Appendix C. RESEARCH & TECHNICAL DOCUMENTS
iv. Planning for Safety

What is strategic safety planning?

Strategic safety planning, which has also been called "safety conscious planning," is a relatively new area of concern. It is done to assure that road safety becomes an explicit priority in land use and transportation planning, thus establishing a safer transportation network. Some categories of planning that have been identified as having the potential to impact safety are (Roberts, 1991):

The fundamental approach is to do whatever possible at each stage of planning and design of transportation infrastructure to promote safety. This includes:

- Establishing a functional transportation network
- Reducing exposure and the amount of travel
- Reducing the risk associated with travel that does take place
- Reducing the consequences of crashes that do occur.

Throughout this paper, the term 'crash' or 'collision' is typically used, rather than 'accident.' NHTSA—the National Highway Traffic Safety Administration—has been trying to encourage agencies to avoid the term 'accident,' because of the implication that an accident is a purely random event outside of human control.

Strategic safety planning was given a considerable boost by passage of the most recent Federal transportation act, known as SAFETEA-LU.[1] For the first time, states were required to prepare and submit strategic safety plans to the US Department of Transportation. California did so late in 2006. This plan, among other things, sets the state's goal as no more than 1 fatality per 100 million vehicle miles traveled, compared to 1.25 today. There is additional description under agency roles.

Another way that strategic safety planning differs from traditional safety planning is that it is proactive in nature. Traditional safety planning has usually been oriented toward identifying an existing problem in the transportation system (usually a street or highway), and then trying to find solutions, known as "counter-measures." There was typically a long feedback time to incorporate information on what was actually safe and what wasn't into the planning and design process. For example, in the 1950s and 1960s it became clear that the lack of shoulders on high-speed roadways and presence of poles were responsible for a significant number of serious crashes. This eventually led to the design standard of including shoulder areas, and the provision of "break away" poles that were "forgiving" to errant vehicles.

Another problem with the traditional approach is that it fails to typically set goals and objectives for the system, and as a result, may fail to allocate the funds used for safety improvement in the most cost-effective way possible. Like all planning, safety planning needs to evaluate benefits against cost, and optimize both the amount of the investment as well as the specific projects that are invested in.

Strategic safety planning is also a process that needs to involve and coordinate the various actors, described later in this chapter, who are responsible for safe travel. One element of traditional safety planning that still has relevance is the "four E's": engineering, education, enforcement, and emergency services:

Engineering of safety into the design of transportation improvements, as well as correcting known deficiencies

1 The Safe, Accountable, Flexible, Efficient Transportation Equity Act: a Legacy for Users.

Education of motorists, pedestrians, cyclists, and others about how to use the system safely

Enforcement of rules used in the operation of the system to promote safety, such as speed limits, prohibitions on driving under the influence, licensure, and so on.

Emergency Services that provide rapid response to a crash, and appropriate medical services in response to a crash.

Strategic safety planning is also related to many elements of transportation systems management and operation and encompasses a collection of different activities and programs to manage and optimize its value as an "asset" in the most productive possible way, including:

- Traffic detection and surveillance
- Work zone management
- Emergency management
- Automated enforcement
- Traffic incident management
- Roadway weather information
- Traveler information services
- Freeway Service Patrols (FSP)

What should the goals of A STRATEGIC SAFETY plan be?

One national organization (AASHTO, 1997) has suggested the following goals for a strategic highway safety plan (this list excludes those that are already being undertaken today):

- Ensuring drivers are fully licensed and competent
- Sustaining proficiency in older drivers
- Curbing aggressive driving
- Keeping drivers alert[2]
- Increasing driver safety awareness
- Increasing safety belt usage
- Making walking and street crossing safer
- Ensuring safer bicycle travel
- Improving motorcycle safety and increasing motorcycle awareness
- Making truck travel safer
- Reducing vehicle-train crashes
- Keeping vehicles on the roadway
- Minimizing the consequences of leaving the road
- Improving the design and operation of highway intersections
- Reducing head-on and across-median crashes
- Designing safer work zones
- Enhancing emergency medical capabilities to increase survivability
- Improving information and decision-support systems
- Creating more effective processes and safety management systems

Safety's Relationship to the Aging Population

Sonoma County's population is projected grow in the future, leading to increased travel. As was discussed in the Existing Conditions chapter, one of the important demographic changes that will take place over the next 25 years is the aging of the population. Between 2005 and 2035, the median age (the age half the population is older than) of county residents is expected to increase from 39.3 to 44.3 years old. Although this seems like a small change, the percentage of population that is 65 or older will go from 13.4% to 27.6% of the total population. In actual numbers, the growth is even greater: from approximately 64,000 people today, to 157,000 in 2035.3 This is an increase of 145%. This trend could have both favorable and unfavorable effects on transportation safety. Older drivers usually drive fewer miles, but also experience higher collision rates per mile traveled, because of a slowing in reaction time, loss of vision/hearing,

2 The Federal Highway Administration later modified this to drowsy or distracted, to include such concern areas as cell phone use while driving.

3 All estimates from ABAG's Projections 2007 for Sonoma County.

and other physical effects of aging. The older population is also represented disproportionately in pedestrian collisions, because the elderly may be more likely to walk, may have slower walking speeds and lesser abilities to avoid a collision. Statewide, the population 65 and over represented approximately 10% of all injury victims for which age data were available, but almost 23% of all fatalities.

Land uses and development trends

Sonoma County's local jurisdictions have been increasingly emphasizing new development patterns that are pedestrian, bicycle, and transit friendly. To the extent that they can reduce travel by private vehicles, these patterns are a favorable trend in reducing exposure to motor vehicle collisions. Of course, bicycles and pedestrians can be victims of such collisions, but attention to safety details in the plan review process is a positive development.

NHTSA defines a "crash" as any contact with an object, either moving or fixed, at any speed in which kinetic energy is measurably transferred or dissipated. This includes other vehicles, roadside barriers, objects on or off the roadway, pedestrians, cyclists, or animals. Source: The Impact of Driver Inattention on Near-Crash/Crash Risk: An Analysis Using the 100-Car Naturalistic Driving Study Data. Report DOT HS 810 594, April 2006.

NHTSA has been trying to discourage use of the term "accident," which carries with it the implication that the event is random and not within the driver's control. Sometimes in this section, the term collision has been used instead of crash; "crash" and "collision" are used interchangeably.

STREET LIGHTING SAFETY

The following is paraphrased from Wolfgang Homburger, Fundamentals of Traffic Engineering, 15th edition, UC Berkeley Institute of Transportation Studies, 2001, page 28-14:

In 1989, a task force of the Illuminating Engineering Society of North America called, Value of Public Roadway Lighting (New York: Report IES CP31-1989, 1989) concluded that:

Adequate lighting that is properly designed, installed, and maintained can usually significantly reduce nighttime crashes.

On Major streets in urban areas, the greatest benefit from lighting modernization came in the reduction of nighttime pedestrian crashes, by between 45 and 80 percent. The reduction of all types of nighttime crashes was in the range of 21 to 36 percent.

Adequate lighting can reduce specific types of crimes.

A more recent study (BRW, Inc., Safety Impacts of Street Lighting at Isolated Rural Intersections, 1999, prepared for the Minnesota Department of Transportation) concluded that the installation of street lighting at rural intersections is a low cost and very effective strategy for mitigating nighttime crashes, reducing crash frequencies (before vs. after) by 25 to 40 percent, and the crash severity 8 to 26 percent.

Lighting is probably most effective when targeted to specific areas; e.g., Caltrans standard practice on freeways is to illuminate merge and diverge areas, and sometimes curves. On city streets, lighting intersections and locations where pedestrians/bicyclists are likely to cross a roadway are likely to be the most cost-effective locations for lighting.

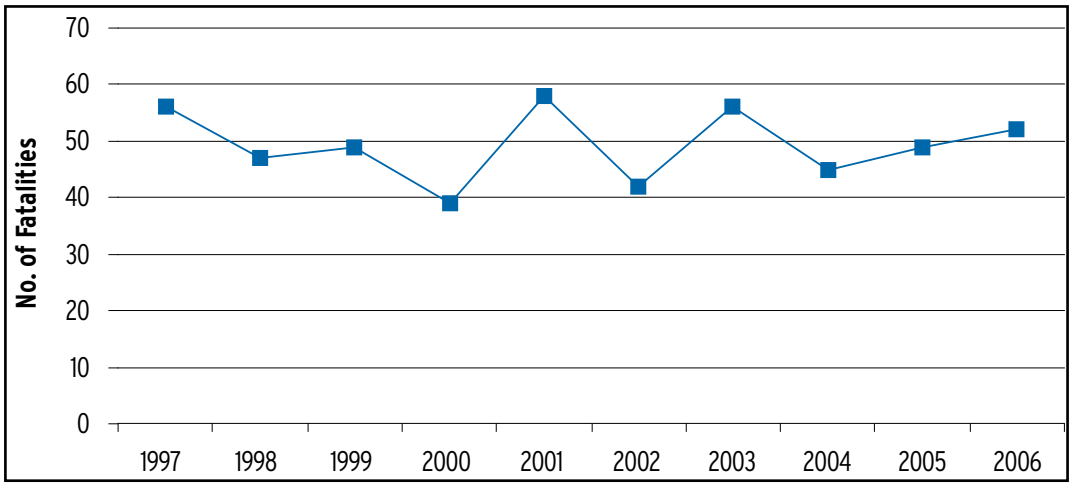
Dimensions of the Existing Safety Problem

The Safety Situation in 2006

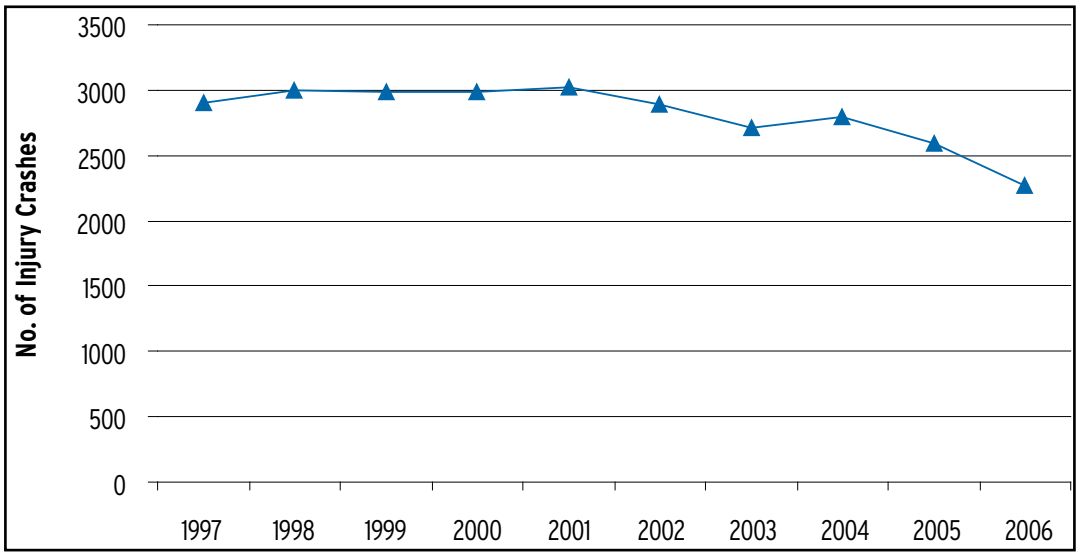
In 2006 (the most recent year for which data are available), Sonoma County experienced 52 motor vehicle involved collisions killing 54 people.

There were 2,267 crashes causing injury to at least one party, and 3,967 recorded property damage only (PDO) crashes (CHP, 2007). The number of PDO crashes is almost certainly understated to a considerable degree, as discussed in the

ANNUAL MOTOR VEHICLE RELATED FATALITY COLLISIONS, 1997-2006 **SOURCE: CHP, SWITRS DATA**



ANNUAL INJURY COLLISIONS IN SONOMA COUNTY, 1997-2006 **SOURCE: CHP, SWITRS DATA**

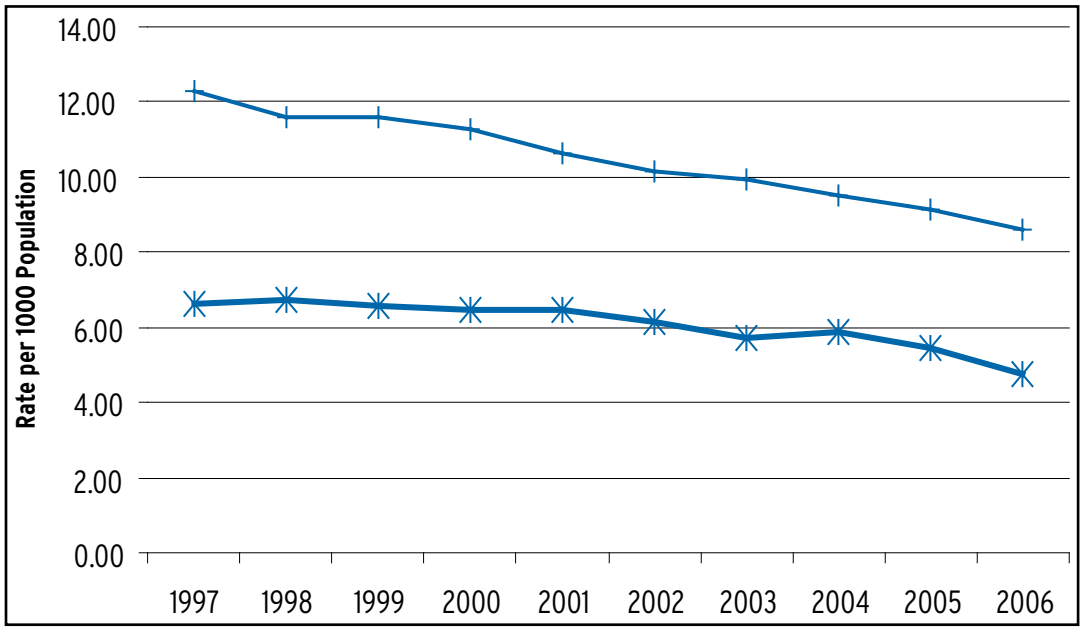


area of data needs. Alcohol was involved in approximately one-third (17) of the fatal crashes, and 13% of the injury crashes. Of the 52 fatal crashes that took place, 8 involved pedestrians, 3 involved bicyclists, and 11 involved a motorcyclist. There were 106 pedestrian involved injury collisions and 155 bicycle involved injury collisions.

Geographically, the distribution of serious crashes was very uneven. Several jurisdictions had no fatalities, e.g., Cloverdale, Cotati, Healdsburg, and Sebastopol. Santa Rosa and Petaluma each had three fatalities. The unincorporated areas of the County had the highest number of fatal incidents—24 on County roads and 19 on State highways in unincorporated areas. In total, 83% of all fatalities took place in unincorporated areas, even though the unincorporated area has approximately one-third of the total population, and represents probably 55-60% of the road mileage.

Although there are many reasons for this lopsided distribution of incidents, there are probably a few key factors responsible. Motorists often travel at higher speeds on county roadways than city streets, the roads are often narrower, they are built to lower levels of design standards due to the road's vintage and physical characteristics, they may be unlighted, and

REPORTED INJURY CRASH RATE PER 1000 POPULATION
NATIONAL IN UPPER LINE; SONOMA COUNTY IN LOWER LINE



additional features may come into play (e.g., terrain, sight distances). As noted in the section on Existing Conditions, the County is responsible for more than half the road mileage in the County. When a crash does occur, its detection and the time needed for first responders to arrive on the scene is often greater than in cities, and emergency medical care farther away.

The geographic distribution of injury crashes is not quite as skewed as the fatalities, but is still significant: 38% took place in unincorporated areas. Overall, Sonoma County's fatality rate was close to but slightly above the statewide average (1.33 per 100 million VMT vs. 1.25 statewide).

Trucks were involved in six fatal and 72 injury incidents in 2006, accounting for six fatalities and 89 injuries. Motorcycles were involved in 11 fatalities and 180 injuries. An increasing number of motorcyclist fatalities nationwide has been a recent safety concern; the trend may be partly attributable to more "baby boomers" purchasing motorcycles who are relatively inexperienced in operating them[4]; and to increasing gas prices that are encouraging more people to turn toward this fuel-efficient mode of transportation. Because of the scenic nature of its roads, Sonoma County is also an attractive destination area for motorcyclists to come to.

Trends Over Time

Although the discussion in the paragraphs above focused on data from the most recent year available, collisions can vary considerably from one year to the next. This is particularly true of fatalities, and as the size of the area analyzed (intersection, city, countywide) gets smaller there tends to be more variation from year to year. Generally, several years of data are used to establish trends. The chart on page 158 shows the trend in fatalities during the past 10 years, which has more or less been stable despite a growth in population. Generally it is hovered at 49 per year, with no clear trend in either direction.

Injury collisions, in contrast, have shown a more favorable downward trend. Although the trend was flat from 1997-2001, averaging 2,800 per year in the past decade, since 2001 there has generally been a decline despite population and VMT

4 News reports can be found at www.startribune.com/local/27115354.htm and www.washingtonpost.com/wp-dyn/articles/&460-2005Apr21.html

THE HIGH COST OF CRASHES

Although no true cost can be placed on the loss of life, or even the suffering caused by an injury, the Federal Highway Administration and CHP have suggested that the following values be used in assessing the costs of collisions and allow for balancing these costs against the cost of remedial measures:

TYPE OF CRASH	COST PER CRASH
Killed	$3,357,000
Injured	
Severely	$232,000
Other Visible Injury	$46,000
Complaint of Pain	$25,000
Property Damage Only	$3,000
Source: CHP 2007, Table 7C	

Using these figures, the cost of fatal crashes in Sonoma County, in 2006, is more than $181 million–or more than 9 times as much revenue as was generated by Measure M in that same year. The total cost of crashes in Sonoma County in 2006 is more than $335 million–or more than 17 times as much revenue as was generated by Measure M in that same year. On a per capita basis, this is equal to a cost of approximately $725 per person per year. These costs attempt to capture direct costs of things that are measurable, such medical care, EMS response, lost wages; they are unable to capture the less tangible costs of things like pain and suffering.

growth. In 2006 there were 2,267 injury incidents that injuring 3,230 people.

Traffic Congestion as a Safety Issue

Although not widely recognized, traffic congestion is also a traffic safety problem. Congestion slows speeds and may therefore reduce the severity of crashes, but it is also likely to increase their number. Some evidence from data on Highway 101 indicates that a very high proportion of the collisions are rear-end, possibly due to the stop-and-go nature of traffic during much of the day, and/or unexpectedly encountering stopped traffic. More severe crashes may occur when a vehicle rear-ends another at high speed, for example, when one vehicle is waiting to make a left turn and is struck from behind by another. There is also anecdotal evidence that increased congestion leads to more aggressive driving behaviors, popularly known as 'road rage,' that may ultimately result in more crashes.

Traffic incident management is also critically important to reducing non-recurring traffic congestion. When a collision occurs, the time taken to identify and clear it can make a critical difference in the amount of resulting congestion, particularly where a lane or lanes are blocked. Even short blockages–15 minutes or less–can result in the persistence of significant traffic congestion. Truck crashes are particularly problematic, because they often block multiple lanes of traffic and take much longer to clear than smaller vehicles.

Reducing traffic congestion–and providing a smoother, more "expected" and even flow of traffic–can reduce collision rates.

SAFETY PLANNING PRINCIPLES

There are four general principles that guide strategic safety planning: establishing a functionally classified street system (which is already done throughout the County); minimizing exposure; minimizing risk; and minimizing consequences.

Establishing a Functionally Classified Network of Streets and Highways

Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of service they are intended to provide. Most travel involves movement through a network of roads. It becomes necessary then to determine how this travel can be channelized within the network in a logical and efficient manner. Functional classification defines the nature of this channelization process by defining the part that any particular road or street should play in serving the flow of trips through a highway network.

Different types of facilities have greatly varying crash rates. Freeways typically have low fatality rates in terms of vehicle miles traveled and despite their higher speeds, because they physically separate high-speed vehicle traffic from pedestrians and bicycles; usually have barriers in opposing traffic directions; and control all access. What are the worst? A bit more on the other classifications.

Minimizing Exposure

The goal here is to work with planners to achieve:

- A reduction of the amount of travel, including the need to travel and the distance, through efficient land use and transportation plans.
- Increased use of modes with better safety per passenger mile traveled, e.g., public transit.

Minimizing Risk

The reduction or minimization of risk relates to two important factors:

- Reducing driver workload, through reducing traffic friction and the speed and volume of conflict between movements. Examples include congestion reduction, as well as use of more "T" intersections, which are inherently safer than four-leg intersections.
- Improving the predictability of the driving task, through the provision of positive guidance, consistency, and improved visibility.

Minimizing Consequences

The reduction or minimization of consequences of crashes is an important consideration in safer highway design. There is potential for planners to contribute in this regard:

- By planning roads to achieve safe and appropriate travel speeds
- Protecting vulnerable road users, e.g., by separating pedestrian and bicycles from other traffic (sidewalks and bike lanes)
- Providing a forgiving roadside, e.g., separation from trees, slopes, and drainage features near the edge of the pavement
- Providing for efficient emergency response routes

Stakeholders

Numerous parties are involved in safety planning; some of the key participants are described in the table on page 163. This table is not intended to be exhaustive, but only highlights the key roles played by a variety of different actors in the transportation safety system. What is obvious from the table is that in many cases the roles and responsibilities of various actors overlap; in such cases there may be potential for cooperation and cross-education between the actors.

HOW SAFETY DATA ARE COLLECTED

All local governments in California are required to participate in the Statewide Integrated Traffic Records System, known as SWITRS. Peace officers fill out a standardized form, which is submitted, to the CHP for data entry. These forms are then merged into a statewide database. Summary information is available on the web. Some jurisdictions also maintain their own collision records system (e.g., Santa Rosa) for internal use and analysis.

There are some limitations about the data that should be understood:

- Accuracy of crashes and crash rates depends on timely submission of the data. Typically, data are complete for only approximately two years in arrears (in this case, 2006 is the latest complete dataset available).
- Forms are filled out only when the crash occurred in public right of way (or a vehicle departed the public right of way prior to the crash). Crashes on private property are generally excluded. This is generally not a significant limitation.
- Data are generally geographically referenced to roadways and intersections, e.g.. "40 feet north of Main Street and Old Redwood Highway." Errors in the field form (e.g., misspellings or mis-measurement of distances) can lead to commensurate inaccuracies in the final database. There may be opportunities to improve field equipment to improve the accuracy of data, such as through use of GPS technology.
- Although the database includes almost all motor vehicle-related fatalities, the percentage of crash type reported is usually commensurate with its severity. Studies indicate that some injury crashes, especially the less severe variety, go unreported. Property damage only collisions are generally conceded to be greatly under-reported; some California jurisdictions, because of scarcity of staffing, will not submit a police report to SWITRS for PDO collisions.
- Increasing demands on law enforcement has meant less time available to enforce traffic rules, to write crash reports, or to analyze available SWITRS.

THE ROLE OF THE SCTA

There are several ways that SCTA can play an important role in achieving the

TRAFFIC CONGESTION AS A SAFETY ISSUE "ROAD RAGE"

'Road rage,' also known as aggressive driving, has been a popular topic of discussion for more than a decade. Unfortunately, hard data is difficult to get on this phenomenon, in part because there's no uniform definition of what constitutes aggressive driving, which also means no information recorded by peace officers in making collision reports (the closest classification an officer could use is "following too close" to another vehicle, although this doesn't capture all aggressive driving incidents).

There has also been debate whether the media has magnified this topic beyond its importance, but there is a perception that it is on the increase. A USA/CNN/Gallup poll in 1997 found that 75% of drivers polled believe other drivers were driving more aggressively than five years before. Only 13% said that they personally were driving more aggressively. Arguably, the perception of increased aggressiveness could also be a result of the media attention paid to it.

There is generally a consensus that aggressive driving may be a result of drivers spending more hours commuting, more stressful lives (more activities scheduled than there is time to reasonably accomplish), and increased traffic congestion. However, for the reasons noted above, there is still debate regarding whether this phenomenon is increasing or not. The types of behaviors that mark aggressive driving– e.g., following too closely, excessive lane changing, driving on shoulders, unsafely cutting into short gaps in traffic–are more likely to be exhibited under congested driving conditions than free-flowing traffic. Excessive speed, which may also be considered an indication of aggressive driving, is more likely to occur when there is little or no congestion, because it is not possible under heavy congestion. Frustration caused in slow moving traffic might lead drivers to increase their speed in areas that are more free flowing, however, possibly as a way to compensate for the time lost in a congested area.

Additional information can be found at:
www.aaafoundation.org/resources/index.cfm?button=agdrtext

goal of a 25% reduction in traffic fatalities and collisions. Among them are:

- Acting as an Effective Safety Advocate. This includes advocacy of safety conscious planning at all levels (local, regional, and state), and potentially revising investment decisions to put greater weight on projects and programs that will improve safety.
- Convening Stakeholders and Building Strategic Alliances. This includes government and non-governmental organizations (e.g., auto insurance companies). Strategic alliances that identify common elements in promoting all these interests will promote the potential for success of the safety plan. Often, these groups are managed with relatively little interaction between them, because of the compartmentalization of government functions.
- Integrating, Improving, and Sharing Information. Examples of these kinds of activities include conferences between constituent agencies; providing training to peace officers or traffic engineers; providing grants to improve the analysis of data (e.g., software acquisition for collision analysis software). This could also include sharing "best practices" in an informal setting (e.g., a meeting where lunch is provided) among practitioners. Data on traffic collisions also tends to vary widely; the knowledge, skills, ability, and time to devote to collision reports can vary widely among peace officers.
- Empowering Practitioners. Practicing planners are often not actively involved in road safety activities yet their role is important. It is critical to make it as easy as possible for practitioners to undertake safety conscious planning and encourage a multi-disciplinary approach to enhance the final product.
- Advocating for Grants/External Funding. Because Congress has made safety a priority (and is likely to continue to do so in the next federal transportation re-authorization bill), there are several categories of funding available to public agencies.
  - Highway Safety Improvement Program (HSIP)
  - High-Risk Rural Roads Program (HRRRP)
  - Safe Routes to Schools
  - Section 402 Community Highway Safety Grants

Conclusions and next steps

This chapter on incorporating safety in the transportation planning process represents a beginning rather than an

ACTORS INVOLVED IN TRAFFIC SAFETY IN CALIFORNIA

WHO	WHAT THEY DO (KEY OR TYPICAL ROLES)
Planners	Depending on specialty, may review subdivision site plans; provide support to decisionmakers in investment decisions; long term plans for roads and other transportation systems.
Traffic Engineers	Design transportation facilities; assist with investment decisions; review and analyze crash data. Select traffic controls (including signals); signage; striping; and setting speed limits on local streets. *
City police and Sheriffs	Enforce traffic laws on local streets and roads; review and analyze crash data; respond to collisions. Decisions about where and when to deploy officers.
CHP	Primary traffic law enforcement on state highways and some County roads under contract; first response to collisions on state highways; maintain SWITRS database and reports statewide. Commercial vehicle inspections (including school buses). Decisions about where and when to deploy officers.
Fire Departments and EMS Personnel	First response to medical emergencies on all types of roads. Suppress vehicle fires.
Hospitals/Clinics	Emergency room and follow-on medical care for crash victims.
Schools	Education of students in traffic safety; establishing safe routes to schools (typically in concert with traffic engineers); provision of crossing guards in some locations.
Caltrans	Design, construction, and maintenance of state highways. Operation of freeway traffic management centers, most traffic signals and traffic controls on state highways. Setting speed limits on state highways.*
Department of Motor Vehicles	Driver licensure and suspension issues; driver education and testing; vehicle safety.
SCTA	Advocacy; for safety and funding convening stakeholders; integrating, improving and sharing information.
SMART/NCRA	Railroad grade crossings and education
Non-Governmental Organizations	These diverse groups promote traffic safety; examples include AAA, auto insurance companies, professional organizations (e.g., Institute of Transportation Engineers), National Safety Council, and so on.

* Within limits set by the State Legislature in the California Vehicle Code.

end. It recommends as a primary goal adopting California's goal of a 25% reduction in the fatality rate (to less than one per 100 million VMT). Further, this plan recommends a goal of a 25% reduction in injury crashes per VMT by 2020.

Transportation plans ideally work to improve all forms of transportation, including roadways, freight, transit, and pedestrian and bicycle facilities. Multimodalism is a critical aspect of safety planning, because when exposure to roadways and traffic congestion is minimized, safety improves. The strategic safety planning process needs to consider a range of transportation agencies in the county and consider a wide range of strategies and involvement of actors that support and promote the '4E' process. By providing mobility alternatives to the auto, transit reduces VMT, resulting in fewer traffic incidents, injuries and fatalities. Encouraging transit ridership among the groups with the highest crash rates, such as young and old drivers, can improve safety. Guaranteed ride home programs at events can help prevent impaired driving.

Elements such as sidewalk, pedestrian crossings, bicycle paths, and bicycle parking that support successful transit service also enhance bicycle use and walking, thus reducing VMT. Safe access to and egress from park-and-ride lots contributes to safe transit use. Concerted action on all of these fronts can lead to a safer Sonoma County travel experience in the future.

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There are also a number of publications available from:
www.safety.transportation.org
www.roadwaysafety.org

National Safety Council: www.nsc.org