase their sensitivity to bicycle issues.

In engineering, the plan has numerous goals. Of note, they want to remove debris from bike lanes, provide bike lanes on all arterial and collector streets. They have also been using signalization for bicyclists to help the bicyclists get through heavily used intersections. The plan also has design guidelines and standards, and claims to be more stringent than the guidelines posted by Caltrans.

URL

http://www.city.davis.ca.us/pw/pdfs/01bikeplan.pdf

Oakland Pedestrian Master Plan

City of Oakland (2002). Pedestrian Master Plan. Oakland, CA. City of Oakland.

RESEARCH NOTES

To make the City of Oakland a more pedestrian friendly environment, they have created this pedestrian master plan.

The City of Oakland's plan has extensive data analysis in their plan. Data they collected from the SWITRS database gave them information on areas of high collision, but they still rely on community outreach in order to find areas where pedestrians are avoiding.

The City of Oakland also emphasizes the "three E's". They created The Oakland Pedestrian Safety Project which is responsible for safety education. Their major activities include: Walk a Child to School Day, Pedestrian Safety Week, pedestrian safety training for children, and public relation campaigns. The Oakland Police has programs such as pedestrian right-of-way enforcements and pedestrian violation enforcement. Specifics about those programs were unavailable.

This master plan contains a significant collection of pedestrian facility design guidelines. They design guidelines are grouped in three different categories: Sidewalks, Crosswalks and Traffic Calming. Each category contains detailed description of treatments used to improve pedestrian facilities. These treatments include: signage, lighting, curb ramps, traffic circles, etc.

URL

http://www.oaklandnet.com/government/Pedestrian/PedMasterPlan.pdf

Portland Pedestrian Master Plan

Portland Pedestrian Transportation Program (1998). Portland Pedestrian Master Plan. Portland, OR., Portland Office of Transportation.

RESEARCH NOTES

The Portland Pedestrian Master Plan's purpose is to set up a 20-year structure for Portland's walking facilities. It is complimented by a pedestrian design guide that provides standards for pedestrian facilities. It also explains the process of placing priority on projects, which involves citizen input. They plan, however, does not have any data analysis nor does it have a way to market safety messages.

The plan does list some of its policies for pedestrian safety. These include street vacations, pedestrian transportation, pedestrian improvement on arterials, etc.

SITE

http://www.portlandonline.com/shared/cfm/image.cfm?id=38514

Toronto Bike Plan

City of Toronto (2001). City of Toronto Bike Plan: Shifting Gears. Toronto, City of Toronto.

RESEARCH NOTES

To double the number of bicycle trips made in Toronto by 2011 and reduce bicycle collisions and injuries, the City of Toronto created this bicycle plan.

Prior to development of this plan, the City of Toronto conducted a survey of over 1,000 residents to find measures that would increase bicycling. On the top of the list of concerns were careless bicyclists and drivers, and bicycle lanes. As for changes they would like to see, most said more bicycle lanes and more off-street bicycle paths. In addition to the survey, they have bicycle collision data from 1990-1999. With that data, they analyzed the scenarios where collisions are most likely to occur. They found most collisions occurred at intersections and driveway, mostly due to motorists turning. The region's coroner was also had a part in identifying the problem. By looking at the fatality victims, the coroner found that large vehicles like buses and trucks cause most of the fatalities.

The City of Toronto has a "six spokes" approach in their plan. They are: bicycle friendly streets, bikeway network, safety and education, promotion, cycling and transit, and bicycle parking. All of the spokes keep the wheel (a bicycle friendly city) rolling. Although no specific countermeasure design was discussed, the planned made many recommendations in each category to improve bicycling in the city.

The City of Toronto hopes to market and promote its message of safe bicycling through leadership. Along with promoting through the media and events such as Bike Week, they plan to set an example by first encouraging all of their employees to bike to work.

URL

http://www.toronto.ca/cycling/bikeplan/pdf/bike_plan_full.pdf

2. Regional Guidelines

Planning and Designing for Pedestrians: San Diego Region

San Diego Association of Governments (2002). Planning and Designing for Pedestrians: Model Guidelines for the San Diego Region. San Diego, CA, San Diego Association of Governments.

RESEARCH NOTES

This report is a design guideline for pedestrian oriented development. It provides the design specifications that would help make neighborhoods designed for pedestrians instead of motorists. They include crosswalk treatments, traffic calming etc. It is an extensive collection of the best practices and countermeasures that make the streets more pedestrian friendly. The guide however does not contain data analyze nor does it identify problems in their roadway network. The guide mainly focuses on design and does not have education and enforcement programs included.

URL

http://www.sandag.org/uploads/publicationid/publicationid_713_3269.pdf

3. State Guidelines

Florida Bicycle Facilities Planning and Design Handbook

Florida Department of Transportation (1999). Florida Bicycle Facilities Planning and Design Handbook. Tallahassee, FL, Florida Department of Transportation.

RESEARCH NOTES

In Florida, planning for bicycle facility begins with observing and gathering data on existing conditions. More specifically, they observe roadways that bicyclists avoid, obstructions that cause collisions and other impediments. They also suggest reviewing major traffic generators such as employment centers, schools, shopping centers, etc, for existing or potential problems. Data is also collected on the number of utilitarian cyclists vs. recreation cyclists, ages of the cyclists and experience of cyclists in order to design for the appropriate user. The plan also suggests public involvement is crucial to identifying problems and factors that affect bicycle transportation.

The Florida plan also contains an extensive and descriptive list of engineering countermeasures. For each measure, the guide explains how they work, the appropriate instances to apply them and the appropriate way to apply them.

URL

http://www.dot.state.fl.us/Safety/ped_bike/ped_bike_standards.htm

Florida Pedestrian and Planning Design Guidelines

University of North Carolina (1999). Florida Pedestrian Planning and Design Handbook. Chapel Hill, NC, Florida Department of Transportation.

RESEARCH NOTES

In an effort to increase walking in the State of Florida, they created this guide to help improve pedestrian facilities. It cited numerous reasons for the low number of walking trips. They included: accessibility, mobility, safety and pleasantness.

This handbook also outlines the pedestrian planning process. First is data collection and Analysis. This step involves gathering data on existing conditions and identifying problems. They suggest turning to census and highway safety agencies for data. Next, they will define objectives and alternative strategies. Then, they will examine them before adopting and designing.

The next section of the handbook highlighted issues and concerns for pedestrians. These included: visibility and detection, motorist yielding and stopping behavior, proper signage etc.

The following section of the handbook delved into the characteristics of pedestrian-motor vehicle crashes. It analyzes data to find the major types of pedestrian-vehicle crashes and the actions of the pedestrians before they were hit. The plan also breakdowns fatalities and injuries by age, lighting, and drug use.

The rest of the handbook has an in-depth discussion of use of different engineering strategies and countermeasures.

SITE

http://www.dot.state.fl.us/Safety/ped_bike/ped_bike_standards.htm

Michigan Pedestrian and Bicycle Safety Action Plan

Michigan Department of Transportation (2006). Michigan Pedestrian and Bicycle Safety Action Plan. Lansing, MI, Michigan Department of Transportation.

RESEARCH NOTES

In the Michigan Pedestrian and Bicycle Safety Action Plan, it started by analyzing state-wide pedestrian statistics. The plan used statistics to help find pedestrian and bicyclist safety issues in Michigan. Using statistics, they analyzed age groups and locations that had the highest pedestrian/vehicle and bicyclists/vehicle crashes.

This plan by the State of Michigan gave descriptions of the strategies they plan to use. They plan to clarify state pedestrian and bicycle laws, recognize jurisdictions and officials that have been actively decreased pedestrian and/or bicycle collisions; encourage the development of local multi-disciplinary/multi-agency safety task groups; research issues and trends with the state and research practices form other states.

For engineering measures, the plan does not have an extensive list of guidelines of how to design their facilities. Instead, it gave general strategies. Engineering strategies include, increasing pedestrian and bicycle safety funding, reviewing other safety programs and implement appropriate strategies from them.

The plan also contained strategies for enforcement and education programs. For enforcement programs, the plan suggests presenting pedestrian and bicycle safety issues at law enforcement meetings and forums, and expanding grant programs for them. For education, they seek to develop training resources on pedestrian and bicycle safety. This includes PPT presentations, development reference manuals for pedestrians and bicyclists. They also plan to create statewide media campaigns to increase public awareness.

URL

http://www.michigan.gov/documents/Ped-BicycleSafety3-7-06_162714_7.pdf

Oregon Bicycle and Pedestrian Plan

Oregon Department of Transportation (1995). Oregon Bicycle and Pedestrian Plan. Salem, OR.

RESEARCH NOTES

The Oregon Bicycle and Pedestrian Plan was developed to help agencies develop bikeway and walkway systems, explain laws, inform citizens and provided planning, designing and maintenance standards. The plan is split into two sections: policy and action plan, and design maintenance and safety. The goal of the plan is to "provide safe, accessible and convenient bicycling and walking facilities and to support and encourage increased levels of bicycling and walking." To achieve that, the plan contains design standards for their street network as well as financial assistance and other policies.

The plan, however, does show data analysis that was used to identify current safety problems and the scenarios that cause it. The plan provided engineering solutions to the problems appropriate practice and countermeasure to treat that problem.

Although the plan does not have any information on the implementation of education and enforcement solutions, the plan strongly encouraged the use of them.

URL

http://www.oregon.gov/ODOT/HWY/BIKEPED/docs/or_bicycle_ped_plan.pdf

Vermont Bicycle and Pedestrian Plan Wisconsin Pedestrian Policy Plan 2020

State of Vermont (1998). Bicycle and Pedestrian Plan. Montpelier, VT, State of Vermont Agency of Transportation.

RESEARCH NOTES

The Vermont Bicycle and Pedestrian Plan offered design guidelines, and policies to improve bicycling and walking as a mode of transportation. It does so through design of bicycle and pedestrian facilities and education program. Those facilities include traffic calming, roadway design, and multi-use paths.

Their education program involves extensive use of the media and schools, which is also a great way to promote their message of safety. The plan does not include implementation of enforcement programs, data analysis and problem identification.

URL

http://www.aot.state.vt.us/planning/Documents/Planning/bikeped1998.pdf

Pedestrian Facilities Guidebook

Washington Department of Transportation (1997). Pedestrian Facilities Guidebook: Incorporating Pedestrians into Washington's Transportation System. Kirkland, WA.

RESEARCH NOTES

This pedestrian guidebook by the Washington Department of Transportation focused on the design of pedestrian facilities. The guidebooks also discussed planning, education programs, and law enforcement programs. In the first part of guide, it discussed the overall condition of walking for pedestrians by analyzing crash severity of crashes versus vehicle speeds, and common characteristics of pedestrian collisions. It also discussed the needs of many different types of pedestrians.

This next part of this guidebook has detailed design treatments on creating an effective pedestrian system. It has facility design recommendations for accessibility, children/school zones, trails and pathways, sidewalks and walkways, intersections, crossings, traffic calming, transit access, and construction work zones.

Lastly, the guide lists its policies for encouraging pedestrian travel and facility design.

URL

http://ntl.bts.gov/lib/12000/12200/12220/12220.pdf

Wisconsin Pedestrian Policy Plan 2020

Wisconsin Division of Transportation Investment Management (2002). Wisconsin Pedestrian Policy Plan, 2020. Madison, WI, Wisconsin Dept. of Transportation, Division of Transportation Investment Management, Bureau of Planning.

RESEARCH NOTES

This report by the Wisconsin Department of Transportation outlines its steps to increase the numbers and quality of walking trips; decrease pedestrian crashes and fatalities; and increase planning and design guidance for local agencies. To achieve their goals, the State of Wisconsin subscribes to the "4-E's" of transportation safety. The Wisconsin Department of Transportation also encourages public involvement with problem identification, and review of plans during the draft and final stages.

In the next section, the report discussed current issues and concerns with pedestrian crashes and fatalities in Wisconsin. The report analyzed pedestrian/vehicle crash data and determined that age, speed and alcohol are the primary factors of Wisconsin's Pedestrian crashes. The plan also analyzed the severity of crashes in relation to vehicle speeds and the percentage of crashes for each posted speed limit. Furthermore, their appendix contained in-depth data analysis of pedestrian fatalities and crashes.

To increase pedestrian safety, the report implements their "4-E's" of transportation safety. Those are: Education, Engineering Enforcement and Encouragement. For education and enforcement, the plan offers grants and reimbursement programs to pedestrian/bicycle education and enforcement programs. They also distribute educational material for motorists and pedestrians to increase awareness of their rights and responsibilities. Lastly, they incorporate pedestrian safety into their motorists' handbooks and examinations. Because this report is a policy plan, no engineering countermeasures were reviewed. They provided general policies for each of the "4-E's" on how to improve pedestrian safety.

URL

http://www.dot.wisconsin.gov/projects/state/docs/ped2020-plan.pdf

4. National Guidelines

AASHTO Guide for the development of bicycle facilities

American Association of State Highway and Transportation Officials (1999). Guide for the Development of Bicycle Facilities. Washington, D.C., American Association of State Highway and Transportation Officials.

RESEARCH NOTES

This guide by AASHTO provides information on how to best accommodate bicyclists in the roadway. This guide mainly focuses on providing guidelines for design of bicycle facilities. Before a designing and planning is done, the guide suggests taking inventory of existing conditions.

For the planning aspects, the guide lists many factors for consideration when selecting a countermeasure. These factors include: skill level of bicyclists, motor vehicle parking, topographical barriers, crash reduction, stops, directness, traffic volumes and speed, etc. The planning section also encourages the use of education programs targeted at these four major audiences: Young bicyclists, parents of young bicyclists, adult bicyclists and motorists. In the design section of the guide, design specifications for are provided for the following bikeway classifications: Shared Roadways, signed shared roadways, bike lanes, shared use paths, and others. These specifications will help agencies design roads.

URL

http://www.communitymobility.org/pdf/aashto.pdf

How to Develop a Pedestrian Safety Action Plan

Zegeer, C. V., L. Sandt, et al. (2006). How to Develop a Pedestrian Safety Action Plan. Chapel Hill, N.C., Federal Highway Administration.

RESEARCH NOTES

This guide was developed to help local and state agencies develop their own pedestrian safety action plans. The first chapter of the guide described the big picture of planning and designing for pedestrian safety, which stressed the main problems and goals of pedestrian safety.

The second chapter of the guide covered stakeholder involvement. It goes over the major stakeholders, examples of good stakeholder involvement, strategies to answer their needs, and using stakeholders as a resource.

In addition to using stakeholders as resources to help identify problems, the third chapter of the guide covered collecting data and identifying pedestrian safety problems. This chapter showed the types of data to be collected. In particular, they highlighted Oakland's effort using geo-coded accident data. Other important data to be look at are police reports. Counts, behavior studies, roadway sidewalk inventories, census data, pedestrian surveys and level of service data were also listed as data that is helpful for identifying problems.

The fourth chapter reviewed how to prioritize the projects based the data collected and provides guidelines on how to seek and implement a solution.

The fifth chapter of the guide discussed the selection of solutions, which include policy, planning and design guidelines. It contains an extensive list of engineering countermeasures; enforcement and education programs that are effective in changing pedestrian and motorist behavior. Enforcement programs include: hot lines, neighborhood speed watches, speed trailers, photo enforcements, etc. For education, the guide suggests three public awareness campaigns, campaigns to targeted groups and situations and individual campaigns. The last category, policy and planning, includes land use policies, parking management, etc.

The sixth chapter of the guide focused on funding. It contains funding strategies (e.g. integrating pedestrian safety in new projects, annual maintenance budget); major funding sources (e.g. FHWA, community grants).

The last chapter contains the steps to create a safety action plan. The steps are laid as followed: 1) Define Objectives 2) Identify Locations 3) Select Countermeasures 4) Develop implementation strategy, 5) Institutionalize Changes to Planning and Design Standards. 6) Consider Land Use, Zonings and Site Design Issues. 7) Reinforcement Commitment 8) Evaluate Results.

The appendix part of the guide showed how to create and run pedestrian advisory boards, how to conduct pedestrian counts and behavior studies, assess pedestrian and motorist behavior, find funding, and evaluate a safety action plan. Furthermore the guide contains summaries of existing

reference guides and plans, and a checklist for engineering and planning solutions.

URL

http://drusilla.hsrc.unc.edu/cms/downloads/howtoguide2006.pdf

ITE: Design and Safety of Pedestrian Facilities

Institute of Transportation Engineers (1998). Design and Safety of Pedestrian Facilities. Washington, DC, Institute of Transportation Engineers.

RESEARCH NOTES

This report compiled by the Institute of Transportation Engineers examines design guidelines for safe pedestrian facilities. With the use of data, the report begins by identifying and explaining the typical safety problems of pedestrian facilities. They discuss which pedestrian group has the highest collisions and which pedestrian group has the highest likelihood of a fatality during a collision. They discuss the role of alcohol in impairing pedestrian and driver ability, as well as the locations and times collisions are more prevalent.

The next part of the report looks at the recommended practices. It gives design considerations for the roadway, pedestrians with disabilities, sidewalks and paths, signage, signalization, crosswalks, refuge islands, pedestrian barriers, curb parking, grade separated crossings, schools, traffic calming, pedestrian-orientated environments, and transit stops. For each of these categories, the report gives thorough discussion giving the reasoning and the resulting effects of each design element.

Although there is no detailed discussion of education and enforcement programs, the report acknowledges that there is a need for education and enforcement programs. It briefly states that comprehensive engineering, enforcement and education programs are essential to improving pedestrian safety.

URL

http://safety.fhwa.dot.gov/PED_BIKE/docs/designsafety.pdf

Table A 1. Comparison of Reviewed Pedestrian and Bicyclist Safety Plans

Plan	Data Analysis	Problem Identification	Countermeasure Design	Best Practices Policies	Safety Marketing Message
AASHTO Bike Guide	None	Inventory of Existing Conditions	Extensive Guidelines for engineering treatments and education program. The guide recognizes the importance of an enforcement program.	Extensive collection of best practices and policies	None
Pedestrian Safety Guidelines for Residential Street (Boston)	"Before and After" studies will be conducted for all projects	Problem ID comes from the citizen's group.	The guide only contains an extensive list of pedestrian facility design guidelines	Contains policy framework	Incorporated in their education program
Cambridge Pedestrian Plan	Only contains means of transportation. No collision data was collected or analyzed	Encourages citizens to report problems. Pedestrian Committee also reviews and compiles problem spots.	The guide contains engineering design guidelines, education programs and enforcement programs	Only for specific policies sidewalks	Incorporated in their education program
Davis Bicycle Plan	Contains collision data analysis.	Contains no plan for problem identification	Extensive discussion of education and enforcement programs. Has more stringent design guidelines and standards.	General policies for bicycling.	Incorporated in their education program
Oakland Pedestrian Master Plan	Extensive collision data collection and analysis.	Data analysis provides trouble spots. Community outreach is used to identify spots pedestrians avoid.	Significant collection of pedestrian facility design guidelines. Contains many established education and enforcement programs.	None	Established public relations campaigns
City of Toronto Bike Plan	Collected and analyzed survey and collision data	In addition survey and collision data, the regional coroner helped identify problems.	No specific countermeasure design guideline.	Contains policies on pedestrian safety and access, streetscaping/land use, education and others.	Promotes safety through media and leadership by having city employees bike to work.
Florida Bicycle Facilities Planning and Design	Inventory of existing conditions. Particularly obstructions that cause collisions and roadways the bicyclists avoid	Data on existing conditions are reviewed as well places that are major traffic generators. Public involvement is also key	Extensive list of engineering countermeasures. No specific information on enforcement. Has existing education programs.	General policies for bicycling.	Suggests community traffic safety events

FHWA: How to Develop a Pedestrian Safety Action Plan	Encourages the collection of geo-coded collision data, police reports, counts, behaviors studies, facility inventory and etc.	Problem ID comes from the data.	Engineering design guidelines refer to other documents.	In depth policy practices for street design, connectivity, access, and land use.	Incorporated in their education program.
Design and Safety of Pedestrian Facilities (ITE)	Used analysis of collision data.	Data identified the types, times and location of collisions.	Extensive list of planning and design guidelines complimented with education and enforcement programs.	Many policy recommendations	None
Michigan Pedestrian and Bicycle Safety Action Plan	Used analysis of statewide collision statistics.	Only used statistics.	Only general engineering, enforcement and education strategies.	None	Public awareness campaigns, standardized presentations.
Oregon Bicycle and Pedestrian Plan	Has little data analysis.	Uses non-comprehensive data to identify its problems.	Encourages education and enforcement. Comprehensive list of design measures.	Outlines current policies and practices	None
Portland Pedestrian Master Plan	None	Assessing needs comes from community outreach, crash locations, facility inventory and citizen requests.	Extensive list of engineering countermeasures. No extensive information on enforcement or education	A few policies listed	None
Planning and Designing for Pedestrians: Model Guidelines for the San Diego Region	None	None	Extensive list of engineering countermeasures. No extensive information on enforcement or education	Extensive collection of best practices and policies	None
Vermont Bicycle and Pedestrian Plan	None	None	Extensive list of engineering countermeasures. No extensive information on enforcement or education	Several recommended policies available.	Through education program
Florida Pedestrian Planning and Design Handbook	Inventory of existing conditions and analysis of collision and census data.	Based on data	Extensive list of engineering countermeasures. No extensive information on enforcement or education	Policy recommendations provided for many pedestrian scenarios.	Suggests community traffic safety events

Washington Pedestrian Facilities Guidebook	Collision Data Analysis	None	Extensive list of engineering countermeasures. No extensive information on enforcement or education	Policy recommendations provided for many pedestrian scenarios.	None
Wisconsin Pedestrian Policy Plan	Collision Data Analysis	Collision Data and public involvement	No engineering design guidelines. Education and enforcement programs are shown.	Extensive collection of best practices and policies	Distribution of educational material.

Appendix B

Literature Review: Pedestrian and Bicyclist Countermeasures

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July 2008

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Introduction

Many transportation agencies are focusing on reducing the number of collisions involving pedestrians and bicyclists in their upcoming projects. Accurate information on the efficacy of countermeasures at addressing these problems is essential in order to target investment in road safety measures effectively. Previous research suggests that a significant number of traditional countermeasures do not have the effects believed, and that some new technology or under-utilized items may carry greater effect. This literature review examines different studies concerning the accuracy and availability of data with respect to countermeasures for pedestrian and bicyclist crashes.

1. Countermeasures for Bicyclist and Pedestrian Crashes

A major problem concerning research in this area is a lack of quality data for the countermeasures. This argument is wonderfully summarized in a piece on the United States Department of Transportation Federal Highway Administration's website:

> "This report is based on a review of many evaluation studies of pedestrian safety initiatives, so it is useful to comment on the difficulties inherent in this kind of research and the study design problems that plague such research efforts.
>
> First, research on the effectiveness of pedestrian safety initiatives is inherently difficult because pedestrian crashes are generally quite rare at any given location; therefore, a study may not have enough data for numerical stability. It is common that years will pass between instances of a pedestrian-vehicle collision at a given site. While the rarity of pedestrian collisions at a site is fortunate, it makes the study of countermeasures difficult. To compensate for small numbers, investigators often aggregate data from many sites. Many intersections will be studied, and the study period will be extended for as long as possible because this is the only way that usable numbers of crashes can be accumulated. However, such aggregation of sites and long time periods creates other sources of crash variability, perhaps partly offsetting the benefit of the larger sample size.
>
> The other significant problem is the almost inevitable study design flaws in many research efforts. These critical study design flaws include selection bias and regression to the mean. These particular study design problems generally are encountered because of the procedures used to decide where to install treatments. Given limited funds and great needs, authorities earmark countermeasure sites based on some kind of priority procedure. It may be a formal warranting procedure, or an informal approach of placing the remedies where the problem is judged to be greatest. This latter procedure is prudent, and is completely justified from an operational standpoint. However, from a research standpoint it can be troublesome, especially in assessing pre- and post-treatment data.
>
> The problem is that the sites where the treatments are introduced were usually different from the comparison sites before the interventions were introduced. That is why the

> treatments were put there rather than somewhere else. This pre-existing difference is very likely to overwhelm the effect of the treatment. If the "after" experience is different from the "before" experience, one cannot know how much of the change was produced by the treatment and how much is a continuation of the pre-existing difference. A special case of selection bias is regression to the mean. If the pretreatment collision record is the basis for introducing an intervention at a particular site, and if the "worst" sites are selected for introduction of countermeasures, then the after-crash experience will be better than before the experience because of the operation of the probability phenomenon called "regression to the mean." When that particular flaw is embedded in a study design, one cannot know whether the favorable results are from the countermeasure, from the regression effects, or from a combination of the two.
>
> Many studies reviewed herein likely suffer from one or the other of these study design flaws. This is not said as a particular criticism of the study authors: Sometimes it is virtually impossible to carry out a study without such flaws, given the manner in which operational decisions are made to install treatments. If studies are to be done in a way that avoids these study design problems, it will be necessary to change the manner of deciding how treatments are to be introduced. These study design problems are not mentioned in many following reviews, but the reader should keep these cautions in mind in assessing the studies reported in the following discussion" (Part 3…).

There are several good sources, however, highlighted by the Pedestrian and Bicycle Crash Analysis Tool (PBCAT), BikeSAFE, and PedSAFE. These sources provide countermeasures for different crash types, approximate costs, ease of implementation, approximate effects, and case studies for each countermeasure. These are by far the most thorough practical resources for countermeasures in the area of pedestrian and bicycle crashes.

Throughout this review, the most common theme was that researchers had conjectures about countermeasures and no tangible or practical way to measure it. There is much theorizing about which countermeasures might help which crash types in different circumstances, but some of the new ideas (and old ideas, for that matter) are difficult to implement in measureable situations, and the data can be difficult to both quantify and use in an appropriate manner.

Having said this, the rest of the report contains an annotated bibliography listing some of the best sources in this area, a bibliography with some sources that could be helpful in certain situations or with more detail/data, and a bibliography with sources that came up in this process that were of little help or were not particular to this situation, and a numbered list of the sources. In an appendix is a list of the countermeasures found, a very coarse gauge of their cost, ease of implementation, effects on pedestrian and bicyclists safety, and which resources mentioned these countermeasures.

2. Annotated Bibliography: Pedestrian and Bicyclist Countermeasures

California Department of Transportation. "Pedestrian and Bicycle Facilities in California." 2005.

RESEARCH NOTES

The primary purpose of *Pedestrian and Bicycle Facilities in California—A Technical Reference and Technology Transfer Synthesis for Caltrans Planners and Engineers* ("Technical Reference") is to provide Caltrans staff with a synthesis of information on non-motorized transportation. It is intended that this "technology transfer" will assist the Department of Transportation in accommodating pedestrians and bicyclists on the state highway system throughout California, serving as a resource on policies, laws, programs, the Caltrans planning and design process, guidelines, and best practices.

The non-motorized transportation field consists of a complex and fast-evolving mix of policies, procedures, guidelines, and standards. These elements are currently located in multiple publications. The Technical Reference is a 'snapshot,' providing an overview as of April, 2005, and references to more detailed materials on particular topics

Relevant federal and state statutes and policies are summarized, as is the Caltrans planning process, regional and local planning efforts, and the project development process including facility design. A valuable tool for implementing these concepts is the "Context Sensitive Solutions" approach of involving stakeholders, in accordance with *Director's Policy on Context Sensitive Solutions (DP 22)*. Potential funding sources are described along with amounts, criteria, and typical applications. The Technical Reference portion concludes with concept sheets on pedestrian facilities, traffic calming, and bicycle facilities. These are followed by appendices on a variety of topics, including pedestrian and bicycle safety conditions in California.

A secondary goal of the Technical Reference is to provide policy and design support for the 'Smart Growth' concepts proposed by the FHWA. As population and vehicle miles traveled continue to grow, transportation planners, engineers, and policy makers are looking to non-motorized transportation, often in combination with transit, to relieve some of the pressure on the framework of the traditional transportation system. Good walking and bicycle facilities extend the reach of transit systems, provide mobility options, improve accessibility for all persons, and help encourage people to have active lifestyles. Safe and efficient non-motorized facilities are essential to the development of a balanced, integrated multi-modal transportation system in California.

URL
http://www.dot.ca.gov/hq/traffops/survey/pedestrian/TR_MAY0405.pdf

Institute of Transportation Engineers. Intersection Safety. "Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer – Chapter 8."

Institute of Transportation Engineers. Intersection Safety. "Pedestrian Safety At Intersections – Chapter 9."

RESEARCH NOTES

These briefing sheets concern various intersection safety-related topics. Their purpose is to enhance communications with the media, decision-makers, the general public and others about intersection safety. The primary audiences are decision makers and officials who are called upon to comment or make decisions on intersection issues.

1. Introduction
2. The Problem
3. Traffic Control Devices
4. Stop Signs
5. Traffic Signals
6. Engineering Countermeasures to Reduce Red-Light-Running
7. Using Red-Light Cameras to Reduce Red-Light-Running
8. *Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer*
9. *Pedestrian Safety at Intersections*
10. Older Drivers at Intersections
11. Pedestrian Design for Accessibility Within the Public Right-of-Way
12. Human Factors Issues in Intersection Safety
13. Access Management
14. Roundabouts
15. Road Safety Audits: An Emerging and Effective Tool for Improved Safety
16. Work Zone Intersection Safety
17. Intersection Safety Resources

URL

http://www.ite.org/library/IntersectionSafety/Pedestrians.pdf

http://www.ite.org/library/IntersectionSafety/toolbox.pdf

Johansson, Charlotta, and Lars Leden. "Short-term effects of countermeasures for improved safety and mobility at marked pedestrian crosswalks in Borås, Sweden." Accident Analysis & Prevention. Volume 39, Issue 3, May 2007, Pages 500-509.

RESEARCH NOTES

The Swedish code concerning car drivers' responsibility to give way to pedestrians was strengthened in 2000. The primary aim of this study is to evaluate the short-term effects of the change in code. Another goal is to look at the effects of the reconstruction of four sites in Borås, Sweden. One site had changes made prior to the change of code, two test sites had countermeasures implemented during the study, and one comparison site was left unchanged. All the sites were chosen because schools were situated nearby. The focus of the evaluation was on children and elderly as pedestrians and cyclists.

The goal of traffic calming of a 90 percentile driving speed below 30 km/h was *not* fulfilled at any of the test sites. A conclusion is that the height of a speed cushion is important. After the speed cushions were lowered from 70 mm to 55 mm, the 90 percentile speed increased from 34 km/h to 41 km/h. Sites with no speed cushions had much higher speeds.

The design of an intersection influences road users' behavior. At the site where one crosswalk was removed, pedestrians that were using the remaining marked crosswalk were given way to less frequently than at the other sites. At intersections where most pedestrians used marked crosswalks, the children benefited the most in mobility. At the intersection where pedestrians used marked crosswalks to a lower extent after reconstruction, children and the elderly had the smallest increase in frequency of being given way to. After reconstruction to a court-yard street, the pedestrians were given way to a lower extent compared with the other sites, though the vehicle speeds were the lowest observed at this study. At the sites were no physical changes were made, the change of code improved driver yield behavior, but no more towards children than other age groups.

URL

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-4MFK44M-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=0dc065d6184c21f351017c538b7cfe1f

Metropolitan Transportation Commission. "MTC Bicycle and Pedestrian Safety TAP – Final Program Summary." 2004.

RESEARCH NOTES

The Metropolitan Transportation Commission (MTC) initiated the Regional Pedestrian and Bicyclist Safety Technical Assistance Program (Safety TAP) project in the fall of 2002 to assist local agencies in improving bicycle and pedestrian safety. The Safety TAP's goal was to create a "culture of safety" by institutionalizing bicycle and pedestrian considerations into city policies and practices.

Four cities were identified and invited to participate as pilot agencies: Fremont, Napa, Santa Rosa, and Sunnyvale. The Safety TAP program began with the formation of a Regional Safety TAP working group for each city. Working groups consisted of city staff for various departments including planning, public works, police, and parks. Working group meetings were held to review program documents and provide feedback. City staff was involved throughout the duration of the Safety TAP. Staff attended working group meetings, assisted in the reviews of high-collision locations, and provided comments and feedback on documents prepared as part of the program.

The products of the Safety TAP analysis included:
• Bicycle and pedestrian collision analysis reports for each of the four pilot cities
• A summary of existing programs, policies, and procedures relating to bicycle and pedestrian safety
• A detailed set of recommended Safety Initiatives, ranked by priority
• An evaluation of several high-incidence bicycle and pedestrian collision locations in each jurisdiction
• A "toolbox" of bicycle and pedestrian countermeasures encompassing education, engineering, and enforcement strategies

URL
http://www.mtc.ca.gov/planning/bicyclespedestrians/files/SafetyTAPProgramSummary.pdf

Oxley, J.A., K. Diamantopoulou & B. F. Corben. Injury Reduction Measures in Areas Hazardous to Pedestrians, Stage 2: Countermeasure Evaluation. Monash University Accident Research Centre – Report #178 - 2001.

RESEARCH NOTES

Victorians have enjoyed substantial reductions in the annual numbers of pedestrians killed after 1989. Despite these excellent gains, the overall problem remains a serious community concern with 76 persons killed and some 736 persons seriously injured in 1999. A large part of the savings appears due to a general downward trend in Victoria's overall road toll after 1989. While pedestrians appeared to have benefited from measures targeted at drivers, pedestrian crashes in high activity/commercial centers still represent a long-standing problem for which few effective solutions have been found. It is suggested that innovative and comprehensive approaches are needed to moderate excessive vehicle speeds to uniformly lower levels in environments where there is high pedestrian activity.

An evaluation was undertaken in areas known to be hazardous to pedestrians utilizing a quasi-experimental before-after comparison of speed profiles and vehicle travel times following the implementation of speed moderating treatments. Large reductions of 7.5 km/h in average vehicle speeds over the full length of the treatment survey site were found. These were associated with estimated reductions of 2-3% in fatal pedestrian crashes and of 15% in serious injury pedestrian crashes. Mean speeds at locations within the survey site also reduced by 1.3 km/h. These reductions were associated with expected reductions of 11% in fatal, 8% in serious injury, and 5% in casualty pedestrian crashes. Furthermore, a significant reduction in the proportion of vehicles travelling at or above given speeds was found, particularly as vehicles entered the shopping precinct.

In summary, this evaluation demonstrated that small gains in speed reduction can lead to very valuable gains in road trauma for pedestrians in environments where there is high pedestrian activity. Innovative countermeasures, such as those evaluated here, provide a cost-effective approach to moderate vehicle speeds, resulting in general benefit to all road users, especially pedestrians.

URL
http://www.monash.edu.au/muarc/reports/muarc178.html

Ragland, David R., Allyson K. Bechtel, and Judy Geyer, "A Review of ITS-Based Pedestrian Injury Countermeasures" (December 19, 2003). *UC Berkeley Traffic Safety Center*. Paper UCB-TSC-RR-2003-09.

RESEARCH NOTES

Crashes between motor vehicles and pedestrians caused at least 4,882 deaths and about 78,000 injuries in 2001 in the United States. In recognition of these troubling statistics, many public and private institutions look to Intelligent Transportation Systems (ITS) technologies. Few resources are available to provide a comprehensive summary of the effectiveness of these options. This report reviews previous scientific evaluation of red light enforcement cameras, illuminated walk signal push buttons, automated pedestrian detection systems for traffic signals, flashing crosswalk lights, countdown signals, and animated eyes. The research and policy implications of these summaries provide guidelines for future research as well as a practical outline of options for transportation planners.

URL
http://repositories.cdlib.org/its/tsc/UCB-TSC-RR-2003-09

Ragland, David R., Emily S. Johnson, Jill F. Cooper, and Terri O'Connor, "Pedestrian and Bicycle Safety Evaluation for the City of Emeryville at Four Intersections" (August 1, 2005). UC Berkeley Traffic Safety Center. Paper UCB-TSC-RR-2005-23.

RESEARCH NOTES

The City of Emeryville is small in area (1.2 square miles) and population (7,000), but it is one of the most regionally connected cities in the Bay Area (California). Emeryville is situated at the eastern end of the San Francisco-Oakland Bay Bridge, contains the intersection of Interstate Highway 80 (I-80) with several regional and other interstate highways, and has extensive transportation access by Amtrak Rail, Alameda County (AC) Transit and heavy cargo facilities at the nearby Port of Oakland. The city has many large employers and several large shopping areas, and the daytime population swells to over 20,000. These factors produce a very high vehicle volume.

Additionally, Emeryville is an important segment of a number of regional pedestrian and bicycle trails including the future Union Pacific right of way (Emeryville Greenway) and the Bay Trail, which will extend across the new eastern span of the Bay Bridge. The completion of planned regional trails in the area will place Emeryville at the nexus of recreational pedestrian and bicycling activity for the area. These factors mean that pedestrian and bicycle travel is likely to increase dramatically.

The combination of very high traffic volume and increasing pedestrian and bicycle traffic raise concerns about safety for pedestrians and bicyclists. Taking a proactive stance, the City has decided to intensify analysis and planning for pedestrian and bicycle safety. As part of this effort, the city contracted with the Traffic Safety Center at U.C. Berkeley to conduct an in-depth review of pedestrian and bicycle safety issues at four key intersections in the heart of Emeryville:

- Powell Street and Frontage Road
- Powell Street and I-80
- Powell Street and Christie Avenue
- Christie Avenue and Shellmound Street

These intersections were selected because they are on major arterials in the city that connect the waterfront, shopping areas, eating areas, residential complexes and business sites, and they are expected to experience increased pedestrian and bicycle traffic.

The resulting report includes: (i) methods, (ii) major issues, (iii) approaches to countermeasures, and (iv) a detailed description of issues and recommended countermeasures.

URL
http://repositories.cdlib.org/its/tsc/UCB-TSC-RR-2005-23

Ragland, David R., Frank Markowitz, and Kara E. MacLeod, "An Intensive Pedestrian Safety Engineering Study Using Computerized Crash Analysis" (May 1, 2003). UC Berkeley Traffic Safety Center. Paper UCB-TSC-RR-2003-12.

RESEARCH NOTES

Over the past year, the San Francisco Department of Parking and Traffic (DPT) conducted an intensive pedestrian-safety engineering study, the PedSafe Study. PedSafe was funded by the Federal Highway Administration (FHWA)*, which also funded companion studies in Las Vegas and Miami. The study was designed to analyze pedestrian injuries by zones (i.e., neighborhoods or districts) and to identify those most amenable to prevention efforts. The DPT expects to utilize the methodology and information from the PedSafe study to help shape a citywide pedestrian master plan. This paper describes the technical procedures and the pedestrian countermeasure plan that resulted. The paper analyzes pedestrian injury problems both citywide and in study zones, using crash data and field observations. It also compares two software packages that can be used to analyze crash patterns: PBCAT1 (Pedestrian and Bicycle Crash Analysis Tool), which is available for no charge, and the CrossroadsTM2 package, available commercially. The countermeasure plan is described for multiple funding levels, and a plan is outlined for evaluation and public outreach. The countermeasure plan proposes basic traffic engineering countermeasures including advance limit lines, curb bulbs, impactable YIELD TO PEDESTRIAN signs, median refuge island improvements, modified signal timing, pavement stencils, pedestrian head start, pedestrian scramble, and vehicle left-turn phases. In addition, Intelligent Transportation Systems (ITS) countermeasures are recommended that include animated eyes signals, automated detection of pedestrians to adjust signal timing, modern flashing beacons, pedestrian countdown signals, radar speed display signs, roadway lighting improvements and smart lighting, and signal visibility improvements.

URL
http://repositories.cdlib.org/its/tsc/UCB-TSC-RR-2003-12

Retting, Richard A., Ferguson, Susan A., McCartt, Anne T. A Review of Evidence-Based Traffic Engineering Measures Designed to Reduce Pedestrian-Motor Vehicle Crashes. Am J Public Health 2003 93: 1456-1463

RESEARCH NOTES

We provide a brief critical review and assessment of engineering modifications to the built environment that can reduce the risk of pedestrian injuries.

In our review, we used the Transportation Research Information Services database to conduct a search for studies on engineering countermeasures documented in the scientific literature. We classified countermeasures into 3 categories—speed control, separation of pedestrians from vehicles, and measures that increase the visibility and conspicuity of pedestrians. We determined the measures and settings with the greatest potential for crash prevention.

Our review, which emphasized inclusion of studies with adequate methodological designs, showed that modification of the built environment can substantially reduce the risk of pedestrian–vehicle crashes.

URL

http://www.ajph.org/cgi/content/full/93/9/1456

United States Department of Transportation Federal Highway Administration. BikeSAFE – Bicycle Countermeasure Selection System. 2006.

RESEARCH NOTES

BIKESAFE is an expert system that allows the user to select appropriate countermeasures or treatments to address specific problems. BIKESAFE also includes a large number of case studies to illustrate treatments implemented in communities throughout the United States.

The system allows the user to refine his or her selection of treatments on the basis of site characteristics, such as geometric features and operating conditions, and the type of safety problem or desired behavioral change. The purpose of the system is to provide the most applicable information for identifying safety and mobility needs and improving conditions for bicyclists within the public right-of-way. BIKESAFE is intended primarily for engineers, planners, safety professionals, and decision makers, but it may also be used by citizens for identifying problems and recommending solutions for their communities.

BIKESAFE was designed to enable practitioners to select engineering, education, or enforcement treatments to help mitigate a known crash problem and/or to help achieve a specific performance objective. While the majority of the specific treatments are engineering countermeasures, many of the case studies include supplemental enforcement activities (e.g., a course that teaches police about enforcing bicycle safety) and/or educational approaches (e.g., educating people about riding on shared roadways or on roads with bicycle facilities). BIKESAFE uses known characteristics of the environment and permits the user to either view all countermeasures associated with a given objective or crash type or to view only those that are applicable to a defined set (as input by the user) of geometric and operating conditions. The objectives of the product are as follows:

- Provide information about bicycle crash types, statistics and other background resources.
- Provide user with information on what countermeasures are available to prevent specific categories of bicycle crashes or to achieve certain performance objectives.
- Outline considerations to be addressed in the selection of a countermeasure.
- Provide a decision process to eliminate countermeasures from the list of possibilities.
- Provide case studies of countermeasures introduced in communities throughout the United States.

URL
http://www.bicyclinginfo.org/bikesafe/treatments.cfm

United States Department of Transportation Federal Highway Administration. "Part 3. Overview of Pedestrian Crash Countermeasures and Safety Programs."

RESEARCH NOTES

This report is based on a review of many evaluation studies of pedestrian safety initiatives, so it is useful to comment on the difficulties inherent in this kind of research and the study design problems that plague such research efforts.

First, research on the effectiveness of pedestrian safety initiatives is inherently difficult because pedestrian crashes are generally quite rare at any given location; therefore, a study may not have enough data for numerical stability. It is common that years will pass between instances of a pedestrian-vehicle collision at a given site. While the rarity of pedestrian collisions at a site is fortunate, it makes the study of countermeasures difficult.

The other significant problem is the almost inevitable study design flaws in many research efforts. These critical study design flaws include selection bias and regression to the mean. These particular study design problems generally are encountered because of the procedures used to decide where to install treatments.

Many studies reviewed herein likely suffer from one or the other of these study design flaws. This is not said as a particular criticism of the study authors: Sometimes it is virtually impossible to carry out a study without such flaws, given the manner in which operational decisions are made to install treatments.

If studies are to be done in a way that avoids these study design problems, it will be necessary to change the manner of deciding how treatments are to be introduced. These study design problems are not mentioned in many following reviews, but the reader should keep these cautions in mind in assessing the studies reported in the following discussion.

URL
http://www.tfhrc.gov/safety/pedbike/pubs/03042/part3.htm

United States Department of Transportation Federal Highway Administration. "Pedestrian and Bicycle Crash Analysis Tool."

RESEARCH NOTES

Every year, scores of pedestrians and bicyclists are killed or injured in collisions with motor vehicles, exacting a terrible toll on individuals, families, businesses, and communities throughout the country. To respond to this national problem, the transportation community continues to develop innovative approaches to enhance the capacity of State and local coordinators, planners, and engineers to address traffic fatalities and injuries. The Pedestrian and Bicycle Crash Analysis Tool (PBCAT): Version 2.0 offers a dynamic and practical method for recording vital information about pedestrian and bicyclist crashes to produce diverse and useful reports. PBCAT also gives access to engineering, education, and enforcement countermeasures that represent promising procedures for mitigating crashes. The details PBCAT captures about crashes between motor vehicles and pedestrians or bicyclists, and the resources it presents, will further efforts of agencies nationwide to identify and select appropriate practices to improve pedestrian and bicyclist safety.

URL
http://safety.fhwa.dot.gov/tools/docs/pbcat.pdf
http://www.tfhrc.gov/safety/pedbike/pubs/06089/06089.pdf

United States Department of Transportation Federal Highway Administration. "PedSAFE – Pedestrian Safety Guide and Countermeasure Selection System." 2006.

RESEARCH NOTES

The Pedestrian Facilities User Guide—Providing Safety and Mobility (published in 2002) provided descriptions of 47 unique engineering countermeasures or treatments that may be implemented to improve pedestrian safety and mobility. Included for each of the 47 treatments were a general description, purpose or objective, considerations for implementation, and estimated costs. While that level of information alone is useful to engineers, planners, and other safety professionals, the guide also included two matrices that related the 47 treatments (plus two additional countermeasures of education and enforcement) to specific performance objectives and specific types of collisions. These matrices provide the practitioner with the ability to select the most appropriate treatment(s) if they have a well-defined crash problem or are trying to achieve a specific change in behavior.

This system is the next generation of the information just described. It includes an update of the content of the first version along with case studies that illustrate these concepts applied in practice in a number of communities throughout the United States. The most significant enhancement is the integration of the countermeasures and case studies into the Selection Tool. The tool allows the user to refine their selection of treatments on the basis of site characteristics, such as geometric features and operating conditions, and the type of safety problem or desired behavioral change. The purpose of the system is to provide the most applicable information for identifying safety and mobility needs and improving conditions for pedestrians within the public right-of-way. PEDSAFE is intended primarily for engineers, planners, safety professionals, and decision makers, but it may also be used by citizens for identifying problems and recommending solutions for their communities.

URL
http://www.walkinginfo.org/pedsafe/treatments.cfm

United States Department of Transportation National Highway Traffic Safety Administration. "Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices." 3rd Edition, 2008.

RESEARCH NOTES

This guide is a basic reference to assist State Highway Safety Offices (SHSOs) in selecting effective, science-based traffic safety countermeasures for major highway safety problem areas. The guide describes major strategies and countermeasures that are relevant to SHSOs, summarizes their use, effectiveness, costs, and implementation time, and provides references to the most important research summaries and individual studies.

The guide is not intended to be a comprehensive list of countermeasures available for State use or a list of expectations for SHSO implementation. For a description of an optimal State countermeasure program, SHSOs should refer to the *Highway Safety Program Guidelines*, which delineate the principal components of each of the major program areas.

States should identify problem areas through systematic data collection and analysis and are encouraged to continue to apply innovation in developing appropriate countermeasures. The evaluations summarized in this guide allow SHSOs to benefit from the experience and knowledge gained by others and to select countermeasure strategies that either have proven to be effective or that have shown promise. States choosing to use innovative programs can contribute to the collective knowledge pool by carefully evaluating the effectiveness of their efforts and publishing the findings for the benefit of others.

URL
http://www.nhtsa.dot.gov/portal/nhtsa_static_file_downloader.jsp?file=/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/HS810891.pdf

United States Department of Transportation National Highway Traffic Safety Administration. "Literature Review on Vehicle Travel Speeds and Pedestrian Injuries." 2006.

RESEARCH NOTES

In the U.S. during 1995, there were about 84,000 pedestrian injuries and 5,585 pedestrian fatalities (NHTSA, 1996), for an overall ratio of 15.0 injured pedestrians for every fatality. This ratio varied substantially as a function of posted speed limits, from 57.1 injuries per fatality on roadways with posted limits of 25 miles per hour or less to just 0.3 injuries per fatality for posted speed limits of 60 mph or higher.

While posted speeds are not necessarily the same as travel speeds or impact speeds, the data clearly suggest a strong relationship between higher vehicle speed and the greater severity of resulting personal injury.

This project had three objectives. First, to reaffirm and quantify the relationship between vehicle speeds and pedestrian crash severities through literature review and data analysis. Second, to describe techniques that have been used for reducing vehicle speeds and review their effectiveness. Third, to synthesize these results into recommendations for countermeasure programs to be tested in this country.

American and international literature related to vehicle speeds and crash results and to speed reduction and control strategies was reviewed. Over 600 potentially relevant references were identified. Articles were sought from libraries, authors, and publishers. Sources contacted in the U.S. included the Transportation Research Board (TRB), the Institute of Transportation Engineers (ITE), the Federal Highway Administration (FHWA), and researchers and traffic engineering practitioners. Foreign sources included individual authors and research organizations in Canada, Great Britain, France, Denmark, Austria, Finland, and South Africa. Additional countries represented in the research articles included Australia, Germany, The Netherlands, Greece, Norway, Sweden, Japan, Jordan, and Kuwait. Discussions were held with researchers and practitioners in the U.S. and abroad.

Also, analyses were conducted of existing crash record datasets. Three datasets were studied: NHTSA's General Estimates System (GES), a nationwide probability sample of police-reported crashes, for 1994 - 1996; State of Florida pedestrian crash data for the years 1993 - 1996; and NHTSA's Fatality Analysis Reporting System (FARS) crashes resulting in pedestrian fatalities for the years 1989 - 1997. GES and Florida data were analyzed to relate posted speed limits and vehicle travel speeds to injury severities. FARS data were analyzed to identify characteristics of these most serious pedestrian crashes.

URL
http://www.nhtsa.dot.gov/people/injury/research/pub/HS809012.html

Victoria Transport Policy Institute. "Identifying Ways to Improve Pedestrian and Bicycle Transport." 2007.

RESEARCH NOTES

Transportation Demand Management (TDM, also called Mobility Management) is a general term for strategies that result in more efficient use of transportation resources. This Encyclopedia is a comprehensive source of information about innovative management solutions to transportation problems. It provides detailed information on dozens of demand management strategies, plus general information on TDM planning and evaluation techniques. It is produced by the Victoria Transport Policy Institute to increase understanding and implementation of TDM.

This chapter describes pedestrian and bicycle planning strategies. Non-motorized Transportation (also known as Active Transportation and Human Powered Transportation) includes Walking, Bicycling, Small-Wheeled Transport (skates, skateboards, push scooters and hand carts) and Wheelchair travel. These modes provide both recreation (they are an end in themselves) and transportation (they provide access to goods and activities), although users may consider a particular trip to serve both objectives. For example, some people will choose to walk or bicycle rather than drive because they enjoy the activity, although it takes longer.

There are many specific ways to improve non-motorized transportation:

- Improve sidewalks, crosswalks, paths and bike lanes.
- Correct specific roadway hazards to non-motorized transport (sometimes called "spot improvement" programs).
- Improve Non-motorized Facility Management and Maintenance, including reducing conflicts between users, and maintaining cleanliness.
- Universal Design (transportation systems that accommodate people with disabilities and other special needs).
- Develop pedestrian oriented land use and building design (New Urbanism).
- Increase road and path Connectivity, with special non-motorized shortcuts, such as paths between cul-de-sac heads and mid-block pedestrian links.
- Street furniture (e.g., benches) and design features (e.g., human-scale street lights).
- Traffic Calming, Streetscape Improvements, Traffic Speed Reductions, Vehicle Restrictions and Road Space Reallocation.
- Safety education, law enforcement and encouragement programs.
- Integrate with transit (Bike/Transit Integration and Transit Oriented Development).
- Create a Multi-Modal Access Guide, which includes maps and other information on how to walk and cycle to a particular destination.

URL
http://www.vtpi.org/tdm/tdm25.htm

3. Annotated Bibliography: Other Sources Examined in Literature Review

Baker S, O'Neill B, Ginsberg M, Li G. The Injury Fact Book. 2nd ed. New York: Oxford University Press; 1992. http://www.health.state.ok.us/PROGRAM/injury/ComGuide/Pedestrian.htm

Bishai, David, and Adnan Hyder. "Modeling the cost effectiveness of injury interventions in lower and middle income countries: opportunities and challenges." http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1379660

Hunter, William W., J. Richard Stewart, Jane C. Stutts, Herman H. Huang, and Wayne E. Pein. Bicycle Lanes versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations. http://www.fhwa.dot.gov/tfhrc/safety/pubs/99035/99035.pdf

Martin, A. Factors Influencing Pedestrian Safety: A Literature Review. http://www.pedestrians-int.org/content/18/222006_p.pdf

North Carolina DOT. North Carolina Bicycle and Pedestrian Safety Study. http://www.ncdot.org/doh/PRECONSTRUCT/traffic/safety/reports/bikeped/bicycleped.pdf

Ragland, David R. and Meghan Fehlig Mitman, "Driver/Pedestrian Understanding and Behavior at Marked and Unmarked Crosswalks" (July 1, 2007). UC Berkeley Traffic Safety Center. Paper UCB-TSC-RR-2007-4. http://repositories.cdlib.org/its/tsc/UCB-TSC-RR-2007-4

TranSafety, Inc. Research Shows Need for Countermeasures to Reduce Pedestrian Fatalities on Interstate Highways. http://www.usroads.com/journals/p/rilj/9807/ri980704.htm

Zeeger, C. V., M. J. Cynecki, et al. (1985). Methods of increasing pedestrian safety at right-turn-on-red intersections. Federal Highway Administration Office of Safety, Washington D.C., 1985.

4. Annotated Bibliography: Other Sources Examined in Literature Review Not Directly Related to Topic

Blakey, L. T. Red-Light Cameras: Effective Enforcement Measures for Intersection Safety. ITE Journal March, 2003. pp: 34-43.

Crandall, J.C., K S Bhalla, and N J Madeley. Designing road vehicles for pedestrian protection. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1123098

FHWA. Bicycle and Pedestrian Planning Publications. http://www.fhwa.dot.gov/environment/bikeped/publications.htm

Hakkert, A. S., V. Gitelman, et al. (2002). An Evaluation of Crosswalk Warning Systems: Effects on Pedestrian and Vehicle Behaviour. Transportation Research Part F. 2002 pp: 233-250.

Hughes, D. R. G. Applying ITS Concepts to Pedestrian Requirements. ITS Quarterly Summer Issue, 1997 Summer Issue, pp 35-48.

Klop, J R, Khattak, A J. " Factors Influencing Bicycle Crash Severity on Two-Lane, Undivided Roadways in North Carolina." TRR 1674. http://trb.metapress.com/content/k5223q075621302l/

Metropolitan Planning Commission. Pedestrian Safety Resource Guide. 2004. http://www.google.com/url?sa=t&ct=res&cd=15&url=http%3A%2F%2Fwww.mtc.ca.gov%2Fplanning%2Fbicyclespedestrians%2FPEDSAFETYRESOURCEGUIDE.doc&ei=rX3PR-TRLarQpgS4pN2FBQ&usg=AFQjCNFm3OHMbbQ8gVGjL48jJvWm1MruvQ&sig2=pIugW_4NFLk6gv57sFygEQ

Michigan DOT. Michigan Pedestrian and Bicycle Safety Action Plan. http://michigan.gov/documents/Ped-BicycleSafety3-7-06_162714_7.pdf

NHTSA. National Strategies for Advancing Bicycle Safety. http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/bicycle_safety/

Ogden, KW. Safer Roads: A Guide to Road Safety Engineering. Ashgate Publishing Company, Brookfield, VT. 1996.

Plotkin, Wendy and Anthony Komornick. Bicycle-Motor Vehicle Accidents in the Boston Metropolitan Region: A Study of Reported Accidents Occurring Within Route 128 in 1979 and 1980. Metropolitan Area Planning Council

Portland Bicycle Master Plan. http://www.portlandonline.com/shared/cfm/image.cfm?id=40414

Portland Pedestrian Master Plan.
http://www.portlandonline.com/shared/cfm/image.cfm?id=90244

Schmitt, Kai-Uwe, Peter Niederer, Felix Walz. Trauma Biomechanics: Introduction to Accidental Injury. Chapter 9. Springer, 2004

Sciortino, S., M. Vassar, et al. (2005). "San Francisco pedestrian injury surveillance: Mapping, under-reporting, and injury severity in police and hospital records." Accident Analysis & Prevention 37(6): 1102-1113.

Somerford, Peter, Tom Pinder, Giulietta Valuri, Sylvie Price, Dr. Margaret Stevens. "Bicycle Injury Hospitalisations and Deaths in Western Australia 1981-1995. Injury Control Program, Disease Control Health Information Centre, Health Department of Western Australia. July 1998.

Stutts, J. C., W. W. Hunter, et al. Pedestrian Crash Types: 1990s Update. In Transportation Research Record 1538, TRB, National Research Council, Washington, DC, 1996. pp: 68-74.

USDOT FHWA. "Selecting Pedestrian Safety Improvements." 2002.
http://www.walkinginfo.org/library/details.cfm?id=3582

USDOT FHWA. Turner-Fairbank Highway Research Center.
http://www.tfhrc.gov/safety/pedbike/index.htm

Zaal, D. Traffic Law Enforcement: A Review of the Literature. Monash University Accident Research Center, Clayton, VIC, Australia. 1994

5. Numbered List of Sources

(1) California Department of Transportation. "Pedestrian and Bicycle Facilities in California." 2005.

(2) Institute of Transportation Engineers. Intersection Safety. "Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer – Chapter 8."

(3) Institute of Transportation Engineers. Intersection Safety. "Pedestrian Safety At Intersections – Chapter 9."

(4) Johansson, Charlotta, and Lars Leden. "Short-term effects of countermeasures for improved safety and mobility at marked pedestrian crosswalks in Borås, Sweden." Accident Analysis & Prevention. Volume 39, Issue 3, May 2007, Pages 500-509.

(5) Metropolitan Transportation Commission. "MTC Bicycle and Pedestrian Safety TAP – Final Program Summary." 2004.

(6) Oxley, J.A., K. Diamantopoulou & B. F. Corben. Injury Reduction Measures in Areas Hazardous to Pedestrians, Stage 2: Countermeasure Evaluation. Monash University Accident Research Centre – Report #178 - 2001.

(7) Ragland, David R., Allyson K. Bechtel, and Judy Geyer, "A Review of ITS-Based Pedestrian Injury Countermeasures" (December 19, 2003). *UC Berkeley Traffic Safety Center*. Paper UCB-TSC-RR-2003-09.

(8) Ragland, David R., Emily S. Johnson, Jill F. Cooper, and Terri O'Connor, "Pedestrian and Bicycle Safety Evaluation for the City of Emeryville at Four Intersections" (August 1, 2005). UC Berkeley Traffic Safety Center. Paper UCB-TSC-RR-2005-23.

(9) Ragland, David R., Frank Markowitz, and Kara E. MacLeod, "An Intensive Pedestrian Safety Engineering Study Using Computerized Crash Analysis" (May 1, 2003). UC Berkeley Traffic Safety Center. Paper UCB-TSC-RR-2003-12.

(10) Retting, Richard A., Ferguson, Susan A., McCartt, Anne T. A Review of Evidence-Based Traffic Engineering Measures Designed to Reduce Pedestrian-Motor Vehicle Crashes. Am J Public Health 2003 93: 1456-1463

(11) United States Department of Transportation Federal Highway Administration. BikeSAFE – Bicycle Countermeasure Selection System. 2006.

(12) United States Department of Transportation Federal Highway Administration. "Part 3. Overview of Pedestrian Crash Countermeasures and Safety Programs."

(13) United States Department of Transportation Federal Highway Administration. "Pedestrian and Bicycle Crash Analysis Tool."

(14) United States Department of Transportation Federal Highway Administration. "PedSAFE – Pedestrian Safety Guide and Countermeasure Selection System." 2006.

(15) United States Department of Transportation National Highway Traffic Safety Administration. "Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices." 3rd Edition, 2008.

(16) United States Department of Transportation National Highway Traffic Safety Administration. "Literature Review on Vehicle Travel Speeds and Pedestrian Injuries." 2006.

(17) Victoria Transport Policy Institute. "Identifying Ways to Improve Pedestrian and Bicycle Transport." 2007.

Table B 1. Countermeasure Summary Matrix

Category	Countermeasure	Cost	Ease of Implementation	Pedestrian Safety Impact	Bicycle Safety Impact
Facility Design	Marked Crosswalks	Low	Medium	Medium	N/A
	Pedestrian Flags	Low	Medium	Low	N/A
	Pedestrian Barriers	Medium	Low	Medium	Low
	Crosswalk Paving Treatments	Medium	Medium	Low	Low
	Raised Crosswalks	Medium	Low	Medium	N/A
	Automated Pedestrian Detection	High	Medium	Low	N/A
	Flashing Crosswalk	Medium	Medium	Medium	Low
	Speed Cushions	Medium	Medium	Low	Low
	Animated Eyes	High	Low	Low	Low
	Contraflow Bike Lanes	Low	Low	N/A	Medium
Roadway Design	Roadway Lighting Enhancements	Medium	Low	Medium	Medium
	Bicycle Lanes	Medium	Medium	N/A	Medium
	Wide Curb Lanes	Medium	Medium	N/A	Medium
	Installing Sidewalks	Low	Medium	High	High
	Rumble Strips	Low	Medium	Low	Low
	Midblock Traffic Signal	High	Low	Medium	Low
	Midblock Crosswalks	Medium	Medium	Medium	Low
	Chicanes/Chokers	Low	Medium	Low	Medium
	Improved Right-Turn Slip Lane Design	Medium	Medium	Medium	Low
	Serpentine Design	Medium	Low	Low	Low
	Paved Shoulders	Medium	Medium	N/A	Medium
Intersection Design	Advance Limit Lines	Low	High	Medium	Low
	Advance Yield Marking	Low	High	Medium	Low

	Additional Lanes at Intersections	High	Low	N/A	N/A
	Pedestrian Refuge	Medium	Medium	Medium	N/A
	Curb Extensions	Medium	High	Low	Low
	Roundabouts	High	Low	Medium	Low
	Pedestrian/Bicycle Overpasses	High	Low	High	High
	Curb Radius Reduction	Medium	Medium	Low	Low
	Modified T-Intersection	Medium	High	Low	Low
	Mini-Circles	Medium	Medium	Medium	Medium
	Raised Intersections	Medium	Low	Medium	Low
	Diverters	Medium	Medium	Low	Low
	Sight Distance Improvements	Medium	Low	Medium	Medium
	Merge/Weave Area Redesign	High	Low	Low	Medium
Traffic Management	Modified Signal Timing	Low	High	Low	Low
	Pedestrian Head Start	Low	High	Medium	Low
	Pedestrian Scramble	Low	High	Low	Low
	Vehicle Left Turn Phases	Low	High	Medium	Medium
	Convert Two-Way Streets to One-Way	Low	Medium	Medium	High
	Pedestrian-Only Streets	Low	Medium	High	Low
	Diagonal Parking	Low	High	Low	Low
	Bicycle Boulevards	Low	Medium	Medium	High
	Assuming Slower Walking Speeds	Low	High	Low	N/A
	Restriction of RTOR	Low	High	Medium	Low
	Removing Traffic Lanes/Retrofitting	Medium	Medium	Low	Medium
	Removing Vehicle Parking	Medium	Medium	Medium	Low
	Transit Stop Treatments/Relocation	Low	Medium	Low	Low
	Street Furniture/Walking Environment	Medium	Medium	Medium	Low

	Gateways	Medium	Medium	Medium	Low
	Landscaping/Woonerf	Medium	Medium	Medium	Low
	Access Management	Medium	Medium	Medium	Medium
Signals and Signs	Adding Signs	Low	High	Medium	Low
	Countdown Signal	Medium	High	Low	N/A
	Illuminated Push Button	Medium	High	Low	N/A
	Add Stop Lights/Signals	Medium	Medium	Medium	Low
	Audible Signals	Medium	High	Low	N/A
	Bicycle Signals	Medium	Medium	N/A	Low
Education/Enforcement/Maintenance	Increased Enforcement	Medium	Medium	Low	Low
	Red Light Camera	High	Medium	Medium	Low
	Crossing Guards at Schools	Medium	Medium	Low	N/A
	Safe Routes To School	Medium	Medium	Medium	N/A
	Pedestrian/Driver Education	Medium	Low	Medium	Low
	Radar Speed Display Sign	Medium	High	Low	Low
	Reduce Speed Limits	Low	Medium	Low	Medium
	Roadway Surface Improvements	High	Medium	Low	Low

Table B 2. Literature resources by Countermeasure

Category	Countermeasure	Sources (*PBCAT (13) incorporates PedSAFE (14) and BikeSAFE (11))
Facility Design	Marked Crosswalks	2 3 4 5 6 8 9 10 12 14 17
	Pedestrian Flags	1 12 14 17
	Pedestrian Barriers	1 2 3 5 6 10 12 14 17
	Crosswalk Paving Treatments	4 6 8 12 14 17
	Raised Crosswalks	1 2 3 5 6 12 14 17

	Automated Pedestrian Detection	1 2 7 9 10 12 14 17
	Flashing Crosswalk	1 2 3 5 7 9 10 12 14 17
	Speed Cushions	1 10 12 14 16 17
	Animated Eyes	2 5 7 9 12 14 17
	Contraflow Bike Lanes	11
Roadway Design	Roadway Lighting Enhancements	1 2 3 5 8 9 10 11 12 14 15 17
	Bicycle Lanes	1 11 15 17
	Wide Curb Lanes	1 11 17
	Installing Sidewalks	1 10 12 14
	Rumble Strips	11 14
	Midblock Traffic Signal	1 2 5 12 14 17
	Midblock Crosswalks	1 2 5 12 14 17
	Chicanes/Chokers	1 2 5 11 12 14 16 17
	Improved Right-Turn Slip Lane Design	1 2 3 5 11 12 14 17
	Serpentine Design	1 3 11 12 14 17
	Paved Shoulders	1 11 12 14 17
Intersection Design	Advance Limit Lines	2 3 5 9 10 12 14 17
	Advance Yield Marking	2 3 5 12 14 17
	Additional Lanes at Intersections	3
	Pedestrian Refuge	1 2 3 5 8 9 10 12 14 17
	Curb Extensions	1 2 3 5 8 9 11 12 14 17
	Roundabouts	1 2 3 5 10 11 12 14 16 17
	Pedestrian/Bicycle Overpasses	10 11 12 14 17
	Curb Radius Reduction	1 2 3 5 9 11 12 14 17
	Modified T-Intersection	1 14
	Mini-Circles	1 12 14 17

	Raised Intersections	1 2 3 5 11 12 14 17
	Diverters	11 12 14 17
	Sight Distance Improvements	11 14 17
	Merge/Weave Area Redesign	1 3 11 14 17
Traffic Management	Modified Signal Timing	1 2 3 5 8 9 10 11 12 14 17
	Pedestrian Head Start	8 9 10 12 14 17
	Pedestrian Scramble	9 12 14 17
	Vehicle Left Turn Phases	3 5 8 9 11 12 14 17
	Convert Two-Way Streets to One-Way	1 3 11 12 14 17
	Pedestrian-Only Streets	3 12 14 17
	Diagonal Parking	3 10 11 14 17
	Bicycle Boulevards	11 12 17
	Assuming Slower Walking Speeds	12 14 17
	Restriction of RTOR	1 3 5 8 12 14 17
	Removing Traffic Lanes/Retrofitting	11 12 14 17
	Removing Vehicle Parking	1 5 11 12 14 17
	Transit Stop Treatments/Relocation	2 3 10 11 12 14 17
	Street Furniture/Walking Environment	1 2 11 12 14 16 17
	Gateways	1 2 11 12 14 16 17
	Landscaping/Woonerf	1 2 11 12 14 17
	Access Management	2 11 12 14 17
Signals and Signs	Adding Signs	1 2 3 5 6 8 9 10 11 12 14 15 17
	Countdown Signal	1 2 3 5 7 8 9 12 14 17
	Illuminated Push Button	1 2 3 5 7 12 14 17
	Add Stop Lights/Signals	1 2 3 10 12 14 17
	Audible Signals	1 2 3 5 12 14 17

	Bicycle Signals	11 17
Education/Enforcement/Maintenance	Increased Enforcement	3 5 8 11 12 14 15 17
	Red Light Camera	1 2 3 5 7 12 14 17
	Crossing Guards at Schools	11 12 14 15 17
	Safe Routes To School	11 12 14 15 17
	Pedestrian/Driver Education	3 11 12 14 15 17
	Radar Speed Display Sign	9 12 14 17
	Reduce Speed Limits	3 6 8 12 14 17
	Roadway Surface Improvements	1 2 3 11 12 14 17

Appendix C

Literature Review: Underreporting of Pedestrian and Bicyclist Collisions

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Contents

Introduction

Many transportation agencies are focusing on limiting the number of road collisions in their upcoming projects. Accurate information on the collisions that have occurred is essential in order to target investment in road safety measures effectively. Previous research suggests that a significant number of road collisions are not reported to the police and are therefore not available on the state or national level. This literature review looks at different studies concerning the under-reporting of traffic collisions with regard to pedestrians and bicyclists.

1. Underreporting of Pedestrian and Bicycle Collisions

The table that comprises Appendix A is a summary of studies done on under-reporting in the past. It summarizes the data compared, the year and location of the study, the sample size, the percent reported by severity and the percent reported by mode. Bolded are numbers of particular interest to this study.

Throughout the studies, the following table summarizes the most common finding pertaining to the general concern of underreporting.

Fatal	90-100%
Serious	60-75%
Slight	40-60%
All	50-70%

The numbers for pedestrian collisions are also higher than the percentage of bicycle collisions reported. Typical pedestrian crashes reported percentages range from 55-70% while typical bicycle crashes reported percentages range from 40-60%. One possible explanation for this is that bicycle crashes are typically less serious in nature, although this claim has been disputed throughout the literature (James 1991). Another more common explanation is that most states and countries require motor-pedestrian collisions to be reported, while no such requirement exists for motor-bicycle collisions.

Certain factors have been found to affect the probability of a pedestrian-motor or bicycle-motor crash being reported. After moving past the obvious characteristic of severity of injury, African-Americans were less likely than Caucasians to have a police report filed, and women were more likely than men to have a police report filed in a study of over 2000 collisions in San Francisco (Sciortino 2005). In 2006 however, Sciortino discovered that among severe collisions the rates were approximately the same for serious injuries and fatalities; minor collisions made up for most of the difference. Stutts and Hunter stated that a collision occurring in the roadway is more likely to be reported than one that occurs in a driveway, parking lot, or other off-road location, and the difference was significant. This was an important finding because as part of the study,

they found that 12% of all pedestrian-motor crashes that required serious and immediate medical attention occurred off-road. They also reported that age also played a role, as teens and young adults from 15-24 were more likely to have their collisions reported than other age groups (Stutts and Hunter 1998).

One particular study with particular significance to this project is the 2005 study completed by Sciortino, et al. The data they collected were based on police-reported incidents and from San Francisco General Hospital (the only trauma center in San Francisco). These data were used to estimate the level of underreported injuries, to estimate underreporting by ethnicity, and to estimate pedestrian injury rates by ethnicity. Using SWITRS (Statewide Integrated Traffic Records System) as the main source of data for San Francisco, 1,909 pedestrian-motor injury collisions were reported during 2000 and 2001. An additional 531 pedestrian injuries were reported at SFGH, meaning that there were at least 21.8% additional pedestrian-motor injury collisions in the city during those two years that were not included in the police data.

Brustman, in a 1999 report for the New York Bicycling Coalition, stated that bicyclists do not have the insurance claim incentive to file their collisions with the local police. He also estimated that at least one-third of bicycle-motor collisions are in no traffic collision database. He also states that systems for collecting bicycle and pedestrian collision data are fairly good, but there are several problems still, namely that the underreporting of bicycle collisions, compared to motor vehicle collisions occurs due to differences in collision definitions, in reporting criteria, and in public awareness of reporting requirements, that not all collected data is processed, meaning that it does not become available for analysis, and finally, that routine bicycle and pedestrian collision analyses and surveillances are few and limited in scope.

He also stated that "further, research indicates even serious bicycle collisions are underreported. This is especially so if a moving vehicle is not involved though the collision is reportable by law or regulation." The current reporting system is oriented to bicycle and pedestrians with moving motor vehicles on public roads. Bicycle-only collisions on public roads and any collision on private roads need not be reported. He concluded that a final major impediment to the capture of good data is that the bicycling population, in general, is largely unaware that there is even a reporting system.

In another study within the United States, a report was derived from a probability sampling of emergency room visits to 42 hospitals in northeastern Ohio. The authors were able to identify police crash reports for only 55 percent of the patients treated for injuries received in a motor vehicle crash; among those hospitalized, 74 percent were matched. In some international case studies, results vary greatly. In Western Australia, 69 percent of pedestrians and 74 percent of bicyclists admitted to hospitals were linked to official police records (Rosman and Knuiman, 1994). It was also discovered that the linkage rate of hospital records to a police record was higher for cyclists living in the metropolitan region, for males, for older cyclists and for those with longer stays in hospital.

One study in the U.K. found that 42 children were brought for medical attention with driveway-related injuries in a period just over four years. These represent 12% of all children admitted with pedestrian-motor vehicle injuries. Fourteen deaths were reported to the 12 years, accounting for 8% of all pediatric pedestrian-motor vehicle deaths reported to the registry. Typically, the

injury involved a parent or relative reversing a motor vehicle in the home driveway over a toddler or preschool-age child in the late afternoon or early evening.

In another study in Japan, the authors found that "underreporting of vehicle occupant injuries in children was greater than for pedestrian injuries: the ratio of the police data to the insurance data was 0.48 in preschoolers. At least twice as many children as officially reported received medical examinations and/or treatments for vehicle occupant injuries, whereas the ratios of the police data to the insurance data in adults ranged from 0.87 to 0.96. In contrast, pedestrian injuries of all age groups were not severely underreported: the ratios were nearly 1.0 (ranging from 0.93 to 1.03), including preschoolers and school age children" (Nakahara and Wakai 2001).

In a study conducted in New Zealand, numbers of hospital admissions over a ten-year period were compared to numbers of police-reported road collision victims (Morrison and Kjellstrom 1987). The proportion of police reported to hospital reported road collision cases declined over the ten-year study period from 66% to 43%. A study in the Netherlands yielded higher overall percentages of 78% for pedestrians and 82% for bicyclists (Maas and Harris, 1984); however, Harris (1990) noted that these percentages had declined to less than 70% by the late 1980s. Lower proportions were also reported in two other European studies that looked only at bicyclists: one study in Germany found that only 30% of hospitalized bicyclists and 20% of bicyclists receiving outpatient treatment only had been reported (Hautzinger et al., 1993), while an earlier British study had reported 24% for bicyclists receiving either inpatient or outpatient treatment (Bull and Roberts, 1973).

A study of California children estimated that police reports only cover 80 percent of hospital admissions (Agran 1990). Under-reporting by police is conservatively estimated at 20% for pedestrians and 10% for cyclists. In Germany the figures are 50 percent for major injury and 35 percent for minor (Hautzinger 1993). In 1998, Agran found that the following family and cultural variables were associated with an increased risk of injury: household, one or more family moves within the past year, poverty, and inability of mother or father to read well. "However, children in single parent households and children whose parents did not drive a car, had less education, or were of rural origin, did not have an increased rate of injury" (Agran 1998).

In another study of pedestrian injuries in San Francisco, Sciortino (2006) found that pedestrians were far more likely to be killed in traffic collisions than other injured parties. Pedestrians accounted for 54% of all traffic fatalities. "The odds of being fatally injured were 27 per 1000 for pedestrians versus 4 per 1000 for drivers or passengers in San Francisco in the years 1992 through 2003 according to SWITRS data." Also, collisions that occurred when the driver was under the influence of drugs or alcohol were nearly three times as likely to result in fatal injury to the pedestrian when compared to collisions involving a pedestrian violation. In collisions where the driver was speeding or driving under the influence, or where the pedestrian was intoxicated, injury to the pedestrian tended to be more severe compared to incidents involving any other type of traffic violation. "Collisions involving pedestrians who were under the influence of drugs or alcohol were strongly correlated with pedestrian fatalities; in such cases the odds of pedestrian fatality vs. minor injury were 5 times greater than for incidents involving other types of violations…however, it is likely that intoxication among pedestrians in *non-fatal* incidents may be underreported; while the San Francisco Office of the Chief Medical Examiner tests a high proportion of the deceased for the presence of drugs or alcohol, non-fatally injured pedestrians are infrequently tested."

There was also a positive correlation was found between the severity of injury and the age of a pedestrian. “Pedestrians over the age of 65 were roughly 9 times more likely to suffer a fatal injury than the 2 younger age groups: those between 18 and 65 years old and those under 18 years.” In addition, the odds of an elderly person sustaining a fatal or severe vs. a minor injury were nearly 4 times greater than for the younger age groups (Table 1b). Lastly, in regards to vehicle movements at the time of the collision, it was discovered that a vehicle driving straight or passing another vehicle prior to a collision with a pedestrian is more likely to result in the pedestrian's death than an incident where the vehicle is turning right or left. This is due to the higher speeds achieved when a motorist drives along a straightaway.

Statistics from the European Union suggest that underreporting of collisions varies among countries. The underreporting of traffic fatalities varies from 5-12% in Germany, the Netherlands, and France. For Italy, the underreporting of traffic fatalities is estimated at 26%. Underreporting of hospitalized casualties is estimated to vary between 30 and 60%.

Underreporting is also more widely seen in undeveloped countries: “Trend data showed that the total number of people killed in road crashes in regions of the developing world continued to increase, whereas in the West there has been a steady decrease over the last fifteen years or so. For example, between 1987-1995 deaths in the Asia-Pacific rose by 40 per cent, in Africa by 26 per cent (excluding South Africa where the increase was minimal) and the Middle East/North Africa region by over 36 per cent. Road deaths doubled in a few Latin America countries and rose by 16 per cent in Brazil. Conversely road deaths in highly motorized countries fell by about 10 per cent over the same period” (Jacobs 2000).

2. Reporting Practices and Policies and Attempts to Increase Reporting

Recently, the San Francisco Municipal Transportation Agency has introduced a plan to improve the reporting of bicycle and pedestrian collisions. The plan includes the following steps:

Action 6.11
Develop a system for hospitals, emergency rooms, and clinics to report all instances of bicycle injury to the SFPD and to the DPT Bicycle Program Manager.

Action 6.12
Implement a system to allow cyclists to report collisions directly to the Bicycle Program website.

Action 6.13
Inform cyclists that they are legally entitled to file a collision report when one is not initiated by the police.

Action 6.14
Develop a standardized procedure for reporting San Francisco Municipal Railway (Muni) bicycle-related incidents and make this information more transparently available to the Bicycle Program.

Their hopes to increase the reporting rate are based on several factors from multiple studies. For the last several years, the San Francisco Department of Public Health has been working on an injury data linkage project using hospital admission data. Currently, San Francisco General Hospital (SFGH) is not obligated to report bicycle injuries to the SFPD. This is left up to the injured parties. EMS (ambulance services) is supposed to report bicycle injuries, but many are not reported. Comparing police collision reports with SFGH emergency room visits or hospital admissions shows that approximately 20 percent of pedestrian injuries (caused by a collision with a motor vehicle) did not show up in police collision reports in 2000 and 2001. The rate for bicycle injuries is probably similarly under-reported. While the SWITRS details 412 bicycle-related collisions for San Francisco in 1998, the Profile of Injury in San Francisco, published by the Department of Public Health Injury Center (www.tf.org) shows that the San Francisco Fire Department EMS Division responded to 441 incidents in which bicyclists were injured in 1998. Anecdotal evidence comes from collisions or near-misses that resulted in very minor or no injury, but were still caused by some of the same unsafe roadway behaviors outlined in this chapter.

"The City should work to educate law enforcement officers and bicyclists about bicyclists' legal right to file a police report about collisions or threatening behavior by motorists. It is not mandatory to report a bicycle/automobile collision to the police. It is only mandatory if an assault is suspected. In addition, there is an issue of breach of confidentiality if collision data is reported without the patient's consent. Therefore, improved injury reporting and coordination between departments is necessary. Collecting this data is also important because communities seeking funding for education or enforcement activities for bicycle safety have to use EMS,

emergency room, or hospital discharge data to show seriousness and number of bicycle and/or pedestrian crashes in addition to "reportable" ones" (SFMTA 2005).

Again, the European Road Safety Observatory is attempting to be a leader in this field. They have put a plan in place to attempt to counteract underreporting:

"The objective of Task 1.5 of the SafetyNet IP is to estimate the actual numbers of casualties in Europe from the CARE database by addressing the issue of under-reporting and differences in national systems for injury classification. The Task will attempt to:

1. Estimate the under-reporting level for each casualty severity (killed, seriously injured, slightly injured) by developing a uniform methodology and applying it in several EU countries.

2. Estimate in each country the number of casualties according to a new common measurement unit.

The results from this Task will expand the scope of EU road collision analyses considerably. It will become possible to make meaningful analyses of non-fatal collisions and casualties. This will allow consideration of road safety to extend beyond the current focus on fatal collisions. Moreover, the increased size of the data sets will reduce the effects of chance, thereby permitting more detailed analyses to be carried out" (ERSO 2007).

They are also attempting to put in place a more uniform system for reporting collisions, due to problems they have fun into while completing the current analysis. "Currently, the only comparable EU road safety data are the numbers of fatal collisions and of people killed, where the degree of under-reporting is acceptably small in most EU Member States and there is a common injury classification. The same is not true of non-fatal collisions and of people with non-fatal injuries. At present the numbers of non-fatal collisions and of people seriously and slightly injured cannot be compared in different EU Member States. In addition, the definition of injury severity differs among member states, so that a casualty which would be recorded in one country might not be recorded in another, while a casualty which might be recorded as 'serious' in one country might be recorded as 'slight' in another" (ERSO 2007).

They go on to detail the plan:

A method has been developed to enable inclusion of non-fatal collision in EU collision comparisons. This method consists of comparing (a) those road collision victims who have been recorded in the national collision database, with (b) those who have been recorded in medical records maintained by hospitals. Based on such a comparison, for each country, the actual number of non-fatal casualties can be estimated from the registered number. Comparison with hospital data is a vital step since hospital data provide a more overview of all traffic injured than the national collision databases and, moreover, also provide a more detailed view of the types of injuries. Data collection procedures can be improved by training persons involved and by application of new methods in the data collection procedure. More information is available at http://euroris.swov.nl/data/content/studies_about_underreporting.htm.

Brustman (1999) also had a vague suggestion as to improving the current system in New York, and his prose on the topic is now where most of the literature stands. "Simple improvements to

data systems are administratively and financially possible: recommended remedial actions are within the existing administrative authorities of overseeing state agencies. Programs in [the principal federal transportation legislation] mean to encourage safety data systems improvement and offer financial assistance to states for system upgrades."

Within the state of California, there are several possible methods for improving the reporting of pedestrian and bicycle collisions. The studies that have been completed have basically done this; they have used other data sources to complement the base record and compare the collisions recorded within each system. Utilizing these methods on a continuous basis, instead of for the small sample of a study, would give more realistic results for the true number of bicycle and pedestrian collisions.

There are several recording systems in place that could be used to more completely record pedestrian and bicycle collisions. For example, Fatality Analysis Reporting System (FARS) contains data on a census of fatal traffic crashes. To be included in FARS, a crash must involve a motor vehicle travelling on a roadway customarily open to the public and result in the death of a person (occupant of a vehicle or a non-occupant) within 30 days of the crash. FARS collects information on over 100 different coded data elements that characterize the crash, the vehicle, and the people involved.

Another system is SWITRS (Statewide Integrated Traffic Records System), which contains data on all reported vehicle crashes in California that occur on a public roadway. SWITRS serves two purposes: to collect collision data from all California traffic enforcement agencies for use in statewide and regional analyses and to provide local agencies with quarterly and annual summaries of their collision data. Comparing these two systems is just one level of a system to check and organize these collisions.

Another way would be to include public health data such as vital statistics, hospital discharges, and ER data. Direct downloads of aggregate patient data are available online, but a more complete patient-level dataset is for sale. Patient discharge pivot profiles were developed using the patient discharge data file aggregated at the hospital level. The profiles display the number and percent of discharges by the various data elements available in the public file. Some health agencies do maintain a database that contains information about causes of hospitalization, whether the hospitalization was fatal or non-fatal, and the patient's age, gender, race/ethnicity and city/place of residence. "For example, San Francisco General Hospital, the local Level I Trauma Center, maintains electronic databases for both emergency department visits and hospital stays. Injured persons are given an external cause of injury code (E-code) for the known cause of injury. The E-coded data can distinguish between motor vehicle-pedestrian or motor vehicle-bicycle collisions. Hospital data provides injury severity assessments, and may include long-term injury outcomes and disability status for each patient (MTC Planning – Bicycles/Pedestrians)."

Lastly, these data could be supplemented with surveys to people throughout the region in question regarding recent pedestrian and/or bicycle collisions. Obviously, the more thorough and widely distributed the survey, the better the returned data will be.

3. Impacts of Underreporting

"At present the numbers of non-fatal accidents and of people seriously and slightly injured cannot be compared in different Member States because there is large underreporting for these data in nearly all EU countries. In addition, the definition of injury severity differs among member states, so that a casualty which would be recorded in one country might not be recorded in another, while a casualty which might be recorded as 'serious' in one country might be recorded as 'slight' in another. The result of the lack of comparability of counts of non-fatal casualties is that international comparisons of road safety focus entirely on fatal accidents and casualties. These form only a small minority of the accident and casualty totals. It is advisable to correct for underreporting and differences in injury recording so that EU-road safety comparisons include the full range of injury severities. Currently, researchers of the SafetyNet project are working towards that aim" (ERSO 2007).

At present the numbers of non-fatal collisions and of people seriously and slightly injured cannot be compared in different EU Member States. The lack of comparability of counts of non-fatal casualties results in international comparisons of road safety that focus entirely on fatal collisions and casualties. Although theses comparisons are useful, they form only a small minority of the collision and casualty totals and in that sense, present a limited view on the problem. In view of this it is desirable to extend these comparisons to include the full range of injury severities.

The Task 1.5 of the SafetyNet project strives to expand the scope of CARE-based road collision analyses by enabling meaningful comparisons of non-fatal collisions and casualties. This will allow consideration of road safety to extend beyond the current focus on fatal collisions and casualties. Moreover, the increased size of the data sets available for analysis will reduce the effects of chance, so that more detailed analyses can be carried out.

4. Annotated Bibliography: Underreporting of Pedestrian and Bicycle Collisions

Agran, P. et al. "Limitations of Data Compiled from Police Reports on Pediatric Pedestrian and Bicycle Motor Vehicle Events." *Accident Analysis and Prevention*, Vol. 22, No. 4, 1990.

RESEARCH NOTES

Police reports were compared to the information provided by a hospital monitoring system for children less than 15 years old injured as pedestrians and bicyclists by moving motor vehicles in Orange County, California. The analysis was limited to identifying caveats in the police report database. Underreporting by police was conservatively estimated at 20% for pedestrians and 10% for bicyclists. Comparison of the pedestrian databases suggested underreporting by police of incidents involving 0-4-year-olds, nontraffic incidents, incidents in which the vehicle was backing up, and cases not involving a child crossing a street. Comparison of the bicyclist databases indicated an underreporting by police of nontraffic cases. These caveats, in part, are related to police agency reporting requirements. The police injury severity scale was found to correlate poorly with a scale based on medical diagnoses, and substantial underreporting by police of serious injuries was demonstrated. We suggest that utilization of police injury severity scales be limited to categories of fatal, injured, and not injured (when available).

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http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-469KRG3-47&_user=10&_coverDate=08%2F31%2F1990&_rdoc=1&_fmt=summary&_orig=browse&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=c6047dccb3f561d45207f4ff7cacbc70

Agran, Phyllis F, Diane G Winn, Craig L Anderson, and Celeste Del Valle. "Family, social, and cultural factors in pedestrian injuries among Hispanic children." Inj. Prev., Sept. 1998; 4: 188-193.

RESEARCH NOTES

Objectives—In an earlier population based surveillance study of pediatric injuries, the rate of Hispanic children injured as pedestrians was 63/100 000 compared with 17/100 000 for non-Hispanic white children. The present study was designed to examine the effect of family, social, and cultural factors on the rate of pedestrian injury in a population of Hispanic children in the southwestern US.

Methods—A case-control study of pedestrian injuries among Hispanic children. The sample consisted of 98 children 0–14 years of age hospitalized as a result of a pedestrian injury and 144 randomly selected neighborhood controls matched to the case by city, age, gender, and ethnicity. Cases were compared with controls using conditional logistic regression; in the study design the odds ratio (OR) estimates the incidence rate ratio.

Results—The following family and cultural variables were associated with an increased risk of injury: household crowding (OR=2.8, 95% confidence interval (CI) 1.1 to 7.1 for 1.01–1.5 persons per room, compared with ≤1.0 persons per room), one or more family moves within the past year (OR 2.2, 95% CI 1.2 to 4.1), poverty (OR 1.9, 95% CI 1.1 to 3.3), and inability of mother (OR 3.6, 95% CI 1.3 to 10) or father (OR 5.6, 95% CI 1.5 to 20) to read well. However, children in single parent households and children whose parents did not drive a car, had less education, or were of rural origin, did not have an increased rate of injury.

Conclusions—These results have implications for childhood pedestrian prevention efforts for low income, non-English speaking Hispanic populations, and perhaps for other immigrant and high risk groups. Prevention programs and materials need to be not only culturally sensitive but also designed for those with limited reading skills. In addition, environmental interventions that provide more pedestrian friendly neighborhoods must be considered.

URL

http://injuryprevention.bmj.com/cgi/content/full/4/3/188#ACK

Aptel I, Salmi LR, Masson F, Bourde A, Henrion G, and P Erny (1999). Road accident statistics: discrepancies between police and hospital data in a French island. Accident Analysis & Prevention, Vol. 31, No. 1/2, pp. 101-108.

RESEARCH NOTES

In most developed countries, information on road crashes are routinely collected by the police. However, comparison of police records and hospital data underlines a deficit of the number of road collisions in the routine statistics. In La Réunion, a French overseas dependency, an epidemiological study of injuries leading to hospitalisation or deaths has been performed from June 1993 to June 1994. The comparison between hospital data and police records showed that only 37.3% of non-fatally traffic-injured in-patients were recorded by the police. Length of stay in hospital, physician in charge of the first aid, urban place of the crash, type of vehicle involved, day and time of the crash and blood alcohol concentration were significantly associated with the presence in the police file. Police overestimated the severity of the injuries. Police notified 100 deaths on the 115 counted by the study. In France, non-fatally traffic-injured should be followed 30 days to improve quality of police death records. A capture–recapture method was used to estimate the total number of injured people. The capture–recapture method consists in merging information from several sources of notification to determine the real number of cases in the population and the exhaustivity of each source. We estimated that 346 subjects were injured in one month whereas police data recorded only 87 and hospital data 137. This method seems interesting to use in routine after validation when unique personal identifiers are available.

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Barancik, J.I. and Fife, D. Discrepancies in Vehicular Crash Injury Reporting: Northeastern Ohio Trauma Study IV. Accident Analysis & Prevention, 17(2), 1985, pp. 147-154.

RESEARCH NOTES

People injured in motor vehicle traffic crashes were identified from a population-representative incidence sample of hospital emergency department visits. Matched police reports of crashes were sought in official state records of motor vehicle traffic crashes. Of the emergency department cases. 55% had matched police reports. The frequency of matched reports was highest for drivers (74%). people transported to the hospital by emergency vehicle (69%). and those requiring hospital admission (74%). The frequency was lowest for people younger than 16 years (28%), people injured as occupants of vehicles other than passenger cars (24%). medicaid recipients (33%). and nonresidents of the study region (40%). Motor vehicle traffic injuries are undercounted in police-reported statistics. For many groups, police reporting is less than 50% of the cases identified through emergency departments. The likelihood that a case of motor vehicle traffic injury will have a matched police report depends on demographic, social and crash factors as well as on injury severity.

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Bull, J.P. and Roberts, B.J. Road Accident Statistics—A Comparison of Police and Hospital Information. Accident Analysis & Prevention, 5, 1973, pp. 45-53.

RESEARCH NOTES

Studies in Sweden have raised doubts as to the accuracy of road collision statistics in relation to serious and slight injuries. To explore the reliability of British statistics an analysis has been made of a sample of 1200 patients injured in road collisions and attending hospital. These same cases have been traced in the police records on which official statistics are based. All fatal cases were correctly notified but two types of discrepancy occurred among injuries. In a small number of cases re-classification of "serious" and "slight" seemed to be required. A more important discrepancy was that about one-sixth of serious injuries and one third of slight injuries known to the hospital did not appear in the police notifications. This is not surprising in view of the limited scope of compulsory notification. The police mostly know of collisions by the calling of an ambulance or as a result of allegations of traffic infringements. Thus many cases where an ambulance is not called or in which a driver only is injured and no other vehicle is involved, escape notification. Injuries to pedal cyclists are particularly poorly notified. Less than one quarter of those known to the hospital appeared in the official statistics. It is concluded that similar comparisons of hospital and police information should be made elsewhere to confirm whether this sample is representative of the national rate of notification. In the meantime it is suggested that figures for injuries to pedal cyclists and for slight injuries in general should be used with caution.

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http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-4698M8J-18&_user=10&_coverDate=04%2F30%2F1973&_rdoc=4&_fmt=summary&_orig=browse&_srch=doc-info(%23toc%235794%231973%23999949998%23326185%23FLP%23display%23Volume)&_cdi=5794&_sort=d&_docanchor=&_ct=8&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=6b9d97f1695061ca5bc20146d222ed30

Cryer, PC, S Westrup, AC Cook, V Ashwell, P Bridger, and C Clarke. "Investigation of bias after data linkage of hospital admissions data to police road traffic crash reports." Injury Prevention 7.3 (Sept 2001): 234. Expanded Academic ASAP. Gale. UC Berkeley. 22 Oct. 2007

RESEARCH NOTES

Research question--Does a database of hospital admission data linked to police road traffic collision (RTA) reports produce less biased information for the injury prevention policymaker, planner, and practitioner than police RTA reports alone?

Design--Data linkage study.

Study population--Non-fatal injury victims of road traffic crashes in southern England who were admitted to hospital.

Data sources--Hospital admissions and police RTA reports.

Main outcome measures--The estimated proportion of road traffic crashes admitted to hospital that were included on the linked database; distributions by age, sex, and road user groups: (A) for all RTA injury admissions and (B) for RTA serious injury admissions defined by length of stay or by nature of injury.

Results--An estimated 50% of RTA injury admissions were included on the linked database. When assessing bias, admissions data were regarded as the "gold standard". The distributions of casualties by age, sex, and type of road user showed major differences between the admissions data and the police RTA injury data of comparable severity. The linked data showed smaller differences when compared with admissions data. For RTA serious injury admissions, the distributions by age and sex were approximately the same for the linked data compared with admissions data, and there were small but statistically significant differences between the distributions across road user group for the linked data compared with hospital admissions.

Conclusion--These results suggest that investigators could be misinformed if they base their analysis solely on police RTA data, and that information derived from the linked database is less biased than that from police RTA data alone. A national linked dataset of road traffic crash data should be produced from hospital admissions and police RTA data for use by policymakers, planners and practitioners.

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http://find.galegroup.com/itx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T002&prodId=EAIM&docId=A78638756&source=gale&srcprod=EAIM&userGroupName=ucberkeley&version=1.0

Elvik, R, Mysen, AB (1999). Incomplete accident reporting: meta-analysis of studies made in 13 countries. Transportation Research Record. 1999, 1665:133-140

RESEARCH NOTES

A meta-analysis of studies of road collision reporting in official collision statistics made in 13 countries is described here. A rigorous comparison of reporting levels between countries is difficult because of differences in the definitions of reportable collisions, reporting levels, and data sources used to assess reporting levels. Based on 49 studies in 13 countries, it is concluded that reporting of injuries in official collision statistics is incomplete at all levels of injury severity. In rounded values, the mean reporting level in the countries included was found to be 95 percent for fatal injuries according to the 30-day rule, 70 percent for serious injuries (admitted to hospital), 25 percent for slight injuries (treated as outpatients), and 10 percent for very slight injuries (treated outside hospitals). Reporting levels vary substantially among countries, ranging from 21 to 88 percent for hospital-treated injuries. Reporting is highest for car occupants and lowest for cyclists. In particular, single-vehicle bicycle collisions are very rarely reported in official road collision statistics.

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http://trb.metapress.com/content/b7r457p625x71876/?p=d6b029b9de18442da0aecaeda0135e25&pi=5

Harris, S. The Real Number of Road Traffic Accident Casualties in the Netherlands: A Year-Long Survey. Accident Analysis & Prevention, 22(4), 1990, pp. 371-378.

RESEARCH NOTES

Between August 1986 and July 1987 more than 24,000 households, containing nearly 67,000 persons, were surveyed by telephone about traffic injuries during the past three months. Expressed on an annual basis, approximately 430,000 people, or about 1 in 34 of the Dutch population, had suffered some sort of injury in a road collision. The road traffic morbidity was, therefore, 2,942 per 100,000 inhabitants. Of these, about 135,000 had to be treated in hospital (20,000 as inpatients). More than 100,000 did not need treatment. Cyclists formed by far the largest category of road user, but mopedists had the highest injury rate per kilometer travelled. 210,000 of these casualties fell within the definition for recording by the police. The police recorded only 49,748 traffic casualties, or about 25%, during the same period. The police data were not representative; the completeness declined according to severity of the injuries: inpatients, about 70%; outpatients 26%; extramural about 11%. Cyclists (11%), children (9%), and single vehicle collisions (5%) were very much underrepresented. The largest category of road user is cyclists, not car occupants as indicated by the police data. A number of recommendations are made for supplementing the police data and the existing hospital inpatient data. These include extending the Home Accident Recording System of outpatients and the General Practitioner Panel to include road collision victims. Together a representative sample of 95% of all those receiving medical treatment would thus be obtained.

URL

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-469KRG3-48&_user=10&_coverDate=08%2F31%2F1990&_rdoc=8&_fmt=summary&_orig=browse&_srch=doc-info(%23toc%235794%231990%23999779995%23326510%23FLP%23display%23Volume)&_cdi=5794&_sort=d&_docanchor=&_ct=15&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=53a57b9e3f3e091a820bc00999d99d78

Holland, Andrew J A, et al. (2000). "Driveway motor vehicle injuries in children." MJA 2000; 173: 192-195

RESEARCH NOTES

Objectives: To describe the frequency, nature and outcome of driveway injuries in children.

Design: Retrospective case series of driveway-related injuries in children less than 16 years of age admitted to the New Children's Hospital (NCH), New South Wales, from November 1995 to February 2000, and deaths reported to the New South Wales Pediatric Trauma Death (NPTD) Registry from January 1988 to December 1999.
Main outcome measures: Circumstances of injury; type and number of injuries identified.

Results: 42 children were admitted to our institution with driveway-related injuries over four years and four months. These represent 12% of all children admitted with pedestrian motor vehicle injuries. Fourteen deaths (including one of the children admitted to NCH) were reported to the NPTD Registry over 12 years, accounting for 8% of all pediatric pedestrian motor vehicle deaths reported to the registry. Typically, the injury involved a parent or relative reversing a motor vehicle in the home driveway over a toddler or preschool-age child in the late afternoon or early evening. Four-wheel-drive or light commercial vehicles were involved in 42% of all injuries, although they accounted for just 30.4% of registered vehicles in NSW. These vehicles were associated with a 2.5-times increased risk of fatality. In 13 of the 14 deaths, the cause was a severe head injury not amenable to medical intervention.

Conclusions: Driveway injuries in children account for a significant proportion of pediatric pedestrian motor vehicle injuries and deaths in NSW. Prevention represents the only effective approach to reducing deaths from this cause.

URL
http://www.mja.com.au/public/issues/173_04_210800/holland/holland.html

Ibrahim K and Silcock DT (1992). The Accuracy Of Accident Data. Traffic Engineering and Control, Vol. 33, No. 9, pp. 492-7.

RESEARCH NOTES

Accident data are the central resource used for evaluating the effectiveness of a remedial treatment. It is important to have reliable data in order to identify problems and obtain an informative evaluation of any particular treatment. For that purpose, time and effort is devoted by police and Highway Authorities to checking and correcting the data before use and before they become nationally available in the STATS 19. This paper reports the results of a survey of all Highway Authorities in Great Britain, in an attempt to examine the problem of inaccuracy of accident data and the amount of time and manpower devoted to checking and correcting them.

URL

http://www.tecmagazine.com/index.cfm?fuseaction=magazine.Article&ArticleID=591

Jacobs, G. D. (2000). The application of engineering principles to road accidents: Reduction and prevention in developing countries. International Transportation Symposium, Moving into the 2 1st Century - Best Practices of Today and Lessons for Tomorrow, Washington D. C., 9 - 12 October 2000.

RESEARCH NOTES

A recent study by TRL has shown that there were between 750, 000 and 880, 000 road deaths worldwide in 1999 and, of this total, about 85 per cent occurred in developing and transitional nations. The study also identified that road deaths have continued to increase throughout Asia, Africa and Latin America over the last twenty years whilst in Western Europe, North America, Australia and Japan there have been significant decreases. This paper suggests that the application of engineering principles can do much to reduce road crashes in developing countries. Thus even if the most common factor in road crashes is road user error, problems are compounded by poor road design and planning. Many countries of Africa and Asia have outdated or inappropriate design standards and modern collision prevention and reduction methods have yet to be introduced despite their considerable potential. In order to encourage more effective approaches, TRL published a road safety Guide for planners and engineers and for some years has been engaged in **a** program of evaluating low cost engineering improvements in a number of countries. This paper provides a brief outline of the key principles contained within the Guide and includes an example of an evaluation study carried out in a developing country.

URL

http://www.transport-links.org/transport_links/filearea/publications/1_770_PA3638_2000.pdf

James, H. (1991). "Under-reporting of road traffic accidents." Traffic Engineering & Control Vol. 32: 574-583.

RESEARCH NOTES

Many potentially reportable road collisions are not reported to the police and therefore do not appear in official statistics. The Department of Transport requires information on the total number and type of casualties occurring, together with their economic cost, so that road safety programs can be as cost-effective as possible and road casualty reduction priorities can be correctly identified.

This paper summarizes the results of a variety of under-reporting studies. The factors affecting whether a collision was reported are identified and their effects discussed. Two recent postal surveys of motorcyclists and car drivers are analyzed to examine the factors affecting reporting in more detail.

Estimates of the total number of collisions not included in official figures for Great Britain are calculated and the national data adjusted for under-reporting. Additional casualty costs are also estimated.

Kim, Joon-Ki, Sungyop Kim, Gudmundur F. Ulfarsson, and Luis A. Porrello. "Bicyclist injury severities in bicycle–motor vehicle accidents." Accident Analysis & Prevention. Volume 39, Issue 2, March 2007, Pages 238-251

RESEARCH NOTES

This research explores the factors contributing to the injury severity of bicyclists in bicycle–motor vehicle collisions using a multinomial logit model. The model predicts the probability of four injury severity outcomes: *fatal*, *incapacitating*, *non-incapacitating*, and *possible or no injury*. The analysis is based on police-reported collision data between 1997 and 2002 from North Carolina, USA. The results show several factors which more than double the probability of a bicyclist suffering a fatal injury in an collision, all other things being kept constant. Notably, inclement weather, darkness with no streetlights, a.m. peak (06:00 a.m. to 09:59 a.m.), head-on collision, speeding-involved, vehicle speeds above 48.3 km/h (30 mph), truck involved, intoxicated driver, bicyclist age 55 or over, and intoxicated bicyclist. The largest effect is caused when estimated vehicle speed prior to impact is greater than 80.5 km/h (50 mph), where the probability of fatal injury increases more than 16-fold. Speed also shows a threshold effect at 32.2 km/h (20 mph), which supports the commonly used 30 km/h speed limit in residential neighborhoods. The results also imply that bicyclist fault is more closely correlated with greater bicyclist injury severity than driver fault.

URL

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-4M04J97-1&_user=10&_coverDate=03%2F31%2F2007&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=e192bf363e0854c3509015d13f8f9ca5

Lopez DG, Rosman DL, Jelinek GA, Wilkes GJ, Sprivulis PC (1999). Complementing police road-crash records with trauma registry data - an initial evaluation. Accident Analysis and Prevention, Vol. 32, pp. 771-777.

RESEARCH NOTES

This paper examines the consistency of hospital and police reporting of outcomes of road traffic crashes using a database of linked police crash reports and trauma registry records. Criteria for inclusion into the trauma registry include trauma-related causes with subsequent stay of more than 24 h or death due to injuries. During the 1997 calendar year there were 497 cases of road-related injuries within the combined trauma registry of Sir Charles Gairdner and Fremantle Hospitals, of which only 82% had matching police records. Linkage rates were associated with gender, injury severity and the number of vehicles involved. Within the road user category, pedestrians were least likely to link. Of the linked records, police classification of injury severity was correct in 78% of cases. Male casualties were more likely to be correctly classified than females, after adjustment for related variables including injury severity. Correct classification of injury by police was also closely related to severity of injury. Identification and targeting of these groups of casualties is vital in refining the road-crash reporting system. Increased crash reporting and availability of data from these two sources will provide road authorities with more reliable measures of injury outcome.

URL

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-40WDSCH-6&_user=10&_coverDate=11%2F30%2F2000&_rdoc=7&_fmt=summary&_orig=browse&_srch=doc-info(%23toc%235794%232000%23999679993%23205379%23FLA%23display%23Volume)&_cdi=5794&_sort=d&_docanchor=&_ct=16&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=efdd859c646185210bcab290b887e671

Maas, M.W. and Harris, S. Police Recording of Road Accident In-Patients. Accident Analysis & Prevention, 16(3), 1984, pp. 167-184.

RESEARCH NOTES

Many road safety research projects make use of the official police road collision data. Their use is often restricted to the data of fatal collisions and fatalities because it is the only complete registration, and the extent of underreporting of injury collisions is unknown. The need to extend the use of data beyond fatalities is great for two reasons: (1) in a small country like the Netherlands the absolute numbers (less than 2000 fatalities per annum in recent years) are often too small for detailed analyses. (2) Fatal collisions are not typical road collisions but an extreme type. Data on surviving in-patients however, is not so extreme and there are more than 20,000 per annum. The incomplete police data on road collision in-patients was compared with the hospital discharge data to establish how representative it was. Hospital data was collected through the Medical Record Foundation, a national institution, which registers approx. 95% of all road collision in-patients. During the years 1977–1979 it was found that the extent of underreporting was constant and for the year 1979 the police data had a coverage of 83% of all road collision in-patients. According to the results of an Eckart-Young analysis, the general structures of the police and hospital data were similar but there were differences. The underreporting of users of motorized vehicles in the age group 15–34 yr was significantly smaller than for others; and of cyclists and pedestrians, particularly in the age group 0–14 yr, significantly greater. The police data is therefore reliable for time series and for period studies of most mode of transport/age group combinations.

URL

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-4692RKG-1B&_user=10&_coverDate=06%2F30%2F1984&_rdoc=3&_fmt=summary&_orig=browse&_srch=doc-info(%23toc%235794%231984%23999839996%23325737%23FLP%23display%23Volume)&_cdi=5794&_sort=d&_docanchor=&_ct=9&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=09d8333a4c16361166b4612a91489fa3

Mills PJ (1989). Pedal cycle accidents - A hospital based study. TRRL Research Report RR220.

RESEARCH NOTES

The main source of road accident data in Great Britain is that collected by the police for input to the national data base. This data base provides limited information about the accidents and injuries sustained by the casualties. Previous research has shown a large number of accidents involving pedal cyclists do not get reported to the police and hence do not appear in the data base. This report describes a one year hospital based study undertaken to identify the main factors and the level of under-reporting of pedal cycle accidents, and to investigate these accidents in depth. Under-reporting rates are calculated for slight, serious and fatal accidents which are used to estimate the total number and actual cost of pedal cycle accidents. The main causes of accidents to children, teenagers and adults are identified, and blame and conspicuity are discussed. The injuries sustained by the casualties are examined by body region and in relation to length of stay in hospital. Engineering and educational measures likely to reduce pedal cycle accidents are discussed and the potential saving in casualty costs, which would accrue from the use of helmets by cyclists, has been estimated.

URL

http://www.trl.co.uk/store/report_detail.asp?srid=5835&pid=177

Morrison, P. J. (1992). "Underreporting of pedestrian accidents." British Medical Journal **304(6829)**: 779-780.

RESEARCH NOTES

David Teanby has calculated that pedestrian collisions are underreported by 16% in the United Kingdom. Figures from a comprehensive survey that Kjellstrom and I carried out in Auckland, New Zealand, over 10 years, showed that reporting ratios for pedestrian collisions decreased from 75% to 48%, with a similar decrease in underreporting of injured car drivers and passengers. This decrease in reporting of collisions by police was partly explained by a decrease in the number of traffic police from six officers per 10000 cars in 1975 to five per 10 000 in 1982.

A breakdown of the figures for preschool children (age 0-4 years) showed that 77% of collisions that occurred on roads were reported but only 3'S, of those that occurred off the road were reported (for example, a parent backing a car over a child in the driveway or a car rolling down a slope because the handbrake had not been applied). Figures for cyclists were greatly underreported (20% in 1975, decreasing to 15% in 1982).

These ratios correlated well with figures from Sweden, Denmark, and the United Kingdom. Our conclusions were that police collision figures (with the exception of figures on fatal collisions) were unreliable as many collisions were not attended by the police even when serious injury had been inflicted. The likelihood of police reporting a collision clearly depends on the type of collision: there is no legal obligation to report some collisions, and people attending to victims rarely report the collision to the police. Often the people involved may not be aware who is responsible for reporting the collision, and if they are they may not want the police to be involved.

Central registration of collisions with a merging of statistics compiled by the Ministry of Transport and the Department of Health with collision compensation statistics is clearly necessary if adequate data are to be used in preventing collisions.

URL

http://www.pubmedcentral.nih.gov/pagerender.fcgi?artid=1881582&pageindex=1

Nakahara S & Wakai S. "Underreporting of traffic injuries involving children in Japan." Inj Prev. 2001, September 7:242-244.

RESEARCH NOTES

BACKGROUND: Significant underreporting of road traffic injuries by the police has been documented, even in developed countries. The objective of this study was to clarify the magnitude of underreporting of police data in Japan.

METHODS: Police reports were compared with those of the fire department and the Marine and Fire Insurance Association of Japan.

RESULTS: The results reveal significant underreporting by police of child vehicle occupant injuries. The true incidence of these injuries in preschoolers was twice as high as that provided by official police reports.

CONCLUSION: Police reports would underestimate the magnitude of vehicle occupant injuries in children and distort any evaluations of preventive initiatives. Improving the police report system, and establishing a more comprehensive trauma registry, that would include data from hospitals and insurance companies should be implemented.

URL

http://injuryprevention.bmj.com/cgi/content/full/7/3/242

Ragland, D. R., Frank Markowitz, and Kara E. MacLeod, (2003). An Intensive Pedestrian Safety Engineering Study Using Computerized Crash Analysis, UC Berkeley Traffic Safety Center. **Paper UCB-TSC-RR-2003-12**.

RESEARCH NOTES

Over the past year, the San Francisco Department of Parking and Traffic (DPT) conducted an intensive pedestrian-safety engineering study, the PedSafe Study. PedSafe was funded by the Federal Highway Administration (FHWA)*, which also funded companion studies in Las Vegas and Miami. The study was designed to analyze pedestrian injuries by zones (i.e., neighborhoods or districts) and to identify those most amenable to prevention efforts. The DPT expects to utilize the methodology and information from the PedSafe study to help shape a citywide pedestrian master plan. This paper describes the technical procedures and the pedestrian countermeasure plan that resulted. The paper analyzes pedestrian injury problems both citywide and in study zones, using crash data and field observations. It also compares two software packages that can be used to analyze crash patterns: PBCAT1 (Pedestrian and Bicycle Crash Analysis Tool), which is available for no charge, and the CrossroadsTM2 package, available commercially. The countermeasure plan is described for multiple funding levels, and a plan is outlined for evaluation and public outreach. The countermeasure plan proposes basic traffic engineering countermeasures including advance limit lines, curb bulbs, impactable YIELD TO PEDESTRIAN signs, median refuge island improvements, modified signal timing, pavement stencils, pedestrian head start, pedestrian scramble, and vehicle left-turn phases. In addition, Intelligent Transportation Systems (ITS) countermeasures are recommended that include animated eyes signals, automated detection of pedestrians to adjust signal timing, modern flashing beacons, pedestrian countdown signals, radar speed display signs, roadway lighting improvements and smart lighting, and signal visibility improvements.

URL

http://repositories.cdlib.org/its/tsc/UCB-TSC-RR-2003-12

Ragland, D. R., Ryan Greene-Roesel, and Mara Chagas Diogenes. (2007). Estimating Pedestrian Accident Exposure: Approaches to a Statewide Pedestrian Exposure Database, UC Berkeley Traffic Safety Center. **Paper UCB-TSC-RR-2007-6**

RESEARCH NOTES

This report discusses approaches to addressing the need for better and more widely available pedestrian volume data in the state of California. While a variety of approaches could be used, this report focuses on the strategy of a statewide pedestrian volume database.

This database would meet a variety of data needs for different stakeholder groups. One of its principal purposes would be to allow safety professionals at the state and local levels to estimate pedestrian exposure to risk at specific sites.

Since exposure data is essentially equivalent to facility usage data, a pedestrian exposure data would be used for many purposes beyond risk analysis. Facility usage data might be used by municipalities to pinpoint new infrastructure needs, or to determine whether new infrastructure encourages more pedestrian activity. Facility usage data might also be used by advocacy groups as a means to promote new facility investments.

If the database includes information beyond pedestrian volumes, such as facility characteristics (e.g. the availability of sidewalks and intersection crossings) or planning variables (e.g. land uses and population densities), it may be used as a means to improve pedestrian demand modeling techniques or to investigate the relationship between pedestrian environmental quality and pedestrian demand. Furthermore, if facility funding data are included, the database may also be used as a means to track spending on pedestrian projects. In short, there is a wide range of usage for a pedestrian volume database. In designing the database, it is important to maximize its utility to pedestrian stakeholder groups while recognizing the costs associated with increased complexity.

Creation of a pedestrian volume database for the state of California involves several major decision points. This report examines these decision points and provides a range of database approaches given different funding and institutional constraints, and describes the challenges that will need to be addressed in the database development process. Chapter 2 discusses the technical and institutional challenges inherent in creation of a pedestrian exposure database. Chapter 3 discusses the need for an inventory of the pedestrian network as a starting point for the database, and present two existing sources for the network. Chapter 4 presents a range of approaches to data collection process, and suggests data points that might be appropriate for inclusion in the data collection process. Chapter 5 discusses how pedestrian demand modeling might be used to estimate pedestrian volumes with limited data inputs. Chapter 6 summarizes the report and provides recommendations for future development of the database.

URL

http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1047&context=its/tsc

Rosman, D.L. and Knuiman, M.W. A Comparison of Hospital and Police Road Injury Data. Accident Analysis & Prevention, 26(2), 1994, pp. 215-222.

RESEARCH NOTES

In order to gather as much information as possible on road crashes and outcomes, routinely collected police reports of traffic collisions and hospital discharge files were individually matched or "linked" using a computerised iterative procedure on name-identified data from both sources. The two groups of linked and unlinked hospital records were compared. Within the linked dataset, a comparison of like variables was made and showed good agreement between the two sources on collision type and road user type. However, police-reported levels of injury severity were shown to be less reliable. In addition, the proportion of hospital inpatient records that linked to a police record was found to be influenced by several factors. The overall linkage rate from hospital to police was 64% but varied from 29% for motorcyclists in single-vehicle collisions to 79% for motor vehicle drivers. The linkage rate increased with increasing levels of injury severity and was substantially lower for casualties of certain ethnic groups. It was deduced that for most instances where a hospital record did not link to a police record, the crash had not been reported. These findings confirm that there was considerable underreporting of hospitalised road casualties to the police and that the extent of underreporting was greater for those less severely injured.

URL

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-4697JK1-24&_user=10&_coverDate=04%2F30%2F1994&_rdoc=10&_fmt=summary&_orig=browse&_srch=doc-info(%23toc%235794%231994%23999739997%23326038%23FLP%23display%23Volume)&_cdi=5794&_sort=d&_docanchor=&_ct=15&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=1e0986ef36520b0a6ac4b7f71d6a8ea4

Rosman DL (2001). The Western Australian Road Injury Database (1987-1996): ten years of linked police, hospital and death records of road crashes and injuries. Accident Analysis & Prevention, Vol. 33, pp. 81-88.

RESEARCH NOTES

Accurate information about injuries and their causes is essential to road safety research, policy development and evaluation. Such information is most powerful when it is available for all road crashes within a jurisdiction. The Western Australian Road Injury Database achieves this through the on-going linkage of crash details from reports to police with the details of injuries to casualties contained in hospital and death records. Over the 10-year period 1987–1996, 386 132 road crashes involving 142 308 casualties were reported to the police in Western Australia. There were also 47 757 hospital discharge records and 2906 death records related to road crashes during this period. Of the 142 308 police casualties, 17 848 had a matching hospital discharge record and 2454 had a matching death registration. Linkage within the hospital records revealed that the 47 757 discharge records involved 43 179 individuals, of whom 39 073 were admitted to hospital once, 3653 were admitted twice, 374 were admitted three times and 78 were admitted more than three times. Of the 43 179 hospitalised casualties, 817 had a matching death record. Linked police, hospital and death records of road crash casualties provide accurate outcome information for casualties in crashes reported to the police. In addition, estimates of under reporting of crashes for different road user groups can be made by comparing hospital records with and without a matching police record. This article demonstrates the power of a linked system to answer complex research questions related to outcome and under-reporting.

URL

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V5S-418PNWR-8&_user=10&_coverDate=01%2F31%2F2001&_rdoc=8&_fmt=summary&_orig=browse&_srch=doc-info(%23toc%235794%232001%23999669998%23210842%23FLA%23display%23Volume)&_cdi=5794&_sort=d&_docanchor=&_ct=15&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=853a241d522a1be84148745e2872edc8

Sciortino, S., M. Vassar, et al. (2005). "San Francisco pedestrian injury surveillance: Mapping, under-reporting, and injury severity in police and hospital records." Accident Analysis & Prevention **37**(6): 1102-1113.

RESEARCH NOTES

Goals: Police reports of severely injured pedestrians help identify hazardous traffic areas in San Francisco, but they under-report non-fatal collisions. We set out to: identify injured pedestrians who were missing from police collision reports, see what biases exist in injury reporting and assess the utility of broad categories of police severe injury (including fatal) for mapping and analysis.

Methods: We linked data on injured pedestrians from police collision reports listed in the Statewide Integrated Traffic Reporting System (SWITRS, n = 1991) with records of pedestrians treated at San Francisco General Hospital (SFGH, n = 1323) for 2000 and 2001. Data were analyzed using bivariate statistics, logistic regression and mapping.

Results: We found that police collision reports underestimated the number of injured pedestrians by 21% (531/2442). Pedestrians treated at SFGH who were African-American were less likely than whites (odds ratio = 0.55, p-value <= 0.01), and females were more likely than males (odds ratio = 1.5, p-value <= 0.01) to have a police collision report. Over 70% of pedestrians deemed by the police to have a severe injury received treatment at SFGH, regardless of the collision's distance from SFGH. The sensitivity of a police-designated severe injury (including fatal) was 69% and the specificity was 89% when compared with a known SFGH assessment. But, sensitivity declined when we included pedestrians without a SFGH record.

Conclusion: Though collision reports have demonstrated limitations, broad categories of police severity may be sensitive enough to map locations where numerous severe injuries occur, for timely countermeasure selection.

URL

http://www.sciencedirect.com/science/article/B6V5S-4GTVYSG-1/2/ce7e66542b2feac25f2a15edef0b7f3b

Stutts, J. and W. Hunter (1998). "Police Reporting of Pedestrians and Bicyclists Treated in Hospital Emergency Rooms." Transportation Research Record **1635**(-1): 88-92.

RESEARCH NOTES

Drawing on a study of injured pedestrians and bicyclists treated at hospital emergency rooms in California, New York, and North Carolina, an attempt was made to match the emergency room cases to state motor vehicle crash data, and to analyze the factors associated with the occurrence of a match. The purpose is to (1) provide additional information on the likely level of underreporting of pedestrian- and bicycle-motor vehicle collisions on state crash files and (2) examine whether cases that are reported differ in any systematic way from those that are not reported. A total of 388 pedestrian- and 255 bicycle-motor vehicle cases were available for inclusion in the analysis, with 56 percent of the pedestrian and 48 percent of the bicycle cases matched to state crash files. After adjusting for other potential confounders, pedestrians who were hospitalized or killed were 1.3 times more likely to be reported on the state crash files than were pedestrians receiving emergency room treatment only; those struck in the roadway were 1.7 times more likely to be reported than those struck in non-roadway locations; and those ages 15 to 24 were 70 percent less likely to be reported than pedestrians of all other ages. In contrast, the only factor found to be associated with police reporting of bicycle-motor vehicle crashes was the severity level of the injury: bicyclists who were hospitalized or killed were 1.4 times more likely to be reported on the state crash files than were bicyclists receiving emergency room treatment only.

URL

http://dx.doi.org/10.3141/1635-12

Teanby, D. (1992). "Underreporting of pedestrian road accidents." British Medical Journal **304(6824)**: 422–422.

RESEARCH NOTES

Methods and results: A one year review (May 1989-April 1990) of trauma care within Mersey region, North Wales, and the Isle of Man was conducted by using information from ambulance services, collision departments, and coroners. All pedestrian collisions that occurred within the Merseyside police area were then analyzed in detail. For 85 cases where pedestrians were killed or severely injured (injury severity score > 15) 2 and where there was information on the site, date, and time of the collision we tried to correlate individual cases with those recorded by Merseyside Police central statistics unit. The unit records details of the site of the collision but not the names and addresses of the victims to maintain confidentiality.

Fourteen of the patients could not be identified in police records. Two of these 14 patients had died, one shortly after arriving at the collision department and one after surviving in a coma for three months. One was aged 74 and the other 82 and their injury severity scores were 38 and 59 (median 48). The 12 survivors had a mean age of 45 years (range 7-78), a median severity score of 32 (17-50), and occupied 1037 hospital bed days with a mean length of stay of 86 days (6-246). The patients whose details were recorded by the police were generally younger. Of the 50 who died, 15 died at the scene of the collision (mean age 41 3 years (6-80); median severity score 45 (19-75)) and 35 died in hospital (mean age 49 4 years (3-93); median severity score 43 (13- 75)) with a mean survival of five days (0-49). The mean age of the 21 survivors was 36-2 years (4-78), their median severity score 27 (17-50), and length of stay 61 days (13-197).

Comment: Government statistics on collisions, traffic planning, and highway design are derived from data collected by the police on road collision report form (STATS 19). In our survey Merseyside Police data under-recorded pedestrian collisions by 16%. If this figure applies nationally up to 10000 casualties a year may be excluded from government statistics. Collisions that cause trivial or no injuries are often not reported, and allowance is made for these. The underreporting of serious and fatal collisions, however, may lead to flaws in planning. Some collision victims may be driven to hospital by private vehicle (the ambulance service industrial dispute coincided with part of the study period) with no emergency call being made; collision victims may decline police involvement; and a few cases may be lost in administration before reaching the statistical unit. Information on road traffic collisions is collected by hospitals to allow them to charge for emergency treatment. This information too is often incomplete, but there is no mechanism for passing it to a central statistical unit. Central registration, either nationally or regionally, of hospital road collision data may allow them to be collated with information from the police and coroners to provide a more complete picture of road collisions in Great Britain.

URL
http://www.pubmedcentral.nih.gov/pagerender.fcgi?artid=1881284&pageindex=1

Turner, S.A., Roozenburg, A.P., Francis, T. 2006. "Predicting accident rates for cyclists and pedestrians." *Land Transport New Zealand Research Report 289.* 180 pp.

RESEARCH NOTES

Recent government legislation and policy promotes an increase in walking and cycling as an alternative to the increasing demand for motor vehicle travel. Concern exists, however, that an increase in these modes, particularly cycling, could lead to a substantial increase in pedestrian and cyclist fatalities and injuries. In this research, carried out between 2002 and 2004, collision rates for cyclists and pedestrians were investigated and interviews carried out with casualties. A high under-reporting rate was observed. Using traffic, cyclist and pedestrian counts and reported collisions between the 'active modes' and motor vehicles, collision prediction models (APMs) were developed. These include models for various collision types at signalized crossroads, roundabouts and mid-block locations. These models were used to calculate the likely change in motor vehicle, pedestrian and cycle collisions and also collision rate per road user for a change in mode, particularly motor vehicle trips to pedestrian and cycle trips. It was found that a noticeable 'safety in numbers' effect exists. Generally, the overall increase in cycle and pedestrian collisions was not substantial and the crash rate per cyclist and pedestrian reduced with increases in their numbers.

URL

http://www.ltsa.govt.nz/research/reports/289.pdf

Ward, H., Ronan Lyons and Roselle Thoreau (2006). Road Safety Research Report No. 69: Under-reporting of Road Casualties - Phase 1. London, England, Department for Transport: London.

RESEARCH NOTES

The conclusions of this study are difficult to draw out. Both the health databases and the police databases have their weaknesses as no perfect database exists. However, the STATS19 database is cross-checked and validated to a certain extent both at local and at national level, whereas the health databases are essentially a descriptive record for health audit purposes and are not internally validated as such.

There have been changes in healthcare practice over the period of study, with a reducing tendency to admit casualties if their injuries can be dealt with as outpatients. However, the three admissions databases show very little overall change in admission numbers to hospital. If the changes in healthcare were in some way being reflected in these databases, this effect would be very difficult to distinguish from a change in severity of injury. The Trauma Audit Research Network (TARN) database is some help here as it only records the much more seriously injured patients. This database shows a flat trend across the period of study leading to a tentative conclusion that the observed reduction in serious injuries in the STATS19 record has not come from a reduction in the more serious injuries. These are mirroring the fatal trends. This, in itself, is not too surprising as the line between death and serious injury is a fine one. As the TARN database is not complete across all hospitals in Britain, it is not possible at this stage to say what proportion of these more serious injuries are represented. The analysis of the A&E data indicates that about 10% of all those reporting at A&E departments across Britain are admitted. Of the serious injuries about half (as classed by STATS19) are admitted. Analyses indicate that the proportions being admitted are not changing very much.

The findings from the analysis of the admissions data and the STATS19 data reported in Road Casualties Great Britain: 2004 – Annual Report (Transport Statistics, 2005) are important. They reveal that there are as many admissions to hospitals in England, Wales and Scotland as there are serious injuries in the STATS19 database for Great Britain. The picture has changed since 1999, when there were fewer admissions than STATS19 serious injuries, to 2003, when there were more. If we take the flatness of the admissions trend with the decline in serious injuries in STATS19, we may conclude that fewer serious injuries are being reported to the police and/or that the police are not recording as many injuries as serious as before. The data indicate that there are twice as many serious injuries occurring on the road as are recorded in the STATS19 database. Some of this is due to underreporting and some due to misreporting. Whilst this finding is not new (see Simpson, 1996) it does highlight the difficulty in interpreting data from only one source and quite how much is due to under-reporting or misreporting is difficult to assess because we cannot make assumptions about the severity of the unmatched police data whether it be serious or slight. Table 6.1 is helpful in showing that, of the casualties that were matched in both data sets, somewhere in the region of 20% of casualties classed as serious by the police were treated and discharged by the hospital (i.e. slight injuries). In actual numbers, of the eight years in the data from the English hospital studied, this amounts to 67 casualties. On the other hand, those treated by the hospital as serious but appearing in the police record as slight accounts for about 8% across the whole eight-year period, dropping gradually from 10% in 1996 to about

5% in 2004. In actual numbers, the incorrect classification of serious as slight involved 231 casualties over the years studied.

For the A&E data, where we know how many admissions have been registered and which have been matched, plus the unmatched hospital data but about which we know severity, we could hypothesize that nearly half are not reported to the police and a further quarter are misreported as slight. Of the outpatient clinic data, 57% are not known to the police and a further 36% are classed as slight. However, as already stressed, these do not reflect the whole picture as we do not know how many in the unmatched police record are in each severity category. The evidence suggests some changes in the consistency of coding in STATS19 especially amongst the vehicle occupants. As slight injuries are about 10 times more common than serious injuries in STATS19, a very small change in judgment about the operational threshold for this categorization could easily produce this degree of change and might well be imperceptible to those who made the change.

URL

http://www.dft.gov.uk/pgr/roadsafety/research/rsrr/theme5/underreportingofroadcasualti4788

5. Annotated Bibliography: Reporting Practices and Policies and Attempts to Increase Reporting (Agencies, Legislation, etc.)

Ameratunga, S., M. Hijar, et al. (2006). Road-traffic injuries: confronting disparities to address a global-health problem. The Lancet. **367:** 1533-1540.

RESEARCH NOTES

Evidence suggests that the present and projected global burden of road-traffic injuries is disproportionately borne by countries that can least afford to meet the health service, economic, and societal challenges posed. Although the evidence base on which these estimates are made remains somewhat precarious in view of the limited data systems in most low-income and middle-income countries (as per the classification on the World Bank website), these projections highlight the essential need to address road-traffic injuries as a public-health priority. Most well-evaluated effective interventions do not directly focus on efforts to protect vulnerable road users, such as motorcyclists and pedestrians. Yet, these groups comprise the majority of road-traffic victims in low-income and middle-income countries, and consequently, the majority of the road-traffic victims globally. Appropriately responding to these disparities in available evidence and prevention efforts is necessary if we are to comprehensively address this global-health dilemma.

URL

http://www.sciencedirect.com/science/article/B6T1B-4JW7X9D-17/2/ee40f76bc8a84d8e11b275e77aee6a4

Hewson, P. (2004). "Deprived children or deprived neighbourhoods? A public health approach to the investigation of links between deprivation and injury risk with specific reference to child road safety in Devon County, UK." BMC Public Health **Vol. 4**(No. 15).

RESEARCH NOTES

Background: Worldwide, injuries from road traffic collisions are a rapidly growing problem in terms of morbidity and mortality. The UK has amongst the worst records in Europe with regard to child pedestrian safety. A traditional view holds that resources should be directed towards training child pedestrians. In order to reduce socio-economic differentials in child pedestrian casualty rates it is suggested that these should be directed at deprived children. This paper seeks to question whether analysis of extant routinely collected data supports this view.

Methods: Routine administrative data on road collisions has been used. A deprivation measure has been assigned to the location where a collision was reported, and the home postcode of the casualty. Aggregate data was analysed using a number of epidemiological models, concentrating on the Generalised Linear Mixed Model.

Results: This study confirms evidence suggesting a link between increasing deprivation and increasing casualty involvement of child pedestrians. However, suggestions are made that it may be necessary to control for the urban nature of an area where collisions occur. More importantly, the question is raised as to whether the casualty rate is more closely associated with deprivation measures of the ward in which the collision occurred than with the deprivation measures of the home address of the child.

Conclusion: Conclusions have to be drawn with great caution. Limitations in the utility of the officially collected data are apparent, but the implication is that the deprivation measures of the area around the collision is a more important determinant of socio-economic differentials in casualty rates than the deprivation measures of the casualties' home location. Whilst this result must be treated with caution, if confirmed by individual level case-controlled studies this would have a strong implication for the most appropriate interventions.

URL

http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=419356

Morrison A and Stone DH (2000). Capture-recapture: a useful methodological tool for counting traffic related injuries? Injury Prevention, Vol. 6, No. 4, pp. 299-304.

RESEARCH NOTES

Introduction—Although the capture-recapture technique is increasingly employed in studies of human populations to correct for under-ascertainment in traditional epidemiological surveillance, it has rarely been used in injury research.

Objectives—To estimate the completeness of official data sources on traffic related injuries (TRIs) by using the capture-recapture technique and to calculate an ascertainment corrected number of fatal and serious TRIs among Scottish young people aged 15–24 years. The appropriateness of the approach in this context is also assessed.

Method—A two sample capture-recapture technique was applied to two official sources of TRI data. Data on TRIs were obtained from the Scottish Health Service and the STATS19 dataset at the University of Essex Data Archive for 1995. Four standards (A-D) of matching were applied to fatalities and serious TRIs to allow plausible relaxation of matching standards within the context of the data collection setting. The completeness of each data source was assessed, and an ascertainment corrected number of fatalities and serious TRIs calculated.

Results—The ascertainment corrected number of TRI fatalities among 15–24 year olds using standard D was 104. This represents only a small increase in the number of fatalities using capture-recapture than when using each individual dataset. The completeness of the Scottish Health Service database for TRI fatalities was 93%. The STATS19 database was 95% complete. The ascertainment corrected number of TRI hospital admissions was 1969. The STATS19 and the Scottish Health Service databases were approximately two thirds and three quarters complete respectively for non-fatal TRIs requiring hospitalisation.

Conclusions—Injury researchers have advocated the linkage of major datasets to supplement and improve the quality of injury data. Using capture-recapture we found that routine databases enumerate TRI fatalities accurately, in contrast to injury morbidity databases that do not. Capture-recapture is a potentially useful method of evaluating the completeness of data sources and identifying biases within datasets. However, ascertainment corrected rates should be viewed with caution. A number of requirements of the capture-recapture technique are unachieved in this study of injury in the human population.

URL

http://injuryprevention.bmj.com/cgi/content/abstract/6/4/299

New York Bicycling Coalition. "Improving Pedestrian and Bicyclist Safety: A Problem-Solving Manual for Advocates and Transportation Professionals in New York State." 2002.

RESEARCH NOTES

This manual provides suggestions and user-friendly information gathering tools for "bridging the gap" between advocacy and engineering. The goal is to enable two important constituencies with a shared interest in bicyclist and pedestrian safety to understand each other's unique needs and perspectives.

The original concept for this manual came out of a desire to compile information that would promote better collaboration between experts and laypersons, but to do so using a hands-on approach. A working-group in each of four selected counties (Albany, Kings, Monroe, and Suffolk) helped choose locations in each county to serve as a baseline for understanding how one might go about creating project proposals for individual intersections. (See Chapter 8 for more background on selection of the county's and individual intersections.) The advocates and transportation professionals who worked with us over the course of this manual's development helped us understand and articulate some obstacles to communication, and some strategies for making improvements.

We realize the categories of "advocate" and "transportation professional" are somewhat problematic. For one thing, they are not mutually exclusive; many individuals may be both. The term "transportation professionals" refers to a wide range of engineers and planners, including consultants and government staff from the local, state, and national levels."Advocates" is also a broad term, and one with which many people do not even identify; they may consider themselves nothing other than responsible, involved citizens.

URL

http://www.nybc.net/programs/NYBC_manual_6-21-02.pdf

San Francisco Municipal Transportation Agency. (2005). San Francisco Bicycle Plan.

RESEARCH NOTES

Major infrastructure and programmatic improvements have taken place since the San Francisco Bicycle Plan was first developed in 1997: miles of new bike lanes have been striped; hundreds of bike racks have been installed; the number of bicycle commuters has more than doubled from 1990 to 2000i; while the number of bicyclist injury collisions has decreased.

The recognition of bicycles as a key component of a sustainable transportation system has permeated local and regional governments and funding agencies. Popular bicycling corridors such as Valencia Street show a more than doubling in bicycle traffic along that street once bike lanes were striped. The passage of Proposition K (the extension of the half-cent local transportation sales tax) in 2003 provides a historic opportunity to systemically upgrade and expand San Francisco's bicycle facilities.

With San Francisco's temperate climate, attractive neighborhoods, limited parking, and compact geography, there is an enormous potential to encourage more people to bicycle: for errands, work, school, or fun.

This updated Plan contains a framework to shape San Francisco into a world-class bicycling city. By investing in and implementing the bicycle facilities, education, and innovative policies and programs in this Plan, the City makes cycling a more viable mobility option. To achieve another major increase in the number of people that use bicycles as transportation, all Action items included in this Plan must be implemented within the next five years. This will require strong leadership from local elected officials, cooperation between a host of city agencies, and an unwavering commitment to the goals contained herein.

URL

http://www.sfmta.com/cms/bproj/bikeplan.htm

6. Annotated Bibliography: Impacts of Underreporting

Brustman, R. (1999). An Analysis of Available Bicycle and Pedestrian Accident Data, New York Bicycling Coalition.

RESEARCH NOTES

The New York Bicycling Coalition (NYBC) has set out on an ambitious three-year New York Community Safety Campaign funded by Governor's Traffic Safety Committee (GTSC). This effort is multi-faceted, touching on many aspects of bicycle and pedestrian safety. This report is one of the initial tasks in the NYBC campaign.

This report, now in its second edition, is one of the initial tasks in the NYBC campaign. Based upon great demand for the report following its initial circulation last fall, NYBC staff made minor stylistic and formatting changes to this new version during January, 2000. Findings, conclusions and recommendations developed by Mr. Brustman have not changed at all.

The report has three purposes, all relating to Bicycle/Pedestrian Accident data. The first purpose is to take stock of what is known or might reasonably be inferred about bicycle and pedestrian collisions in New York State. The idea is to review readily available data and summarize the scope and character of the problem. The second purpose is to help guide the collision field investigations that will take place later in the project. This report will be shared with members of the local task force in the four pilot counties selected for participation in this grant, other transportation and enforcement officials, at all levels of government, as well as local bicycle and pedestrian constituencies and other interested citizens. It is NYBC's hope that this report will help generate input and support for the investigations, which will include detailed engineering analyses of problem sites. This report will be used to help narrow the selection of initial investigation areas to those counties most likely to yield useful results.

The third purpose is to suggest possible improvements in local and statewide data collection systems and current analytical approaches. The report offers observations on the available data, discussing sources and related issues. The report provides some ideas on how this data might be made more complete and how bicycle and pedestrian collisions can be better reported.

URL

http://www.nybc.net/news/releases/bikepedaccid.pdf

Sciortino, Stanley and Elyse Chiapello. (2006). Environmental, Behavioral, and Demographic Factors that Affect the Severity of Pedestrian Injuries.

RESEARCH NOTES

The California Statewide Integrated Traffic Reporting System (SWITRS) database categorizes pedestrian injuries into four broad categories: Fatal, severe, visible injury, and complaint of pain. "Fatal" denotes death within 30 days of the incident. For the purposes of this study, visible injury and complaint of pain were grouped together under the designation "Minor Injury." DUI collisions denote those incidents in which the driver was cited for driving while intoxicated. "Alcohol-related" collisions are incidents in which the reporting officer suspected either the driver or pedestrian victim of being intoxicated, and recorded this under a "had been drinking" designation.

The purpose of the study was to assess what circumstances contribute to a greater or lesser severity of injury among affected pedestrians, and to compare the strength of such contributions. The factors studied included the type of vehicle movement involved in the incident, the age and gender of the pedestrian victim, the type of violation that led to the collision, and the lighting conditions in the vicinity of the collision.

Using two severity comparisons, "Fatal vs. Minor" and "Fatal/Severe vs. Minor," odds ratios for the likelihood of each severity category were calculated for a variety of behavioral, environmental, and demographic circumstances surrounding the collisions (See Table 1, page 10). Odds ratios show the magnitude of risk for either a fatal, severe, or minor injury in each situation, relative to a baseline category, which is given the odds ratio of one.

URL

http://www.dph.sf.ca.us/traffic_safety/EnviroFactorsSeverity4.pdf

Sciortino, Stanley and Elyse Chiapello. (2006). "Pedestrian Injuries in San Francisco and the Bay Area 2001 through 2003: Rate Ratios by Ethnic Group."

RESEARCH NOTES

The purpose of this study was to determine the impact that pedestrian injuries have on different ethnic communities in San Francisco, the Bay Area, and other regions of California. Using data compiled by the San Francisco Department of Public Health for 2001 and the Statewide Integrated Traffic Reporting System (SWITRS) for years 2002 and 2003, rate ratios were calculated for the incidence of pedestrian injuries by race and ethnicity. These ratios were derived from age-adjusted injury rates utilizing San Francisco, Bay Area, and regional population estimates and ethnic groupings based on the 2000 U.S. Census. Rate ratios show how incidence rates for different communities compare to a base-line group, in this case the category of "white." The baseline category is assigned the rate ratio of one. Additionally, regional data from SWITRS regarding persons injured in traffic collisions was analyzed to determine how frequently the ethnicity of injured parties was recorded. The designation of ethnicity for collision victims is essential in determining the impact of traffic injury and mortality on California's diverse populations and regions. SWITRS divides California into 5 regions: the San Francisco Bay Area, Los Angeles, Southern California, Central Valley, and Northern Mountain regions. Due to its size, Los Angeles County was considered a region for this analysis.

URL

http://dphwww.sfdph.org/traffic_safety/RR_Race6.pdf

Table C 1. Underreporting Results Summary

Location	Year(s)	Type of Study	Sample Size	Percent Reported		Percent Reported by Mode	
James (1991)							
U.K.	1970	Police vs. hospital	1200	All	65%	Pedestrian	85%
				Serious	82%	Vehicle Occupant	75%
				Slight	65%	Motorcycle	66%
				Single-vehicle	20%	Bicycle	24%
U.K.	1974-1976	Police vs. hospital	3641	Fatal	100%	Pedestrian	73%
				Serious	79%	Vehicle Occupant	86%
				Slight	66%	Motorcycle	64%
				All	72%	Bicycle	34%
U.K.	1972	Police vs. hospital	7630	All Injuries	50%		
U.K.	1986	Police vs. GP data	21	All	24%		
U.K.	1983-1984	Police vs. hospital	5649	Fatal	100%	Pedestrian	75%
				Serious	66%	Vehicle Occupant	82%
				Slight	55%	Motorcycle	58%
				All	61%	Bicycle	24%
				Single-vehicle	35%		
				Multi-vehicle	77%		
U.K.	1977-1978	Police vs. hospital	1007	Serious	42%	Motorcycle	56%
				Slight	18%	Bicycle	22%
U.K.	1984-1985	Police vs. hospital (bicycles)	776	All	32%		
				Fatal	100%		
				Serious	39%		
				Slight	26%		
				Bicycle Only	4%		
				Non-Motor	13%		
				Motor Veh	64%		
California	1963	Police vs. DOH records	438	Fatal	100%		

				Injury	93%		
				PDO	38%		
				All	49%		
Sweden	1966	Police vs. hospital	2424	In-patient	49%	Car	55%
				Serious	28%	Motorcycle	35%
						Bicycle	12%
U.S.A.	1970	Police vs. Self-reported	576	All	35%		
North Carolina	1974	Insurers vs. DMV		All	89%		
Canada	1974	Police vs. hospital	1008	Fatal	100%		
				In-patient	97%		
				Out-patient	76%		
				All Injuries	88%		
Sri Lanka	1977-1981	Police vs. hospital	1771	Fatal	77%	Pedestrian	75%
				All Injuries	80%	Vehicle Occupant	70%
				Children	35%	Motorcycle	82%
						Bicycle	25%
						RTA	80%
W. Germany	1980	Police vs. hospital	"Medium"	Fatal	91%		
Many	1970s-1980s	Police vs. hospital (fatalities)	"Large"	Netherlands	106%		
				New Zealand	97%		
				Norway	80%		
				Sweden	93%		
				U.S.A.	96%		
				W. Germany	104%		
Netherlands	1977-1979	Police vs. hospital	25000	In-patient	85%		
				All Injuries	45%		
Ohio	1977	Hospital vs. DMV	882	All Injuries	55%	Pedestrian	46%
				<16 years old	28%	Bicycle	43%
						Drivers	74%
						Drivers/Occupants	61%
						Occupants	24%

California	1981-1982	Hospital vs. Police non-crash	65	All Injuries	38%		
				All Events	13%		
W. Germany	1983	Police vs. Insurance	2744	Fatal	95%		
				Serious	78%		
				Slight	62%		
Netherlands	1986-1987	Telephone interviews	67000	All	24%	Pedestrian	25%
				In-patient	70%	Occupants	41%
				Out-patient	26%	Motorcycle	36%
				No hospital	11%	Bicycle	11%
				Single-vehicle	5%		
				Multi-vehicle	35%		
North Dakota	1981	Insurers vs. DMV		All	47%		
Canada	1981	Police vs. Hospital	1767	Injury	59%		
Australia	1984-1985	Police vs. hospital (bicycles)	300	All	11%		
North Carolina	1985-1986	Police vs. hospital (bicycles)	649	All	11%		
				Motor Veh	60%		
				No motor veh	0.2%		
California	1987	Police vs. hospital (bicycles)				Pedestrian	80%
						Bicycle	90%
U.K.	Across Studies	Pedestrian		Fatal	100%		
				Serious	85%		
				Slight	67%		
				All	77%		
		Bicycle		Fatal	100%		
				Serious	33%		
				Slight	21%		
				All	27%		
Sciortino (2005)							
San Francisco	2000-2001	Pedestrian	2400			All	78%
Brustman (1999)							
New York State	1990s	Bicycle				All	67%

		Bike/Ped as % of fatalities			30%		
		Bike/Ped as % of serious			16%		
		Bike/Ped as % of all			11%		
Morrison (1992)							
New Zealand	1981	Pedestrian				All	75%
	1991					All	48%
Stutts (1998)							
New York State		Pedestrian				All	56%
California		Bicycle				All	48%
North Carolina							
Teanby (1992)							
U.K.	1989	Pedestrian				All	83%
Cryer (2001)							
U.K.							
Ward (2006)							
U.K.	1992	Police vs. Hospital				Bicycle	67%
						Pedestrian	75%
U.K.	1993	Police vs. Hospital		All	64%		
U.K.	1996	Police vs. Hospital		All	46%	Bicycle	22%
				Serious	55%	Pedestrian	60%
				Slight	45%		
U.K.	2005	Police vs. Hospital		All	61%	Bicycle	43%
						Pedestrian	66%
U.K.	1994	Police vs. Hospital				Pedestrian	74%
U.K.	2005	Police vs. Hospital				Pedestrian	56%

Appendix D

Pedestrian Brochures

The data for these analyses were obtained from the California Statewide Integrated Traffic Records System (SWITRS) for years 1998-2007 and 2005-2007.

The purpose of these documents is to assist in understanding pedestrian injury collisions in California in the context of overall injury and fatality characteristics and trends. Brochures are available for all 58 counties, although only Alameda County is included in this report to save space. Please contact SafeTREC to obtain the brochures electronically.

Pedestrian Safety Facts 2003-2007

ALAMEDA COUNTY

UC Berkeley Safe Transportation Research & Education Center

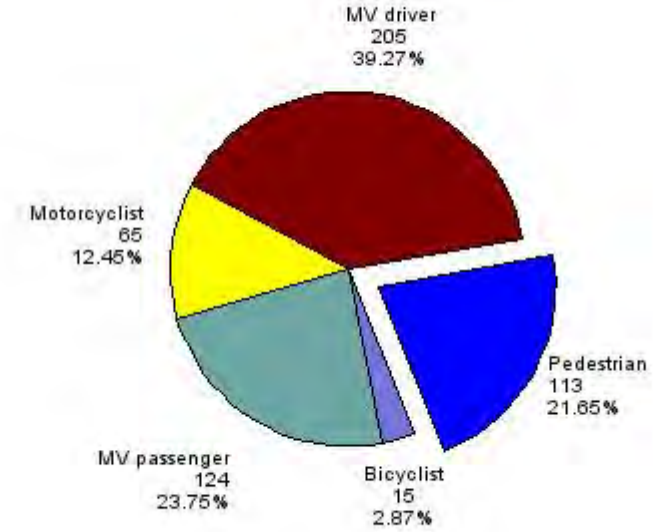
Updated February 2010

CONTENTS

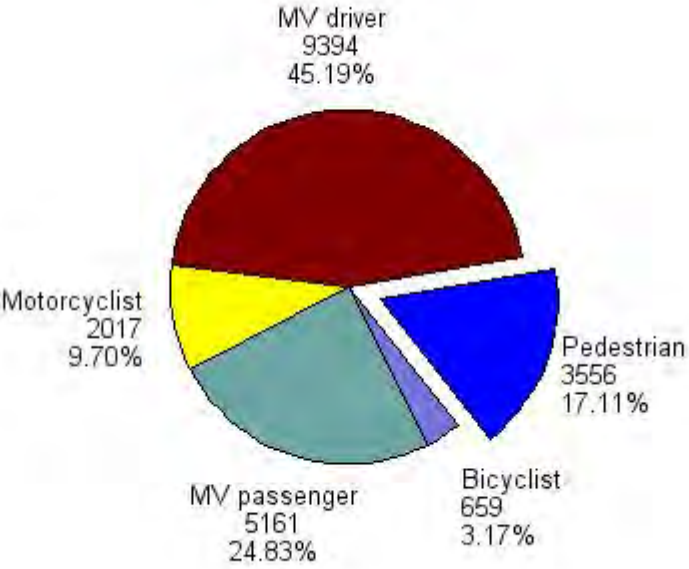
A note on under- and non-reporting of pedestrian-involved collisions: Previous research suggests that a significant number of pedestrian-involved roadway collisions are not reported to the police and are therefore not reflected in the state or national collision databases. Additionally, there is no mechanism for reporting non-roadway collisions for inclusion in SWITRS. The number of reported pedestrian-involved collisions represents an estimated 55-70% of all such collisions.

Pedestrians represent nearly 22% of traffic fatalities in ALAMEDA COUNTY.

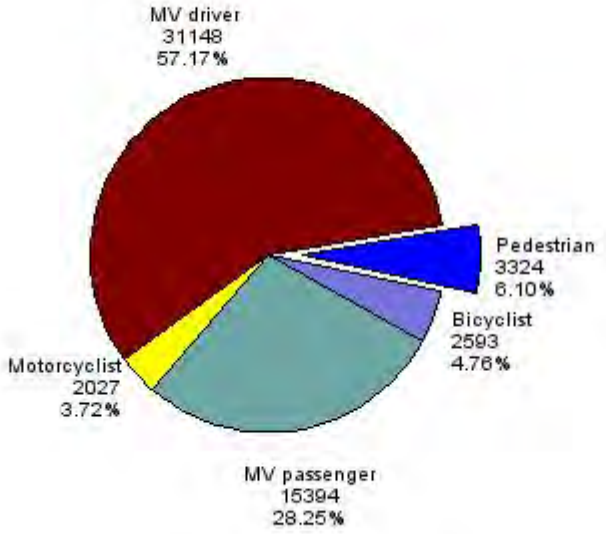
Fatal victim types, ALAMEDA COUNTY SWITRS 2003-2007



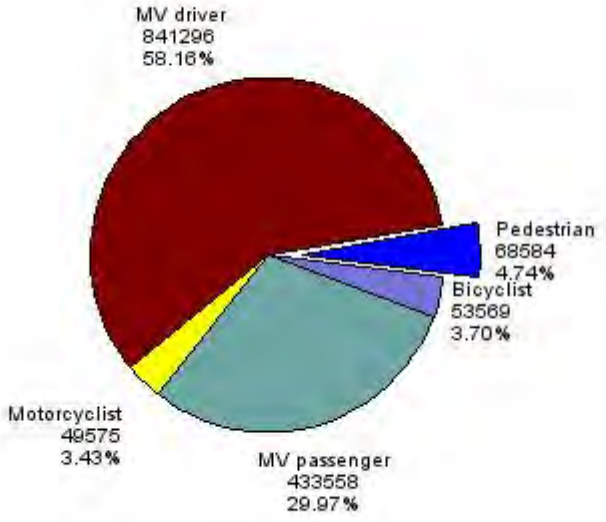
Fatal victim types, California SWITRS 2003-2007



Injury victim types, ALAMEDA COUNTY SWITRS 2003-2007



Injury victim types, California SWITRS 2003-2007

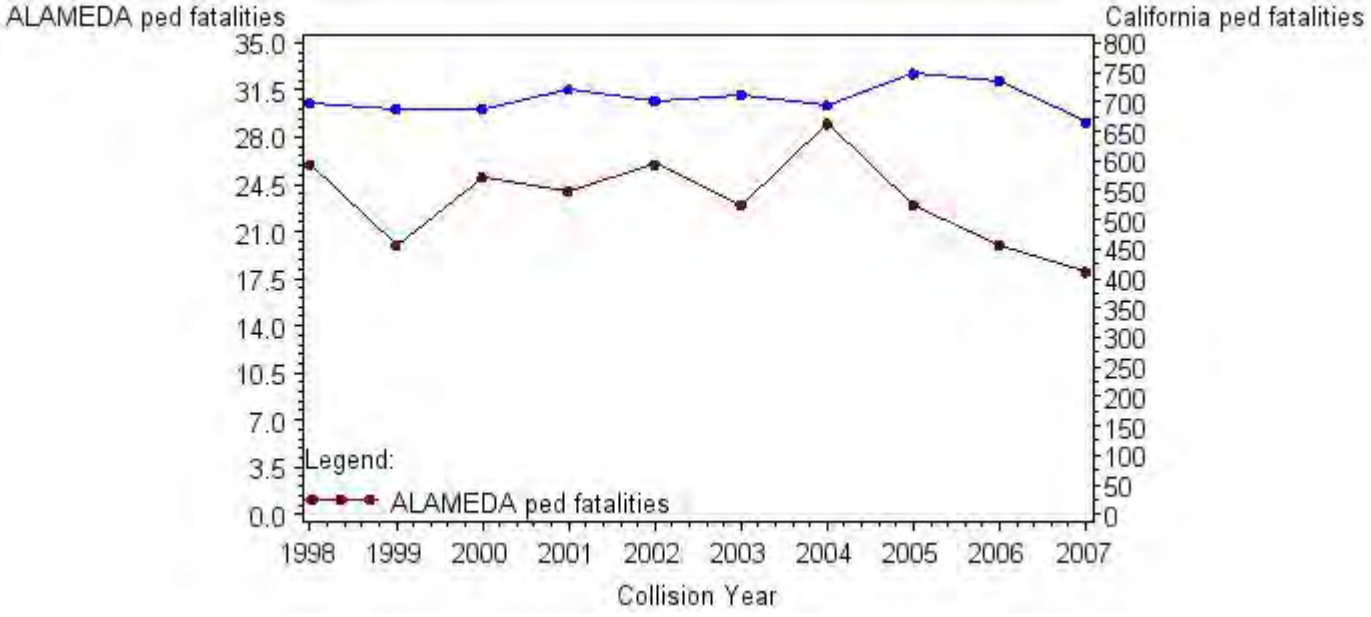


Pedestrians are 5 times more likely to suffer a fatal injury in a motor vehicle collision than persons inside a vehicle.

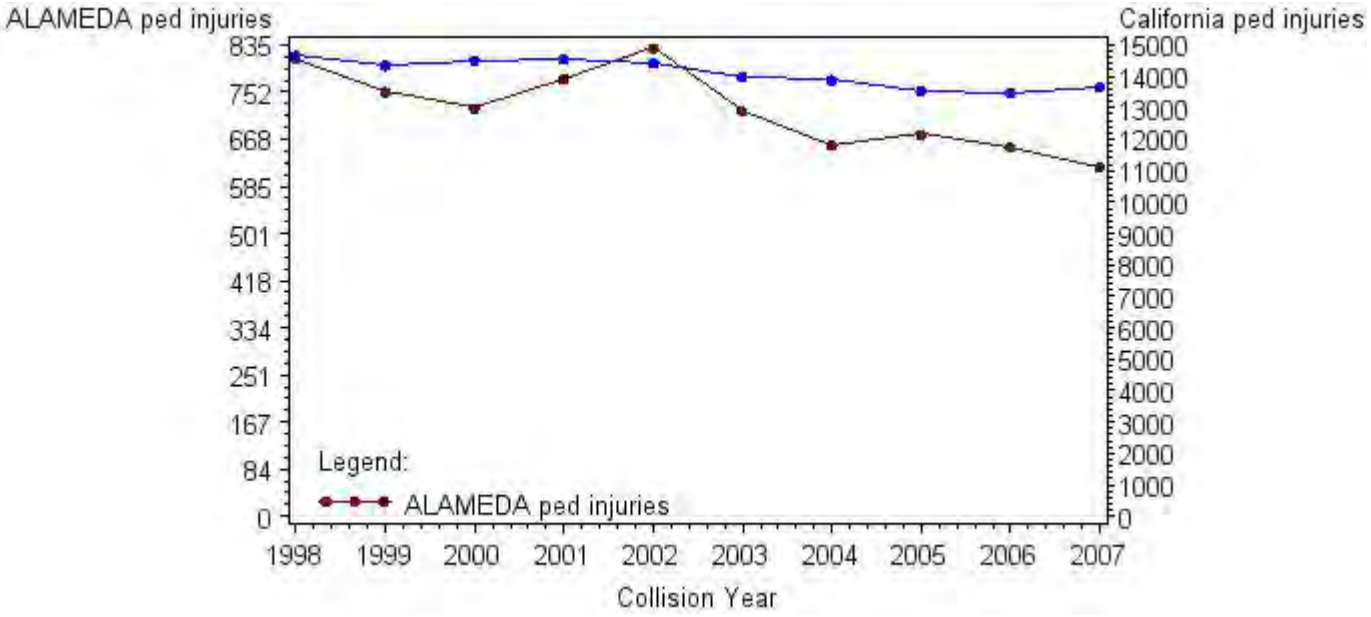
Pedestrian victims by injury severity, ALAMEDA COUNTY SWITRS 2003-2007

Pedestrian victims by injury severity, California SWITRS 2003-2007

Number of Pedestrian Fatalities, ALAMEDA COUNTY and California SWITRS 1998-2007

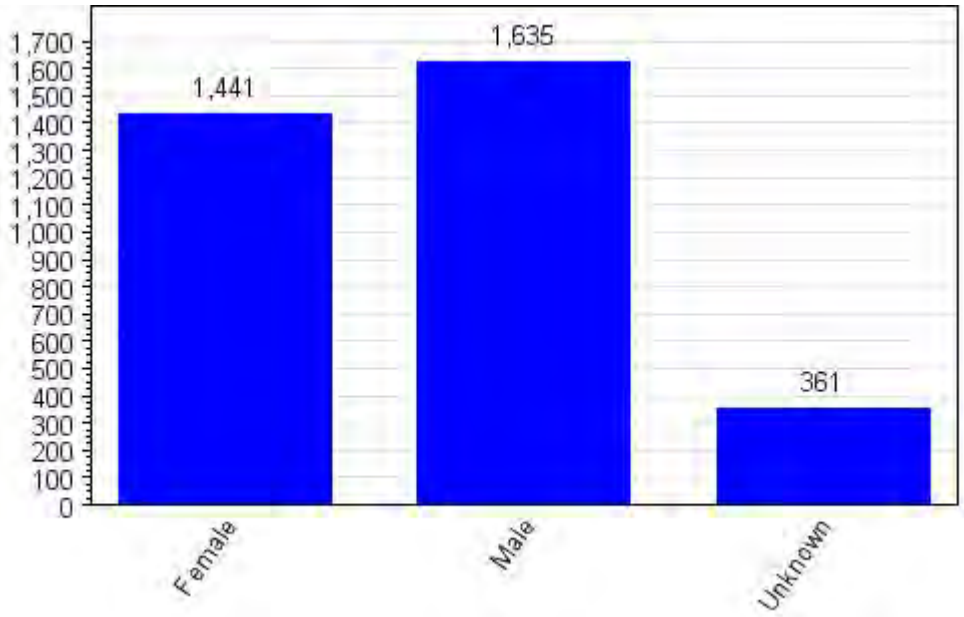


Number of Pedestrian Injuries, ALAMEDA COUNTY and California SWITRS 1998-2007

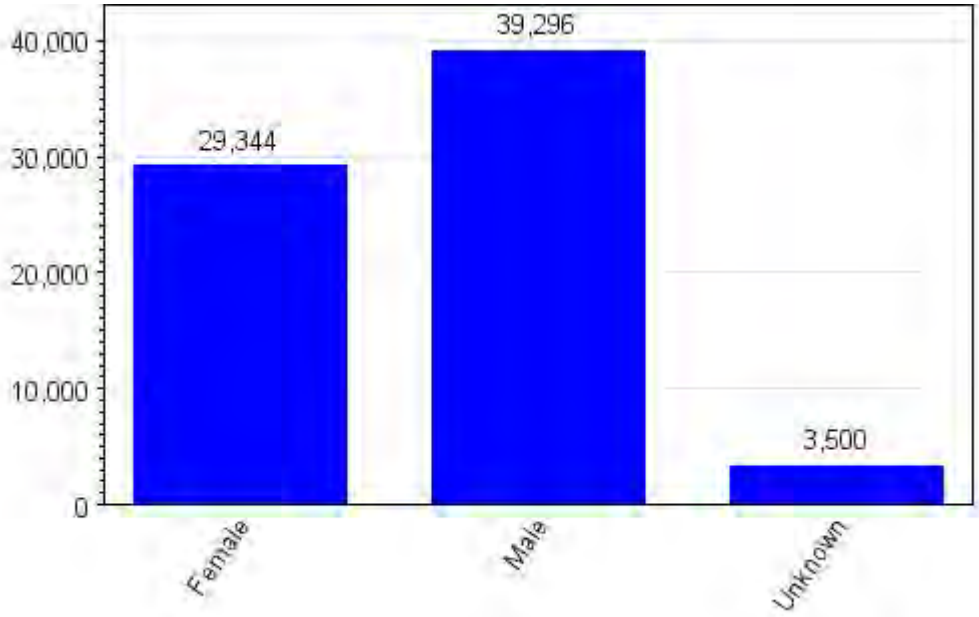


Males are more likely than females to be involved in collisions – as pedestrians and as drivers.

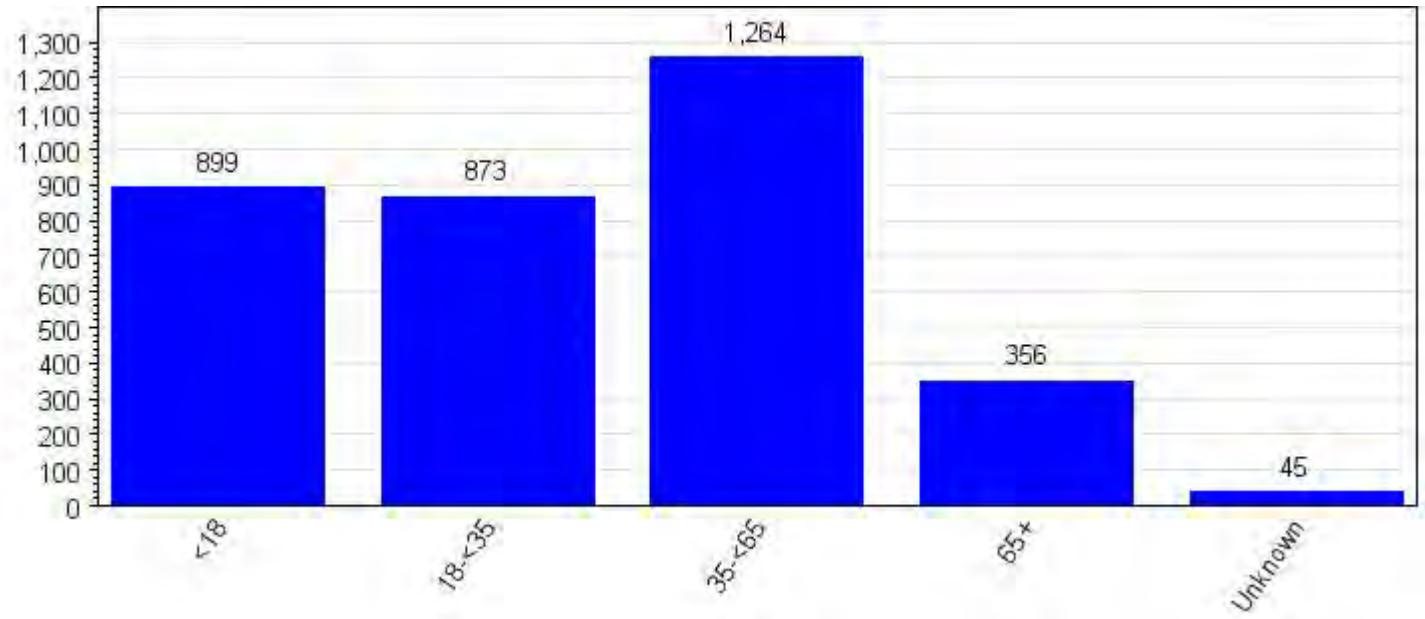
Number of Pedestrian Victims by Sex, ALAMEDA COUNTY SWITRS 2003-2007



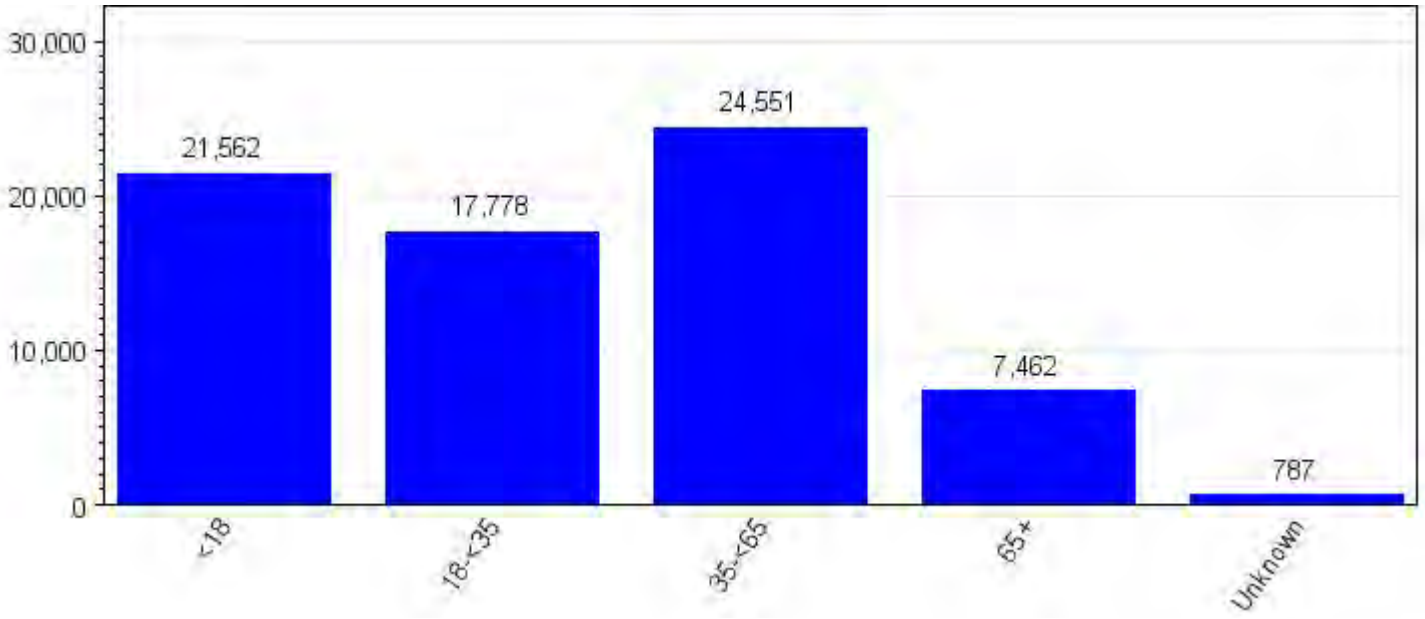
Number of Pedestrian Victims by Sex, California SWITRS 2003-2007



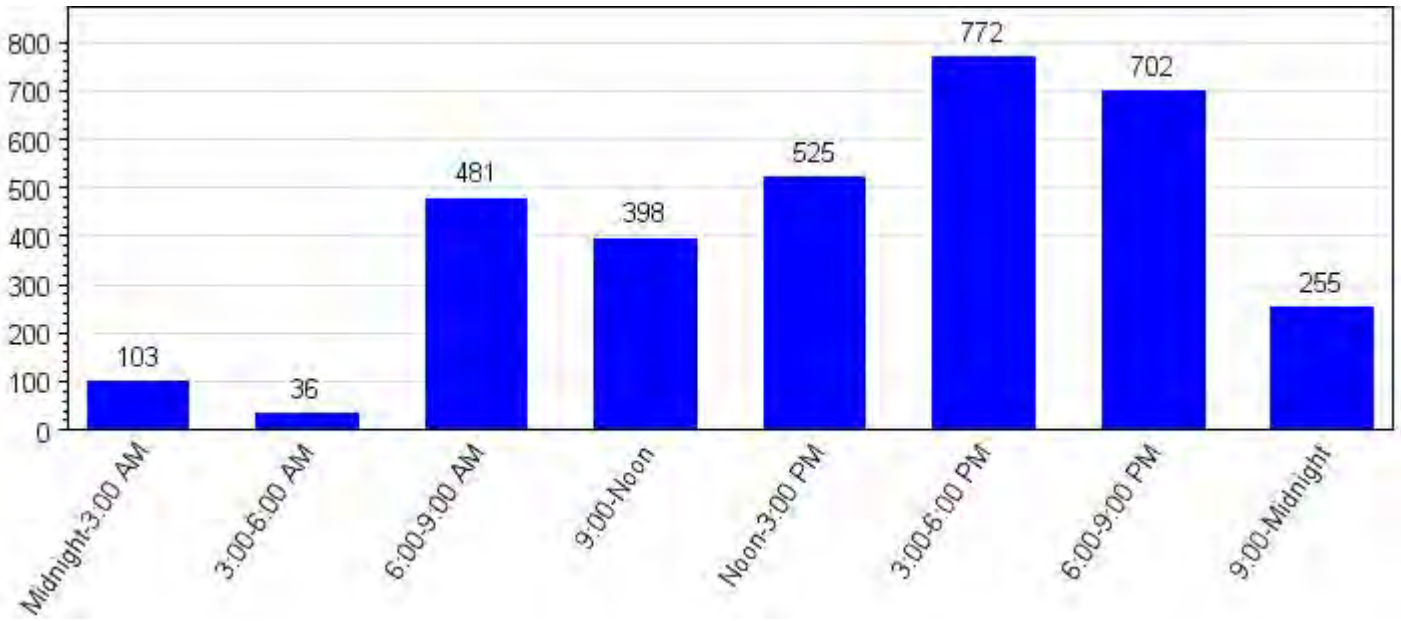
Number of Pedestrian Victims by Age, ALAMEDA COUNTY SWITRS 2003-2007



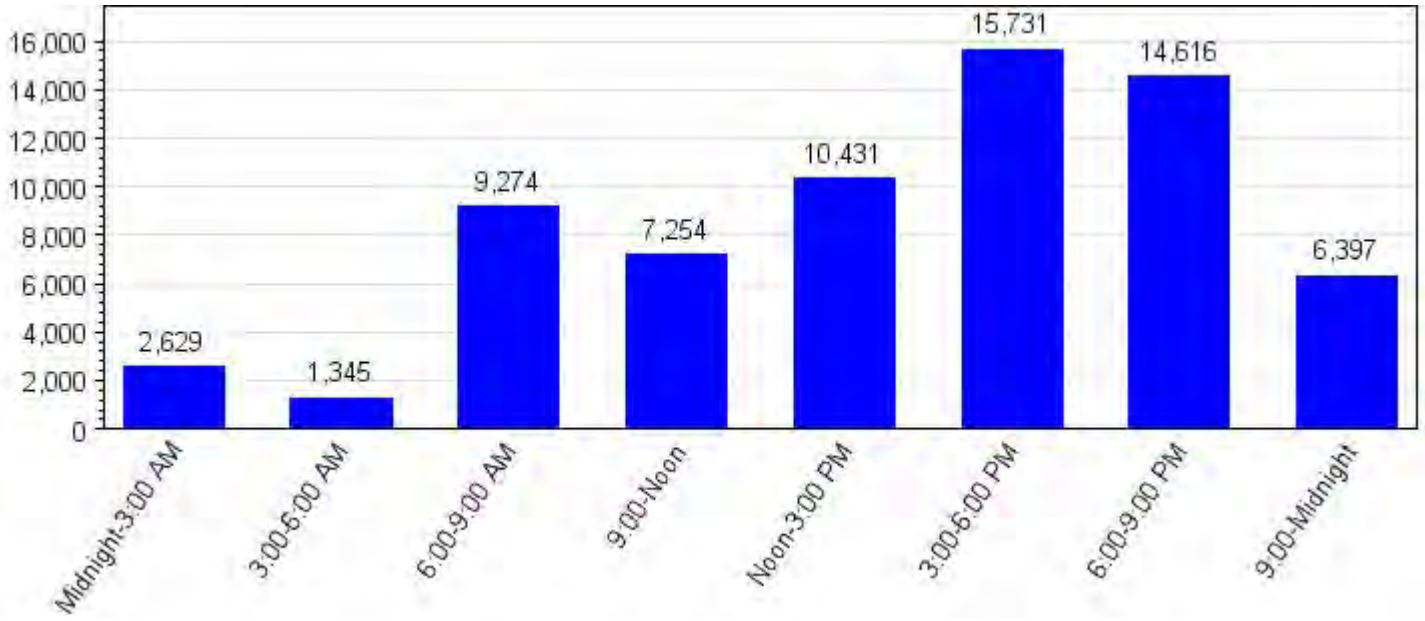
Number of Pedestrian Victims by Age, California SWITRS 2003-2007



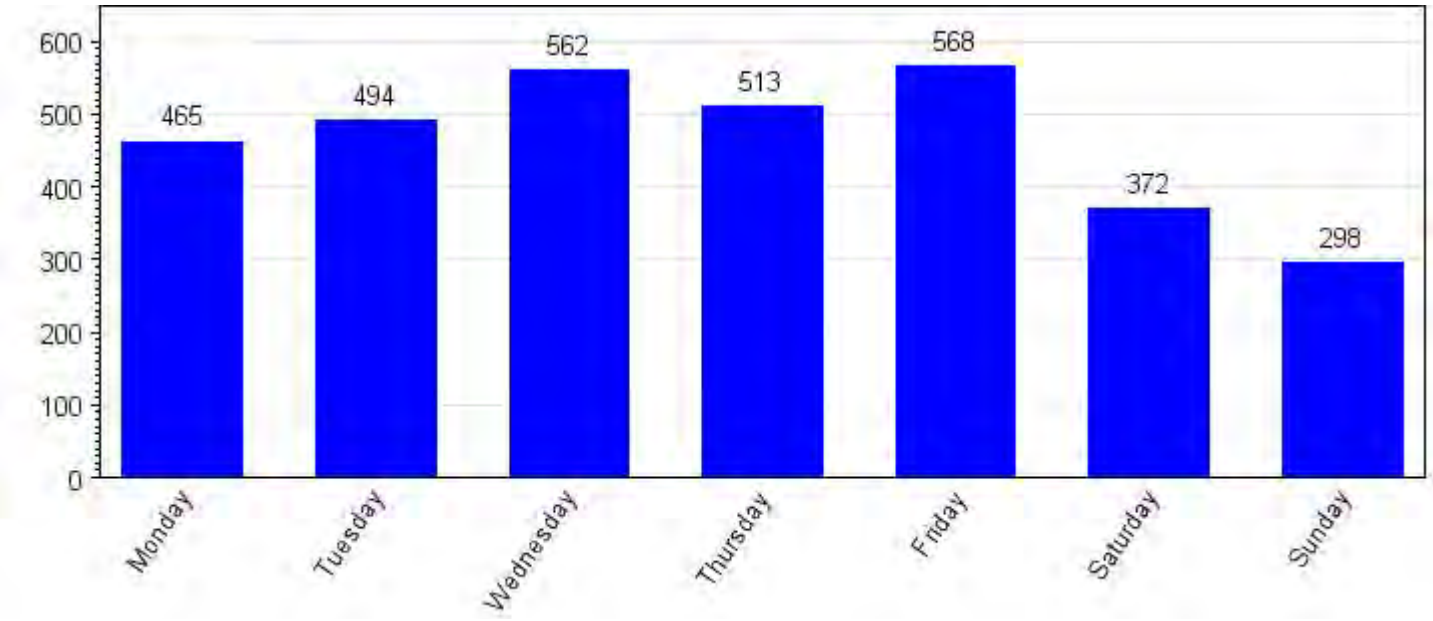
Number of Pedestrian Crashes by Hour, ALAMEDA COUNTY SWITRS 2003-2007



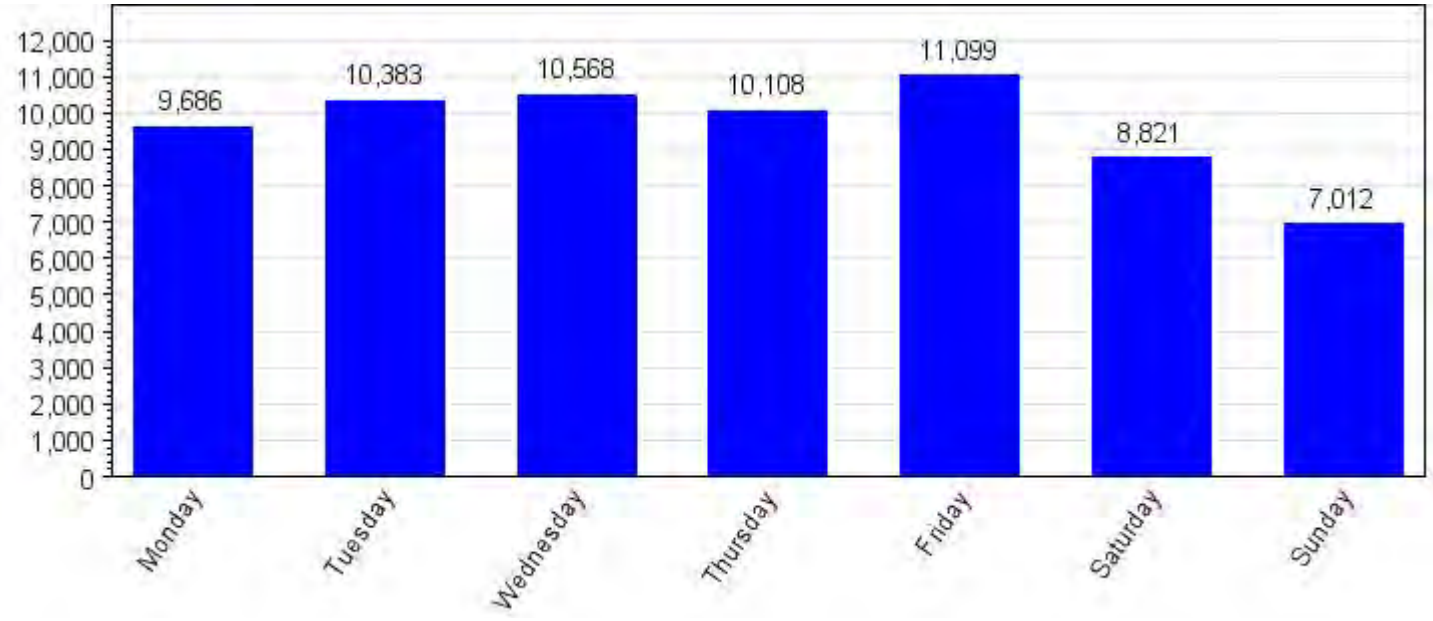
Number of Pedestrian Crashes by Hour, California SWITRS 2003-2007



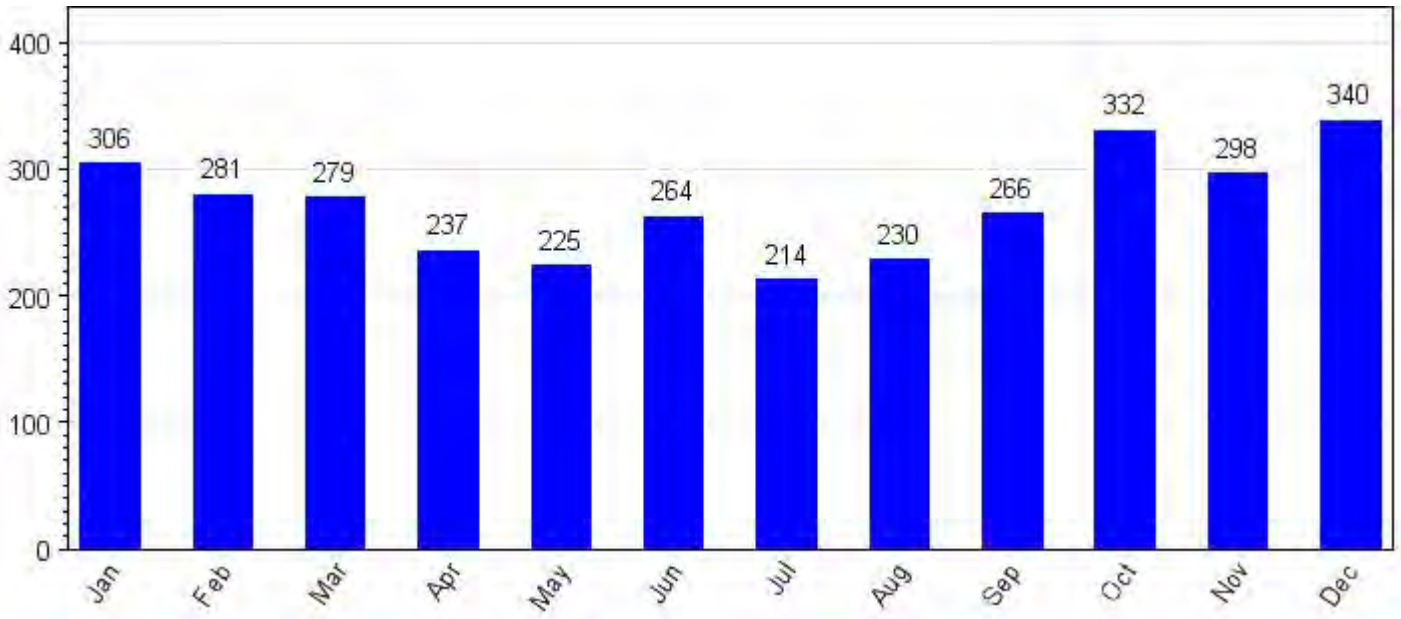
Number of Pedestrian Crashes by Day of Week, ALAMEDA COUNTY SWITRS 2003-2007



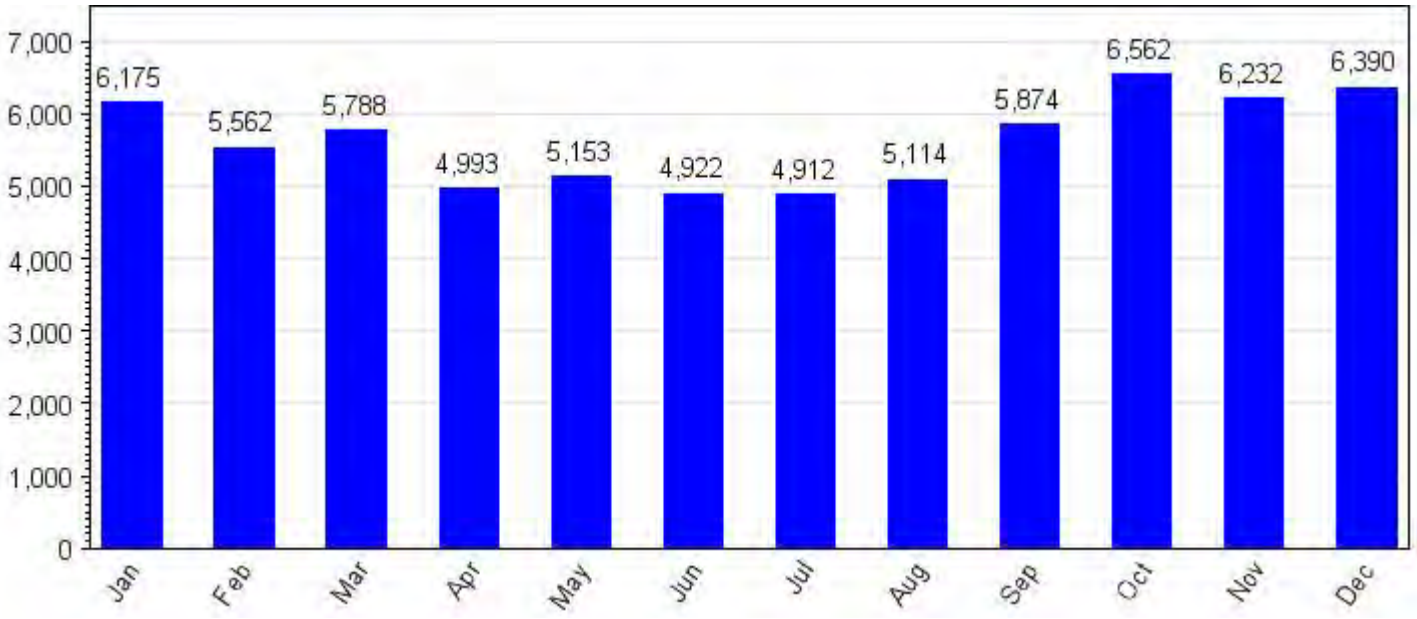
Number of Pedestrian Crashes by Day of Week, California SWITRS 2003-2007



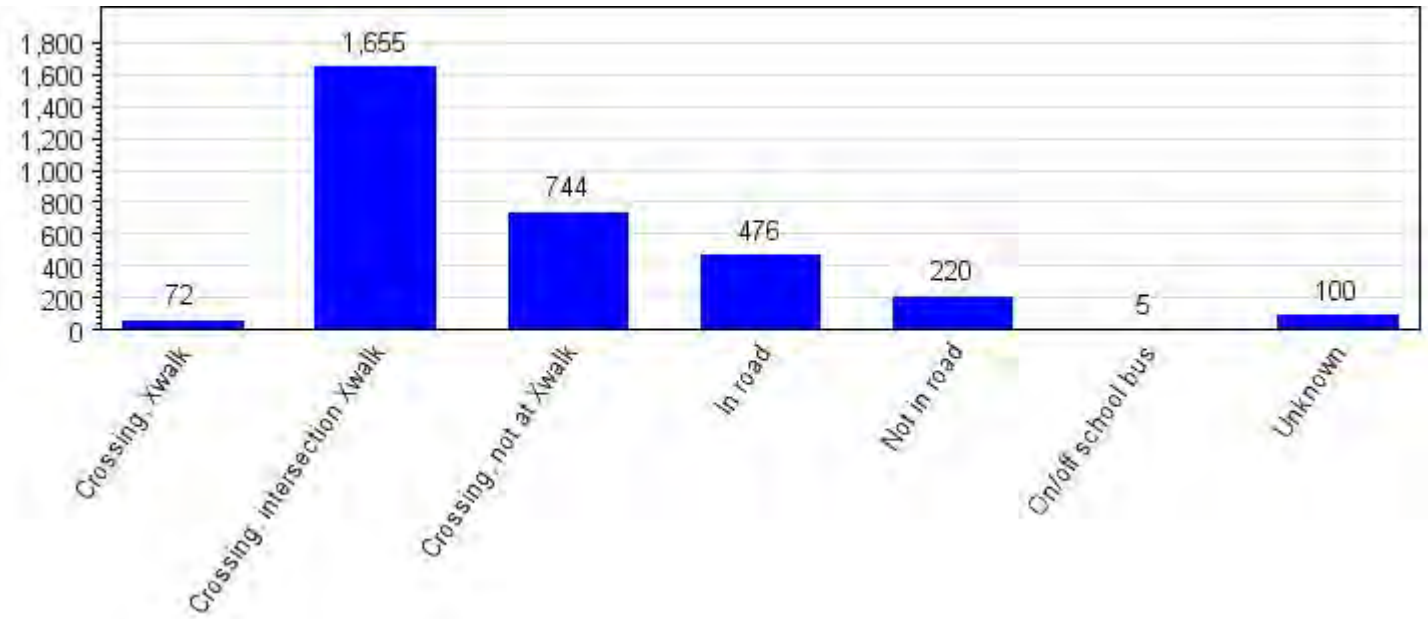
Number of Pedestrian Crashes by Month, ALAMEDA COUNTY SWITRS 2003-2007



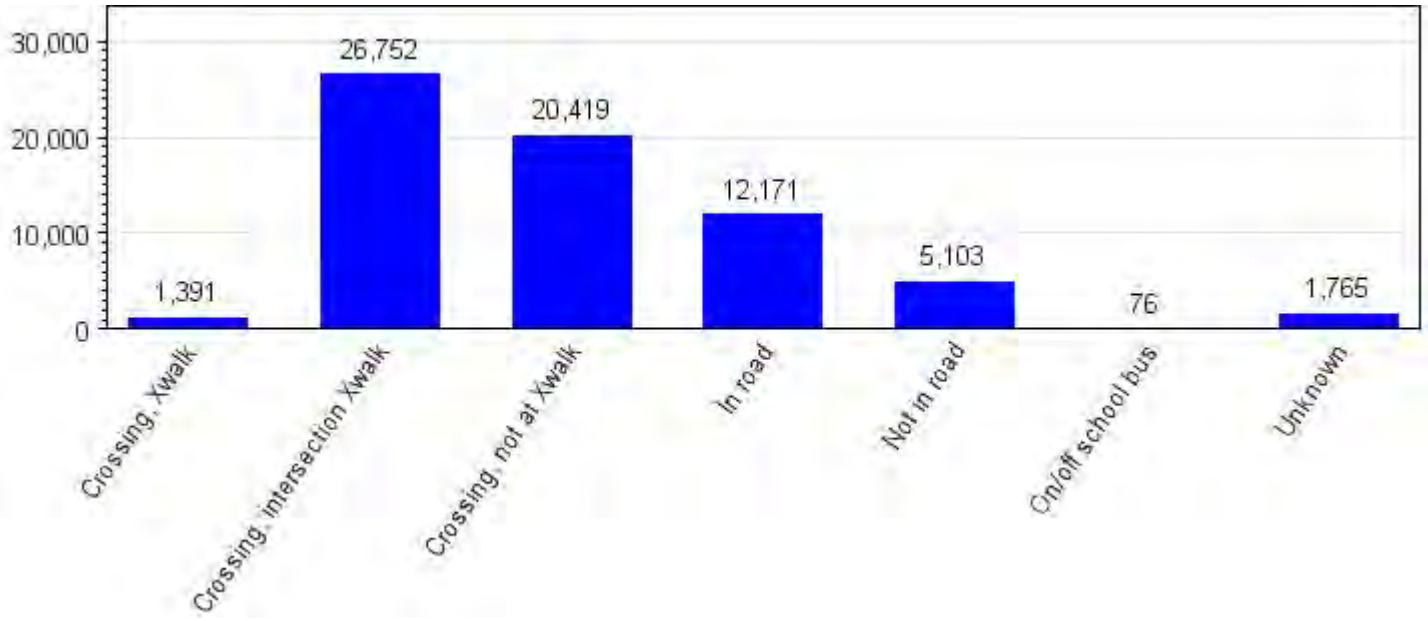
Number of Pedestrian Crashes by Month, California SWITRS 2003-2007



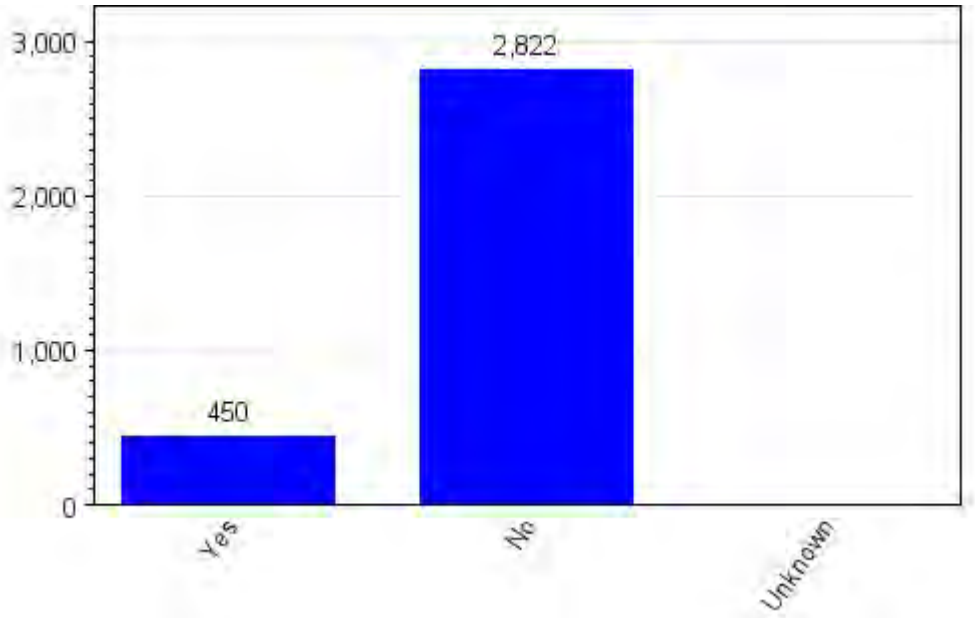
Number of Pedestrian Crashes by Location, ALAMEDA COUNTY SWITRS 2003-2007



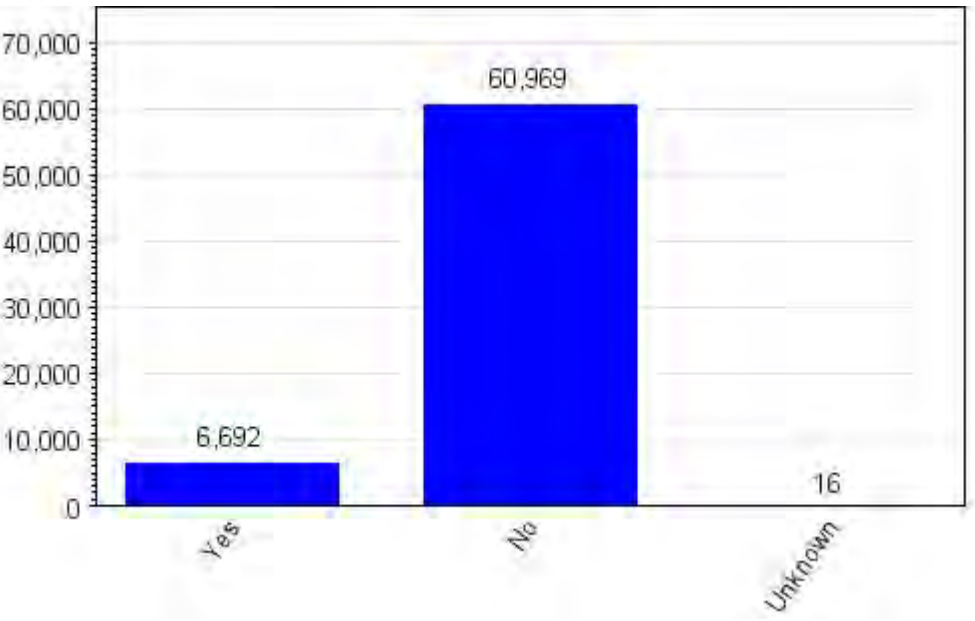
Number of Pedestrian Crashes by Location, California SWITRS 2003-2007



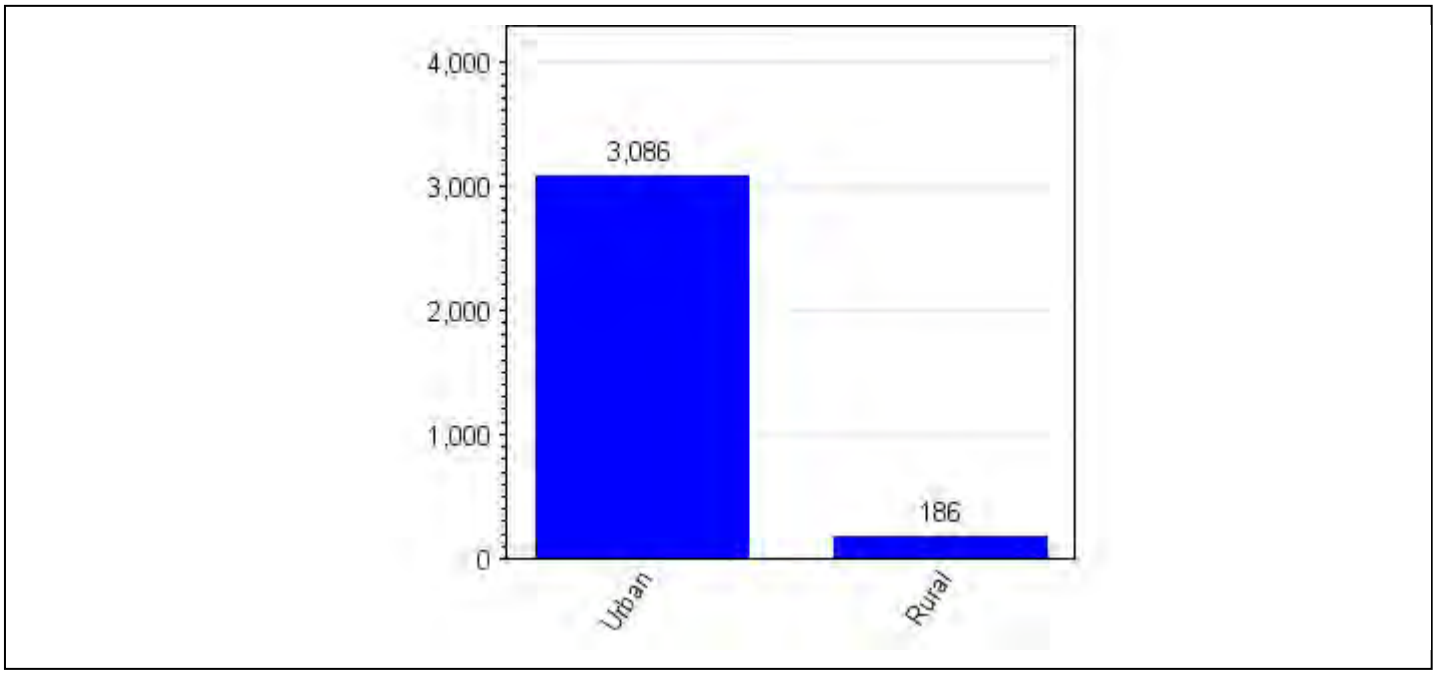
Number of Pedestrian Crashes by State Highway status, ALAMEDA COUNTY SWITRS 2003-2007



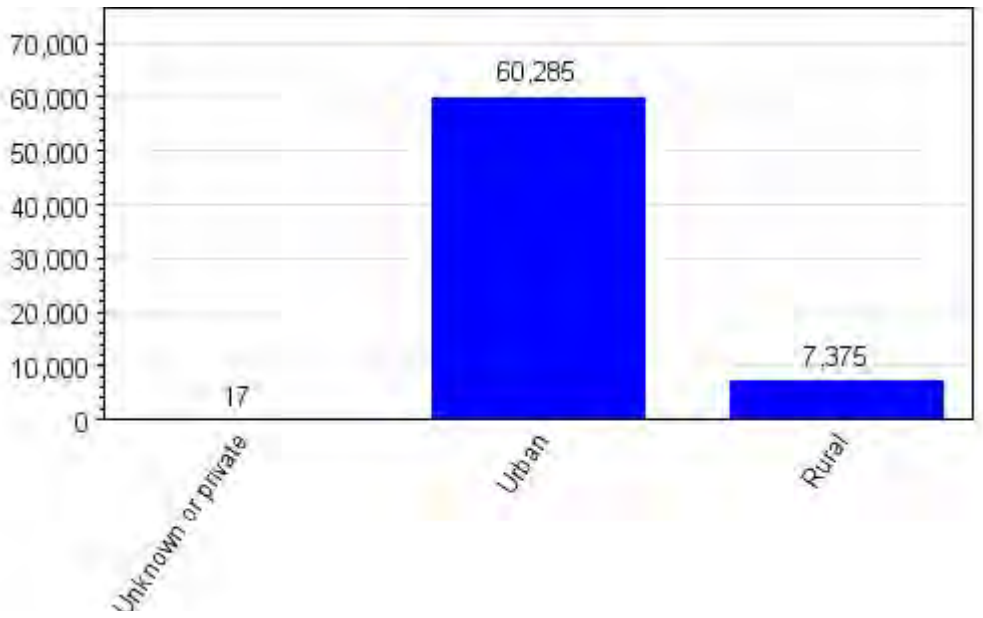
Number of Pedestrian Crashes by State Highway status, California SWITRS 2003-2007



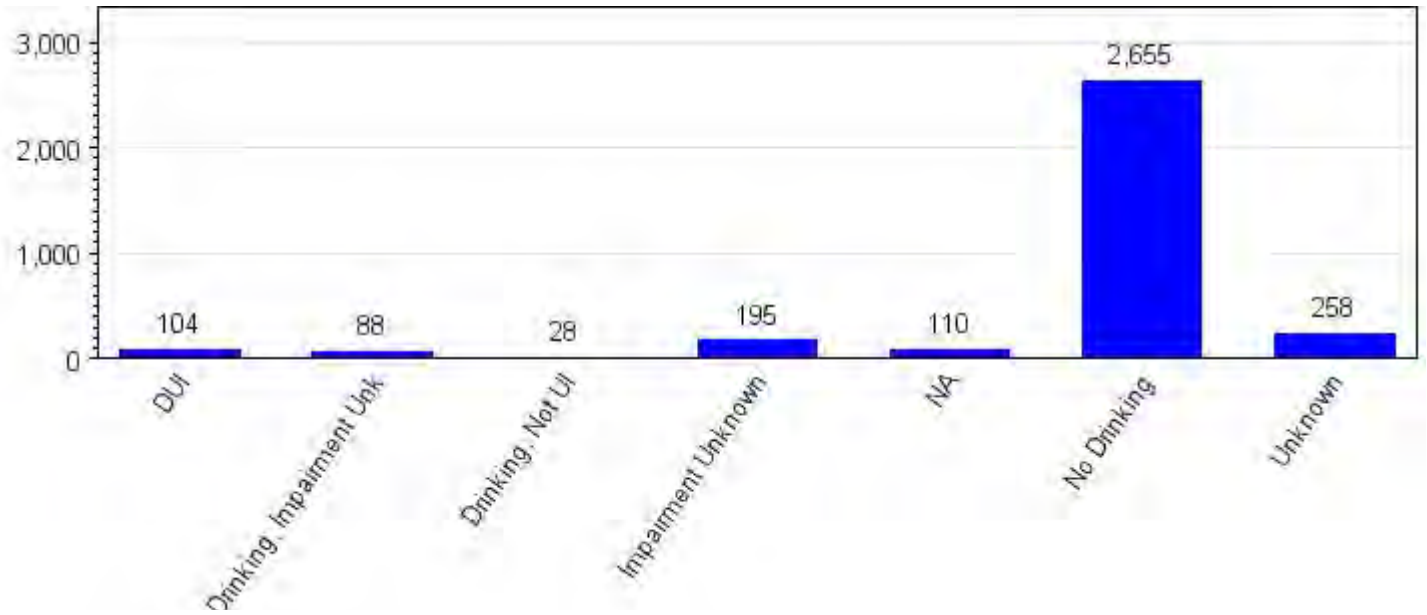
Number of Pedestrian Crashes by Urban status, ALAMEDA COUNTY SWITRS 2003-2007



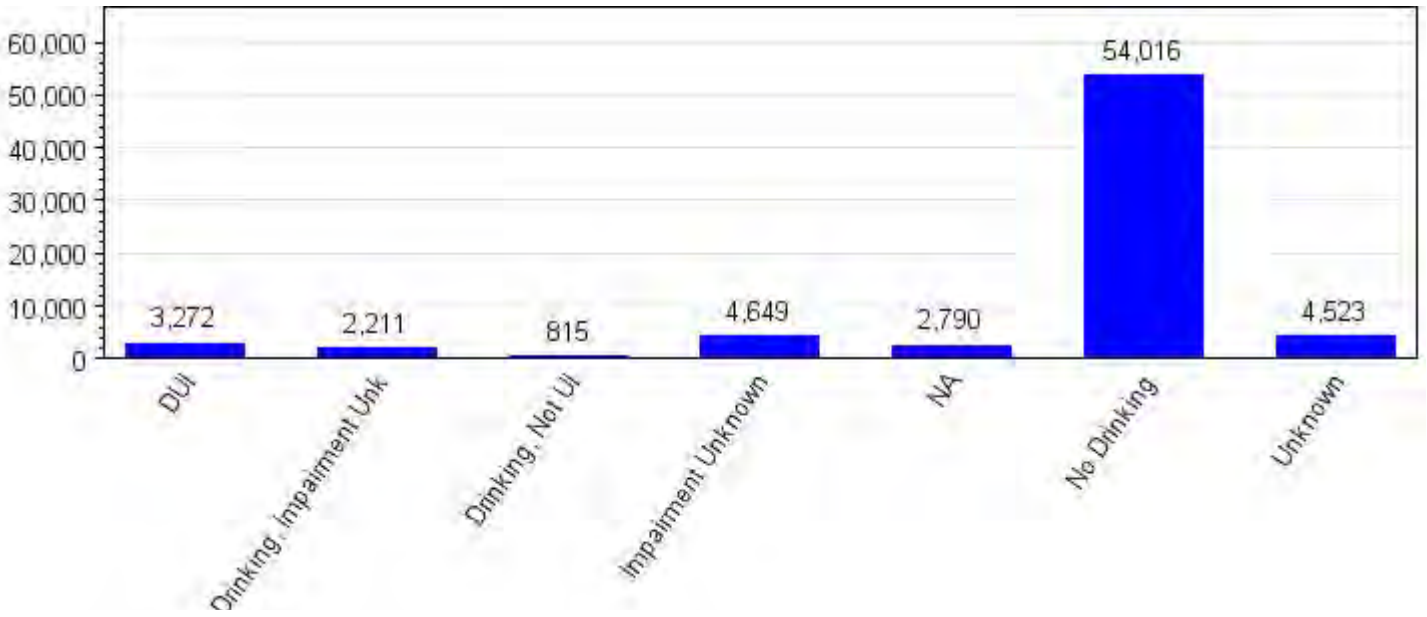
Number of Pedestrian Crashes by Urban status, California SWITRS 2003-2007



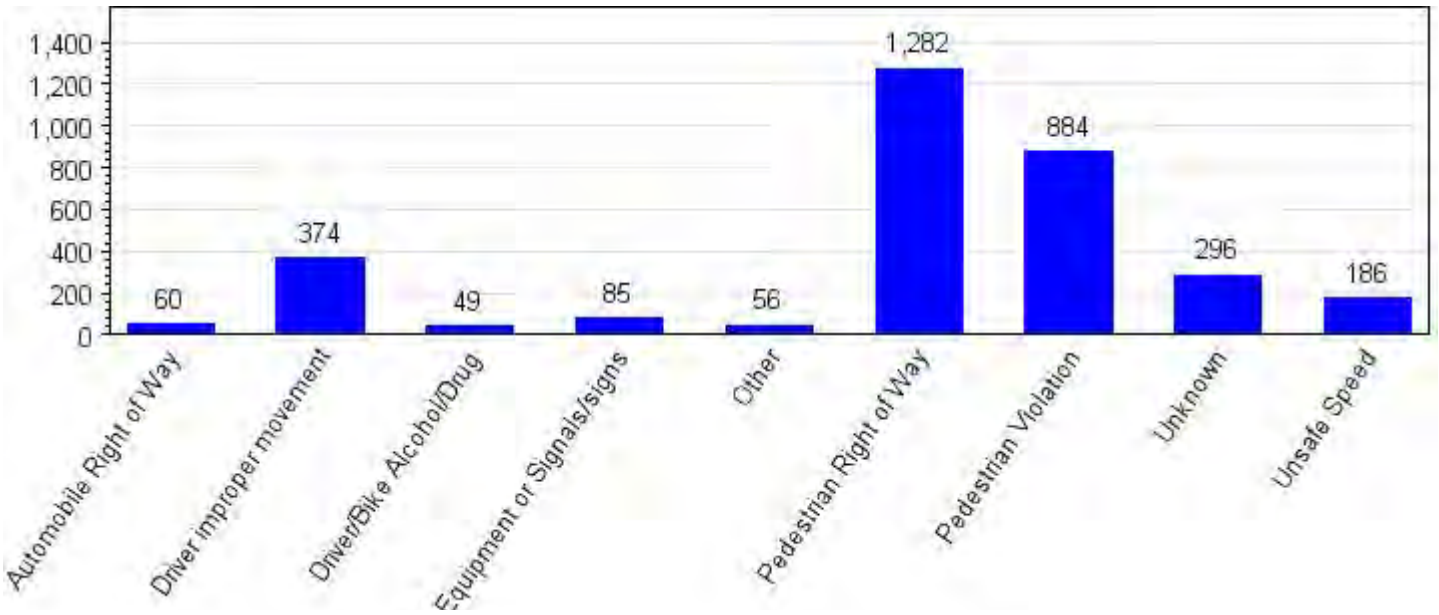
Number of Pedestrian Parties by Sobriety, ALAMEDA COUNTY SWITRS 2003-2007



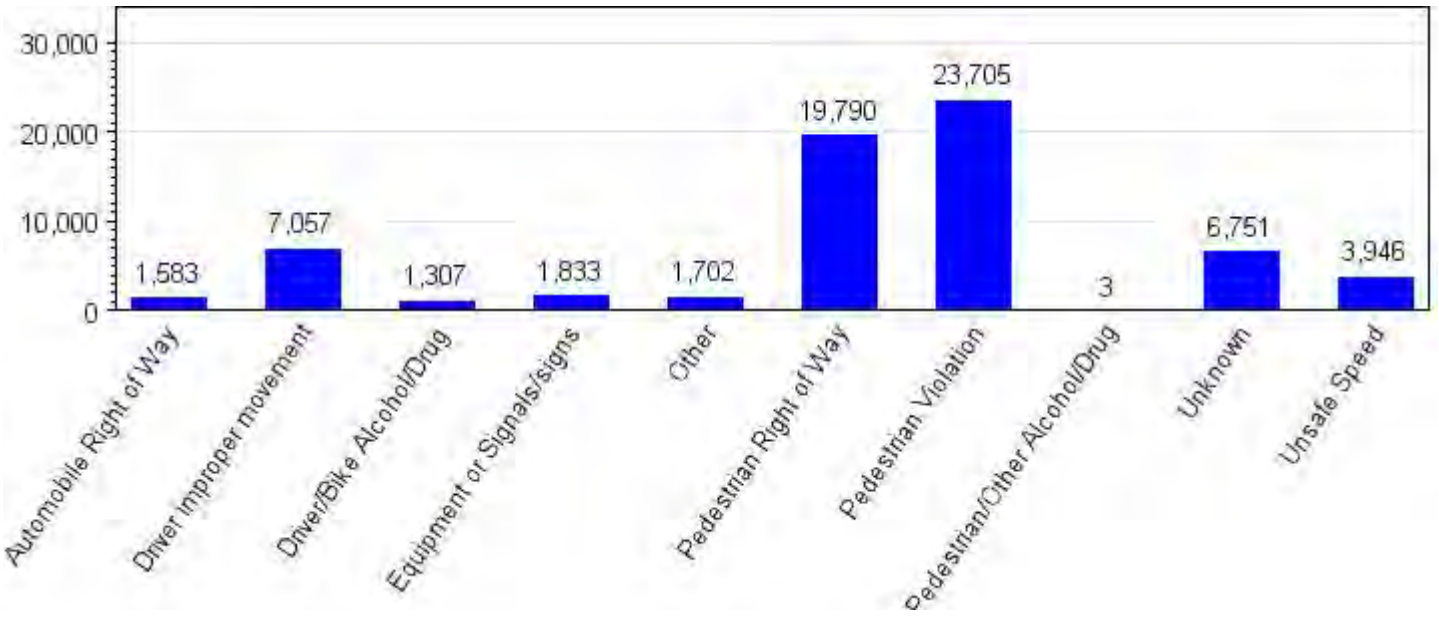
Number of Pedestrian Parties by Sobriety, California SWITRS 2003-2007



Primary Collision Factor, ALAMEDA COUNTY SWITRS 2003-2007



Primary Collision Factor, California SWITRS 2003-2007



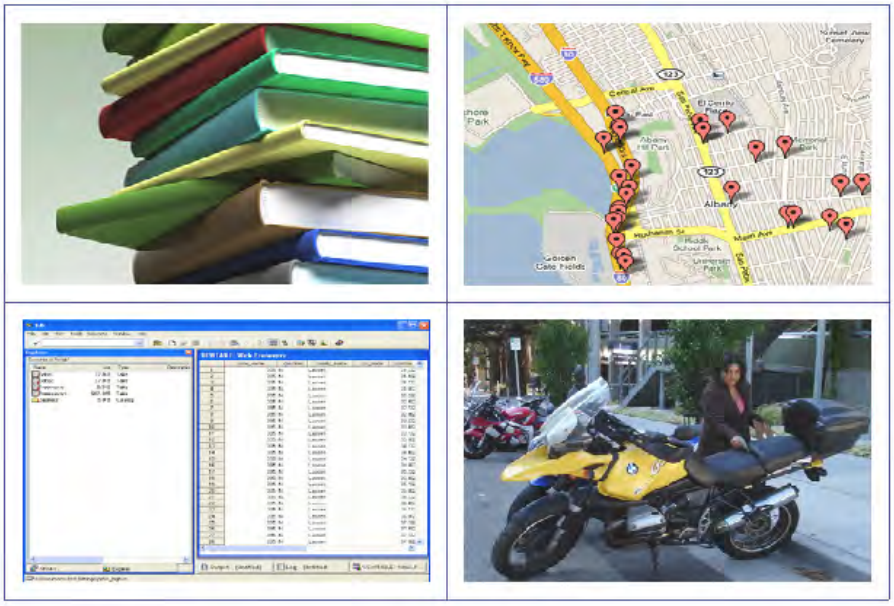
Pedestrian Victim* Rate by County, SWITRS 2007

County	N Ped Victims	% Ped Victims of All Victims	Ped victims per 10,000 population
ALAMEDA	636	6.31	4.16
ALPINE	0	0.00	0.00
AMADOR	4	0.92	1.04
BUTTE	50	3.87	2.28
CALAVERAS	7	1.52	1.52
COLUSA	4	1.76	1.83
CONTRA COSTA	261	5.11	2.50
DEL NORTE	7	3.57	2.40
EL DORADO	33	2.60	1.85
FRESNO	239	3.90	2.59
GLENN	6	2.50	2.07
HUMBOLDT	37	3.45	2.79
IMPERIAL	30	2.99	1.72
INYO	6	2.63	3.28
KERN	230	4.03	2.84
KINGS	37	3.47	2.41
LAKE	14	3.13	2.19
LASSEN	6	2.87	1.66
LOS ANGELES	5623	6.76	5.46
MADERA	35	3.04	2.33
MARIN	87	6.30	3.39
MARIPOSA	5	2.79	2.72
MENDOCINO	26	3.57	2.90
MERCED	70	3.61	2.77
MODOC	5	6.17	5.15
MONO	1	0.81	0.71
MONTEREY	145	6.33	3.41
NAPA	27	2.45	1.99
NEVADA	18	2.51	1.81
ORANGE	820	4.04	2.65
PLACER	45	2.03	1.36
PLUMAS	3	1.63	1.44
RIVERSIDE	452	3.03	2.18
SACRAMENTO	518	4.17	3.66
SAN BENITO	21	5.43	3.65
SAN BERNARDINO	513	3.32	2.52
SAN DIEGO	1190	5.64	3.81
SAN FRANCISCO	831	16.9	10.2
SAN JOAQUIN	256	4.19	3.76
SAN LUIS OBISPO	41	2.45	1.53
SAN MATEO	252	6.80	3.43
SANTA BARBARA	165	5.62	3.88
SANTA CLARA	538	5.42	2.96
SANTA CRUZ	106	6.57	4.00
SHASTA	54	3.24	2.98
SIERRA	1	3.45	2.94
SISKIYOU	7	1.99	1.53
SOLANO	129	4.93	3.04
SONOMA	118	3.76	2.45
STANISLAUS	182	4.05	3.48
SUTTER	21	2.77	2.20
TEHAMA	13	2.57	2.09
TRINITY	0	0.00	0.00
TULARE	119	3.73	2.76
TUOLUMNE	16	2.93	2.81
VENTURA	205	3.64	2.48
YOLO	45	3.73	2.28
YUBA	19	4.65	2.65
CALIFORNIA	14329	5.29	3.79

* Injury and fatality

Appendix E

Location Analysis Website



Task Order 6221

SafeTREC Safe Transportation Research & Education Center

CALIFORNIA PATH

Caltrans

In California, local law enforcement agencies and the California Highway Patrol (CHP) collect and aggregate data from police collision reports. The data are stored in an electronic database, the Statewide Integrated Traffic Records System (SWITRS), and are made available to the public. The data are used extensively by law enforcement, researchers, and injury prevention practitioners to monitor collision rates, identify high collision locations, and develop and evaluate traffic safety programs. Many users of the data have attempted to assign latitude-longitude coordinates so that the data can be linked with geographical information (e.g., census population counts, housing characteristics, and the location of schools or parks). This assignment is known as geocoding and is performed with Geographic Information Systems (GIS) software. Barriers that prevent the accurate, affordable, and efficient geocoding of the collision data at the local level include expense, ease-of-use, and redundancy of efforts.

SafeTREC was able to geocode 90% of SWITRS statewide fatal and severe injury collisions from 1998 to 2007 under a project funded by the California Office of Traffic Safety (OTS) and the National Highway Traffic Safety Administration. Overall, 20 counties had over 90% of collisions geocoded, whereas only 8 counties had less than 80% geocoded. State highway collisions with postmile information had very high match success; above 99.5% for most counties. Intersection offset collisions were the most difficult to geocode, with a wide range in success rates.

SafeTREC also developed a web-based system to disseminate the geocoded data. Latitude and longitude coordinate information was added to the SWITRS collision table and an online query tool was created to allow users to subset data based on a number of specifications. After creating a subset of the data, users can download a data set and create a simple pin map using Google Maps. Labeling, drawing, printing and Google Earth export options are available to the user.

The result of these efforts is a user-friendly, web interface was created to facilitate the use of SWITRS data with geographic coordinates. The tool may lower barriers to California traffic collision data and increase the use of empirical data in traffic injury prevention activities. SafeTREC, Caltrans, and OTS are currently engaged in discussions about liability and access to the system before it will be available.

This report demonstrates how the website can be used to analyze pedestrian crashes in particular. The screenshots below depict the steps involved in an analysis.

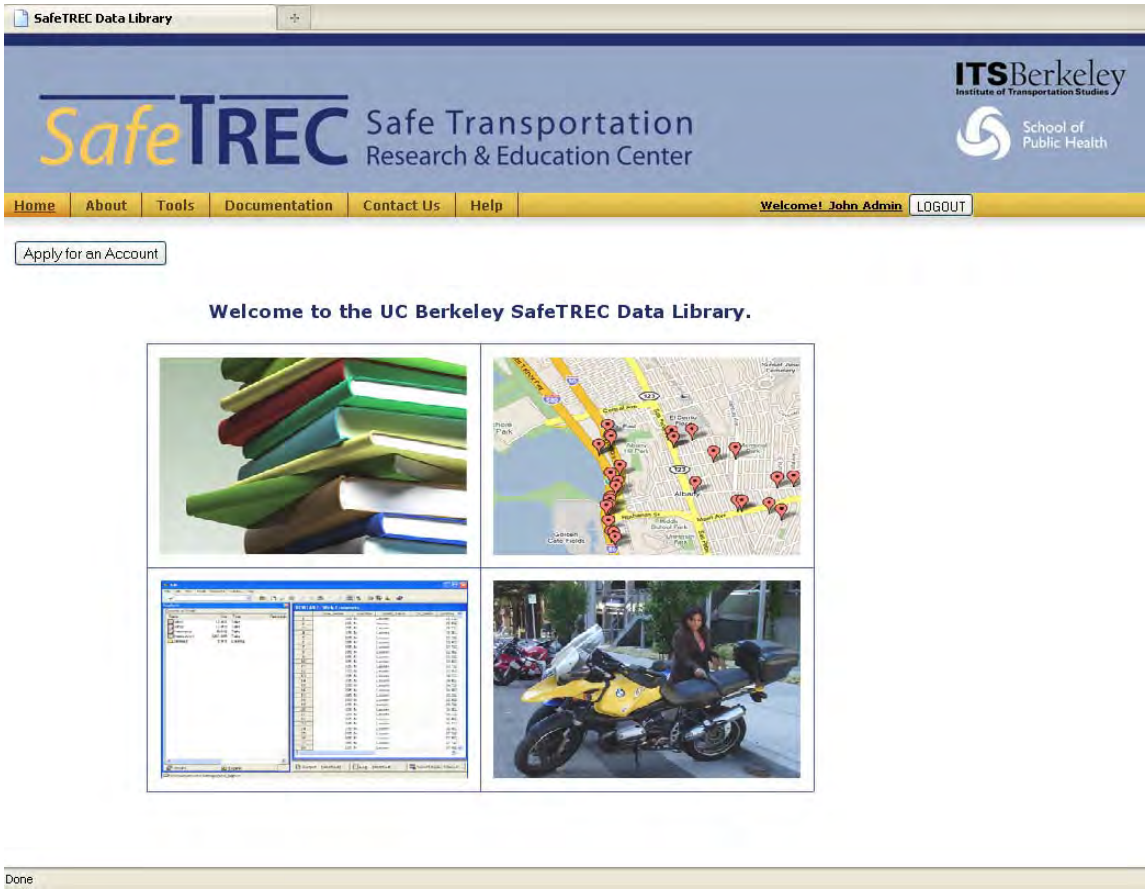


Figure E 1. Data Library homepage

The Data Library homepage is the gateway to the SWITRS query tool. It links to the SafeTREC homepage as well as to documentation and help sections, and contact information for the web-administrator. A user can apply for an account or login to the system if he or she already has an account established.

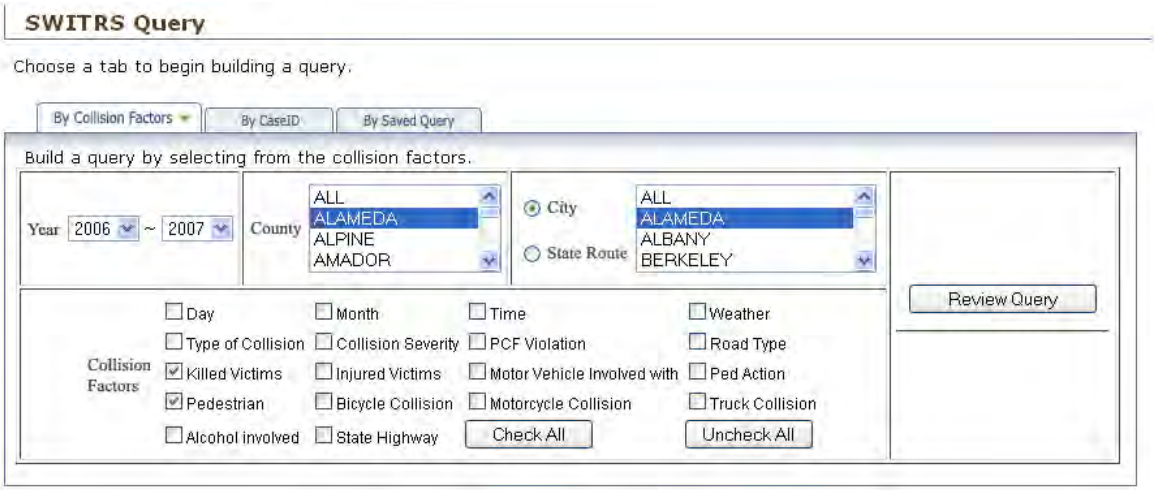


Figure E 2. SWITRS Query Tool

From the homepage, a user accesses the SWITRS Query Tool from the "Tools" drop-down menu. A user can query by collision factor(s), SWITRS case ID, or recall a previously saved query. If querying by collision factors, the user selects the year or years of data to query, as well as the county (or ALL) and city or state route (or ALL) of interest. The user can check one or more collision factors.

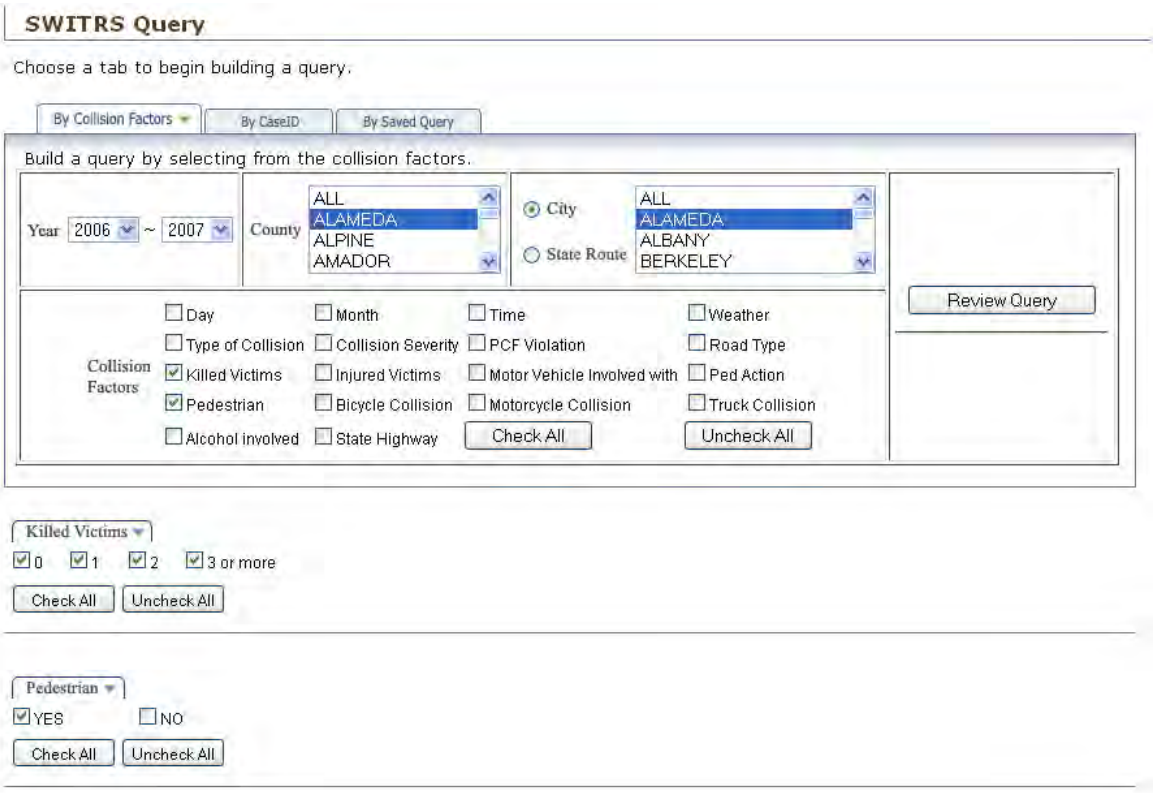


Figure E 3. Collision Factors options

For each collision factor selected, options will appear to refine the query. Clicking "Review Query" will take the user to the collision data summary.

1. PCF Violation			2. Type of Collision		
Factor	Number	Percent	Factor	Number	Percent
01: Driving or Bicycling Under the Influence of Alcohol or Drug	1	13%	A: Head-On	1	13%
02: Impeding Traffic	0	0%	B: Sideswipe	0	0%
03: Unsafe Speed	0	0%	C: Rear End	0	0%
04: Following Too Closely	0	0%	D: Broadside	2	25%
05: Wrong Side of Road	0	0%	E: Hit Object	0	0%
06: Improper Passing	0	0%	F: Overturned	0	0%
07: Unsafe Lane Change	0	0%	G: Vehicle/Pedestrian	5	63%
08: Improper Turning	0	0%	H: Other	0	0%
09: Automobile Right of Way	1	13%	-: Not Stated	0	0%
10: Pedestrian Right of Way	2	25%	Others	0	0%
11: Pedestrian Violation	2	25%	TOTAL	8	100%
12: Traffic Signals and Signs	1	13%	**3. Collision Severity**		
13: Hazardous Parking	0	0%	Factor	Number	Percent
14: Lights	0	0%	Severe Injury	8	100%
15: Brakes	0	0%	Fatality	0	0%
16: Other Equipment	0	0%	TOTAL	8	100%
17: Other Hazardous Violation	0	0%	**4. Pedestrian Collision**		
18: Other Than Driver (or Pedestrian)	0	0%	Factor	Number	Percent
19:	0	0%	Pedestrian	8	100%
20:	0	0%	**5. Bicycle Collision**		
21: Unsafe Starting or Backing	0	0%	Factor	Number	Percent
22: Other Improper Driving	0	0%	Bicycle	0	0%
23: Pedestrian or "Other" Under the Influence of Alcohol or Drug	0	0%	**6. Motorcycle Collision**		
24: Fell Asleep	0	0%	Factor	Number	Percent
00: Unknown	0	0%	Motorcycle	0	0%
-: Not Stated	1	13%	**7. Truck Collision**		
Others	0	0%	Factor	Number	Percent
TOTAL	8	100%	Truck	0	0%

Save Result

Figure E 4. Collision Data Summary output

The summary output displays all collisions matching the criteria specified by the user in the query. In this example, data for collisions that occurred in the city of Alameda in Alameda County for the years 2006-2007 and involved a pedestrian with any number of fatalities is displayed. The data indicate that there were 8 pedestrian-involved severe injury collisions, half of which involved a pedestrian violation or right of way as a collision factor.

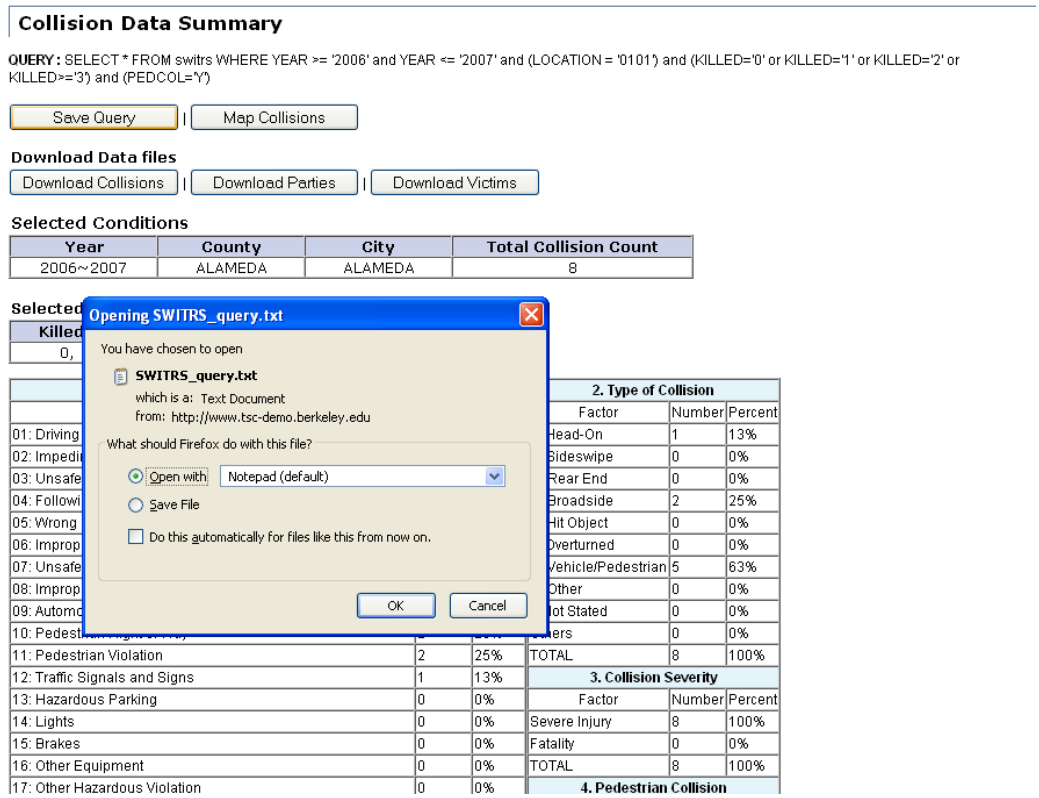
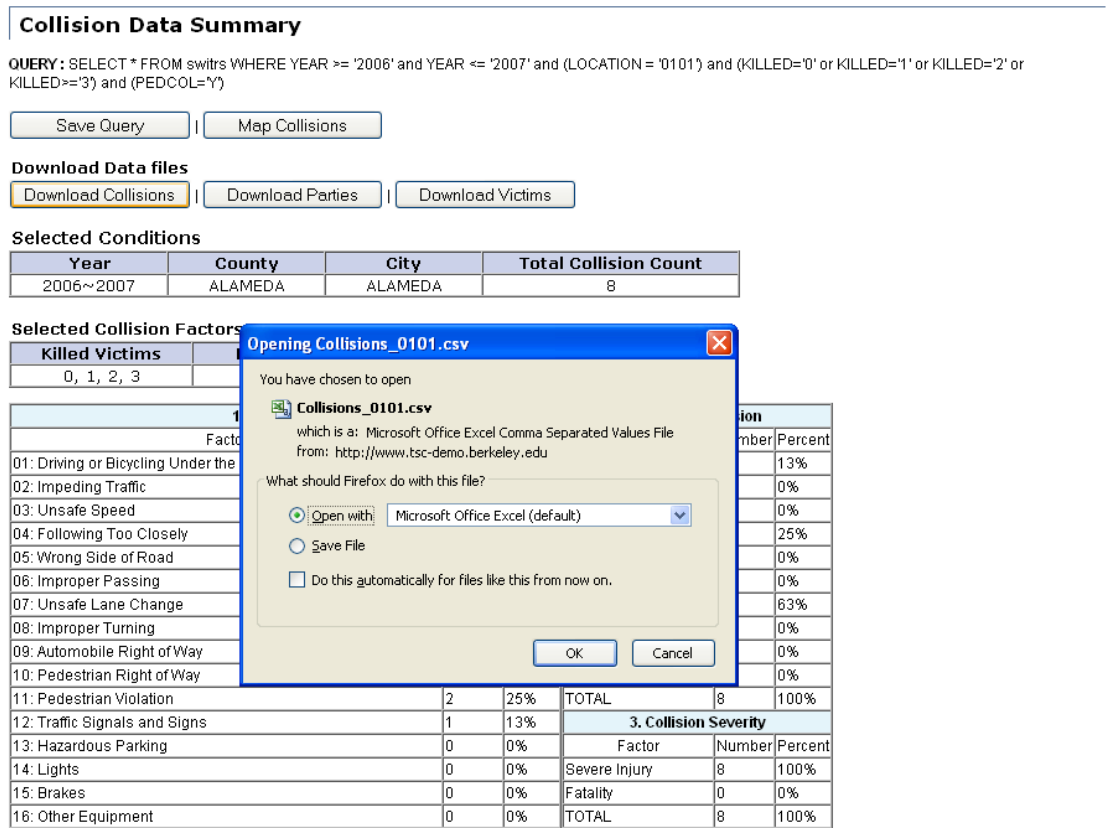


Figure E 5. Option to save SWITRS query

After clicking "Save Query," a dialog box appears with options to open the query using another program (shown below) or save it to disk.

Figure E 6. Query displayed in Notepad



Collision Data Summary

QUERY: SELECT * FROM switrs WHERE YEAR >= '2006' and YEAR <= '2007' and (LOCATION = '0101') and (KILLED='0' or KILLED='1' or KILLED='2' or KILLED>='3') and (PEDCOL='Y')

Save Query | Map Collisions

Download Data files

Download Collisions | Download Parties | Download Victims

Selected Conditions

Year	County	City	Total Collision Count
2006~2007	ALAMEDA	ALAMEDA	8

Selected Collision Factors

Killed Victims	
0, 1, 2, 3	

Opening Collisions_0101.csv

You have chosen to open

Collisions_0101.csv

which is a: Microsoft Office Excel Comma Separated Values File

from: http://www.tsc-demo.berkeley.edu

What should Firefox do with this file?

Open with: Microsoft Office Excel (default)

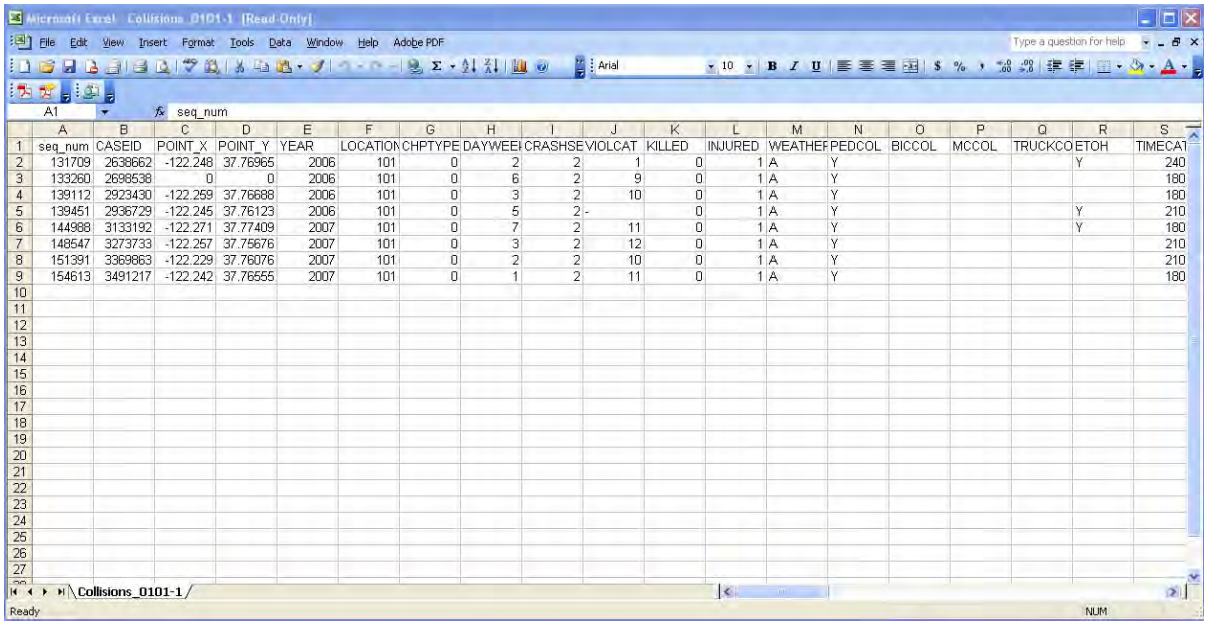
Save File

Do this automatically for files like this from now on.

OK | Cancel

Factor				nber	Percent
01: Driving or Bicycling Under the					13%
02: Impeding Traffic					0%
03: Unsafe Speed					0%
04: Following Too Closely					25%
05: Wrong Side of Road					0%
06: Improper Passing					0%
07: Unsafe Lane Change					63%
08: Improper Turning					0%
09: Automobile Right of Way					0%
10: Pedestrian Right of Way					0%
11: Pedestrian Violation	2	25%	TOTAL	8	100%
12: Traffic Signals and Signs	1	13%	**3. Collision Severity**		
13: Hazardous Parking	0	0%	Factor	Number	Percent
14: Lights	0	0%	Severe Injury	8	100%
15: Brakes	0	0%	Fatality	0	0%
16: Other Equipment	0	0%	TOTAL	8	100%

Figure E 7. Option to download Collision Data as an Excel file



Microsoft Excel - Collisions_0101-1 [Read-Only]

File Edit View Insert Format Tools Data Window Help Adobe PDF

A1 seq_num

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	seq_num	CASEID	POINT_X	POINT_Y	YEAR	LOCATION	CHPTYPE	DAYWEEK	CRASHSE	VIOLCAT	KILLED	INJURED	WEATHER	PEDCOL	BICCOL	MCCOL	TRUCKCO	ETOH	TIMECAT
2	131709	2638662	-122.248	37.76965	2006	101	0	2	2	1	0	1	A	Y				Y	240
3	133260	2698538	0	0	2006	101	0	6	2	9	0	1	A	Y					180
4	139112	2923430	-122.259	37.76688	2006	101	0	3	2	10	0	1	A	Y					180
5	139451	2936729	-122.245	37.76123	2006	101	0	5	2	-	0	1	A	Y				Y	210
6	144988	3133192	-122.271	37.77409	2007	101	0	7	2	11	0	1	A	Y				Y	180
7	148547	3273733	-122.257	37.75676	2007	101	0	3	2	12	0	1	A	Y					210
8	151391	3369863	-122.229	37.76076	2007	101	0	2	2	10	0	1	A	Y					210
9	154613	3491217	-122.242	37.76555	2007	101	0	1	2	11	0	1	A	Y					180

Collisions_0101-1

Ready NUM

Figure E 8. Collisions displayed in Excel

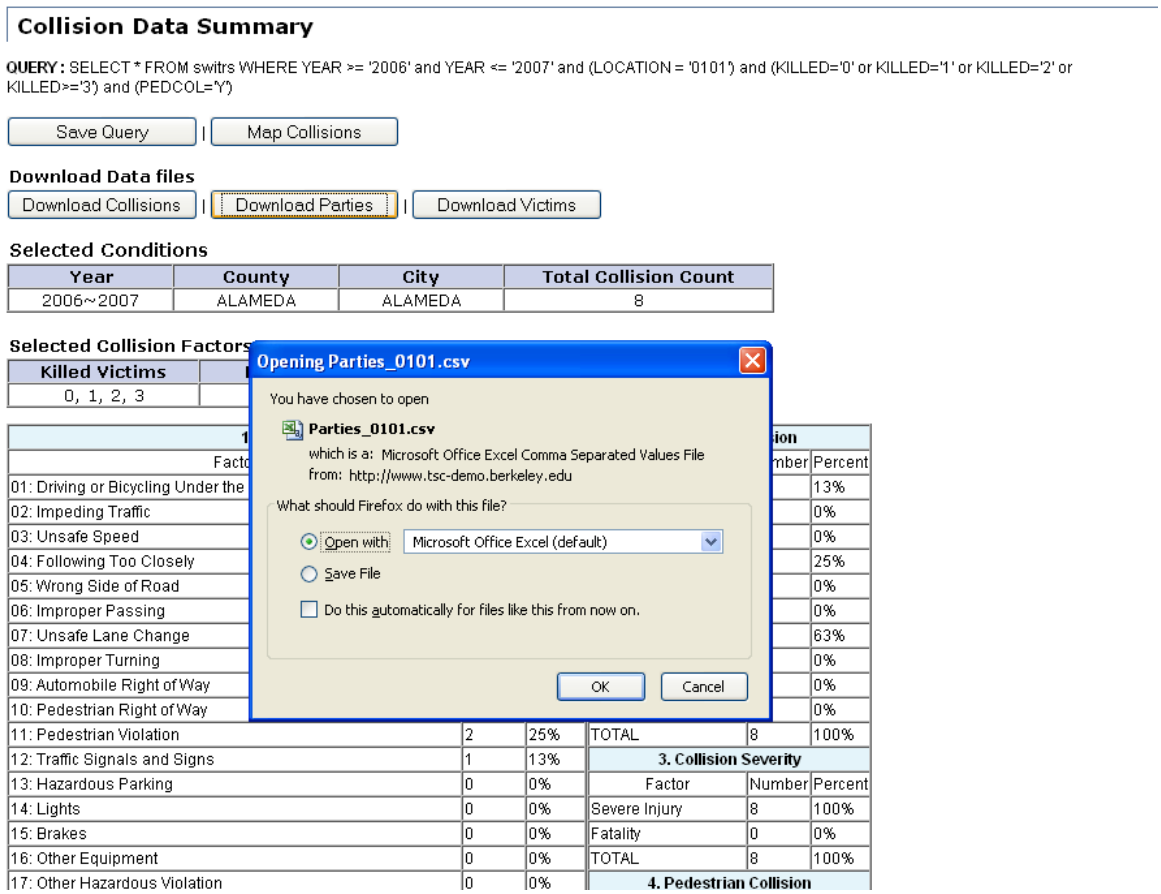


Figure E 9. Option to download Party Data as an Excel file

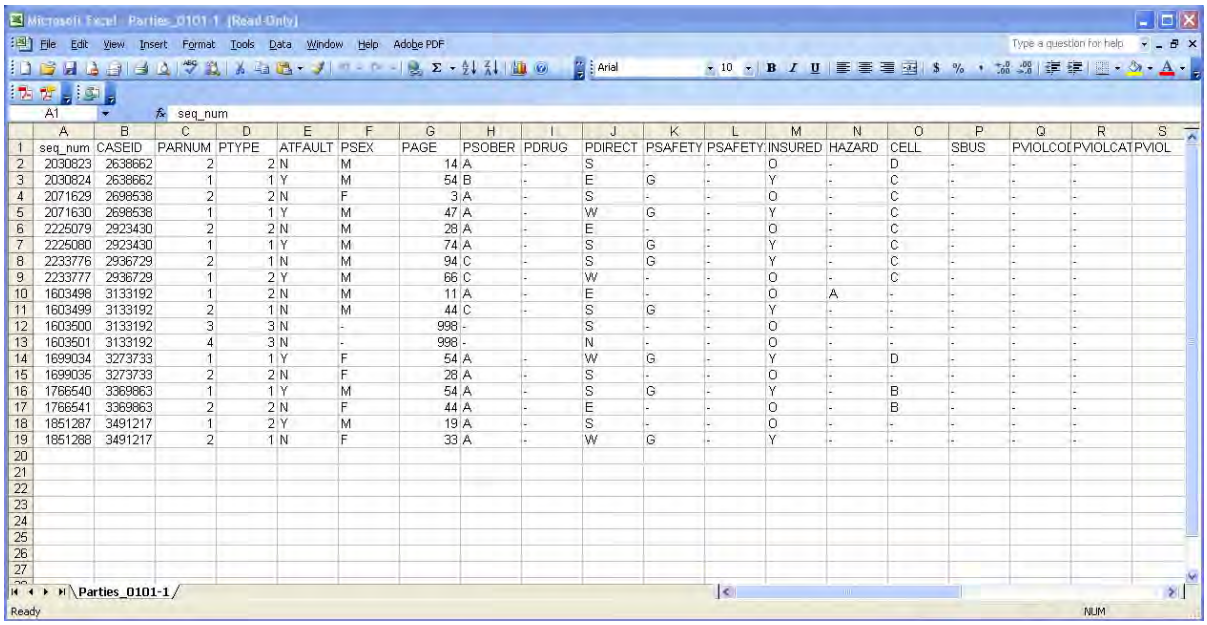


Figure E 10. Party data displayed in Excel

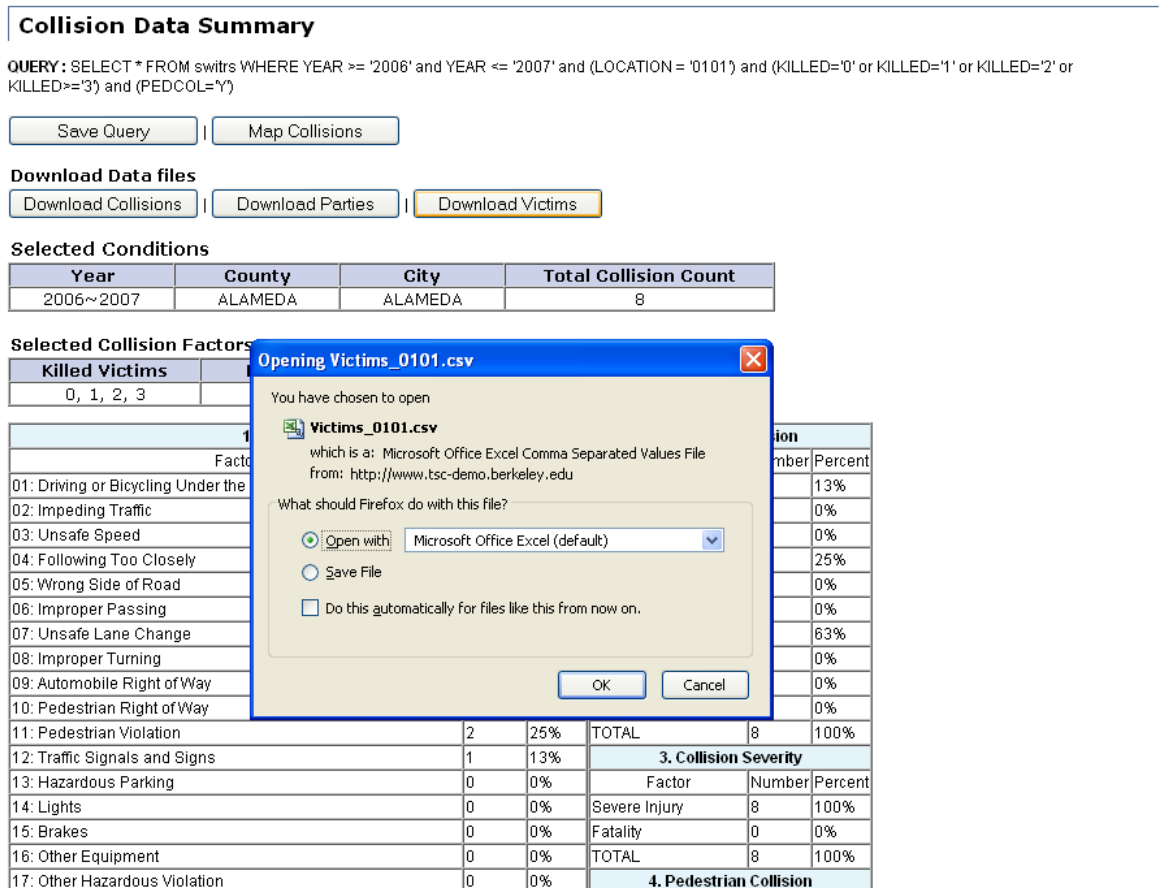


Figure E 11. Option to download Victim Data as an Excel file

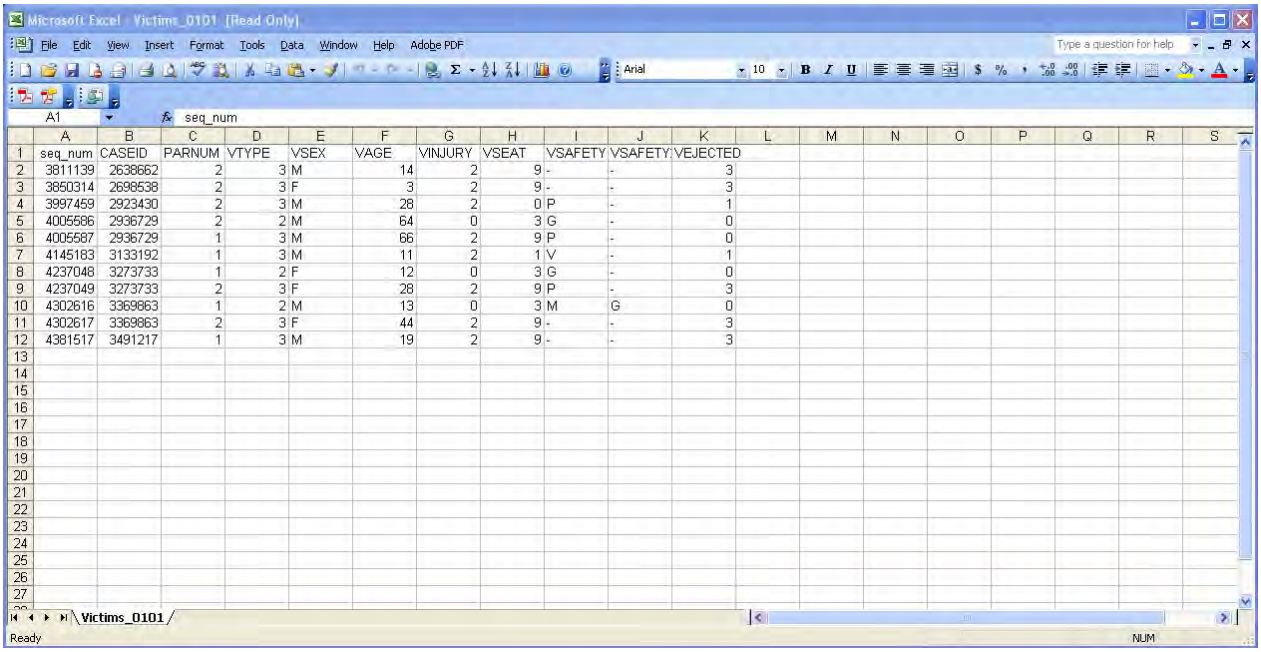


Figure E 12. Victim data displayed in Excel

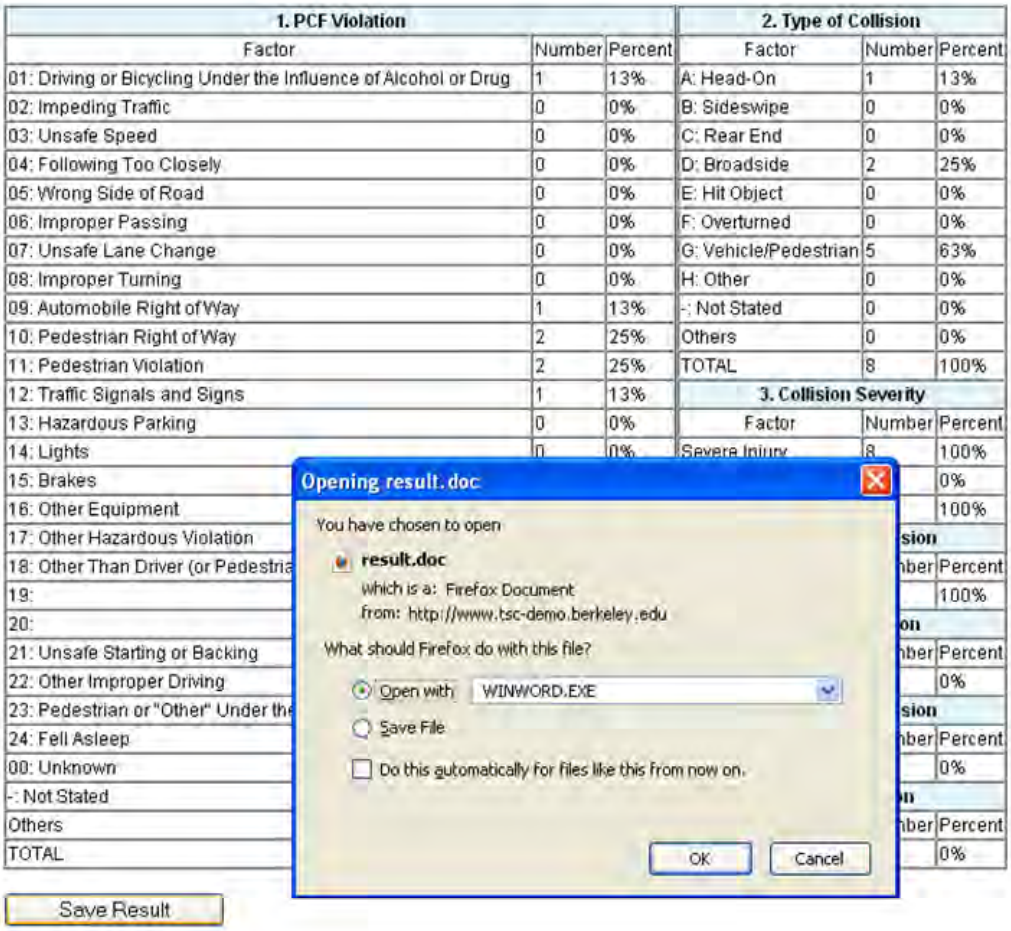
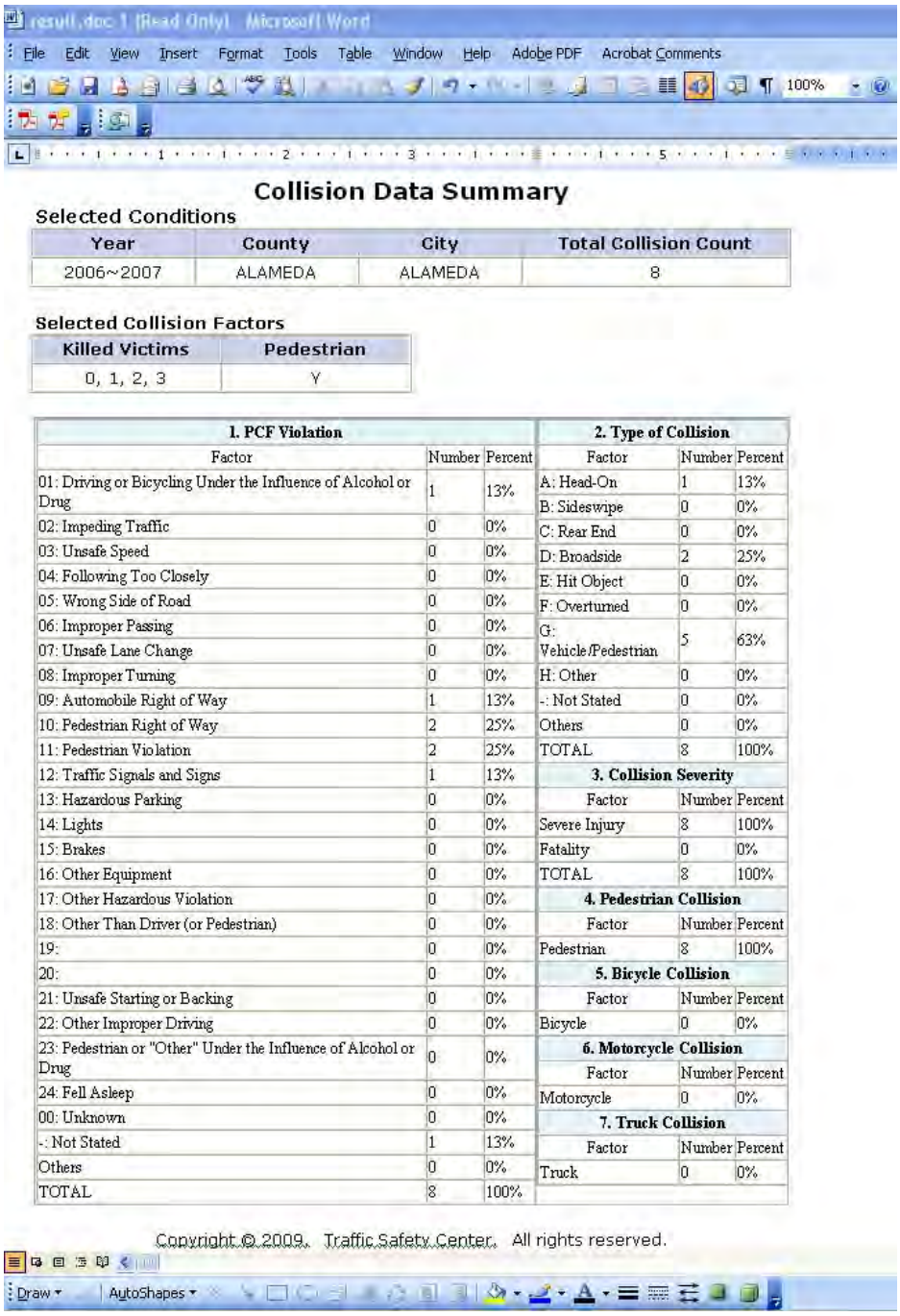


Figure E 13. Option to download results using Microsoft Word



result.doc [Read-Only] - Microsoft Word

File Edit View Insert Format Tools Table Window Help Adobe PDF Acrobat Comments

Collision Data Summary

Selected Conditions

Year	County	City	Total Collision Count
2006~2007	ALAMEDA	ALAMEDA	8

Selected Collision Factors

Killed Victims	Pedestrian
0, 1, 2, 3	Y

1. PCF Violation			2. Type of Collision		
Factor	Number	Percent	Factor	Number	Percent
01: Driving or Bicycling Under the Influence of Alcohol or Drug	1	13%	A: Head-On	1	13%
			B: Sideswipe	0	0%
02: Impeding Traffic	0	0%	C: Rear End	0	0%
03: Unsafe Speed	0	0%	D: Broadside	2	25%
04: Following Too Closely	0	0%	E: Hit Object	0	0%
05: Wrong Side of Road	0	0%	F: Overturned	0	0%
06: Improper Passing	0	0%	G: Vehicle/Pedestrian	5	63%
07: Unsafe Lane Change	0	0%			
08: Improper Turning	0	0%	H: Other	0	0%
09: Automobile Right of Way	1	13%	-: Not Stated	0	0%
10: Pedestrian Right of Way	2	25%	Others	0	0%
11: Pedestrian Violation	2	25%	TOTAL	8	100%
12: Traffic Signals and Signs	1	13%	**3. Collision Severity**		
13: Hazardous Parking	0	0%	Factor	Number	Percent
14: Lights	0	0%	Severe Injury	8	100%
15: Brakes	0	0%	Fatality	0	0%
16: Other Equipment	0	0%	TOTAL	8	100%
17: Other Hazardous Violation	0	0%	**4. Pedestrian Collision**		
18: Other Than Driver (or Pedestrian)	0	0%	Factor	Number	Percent
19:	0	0%	Pedestrian	8	100%
20:	0	0%	**5. Bicycle Collision**		
21: Unsafe Starting or Backing	0	0%	Factor	Number	Percent
22: Other Improper Driving	0	0%	Bicycle	0	0%
23: Pedestrian or "Other" Under the Influence of Alcohol or Drug	0	0%	**6. Motorcycle Collision**		
			Factor	Number	Percent
24: Fell Asleep	0	0%	Motorcycle	0	0%
00: Unknown	0	0%	**7. Truck Collision**		
-: Not Stated	1	13%	Factor	Number	Percent
Others	0	0%	Truck	0	0%
TOTAL	8	100%			

Draw AutoShapes

Figure E 14. Query results displayed in Microsoft Word

Collision Data Summary

QUERY : SELECT * FROM switrs WHERE YEAR >= '2006' and YEAR <= '2007' and (LOCATION = '0101') and (KILLED='0' or KILLED='1' or KILLED='2' or KILLED>='3') and (PEDCOL='Y')

Save Query | Map Collisions

Download Data files

Download Collisions | Download Parties | Download Victims

Selected Conditions

Year	County	City	Total Collision Count
2006~2007	ALAMEDA	ALAMEDA	8

Selected Collision Factors

Killed Victims	Pedestrian
0, 1, 2, 3	Y

1. PCF Violation			2. Type of Collision		
Factor	Number	Percent	Factor	Number	Percent
01: Driving or Bicycling Under the Influence of Alcohol or Drug	1	13%	A: Head-On	1	13%
02: Impeding Traffic	0	0%	B: Sideswipe	0	0%
03: Unsafe Speed	0	0%	C: Rear End	0	0%
04: Following Too Closely	0	0%	D: Broadside	2	25%
05: Wrong Side of Road	0	0%	E: Hit Object	0	0%
06: Improper Passing	0	0%	F: Overturned	0	0%
07: Unsafe Lane Change	0	0%	G: Vehicle/Pedestrian	5	63%
08: Improper Turning	0	0%	H: Other	0	0%
09: Automobile Right of Way	1	13%	-: Not Stated	0	0%
10: Pedestrian Right of Way	2	25%	Others	0	0%
11: Pedestrian Violation	2	25%	TOTAL	8	100%
12: Traffic Signals and Signs	1	13%	**3. Collision Severity**		
13: Hazardous Parking	0	0%	Factor	Number	Percent
14: Lights	0	0%	Severe Injury	8	100%
15: Brakes	0	0%	Fatality	0	0%
16: Other Equipment	0	0%	TOTAL	8	100%
17: Other Hazardous Violation	0	0%	**4. Pedestrian Collision**		

Figure E 15. Option to Map Collisions

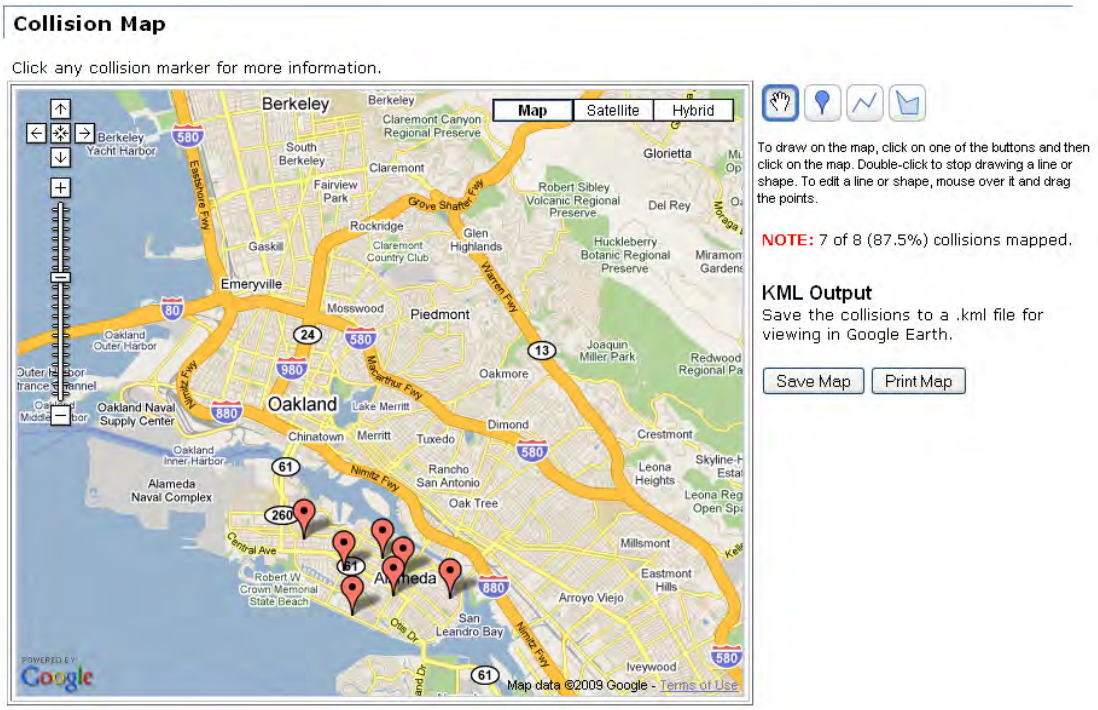


Figure E 16. Collisions mapped using Google Earth

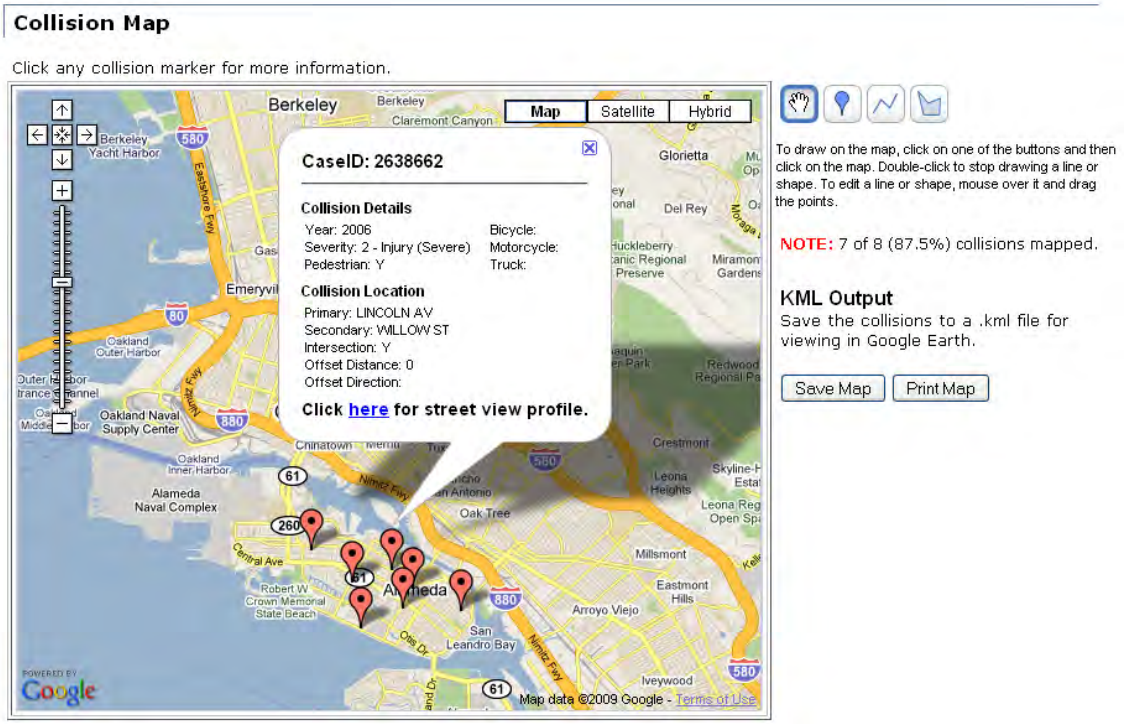


Figure E 17. Details for a selected collision

A user can click on the mapped collisions to display details in a pop-up. Clicking on the hyperlink labeled “here” in the pop-up brings the user to the Street View, seen below.

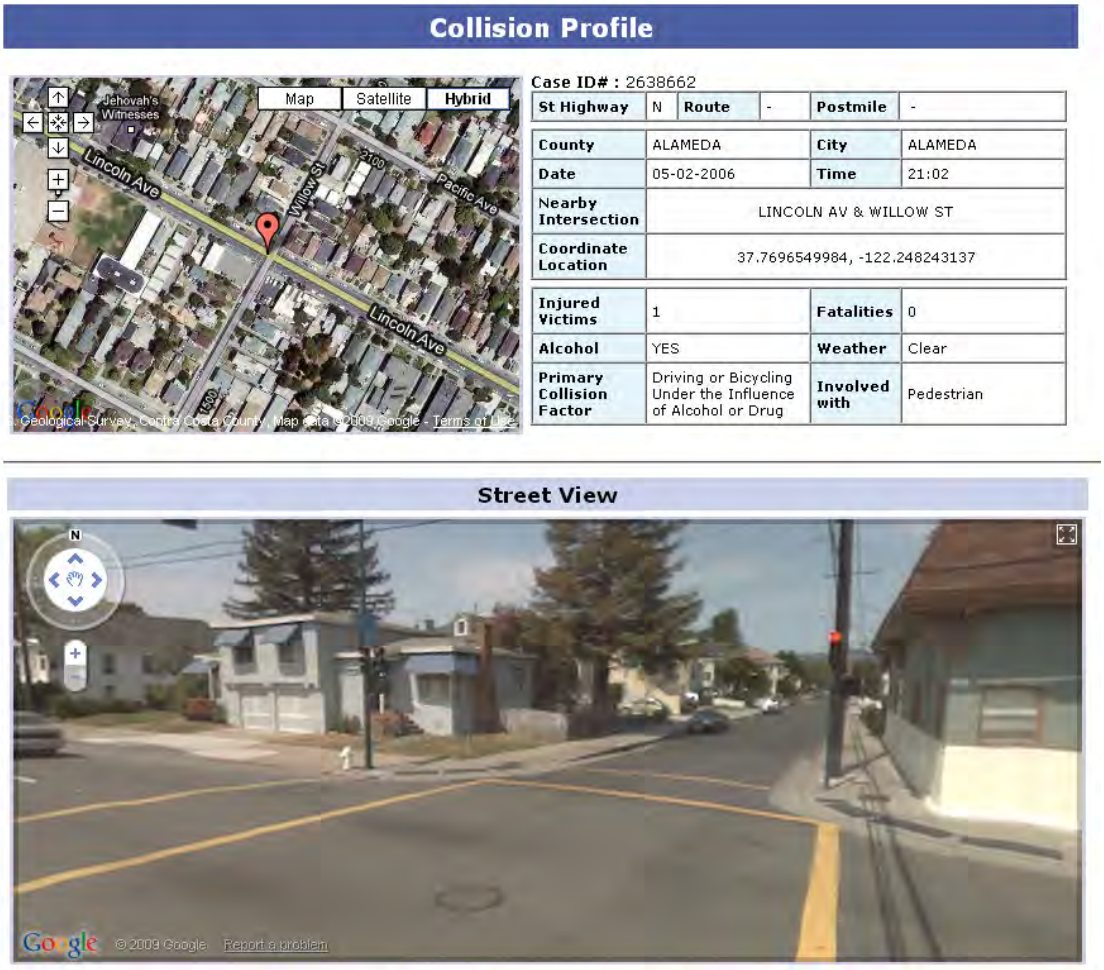


Figure E 18. Collision Profile and Street View using Google

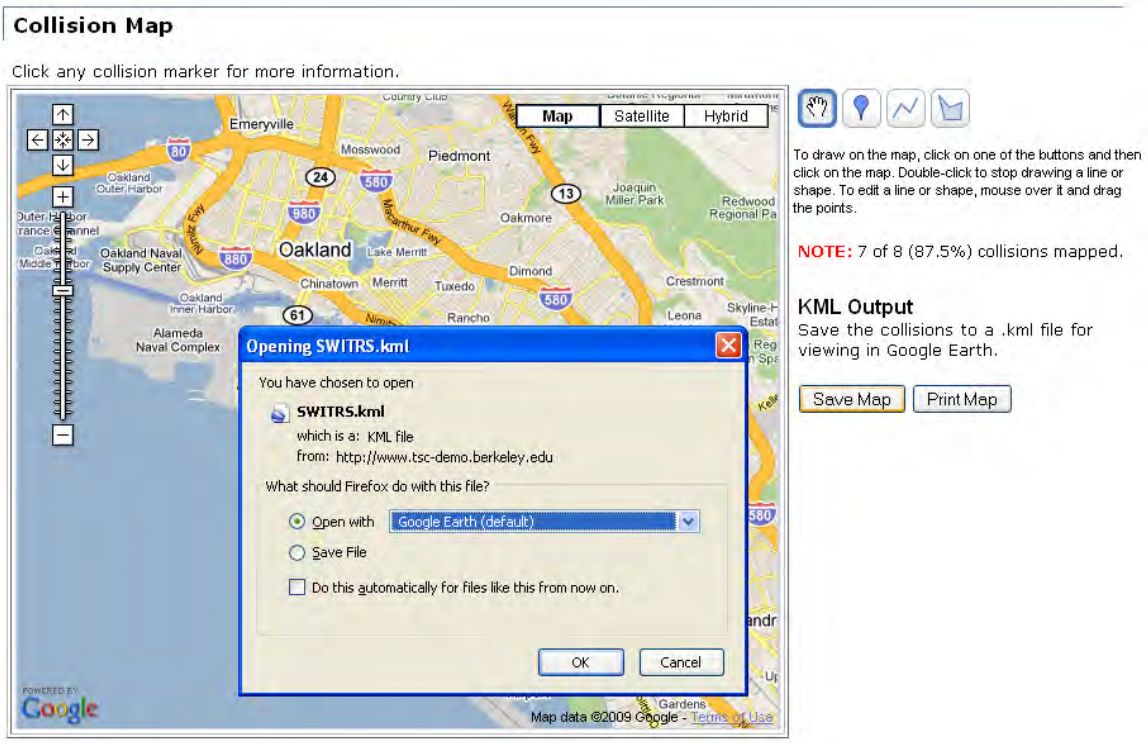


Figure E 19. Option to save map as a .kml

This option allows the user to open the map with a GIS application such as Google Earth or ArcMap.

Appendix F

Pilot California Pedestrian Safety Data Source Website

Task Order 6221

CALIFORNIA PATH

Caltrans

SafeTREC Safe Transportation Research & Education Center

There is growing interest in and pressure to increase the amount of walking and bicycling as a share of travel in the CA and U.S. transportation systems. Numerous California communities have pedestrian and bicycle planning and safety programs, or take part in programs such as Safe Routes to School that promote walking and bicycling. The increase in interest and activity around these active modes has created a growing demand for information about methods to improve conditions for walking and bicycling. According to the *Caltrans Pedestrian/Bicycle Collision Causes and Countermeasures Study: Needs Assessment* conducted for this Task Order, most local agencies reported significant need for assistance in areas such as education programs about pedestrian and bicycle safety, engagement of citizen advisory groups, and central coordination of pedestrian and bicycle safety efforts in the context of their day-to-day transportation operations.

The UC Berkeley Safe Transportation Research & Education Center (SafeTREC) has created the California Pedestrian Safety Data Source to meet this need by providing researchers, practitioners, stakeholders, and other interested parties access to up-to-date information and data related to pedestrian safety. This pilot website was created as part of Caltrans Task Order 6221 to demonstrate the potential utility of a web-based resource for pedestrian safety information. The site is organized into the following taxonomy:

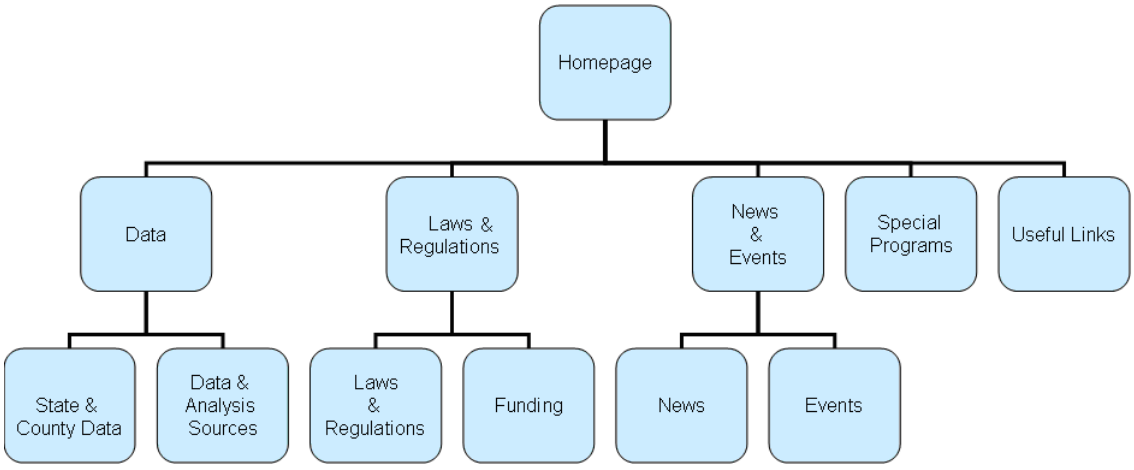


Figure F 1. Taxonomy of CA Pedestrian Safety Data Source website

The following screenshots illustrate the layout and content of the site.

Figure F 2. CA Pedestrian Safety Data Source homepage

Figure F 3. Data Section: State and County Data, Data Analysis, and Sources

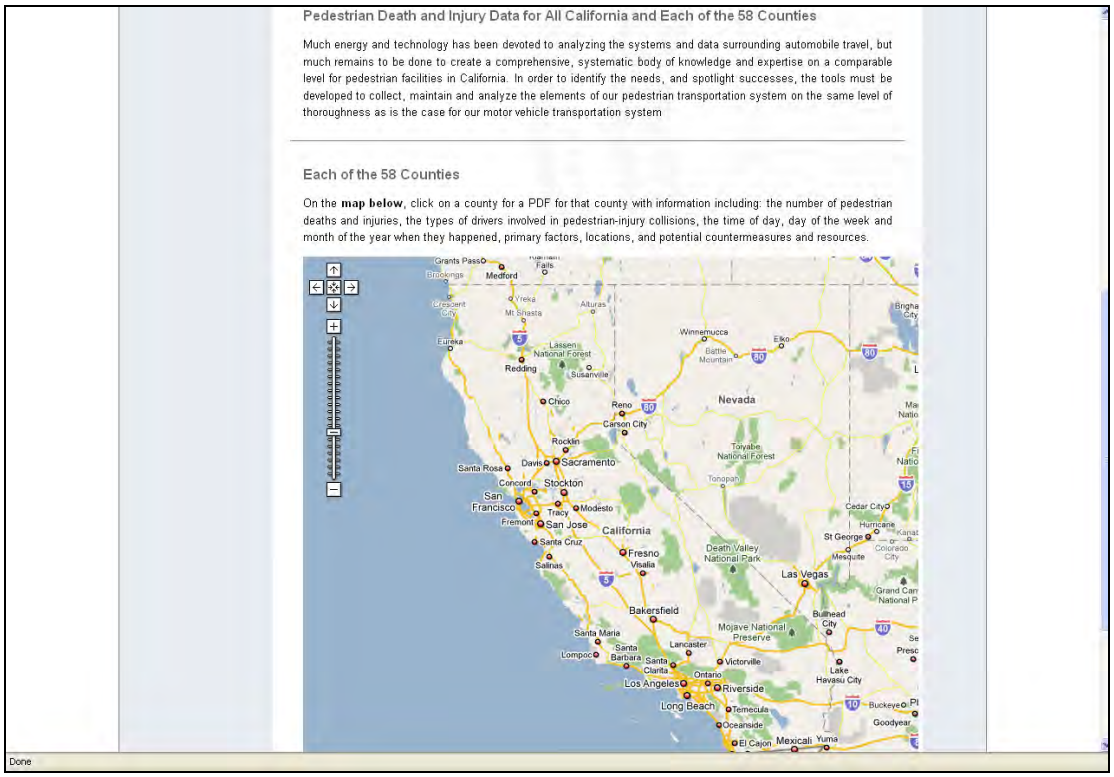


Figure F 4. Data Section: Interactive Mapping of Geocoded Crashes

Figure F 5. Laws, Regulations, and Funding Section

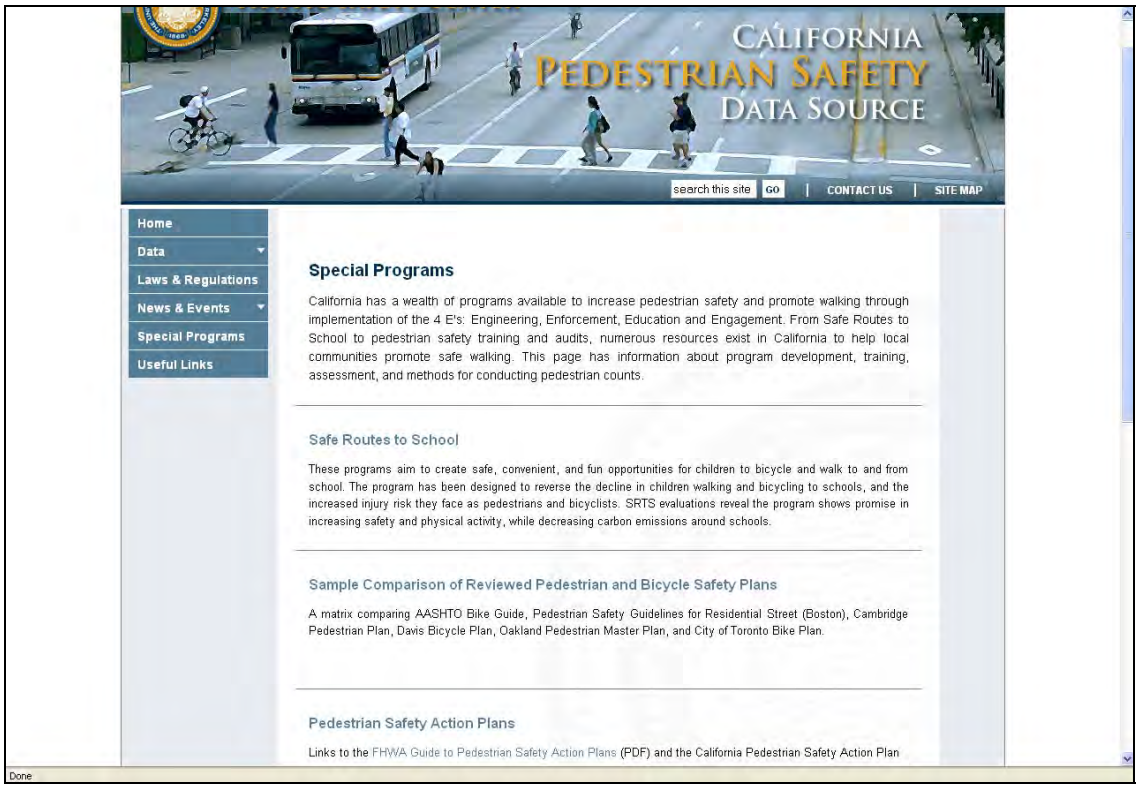


Figure F 6. Special Programs section

Appendix G

Pilot Safety Index for Pedestrian Safety Funding

CALIFORNIA PATH

Caltrans

SafeTREC Safe Transportation Research & Education Center

Two programs are administered by Caltrans to distribute safety funding to local jurisdictions. These programs, the Highway Safety Improvement Program (HSIP) and the High Risk Rural Roads (HR3) Program, are focused on engineering countermeasures to address vehicular collisions. Pedestrian and bicyclist safety improvements may not qualify through these programs due to lack of specific Safety Index criteria.

In order to appropriately allocate funds for pedestrian and bicycle safety improvements, a specific Safety Index program is needed. This deliverable is a pilot demonstration of an application for identification and prioritization of pedestrian countermeasures. A parallel application could be developed for bicycle countermeasures. The application, run in Microsoft Excel, is illustrated in the following screenshots. This report describes the application and documents its use. The application produces a quantitative estimate of the expected effect of a given countermeasure or combination of countermeasures at a specific location, based on the collision history of the location and Crash Reduction Factors (CRFs) from the Federal Highway Administration's (FHWA) *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes.*[1]

This application was developed in association with the Caltrans-funded project *Evaluation of Safety Index Calculations*.

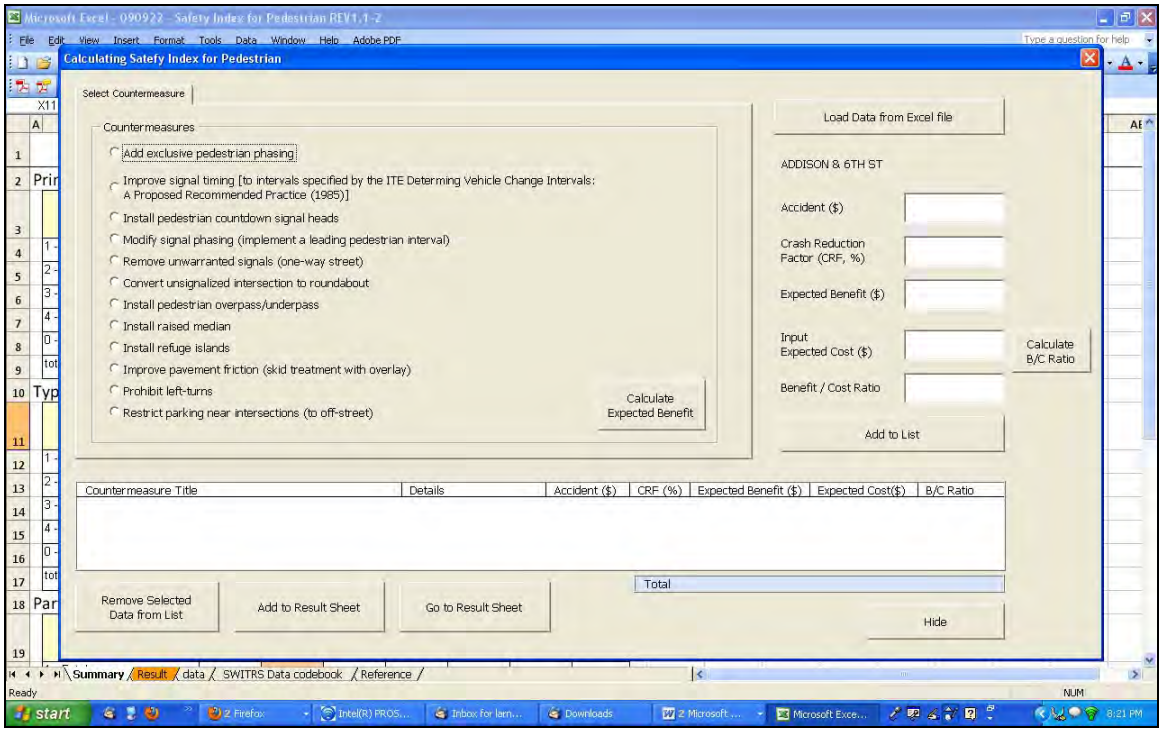
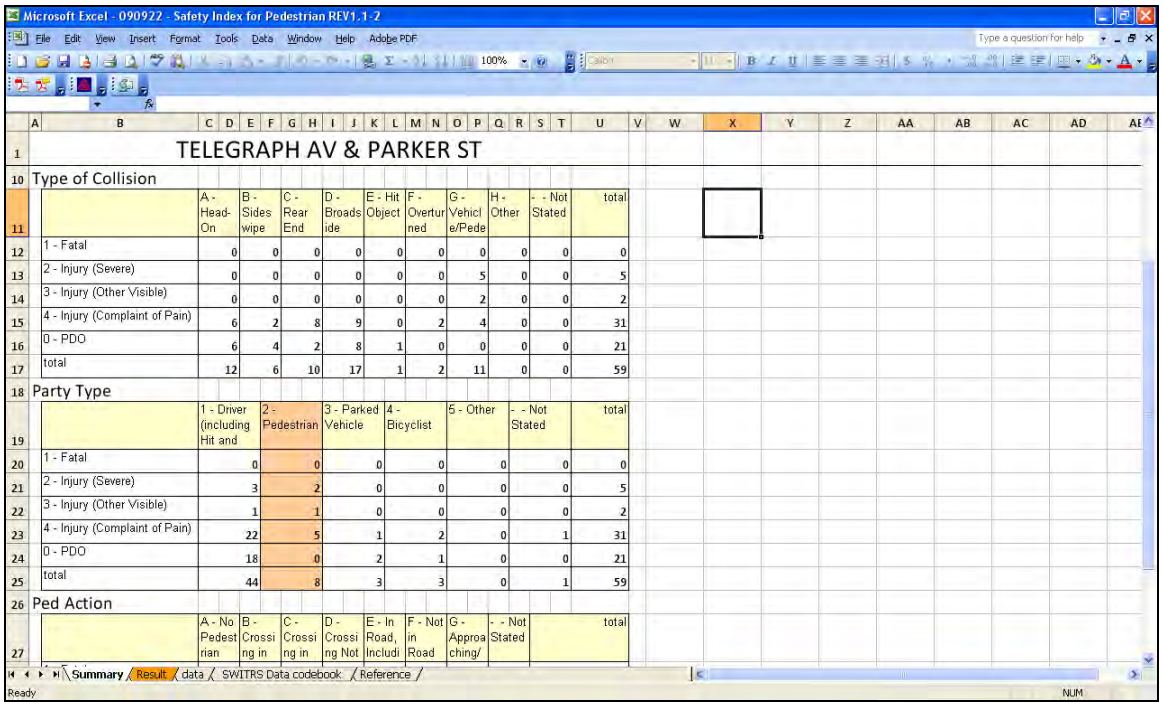


Figure G 1. Safety Index for Pedestrians main screen

[1] http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_tctpepc/ped_tctpepc.pdf

The main screen displays the list of available countermeasures to reduce pedestrian-involved collisions at intersections. The "Load Data from Excel file" button located in the top right of the screen is used to import data for a location from an existing Excel file. The currently loaded intersection is displayed below this button.



Microsoft Excel - 090922 - Safety Index for Pedestrian REV1.1-2

TELEGRAPH AV & PARKER ST

Type of Collision

	A - Head-On	B - Sideswipe	C - Rear End	D - Broadside	E - Hit Object	F - Overturned	G - Vehicle/Pede	H - Other	- - Not Stated	total
1 - Fatal	0	0	0	0	0	0	0	0	0	0
2 - Injury (Severe)	0	0	0	0	0	0	5	0	0	5
3 - Injury (Other Visible)	0	0	0	0	0	0	2	0	0	2
4 - Injury (Complaint of Pain)	6	2	8	9	0	2	4	0	0	31
0 - PDO	6	4	2	8	1	0	0	0	0	21
total	12	6	10	17	1	2	11	0	0	59

Party Type

	1 - Driver (including Hit and	2 - Pedestrian	3 - Parked Vehicle	4 - Bicyclist	5 - Other	- - Not Stated	total
1 - Fatal	0	0	0	0	0	0	0
2 - Injury (Severe)	3	2	0	0	0	0	5
3 - Injury (Other Visible)	1	1	0	0	0	0	2
4 - Injury (Complaint of Pain)	22	5	1	2	0	1	31
0 - PDO	18	0	2	1	0	0	21
total	44	8	3	3	0	1	59

Ped Action

	A - No Pedestrian	B - Crossing in	C - Crossing in	D - Crossing Not	E - In Road, Includi	F - Not in Road	G - Approaching/	- - Not Stated	total

Summary | Result | data | SWITRS Data codebook | Reference

Ready NUM

Figure G 2. Location Collision History Summary

The collision history is summarized for the currently loaded location file. This includes property damage only, injury, and fatal collisions. Injury severity is presented by collision type, party type, and pedestrian action. This information allows a user to select appropriate countermeasures according to the collision history and specific safety problems at a location.

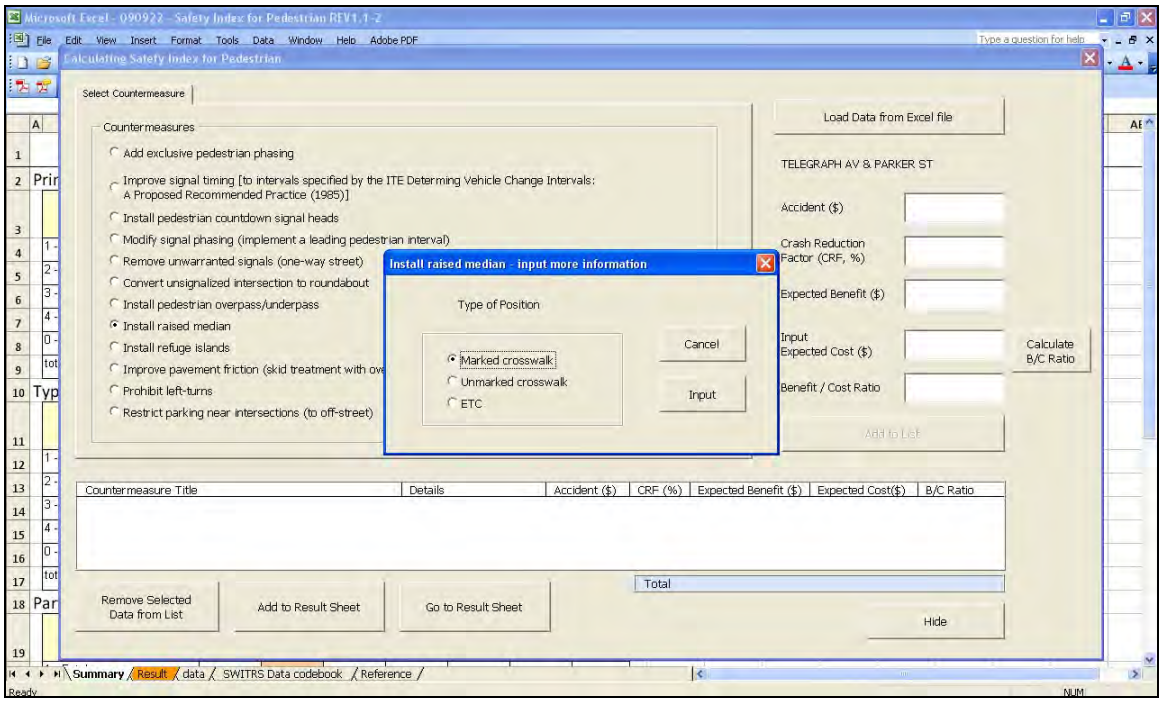


Figure G 3. Countermeasure Selection for Location

After reviewing the collision history, a user selects a countermeasure from the main calculation screen. Some countermeasures, such as medians, as shown, require a user to select a subcategory. After pressing "Input" and then "Calculate Expected Benefit," the current accident cost, CRF, and expected benefit are displayed on the main screen.

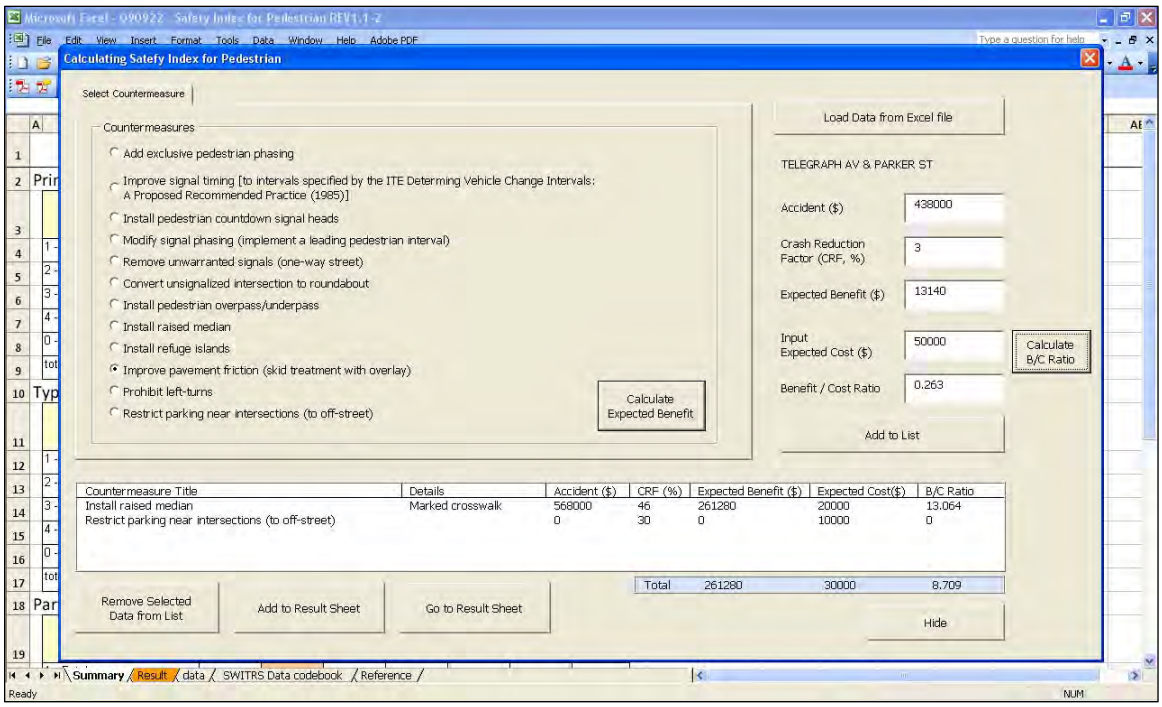
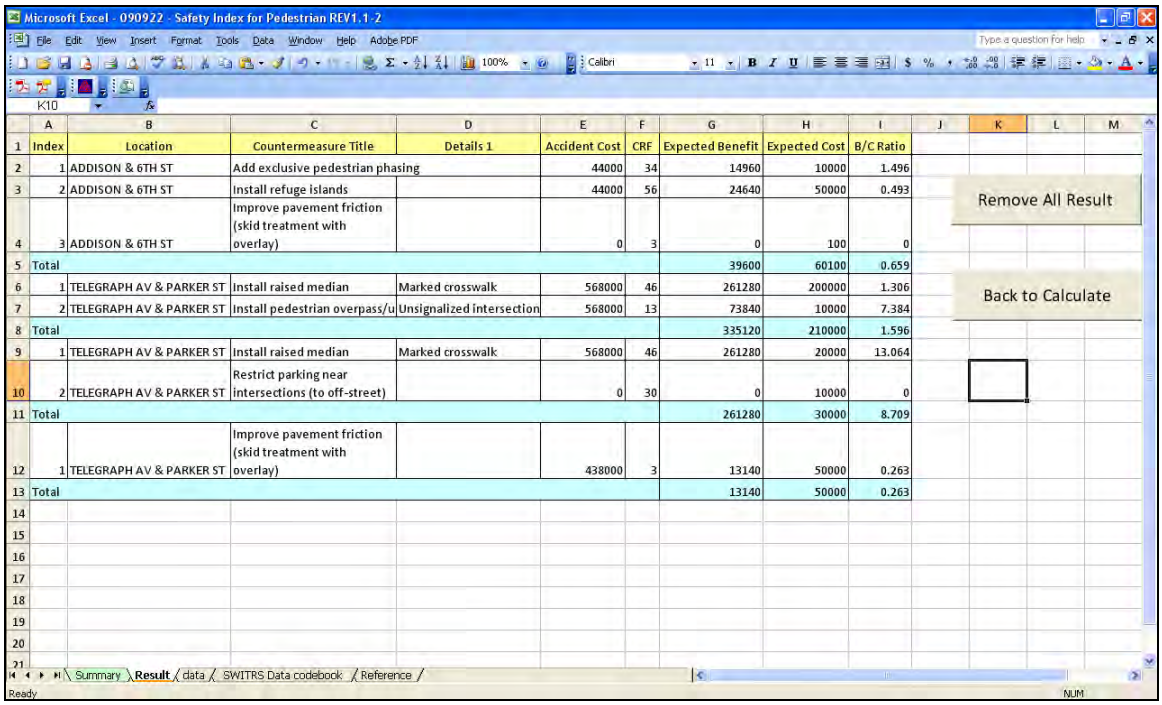


Figure G 4. Calculation of Expected Benefit, Benefit/Cost Ratio, and Selection of Multiple Countermeasures

This application also allows a user to determine the Benefit/Cost Ratio (B/C) of a particular countermeasure if he or she knows the expected cost of installation. Because construction costs vary widely across geographical areas and are not provided in FHWA's *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes,* this feature requires user input. However, if the user does not enter an expected cost, the B/C ratio simply will not be calculated.

At this point, a user can add the countermeasure to the list in the white box near the bottom of the screen by clicking the "Add to List" button, or may continue calculations for additional countermeasures, which may also be added to the list. Once one or more countermeasures have been added, clicking the "Add to Result Sheet" button will display that scenario in an Excel sheet. Multiple combinations of countermeasures can be added to the results sheet to compare different scenarios. Lastly, clicking the "Go to Result Sheet" button allows the user to view the scenarios.



Index	Location	Countermeasure Title	Details 1	Accident Cost	CRF	Expected Benefit	Expected Cost	B/C Ratio
1	ADDISON & 6TH ST	Add exclusive pedestrian phasing		44000	34	14960	10000	1.496
2	ADDISON & 6TH ST	Install refuge islands		44000	56	24640	50000	0.493
3	ADDISON & 6TH ST	Improve pavement friction (skid treatment with overlay)		0	3	0	100	0
Total						39600	60100	0.659
1	TELEGRAPH AV & PARKER ST	Install raised median	Marked crosswalk	568000	46	261280	200000	1.306
2	TELEGRAPH AV & PARKER ST	Install pedestrian overpass/u	Unsignalized intersection	568000	13	73840	10000	7.384
Total						335120	210000	1.596
1	TELEGRAPH AV & PARKER ST	Install raised median	Marked crosswalk	568000	46	261280	20000	13.064
2	TELEGRAPH AV & PARKER ST	Restrict parking near intersections (to off-street)		0	30	0	10000	0
Total						261280	30000	8.709
1	TELEGRAPH AV & PARKER ST	Improve pavement friction (skid treatment with overlay)		438000	3	13140	50000	0.263
Total						13140	50000	0.263

Figure G 5. Result Sheet showing 2 locations with multiple scenarios

The Result Sheet can be used to track and compare multiple scenarios of installing countermeasures. More than one location can be tracked on the same result sheet, and the results can easily be saved and/or exported in many file formats.

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Caltrans Pedestrian/Bicycle Collision Causes and Countermeasures Study: Needs Assessment

Submitted by:

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Submitted to:

SafeTREC Safe Transportation Research & Education Center

and

Caltrans

May 2010

SF08-0383

TABLE OF CONTENTS

APPENDICES

ACKNOWLEDGEMENTS

The study team would like to acknowledge Richard Haggstrom and Ken McGuire of Caltrans for helping to distribute the survey, the study's technical advisory committee for reviewing the survey, and the numerous survey respondents who contributed to this study.

EXECUTIVE SUMMARY

Study Purpose

The goal of the *Caltrans Pedestrian/Bicycle Collision Causes and Countermeasures Study*[1] is to determine the level and type of resources needed for local and regional jurisdictions to improve pedestrian and bicycle safety throughout the State of California. This portion of the study is a needs assessment of such resources, and takes stock of the current policies, programs, and practices of both Caltrans and local jurisdictions as compared to national best practices.

Approach

To gauge the level of resources and technical assistance for pedestrian and bicycle safety available to local agencies in California, as well as current practices within Caltrans itself, Fehr & Peers Transportation Consultants collaborated with the UC Berkeley Traffic Safety Center and Caltrans to conduct surveys and interviews as a component of the overall *Pedestrian/Bicycle Collision Causes and Countermeasures Study.* The survey collected data from more than 100 jurisdictions throughout the State. In-depth interviews were conducted with selected survey respondents to learn more about the challenges and opportunities with regard to access to resources for pedestrian and bicycle safety enhancement.

Survey Findings & Recommendations

Using a benchmarking process that compared local efforts to national best practices, survey results found that local agencies have been more successful in certain policy areas than in others. Policy areas that could benefit from additional enhancement are identified along with recommendations on how to work towards best practices.

The most frequent comment in both the survey and interviews is that funding for pedestrian and bicycle projects is too limited.

Key Findings from the Local Agency Surveys

- 70% of local agencies have a Bicycle Master Plan
- 22% of local agencies have a Pedestrian Master Plan
- The majority of agencies do not have a Pedestrian and/or Bicycle Coordinator
- 20% of agencies have School Safety Programs
- While almost all agencies have a practice of ensuring ADA compliance with new projects, few have a plan to upgrade existing facilities.

[1] This report was conducted by the UC Berkeley Safe Transportation Research & Education Center and Fehr & Peers on behalf of Caltrans.

Key Opportunities for Caltrans to Exercise Leadership in Pedestrian & Bicycle Safety

- Increase funding for projects to improve pedestrian and bicycle safety
- Strategically implement Deputy Directive 64 (R1)
- Support the use of innovative tools such as the HAWK and Stutter Flash (Rectangular Rapid Flashing) Beacon
- Develop model speed limit guidance
- Improve communication/ collaboration with Caltrans Local Assistance Offices
- Enhance the pedestrian and bicycle sections of the Caltrans website
- Provide technical assistance to local agencies for planning, grant writing, and implementation

The Caltrans District staff survey results generated similar benchmarks to the local agencies. However, Caltrans stands out from local agencies in key policy areas. For example, Caltrans has a Complete Streets policy, Deputy Directive 64 (R1), which mandates routine accommodation of all modes and users. As a statewide agency, Caltrans can model best practices for local agencies to follow. In order for local agencies to adopt such practices, Caltrans may also provide technical assistance and additional funding for specific program areas.

Interview Findings & Recommendations

Local agency interviews provided specific and concrete examples of how Caltrans can best support local efforts to improve pedestrian and bicycle safety. First, many interviewees spoke to the challenges of applying for grants. **The most frequent comment in both the survey and interviews is that funding for pedestrian and bicycle projects is too limited.** In addition, some agencies do not have the resources or technical skills to fulfill all the Caltrans grant requirements, such as having a current Bicycle Master Plan. **Others found some grant application processes so time consuming that it was no longer cost-effective to pursue funding for smaller-scale projects.** To address this issue, Caltrans may consider allocating additional funding for projects to improve pedestrian and bicycle safety. Caltrans may also consider making grant applications more flexible to better match the resources and capacity of different types of agencies and jurisdictions.

Interviewees suggested that Caltrans could better communicate funding opportunities, deadlines, and announcement of awards.

Second, many interviewees and survey respondents felt that communication with Caltrans Local Assistance Offices could be improved, particularly to **communicate funding opportunities, deadlines, and announcement of awards.** Finally, several interviewees discussed the challenge of interfacing with decision-making processes within Caltrans. For example, Caltrans Deputy Directive 64 mandates routine accommodation of all modes and users. However, this policy seems to not always filter down to Caltrans engineers and other staff. Because of this, innovative, local pedestrian and bicycle projects may stall out at the boundary of Caltrans facilities and local agencies may avoid employing innovative practices. To address this, Caltrans could consider additional opportunities to implement Deputy Directive 64 at all staff levels and through all funding and grant programs.

1. INTRODUCTION

Increasingly, communities throughout California are expressing a desire for safer and more accommodating walking and bicycling conditions. To meet this rising demand and to follow the national paradigm shift toward more "Complete Streets," local jurisdictions are developing plans and seeking funds to implement projects to improve pedestrian and bicycle safety and mobility. However, with limited funding and resources, some communities are having greater success than others.

At the same time, Caltrans, the California Department of Transportation, is increasingly focused on the implementation of the agency's Complete Streets Deputy Directive 64 (revised). In addition to improving multimodal access and safety on state facilities, Caltrans has the opportunity to take the lead in revising policies and funding mechanisms which largely shape decision-making and funding availability at the local level.

To gauge the level of resources and technical assistance for pedestrian and bicycle safety available to local agencies in California, as well as current practices within Caltrans itself, Fehr & Peers collaborated with the UC Berkeley Traffic Safety Center and Caltrans to conduct surveys and interviews as a component of the overall *Pedestrian/Bicycle Collision Causes and Countermeasures Study.*[2] The larger study is examining existing conditions and enhancement opportunities related to pedestrian and bicycle safety on Caltrans facilities.

This report summarizes the findings from the surveys and interviews and provides insight on the current successes and constraints experienced. The report also presents specific recommendations for programs, practices, policies, and funding allocations to enhance pedestrian and bicycle safety across the State.

This report documents an existing conditions baseline for pedestrian and bicycle safety programs, policies, and practices at both the local and state level in California. In reviewing the existing conditions, opportunities for adjustments and new initiatives are identified.

Caltrans Deputy Directive 64 (R1)

"The California Department of Transportation (Caltrans) provides for the needs of travelers of all ages and abilities in all planning, programming, design, construction, operations, and maintenance activities and products on the State highway system. The Department views all transportation improvements as opportunities to improve safety, access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system.

The Department develops integrated multimodal projects in balance with community goals, plans, and values. Addressing the safety and mobility needs of bicyclists, pedestrians, and transit users in all projects, regardless of funding, is implicit in these objectives. Bicycle, pedestrian, and transit travel is facilitated by creating "complete streets" beginning early in system planning and continuing through project delivery and maintenance and operations. Developing a network of "complete streets" requires collaboration among all Department functional units and stakeholders to establish effective partnerships."

http://www.dot.ca.gov/hq/tpp/offices/ocp/complete_streets_files/dd_64_r1_signed.pdf

[2] This report was conducted by the UC Berkeley Safe Transportation Research & Education Center and Fehr & Peers on behalf of Caltrans.

2. METHODOLOGY

In order to understand the existing efforts local agencies are making to improve pedestrian and bicycle safety, data was collected on local policies, programs, and practices. Information on barriers to improving pedestrian and bicycle safety was also collected. This data was collected in two ways: through an on-line survey with local agencies and Caltrans District staff; and phone interviews with local agencies throughout California.

The survey was developed with input from the study's technical advisory committee.

LOCAL AGENCY SURVEY

The purpose of the survey was to gather data on current bicycle and pedestrian programs, policies, and practices for individual agencies. The survey was administered through Survey Monkey, an on-line survey tool, and included 73 questions on agency practices in the following topic areas:

- Collision data and analysis
- Bicycle and pedestrian volume data collection
- Policies and programs specific to bicycling and walking
- Routine inspection/maintenance of bicycle and pedestrian facilities
- Past and present expenditures on bicycle and pedestrian infrastructure and support programs
- Grant applications and funding pursuits for bicycle and pedestrian projects

The complete list of survey questions is included in Appendix A. The survey was distributed by Caltrans headquarters staff to District Local Assistance Engineers who then distributed the survey to the cities and counties within their District. In total, 107 unique respondents, representing 18 county agencies, 66 city agencies, and various other transportation agencies participated in the survey. The survey results were qualitatively analyzed to determine key issues and trends, and to identify gaps in the data for additional questioning during the phone interviews. The aggregate results are summarized in Appendix A.

CALTRANS DISTRICT STAFF SURVEY

The local agency survey was also distributed by Caltrans headquarters to Caltrans District representatives. Eleven staff members responded to the survey, representing Caltrans districts statewide. As with the local agency survey, the survey results were qualitatively analyzed to determine key issues and trends, and in particular to illustrate areas where Caltrans has an opportunity to take a leadership role.

LOCAL AGENCY INTERVIEWS

To gain additional insight on agency practices, eight local agency survey respondents were chosen for a follow-up interview. Interviewees were chosen based on several criteria, in order to have a diverse and representative sample.

Criteria included the following:

- Type of community – i.e. urban, suburban or rural
- Size of population
- Geographic region
- Pedestrian and bicycle collision rates by population – based on rankings by the Office of Traffic Safety
- Agency position – i.e. pedestrian and bicycle coordinator, traffic engineer, Public Works staff

Table 2-1 provides a list of jurisdictions that participated in the interviews.

TABLE 2-1. INTERVIEW PARTICIPANTS

Jurisdiction	Type of Community	Population	Collision Index*	Region	Agency Role
Town of Truckee	Rural	16,000	N/A	Sierra Region	Assistant Engineer
City of El Cajon	Suburban	95,000	6	Southern California (inland)	Bicycle Coordinator is within Department
City of Elk Grove	Suburban	140,000	N/A	Northern California (Inland)	Traffic Engineer, Public Works
City of Palm Springs	Transition (Suburban/Rural)	50,000	0	Southern California (inland)	Traffic Engineering & Operations
City of Rialto	Transition (Urban/Suburban)	100,000	0	Southern California (inland)	Public Works Analyst
City of Oceanside	Transition (Urban/Suburban)	180,000	0	Southern California (coastal)	Pedestrian & Bicycle Coordinator
City of Riverside	Urban	300,000	10	Southern California (inland)	Bicycle Coordinator
City of San Diego	Urban	1,300,000	7	Southern California (coastal)	Bicycle Coordinator

*As determined by the California Office of Traffic Safety based on per capita collisions (pedestrian-vehicle collisions where a pedestrian was killed or injured). The ranking is provided within four population groups of cities, with a rank of 1 being the worst.
Source: Fehr & Peers, 2009

The interviews were conducted over the phone, and were approximately 20-30 minutes in length. Questions varied for each participating jurisdiction, and were determined by their survey responses. Sample questions included the following:

- Please describe some of your best practices for bicycle and pedestrian projects.
- What types of grant funding have you had the most success in receiving?
- In your opinion, what are the most significant limitations for implementing pedestrian and bicycle safety projects?
- What types of technical assistance for bicycle and pedestrian safety projects would be most helpful?
- What has your experience been interfacing with Caltrans on bicycle and pedestrian projects that cross Caltrans-owned roadways?
- What kind of collision data analysis software do you use?

Based on the interview results, key findings and recommendations were developed. Survey results were cross-tabulated to provide supporting data for each finding.

The following chapters summarize the results and recommendations from the surveys and interviews.

3. LOCAL AGENCY SURVEYS: KEY FINDINGS & RECOMMENDATIONS

The local agency survey responses were qualitatively analyzed with a benchmarking matrix, as shown in Table 3-1. Benchmarking provides a process to compare a local agency's efforts for policies, programs, and practices in pedestrian and bicycle safety against national best practices. Benchmarking is a helpful tool in evaluating key strengths and areas for improvement in this field. The benchmark metrics are provided in Appendix D. Table 3-1 shows the typical (based on the most frequent response) local agency's key strengths (a rating based on meeting or exceeding the national best practice), areas for enhancements (where the typical agency is about average / could improve), and opportunity areas (areas for significant improvement). The results presented in Table 3-1 are further elaborated in the following sections.

TABLE 3-1. LOCAL AGENCY SURVEY BENCHMARKING RESULTS SUMMARY

Topic	Survey Question	Rating for Most Frequent Response
Regular Maintenance of Traffic Control Devices	Does your organization conduct regular assessments of your jurisdiction's traffic control devices or fix problems reported only on an as-needed basis?	Key Strength
Sidewalk Projects in Capital Improvement Program	Are sidewalk projects (new and/or maintenance) included in your capital improvements program?	Key Strength
Bicycle Facility Projects in Capital Improvement Program	Are bicycle facility improvements (new and/or maintenance) included in your capital improvements program?	Key Strength
Bicycle Master Plan	Does your organization have a Bicycle Master Plan?	Key Strength
Review of Pedestrian-Vehicle Collision Data	What are your organization's practices for reviewing pedestrian-vehicle collision data?	Enhancement
Review of Bicycle-Vehicle Collision Data	What are your organization's practices for reviewing bicycle-vehicle collision data?	Enhancement
Review of Speed Limits	What is your organization's policy/practice for reviewing speed limits?	Enhancement
Inventory of Pedestrian Facilities	Does your organization have and maintain an inventory of pedestrian facilities (including signs, markings, traffic signals, and existing sidewalks)?	Enhancement
Inventory of Bicycle Facilities	Does your organization have and maintain an inventory of bicycle facilities (including routes, signs, markings, and traffic signals)?	Enhancement

Key Strength: On par with national best practices
Enhancement: Average effort / Area for improvement
Opportunity: Area for significant improvement

TABLE 3-1. LOCAL AGENCY SURVEY BENCHMARKING RESULTS SUMMARY (CONTINUED)

Topic	Survey Question	Rating for Most Frequent Response
Rural Shoulder Widening Program	If your organization is in a rural area, do you have a program for widening shoulders to accommodate pedestrians?	Enhancement
ADA Compliance Procedures	What are your organization's policies and practices for bringing existing facilities in line with Americans with Disabilities Act (ADA) requirements?	Enhancement
General Plan Accommodation of Pedestrians	Does your organization's General Plan include policies for pedestrian facilities and accommodation?	Enhancement
General Plan Accommodation of Bicycles	Does your organization's General Plan include policies and practices for accommodating bicycles?	Enhancement
Bicycle/Pedestrian Coordinator Position	Do you have a full time Bicycle/Pedestrian Coordinator(s) on staff?	Opportunity
Pedestrian Volume Data Collection	Does your organization collect pedestrian volume data?	Opportunity
Bicycle Volume Data Collection	Does your organization collect bicycle volume data?	Opportunity
Crosswalk Installation, Enhancement, and Removal Policy	How does your organization make decisions regarding installation, removal, and enhancement treatments for uncontrolled marked crosswalks (crossing locations without stop signs or traffic signals)?	Opportunity
Complete Streets Policy	Does your organization have a policy that calls for planning that specifically addresses walking and bicycling needs on the same footing as transit and driving needs?	Opportunity
Pedestrian Master Plan	Does your organization have a Pedestrian Master Plan?	Opportunity
Citizen's Advisory Committee - Pedestrian	Does your organization have a citizen's advisory committee that informs decisions on pedestrian issues?	Opportunity
Citizen's Advisory Committee – Bicycle	Does your organization have a citizens' committee that addresses bicycle pedestrian issues?	Opportunity
School Safety Program and Coordinator	Does your organization have a department or a staff person dedicated to traffic safety around schools?	Opportunity
Traffic Calming Program	Does your organization have a traffic calming/ neighborhood traffic management program?	Opportunity
Pedestrian/Bicycle Education Program	Do you have a bicycle, pedestrian, or general traffic safety education curriculum in your jurisdiction's schools and/or community centers?	Opportunity

Key Strength: On par with national best practices
Enhancement: Average effort / Area for improvement
Opportunity: Area for significant improvement
Source: Fehr & Peers, 2009

Funding-related questions were not benchmarked because the response format is not conducive to this analysis approach. The funding topics are instead discussed in the summary of interview findings in Chapter Five, where more detailed questions regarding funding needs and opportunities are explored.

A description of each topic area for the benchmarking follows. Within each section, recommendations are presented for local agency consideration to further enhance their program, policy, or practice.

3.1 KEY STRENGTHS

(a) Traffic Control Devices

Regular inspection and maintenance of traffic control devices, including signs, pavement markings, and signals, is an essential, proactive strategy for pedestrian and bicycle safety.

The most frequent response to this survey question was, "We routinely assess, re-evaluate, upgrade, and maintain our traffic control devices."

Local Agency Recommendations for Further Enhancement:

- Establish a web-based reporting and tracking system for maintenance requests.
- Upgrade all traffic signals to LED indication.
- Install and maintain pedestrian countdown signals at all traffic signals (both new and existing locations). Provide pedestrian signal timing to accommodate a walking speed of 3.5 feet/second. (Note both strategies are expected to be a requirement with the next revision to the *Manual on Uniform Traffic Control Devices* (MUTCD).)
- Provide bicycle detection for actuated traffic signals on all roads where bicycling is not prohibited.
- Develop and maintain a Geographic Information System (GIS), or mapped database, inventory of pedestrian traffic control devices and markings and include maintenance records within the GIS database.

City of Bakersfield
Rubber Sidewalk Program

(b) Sidewalk Maintenance and "Gap Fill" Projects

The most frequent response to this survey question was, "New sidewalks are included in our capital improvements program (CIP)." Earmarked funding for sidewalk projects, such as inclusion in the CIP, is essential for systematically improving pedestrian safety and accommodations.

Local Agency Recommendations for Further Enhancement:

- Develop and maintain a GIS inventory of sidewalks (or at a minimum missing sidewalk locations). Include sidewalk maintenance records in the GIS database as well as key information such as

presence of street trees, sidewalk width, and pedestrian volumes.

- Prioritize sidewalk improvements through a *Pedestrian Master Plan* or a GIS-index process. This should include coordination with the ADA *Transition Plan*'s prioritization process.
- Include trails, paseos, and other connections along key desire lines in the sidewalk prioritization and installation program.
- Ensure maintenance funding is also provided in the CIP.

Recommendations for sidewalks in rural areas are provided in Section 3.2 (d).

(c) Bicycle Facility Maintenance and "Gap Fill" Projects

A majority of cities responding to the survey also include funding for new bicycle facilities in their CIP. As with sidewalks, funding for bicycle infrastructure projects is essential for systematically improving safety and accommodations.

Local Agency Recommendations for Further Enhancement:

- Develop and maintain a GIS inventory of all roads where bicycles are not prohibited. Include maintenance records in the GIS database as well as key information such as facility class and bicycle volumes.
- Prioritize improvements for bicycling or additions through a *Bicycle Master Plan* or a GIS-index process.
- Ensure maintenance funding is also provided in the CIP.

(d) Bicycle Master Plans

Bicycle Master Plans inventory existing conditions and prioritize the implementation of capital and maintenance projects to improve bicycling conditions. The Plans provide an important policy backdrop for decision-making citywide, and can set California Environmental Quality Act (CEQA) thresholds for consideration during the environmental review process with new developments. Cities must have a Bicycle Master Plan (updated within five years) to be eligible for statewide Bicycle Transportation Account (BTA) funds.

Likely as a result of the eligibility requirement for funding, more than 70 percent of local agency survey respondents have a Bicycle Master Plan in their city. In many cases, these Plans could be enhanced with updates to incorporate recommendations from this report.

3.2 ENHANCEMENTS

(a) Review of Collision Data

Comprehensive monitoring of collision data using Crossroads or PBCAT software, for example, allows for more proactive pedestrian and bicycle safety projects with crash typing for countermeasure selection.

The most frequent local agency response to this question for both pedestrian-vehicle and bicycle-vehicle collision data was, "We review collision data in response to citizen requests/concerns." While this review practice is preferable to no collision review practice, it is largely reactive.

Local Agency Recommendations for Further Enhancement:

Resources and Tools for Collision Analysis

Geographic Information Systems (GIS) are a useful tool for analyzing transportation trends and managing location-based data such as collisions. Examples of communities using GIS from the San Francisco Bay Area Metropolitan Transportation Commission (MTC) are available at the below links:

- *Maps and Data*
- *Sharing GIS information*

The Statewide Integrated Traffic Records System (SWITRS) is frequently used to compile police report information from the California Highway Patrol. SWITRS data is available via the below link:

- *CHP SWITRS*

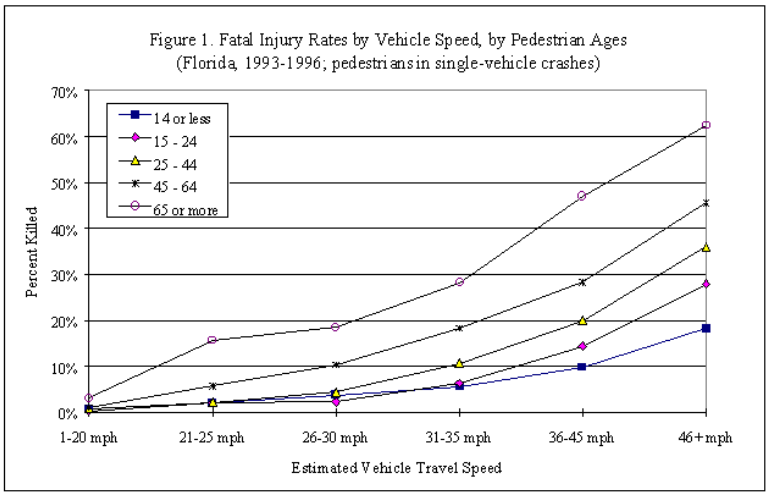
- Develop and maintain a GIS database of pedestrian-vehicle and bicycle-vehicle collisions.
- Conduct routine analysis of collision data with collision analysis software to identify trends and potential countermeasures.
- Centralize access to collision data across city departments.
- Combine inventory of collisions with pedestrian and bicycle volume counts to monitor collision rates more comprehensively; collision locations could be prioritized for improvements based on this data and other factors such as proximity to schools, etc.

(b) Speed Management

Fatality rates increase exponentially with vehicle speed. Studies have found that reducing vehicle speeds in bicycle and pedestrian oriented areas through engineering and design is one of the most important strategies for enhancing safety.[3] The standard speed limit setting practice, per the California Vehicle Code, is based on an observation of 85th percentile speeds. Survey responses show that most local agencies follow state requirements for conducting speed surveys every five years and setting speed limits based on the resulting 85th percentile speed.

[3] Ewing, R. and Dumbaugh, E. (2209) "The Built Environment and Traffic Safety: A Review of Empirical Evidence." Journal of Planning Literature 2009; 23 347.
Available on-line at: http://jpl.sagepub.com/cgi/content/abstract/23/4/347

There has been some debate among the California Traffic Control Devices Committee (CTCDC) about whether to recommend that jurisdictions set speed limits by rounding the 85th percentile speed up to the nearest factor of five/zero, or to allow local jurisdictions to round down to the nearest factor of five/zero. Previously, jurisdictions were permitted to round down to the nearest factor of five/zero, and reduce the limit by an additional five miles per hour based on local engineering judgment. The most recent CTCDC decision reduces this flexibility by only allowing jurisdictions to round to the nearest five/zero in either direction. Any reduction beyond that (of 5 mph) must be demonstrated with a certified engineering survey.



Fatal Injury Rates by Vehicle Speed for Several Pedestrian Age Groups
Image source: www.nhtsa.dot.gov

Because of the significant role that speed has in injury and fatal collisions, a more comprehensive and strategic approach to speed management is needed. Such an approach would require leadership at the state level. The FHWA has developed Speed Management Guidelines which may serve as a model. Speed management programs such as USLIMITS could also be employed.

Local Agency Recommendations for Further Enhancement:

- Ensure street design standards include context-appropriate design speeds.
- Consider pedestrian and bicycle safety when setting speed limits, and employ traffic calming strategies where speed surveys suggest traffic speeds are too high for pedestrian and bicycle oriented areas.
- Target high collision areas and other areas where traffic speeds are incompatible with pedestrian and bicyclist safety needs for speed enforcement and speed management.
- Consider use of the newly-authorized 15 MPH speed zone in school areas.

Speed Management Policy - Arterial Roadway Design:

High speeds make it harder to avoid a crash, and increase the severity of a crash and the likelihood of a fatality. Speed reduction should be a primary tool in reducing pedestrian crashes. Simply lowering speed limits is usually ineffective. Roadways must be redesigned to encourage lower speeds.

National Resources include the below links:

FHWA Desktop Reference for Crash Reduction Factors

FHWA Safety Program

FHWA Speed Management Strategic Initiative

USLIMITS is a web-based expert speed zoning advisor to assist in setting appropriate and consistent speed limits. The expert system recommends a speed limit for a section of road based on road function, roadside development, operating speeds, road characteristics and other factors required to determine appropriate speed limits in speed zones.

- *Access USLIMITS web based tool*
- *USLIMITS technical brief*

(c) Facilities Inventory

A GIS-based sidewalk and bicycle facilities inventory enables project identification and prioritization, as well as project coordination with new development, roadway resurfacing, etc. The most frequent answer to this question was, "We do not have a complete inventory of pedestrian facilities, but we have a partial inventory of major locations or areas." Deployment and maintenance of a complete, GIS-based inventory is recommended, as described above in the maintenance and "gap fill" discussions.

(d) Rural Shoulder Widening

In rural areas, providing sidewalks or striped bicycle lanes may be challenging based on available right-of-way. Additionally, pedestrian and bicycle volumes are typically lower in these areas. However, for those who choose to or must walk or bicycle along rural roads, providing wide shoulders can enhance safety. The most frequent answer to this question (for agencies in rural areas) was, "We widen shoulders as an occasional practice."

Local Agency Recommendations for Further Enhancement:

- Develop and maintain a GIS inventory of wide shoulders and roadway widths in general (as well as an inventory of key destinations for pedestrians and bicyclists, pedestrian and bicycle volumes, and collisions).
- Provide paved, wide shoulders will all new roadway installations.
- Restripe roads during roadway resurfacing/maintenance to provide for wider shoulders where lane widths can be reduced.

- Prioritize retrofits and shoulder widenings based on pedestrian, bicycle, and vehicle volumes and vehicle speeds, nearby land uses, collision data, etc.

> ***Resources for Accommodating Pedestrians in Rural Areas***
>
> *Providing shoulders or sidewalks in rural areas addresses walking along the roadway collisions. See An Analysis of Factors Contributing to "Walking Along Roadway" Crashes: Research Study and Guidelines for Sideways and Walkways FHWA-RD-01-101 for more details on walking along roadway collision countermeasures*
>
> *Additional References/Guidance/Cost Estimates:*
>
> - *AASHTO – A Policy on Geometric Design of Highways and Streets Ch. 4 Cross Section Elements - Width of Shoulders*
> - *Pedsafe – Table 1. Recommended Guidelines for New Sidewalk/Walkway Installation*
> - *An example from Allegheny County, PA*

(e) ADA Compliance

Compliance with the Americans with Disabilities Act (ADA) guidelines for accommodation is important not only to enhance community accessibility, but also to improve walking conditions for all pedestrians.

Almost all local agency respondents have a practice of ensuring ADA compliance with new projects. However, fewer agencies have a plan in place to systematically upgrade existing facilities to meet ADA requirements.

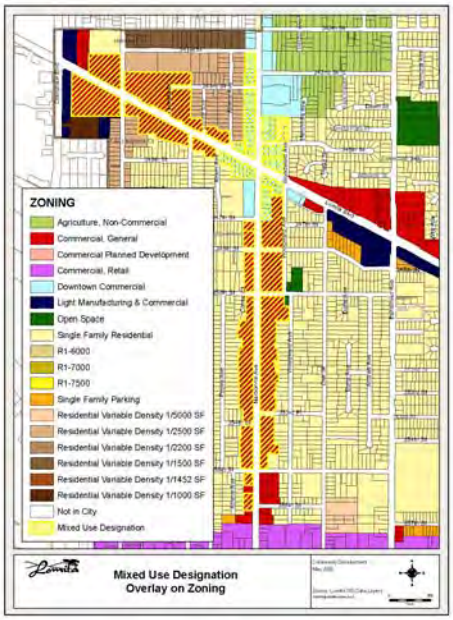
Local Agency Recommendations for Further Enhancement:

- Prepare an ADA Transition Plan that addresses street and sidewalk improvements.
- When constructing new curb ramps, consider opportunities to improve or construct other pedestrian improvements at the intersection, such as bulb outs and landscaping.
- Implement audible pedestrian signals (APS) through a prioritization project for new signals and signal modifications.
- Focus on crosswalk retrofits in areas with high pedestrian volumes, such as in downtown commercial areas.

- Address cross-slope deficiencies and establish design guidelines for driveways to reduce cross-slope issues with new developments.
- Provide two curb ramps (directional ramps) per corner as a standard practice, designed per current guidance for slopes, landings, truncated domes, etc.
- Ensure pedestrian push buttons are accessibly located and installed per current guidance (one per crossing, vibro-tactile, etc.).

(f) General Plan Accommodation of Pedestrians and Bicycles

Planning principles contained in a city's *General Plan* can provide an important policy context for developing pedestrian-oriented, walkable areas and supporting efficient and safe bicycle travel. Transit-oriented development, higher densities, and mixed uses are important planning tools for pedestrian- and bicycle-oriented areas. These planning tools are typically associated with lower travel speeds and higher pedestrian and bicycle volumes, both of which may contribute to enhanced safety.



A majority of local agencies responded that their *General Plan* includes a brief discussion of pedestrian and bicycle issues and needs, but not a significant focus.

<u>Local Agency Recommendations for Further Enhancement:</u>

- Consider developing overlay zones with an emphasis on "walkability," "bikability," and place-making. Overlay zones may include pedestrian nodes as well as neighboring residential communities and retail destinations to improve connectivity to major destinations, not just within major destinations.
- Consider mixed-uses and pedestrian- and bicycle- orientation as a high priority for new developments.
- Establish a policy for developing and routinely updating a *Pedestrian and Bicycle Master Plan(s).*
- Establish a policy for Complete Streets and Routine Accommodation.

3.3 OPPORTUNITIES

(a) Pedestrian/Bicycle Coordinator Position

In a sampling of pedestrian-oriented California cities, a full-time pedestrian/bicycle coordinator is typically provided at a ratio of one per 100,000 population. Part- or full-time coordinators are frequently tasked with convening a formal advisory committee and implementing many of the types of strategies recommended in this report. Federal legislation requires each state to have a Pedestrian/Bicycle Coordinator. No similar requirement is in place at the local level.

A majority of local agency representatives responded that their city has neither a Pedestrian, Bicycle, nor Pedestrian/Bicycle Coordinator.

Local Agency Recommendations for Further Enhancement:

Consider employing a Pedestrian/Bicycle (or separate Pedestrian and Bicycle) Coordinator at a ratio of one full time staff member per 100,000 population.

(b) Pedestrian/Bicycle Volume Data Collection

Pedestrian and bicycle volume data is important for determining and designing appropriate infrastructure projects and enhancements, prioritizing projects, and developing collision rates. A majority of local agency survey respondents said that they do not collect pedestrian or bicycle volume data. For those who do collect data, it is typically collected on a case-by-case basis with no routine practice.

Local Agency Recommendations for Further Enhancement:

- Consider routinely collecting pedestrian and bicycle volumes by requiring that they be collected in conjunction with manual vehicle turning movement counts.
- Geocode pedestrian volume data with GIS software along with other data such as pedestrian control devices and collisions to better analyze data for trends or hotspots.

(c) Crosswalk Policy and Practices

A formal policy for crosswalk installation, removal, and enhancements provides transparency in decision-making and can adopt best practices in pedestrian safety and accommodation. The most frequent response to this question was, "We evaluate pedestrian crossings on a case-by-case basis but have no formal process for the review." This was followed by the response, "We evaluate potential crosswalk treatments using a formal review process based on guidelines contained in the MUTCD." Very few agencies have a city (context)-specific, formal review process to guide crosswalk location decisions, treatment toolbox components, and selection procedures.

Crosswalk policy resources include:

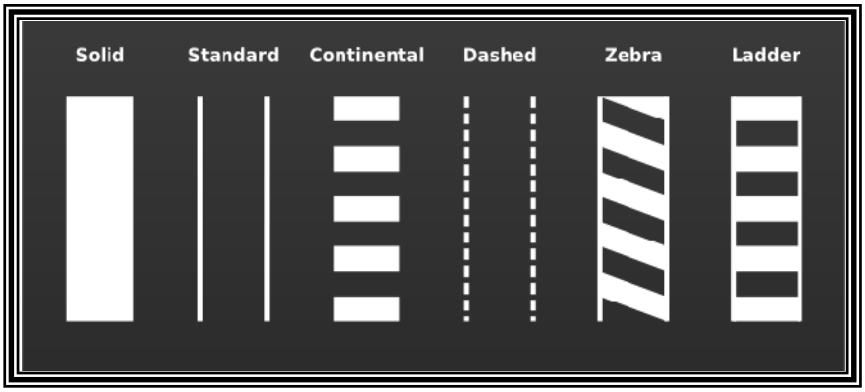
- *Sacramento Crosswalk Policy: www.cityofsacramento.org/dsd/development-engineering/documents/Ped_Safety.pdf*
- *Stockton Crosswalk Policy: www.stocktongov.com/publicworks/publications/PedGuidelines.pdf*
- *Federal Highway Administration Study on Marked versus Unmarked Crosswalks: http://safety.fhwa.dot.gov/ped_bike/docs/cros.pdf*
- *National Cooperative Highway Research Program Report on Crosswalks at Uncontrolled Locations: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf*
- *Caltrans/UC Berkeley Study on Pedestrian/Driver Behavior at Marked versus Unmarked Crosswalks: http://repositories.cdlib.org/its/tsc/UCB-TSC-RR-2007-4/*

Local Agency Recommendations for Further Enhancement:

- Develop and routinely update a city-specific crosswalk policy to address installation, removal, and enhancements, and to reflect best practices[4]. Provide the policy and an easily-read brochure version on the city's website.
- Develop and maintain a GIS inventory of all uncontrolled marked crosswalks. Using the Seattle model, systematically determine which crosswalks should remain, which should be removed, and where new crosswalks should be installed. Use the above city-specific crosswalk policy to provide enhancements (beyond striping and signing) to the resulting marked crosswalks where necessary, such as on multi-lane roads.
- Provide marked crosswalks on all approaches of signal- and stop-controlled intersections where feasible, supplemented with advanced stop bars.[5]

The following cities have established practices for Complete Streets and Routine Accommodations and may serve as models:

- *Fort Collins, Colorado's Multi-Modal Level of Service Manual: www.fcgov.com/link-disclaimer.php?TABID=5&URL=http://www.co.larimer.co.us/engineering/GMARdStds/ApdxH%2010-01-02.pdf*
- *Charlotte, North Carolina's Urban Street Design Guidelines: www.charmeck.org/Departments/Transportation/Urban+Street+Design+Guidelines.htm*
- *Sacramento Transportation and Air Quality Collaborative Best Practices for Complete Streets: www.completestreets.org/documents/FinalReportII_BPCompleteStreets.pdf*
- *San Francisco, California, Department of Public Health's Pedestrian Quality Index: www.sfphes.org/HIA_Tools/PEQI.pdf*
- *San Francisco County Transportation Authority's Multi-modal Impact Criteria: www.sfcta.org/images/stories/Planning/CongestionManagementPlan/2007%20-%20appendix%2005%20-%20tia.pdf*



Standard Crosswalk Marking Patterns

Image source: FHWA, Planning and Designing for Pedestrian Safety

[4] Considerable research on crosswalk safety and treatment efficacy has been conducted in recent years, which includes many new countermeasures.

[5] See Zegeer, C.V., et al. "Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines." FHWA-HRT-04-100, August 2005.

(d) Complete Streets Policy

Routine Accommodations or Complete Streets Policies accommodate all modes of travel and travelers of all ages and abilities. Implementation can include use of multi-modal level of service/quality of service analysis procedures for transportation impact and mitigation studies. Most local agencies responding to the survey do not have a Complete Streets Policy.

Local Agency Recommendations for Further Enhancement:

Consider establishing a Complete Streets Policy and accommodating all modes in standard cross-sections for collectors and arterials. This policy could include a checklist for use during development application review and adoption of multi-modal level of service criteria.

(e) Pedestrian Master Plans

Similar to Bicycle Master Plans, Pedestrian Master Plans inventory existing conditions and prioritize the implementation of capital and maintenance projects to improve pedestrian environments. Model Pedestrian Master Plans address the accommodation of pedestrians during construction, street tree or street furniture standards, pedestrian connectivity, system-wide consistency, and interdepartmental coordination. The Plans provide an important policy backdrop for decision-making citywide, and can set CEQA thresholds for consideration during the environmental review process with new developments. Only twenty-two percent of local agency survey respondents have a Pedestrian Master Plan in their city.

Example Pedestrian Master Plan from the City of Sacramento

Local Agency Recommendations for Further Enhancement:

Develop a Pedestrian Master Plan to document pedestrian needs and opportunities, establish design standards, formalize policies (such as the above-recommended crosswalk policy), and prioritize improvements.

(f) Citizen's Advisory Committees

Pedestrian and/or Bicycle Advisory Committees act as a medium of public input so that cities can best address needs of their walking and bicycling populations. A majority of local agencies responding to the survey do not have a Bicycle Advisory Committee. Even more do not have a Pedestrian Advisory Committee.

Local Agency Recommendations for Further Enhancement:

- Create separate Pedestrian and Bicycle Citizen's Advisory Committees and designate the Pedestrian/Bicycle Coordinator (or other appropriate staff member) as the staff liaison to the committees.

- Consider opportunities to "task" the committees and/or the advocacy community with efforts that could improve pedestrian and bicycle safety, such as pedestrian and bicycle counts and education campaigns. The cities of Santa Barbara and Chicago offer model approaches for advocate engagement.

(g) School Safety Programs

Safe Routes to School programs encourage children to safely walk and bike to school. The Marin County Bicycle Coalition is a paragon for this initiative, which has spread nationally (refer to best practices at www.saferoutestoschools.org). Safe Routes to School programs are important both for increasing physical activity and safety, and for reducing morning traffic associated with school drop-off (as much as 30% of AM peak hour traffic). Funding for Safe Routes to School programs and/or projects is available at the state and federal levels.

Most survey respondents do not have staff or a department in their city focused on school safety issues. Only 20 percent of respondents said they have a school safety program in their city.

Local Agency Recommendations for Further Enhancement:

- Begin or continue applying for state and federal grant funding for both infrastructure and non-infrastructure Safe Routes to School projects.
- Improve city involvement in the Safe Routes to School process by establishing a formal city-wide Safe Routes to School Program; conducting ongoing education, enforcement, and encouragement campaigns; and meeting regularly with school representatives, PTAs, and other stakeholders to discuss issues and opportunities.
- Engage the public health community in Safe Routes to School efforts.

(h) Traffic Calming/ Neighborhood Traffic Management Programs

Traffic calming programs and policies set forth a consensus threshold on neighborhood requests and approvals, as well as standard treatments and criteria. Traffic calming is especially important because of the direct correlation between higher speeds and injuries in traffic collisions. However, traffic calming is inherently a reactive practice that stems from contextually inappropriate street design. As such, traffic calming programs should be paired with revised street design standards.

A majority of local agency survey respondents do not have a traffic calming program in their city. For those that do, it does not typically have a dedicated funding source.

Local Agency Recommendations for Further Enhancement:

- Formalize traffic calming practices for existing neighborhoods with a Neighborhood Traffic Management Plan and Program. A Neighborhood Traffic Management Program would spell out a process for developing area-wide traffic calming improvements. An allocation of resources to an on-going program would allow for a proactive approach.
- Identify opportunities to coordinate traffic calming with other projects, such as repaving and redevelopment, etc.
- Pair traffic calming efforts with revised street design standards to prevent future traffic calming needs.

Best practices resources include: www.trafficcalming.org and the City of Sacramento's Traffic Calming Guidelines, available online at: www.cityofsacramento.org/transportation/dot_media/engineer_media/pdf/trafficcalming.pdf.

(i) Education Program

Education is a critical element for a complete and balanced approach to improving pedestrian and bicycle safety. Education campaigns should focus on pedestrians and bicyclists of all ages, especially emphasizing education of schoolchildren where safe walking and bicycling habits may be instilled as lifelong lessons. Campaigns should also target drivers. The most frequent survey response to this question was, "We do not have a safety education curriculum for our schools or community centers."

Example Safe Routes to School Activity

Local Agency Recommendations for Further Enhancement:

- Develop a pedestrian, bicycle and driver safety curriculum for schools and community centers.
- Develop, and secure a steady source of funding for, safety education campaigns.
- Provide education to encourage walking and bicycling as well as improve safety.
- Conduct walkability and bikability audits with stakeholders on a regular basis, at least every year.

CHAPTER SUMMARY

Local agencies throughout the State of California are developing policies and programs to improve pedestrian and bicycle safety. Using a benchmarking process that compares local efforts to national best practices, survey results found that local agencies have been more successful in certain policy areas than in others. Key strengths include regular maintenance of traffic control devices, pedestrian and bicycle maintenance programs funded by local capital improvement programs (CIP), and adoption of a Bicycle Master Plan.

The benchmarking process also identified policy areas where local agencies are actively engaged but could benefit from further enhancement. Areas that may be enhanced include a comprehensive review of collision data, speed management policies, inventories of pedestrian and bicycle facilities, and inclusion of pedestrian and bicycle policies in local General Plans.

Finally, opportunities for overall improvement include the collection of pedestrian and bicycle volume data, establishing paid coordinator positions and citizens' advisory groups, as well as adopting a Pedestrian Master Plan and Traffic Calming Program.

4. CALTRANS DISTRICTS SURVEYS: KEY FINDINGS & RECOMMENDATIONS

The Caltrans Districts survey responses were also qualitatively analyzed with a benchmarking matrix, as shown in Table 4-1. The survey was identical to the survey distributed to local agencies. However, some survey topics have been removed where the typical response was "not applicable." The results in Table 4-1 are further elaborated in the following sections.

TABLE 4-1. CALTRANS DISTRICTS SURVEY BENCHMARKING RESULTS SUMMARY

Topic	Survey Question	Rating for Most Frequent Response
Regular Maintenance of Traffic Control Devices	Does your organization conduct regular assessments of your jurisdiction's traffic control devices or fix problems reported only on an as-needed basis?	Key Strength
Sidewalk Projects in Capital Improvement Program	Are sidewalk projects (new and/or maintenance) included in your capital improvements program?	Key Strength
Complete Streets Policy	Does your organization have a policy that calls for planning that specifically addresses walking and bicycling needs on the same footing as transit and driving needs?	Key Strength
Review of Pedestrian-Vehicle Collision Data	What are your organization's practices for reviewing pedestrian-vehicle collision data?	Enhancement
Review of Bicycle-Vehicle Collision Data	What are your organization's practices for reviewing bicycle-vehicle collision data?	Enhancement
Review of Speed Limits	What is your organization's policy/practice for reviewing speed limits?	Enhancement
Inventory of Bicycle Facilities	Does your organization have and maintain an inventory of bicycle facilities (including routes, signs, markings, and traffic signals)?	Enhancement
Rural Shoulder Widening Program	If your organization is in a rural area, do you have a program for widening shoulders to accommodate pedestrians?	Enhancement
ADA Compliance Procedures	What are your organization's policies and practices for bringing existing facilities in line with Americans with Disabilities Act (ADA) requirements?	Enhancement
Bicycle/Pedestrian Coordinator Position	Do you have a full time Bicycle/Pedestrian Coordinator(s) on staff?	Enhancement

Key Strength: On par with national best practices
Enhancement: Average effort / Area for improvement
Opportunity: Area for significant improvement

TABLE 4-1. CALTRANS DISTRICTS SURVEY BENCHMARKING RESULTS SUMMARY (CONTINUED)

Topic	Survey Question	Rating for Most Frequent Response
Crosswalk Installation, Enhancement, and Removal Policy	How does your organization make decisions regarding installation, removal, and enhancement treatments for uncontrolled marked crosswalks (crossing locations without stop signs or traffic signals)?	Enhancement
Bicycle Facility Projects in Capital Improvement Program	Are bicycle facility improvements (new and/or maintenance) included in your capital improvements program?	Opportunity
Inventory of Pedestrian Facilities	Does your organization have and maintain an inventory of pedestrian facilities (including signs, markings, traffic signals, and existing sidewalks)?	Opportunity
Pedestrian Volume Data Collection	Does your organization collect pedestrian volume data?	Opportunity
Bicycle Volume Data Collection	Does your organization collect bicycle volume data?	Opportunity
Pedestrian Master Plan	Does your organization have a Pedestrian Master Plan?	Opportunity
Bicycle Master Plan	Does your organization have a Bicycle Master Plan?	Opportunity
Citizen's Advisory Committee - Pedestrian	Does your organization have a citizen's advisory committee that informs decisions on pedestrian issues?	Opportunity
Citizen's Advisory Committee – Bicycle	Does your organization have a citizens' committee that addresses bicycle pedestrian issues?	Opportunity
School Safety Program and Coordinator	Does your organization have a department or a staff person dedicated to traffic safety around schools?	Opportunity
Traffic Calming Program	Does your organization have a traffic calming/ neighborhood traffic management program?	Opportunity

Key Strength: On par with national best practices
Enhancement: Average effort / Area for improvement
Opportunity: Area for significant improvement
Source: Fehr & Peers, 2009

Chapter Three presented the rationale for improving pedestrian and bicycle safety by enhancing programs, policies, and practices within each topic area. The recommendations for local agencies are largely transferable to Caltrans in terms of programs, policies, and practices that could be employed within the state's jurisdiction. Caltrans' striving to meet a "key strength" benchmark in each of the topic areas would set a significant precedent for local agencies.

Beyond this, Caltrans also has an opportunity to set model policies and practices, develop statewide programs and databases, provide technical assistance, and allocate/prioritize funding. Table 4-2 notes which approach would likely be the most beneficial for local agencies within each of the topic areas.

TABLE 4-2. SUGGESTED CALTRANS ROLE IN ADVANCING PROGRAMS, POLICIES, AND PRACTICES		
Topic	**Rating for Most Frequent Response**	**Suggested Caltrans Role in this Topic Area**
Regular Maintenance of Traffic Control Devices	Key Strength	Model policies and practices, technical assistance, funding
Sidewalk Projects in Capital Improvement Program	Key Strength	Model policies and practices, technical assistance, funding
Complete Streets Policy	Key Strength	Model policies and practices, funding (prioritization)
Review of Pedestrian-Vehicle Collision Data	Enhancement	Statewide database, technical assistance, funding
Review of Bicycle-Vehicle Collision Data	Enhancement	Statewide database, technical assistance, funding
Review of Speed Limits	Enhancement	Model policies and practices, technical assistance, funding
Inventory of Bicycle Facilities	Enhancement	Model policies and practices, statewide database, technical assistance, funding
Rural Shoulder Widening Program	Enhancement	Model policies and practices, technical assistance, funding
ADA Compliance Procedures	Enhancement	Model policies and practices, statewide database, technical assistance, funding
Bicycle/Pedestrian Coordinator Position	Enhancement	Model policies and practices, technical assistance, funding
Crosswalk Installation, Enhancement, and Removal Policy	Enhancement	Model policies and practices, technical assistance, funding
Bicycle Facility Projects in Capital Improvement Program	Opportunity	Model policies and practices, technical assistance, funding
Inventory of Pedestrian Facilities	Opportunity	Statewide database, technical assistance, funding
Pedestrian Volume Data Collection	Opportunity	Statewide database, technical assistance, funding
Bicycle Volume Data Collection	Opportunity	Model policies and practices, statewide database, technical assistance, funding
Pedestrian Master Plan	Opportunity	Model policies and practices, technical assistance, funding (to prepare the Plan and prioritization for cities with a Plan)
Bicycle Master Plan	Opportunity	Model policies and practices, technical assistance, funding

TABLE 4-2. SUGGESTED CALTRANS ROLE IN ADVANCING PROGRAMS, POLICIES, AND PRACTICES (CONTINUED)

Topic	Rating for Most Frequent Response	Suggested Caltrans Role in this Topic Area
Citizen's Advisory Committee - Pedestrian	Opportunity	Model policies and practices
Citizen's Advisory Committee – Bicycle	Opportunity	Model policies and practices
School Safety Program and Coordinator	Opportunity	Technical assistance, funding
Traffic Calming Program	Opportunity	Technical assistance, funding

Source: Fehr & Peers, 2009

CHAPTER SUMMARY

The Caltrans District staff survey results generated similar benchmark ratings to the local agencies. For example, Caltrans regularly maintains traffic control devices and includes sidewalk projects in capital improvements. However, Caltrans stands out from local agencies in key policy areas. For example, Caltrans has a Complete Streets policy, Deputy Directive 64, which mandates routine accommodation of all modes and users.

As a statewide agency, Caltrans may model their best practices for local agencies to follow. In order for local agencies to adopt such practices, Caltrans may also provide technical assistance and additional funding for specific program areas.

5. INTERVIEWS: KEY FINDINGS & RECOMMENDATIONS

Eight follow-up interviews were conducted with local agency survey respondents to further explore topics from the electronic survey as well as discuss concerns and opportunities in general. The discussions largely focused on funding and technical assistance needs. A summary of the interview is presented in Appendix C. The following section summarizes the key findings and recommendations based on the interviews and survey data.

Finding 1.1

Grant funding for pedestrian and bicycle projects is insufficient.

The most significant challenge for local agencies is pursing and securing funding for pedestrian and bicycle projects. This is especially true given current local agency funding crises in the midst of a recession.

In both the interviews and survey, respondents noted that a significant number of agencies compete for a limited amount of funding. For example, in the most recent cycle (Cycle 8) of state Safe Routes to School grants projects, more than 400 applications were submitted and Caltrans awarded funding for 109 projects. Similarly, respondents felt that Bicycle Transportation Account funding was insufficient based on demand. For the FY 08/09 funding cycle, 142 applications were submitted requesting a total of over $60 million, and 18 projects were recommended for the $7.2 million of available funding.

Recommendation 1.1

Allocate additional funding to pedestrian and bicycle projects

Reauthorization of the federal transportation bill and/or additional federal stimulus money may offer opportunities for increasing funding for pedestrian and bicycle projects, especially funds earmarked for climate change mitigation projects. Additional communication with local agencies regarding use of this new funding is needed.

For example, the City of San Diego received a significant amount of funding for pedestrian and bicycle projects through the 2009/2010 federal stimulus package. In particular, ADA access projects in the City were "shovel ready" because they had been previously identified for improvement.

Reallocation of state transportation funds through new pedestrian and bicycle funding mechanisms or for additional Complete Streets (per revised Deputy Directive 64) requirements on conventional road projects

Pedestrian & Bicycle Master Plans

Only 22% of surveyed jurisdictions have a Pedestrian Master Plan, while 70% have a Bicycle Master Plan. The discrepancy may be due to the fact that the Caltrans' Bicycle Transportation Account requires applicants to have an adopted Bicycle Master Plan to be eligible for funds.

Less than one quarter of local jurisdictions with a Pedestrian Master Plan received state funding for pedestrian projects, whereas two thirds of jurisdictions with a Bicycle Master Plan received funds from the state for bicycle projects.

would also address local needs. Additional pedestrian funding could be paired with a requirement for a Pedestrian Master Plan, with funding also offered for the preparation of the Plan.

Finding 1.2

Limited local technical resources are available for grant applications; additional mechanisms are needed for smaller agencies to compete for funds.

Smaller jurisdictions, or agencies with limited staff resources, have difficulty fulfilling the technical requirements in various grant applications. Many agencies do not have access to grant writers who are familiar with planning/engineering issues specific to pedestrian and bicycle projects, and who are also familiar with the specific application requirements. While some agencies that do not have these resources in-house use consultants that specialize in preparing grant applications for Safe Routes to School or similar grants types, other agencies noted that they have chosen not to pursue grants.

Respondents also identified specific criteria that prevented them from being eligible for certain grants. For example, the Caltrans' Bicycle Transportation Account funding program requires that jurisdictions have an adopted Bicycle Master Plan to be eligible. Some jurisdictions that have not had funding to develop a Bicycle Master Plan felt that this was a barrier to pursuing funds for bicycle projects.

Additionally, several respondents felt that many types of grant applications were so time consuming that it was no longer cost-effective to pursue funding for small-scale projects. Supporting documentation, such as letters of community support and photos of the project site, were considered an unnecessary and cumbersome task by several respondents.

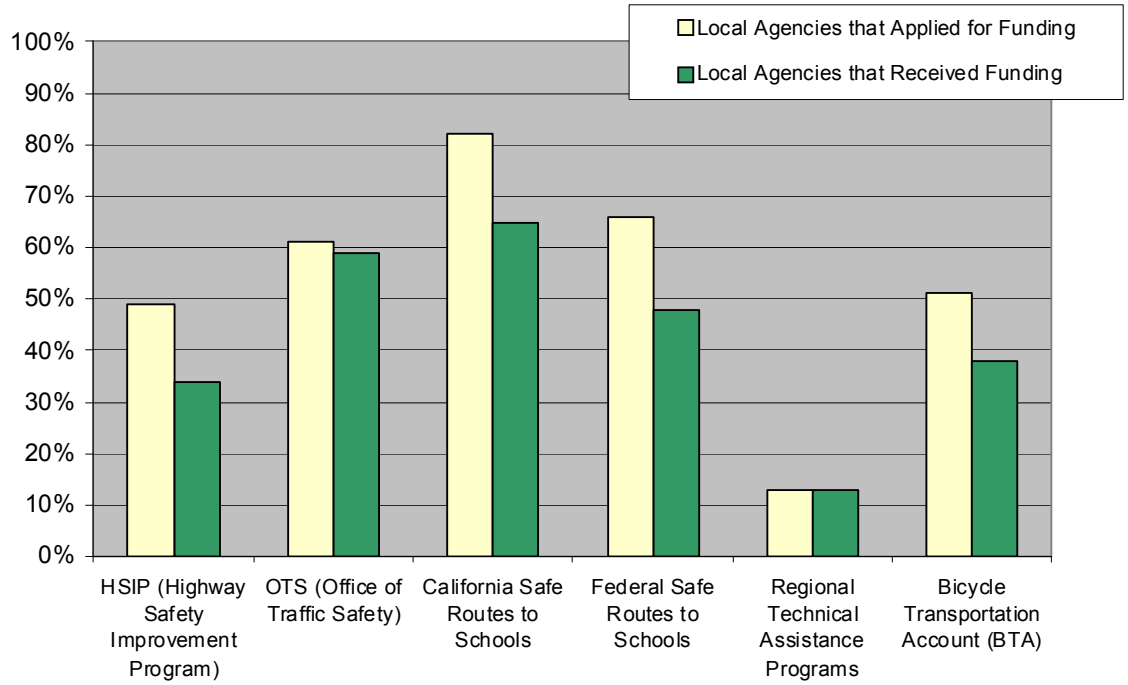
Grant Funding Success Rate

Despite the increasing level of competition for grants, local agencies have had reasonable success in obtaining the grants they have pursued. Depending on the type of grant program, survey results found a success rate around 60%-90%. When asked which funding sources they had applied for, and which sources they successfully received funds from, California and Federal Safe Routes to Schools were the most popular funding sources to pursue, 82% and 59% respectively. These funding sources also had relatively high success rates for those of the respondents who applied, 77% for the California program and 68% for the Federal program. Respondent applicants were most successful in obtaining funding from the Office of Traffic Safety (89%) and Regional Technical Assistance

Programs (82%).[6] The below graph illustrates these survey results.

Aside from the grants, agencies are typically constructing pedestrian and bicycle projects through routine accommodation/ complete streets projects, such as striping bike lanes when a road is widened or restriped.

Application & Success Rates for Pedestrian & Bicycle Funding



Smaller projects, such as a gap closure for a shared use path, are less likely to be implemented unless covered in a Capital Improvement Program or other local funding source.

Recommendation 1.2

Make grant applications more flexible and streamline the process

To better match the resources and capacity of different types of agencies and jurisdictions, state-funded pedestrian and bicycle grant applications could become more flexible. For example, different levels of requirements could be matched to the project scope and size of requested budget.

[6] Other funding sources for pedestrian and bicycle projects noted by survey respondents included TDA (Transportation Development Act), TEA (Transportation Equity Act), CMAQ (Congestion Mitigation and Air Quality), and AQMD (Air Quality Management Districts).

Smaller grant requests could be streamlined by providing an abbreviated application form that would require less time and resources to complete.

In addition, Caltrans could provide additional resources for the application process, such as sample graphics, text, letters of support, and budgets. Local agencies noted that it was very helpful when sample applications were posted on the Caltrans website, as well as listings of past projects that have been awarded and the amount of funding awarded.

Finding 2

Communication/Collaboration with Caltrans Local Assistance offices could be improved

A frequent comment from interviewees was that pedestrian and bicycle projects would benefit if local agencies could have more direct communication with Caltrans staff. Many agencies noted that they typically initiate contact with their local assistance office, and correspondence can be sporadic.

For example, the 2009/2010 Bicycle Transportation Account (BTA) funding awards were delayed due to State budget issues. Updates regarding the process were not provided on the Caltrans website or through other means of communication, putting the onus on local agencies to repeatedly inquire with their local assistance office. In other circumstances, waiting times to hear back from grant applications have felt excessively long to some applicants. This can be a particular challenge for jurisdictions with short construction windows, such as those in the Sierra region. When time lapses for funding cycles become excessively long, these jurisdictions may miss the opportunity to build projects in a given year.

Recommendation 2.1

Enhance the Pedestrian and Bicycle sections of the Caltrans website; Provide regular updates on funding cycles and deadlines on the Caltrans website

Several respondents noted that while many sections of the Caltrans website are very comprehensive, the BTA website is static. Regular updates on the status of funding cycles and deadlines would help inform local agencies and reduce the demands on local assistance offices.

Significant enhancements to the pedestrian and bicycle sections of Caltrans' website, with a more user-friendly interface and updated content, are recommended as would make a very visible statement regarding Caltrans' dedication to pedestrian and bicycle safety. Caltrans might consider contracting the technical assistance portions of the website to a third party organization. New York City's Department of Transportation recently revamped website could be a model for enhanced web communication techniques.

Recommendation 2.2

Provide training to local agencies on how to fund and manage pedestrian and bicycle projects

Many local agencies, particularly those with new or less experienced staff, would benefit from learning more about how to navigate the federal and state funding programs. Direct outreach to jurisdictions with high pedestrian or bicycle collision rates and/or that have not applied/been successful for funding may be appropriate.

For example, a staff member from the Town of Truckee discussed the merits of a recent Caltrans training session she attended. The five-session course, provided by UC Berkeley via the Caltrans District 3 Local Assistance Office, provided training on how to manage a federally funded project. Similar classes or webinars on how to successfully navigate grant funding opportunities would help agencies that have fewer resources or less experience with bicycle and pedestrian projects.

Recommendation 2.3

Enhance Local Assistance Offices' communication and collaboration with local jurisdictions

Enhanced District-level communication and collaboration could expand the knowledge and capabilities of local jurisdictions and encourage collaboration on pedestrian and bicycle project on or across Caltrans facilities. This could take the form of an Advisory Committee, quarterly phone calls or webinars, web chat, or "help lines," etc. A District-level Pedestrian and Bicycle Coordinator could assist in this effort. One interviewee noted in Southern California the local Caltrans agency's Coordinator has been very collaborative on local projects, resulting in much more streamlined and innovative pedestrian and bicycle efforts. In some cases, similar work may already be happening in the public health community, where additional collaboration opportunities may exist.

Finding 3.1

Caltrans' decision-making process for pedestrian and bicycle projects can be cumbersome; Innovative and Complete Streets practices are in some cases being avoided because of current practices and policies within Caltrans

Interviewees noted the following challenges that sometimes arise when working with Caltrans staff on pedestrian and/or bicycle projects.

- Innovative projects that have not been approved in the CA MUTCD are particularly onerous to get approved. This is perceived as in conflict with revised Deputy Directive 64 and Caltrans' frequent sponsorship of pedestrian/bicycle conferences and Complete Streets Symposia where such ideas have been presented.
- Caltrans departments are seen as very compartmentalized; thus, it can take a long time for various staff to reach a decision on approving a local project.

- A single Caltrans project manager is not typically assigned to a given project, and decision-makers are not always present at meetings. As such, solutions that seem to "work ok" in one meeting may run into roadblocks in future meetings.

- Some cities have decided to cut their projects at the Caltrans right-of-way line so they don't have to delve into a slow bureaucratic process. However, this may exacerbate the experience of state facilities being barriers to walking and bicycling in a community.

Recommendation 3.1

Implement Revised Deputy Directive 64 at all staff levels and in all funding and grant programs

Many of the funding and bureaucratic hurdles described in the above findings may be addressed through a transparent and deliberate implementation of the revised Caltrans Deputy Directive 64, which mandates routine accommodation of all modes and users. The implementation may require training at the District level to ensure headquarters' policies are being carried out in District practices.

CHAPTER SUMMARY

Local agency interviews provided specific examples of how Caltrans can best support local efforts to improve pedestrian and bicycle safety. First, many interviewees spoke to the challenges of applying for grants. The most frequent comment in both the survey and interviews is that funding for pedestrian and bicycle projects is too limited. In addition, some agencies do not have the resources or technical skills to fulfill all the Caltrans grant requirements, such as having a current Bicycle Master Plan. Others found that some grant applications processes so time consuming that it was no longer cost-effective to pursue funding for smaller scale projects. To address this issue, Caltrans may consider allocating additional funding to pedestrian and bicycle projects. Caltrans may also consider making grant applications more flexible to better match the resources and capacity of different types of agencies and jurisdictions.

Second, many interviewees and survey respondents felt that communication with Caltrans Local Assistance Offices could be improved, particularly to communicate funding opportunities, deadlines, and announcement of awards. To enhance communication, Caltrans may consider improvements to the pedestrian and bicycle funding sections of its website. Currently the BTA homepage is static, but could provide regular updates and information about funding cycles and deadlines. In addition, greater emphasis on collaboration between local assistance offices and local agencies through training, quarterly phone calls, or webinars could be helpful.

Finally, several interviewees discussed the challenge of interfacing with decision-making processes within Caltrans. For example, while Caltrans has Deputy Directive 64, which mandates routine accommodation of all modes and users, this policy often does always appear to filter down to Caltrans engineers and other staff. Because of this, innovative pedestrian and bicycle projects can stall out at the boundary of Caltrans facilities or local agencies may be deterred from innovative practices. To address this, Caltrans could consider additional opportunities to implement Deputy Directive 64 at all staff levels and through all funding and grant programs.

APPENDIX A:
LOCAL AGENCY SURVEY RESULTS

SUMMARY OF SURVEY FINDINGS

INTRODUCTION

The survey consisted of 73 questions. One hundred nineteen respondents filled out the survey representing 18 counties, 66 cities, two towns, two transportation commissions, one metropolitan planning organization, one forest service, and one airport. Respondents also represented a variety of departments such as Planning and Building, Department of Transportation, Public Works, and Police Department. In the following section, each question and its resulting findings will be summarized.

TABLE A-1. RESPONDENTS SUMMARY

	Total Respondents	Total Unique
City	73	66
County	23	18
Other	7	7
No response	16	16
Total	**119**	**107**

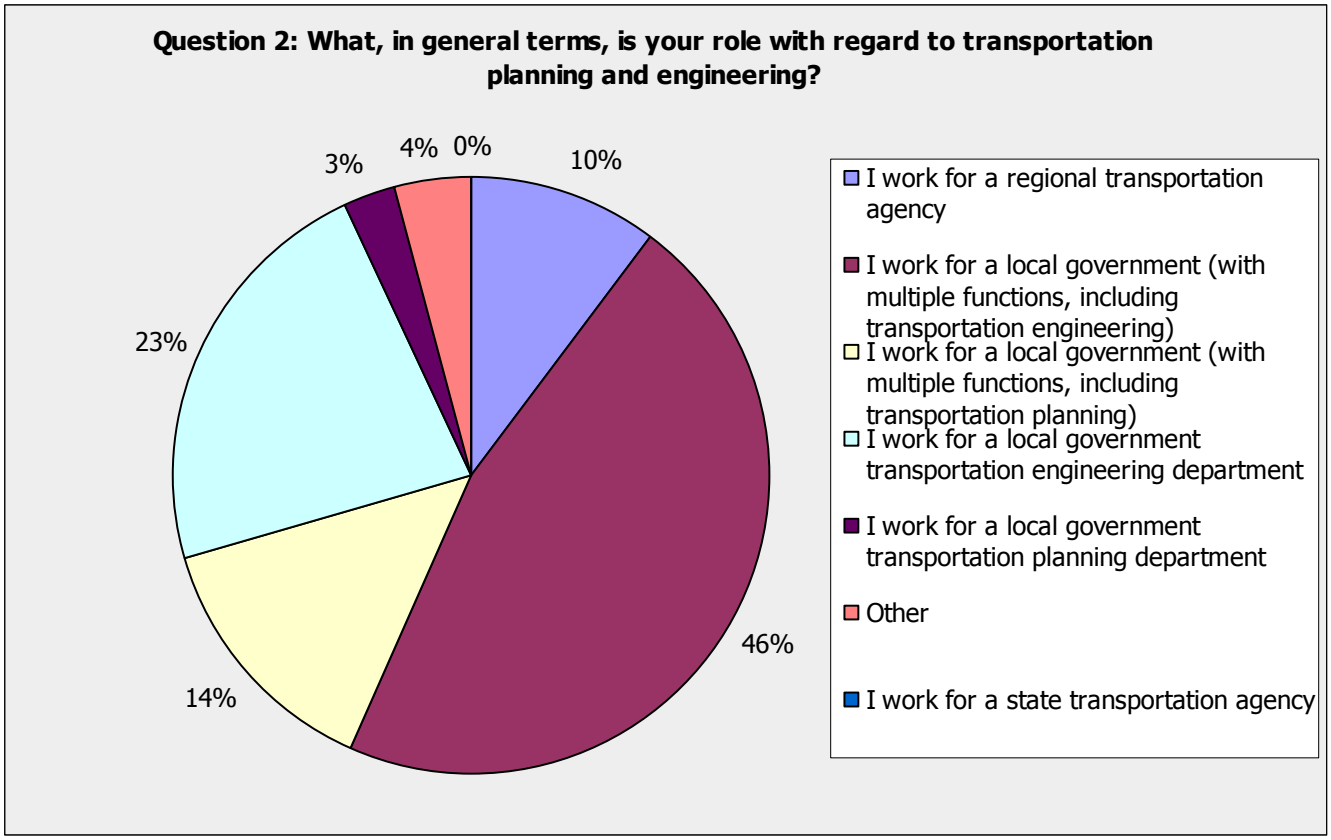
Source: Fehr & Peers, 2009

FINDINGS BY QUESTION

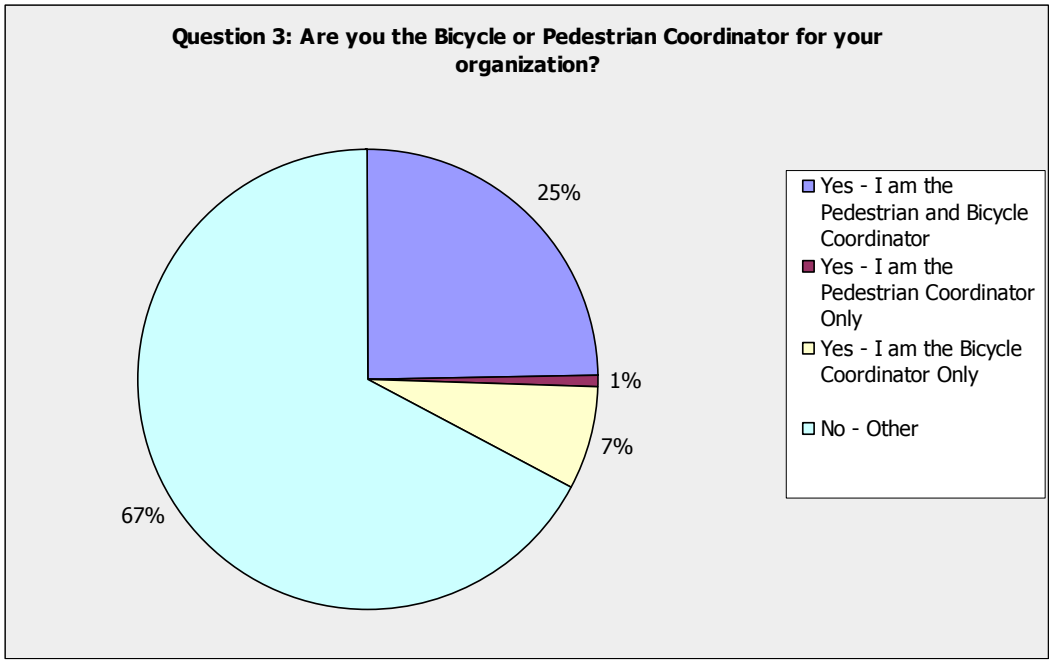
Introductory Questions

Question #2 asked respondents for their role with regard to transportation planning and engineering. 85%[7] (98) of respondents to this question work for a local government, with 54% of that group working for a local government with multiple functions with include transportation engineering. No respondents work for a state agency. Four out of the 119 total respondents skipped this question.

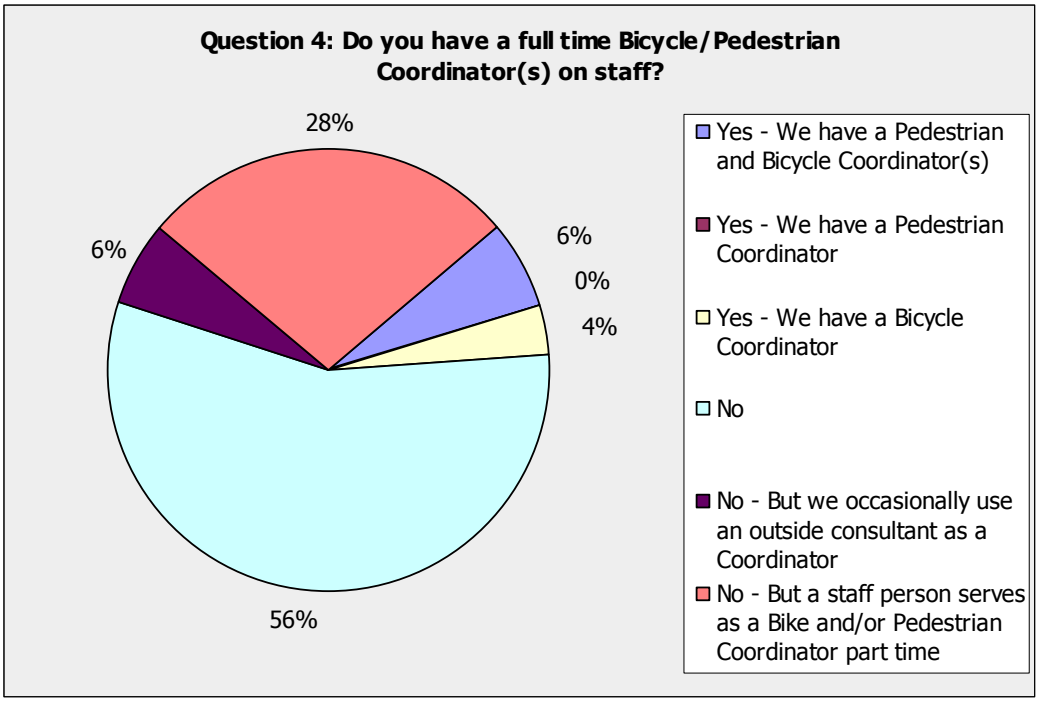
[7] Percentages are based on the number of respondents who answered this particular question. For example, 85% is based off of the 115 respondents who answered Question #2. This applies to all questions discussed in this entire section, unless otherwise specified.



Question #3 asked respondents if they were a Pedestrian, Bicycle, or Bike/Ped Coordinator. 67% (76) of respondents' roles did not fall into any of those categories. Of the remaining respondents, 76% were Pedestrian and Bicycle Coordinators, 22% were Bicycle Coordinators, and 3% were Pedestrian Coordinators. Six out of the 119 total respondents skipped this question.



Question #4 asks if there is a full-time Bicycle/Pedestrian Coordinator on staff. Over half (56%) do not have any sort of Coordinator, whether it be full-time, part-time, or an outside consultant. 28% have a staff person who serves as a part-time Coordinator. Only 10% have a dedicated staff person serving as either a Pedestrian, Bicycle, or Ped/Bike Coordinator.



Question #5 asks the respondents to estimate the percentage of time the designated Coordinator works on pedestrian or bicycle projects. The majority of Coordinators spend less than 25% of their time on either pedestrian or bicycle projects.

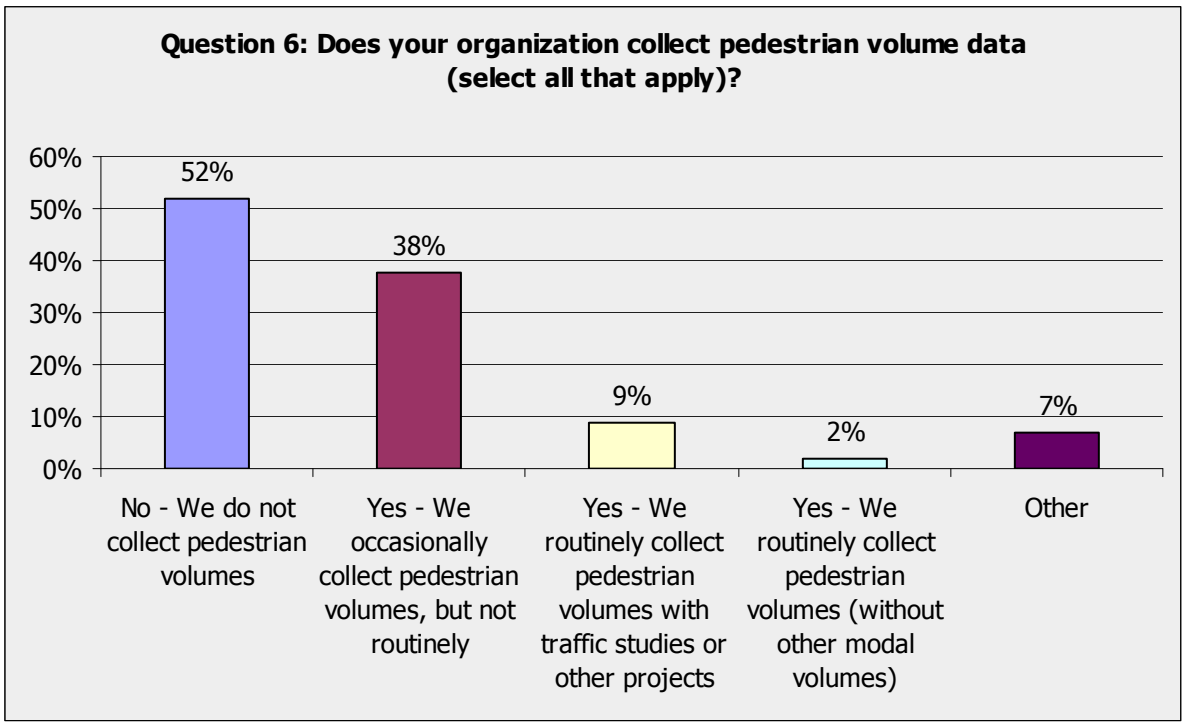
TABLE A-2. QUESTION 5: PERCENTAGE OF TIME DEVOTED TO PED OR BIKE PROJECTS (BY ROLE)

	less than 25 percent of his/her time	25 to 50 percent	50 to 75 percent	more than 75 percent of his/her time	N/A
Our Pedestrian Coordinator					
Works on Pedestrian Projects:	25%	2%	0%	4%	70%
Works on Bicycle Projects:	24%	2%	0%	0%	73%
Our Bicycle Coordinator					
Works on Pedestrian Projects:	32%	5%	0%	2%	61%

Works on Bicycle Projects:	32%	15%	0%	2%	51%
Our Pedestrian/Bicycle Coordinator					
Works on Pedestrian Projects:	48%	8%	3%	0%	41%
Works on Bicycle Projects:	48%	10%	6%	2%	35%
Source: Fehr & Peers, 2009					

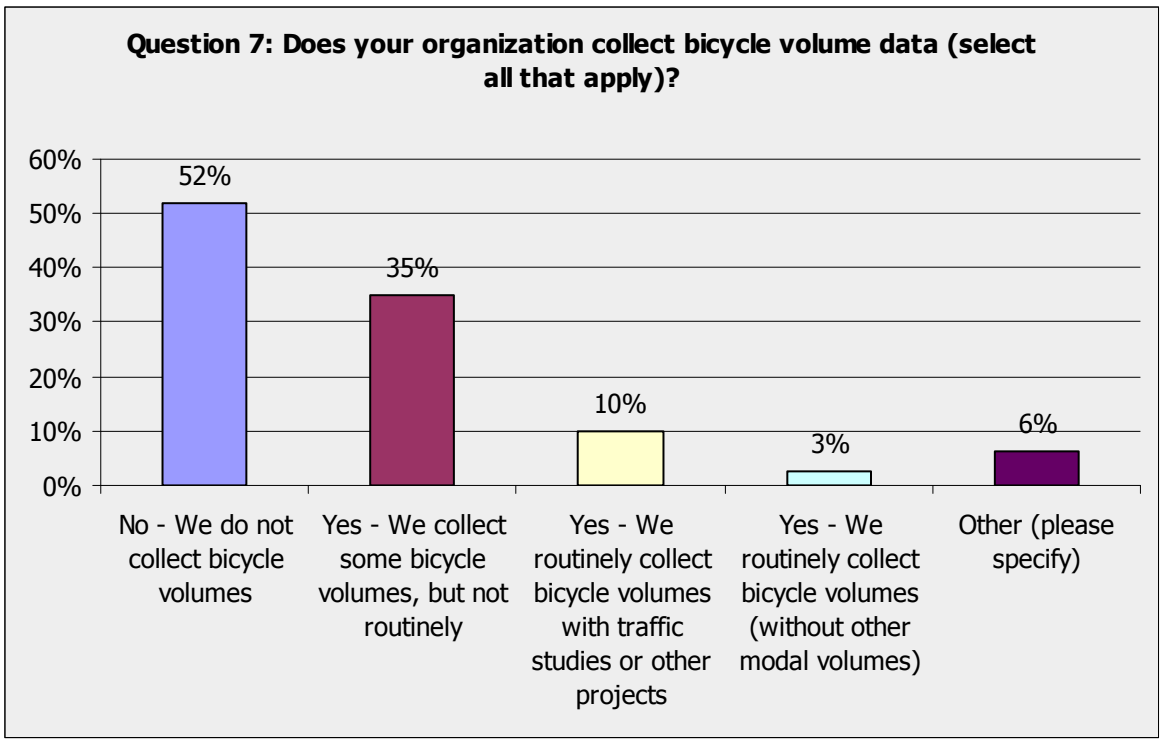
Pedestrian and Bicycle Volume Questions

Question #6 asks respondents to what degree do they collect pedestrian volume data. They were allowed to select multiple answers. A majority (52%) of respondents do not collect any pedestrian volumes while only 11% routinely collected pedestrian volumes. Of the "other" category, 63% of these responses would fall under an "occasional collection" of pedestrian volumes.



Question #7 asks respondents to what degree do they collect bicycle volume data. These answers were similar to Question #6. Fifty-two percent of respondents do not collect any bicycle volume data. Only

13% routinely collect bicycle volume data. Of the "other" category, 57% of these responses would fall under an "occasional collection" of bicycle volumes.



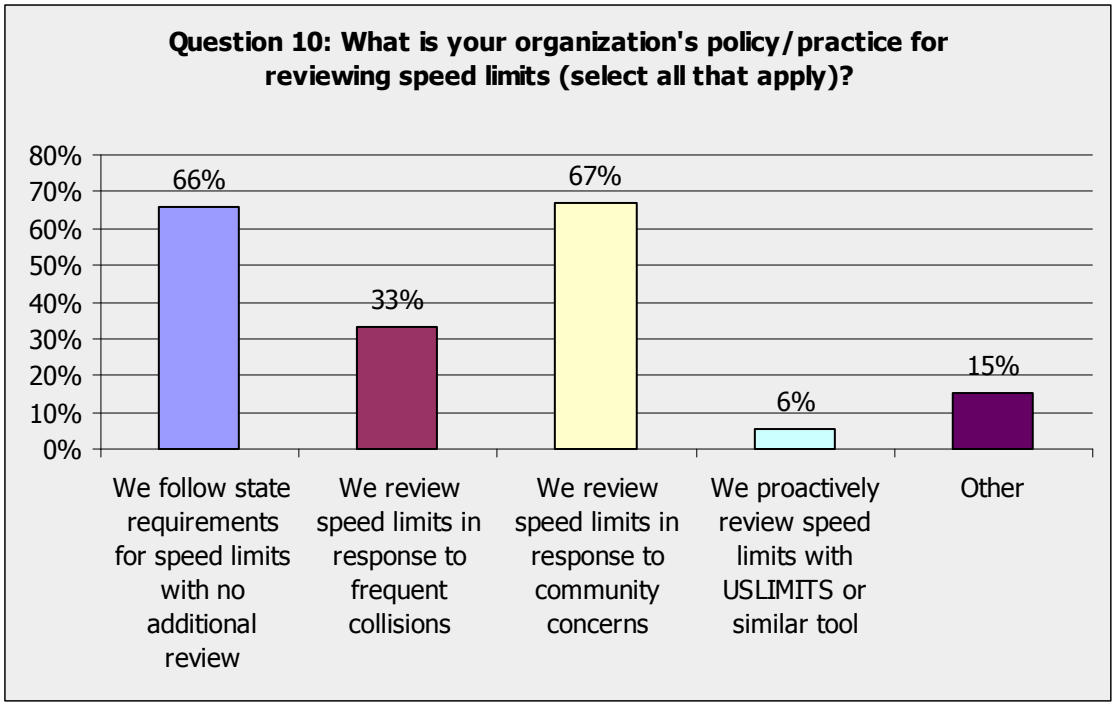
Collision History and Reports Questions

Question #8 asks about the organization's practices for reviewing pedestrian-vehicle collision data. Respondents could select multiple answers. The most popular practices for reviewing ped-vehicle data were: in response to citizen requests (42%), with projects and/or other studies (39%), and after a fatality or high-profile incident (36%). Almost a third of the respondents did not have set practices for data review.

Question #9 asks about the organization's practices for reviewing bicycle-vehicle collision data. Respondents could select multiple answers. The most popular practices for reviewing bike-vehicle data were: in response to citizen requests (44%), with projects and/or other studies (40%), and after a fatality or high-profile incident (37%). Almost a third of the respondents did not have set practices for data review.

Speed Limits and Surveys Questions

Question #10 asks about the organization's policy/practice for reviewing speed limits. Respondents could select multiple answers. 67% of respondents review speed limits in response to community concerns, 66% follow state requirements for speed limits, and 33% review in response to frequent collisions.



Pedestrian and Bicycle Control Devices Questions

Question #11 asks if the organization maintains an inventory of pedestrian facilities (including signs, markings, traffic signals, and existing sidewalks). Fifty-two percent only have a partial inventory of major locations or areas, 27% do not have any inventory of pedestrian facilities, and 21% maintain a complete inventory. Of the organizations who maintain a complete inventory, 77% update it routinely while 23% only update as hard copy drawings get converted to digital files.

Question #12 asks what format the inventory of pedestrian facilities is stored. Answers were roughly evenly distributed amongst all options: GIS shapefiles (17%), digital format but not GIS (17%), hard format (paper drawings, and/or tables) but is gradually being converted to digital format (18%), hard format and not currently converting to digital (15%), and not applicable (32%).

Question #13 asks if the organization maintains an inventory of bicycle facilities (including routes, signs, markings, and traffic signals). Forty-four percent only have a partial inventory of major locations or areas, 20% do not have any pedestrian facilities inventory, and 36% maintain a complete inventory. Of the organizations who maintain a complete inventory, 70% update it routinely while 30% only update as hard copy drawings get converted to digital files.

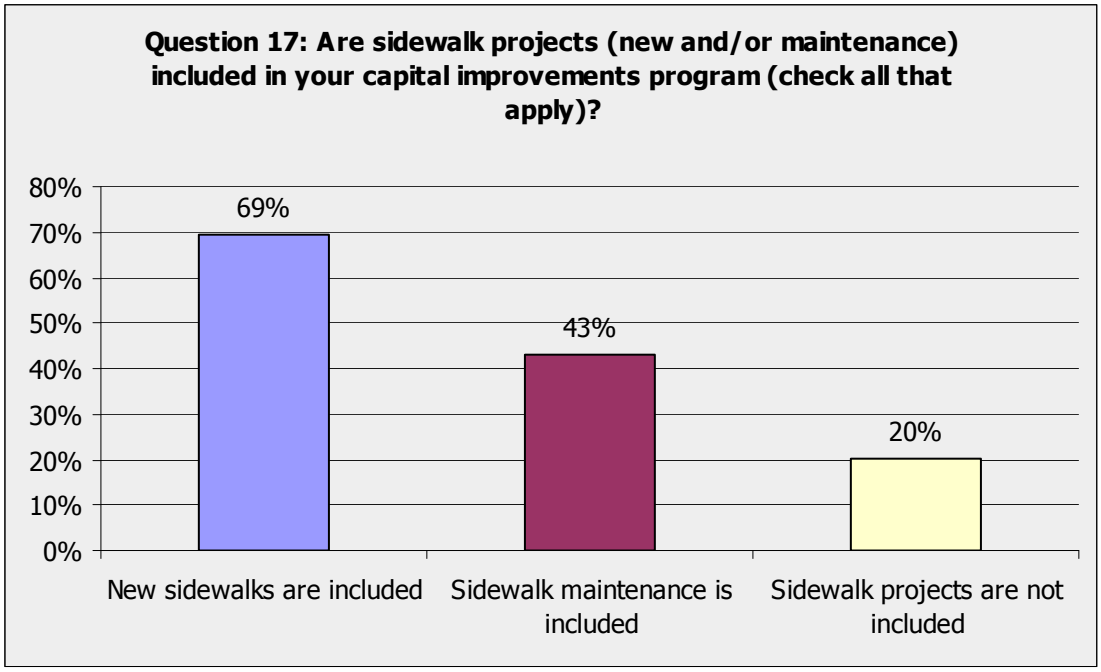
Question #14 asks what format the inventory of bicycle facilities is stored. Almost half of the respondents store in digital format (27% in GIS, 19% other). The remaining responses include: hard format but is gradually converting to digital (17%), hard format and not currently converting to digital (10%), and not applicable (26%).

Question #15 asks respondents if their organization is responsible for operation and maintenance of traffic control devices (signs, signals, and markings designed to regulate, warn, or guide traffic). Eighty-seven percent (90) respondents responded as being responsible for the traffic control devices.

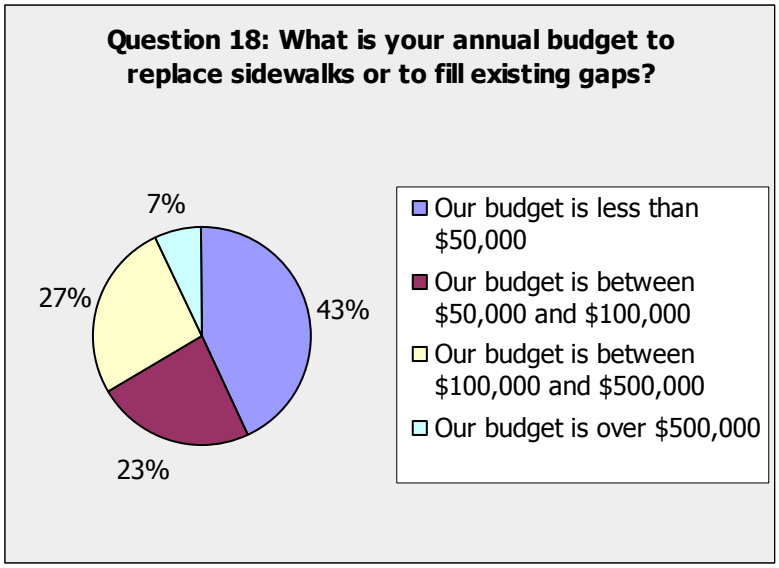
Question #16 asks if the organization conducts regular assessments of jurisdiction's traffic control devices or fix problems reported on an as-needed basis. Forty-nine percent (51) of organizations routinely assess, re-evaluate, upgrade, and maintain traffic control devices. Thirty-nine percent (40) of organizations re-evaluate traffic control devices and fix problems only on an as-needed basis when problems are reported to the organization or in response to complaints or concerns by the public. Two percent (2) organizations re-evaluate traffic control devices and fix problems only when they are included in a larger project. Eleven percent (11) are not applicable.

Bicycle and Pedestrian Facilities Questions

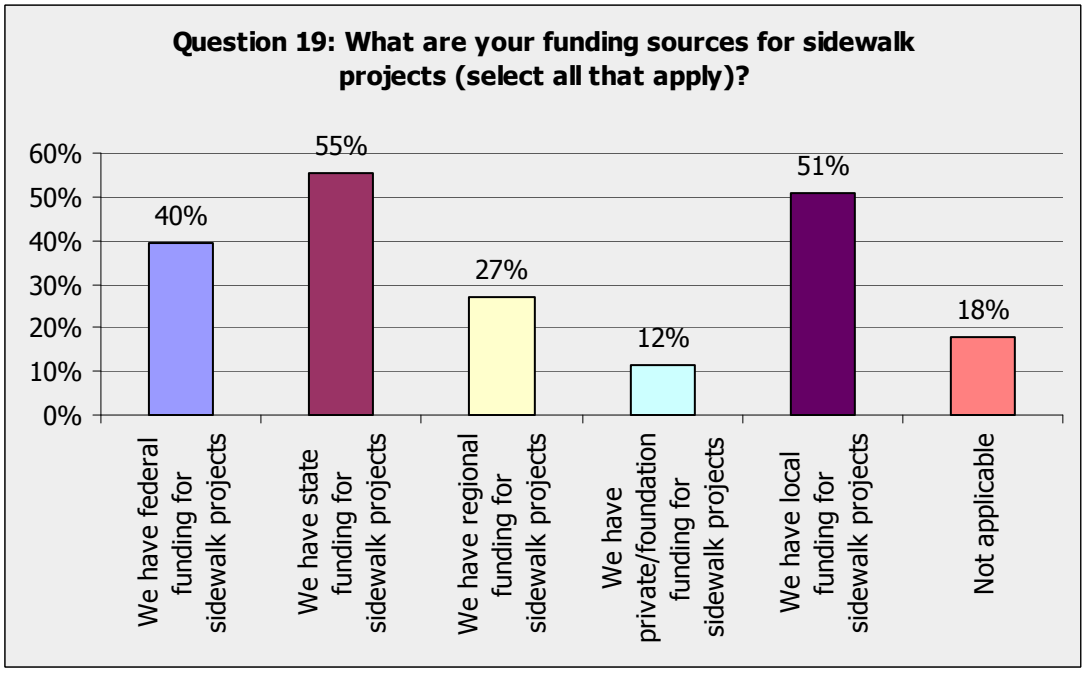
Question #17 asks if sidewalk projects are included in the capital improvement programs. Respondents could select multiple answers. Over two-thirds of respondents have new sidewalks included in their capital improvement programs and almost one-half have sidewalk maintenance.



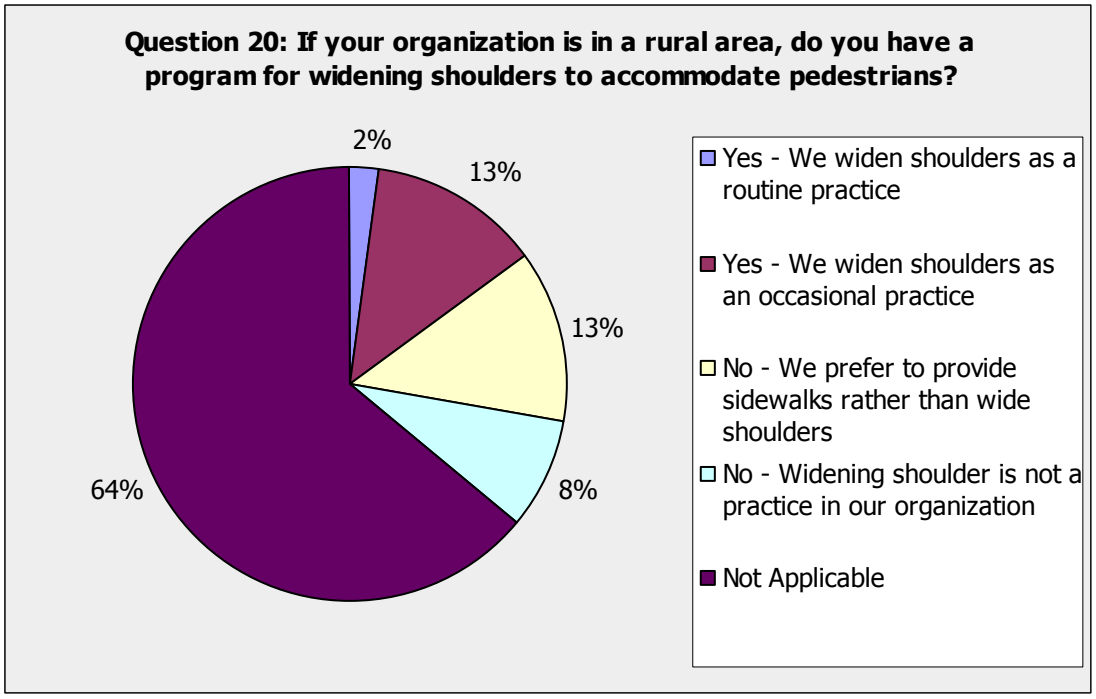
Question #18 asks about the annual budget for replacing sidewalks or filling existing gaps in sidewalks. 66% of respondents have a budget of $100K or less. Forty-three percent have a budget of less than $50K.



Question #19 asks what funding sources are available to the organization for sidewalk projects. Respondents can select multiple answers. A majority of respondents have state and local funding for sidewalk projects. Forty percent have federal funding, 27% have regional funding, and 12% have private/foundation funding.

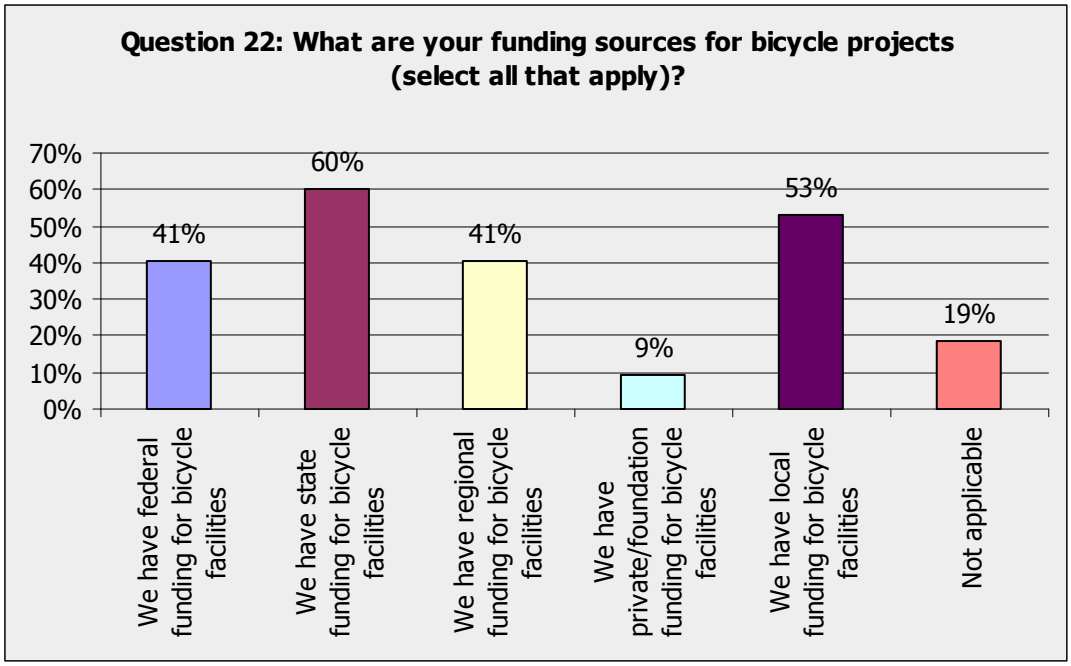


Question #20 asks organizations in rural areas if they have a program for widening shoulders to accommodate pedestrians. Most respondents (64%) widen shoulders as an occasional practice. Only 2% widen shoulders as a routine practice.



Question #21 asks if bicycle facility improvements (new and/or maintenance) are included in capital improvement programs (CIP). Respondents could select multiple answers. Sixty-six percent (65) of respondents have new bicycle facilities in their CIP, 38% (37) had bicycle facility maintenance in their CIP, and 24% had no bicycle facility improvements included in the CIP.

Question #22 asks what funding sources are used for bicycle projects. Multiples answers could be selected. Over 60% of respondents have state funding and 53% have local funding.



Americans with Disabilities Act (ADA) Improvements Questions

Question #23 asks if the organizations' policies and practices bring existing facilities in line with ADA requirements. Multiple answers could be chosen. Eighty-three percent provide ADA upgrades with new projects, 38% have a plan in place to systematically upgrade the facilities to meet ADA requirements, 4% have no regular practices for ADA compliance, and 9% selected "other."

Question #24 asks for the funding sources of ADA improvements. Multiple answers could be selected. Over half of respondents receive local funding. Fourteen percent have no funding for ADA improvements.

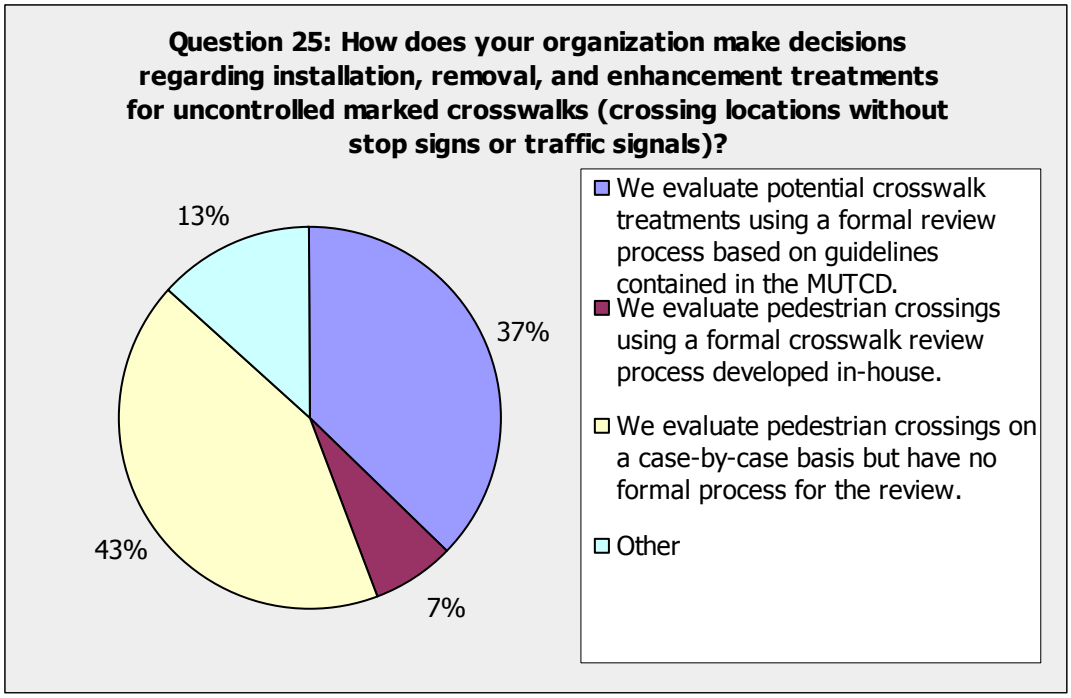
TABLE A-4. QUESTION 24: WHAT ARE YOUR FUNDING SOURCES FOR ADA IMPROVEMENTS (SELECT ALL THAT APPLY)?

Funding Source	Response %	Response Count
Federal funding	46%	45
State funding	50%	48
Regional funding	29%	28
Private/foundation funding	8%	8
Local funding	62%	60
Do not have funding for ADA	14%	14

Other	7%	7
Source: Fehr & Peers, 2009		

Crosswalk Policies Questions

Question #25 asks how decisions are made regarding installation, removal, and enhancement treatments for uncontrolled marked crosswalks. Most organizations do not employ a city-specific, formal policy.



Complete Streets Questions

Question #26 asks if the organization has a policy that calls for planning that specifically addresses walking and bicycling needs on the same footing as transit and driving needs. Sixty-nine percent of respondents do not. Thirty-one percent have such a policy, and over 40% of those come from their general plan.

Pedestrian Plan Questions

Question #27 asks how sidewalk maintenance projects are funded. Multiples answers could be selected. 49% of respondents say their organization funds all sidewalk maintenance while 33% say property owners must pay for all sidewalk maintenance. Ten percent have a cost sharing program with the property owners and 23% fall under the "other" category.

Question #28 asks how sidewalk capital projects (new installations) are funded in the organization. See Table A-5 for detailed results. In the "other" category, about a third of the responses listed grant funding.

TABLE A-5. QUESTION 28: HOW ARE SIDEWALK CAPITAL PROJECTS (NEW INSTALLATIONS) FUNDED IN YOUR ORGANIZATION? (SELECT ALL THAT APPLY)

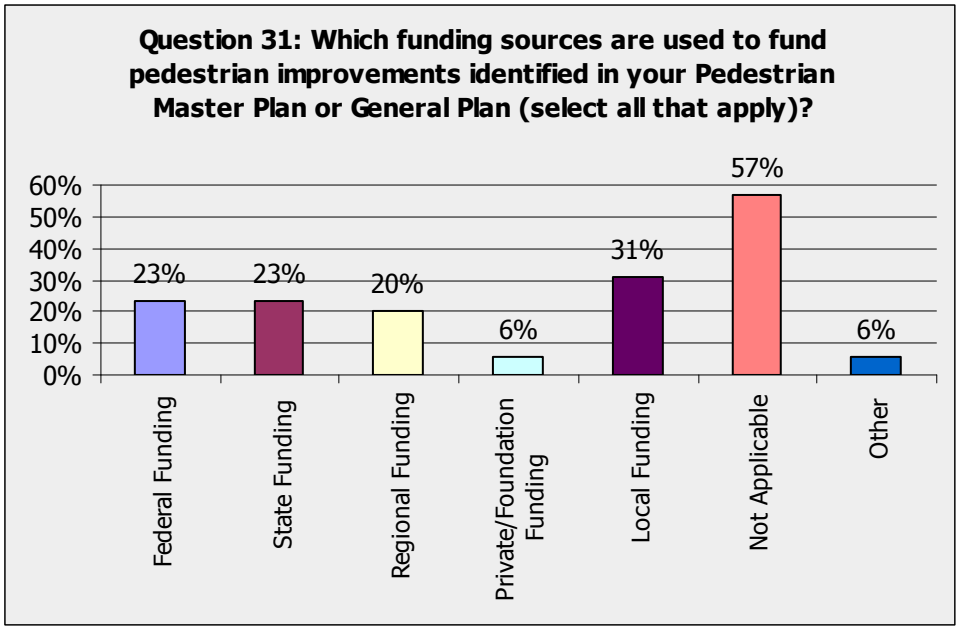
Funding Source	Response %	Response Count
Property owners must install sidewalks and must pay for the installation for new development	62%	57
Property owners must install sidewalks and must pay for the installation with existing properties when building permits are requested	42%	39
Property owners may install sidewalks and must pay for the installation	35%	32
Our organization installs sidewalks on all new streets	25%	23
Our organization pays for sidewalk installations to fill in missing gaps	47%	43
We have a cost sharing program with property owners for sidewalk installations	4%	4
Other	27%	25

Source: Fehr & Peers, 2009

Question #29 asks if the General Plan includes policies for pedestrian facilities and accommodation. Thirty-three percent of respondent's General Plan include a significant pedestrian focus, 61% include a brief discussion of pedestrian issues and needs, and 7% do not have a pedestrian focus.

Question #30 asks whether the organization has a Pedestrian Master Plan. Only 22% of respondents had a Pedestrian Master Plan, and of those, 76% had been updated in the past five years. Twenty-five out the 119 total respondents skipped this question.

Question #31 asks which funding sources are used for pedestrian improvements identified in the Pedestrian Master Plan or General Plan. Funding came mainly from local sources (31%). Federal (23%), State (23%), and Regional (20%) funding was also significant. Twenty-nine out the 119 total respondents skipped this question.

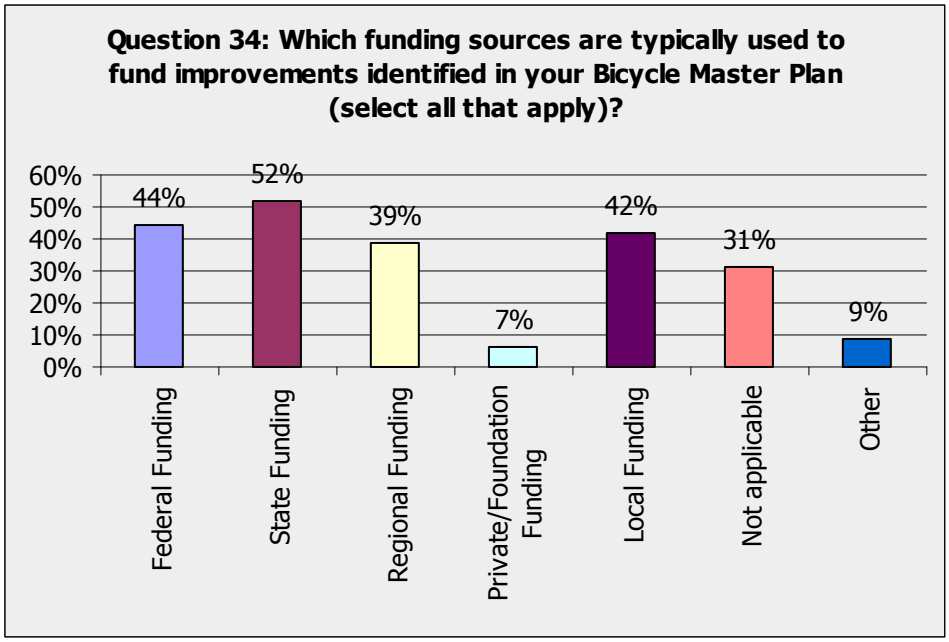


Bicycle Plan Questions

Question #32 asks whether the organization's General Plan includes policies and practices for accommodating bicycles. Bicycles are a significant focus in the Plan for 58% of respondents, only briefly addressed in the Plan for 36%, and not a focus of the General Plan for the remaining 7%. Twenty-six out the 119 total respondents skipped this question.

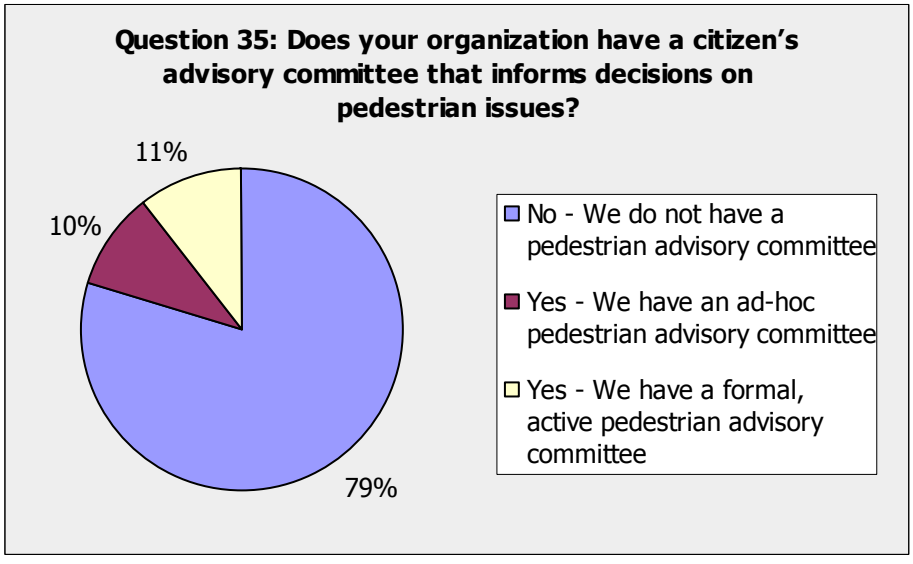
Question #33 asks if the organization has a Bicycle Master Plan. Seventy percent of respondents have a Bicycle Master Plan. 72% of these Bicycle Master Plans have been updated within the past 5 years. Twenty-five out the 119 total respondents skipped this question.

Question #34 asks which funding sources are used for improvements identified in the Bicycle Master Plan. Funding mainly came from State (52%), Federal (44%), Local (42%), and Regional (39%) sources.



Public Involvement Questions

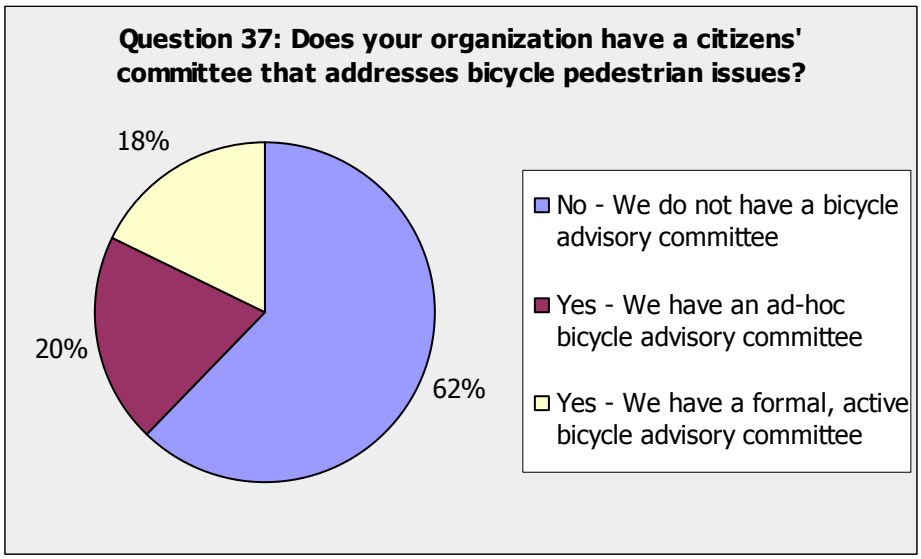
Question #35 asks if the organization has a citizen's advisory committee to address pedestrian issues. Only 21% of respondents have some sort of advisory committee. Of those, only about 50% are formal committees. Twenty-five out the 119 total respondents skipped this question.



Question #36 asks the respondents for the name of their pedestrian advisory committee, roles, responsibilities, and limitations of this committee. Most of the responses were brief and included one-sentence descriptions. One respondent from Daly City wrote, "The committee's primary function is to

provide vision and recommendation regarding bicycle and pedestrian activities in Daly City. Members review and comment on the design of Capital Improvement Program projects, street improvements and traffic signal projects insofar as they related to pedestrian and bicycle safety."

Question #37 asks if the organization has a citizen's committee to address bicycle pedestrian issues. Only 38% of respondents have some sort of advisory committee. Of those, only about 50% are formal committees.



Question #38 asks the respondents for the name of their bicycle advisory committee, roles, responsibilities, and limitations of this committee. Most of the responses were brief and included one-sentence descriptions. One respondent from Thousand Oaks wrote, "The committee is called the BAT - the Bicycle Advisory Team - generally the BAT meets 4 times a year to review current issues and provide input to City projects. The BAT consists of local bicycle riders -who feel they [are] limited since the group does not have any real advisory "power"."

Question #39 asks the respondents if their agency had any other pedestrian or bicycle public involvement programs. A variety of programs were listed, including: Bike and Pedestrian Safety Task Force, Disability Advisory Commission, Safe Routes to Schools, Bike to Work or School Day, Bicycle/Pedestrian Plan Wiki to allow for public comment, School Safety presentations, and Traffic Safety Advisory Committee.

Safe Routes to School Program Questions

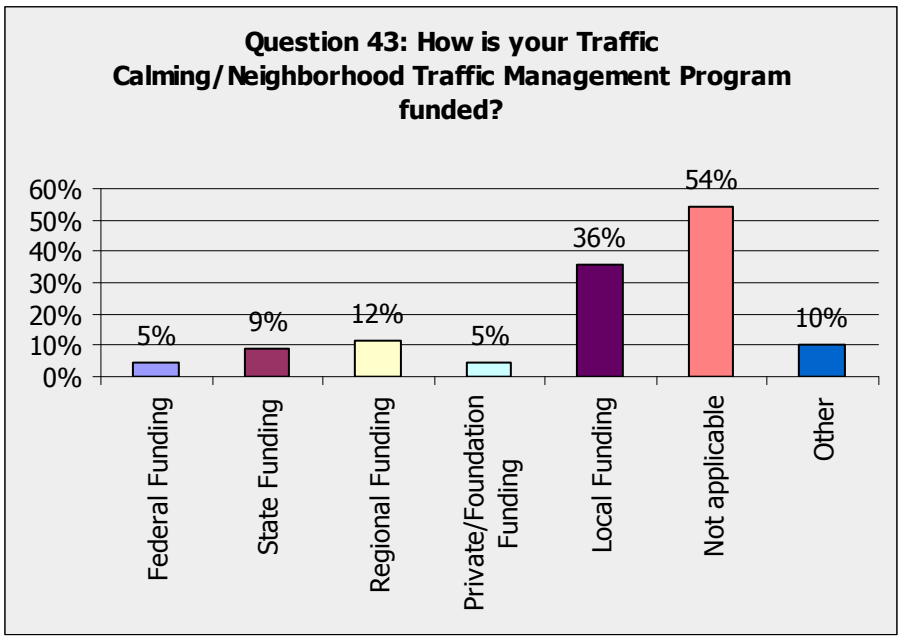
Question #40 asks if the organization has a department or staff person dedicated to traffic safety around schools. Multiple answers could be selected. Twenty percent (19) have a school safety program, 13% (12) have a school safety coordinator, and 72% (68) do not have a department or staff person.

Question #41 asks if any other organizations within the respondent's jurisdiction organizes and/or funds Safe Routes to School Programs and if so, to provide the name of the organization. Forty percent said there were other organizations supporting Safe Routes to School. Some of the organizations listed include: school districts, public works department, police department, Caltrans, local public health agency, the city, and citizens committee.

Traffic Calming Programs Questions

Question #42 asks if there is a traffic calming/ neighborhood traffic management program. Forty-eight percent (46) of respondents say there is such a program. 35% (16) of these programs have a dedicated funding source. 52% (49) do not have a traffic calming/ neighborhood traffic management program.

Question #43 asks how these traffic calming/ neighborhood traffic management programs are funded. They are mainly funded from local sources (36%). Regional (12%), State (9%), Federal (5%), and Private/Foundation (5%) also provide some funding.



Climate Change and Energy Questions

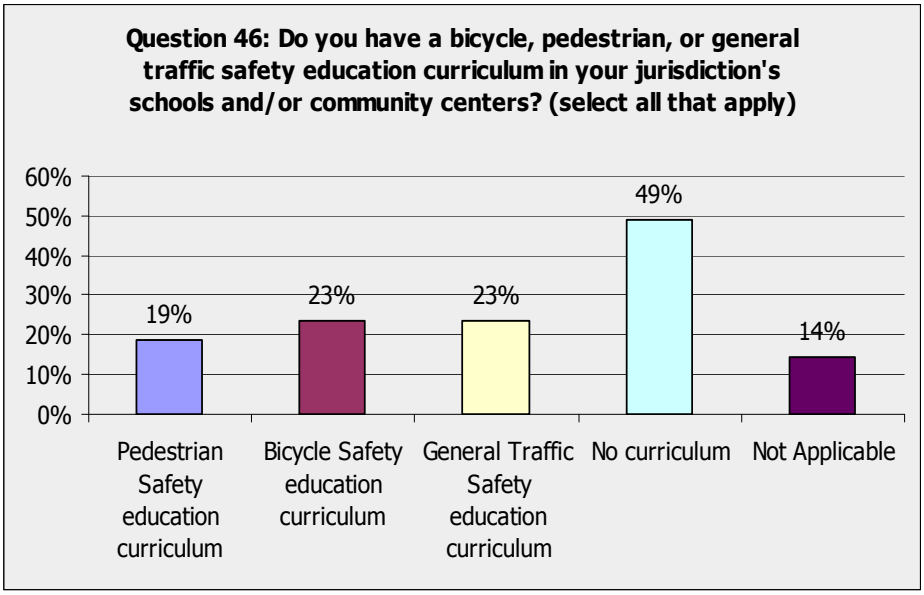
Question #44 asks whether the organization has a Climate Action Plan. A large majority of respondents (67%) do not have a Climate Action Plan. 21% have a Plan, while 12% are currently developing a Climate Action Plan. Sixty-one out the 119 total respondents skipped this question; however, the survey did not direct all respondents to this question due to a question logic error in the first few days of the survey.

Question #45 asks which practices/policies are used in considering the climate impact of transportation. Multiple answers could be selected. The most popular practices are zoning or policies encouraging mixed-use development (73%), zoning or policies encouraging transit-oriented development (61%), and trip generation and impact analysis policies that incorporate "internalized" trips (51%). The least used practice is having parking maximum limits instead of parking minimum requirements (5%).

TABLE A-6. QUESTION 45: IN CONSIDERING THE CLIMATE IMPACT OF TRANSPORTATION, WHICH OF THE FOLLOWING PRACTICES/POLICIES APPLY TO YOUR ORGANIZATION? (SELECT ALL THAT APPLY)		
Practices/Policies	**Response %**	**Response Count**
We have multi-modal level of service standards	17%	7
We have greenhouse gas emission inventory and tracking requirements	20%	8
We have zoning or policies encouraging transit-oriented development	61%	25
We have zoning or policies encouraging mixed-use development	73%	30
We have parking maximum limits instead of parking minimum requirements	5%	2
We have bicycle parking requirements	34%	14
We have trip generation and impact analysis policies that incorporate "internalized" trips	51%	21
Other related policy/practice	10%	4
Source: Fehr & Peers, 2009		

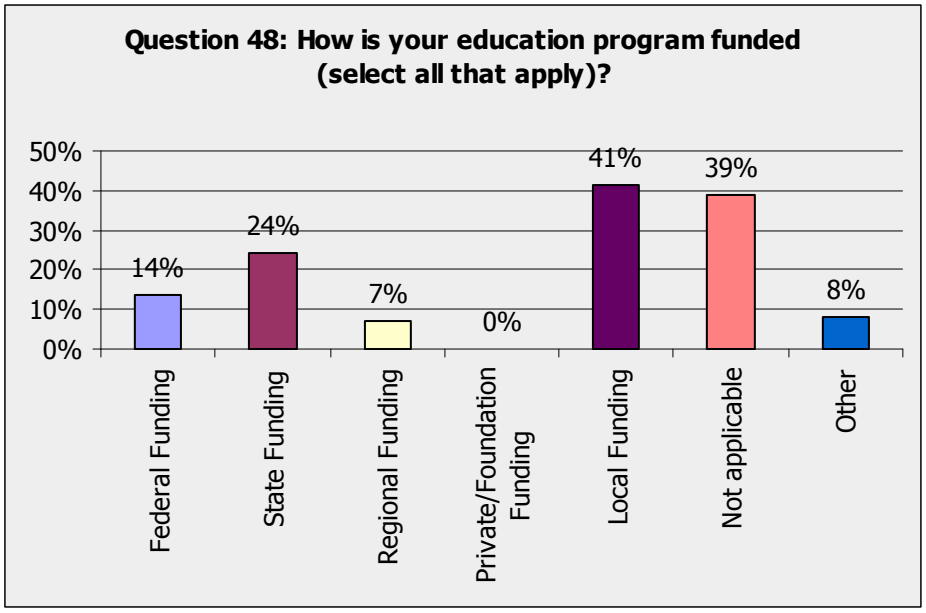
Education Programs Questions

Question #46 asks if there are bicycle, pedestrian, or general traffic safety education curriculum in the jurisdiction's schools and/or community centers. Multiple responses could be selected. Almost half (49%) of the respondents have no such curriculum. Nineteen percent have pedestrian safety curriculum, 23% have bicycle safety curriculum, and 23% have general traffic safety curriculum.



Question #47 asks if there are any other education programs offered in the respondent's jurisdiction (regarding bicycle, pedestrian, or general traffic safety education). Multiple responses could be selected. Seventy-one percent of respondents have police officers visiting classrooms, 39% distribute safety brochures, 24% conduct educational campaigns, and 30% selected "other". Other responses included: media outreach campaigns, newsletters, bicycle redoes, helmet giveaways, safe cycling demonstrations, and tabling at community events.

Question #48 asks how the education programs are funded. Multiple answers could be selected. Local funding was the largest source at 41%, followed by State (24%), Federal (14%), and Regional (7%) funding.



Funding Questions

Question #49-60 ask respondents if they have applied to various funding sources (listed in table below). A follow-up question for each funding source asks if the respondent was successful in receiving the funding. California and Federal Safe Routes to Schools were the most popular funding sources to apply for, 82% and 59% respectively. These funding sources also had relatively high success rates for those who applied, 77% for California and 68% for Federal. Office of Traffic Safety funding had the highest success rate (89%).

TABLE A-7. FUNDING QUESTIONS

Question #	Funding Source	Have you applied for…?			If you have applied, did you receive funding?				Success Rate
		Yes	No	Skipped	Yes	No	N/A	Skipped	
49, 50	HSIP (Highway Safety Improvement Program)	44 (49%)	46 (51%)	29	26 (34%)	18 (23%)	33 (43%)	42	59%
51, 52	OTS (Office of Traffic Safety)	54 (61%)	34 (39%)	31	48 (59%)	7 (9%)	26 (32%)	38	89%
53, 54	California Safe Routes to Schools	74 (82%)	16 (18%)	29	57 (65%)	18 (21%)	13 (15%)	31	77%
55, 56	Federal Safe Routes to Schools	59 (66%)	31 (34%)	29	40 (48%)	20 (24%)	24 (28%)	35	68%

57, 58	Regional Technical Assistance Programs	11 (13%)	77 (88%)	31	9 (13%)	5 (7%)	58 (81%)	47	82%
59, 60	Bicycle Transportation Account (BTA)	45 (51%)	43 (49%)	31	30 (38%)	14 (18%)	36 (45%)	39	67%

Source: Fehr & Peers, 2009

Question #61 asks respondents what other bicycle and/or pedestrian funding they have received (not already covered in prior questions). Fifty-two percent did not receive funding. Of those that did receive funding, many came from TDA (Transportation Development Act), TEA (Transportation Equity Act), CMAQ (Congestion Mitigation and Air Quality), and AQMD (Air Quality Management Districts).

Question #62 asked respondents why they have not applied to the above mentioned funding sources (if they have not). The most common reasons were limited staff availability (61%), not aware of program (39%), and local matching grants required (33%). Competition and minimum criteria requirements were a couple of the reasons the respondents listed in the "other" category.

TABLE A-7. QUESTION 62: IF YOU HAVE NOT APPLIED FOR ONE OR MORE OF THE ABOVE FUNDING SOURCES, WHY HAVE YOU NOT APPLIED? (SELECT ANY/ALL THAT APPLY)

Reasons	Response %	Response Count
We have limited staff availability	61%	37
We have sufficient funding	2%	1
Local matching grants are required	33%	20
We would require technical assistance for the application	18%	11
We were not aware of the program	39%	24
The process is arduous	30%	18
Pedestrian and bicycle programs rarely receive funding	12%	7
We do not have the required Master Plan in place	25%	15
Other	23%	14

Source: Fehr & Peers, 2009

Question #63 asks the respondents what sort of hurdles they experienced when applying for funding for bicycle and/or pedestrian projects. This question was a short-answer response. Of those that did respond, there were a few common hurdles experienced (those responses that repeated reasons from Question #62 were ignored).

TABLE A-8. QUESTION 63: WHAT, IF ANY, HURDLES HAVE YOU EXPERIENCED WHEN APPLYING FOR

FUNDING FOR BICYCLE AND/OR PEDESTRIAN PROJECTS?	
Categories of Common Responses	**Response Count**
Competition	7
Funding money too small, limited	7
Favoring of urban areas, ped/bike volumes too low	5
Strict requirements	4
Right-of-Way issues, required implementation schedule too short	3
Don't have traffic data	2
Lack of advanced notice of funding availability, application period too short	2
Source: Fehr & Peers, 2009	

Pedestrian/Bicycle Budget Questions

Question #64 asks for the annual budget for pedestrian projects. This question was a short-answer response. A large percentage (23%) of respondents have no budget for pedestrian projects.

TABLE A-9. QUESTION 64: WHAT IS YOUR ORGANIZATION'S ANNUAL BUDGET FOR PEDESTRIAN PROJECTS?

	Categories of Responses							
	NA	**$0**	**Depends**	**<$50K**	**<$100K**	**<$500K**	**<$1M**	**$1M+**
Response Count	5	16	11	9	12	8	5	4
Response %	7%	23%	16%	13%	17%	11%	7%	6%

Fehr & Peers, 2009

Question #65 asks for the percentage of the transportation budget that the pedestrian budget represents. This question was a short-answer response.

TABLE A-10. QUESTION #65: WHAT PERCENTAGE OF YOUR TRANSPORTATION BUDGET DOES YOUR

PEDESTRIAN BUDGET REPRESENT?							
	Categories of Responses						
	NA	0	varies	"very small"	<1%	<5%	>=5%
Response Count	3	13	9	1	7	15	11
Response %	5%	22%	15%	2%	12%	25%	19%
Fehr & Peers, 2009							

Question #66 asks for the annual budget for bicycle projects. This question was a short-answer response. A large percentage (26%) of respondents have no budget for bicycle projects.

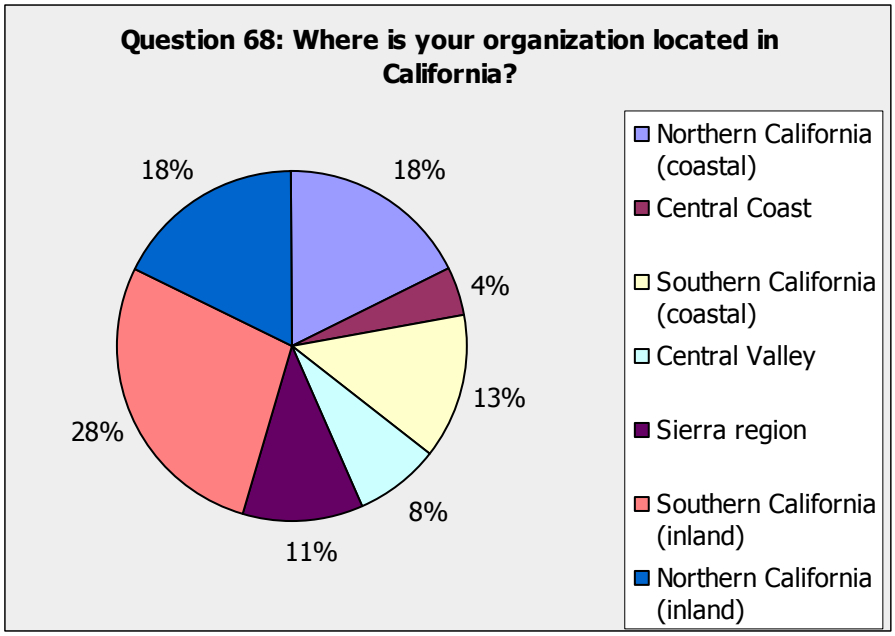
TABLE A-11. QUESTION 66: WHAT IS YOUR ORGANIZATION'S ANNUAL BUDGET FOR BICYCLE PROJECTS?								
	Categories of Responses							
	NA	$0	Depends	<$50K	<$100K	<$500K	<$1M	$1M+
Response Count	3	18	15	10	6	8	1	7
Response %	4%	26%	22%	15%	9%	12%	1%	10%
Fehr & Peers, 2009								

Question #67 asks for the percentage of the transportation budget that the bicycle budget represents. This question was a short-answer response.

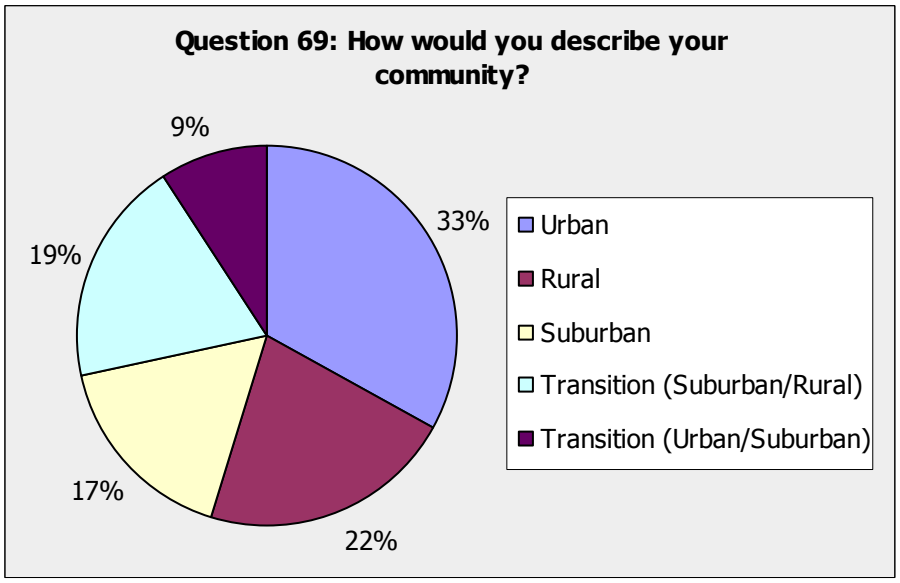
TABLE A-12. QUESTION 67: WHAT PERCENTAGE OF YOUR TRANSPORTATION BUDGET DOES YOUR BICYCLE BUDGET REPRESENT?						
	Categories of Responses					
	NA	$0	Varies	<1%	<5%	>=5%
Response Count	5	12	12	0	8	9
Response %	8%	20%	20%	0%	13%	15%
Fehr & Peers, 2009						

Organization Information Questions

Question #68 asks for the location of the organization. The largest percentage of respondents represent the Southern California – inland region (28%). Lowest representation (4%) came from the Sierra region.



Question #69 asks respondents to describe their community. Urban communities were the largest group (33%), followed by rural communities (22%).



Question #70 asks respondents how many residents live in their jurisdiction. This was a short-answer response. Sixty percent of respondents had jurisdictions with population of 50,000 or more.

TABLE A-13. QUESTION 70: HOW MANY RESIDENTS LIVE IN YOUR JURISDICTION?		
Categories of Responses	**Response Count**	**Response %**
<2,500	2	2%
2,500 - 10K	4	5%
10K - 50K	28	33%
50K - 1M	44	51%
1M+	8	9%
Source: Fehr & Peers, 2009		

Question #71 asks respondents to rate how important various issues are to the residents of their jurisdiction. Respondents could rate each issue from "not very important to residents" to "very important to residents". Economic vitality, public health and pedestrian facilities were rated as the most important issues to residents. Bicycle support facilities had the lowest rating, with 39% of respondents putting it as "not very important".

TABLE A-14. QUESTION 71: HOW IMPORTANT WOULD YOU ESTIMATE THE FOLLOWING ISSUES ARE TO RESIDENTS IN YOUR JURISDICTION?				
Issue	**Not very important**	**Moderately important**	**Important**	**Very Important**
Pedestrian facilities (sidewalks, crosswalks, etc.)	6%	31%	**43%**	20%
Pedestrian safety	1%	20%	**40%**	38%
Walkability	8%	**39%**	38%	15%
Economic vitality	3%	12%	38%	**47%**
Bicycle facilities	7%	**49%**	33%	11%
Bicycle safety	2%	34%	**37%**	27%
Bicycle support facilities (parking, showers, etc.)	**39%**	38%	17%	6%
Sustainable development	6%	**43%**	36%	15%
Transit options	13%	**39%**	34%	15%
Climate Change/ Energy	19%	**40%**	27%	13%
Public Health	9%	25%	**43%**	23%
Source: Fehr & Peers, 2009				

APPENDIX B:
CALTRANS DISTRICT SURVEY RESULTS

OPEN-ENDED REPONSES ARE AVAILABLE ONLINE AT

HTTP://WWW.SURVEYMONKEY.COM/SR.ASPX?SM=MVUEGCZYA_2FOOEIUUGFKZLDO0NQ_2FK9SOEMZON8FFOGNG_3D

APPENDIX C:
INTERVIEW SUMMARIES

Eight phone interviews were conducted with local agency survey respondents to further explore topics from the electronic survey as well as discuss concerns and opportunities in general. The discussions largely focused on funding and technical assistance needs. Comments regarding these themes are included below.

How successful has your agency been in receiving grant funding for pedestrian and bicycle projects?

- We have been able to get considerable grant funding for major roadway projects and have incorporated bike/ped projects into that. i.e. trail crossing over a highway.
- Grant funding – did not receive Bicycle Transportation Account (BTA) funding or state Safe Routes to School (SR2S) funding. Seems like a huge resource and funding source but so difficult to get funding. So much competition. Has the sense that larger agencies get awarded most of the money.
- Just updated their bike plan and pedestrian master plans so they can be more competitive for such funding. Not sure whether having Caltrans help with grant writing would help. Seems like to takes forever to hear back from SR2S grant applications. Communication was just lost. Same with BTA grant cycles – go through months without even knowing. Updates and communication would be helpful.
- We pursue two basic funding sources:
    - 821 through RCDC, prepared in-house and received 3 out of 4.
    - SR2S grant: bring in a consultant that specializes in those to prepare application and diagrams, received 4 out of 6.
- Just applied for BTA funds last year, again still waiting to hear back. All the initial contact has been made on the part of the city. They have been very responsive though. Applications are pretty easy to do, streamlined process, most info on the web.
- Just got rejected for the latest SR2S application. Had success for two to three cycles, also with safe routes to school on the federal level. Rejected app had countdown signals, sidewalk improvements.
- Pedestrian/sidewalk budget come from Community Development Block Grants, Measure I: sales tax revenue for regional improvements and surface improvements, also matched through development fees.
- Currently working on a Rails to Trails project: Pacific Electric Trail, 21-mile trail from Claremont to Rialto. Finalizing design, trying to get funds. Applied for SR2S and TDA funds, did not get SR2S grant, still waiting to hear on TDA funds.
- For pedestrian funding we usually go through the local MPO for a call for projects
- Limited funds to cities without a Bicycle Master Plan (BMP) in place. So now we're updating our BMP so we can apply for projects to pursue TDA money.
- SR2S grant application recently turned down, but did receive one a few years ago. We were steered in the wrong direction by Caltrans about what type of project would be funded.

- Safety related grant HSIP: has been successful with that.
- San Diego County did not get too much SR2S funding
- Having trouble obtaining funding. We don't have resources, don't have a grant writer that is experienced, knows ped/bike issues. Was rejected on a technicality on SR2S application. Don't have the resources to develop a BMP. A lot of things the grants call for are not feasible for a city the size of ours.
- Have put bike facilities in with other projects, such as new roads. Capital Improvement projects are the only way we've been able to implement.
- Frustrating trying to get TDA funding through the County. Requires a housing element and smart growth targets to get ped/bike funding from SANDAG.
- Now updating Circulation Element. Bike and pedestrian master plans are part of that process. Have a very strong bicycle advisory committee. They pursued the bike-friendly status award.
- Really beefing up education and encouragement efforts, including 30 new bike racks. But it all takes money, so hard to find it. Losing staff with budget constraints.
- Also have a roadway fee associated with new construction that's been hit hard by economic downturn.
- Capital Improvement Project program has about $100K per year for small projects.
- We are just about to update their BMP (last was in 2004).
- Didn't get one grant proposal for a project that went through a neighborhood and went down a residential collector. Probably because it wasn't on a major road.
- We are still waiting to hear back from the state about our SR2S application.
- About a third of our projects are trail related. Have a couple of active trail projects. Private development is required to build trails.
- Local funds spent on development of projects, and then funds to pay for design, environmental clearance construction.
- SR2S grant received in 2007. Truckee has such a short construction window that they needed to move forward before they had the money in grant, so they used other sources to fund one segment and then SR2S grant for the second section. Time lapse for funding cycles is a challenge to move forward during construction window. Approval time takes so long.
- Pedestrian projects—some funded by redevelopment funds, the rest gets built by private development.
- Haven't applied for BTA funds for a while, have applied community-based planning grants. Transportation Planning Grant Funding Program: application repetitive, poorly written, unclear what the criteria was.
- Bike lanes are striped whenever roadways are widened.

How can Caltrans support your pedestrian and bicycle safety improvement efforts?

- We have not focused on grant funding for smaller level projects, because sometimes it is onerous to do all the paperwork. We have found that smaller projects like restriping or small trail connection gap closure are difficult to fund. Amount of staff time to do all the leg work makes it infeasible. Finding a local source or allocating capital improvements funds – local sales tax and gas tax has been easier. Local revenue has been able to fill that gap.

- A few years ago there was a bike/pedestrian conference in the Sacramento area and Caltrans was a sponsor. A context sensitive design group put the event on. Seemed ironic that Caltrans was sponsoring a bike/pedestrian conference, because we often hit a wall with them on a technical level. It is frustrating that these ideas don't filter down to the technical staff level. I.e. when a bike project goes across a Caltrans state right-of-way, that bike project is often limited because technical staff from Caltrans aren't always open to it. Or maybe a sign doesn't meet MUTCD CA standards etc. Could there be lee-way to allow discretion from local partner to loosen Caltrans requirements?

- When you talk to their engineers one-on-one in meetings they seem to understand these issues. Good dialogue happens, and then whenever you meet with Caltrans there are 5-8 staff from all different disciplines, but never seems to include the person who can make the decision! So they're saying yes and are sympathetic, and then receive a letter/list of reasons project doesn't meet criteria, design exceptions etc… This pattern repeats all the time. Talk for an hour and then they say they'll get back to you.

- Wants to see more funding for bike/ped programs and make it competitive for smaller agencies.

- RCDC gives a lot of technical support for grants, so Caltrans wouldn't need to do this. However, competition for Caltrans grants is so tight. Population criteria puts us at a disadvantage for Caltrans funding.

- Takes quite a long time to get permits, feedback and issues resolved for Caltrans ROW issues. Caltrans depts. are very compartmentalized, takes a long time to find the right person to talk to and get permission from. Any given project should only have one Caltrans engineer to deal with.

- Main problem is the funding. The last grant cycle for SR2S out of 450+ applications Caltrans approved just 156. Very competitive.

- We don't have a traffic calming program or climate action plan. Traffic engineering is going to do more traffic calming on a case by case basis. Would like to become more preemptive on traffic calming efforts.

- Caltrans does a pretty good job in SoCal. Local assistance staff comes to SANDAG meetings related to bike/ped projects. SANDAG also has a bike/ped working group.

- Can Caltrans steer additional funding towards bike/ped projects?

- Caltrans local assistance office is not always that easy to get assistance from. Often haven't returned phone calls, don't return emails. This is frustrating. Very poor communication, not so friendly.

- We would like more funding. Are the requirements realistic for a small city to fulfill? We would like an easier application process for a smaller city.

- There is a lot of red tape with Caltrans, takes a while to figure out how all it works. After recovery money came out the District 3 local assistance office had classes on how to manage a federally funded project. Institute of Traffic Studies by UC Berkeley put it on for Caltrans. Very helpful training classes (5 in total.)

- Feel like I'm bugging people at Caltrans – is there a better way to check on projects – can it be posted on the web? The BTA website is so static – they put two sentences on the site about the status of projects.

- Regarding Caltrans right-of-way, sometimes it's easier to say "let's cut the project at the Caltrans ROW line so we don't have to delve into a slow bureaucratic process."

- Local Caltrans agency has been very cooperative on local projects. Agency has a local bike/pedestrian coordinator. City of San Diego has a full-time Caltrans liaison who helps with communication. That person has also been closely involved with ped/bike projects and has been able to advocate for such projects.

- We'd like to see more education for Caltrans staff to shift the paradigm towards a more multimodal understanding. We're already seeing the shift. It depends on the Caltrans staff you're dealing with.

- The grants program really needs to become more flexible, more streamlined. It's so bureaucratic, it takes so long. Something should be done to make it smoother and easier. So time consuming, sometimes it's not even cost-effective if you're going for a small-sized grant. i.e. gathering support letters, getting photos etc. for SR2S apps. Is the pay-back worth it? Not getting a lot for what we've put in.

- Our engineers are really skiddish about trying innovative methods that have not been blessed by Caltrans – prevents innovation.

- Many of our bike pedestrian projects were included in federal stimulus projects, i.e. for accessibility improvements, and for the San Diego Rose Creek Bridge. Our ADA access projects were a shovel-ready.

How do you review and analyze collision data?

- Use Crossroads for looking at collision data, intern enters them into a database. Fairly up to date.

- Use Crossroads software to review collisions.

- Use Crossroads

- We do not look at collisions regularly, maybe if we get a complaint, or if it's required for a grant application, or community concern for a location.

- San Diego uses the TCRS system for collision analysis – designed in house with support from the Office of Traffic Safety. It has capabilities for creating collision diagrams. However, it's 15 year-old software, so we are looking for more up to date software that works with GIS.

APPENDIX D:
BENCHMARKING METRIC

Appendix I: The Road to Great Walking and Bicycling Communities: Resources for Pedestrian & Bicycle Safety Programs

Local Agency Benchmarking

	survey percentages			adjusted percentages (total = 1)				
	Key Strength	Enhancement	Opportunity		Key Strength	Enhancement	Opportunity	MAX
	both ped and bike coordinator	one or the other, consultant	nothing	Benchmark	both ped and bike coordinator	one or the other, consultant	nothing	0%
Do you have a full time Bicycle/Pedestrian Coordinator(s) on staff?	6.3	37.6	56.3	Opportunity	6%	38%	56%	56%
	routinely	occasionally	never		routinely	occasionally	never	0%
Does your organization collect pedestrian volume data (select all that apply)?	10.6	37.7	51.8	Opportunity	11%	38%	52%	52%
Does your organization collect bicycle volume data (select all that apply)?	12.5	34.8	51.8	Opportunity	13%	35%	52%	52%
	proactive	reactive	no set practices		proactive	reactive	no set practices	0%
What are your organization's practices for reviewing pedestrian-vehicle collision data? (Select all that apply)	45	116.5	33	Enhancement	23%	60%	17%	60%
What are your organization's practices for reviewing bicycle-vehicle collision data? (Select all that apply)	47.2	121.2	31.5	Enhancement	24%	61%	16%	61%
	proactive	reactive	state requirements		proactive	reactive	state requirements	0%
What is your organization's policy/practice for reviewing speed limits (select all that apply)?	5.7	100	66	Enhancement	3%	58%	38%	58%
	complete	partial	none		complete	partial	none	0%
Does your organization have and maintain an inventory of pedestrian facilities (including signs, markings, traffic signals, and existing sidewalks)?	21.4	51.5	27.2	Enhancement	21%	51%	27%	51%
Does your organization have and maintain an inventory of bicycle facilities (including routes, signs, markings, and traffic signals)?	35.9	43.7	20.4	Enhancement	36%	44%	20%	44%
	routinely	occasionally			routinely	occasionally	0%	0%
Does your organization conduct regular assessments of your jurisdiction's traffic control devices or fix problems reported only on an as-needed basis?	49	40.4		Key Strength	55%	45%	0%	55%
	new	maintenance	no funding		new	maintenance	no funding	0%
Are sidewalk projects (new and/or maintenance) included in your capital improvements program (check all that apply)?	69.4	42.9	20.4	Key Strength	52%	32%	15%	52%
Are bicycle facility improvements (new and/or maintenance) included in your capital improvements program (select all that apply)?	66.3	37.8	24.5	Key Strength	52%	29%	19%	52%
	routinely	occasionally	no		routinely	occasionally	no	0%
If your organization is in a rural area, do you have a program for widening shoulders to accommodate pedestrians?	2.3	12.8	8.1	Enhancement	10%	55%	35%	55%
	systematic upgrades	new projects	no policy		systematic upgrades	new projects	no policy	0%
What are your organization's policies and practices for bringing existing facilities in line with Americans with Disabilities Act (ADA) requirements (select all that apply)?	38	83	4	Enhancement	30%	66%	3%	66%
	City-specific	MUTCD	case-by-case		City-specific	MUTCD	case-by-case	0%
How does your organization make decisions regarding installation, removal, and enhancement treatments for uncontrolled marked crosswalks (crossing locations without stop signs or traffic signals)?	7.2	37.1	42.3	Opportunity	8%	43%	49%	49%
	yes		no		yes		no	0%
Does your organization have a policy that calls for planning that specifically addresses walking and bicycling needs on the same footing as transit and driving needs?	30.9		69.1	Opportunity	31%	0%	69%	69%
	significant	brief	none		significant	brief	none	0%
Does your organization's General Plan include policies for pedestrian facilities and accommodation?	32.6	60.9	6.5	Enhancement	33%	61%	7%	61%
Does your organization's General Plan include policies and practices for accommodating bicycles?	35.5	58.1	6.5	Enhancement	35%	58%	6%	58%
	yes		no		yes		no	0%
Does your organization have a Pedestrian Master Plan?	22.3		77.7	Opportunity	22%	0%	78%	78%
Does your organization have a Bicycle Master Plan?	29.8		70.2	Opportunity	30%	0%	70%	70%
	formal	ad hoc	none		formal	ad hoc	none	0%
Does your organization have a citizen's advisory committee that informs decisions on pedestrian issues?	10.6	9.6	79.8	Opportunity	11%	10%	80%	80%
Does your organization have a citizens' committee that addresses bicycle pedestrian issues?	17.9	20	62.1	Opportunity	18%	20%	62%	62%
	coordinator	program	none		coordinator	program	none	0%
Does your organization have a department or a staff person dedicated to traffic safety around schools (select all that apply)?	12.6	20	71.6	Opportunity	12%	19%	69%	69%
	yes with funding	yes without funding	no		yes with funding	yes without funding	no	0%
Does your organization have a traffic calming/ neighborhood traffic management program?	16.8	31.6	51.6	Opportunity	17%	32%	52%	52%
	ped or bike	general traffic safety	none		ped or bike	general traffic safety	none	0%
Do you have a bicycle, pedestrian, or general traffic safety education curriculum in your jurisdiction's schools and/or community centers? (select all that apply)	41.2	23.3	48.9	Opportunity	36%	21%	43%	43%

Appendix I: The Road to Great Walking and Bicycling Communities: Resources for Pedestrian & Bicycle Safety Programs

Caltrans Staff Survey Benchmarking

	survey percentages			adjusted percentages (total = 1)				
	Key Strength	Enhancement	Opportunity		Key Strength	Enhancement	Opportunity	MAX
	both ped and bike coordinator	one or the other, consultant	nothing	Benchmark	both ped and bike coordinator	one or the other, consultant	nothing	0%
Do you have a full time Bicycle/Pedestrian Coordinator(s) on staff?	18.2	72.7	9.1	Enhancement	18%	73%	9%	73%
	routinely	occasionally	never		routinely	occasionally	never	0%
Does your organization collect pedestrian volume data (select all that apply)?		30	60	Opportunity	0%	33%	67%	67%
Does your organization collect bicycle volume data (select all that apply)?		30	60	Opportunity	0%	33%	67%	67%
	proactive	reactive	no set practices		proactive	reactive	no set practices	0%
What are your organization's practices for reviewing pedestrian-vehicle collision data? (Select all that apply)	20	90	50	Enhancement	13%	56%	31%	56%
What are your organization's practices for reviewing bicycle-vehicle collision data? (Select all that apply)	18.2	81.9	45.5	Enhancement	13%	56%	31%	56%
	proactive	reactive	state requirements		proactive	reactive	state requirements	0%
What is your organization's policy/practice for reviewing speed limits (select all that apply)?	11.1	66.6	11.1	Enhancement	13%	75%	13%	75%
	complete	partial	none		complete	partial	none	0%
Does your organization have and maintain an inventory of pedestrian facilities (including signs, markings, traffic signals, and existing sidewalks)?		44.4	55.6	Opportunity	0%	44%	56%	56%
Does your organization have and maintain an inventory of bicycle facilities (including routes, signs, markings, and traffic signals)?	11.1	55.6	33.3	Enhancement	11%	56%	33%	56%
	routinely	occasionally			routinely	occasionally	0%	0%
Does your organization conduct regular assessments of your jurisdiction's traffic control devices or fix problems reported only on an as-needed basis?	66.7	33.3		Key Strength	67%	33%	0%	67%
	new	maintenance	no funding		new	maintenance	no funding	0%
Are sidewalk projects (new and/or maintenance) included in your capital improvements program (check all that apply)?	71.4		28.6	Key Strength	71%	0%	29%	71%
Are bicycle facility improvements (new and/or maintenance) included in your capital improvements program (select all that apply)?	37.5	12.5	50	Opportunity	38%	13%	50%	50%
	routinely	occasionally	no		routinely	occasionally	no	0%
If your organization is in a rural area, do you have a program for widening shoulders to accommodate pedestrians?	25	62.5		Enhancement	29%	71%	0%	71%
	systematic upgrades	new projects	no policy		systematic upgrades	new projects	no policy	0%
What are your organization's policies and practices for bringing existing facilities in line with Americans with Disabilities Act (ADA) requirements (select all that apply)?	44.4	88.9	11.1	Enhancement	31%	62%	8%	62%
	City-specific	MUTCD	case-by-case		City-specific	MUTCD	case-by-case	0%
How does your organization make decisions regarding installation, removal, and enhancement treatments for uncontrolled marked crosswalks (crossing locations without stop signs or traffic signals)?		50	40	Enhancement	0%	56%	44%	56%
	yes		no		yes		no	0%
Does your organization have a policy that calls for planning that specifically addresses walking and bicycling needs on the same footing as transit and driving needs?	66.7		33	Key Strength	67%	0%	33%	67%
	significant	brief	none		significant	brief	none	0%
Does your organization's General Plan include policies for pedestrian facilities and accommodation?	40	20	40	Opportunity	40%	20%	40%	40%
Does your organization's General Plan include policies and practices for accommodating bicycles?	60		40	Key Strength	60%	0%	40%	60%
	yes		no		yes		no	0%
Does your organization have a Pedestrian Master Plan?			100	Opportunity	0%	0%	100%	100%
Does your organization have a Bicycle Master Plan?	12.5		87.5	Opportunity	13%	0%	88%	88%
	formal	ad hoc	none		formal	ad hoc	none	0%
Does your organization have a citizen's advisory committee that informs decisions on pedestrian issues?	50		50	Opportunity	50%	0%	50%	50%
Does your organization have a citizens' committee that addresses bicycle pedestrian issues?	37.5	12.5	50	Opportunity	38%	13%	50%	50%
	coordinator	program	none		coordinator	program	none	0%
Does your organization have a department or a staff person dedicated to traffic safety around schools (select all that apply)?		28.6	71.4	Opportunity	0%	29%	71%	71%
	yes with funding	yes without funding	no		yes with funding	yes without funding	no	0%
Does your organization have a traffic calming/ neighborhood traffic management program?			100	Opportunity	0%	0%	100%	100%
	ped or bike	general traffic safety	none		ped or bike	general traffic safety	none	0%
Do you have a bicycle, pedestrian, or general traffic safety education curriculum in your jurisdiction's schools and/or community centers? (select all that apply)	37.5	12.5	25	Key Strength	50%	17%	33%	50%

Increasingly, communities throughout California are expressing a desire for safer and more accommodating walking and bicycling infrastructure. To meet this rising demand and to follow the national paradigm shift toward more "Complete Streets," local jurisdictions are developing plans and seeking funds to implement projects to improve conditions for walking and bicycling.

This brochure provides information on resources and technical assistance available to help make these projects a reality.

Look inside for:

Website links for additional resources

Recommended implementation tool or first step

Topics in this brochure include:

- Complete Streets
- Pedestrian & Bicycle Master Plans
- School Safety
- Traffic Calming
- Program, Policy & Practices – Benchmarking
- Collision Analysis
- Speed Management
- Crosswalk Policies
- Pedestrian Safety Action Plans
- Pedestrian Safety Assessments

FUNDING SOURCES

Highway Safety Improvement Program @ fhwa.dot.gov/safetealu

Federal funding from the Transportation Equity Act (SAFETEA-LU).

Office of Traffic Safety @ ots.ca.gov

A state grant funding source for traffic safety.

Safe Routes to School @ saferoutestoschools.org

Federal and state funding that promotes walking and bicycling to school.

Regional Technical Assistance Programs @ dot.ca.gov/hq/tpp

State funding distributed though regional transportation planning agencies.

Bicycle Transportation Account @ dot.ca.gov

Caltrans grant funding for bicycle improvements.

FREE RESOURCES

Traffic Calming @ trafficcalming.org

A practical guide to traffic calming and neighborhood traffic management.

Cool Connections @ coolconnections.org

Information and resources on transportation and land use strategies that promote sustainable solutions to climate change, energy and public health.

SafeTREC @ safetrec.berkeley.edu

The Safe Transportation Research and Education Center provides research, curriculum, training and outreach on transportation safety and travel risk.

Pedestrian Safety Assessments @ techtransfer.berkley.edu/pedsafety

UC Berkeley Tech Transfer provides free Pedestrian Safety Assessments (PSA) to California cities upon request.

Pedestrian Safety Action Plans @ walkinginfo.org

The Federal Highway Administration offers free training and plan development workshops.

Caltrans

FEHR & PEERS TRANSPORTATION CONSULTANTS

SafeTREC

THE ROAD TO GREAT WALKING & BICYCLING COMMUNITIES:

RESOURCES FOR PEDESTRIAN & BICYCLE SAFETY PROGRAMS

Complete Streets

Complete Streets work for all modes and all users. Routine Accommodations or Complete Streets Policies ensure all new installation and maintenance decisions follow this philosophy. Implementation can include use of multi-modal level of service/quality of service analysis procedures for transportation impact and mitigation studies or revised street design guidelines.

Caltrans Deputy Directive 64:
"The Department views all transportation improvements as opportunities to improve safety, access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system."

@ *completestreets.org*

Consider establishing a Complete Streets Policy and accommodating all modes in standard cross-sections for collectors and arterials.

Pedestrian & Bicycle Master Plans

Pedestrian and Bicycle Master Plans inventory existing conditions and prioritize the implementation of capital and maintenance projects to improve walking and bicycling environments. Model Master Plans address the accommodation of pedestrians and bicyclists during construction, street tree or street furniture standards, connectivity, system-wide consistency, and interdepartmental coordination.

Cities must have a Bicycle Master Plan (updated within five years) to be eligible for statewide Bicycle Transportation Account (BTA) funds.

A key step toward a Bicycle or Pedestrian Master Plan includes establishing an advisory committee. Grant funding is available for technical assistance to complete plans.

@ *Sample plans are available at: walkinginfo.org*

School Safety

Safe Routes to School programs encourage children to safely walk and bike to school. Safe Routes to School programs are important both for increasing physical activity and safety, and for reducing morning traffic associated with school drop-off. Funding for Safe Routes to School programs and/or projects is available at the state and federal levels.

@ *saferoutestoschools.org*

Consider developing "Recommended Routes to School" for each school in your city and hosting an annual Walk and Roll to School day.

Traffic Calming

Communities use traffic calming measures to reduce vehicle speeds, improve safety and enhance quality of life. Traffic calming measures typically alter the design of the street, but can also include education and enforcement programs. Neighborhood Traffic Management Programs spell out a process for developing area-wide traffic calming improvements.

@ *trafficcalming.org*

Formalize traffic calming practices for existing neighborhoods with a Neighborhood Traffic Management Plan and Program.

Collision Analysis

Comprehensive monitoring of collision data allows for more proactive pedestrian and bicycle safety projects with crash typing for countermeasure selection.

Start by developing and maintaining a GIS database of pedestrian-vehicle and bicycle-vehicle collisions.

@ *Check out the Statewide Integrated Traffic Records System (SWITRS) on the California Highway Patrol website: chp.ca.gov/switrs*

Speed Management

Fatality rates increase exponentially with vehicle speed. Consider pedestrian and bicyclist safety when setting speed limits, and employ traffic calming strategies where speed surveys suggest traffic speeds are too high for pedestrian and bicycle safety.

@ *safety.fhwa.dot.gov*

Target high-collision areas and areas whose land uses are conducive to pedestrian and bicycle activity for speed management and enforcement.

Program, Policy & Practices – Benchmarking

Benchmarking provides a process to compare a local agency's efforts for policies, programs, and practices in pedestrian and bicycle safety against national best practices.

@ *Apply for a free Pedestrian Safety Assessment from UC Berkeley's Tech Transfer Program: techtransfer.berkeley.edu/pedsafety*

A Pedestrian Safety Action Plan helps communities know where to begin to address pedestrian safety issues, as well as help enhance existing efforts. Learn how to develop a Pedestrian Safety Action Plan at www.walkinginfo.org

Crosswalk Policy

A formal policy for crosswalk installation, removal, and enhancements provides transparency in decision-making and can adopt best practices in pedestrian safety and accommodation.

Develop a GIS-based inventory of existing marked crosswalks in your city.

@ *Sacramento and Stockton both have excellent examples of crosswalk policies.*

Standard Crosswalk Marking Patterns Image source: FHWA