TRAFFIC SAFETY INVESTIGATIONS FOR LOCAL AGENCIES

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by
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ABSTRACT

Traffic Safety Investigations for Local Agencies

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National and statewide (California) collision numbers are currently on the decline; however, the U.S. is declining at a much slower rate than most other developed countries, and in some aspects is actually regressing in terms of traffic safety. Although state highway safety is improving, local roadway safety may actually be regressing. Approximately three-quarters of all U.S. public roadways, and approximately 80% of all injury accidents fall under the jurisdiction of cities. However, cities may not be allocating the proper level of resources, or operating under the proper administrative methodologies to adequately address these safety issues.

This research finds that on average, California cities are experiencing increasing annual collision rates. In particular, small cities with populations of less than 25,000 are experiencing the largest increases, whereas larger cities are experiencing static or slightly decreasing collision rates. California's statewide collision statistics and the administration surveys conducted as part of this study indicate that there is a correlation between a city's administrative analysis/mitigation methodologies and their annual collision rate trends. Specifically, cities with lower traffic engineering staff to population ratios tend to have increasing collision rates, as opposed to cities with high staff to population ratios, which have decreasing collision rates. Also, this research shows that cities that allocate more traffic safety resources to enforcement over engineering tend to have increasing collision rates, as opposed to cities allocating more resources to engineering that have decreasing collision rates.

This research also finds that there are predominant and correctable factors that lead to the various collision types. Cities that employ routine system wide traffic safety audits addressing location-specific collision trends based on these predominant factors tend to have decreasing collision rates, as opposed to those that do not.

In general, collision rates among U.S. cities are increasing largely due to increasing rates on roadways within the jurisdiction of smaller cities, most commonly with populations under 25,000. Over one-third of cities are not staffed at the proper levels, not allocating the necessary resources to traffic engineering activities, and are not employing an adequate evaluation/mitigation strategy. The findings of this study provide guidance and framework to cities for developing effective traffic safety strategies by identifying the characteristics of those cities that have been successful in reducing collision rates as examples. In particular the value of this research is important for non-engineering administrative staff and political bodies in terms of establishing appropriate staffing levels and resource allocations necessary for an effective traffic safety program.

The findings of this study provide guidance and framework to cities for developing effective traffic safety policy preference by identifying the characteristics of those cities that have been successful in reducing collision rates as examples. In particular this research is important for non-engineering administrative staff and political bodies in terms of establishing appropriate staffing levels and resource allocations necessary for a transportation department to be effective in reducing traffic collisions and resulting damages.

Preface

This thesis is the final work of my graduate study at the California Polytechnic University of San Luis Obispo in the field of civil and environmental engineering with a specialization in transportation. It serves as documentation of my research and findings regarding the traffic safety practices of California cities that were conducted from January of 2008 thru February of 2009 under the direction of the late Dr. Edward Sullivan.

This research has been conducted as an extension of my professional experience and interests. Over the course of my last 10 years in the transportation field working for various public agencies and being actively involved in the Institute of Transportation Engineers (ITE), traffic safety has emerged as one of the focuses in my career. Since 2001, I have been developing and implementing a traffic safety program for the city of San Luis Obispo, which in 2009 was recognized internationally by ITE and given the Public Agency Achievement Award, one of the highest awards a public agency can receive for its traffic safety practices.

Recognizing that methodologies that are effective for some agencies may not be effective for others, I decided, as part of this research, to investigate the effectiveness of various agency methodologies for addressing traffic safety with the goal of establishing guidance for cities to develop and improve their own practices.

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Chapter I: Introduction

Background

Automobile collisions are the number one cause of death in the United States (U.S.). From 1994 to 2004, there were over 462,000 fatalities due to automobile collisions alone, more than the casualties of any American war. The total number of injuries from automobile accidents during that same 10-year period is more than 30 times the total number of injured from all of America's wars combined. Compared to European countries such as France, Germany, Great Britain, the Netherlands, and Switzerland, which all have experienced a reduction in traffic related fatalities from 2000-2004, the U.S. is regressing in terms of traffic safety as it has experienced significant increases in collision rates during that same time period.¹

Although astounding, the issue of increasing collision rates in the U.S. is not as broad as it may seem. More than 75% of public roadways are owned and operated by local cities.² In California, more than half of traffic fatalities and nearly 80% of traffic injuries occur within the jurisdiction of local agencies, and on city streets. However at the city level, methodologies for addressing traffic safety issues vary significantly; they span from agencies with comprehensive traffic engineering programs and extensive budgets to agencies with no traffic safety-related engineering programs, who rely solely on enforcement type activities. At the state highway level, injury and fatal accident rates are decreasing, whereas injury and fatal accident rates across all local agencies are increasing on average

¹ "Britain Reduces Traffic Fatalities by Half While U.S. Shows Little Change" The Urban Transportation Monitor, 11 November 2005

² "Traffic Safety Facts" FHWA, August 2005

by 32% or .01 collisions per 1,000 capita annually.³ As shown in the California State Wide Intergraded Traffic Records System (SWITRS) data, this increase is not a result of shifts in overall collision severity. The data shows that from 2004 to 2006, approximately one-third of all California cities experienced increases in overall collision rates, with smaller Cities having the highest influx of collision rates.

The most alarming aspect of local collision statistics is their economic burden to society. The National Highway Traffic Safety Administration defines comprehensive costs as, “including not only the economic cost components of a collision, but also a measure of the value of lost quality of life associated with the fatalities and injuries, that is, what society is willing to pay to prevent them.”⁴

Based on these costs, local agencies across the U.S. cumulatively incur approximately \$141 billion annually in costs associated with traffic collisions. However, based on a survey of California cities, approximately \$325,000 is allocated to traffic safety each year per city, and with 18,443 incorporated cities in the United States it is estimated that only \$6 billion is specifically allocated annually for traffic safety improvements among local cities nationwide.

Approximately half of this funding, \$3-4 billion, is allocated through state and federal grants such as the Safe Routes to School program (SRTS), Hazard Elimination Safety program (HES), Highway Safety Improvement program (HSIP), and the High Risk Rural Roads program (HR3); the remaining half is primarily funded through local general funds and/or development fees.

A major issue contributing to this problem is that less than half of all cities in California have a program or mechanism for identifying roadway conditions

³ “SWITRS” California DOT, 2000-2006

⁴ “Traffic Safety Facts 2002” NHTSA, January 2004

that are contributing to traffic collisions, or an adequate funding mechanism to correct these conditions. Also, more than half of cities primarily rely on enforcement activities to address engineering-related safety issues, such as where persistent physical geometric deficiencies may be contributing to traffic collisions, and this could be corrected through an alteration or improvement of the facility. Based on a survey of California cities conducted as part of this research, approximately 80% of local agencies primarily evaluate and prioritize roadway safety issues reactively, based on non-empirical sources such as public complaint or political pressure, whereas only 20% of local agencies either evaluate and prioritize safety issues based on routine systemwide assessments or preemptive safety audits. The motivation for this research is to provide City administrative staff and political bodies a better understanding of the relationship between the structure of their organizations and the effectiveness of their traffic safety programs. The intent of this research is also to lay the foundation for developing a best practice in terms of specifically what staffing ratios, resources allocations, and safety programs are appropriate for reducing collision rates.

Thesis Statement

Although most agencies either lack the resources or refuse to embrace a standardized engineering-oriented methodology to address traffic safety issues, agencies should implement a comprehensive engineering orientated traffic safety program in order to make reductions in collision rates. Based on a survey of California cities conducted as part of this research and statewide collision statistics, it is evident that agencies with standardized traffic safety programs have a greater propensity for reducing collision rates, whereas agencies that

primarily or exclusively rely on enforcement activities to address their traffic safety issues will generally experience increasing annual collision rates.

In addition, even though the primary methodology for identifying safety issues and reducing collision rates varies significantly among agencies, and the current state of practice suggests that no single methodology is appropriate for all agencies, all agencies should primarily analyze and attempt to mitigate traffic safety issues based on collision patterns (type and frequency) at specific locations in order to reduce collision rates. Most agencies employing this methodology have declining collision rates, and intuitively, location-specific collision patterns readily indicate contributing factors that can be corrected.

For example, a city might determine that no one methodology is appropriate for every agency and make the determination that enforcement alone is the best approach. However, based on this research, that city would be less likely to reduce collision rates than another city that made the determination to apply a higher level of engineering in combination with enforcement.

Current Research

Based on this researcher's ten years of practical professional experience in the field of traffic safety, logistically safety efforts at the local level can be broken down into three primary elements: 1) resources, 2) analysis and prioritization, and 3) mitigation and implementation. The first element, resources, is the level of staffing that an agency employs to carry out its safety efforts, and the amount of funding that an agency establishes to develop and implement safety programs and projects. The second element, analysis and prioritization, is an agency's methodology for evaluating safety issues and prioritizing those issues for mitigation. The third element, mitigation and implementation, is the

strategy that an agency takes to correct safety issues and the approach to implement those mitigation measures.

Resources. The first and most difficult tasks in reducing collision rates are developing a methodology, identifying staffing levels, and establishing an adequate budget. Little research has been completed to date on the staffing and funding elements of local jurisdictions in regards to their traffic safety efforts. Most current research, including those identified later in this chapter, recommends that each agency is different, and therefore should establish funding levels and a staff base to meet their needs. While the general state of the practice is intuitively sound, it fails to provide an adequate framework or baseline guidance to agencies for how to identify their needs and develop the methodologies to address them.

The bulk of research on staffing and funding for transportation agencies comes out of the Transportation Research Board (TRB) and the National Cooperative Highway Research Program (NCHRP). In 2003, the NCHRP released Synthesis 321, *“Roadway Safety Tools of Local Agencies.”* The basis for the NCHRP’s research is quite similar to the basis for this research. Although not substantiated by data, the NCHRP 321 Report also suggests that local agencies may not be performing as well as they should as the result of their lack of staff resources. The NCHRP writes:

There is significant variation in work force size, responsibility, expertise, and resources. Many small cities/townships have limited budgets and employ only a clerk–treasurer as the full-time employee. Others can support full-time road crews with or without a full-time engineer. Some cities employ a public works director and traffic engineers, and they retain

consulting firms to perform selected services. Many counties have a work force in which the road supervisor has many years of on-the-job experience, but little if any formal educational training, whereas others have full-time engineers and/or traffic engineers. The range of expertise and understanding of transportation safety issues varies as well.⁵

There has been very little research conducted on funding levels for traffic safety activities at the local level. However, some research has been conducted on staff resources. The two predominant resources on this subject are Special Report 275: *The Workforce Challenge* (2003), and Special Report 289: *Building the Road Safety Profession in the Public Sector* (2007), and are both published by the TRB.

The TRB's Special Report 275 takes the typical approach, suggesting that there is no single organizational or operating model because each agency is unique because of state or local politics, history, geography, size, population, governmental structure, and other conditions.⁶ This may be completely valid at the State Department of Transportation (DOT) level, at which traffic safety efforts are broad and primarily policy based, such as the application of traffic control devices and restriction of cell phone usage. However, it leaves little guidance for cities that are responsible for very specific issues, such as a specific collision pattern at a particular intersection. There should be some general staffing recommendations made that may be appropriate for all local agencies. However, this report does support the theory that most local transportation agencies are having difficulties determining their needs in regards to staff, funding, and

⁵ "NCHRP Synthesis 321: Roadway Safety Tools of Local Agencies" TRB, 2003

⁶ "NCHRP Special Report 275: The Workforce Challenge" TRB, 2003

methodologies. The findings of the TRB 275 Report are consistent with the finding of this research, which is discussed in later chapters.

The TRB Special Report 289 suggests a significant gap in the roadway safety sector of public agencies. The report indicates that there are approximately 10,000 professionals across federal, state, and local agencies that are employed full time in roadway safety efforts, and approximately 10,000 agencies nationwide that are responsible for roadway safety within their respective jurisdictions.

This means that road safety professionals account for only a small fraction of the total workforce of public agencies which are responsible for traffic safety. Most state departments of transportation employ four to five times as many environmental analysts and planners as they do full-time safety professionals, in part because of the need to comply with the requirements of federal and state environmental laws and regulations. In contrast, most local highway agencies do not employ a single full-time safety specialist.⁷

Analysis and prioritization methodologies. All safety analysis methodologies break down into two basic approaches, responsive and preemptive. The preemptive approach is a relatively uncommon approach among local agencies, and essentially comprises of either a roadway safety audit or a predictive collision model based on future planned roadway geometrics. Currently, there is significant growth in the volume of research on roadway safety audits and predictive collision models; the most prominent research is being conducted by the Federal Highway Administration, the Institute of Traffic Engineers, and the TRB.

⁷ “NCHRP Special Report 275: The Workforce Challenge” TRB, 2003

Responsive analysis. The responsive approach is the most common among local agencies, given that it is difficult to allocate resources to accommodate predicted safety issues when current safety issues persist. The backbone of any city's ability to evaluate current traffic safety issues is its collision records system. The Office of Traffic Safety (OTS), a division of the California State DOT, is a primary source of research on collision records systems in California; however, according to the California OTS, some of the best advances in collision records systems are being made at the local agency level.

As part of its annual Highway Safety Plan Report, the OTS has identified improving traffic record systems as one of its major program areas. This report published annually by the OTS indicates the state of the primary collision records program, the SWITRS. This report consistently identifies significant issues with local agencies attempting to use the SWITRS database; the most apparent are the length of time to receive reports and the volume of inconsistencies in the identification of local street names. According to the report, most agencies require a local automated collision detail information system in order to provide up-to-date and accurate collision information:

All cities and counties maintain traffic-related records, including data on local roadways. Many agencies report optimal effectiveness can be achieved by maintaining a local system that includes many of the same data elements contained in the statewide systems. A local system

includes collision records, records of arrests and citations, and crash data on local streets and roads.⁸

The OTS supports local collision records system development through their annual grant programs. It is this level at which the most significant research and development is taking place. In 2007, with the financial assistance of the OTS, the city of Watsonville, in association with the Santa Cruz Metro Police Department, began a multi-jurisdictional traffic safety effort across four local agencies to improve the accuracy and efficiency of collision reporting through the development of an automated reporting system. The city of San Luis Obispo has also begun development of a similar program. The city of Goleta and the county of Amador have indicated that they are currently developing advanced spatial collision database systems, and at the state level, the California Highway Patrol is developing improvements to their existing SWITRS system to include Internet access for allied agencies and geographic mapping capabilities.

Collision databases generated by police departments are the industry standard, and this is reflected in nearly all collision records systems; however, there is some research indicating certain pitfalls of formulating findings based on that data. As part of the TRB's Circular E-C094 "Safety Data Analysis & Evaluation," it was found that police-reported collision databases are biased toward more serious events. Minor events and collisions, such as "property damage only" collisions and "non-collision" traffic incidents are underreported, even though they represent social and economic consequences. The objective of the TRB's research is to develop a method of routinely measuring these underreported events through

⁸ "Annual Highway Safety Plan" CA DOT: Office of Traffic Safety, 2008

user surveys, which should ultimately provide guidance on how to improve the accuracy of police-reported collision databases.

Preemptive analysis. The preemptive approach is the least common among local agencies, given that most agencies lack the expertise or resources to conduct such analysis. There are essentially two different methodologies of the preemptive approach, statistical modeling and roadway safety audits. Roadway safety audits first appeared in the late 1980s in the United Kingdom and were eventually formalized in 1990 by England's Institute of Highways & Transportation's Guidelines for the Safety Audit of Highways. Currently, most research and development for roadway safety audits emerge from New Zealand and Australia.

In 1996/1997, the Federal Highway Administration published a report (FHWA Study Tour of Roadway Safety Audits-Parts I & II) on a research trip to New Zealand and Australia that they facilitated with representatives from United States state, local, federal, and academia organizations. The report concluded that conducting roadway safety audits has significant potential to improve roadway design; however, its specific application needs to be defined within the context of the U.S.⁹ Most recently, the FHWA has begun development on roadway safety audit guidelines, which are expected to be completed some time in 2010-2011.

The largest collective body of research for roadway safety audits was presented at the 2005 International meeting for the Institute of Traffic Engineers in Melbourne, Australia. A portion of the conference was essentially a presentation of the various guidelines and manuals adopted by government

⁹ "FHWA Activities in Road Safety Audits" ITE, January 1999

agencies in New Zealand and Australia. The overall objective of the research was to show that assessing roadway designs based on engineering standards will fail to identify real safety issues within the context of the actual location and field condition, and to demonstrate the growing use and importance of roadway safety audits by local agencies.¹⁰

It is unclear when statistical modeling for collision prediction first began; however, today there are numerous theories and methods of conducting such analysis. An overall research effort has been conducted on the accuracy of the various statistical models by the TRB as part of their “Alternative Risk Models for Ranking Locations for Safety Improvement.”¹¹ This report outlined the methodologies of some of the most predominant collision prediction models, such as basic poisson, negative binomial, zero-inflated, and hierarchical Bayesian. The purpose of the research was to determine the relative effectiveness of site ranking and the practical implications of predictive collision models. Three specific models were evaluated for this study: the traditional negative binomial, heterogeneous binomial, and the poisson lognormal models. Using each model, two different collision predictions were calculated using a conditional mean for two different distributions and calibrated with a five-year accident history, the study concluded that the choice of model criteria and assumptions resulted in a significant difference of collision predictions.

Given the difficulty in justifying resources for collision prediction models and roadway safety audits while current collision trends are occurring, and the variations in predictive models, in this researcher’s experience, cities tend not to pursue preemptive approaches. Rather, predictive analysis is typically reserved

¹⁰ “Road Safety Audits – Practice in Australia & New Zealand” ITE, Jul 2005

¹¹ “Alternative Risk Models for Ranking Locations for Safety Improvements” TRB, 2005

for large state highway facilities. For example, an agency would have difficulty justifying funding for a model to forecast future collision potential in lieu of funding corrective measures for existing collision patterns.

Mitigation and implementation. Of the three elements of a local safety program, collectively, mitigation and implementation have the largest body of research. Mitigation is essentially the strategy or method an agency takes to correct a collision pattern or other traffic safety issue. Some of the major publications on the subject include the *Highway Safety Design and Operations Guide*,¹² and the *Policy on the Geometric Design of Highways and Streets*,¹³ both published by the American Association of State Highway and Transportation Officials (AASHTO). Additionally, there is the *Traffic Safety Toolbox: A Primer On Traffic Safety*,¹⁴ published by the Institute of Transportation Engineers. Highway design manuals and guides are the most commonly used resources for the mitigation of collision patterns.

In California, the five most commonly used publications are: the *ITE Traffic Engineering Handbook*, published by the Institute of Transportation Engineers; the NCHRP Report 500: *Guidance for Implementation of the California Strategic Highway Safety Plan* AASHTO *Strategic Highway Safety Plan: the California Manual on Uniform Traffic Control Devices* (MUTCD) published by the California State DOT; *Signalized Intersections: an Informational Guide* published by FHWA; and the *CalTrans Highway Design Manual* published by the California State DOT. The underlying theme of all mitigation research is conflict reduction and device standardization. What follows are summaries of how these reports pertain to this research.

¹² “*Highway Safety Design and Operations Guide*.” AASHTO, 1997

¹³ “*Policy on the Geometric Design of Highways and Streets*” AASHTO, 2001

¹⁴ “*Traffic Safety Toolbox: A Primer on Traffic Safety*” ITE, 1999

ITE Traffic Engineering Handbook. Chapter 7: Community Safety, of *ITE's Traffic Engineering Handbook* provides an excellent overview of international and national collision statistics, general data collection and analysis methodologies, and most pertinent to this body of research, accident pattern countermeasures. Table 7-14 of the *ITE Traffic Engineering Handbook* identifies possible causes, studies, and mitigation measures for various accident types. For example, the publication identifies driver awareness approaching an intersection as a possible cause for rear-end collisions, suggests a review of signing, and identified improvements to intersection warning signs as mitigation for the collision pattern.

NCHRP Report 500. The NCHRP Report 500 was developed in response to the 1998 AASHTO Strategic Highway Safety Plan. The goal of the Strategic Highway Safety Plan was to reduce annual traffic fatalities by 10% to 15%. The NCHRP Report is actually a volume of 21 guides for reducing collisions of various types, from collisions resulting from aggressive driving to reducing bicycle and pedestrian collisions. Six particular volumes are most pertinent to local agencies, and as such, are the most commonly referenced: Volume 4: A guide for reducing head-on collisions; Volume 5: A guide for reducing unsignalized intersection collisions; Volume 6: A guide for reducing run off road collisions; Volume 10: A guide for reducing pedestrian collisions; Volume 12: A guide for reducing signalized intersection collisions; and Volume 18: A guide for reducing bicycle collisions.

California MUTCD. The California MUTCD is the primary reference for the justification and application of “traffic control devices including signs, signals, markings, and other such devices used to regulate, warn, or guide traffic, placed

on, over, or adjacent to a street, highway, pedestrian facility or bikeway.” This manual establishes guidance and standards for the placement and application of traffic control devices based on significant bodies of research. The manual identifies conditions under which various traffic control devices are warranted for the mitigation of traffic safety issues, and under which conditions those various traffic control devices are not likely to be effective and/or may cause secondary traffic safety issues.

Chapter II: Methodology

The goal of this research is to provide local jurisdictions with general guidance on developing and administering effective traffic safety programs. The first objective is to quantify the performance of California cities in terms of changes in their annual traffic collision rates, then identify the administrative methodologies of those cities, and correlate those methodologies to their historical collision rate performance. The second objective is to identify the conditions and factors that most commonly contribute to traffic collision patterns, and then identify the most effective strategies for correcting those patterns.

Ultimately this research should provide general guidance to cities for developing effective practices to reduce collision rates. Given the almost infinite number of variables associated with specific collision trends, this study cannot provide a definitive formula for how a city should address its traffic safety issues; rather, the purpose of this study is to determine, on an order of magnitude, what has and has not been effective for other agencies. These findings should provide cities with a level of guidance and framework to determine their own needs and how to develop a methodology for addressing those needs.

The scope of the study has been defined as the following three tasks:

Step I: Collect collision statistics for all 460 incorporated cities in California and evaluate trends in annual collision rates.

Step II: Conduct a survey of California city administrative methodologies, evaluate methodology trends, and correlate with the performance of annual collision rates.

Step III: Collect a sample of individual collisions and evaluate patterns among individual collision types. Identify common standard mitigation strategies for those collision patterns based on contributing factors.

Agency Groups

An important consideration when evaluating how effective different agencies are and how different agencies operate is that not all agencies are alike. For example, smaller agencies typically have more rural roadway conditions and a different social demographic than larger agencies with more urban roadway conditions. Logically, these differences would affect collision trends and what would be required to mitigate those collision trends. Therefore, for the purposes of this research, all agencies have been divided into separate classes for analyses based on their population size, and these population groups are identified in Table II-1 below.

Table II-1: Population Groups	
Class V	0 - 25,000 Population
Class IV	25,000 – 50,000 Population
Class III	50,000 – 100,000 Population
Class II	100,000 – 250,000 Population
Class I	250,000 or More Population

Based on the survey of all 460 incorporated California cities, these classifications were determined based on the natural breaks in their transportation-to-staff ratios, and then group by population as shown in Figure II-1, below. The color differences in Figure II-1 are for graphical purposes only.

Figure II-1: City Classifications

**The color differences in Figure II-1 are for graphical purposes only.*

It is important to note that in some rare cases, classification based on population may be inaccurate. For example, in the case of the city of Industry, which only has a resident population of approximately 800 and a daytime population of almost 80,000, roadway miles would be the most appropriate classifier. However, aside from these rare exceptions, the most accurate classification model is population based as opposed to roadway miles based. As shown in Figures II-2 and II-3, below, collision trends have a better correlation to population than they do to roadway miles.

Figure II-2: Population to Collision Trend Correlation

Figure II-3: Roadway Miles to Collision Trend Correlation

Considering that population-based classifications and assessments are the most accurate for the entire study group with the exception of a few cities, population based classes and assessments will be used for the purposes for this research.

Collision Rates

The primary measure of effectiveness for evaluating city collision trends is the collision rate. The significance of a city's collision rate is that it is a normalized indicator when comparing to other agencies. The most accurate method of calculating a collision rate is based on the ratio between the number of collisions and the population of an agency ($[(\text{Collisions})/(\text{Population}/1000)]$).

Various types of collision rates are used by police departments to target traffic enforcement and by engineers to establish traffic safety mitigation measures. While static collision rates or straight collision frequency is important for identifying specific problems for correction at the city level, the purpose of this study is to evaluate a city's ability to correct collision patterns over time, therefore the primary measure in this study is the annual average change in collision rates

For the purposes of this study collision rates are based on collision statistics and population numbers provided by Caltrans. Based on this information it is apparent that annual collision rates are rising despite the rates being normalized by population growth. The primary theory for this phenomenon is an inability of City's to respond to new collision patterns arising out of various change, not associated with increased exposure, such as overall infrastructure or behavioral shifts. However, within the scope of this thesis an explanation of what specific changes might be causing the increased rates could only be speculation and would certainly vary from agency to agency. Rather the intent of this research is to provide direction based on empirical evidence from past experience to agencies on what organizational structure would provide the appropriate capacity to respond to changes in collision rates.

Staffing Ratios

Staffing ratios represent the level of resources an agency adopts in order to address traffic safety issues. The significance of an agency's staffing to population ratio is that it is a normalized indicator for comparison with other agencies. Various types of staffing ratios are used by public agencies for particular functions, for example the *Traffic Control System Operations Manual*,¹⁵ published by the Institute of Transportation Engineers, establishes that approximately 20 hours of engineering staff time per signal per year is required to provide minimum operational requirements. This type of ratio would represent a staff-to-traffic signal ratio for signal operations. For the purposes of this study, the staff to population ratio shall be used as the measure of agency resource allocation, because as shown in Figure II-2 above, population is the

¹⁵ "Traffic Control System Operations", ITE 2000

most accurate collision prediction variable, and no other resource indicator has been identified in other publications or studies.

It is important to understand that transportation staff is essentially represented in two forms: internal staffing and outside consultants. Based on this researcher's professional experience, there is a clear dichotomy between these two forms of staffing: internal staff provide comprehensive ongoing programmatic and project specific services, whereas outside consultants typically provide narrow individual project by project design and study services. Outside contract staff more or less represent an extension of or supplement to internal agency staffing. As shown in the city survey data collected as part of this study, there are some cases where agencies rely solely on outside contract staffing; however, as represented in the SWITRS data, these agencies are ineffective in reducing collision rates. Because of the dichotomy between internal and outside consultant staffing, this study will only evaluate staff to population ratios in terms of internal staffing.

Chapter III: Local Agency Collision Rates

The method of understanding how effective local agencies are at responding to collision patterns is an evaluation of their annual number of collisions and their respective change in annual collision rates. As discussed previously, collision rates are based on a ratio between collisions and population. For the population data source, the U.S. Census Bureau statistics on demographics is considered to be the most comprehensive and accurate database, and therefore is used in this analysis. Collision statistics, such as total injury collisions, total fatal collisions, and total overall collisions were collected from the SWITRS for approximately 460 California local agencies from 2002 through 2005.

It is important to note that although SWITRS was used as the data source, the most accurate data source is from the individual cities themselves. As an example, a comparison of reported collisions in the SWITRS database versus reported collisions in the city of San Luis Obispo's local database indicated a 10% difference, primarily in property damage only collisions or late reports. While considered the most comprehensive database in the state, SWITRS does not accurately account for some collision types. According to the California OTS, in most cases the local databases more accurately represented actual collision history. This is also supported by an informal study this researcher conducted as the senior traffic engineer for the city of San Luis Obispo, and found that the state records database underreported collisions by approximately 10%-15% consistently each year when compared to the city's local database. These discrepancies are typically the result of reports that are taken too late to be incorporated in the SWITRS database, or are miscoded. However, since most

local agencies do not maintain their own databases, all California cities utilize the SWITRS dataset, and as the SWITRS database contains all severe collisions, the SWITRS data is the most appropriate for this study.

Class V Agencies (0 to 25,000 Population)

Figures III-1 and III-2, below, depict the overall collision number and average annual collision rate change for the 208 cities within the Class V agency group. The highest number of annual collisions in this group was 385 for the city of Santa Fe Springs in 2005, three agencies in this group had no injury or fatal collisions, and the median number of annual collisions for this group was 45. The highest collision rate (2002-2005) in the group was 1,358 collisions per capita for the city of Vernon, and the median annual collision rate for the group was three collisions per 1,000 capita. The highest average annual collision rate increase in the group was 50.7 collisions per 1,000 capita, and was also for the city of Vernon. The overall average collision rate increase for Class V agencies is approximately .11 collisions per 1,000 capita annually. Of the agencies in the group, 39% (82) experienced increases in collision rates.

Figure III-1: Class V Agency Average Annual Collision Rate

As discussed earlier, within the Class V agency group there are a few non-traditional cities that are primarily commercial and/or industrial based, for example, the city of Vernon, which only has a population of 91 in the year 2000. However, there are approximately 46,000 to 54,000 people employed by businesses within the city of Vernon. Another example is the city of Industry, which only has a population of approximately 777 in the year 2000; however there are approximately 80,000 people employed by businesses within the city of Industry. These non-traditional cities will yield non-comparable population based collision rates: however, since the median values are used in lieu of averages, these outlier non-traditional cities will not skew the data.

Class IV Agencies (25,000 to 50,000 Population)

Figures III-3 and III-4, below, depict the overall collision numbers and average annual collision rate change for the 94 cities within the Class IV agency group. The highest number of annual collisions in this group was 416, for the city of Palm Springs in 2005. The lowest number of annual collisions in this group

was 11 for the city of Soledad, also in 2005, and the median number of annual collisions was 127. The highest collision rate in the group was 12 collisions per 1,000 capita for the city of Eureka in 2005, and the median annual collision rate for the group was four collisions per 1,000 capita. The highest average collision rate increase (2002-2005) in the group was .51 collisions per 1,000 capita annually for the city of Paso Robles, and the overall average annual collision rate decrease for Class IV agencies is .5% per 1,000 capita annually. Of the agencies in the group, 35% (33) experienced rising collision rates.

Figure III-3: Class IV Agency Average Annual Collision Rate Change

Figure III-4: Class IV Agency 05' Collisions

Class III Agencies (50,000 to 100,000 Population)

Figures III-5 and III-6, below, depict the overall collision number and average annual collision rate change for the 96 cities within the Class III agency group. The highest number of annual collisions in this group was 717 for the city of Redding in 2005. The lowest number of annual collisions in this group was 54 for the city of Rancho Santa Margarita, also in 2005, and the median number of annual collisions was 310. The highest collision rate in the group was 8.5 collisions per 1,000 capita for the city of Cerritos in 2005, and the median annual collision rate for the group was 4.6 collisions per 1,000 capita. The highest average collision rate increase (2002-2005) in the group was 1.64 collisions per 1,000 capita annually for the city of Rancho Cordova, and the overall average annual collision rate decrease for Class III agencies is 1.3% per 1,000 capita annually. Of the agencies in this group, 31% (30) experienced rising collision rates.

Figure III-5: Class III Agency Average Annual Collision Rate Change

Figure III-6: Class III Agency 05' Collisions

Class II Agencies (100,000 to 250,000 Population)

Figures III-7 and III-8, below, depict the overall collision number and average annual collision rate change for the 49 cities within the Class II agency group. The highest number of annual collisions in this group was 1,436 for the city of Modesto in 2005. The lowest number of annual collisions in this group was 278 for the city of Daly City, also in 2005, and the median number of annual collisions was 711. The highest collision rate in the group was 8.25 collisions per 1,000 capita for the city of Ontario in 2005, and the median annual collision rate for the group was 5.5 collisions per 1,000 capita. The highest average collision rate increase (2002-2005) in the group was .41 collisions per 1,000 capita annually for the city of Palmdale, and the overall annual average collision rate decrease for Class II agencies is 2.4% per 1,000 capita annually. Of the agencies in this group, 24% (12) experienced rising collision rates.

Figure III-7: Class II Agency Average Annual Collision Rate Change

Figure III-8: Class II Agency 05' Collisions

Class I Agencies (250,000+ Population)

Figures III-9 and III-10, below, depict the overall collision number and average annual collision rate change for the 14 cities within the Class I agency group. The highest number of annual collisions in this group was 28,083 for the city of Los Angeles in 2005. The lowest number of annual collisions in this group was 1,070 for the City of Bakersfield, also in 2005, and the median number of annual collisions was 2,500. The highest collision rate in the group was 9.5 collisions per 1,000 capita for the city of Sacramento in 2005, and the median annual collision rate for the group was six collisions per 1,000 capita. The highest average collision rate increase (2002-2005) in the group was .28 collisions per 1,000 capita annually for the city of Anaheim, and the overall annual average collision rate decrease for Class I agencies is 1.9%. Of the agencies in this group, 21% (3) experienced rising collision rates.

Figure III-9: Class I Agency Average Annual Collision Rate Change

Figure III-10: Class I Agency 05' Collisions

Based on this statewide collision data, it is evident that overall, statewide collision rates are increasing by approximately 32% annually, and that

approximately one-third of all California cities are experiencing increases in overall collision rates. Smaller agencies in the Class V and IV groups have the highest overall increases, whereas the larger agencies in the Class III, II, and I groups are actually maintaining their rates or experiencing reductions.

Table III-1: California City Collision Rate Summary

Agency Class	Highest Ave. Ann. Collisions Per 1K Capita	Overall Ave. Ann. Increase	% Cities W. Increasing Rates
Class V	Vernon 50%	11.0%	39%
Class IV	Paso Robles 51%	0.5%	35%
Class III	Rancho Cordova 1.64%	-1.3%	31%
Class II	Palmdale 0.4%	-2.40%	24%
Class I	Anaheim 0.3%	-1.90%	21%

Chapter IV: City Administration

With a baseline measure of effectiveness established across all California cities, it is important to understand the methods, resources, and policies under which agencies operate that may affect the number of collisions those agencies experience and the changes in their annual collision rate. In order to collect and quantify this data, a survey was sent to all 460 incorporated cities in California, of which 16% replied. The response rate of the various city classification groups is shown in table IV-1 below.

Table IV-1: State Wide City Survey Responses

Classification Group	Total In Group	Total Responded	% Responded
Class V Cities	208	15	7%
Class IV Cities	94	19	20%
Class III Cities	96	21	22%
Class II Cities	49	18	36%
Class I Cities	13	2	15%

The survey included information regarding the distribution of resources between education, enforcement, and engineering efforts. The survey also included staff methodologies, traffic safety investigation programs, agency priorities, and general collision pattern corrective methodologies. The following sections are a summary of that survey; additionally, the raw survey data is included as Appendix A. It is important to understand that the nature of this survey could allow for responding cities to have a self-selecting bias; however, based on the range of responses, there are no apparent biases. In terms of resource allocations and agency priorities the term “Engineering” encompasses Capital projects, engineering staff, engineering studies, and surveys. The term “Enforcement” encompasses policing of traffic laws, law enforcement staff, specific enforcement campaigns.

Class V Agencies (0 to 25,000 Population)

Surveys were sent to all 208 agencies in this group, of which 7% responded. In regards to project funding and staff resources, 7% of agencies within this group primarily dedicated resources to education efforts, 20% to engineering efforts, and 73% to enforcement activities related to traffic safety. Nearly all agencies in this group rely on “outside” contract engineering services to evaluate, prioritize, and identify mitigation measures for safety issues as opposed to “in-house” engineering staff. About half of these agencies have no traffic engineering staff, and on average for this group, there are approximately 0.9 traffic engineering staff members per 10,000 citizens.

Half of the agencies within this group utilize state data for collision records and primarily rely on their police departments to maintain historical collision databases. Approximately only one-third of these agencies have established engineering oriented traffic safety programs; however, many of the objectives of these programs are specific to measures ranging from speed reduction to modifying maintenance schedules, as opposed to specifically reducing collision rates.

Class IV Agencies (25,000 to 50,000 Population)

Surveys were sent to all 94 agencies in this group, of which 20% responded. In regards to project funding and staff resources, 0% of agencies within this group primarily dedicate resources to education efforts, 42% to engineering efforts, and 58% to enforcement activities related to traffic safety. Approximately half of agencies in this group also primarily rely on “outside” contract engineering services, and half of agencies primarily rely on “in-house” engineering staff to evaluate, prioritize, and identify mitigation measures for safety. On average, agencies within this group have approximately 0.8 traffic

engineering personnel per 10,000 citizens; the smallest ratio is 0.3 for the city of Calexico, and the largest ratio is two for the city of San Dimas.

Of all of the agencies in this group, 58% utilize local collision reports for their collision databases, and 42% utilize state SWITRS data. The majority of these agencies maintain electronic collision databases within their engineering departments. Approximately 43% of these agencies have established engineering oriented traffic safety programs; however, the most common of the objectives of these programs are specific to evaluating the applicability and enforcement of policies, laws, and codes, as opposed to attempting specifically to address collision patterns.

Class III Agencies (50,000 to 100,000 Population)

Surveys were sent to all 96 agencies in this group, of which 22% responded. In regards to project funding and staff resources, 0% of agencies within this group primarily dedicated resources to education efforts, 62% to engineering efforts, and 38% to enforcement activities related to traffic safety. Approximately 28% of agencies in this group rely primarily on “outside” contract engineering services, and 72% primarily rely on “in-house” engineering staff to evaluate, prioritize, and identify mitigation measures for safety. On average, agencies within this group have approximately 0.4 traffic engineering personnel per 10,000 citizens; the smallest ratio is 0.1 for the city of Buena Park, and the largest ratio is 0.7 for the city of Whittier.

Of all the agencies in this group, 72 % utilize local collision reports for their collision databases, and 27% utilize state SWITRS data. The majority of these agencies maintain electronic collision databases within their engineering departments. Approximately 64% of these agencies have established

engineering oriented traffic safety programs; however, the most common of the objectives of these programs are again specific to evaluating the applicability and enforcement of policies, laws, and codes, as opposed to specifically attempting to address collision patterns.

Class II Agencies (100,000 to 250,000 Population)

Surveys were sent to all 49 agencies in this group, of which 36% responded. In regards to project funding and staff resources, 0% of agencies within this group primarily dedicated resources to education efforts, 61% to engineering efforts, and 39% to enforcement activities related to traffic safety. Generally, all of the agencies in this group rely on “in-house” engineering staff as opposed to “outside” contract engineering services to evaluate, prioritize, and identify mitigation measures for safety. On average, agencies within this group have approximately 0.3 traffic engineering personnel per 10,000 citizens; the smallest ratio is 0.07 for the city of Orange, and the largest ratio is 0.9 for the city of Vallejo.

Of all the agencies in this group, 61 % utilize local collision reports for their collision databases, and 39% utilize state SWITRS data. Generally, all of these agencies maintain electronic collision databases within their engineering departments. Approximately 60% of these agencies have established engineering oriented traffic safety programs, the majority of which are established to identify and mitigation collision pattern types and frequencies at specific locations.

Class I Agencies (250,000 + Population)

Surveys were sent to all 13 agencies in this group, of which 15% (2) responded. In regards to project funding and staff resources, 100% of agencies

within this group primarily dedicated resources to engineering efforts. Generally, all of the agencies in this group primarily rely on “in-house” engineering staff as opposed to “outside” contract engineering services to evaluate, prioritize, and identify mitigation measures for safety. On average, agencies within this group have approximately 0.2 traffic engineering personnel per 10,000 citizens; the smallest ratio is 0.08 for the city of Long Beach, and the largest ratio is 0.3 for the city of San Diego.

Of the agencies in this group, all utilize local collision reports for their collision databases as opposed to state SWITRS data. The majority of these agencies maintain electronic collision databases within their engineering departments. Generally, all of these agencies have established engineering oriented traffic safety programs, all of which were established to identify and mitigation collision pattern types and frequencies at specific locations.

Table IV-2, below, shows the typical corrective measures used by the various agency classifications to correct particular collision types.

Table IV-2: Typical City Corrective Measures By Classification

Collision Type	Typical Corrective Measure
Class I	
Head-On	Signing & Striping Modifications, Centerline Barriers
Sideswipe	Striping Modifications & Centerline Barriers
Rear-End	Signal Timing Modifications, Signal Indication Modifications
Broad-Side	Signal & Stop Control Modifications, Signal Timing Modification, Sight Distance Imp.
Auto Vs. Ped.	Signal Timing, Signal Indication Improvements
Auto Vs. Bike	Signing & Striping, New Facility Construction
Class II	
Head-On	Signing & Striping Modifications, Centerline Barriers
Sideswipe	Signing & Striping
Rear-End	Signal Timing Modifications
Broad-Side	Signal & Stop Control Modifications, Signal Timing Modification, Sight Distance Imp.
Auto Vs. Ped.	Signing & Striping, New Facility Construction
Auto Vs. Bike	Signing & Striping, New Facility Construction
Class III	
Head-On	Medians & Centerline Barriers
Sideswipe	Signing & Striping, Speed Reduction Measures
Rear-End	Signal Timing Modifications, Sight Distance Improvments
Broad-Side	Signal & Stop Control Modifications, Signal Timing Modification
Auto Vs. Ped.	Signal Timing Modifications, Signal Indication Improvements, Sight Distance Improvements
Auto Vs. Bike	Signing & Striping / New Bicycle Facility Construction
Class IV	
Head-On	Signing & Striping Modifications, Centerline Barriers
Sideswipe	Signing & Striping, Speed Reduction Measures
Rear-End	Signal Timing Modifications
Broad-Side	Signal & Stop Control Modifications, Signal Timing Modification, Movement Restrictions
Auto Vs. Ped.	Signing & Striping, New Facility Construction
Auto Vs. Bike	Signing & Striping, New Facility Construction
Class IV	
Head-On	Geometric Mods & Rounabouts
Sideswipe	None
Rear-End	Signing & Striping
Broad-Side	Signal & Stop Control Modifications / Movement Restrictitons
Auto Vs. Ped.	Signing & Striping
Auto Vs. Bike	Signing & Striping / New Bicycle Facility Construction

Chapter V: Statewide City Collision Trends

With a baseline measure of effectiveness established across all California cities, and an understanding of current administrative methodologies, it is important to understand the specific conditions and factors that may be contributing to particular collision patterns in order to evaluate appropriate mitigation methodologies. As part of this research, a sample of 32,000 individual collisions were analyzed for key collision pattern indicators. The data sample of 32,000 collisions is a complete three-year collision history (2004-2006) for five randomly selected cities, one from each classification group. The 32,000 collisions is a 2% representative sample of the two million collisions that occurred in California from 2004 to 2006.

Collision types are the primary basis for any form of pattern identification; in California there are nine types of ways an officer can classify a collision. These collision types are shown in Table V-1 below.

Table V-1: California Collision Types

Rearend	Pedestrian
Broadside	Overtaken
Sideswipe	Other
Headon	N/A
HitObject	

In this researcher's professional experience, he has found that there are typically five key indicators for identifying corrective strategies for collision patterns. What follows is a summary of those key indicators:

Five Key Indicators

I - Total collisions in pattern with a frequency of three or more. Any pattern with a collision frequency of three or more of the same type, within one hundred feet from each other, and within a 12-month period is identifiable, and is in this researcher's experience most commonly considered potentially correctable. These represent an identifiable collision pattern that could potentially be corrected regardless of cost.

II – Collision severity. Collision severity is the category assigned to a collision to indicate how significant the collision was. In California, there are five categories for collision severity that a officer can use to classify a collision. These categories are shown in Table V-2, below.

Table V-2: California Collision Severity Types

Property Damage Only (PDO)	Severe Injury
Complaint of Pain	Fatal
Visible Injury	

III – Causal violation. Causal violation is the violation of the California Vehicle Code that occurred which resulted in the collision. In California, there are 17 violation categories that an officer can assign to a collision. These violations are shown in Table V-3, below.

Table V-3: California Causal Violations

Under the Influence (DUI)	Improper Passing	Traffic Signal
Impeeding Traffic	Improper Lane Change	Parking
Speeding	Improper Turning	Equipment Failure
Too Close	Automobile Right of Way	N/A
Wrong Lane	Pedestrian Right of Way	

IV – Contributing factor. Contributing factor refers to any conditions or actions secondary to the causal violation category that may have contributed to the collision. In California, there are nine factors that an officer can assign to a collision. These factors are shown in Table V-4, below.

Table V-4: California Contributing Factors

None	Congestion	Defective Equipment
Inattention	Sight Distance	Other
Previous Violation	Other Vehicle	N/A

V – Movement preceding collision. Party at fault movement preceding a collision refers to an action made by the party at fault that resulted in a collision. In California, there are 17 categories that an officer can use to classify a collision. These movements are shown in Table V-5, below.

Table V-5: California Movements Preceding Collision

Straight	U-Turn	Off Road
Right	Slowing / Stopping	Other Turn
Left	Stopped	Other
Backing	Wrong Way	N/A
Changing Lanes	Parked	
Entering Traffic	Parking	

As part of this assessment the number of correctable collisions within each collision type was also evaluated to understand the collision reduction potential. Collisions are considered correctable when they occur in groups of three or more in an associated period of time, associated spatial location, and associated roadway conditions. This methodology is supported by the fact that any collision pattern can be corrected by some measure regardless of cost of secondary impact. However, because this methodology ignores unjustifiable measures due to cost and secondary impacts the total reduction potential will inevitably be higher than actual reduction potential.

Statewide City Collision Trends

The most common collision types among cities are rear-ends at 30%, broadsides at 26%, and sideswipes at 20%. Collision frequencies are shown in Figure V-1, below.

Approximately 15% of all collisions within California cities can be considered potentially correctable. Rear-ends have the highest percentage of correctable collisions, with approximately 23% being correctable, while 19% of broadsides are correctable, and 11% of sideswipes and hit objects are correctable. Correctable collision percentages are shown in Figure V-2, below.

Although some collision types may have higher frequencies than others, priority is often placed on collision patterns of higher severity. Pedestrian collisions have the highest frequency of injury and fatal related collisions. Overturned collisions have the highest percentage of injury and fatal collisions not involving a pedestrian. Sideswipe collisions have the lowest percentage of

injury and fatal collisions. Collision severity frequency by collision type is shown in Figure V-3, below.

Rear-end collision trends. Rear-end collisions typically have a lower severity than most other collision types; As shown in Figure V-3, approximately 70% of all rear-end collisions result in property damage only. Less than 7% of rear-end collisions result in visible injuries or worse. Rear-end collisions are primarily caused by speeding and following too close, and those two causal factors combined result in approximately 72% of rear-end collisions. Another common casual violation is equipment failure, typically seen as a result of failing to properly maintain brakes, and this results in approximately 7% of rear-end collisions. Causal violations for rear-end collisions are shown in Figure V-4, below.

Typically, rear-end collisions have no secondary factors contributing to the collision; the primary violation is the sole causal factor in approximately 67% of rear-end collisions. However, inattention is a contributing factor in approximately 14% of rear-end collisions. Additional violations, such as speeding, are also attributed as contributing factors in 11% of rear-end collisions. The frequency of secondary factors in rear-end collisions are shown below in Figure V-5.

The two most common “at-fault” movement types preceding a rear-end collision are straight and slowing. Straight movements are the most common at 74%. Left turns and backing is also attributed to approximately 10% of rear-end

collisions. The frequencies of movements prior to rear-end collisions are shown below in Figure V-6.

Broadside collision trends. Broadside collisions are typically a higher priority for collision pattern mitigation, and are commonly the focus of traffic control warrant justification, such as traffic signal and stop sign collision warrants, most likely because broadsides have a relatively high severity for being the second most common collision type. As shown in Figure V-3, approximately 40% of broadside collisions result in injuries, with over 14% resulting in visible injuries or worse. The most common causal violation types among broadside collisions are right-of-way and traffic signal violations, which occur in approximately 60% of broadside collisions as either failing to stop at a stop sign or red traffic signal indication. Illegal turning movements contribute to 10% of broadside collisions. The frequency of causal violations for broadside collisions is shown below in Figure V-7.

Approximately 72% of broadside collisions have no secondary factor contributing to the collision; the primary violation is typically the sole causal factor. Inattention is also attributed as a secondary factor in 12% of broadside collisions, and additional violations, such as speeding, are attributed as secondary factors in 10% of broadsides. The frequency of secondary factors in broadside collisions is shown below in Figure V-8.

The two most common “at-fault” movement types preceding a broadside collision are straight and left turn, again typically in the form of failing to stop for a

stop sign or red signal indication. The frequency of movements preceding broadside collisions is shown below in Figure V-9.

Sideswipe collision trends. Sideswipe collisions have the lowest severity of all collision types, primarily due to the indirect glancing nature of the collision type. As shown in Figure V-3, approximately 85% of all sideswipe collisions result in property damage only. Of the other 15% percent resulting in injuries, 10% are complaints of pain. Sideswipe collisions are primarily caused by illegal lane changes and turning movements, occurring in approximately 54% of sideswipe collisions. The frequency of sideswipe causal violations is shown below in Figure V-10.

Approximately 70% of sideswipe collisions have no secondary factor contributing to the collision; the primary violation is typically the sole causal factor. Additional violations, such as speeding, are attributed as secondary factors in 13%, and inattention is attributed as a secondary factor in 10% of sideswipe collisions. The frequency of secondary factors in sideswipe collisions is shown below in Figure V-11.

The two most common “at-fault” movement types preceding a sideswipe collision are straight and changing lane. Straight movements precede collisions in approximately 37% of sideswipes, and lane changes precede collisions in

approximately 20%. The frequency of movements preceding sideswipe collisions is shown below in Figure V-12.

Hit-object collision trends. Hit-object collisions have a relatively low severity compared to other collision types. The physical nature of collisions within this category can vary substantially, from a vehicle hitting a small animal in the roadway, to a vehicle running off the road and hitting a utility pole. As shown in Figure V-3, approximately 74% all hit -object collisions result in property damage only. Of the 16% resulting in injury, 10% are complaints of pain. Illegal turning movements are the most common causal violations, leading to hit -object collisions in approximately 35% of hit -object collisions. Excessive speed also is attributed to 23% of hit -object collisions, and driving under the influence in 11%. The frequency of hit -object causal violations is shown below in Figure V-13.

Approximately 65% of hit-object collisions have no secondary contributing factor; the primary violation is typically the sole causal factor. Additional violations, such as speeding, are attributed as secondary factors in 17% of the collisions, and inattention is attributed as a secondary factor in 7% of the collisions. The frequency of secondary factors in hit-object collisions is shown below in Figure V-14.

The two most common “at-fault” movement types preceding a hit-object collision are straight and other. Straight movements are the most common at

31%, and other movements are the second most common at 17%. “Other” movements are categorized as unusual movements that cannot be defined by the standard 17 movement types in California. The frequency of movements preceding hit-object collisions is shown below in Figure V-15.

Head-on collision trends. Head-on collisions have a relatively high severity compared to other collision types. As shown in Figure V-3, approximately 40% of all head-on collisions result in injuries, of which 1% are typically fatal. Head-on collisions are primarily caused by right-of-way violations and illegal turning movements, occurring in approximately 45% of head-on collisions. Most commonly, this is presented as a vehicle turning left from a major street to a side street under a permissive movement and failing to yield to oncoming traffic. Traveling the wrong way also contributes to 9% of head-on collisions. The frequency of head-on causal violations is shown below in Figure V-16.

Approximately 60% of head-on collisions have no secondary factor contributing to the collision; the primary violation is typically the sole causal factor. Additional violations, such as speeding, are attributed as secondary factors in 18% of the head-on collisions, and inattention is attributed as a secondary factor in 13%. The frequency of secondary factors in head-on collisions is shown below in Figure V-17.

The two most common “at-fault” movement types preceding a head-on collision are straight and left turns, which is consistent with the casual violations. The frequency of movements preceding head-on collisions is shown below in Figure V-18.

Overturned collision trends. Overturned collisions have relatively higher severity than most collision types. As shown in Figure V-3, approximately 52% of all overturned collision result in injuries. Overturned collisions are primarily the

result of speeding violations, occurring in approximately 36% of overturned collisions. Additionally, turning violations contribute to 30%. The frequency of overturned collision causal violations is shown below in Figure V-19.

Approximately 63% of overturned collisions have no secondary factor contributing to the collision; the primary violation is typically the sole causal factor. Secondary violations such as speeding are attributed to 17% of overturned collisions. Inattention is attributed as a secondary factor in 6% of overturned collisions. The frequency of secondary factors in overturned collisions is shown below in Figure V-20.

The most common “at-fault” movement type preceding an overturned collision is straight. Straight movements are the most common at 51%, and other unclassifiable movements are the second most common at 14%. Additionally, changing lanes and right turns contribute to 8%, respectively, of overturned collisions. The frequency of movements preceding overturned collisions is shown below in Figure V-21.

Pedestrian collision trends. As to be expected, pedestrian collisions have the highest severity of all collision types. As shown in Figure V-3, approximately 88% all pedestrian collisions result in injuries, of which 45% result in visible or severe injuries and 3% result in a fatality. The physical nature of pedestrian collisions can also vary substantially, from collisions at signalized intersection to collisions on the shoulder of rural arterials. Pedestrian collisions are primarily caused by vehicles violating a pedestrian's right-of-way, most commonly turning right at an intersection while looking left for oncoming traffic. Pedestrians violating vehicle right-of-way is attributed to 26% of pedestrian collisions, represented most commonly by stepping from a sidewalk into oncoming traffic. The frequency of pedestrian collision causal violations is shown below in Figure V-22.

Approximately 68% of pedestrian collisions have no secondary factor contributing to the collision; the primary violation is typically the sole causal factor. Inattention is attributed as a secondary factor in 15% of collisions, and secondary violations such as speeding are attributed to 8% of pedestrian

collisions. The frequency of secondary factors in pedestrian collisions is shown below in Figure V-23.

The two most common “at-fault” movement types preceding a pedestrian collision are straight and right turns. Straight movements are the most common at 43%, and right turns are the second most common at 14%. In addition, left turns contribute to 11% of pedestrian collisions. The frequency of movements preceding pedestrian collisions is shown below in Figure V-24.

Chapter VI: Collision Pattern Mitigation Overview

Based on statewide collision statistics and a survey of California cities, there appears to be a correlation between administrative methodologies and changes in annual collision rates. If this correlation does exist, it's important to further understand what factors lead to the collision types, and how to correct them in order to achieve declining collision rates.

Rear-End Collisions

The large majority of rear-end collisions have a relatively low severity, with approximately 70% resulting in property damage only, and 24% resulting in complaints of pain. Having primarily low severity, rear-end collisions also carry much lower comprehensive costs; approximately \$2,300 per event.¹⁶ The low severity nature of these collision types and the low costs associated with them may be an indication as to why a high percentage of these collisions are potentially correctable collisions. Whereas improvements are difficult to justify for agencies using traditional cost benefit models, these collisions don't carry much public interest, and are subsequently easily overlooked by agencies. However, rear-end collisions are the most frequent collision type at approximately 30% of all collisions.

In general, rear-end collisions are primarily caused by speeding and occasionally contributed to by inattention while preceding straight, typically on an approach to an intersection. The *NHCRP Report 500* has identified two strategies for addressing these particular factors contributing to rear-end collisions: 1) improve driver awareness of intersections and sight distance from the intersection approach, and 2) reduce operating speeds on specific

¹⁶ "Traffic Safety Facts 2002" NHTSA, January 2004 (adjusted to 2007 \$'s)

intersection approaches. These two strategies are generally consistent with overall rear-end collision trends.

Intersection awareness. Particularly at un-signalized intersections, and depending on intersection facilities, a driver may have difficulty perceiving an approaching intersection and not have the ability to react appropriately before arriving at the intersection. At signalized intersections, a particular concern is not only a driver's ability to perceive an intersection that they are approaching, but also the vehicles queued at the intersection on that particular approach. The NCHRP Report 500 suggests that advance signing and pavement delineation is an appropriate mitigation measure for such a collision pattern:

Making drivers aware that they are approaching an intersection, through the use of enhanced signing and delineation, should improve safety at the intersection because drivers will be more alert. This heightened awareness will quicken drivers' reaction times when conflicts occur.

However, the effectiveness of this strategy has not been quantified.¹⁷ Particularly at signalized intersections, the NCHRP Report 500 suggests that intersection lighting and specialized queue detection is an appropriate mitigation measure for rear-end collision patterns.

Of a particular concern for cities that struggle with traffic congestion are rear-end traffic collisions, with congestion as a contributing factor. In April of 2005, the National Transportation Operations Coalition (NTOC) finalized results on a "traffic signal report card" study. The purposes of this study were to assess the state of practice for signal operations, and to develop a case for improving traffic signal management programs. The results of the study indicated that the overall scores for the U.S. were low. Of all the responding agencies, 68% either

¹⁷ "NCHRP Report 500: Guidance for Implementation of the Strategic Highway Safety Plan" TRB, 2003

had no documented management plan for their signal operations or were managing their signals on an *ad hoc* basis, 57% of agencies were not conducting routine reviews of signal timing and operation parameters on coordinated corridors, and 77% were not conducting routing reviews at individual intersections.¹⁸ While this report is primarily related to traffic operations, the safety implications are clear. Most agencies are not only neglecting performance, but also the safety implications that are inherently associated with efficient signal operations.

Operating speeds. Speeding is the most common type of violation leading to rear-end collisions, occurring in approximately 64% of reported incidences. This issue is particularly difficult to address from an engineering perspective, because rear-end collisions occurring as the result of speeding are likely the most human behavioral dependent type of collisions, unlike most other collision types that are typically a combination of behavioral, vehicle, and roadway factors. For lower volume local and collector roadways, traffic calming is the typical approach to reduce operating speeds. There are essentially three types of speed calming measures; vertical deflection, horizontal deflection, and horizontal narrowing.

Types of vertical deflection measures include speed humps, speed tables, raised crosswalks, raised intersections, and textured pavements. Studies have shown a 22% reduction in speed and an 11% to 41% reduction in traffic collisions after the installation of speed tables, and an average 18% reduction in speeds and a 45% reduction in collisions after the installation of speed tables. Types of horizontal deflection measures include traffic circles, roundabouts, chicanes, and

¹⁸ “The National Traffic Signal Report Card” ITE, June 2005

intersection realignments. Studies have shown an average of 11% reduction in speeds and a 73% reduction in collisions after the installation of traffic circles.

Types of horizontal narrowing include neck downs, medians, and chokers.¹⁷

Studies have shown an average 7% reduction in speeds after the installation of various horizontal narrowing measures.¹⁷

For higher volume arterial-type roadways, traffic calming is typically not ideal because of the significant operational impacts; therefore, enforcement is typically the most common method of speed reduction. However, the inherent issue with using enforcement as a speed reduction measure is that it only achieves periodic effectiveness. For example, an agency is unable to police every stretch of roadway during all periods of time, and this increases the propensity of drivers to speed. Automated enforcement, although not very prevalent, is becoming more commonly accepted as the resolution to this issue.

From 1979 to 2004, both the U.S. & UK experienced an average annual 2.6%-2.7% increase in Vehicle Miles Traveled (VMT); however in that same time period, Britain experienced a 53% reduction in fatalities, whereas the U.S. only experienced a 6% reduction. A strong indication as to why such a large difference exists between the two nations is the volume of speed-related collisions and the use of speed cameras. Speed cameras are used heavily throughout Britain, whose percent of speed related crashes is approximately 17%, whereas speed cameras are only used in six of the 52 states here in the U.S., to a percentage of speed-related crashes almost double that of Britain's at 31%.¹⁹

¹⁹ "Traffic Safety Facts 2002" NHTSA, January 2004

Broadside Collisions

Broadside collisions account for the second most common collision type, consisting of approximately 25% of all reported collisions. Aside from overturned and pedestrian collisions, broadside collisions have the highest severity of all collision types, with approximately 42% resulting in injuries and 0.5% resulting in fatalities. Having higher severity, broadside collisions carry much higher comprehensive costs; on average, they cost approximately \$36,000 per event.²⁰ The high severity of these collision types and the high cost associated with them may be an indication as to why these collisions are most commonly used for justification for all-way stop control and signalization as part of typical warrant analyses.

In general, broadside collisions are caused by right-of-way type violations that include not heeding traffic signals and stop signs. Primarily broadside collisions are caused by vehicles making left turns and by vehicles proceeding straight. Because broadside collisions are generally caused by right-of-way type violations, the strategy established by the *CalTrans Traffic Manual* and the California MUTCD is to install and/or upgrade additional right-of-way controls. These manuals establish thresholds for which protected left turn phasing, all-way stop control, or signalization is justified. The number of broadside collisions is the primary factor used to satisfy these thresholds.

For signalized intersections, the *Traffic Engineering Handbook*²¹ has also identified visibility and inadequate signal timing and possible causes of broadside collisions. The NCHRP Report 500 also identified visibility and driver compliance with control as possible causes. For unsignalized intersections, the *Traffic Engineering Handbook* identifies approach speeds and high volumes in addition

²⁰ "Traffic Safety Facts 2002" NHTSA, January 2004

²¹ "Traffic Engineering Handbook 5th Ed." ITE, 1999

to inadequate sight distance as possible causes of broadside collisions. In general, there are three strategies for correcting broadside collisions: improving intersection sight distance, installing appropriate controls for the volume of traffic (i.e., traffic signals), and reducing operating speeds.

Sideswipe Collisions

Sideswipes account for the third most common collision type, consisting of approximately 20% of all reported collisions. Sideswipe collisions have the lowest severity of all collision types with approximately 15% resulting in injuries and 0.2% resulting in fatalities. Having the lowest severity, sideswipe collisions also carry lower comprehensive costs; on average approximately \$15,800 per event.²² Similar to rear-end collisions, the low severity nature of these collision types and the low costs associated with them may be an indication as to why a high percentage of these collision types are potentially correctable.

Sideswipe collisions are most commonly caused by lane changes and turning movements. The *Traffic Engineering Handbook* has identified two strategies for addressing these factors that contribute to sideswipe collisions: 1) improve lane delineation and signing, and 2) reduce operation speeds. These two strategies are generally consistent with overall rear-end collision trends.

Methods for reducing operating speeds is discussed in the section on rear-end collisions. Methods for improving lane delineation and signing include installing/improving centerlines, lane lines, and edge lines, installing reflective markers, improving channelization with acceleration/decelerations lanes and turning bays, and providing adequate directional and warning signs.

²² "Traffic Safety Facts 2002" NHTSA, January 2004

Hit-object Collisions

Hit-object collisions account for the fourth most common collision type, consisting of approximately 8% of all reported collisions. Over 90% of hit-object collisions are vehicle versus animal, and the remaining 10% generally include hitting parked cars or roadside objects. Hit-object collision types are of relatively low severity, with approximately 25% resulting in injuries and 1% resulting in fatalities. Having low severity, hit-object collisions also carry higher comprehensive costs; on average, they cost approximately \$49,000 per event.²³ Given that these collision types are primarily related to animals entering the roadway in front of vehicles, the percentage of potentially correctable collisions is low.

According to the *NCHRP Synthesis 370 Report*, “In the United States, the total number of annual deer-vehicle collision was estimated at more than 1 million in the early 1990’s. These collisions were estimated to cause 155-211 human fatalities, 13,700-29,000 human injuries, and more than \$1 billion in property damages a year.” The NCHRP Synthesis 370 Report identifies two strategies for mitigating animal versus vehicle collisions: 1) work with wildlife officials to develop safe animal crossing provisions, and 2) identify common wildlife crossings and post warning signs for drivers.

Head-on Collisions

Head-on collisions account for the fifth most common collision type, consisting of approximately 3% of all reported collisions. Head-on type collisions are typically of high severity, with approximately 40% resulting in injuries, and 1%

²³ “Traffic Safety Facts 2002” NHTSA, January 2004

resulting in fatalities. Having high severity, head-on collisions also carry higher comprehensive costs; on average, they cost approximately \$48,000 per event.²⁴

In general, head-on collisions are primarily caused by right-of-way violations by vehicles making left turns. The *NCHRP 500* identifies two strategies for mitigating head-on collisions: 1) prevent vehicles from encroaching into opposite lane, and 2) minimize the likelihood of crashing into oncoming vehicle. These strategies seem to be consistent only with a small portion of head-on collision types, those primarily associated with roadway curvature; however, the majority of head-on collisions within the jurisdiction of local agencies appears to be at intersections. Similar to broadside collisions, head-on collisions are typically caused by right-of-way violations. Typical mitigation for this collision type should be consistent with broadside collision pattern correction; reduce operating speeds and improve traffic controls.

²⁴ “Traffic Safety Facts 2002” NHTSA, January 2004

Chapter VII: Findings

City Collision Trends and Administrative Methodologies

Based on annual collision totals, rates, agency resources, methodologies and collision type factors, it is evident that there is a correlation between how an agency chooses to function and collision rate performance. Based on agency surveys conducted as part of this research, there also appears to be a distinction between what level of resources and methodologies are consistent with declining and increasing collision rates among each of the agency classifications.

Class V Cities. The Class V group consists of 208 cities with populations ranging from zero to 25,000. The demographics of Class V agencies show that they are typically older and less educated in comparison to other agency classifications, with the median age of approximately 36 years. The median percent of population with higher education is approximately 10%. Class V cities only allocate approximately 20% of traffic safety resources to engineering efforts, with over 70% going to enforcement. Class V cities also have a relatively low staff per capita ratio of 0.9:10,000. Ultimately, overall collision rates among Class V agencies are increasing by approximately 12% each year, as 40% (83) of all Class V agencies are experiencing increased collision rates annually.

When comparing those cities in this classification that are experiencing increasing collision rates versus those experiencing decreasing collision rates, both have similar demographics. As shown in Table VII-1, below, the results of an equal variance two sample t-test for total population, median age, and percent of population with higher education result in a low p value, indicating similar

variances in the populations of both rising collision rate cities and decreasing collision rate cities.

Table VII-1 Class V City Demographic T-Test: Rising Collision Rate Cities vs Decreasing Collision Rate Cities				
		Observations	Mean	P-Value
Total Population	Rising Rates	81	10,975	0.324
	Decreasing Rates	125	11,422	
Median Age	Rising Rates	81	36.86	0.398
	Decreasing Rates	125	36.57	
% Higher Edu.	Rising Rates	81	17.70%	0.342
	Decreasing Rates	125	16.75%	

Although these cities are demographically similar, cities with increasing collision rates have significantly lower staff per capita ratios, lower allocation of resources to engineering efforts, and are more reactive as opposed to routine when compared to cities with declining collision rates, as shown in Table VII-2, below.

Table VII-2: Class V Cities - Performance Comparison		
	INCREASING RATES	DECLINING RATES
AVE. STAFF PER CAPITA	0.78 : 10,000	1.30 : 10,000
AVE. ENGINEERING RESOURCE	31%	40%
PREDOMINANT METHODOLOGY	Reactive	Routine/Proactive

Increasing collision rates are defined as any positive rate above .0001, and decreasing rates are defined as any negative rate below -.0001.

Class IV Cities. The Class IV group consists of 94 cities with populations ranging from 25,000 to 50,000. The demographics of Class IV agencies show that they are typically close to middle age and are the highest educated in comparison to other agency classifications, with the median age of approximately 34 years. The median percent of population with higher education is approximately 15%. Class IV cities allocate approximately 40% of traffic safety resources to engineering efforts and 60% to enforcement. Class IV cities also

have a relatively low staff per capita ratio of 0.8:10,000. Ultimately, overall collision rates among Class IV agencies are relatively unchanged each year; however, 35% (33) of all Class IV agencies are experiencing increased collision rates annually.

When comparing those cities in this classification that are experiencing increasing collision rates versus those experiencing decreasing collision rates, both have similar demographics. As shown in Table VII-3, below the results of an equal variance two sample t-test for total population, median age, and percent of population with higher education result in a low p value, indicating similar variances in the populations of both rising collision rate cities and decreasing collision rate cities.

Table VII-3 Class IV City Demographic T-Test: Rising Collision Rate Cities vs Decreasing Collision Rate Cities				
		Observations	Mean	P-Value
Total Population	Rising Rates	32	38,700	0.016
	Decreasing Rates	60	35,251	
Median Age	Rising Rates	32	35.05	0.122
	Decreasing Rates	60	33.65	
% Higher Edu.	Rising Rates	32	17.40%	0.478
	Decreasing Rates	60	17.58%	

Although these cities are demographically similar, cities with increasing collision rates have significantly lower staff per capita ratios, lower allocation of resources to engineering efforts, and are more reactive as opposed to routine when compared to cities with declining collision rates, as shown in Table VII-4, below.

Table VII-4: Class IV Cities - Performance Comparison		
	INCREASING RATES	DECLINING RATES
AVE. STAFF PER CAPITA	0.60 : 10,000	0.92 : 10,000
AVE. ENGINEERING RESOURCE	47%	50%
PREDOMINANT METHODOLOGY	Reactive	Routine/Proactive

Class III Cities. The Class III group consists of 96 cities with populations ranging from 50,000 to 100,000. The demographics of Class III agencies show that they are typically close to median middle age, and are also close to median education in comparison to other agency classifications, with the median age of approximately 34 years, and the median percent of population with higher education is approximately 12%. Class III cities allocate approximately 60% of traffic safety resources to engineering efforts and 40% to enforcement. Class III cities also have a relatively high staff per capita ratio of 0.4:10,000. Ultimately, overall collision rates among Class III agencies are declining each year: however 31% (30) of all Class III agencies are annually experiencing increased collision rates.

When comparing those cities in this classification that are experiencing increasing collision rates versus those experiencing decreasing collision rates, both have similar demographics. As shown in Table IV-5, below, the results of an equal variance two sample t-test for total population, median age, and percent of population with higher education result in a low p value, indicating similar variances in the populations of both rising collision rate cities and decreasing collision rate cities.

Table VII-5 Class III City Demographic T-Test: Rising Collision Rate Cities vs Decreasing Collision Rate Cities				
		Observations	Mean	P-Value
Total Population	Rising Rates	29	68,190	0.187
	Decreasing Rates	65	70,952	
Median Age	Rising Rates	29	34.36	0.093
	Decreasing Rates	65	33.04	
% Higher Edu.	Rising Rates	29	17.66%	0.208
	Decreasing Rates	65	15.55%	

Although these cities are demographically similar, cities with increasing collision rates have significantly lower staff per capita ratios, lower allocation of

resources to engineering efforts, and are more reactive as opposed to routine when compared to cities with declining collision rates, as shown in Table VII-6, below.

Table VII-6: Class III Cities - Performance Comparison

	INCREASING RATES	DECLINING RATES
AVE. STAFF PER CAPITA	0.31 : 10,000	0.49 : 10,000
AVE. ENGINEERING RESOURCE	48%	50%
PREDOMINANT METHODOLOGY	Reactive	Routine/Proactive

Class II Cities. The Class II group consists of 49 cities with populations ranging from 100,000 to 250,000. The demographics of Class II agencies are slightly younger and more educated in comparison to other agency classifications, with the median age of approximately 33 years, and the median percent of population with higher education is approximately 13%. Class II cities allocate approximately 61% of traffic safety resources to engineering efforts and 39% to enforcement. Class II cities also have a relatively high staff per capita ratio of 0.3:10,000. Overall collision rates among Class II agencies are declining each year; however, 24% (12) of all Class III agencies are annually experiencing increased collision rates.

When comparing those cities in this classification that are experiencing increasing collision rates versus those experiencing decreasing collision rates, both have similar demographics. As shown in Table VII-7, below, the results of an equal variance two sample t-test for total population, median age, and percent of population with higher education result in a low p value, indicating similar variances in the populations of both rising collision rate cities and decreasing collision rate cities.

Table VII-7 Class II City Demographic T-Test: Rising Collision Rate Cities vs Decreasing Collision Rate Cities				
		Observations	Mean	P-Value
Total Population	Rising Rates	11	143,021	0.476
	Decreasing Rates	36	142,313	
Median Age	Rising Rates	11	32.2	0.400
	Decreasing Rates	36	32.48	
% Higher Edu.	Rising Rates	11	16.67%	0.153
	Decreasing Rates	36	13.86%	

Although these cities are demographically similar, cities with increasing collision rates have significantly lower staff per capita ratios, lower allocation of resources to engineering efforts, and are more reactive as opposed to routine when compared to cities with declining collision rates, as shown in Table VI-4, below.

Table VII-8: Class II Cities - Performance Comparison		
	INCREASING RATES	DECLINING RATES
AVE. STAFF PER CAPITA	0.25 : 10,000	0.35 : 10,000
AVE. ENGINEERING RESOURCE	41%	42%
PREDOMINANT METHODOLOGY	Reactive	Routine/Proactive

Class I Cities. The Class I group consists of 13 cities with populations over 250,000. The demographics of Class I agencies show that they are younger and more educated in comparison to other agency classifications, with the median age of approximately 31 years, and the median percent of population with higher education is approximately 13%. All Class I cities that responded to the survey predominately allocated more resources to engineering efforts as opposed to enforcement. Class I cities also have a relatively low staff per capita ratio of 0.2:10,000. Of the two Class I agencies that responded to the survey, both are experiencing decreasing collision rates.

Collision Patterns and Mitigation Strategies

Based on statewide collision data, there are specific factors that most commonly contribute to specific collision types and typically site-specific collision patterns. The three most common and correctable collision types or patterns are rear-end, broadside, and sideswipe collisions.

Rear-end collisions. Rear-end collisions are the most common collision type, occurring in approximately 30% of all collisions. The most common primary factors include speeding, driving too close, and equipment failures, which are most commonly the brakes. Approximately 23% of rear-end collisions are considered correctable and based on the primary factors, they are most likely to be corrected by reducing operating speeds, congestion, and intersection visibility. These types of improvements include traffic signal timing and coordination, advance warning signing, and enlarging signal indications. This is also supported by the *NCHRP Report 500*, which identifies a reduction of operating speeds and improving intersection visibility as most effective for correcting rear-end collisions.

Broadside collisions. Broadside collisions are the second most common collision type, occurring in approximately 26% of all collisions. The most common primary factors include traffic signal violations such as red light running, auto right-of-way violations such as stop sign running, and illegal turning movements. Approximately 19% of broadside collisions are considered correctable, and based on the primary factors, they are most likely to be corrected by improving intersection visibility, traffic operations, and driver compliance. These types of improvements include increasing traffic signal clearance intervals, enlarging

signal indications, and removing intersection sight obstructions. This is also supported by the *NCHRP Report 500, California Manual on Uniform Traffic Control Devices*, and the *ITE Traffic Engineering Handbook*, all of which identify improving operational control and intersection visibility as most effective for correcting broadside collisions.

Sideswipe collisions. Sideswipe collisions are the third most common collision type, occurring in approximately 20% of all collisions. The most common primary factors include illegal lane changes, illegal turns, and equipment failures, which are most commonly the turn signals or brakes. Approximately 11% of rear-end collisions are considered correctable, and based on the primary factors, they are most likely to be corrected by improving channelization and lane delineation in addition to lowering operating speeds. These types of improvements typically include signing and striping modifications. This is also supported by the *ITE Traffic Engineering Handbook*, which identifies the reduction of operating speeds and channelization as most effective for correcting sideswipe collisions.

City of San Luis Obispo Traffic Safety Program

Each year, the ITE recognizes public agency achievements internationally. In 2009, the city of San Luis Obispo received the International ITE Public Agency Achievement Award for excellence in how the city conducts its traffic safety practices, one of the highest awards a public agency can receive for its traffic engineering practices. The following information is based on a paper this author published for the 2009 Western District ITE meeting in Denver, Colorado. The city of San Luis Obispo's traffic safety program is an excellent example of successful local agency traffic safety investigations. Table VII-9, below, depicts the city of San Luis Obispo's current traffic division administrative statistics.

Table VII-9: City of San Luis Obispo Admin Statistics

	STATS
AVE. STAFF PER CAPITA	1.5 : 10,000
AVE. ENGINEERING RESOURCE	60%
PREDOMINANT METHODOLOGY	Routine / Reactive

Beginning in 2000, the city of San Luis Obispo began development of a traffic safety program with the goal of establishing a proactive mechanism for systematically identifying safety issues throughout the city and empirically prioritizing funding to correct those issues. The overall purpose of such a program was not only to provide a mechanism for identifying and correcting problematic locations, but also to be used as a tool for justifying and prioritizing limited funding resources, in addition to defending the city against litigation.

In January of 2002, the city first implemented its comprehensive annual traffic safety program. The program has proven to have a tremendous positive community impact, with a 30 percent reduction in collisions over a six-year period that is equivalent to a seven million dollar reduction in damages. Over the six years of the program, over 150 medium to low cost safety improvements have been implemented with an annual allocation of approximately \$30,000, and over 15 high cost safety improvements have been implemented with a combined allocation of approximately \$3.2 million. As a result of this program, the city has experienced an average five percent reduction in overall collisions, an average three percent reduction in injury-related collisions, and an average nine percent reduction in pedestrian collisions each year since 2002. These reductions occurred despite the citywide traffic volumes which increased on average by five percent annually.

Figure VI-1, below, depicts the average annual 11 percent increase in traffic collisions that the city had been experiencing up until the traffic safety program was first implemented, followed by the average annual five percent

reduction in traffic collisions since the program began. The figure also shows that this decline in collisions occurred despite increasing traffic volumes.

* In 2004, congestion caused by the detour of a major route due to a bridge failure and reconstruction, contributed to a significant spike in overall collisions.

Figure VII-1: Citywide Collisions and Average Intersection Volumes

The city's traffic safety program is an annual assessment and prioritization of citywide traffic safety issues. The primary component of this safety program is an accurate and up-to-date collision database. While most California cities utilize the SWITRS, San Luis Obispo city staff found that the state collision reporting system can vary as much as 10 to 15 percent from what is actually reported. Some of this inconsistency stems from lost reports, miscoded locations, or miscoded jurisdictions within the state system. At the local agency level, inaccuracies of this magnitude can affect the calculation of intersection collision rates and ultimately limit the staff's ability to identify collision patterns. Therefore, the city of San Luis Obispo maintains its own local collision database.

The city's collision database is actually a combination of the police department's incident reporting system (Spillman) and the public works department's collision database (Intersection Magic) that work in tandem. As collision reports are approved by police officials within their incident reporting

system, the collision data and a digital copy of the actual reports are then automatically exported into the public works collision database. Both of these database types are commonly used among other agencies, and the application for data export has already been developed by Pd Programming (*Intersection Magic*) in cooperation with Spillman, so other cities using these systems should be able to purchase this add-on application at a relatively low cost. An up-to-date inventory of traffic counts is also necessary to calculate collision rates; the city collects counts on a bi-annual basis.

The first step in the annual program is an analysis of citywide collision trends including the following:

- Overall collisions
- A comparison of city collision rates with national and state rates
- Classifying the types of collisions

This data is used to measure the program's effectiveness and provide the staff with key indications of when a shift in operational strategy is necessary. For example, early in the program, public works staff identified a steady rise in overall citywide collisions within work zones; given this information, staff implemented a more stringent review and approval process for temporary traffic control applications. The staff also publishes the annual cost of citywide collisions based on values published by the National Highway Traffic Safety Council; this provides a qualitative value of the lost quality of life due to traffic collisions, and assists in the justification of traffic safety projects and funding.

The second step in the annual program is an inventory and ranking of intersections and segments based on classification and collision rates. Using a

function within the Intersection Magic database, a list of all intersections and segments with three or more collisions is produced. These locations are then sorted by 11 different classifications (Arterial/Collector Intersections, Arterial Segments, etc.) and ranked the within each classification using volume-based collision rates. For intersections, the rate is the annual collision frequency per million vehicles entering the intersection. For segments, the rate is the annual collision frequency per million vehicle miles traveled along the segment. The staff attempts to identify collision patterns and performs field safety audits to identify conditions for the top five locations within each category that maybe contributing to the collision patterns. Corrective strategies and their associated costs are developed based on this analysis.

The third and final step in the program is the preparation of an annual report, presentation of findings to the city council, the development of funding strategies, and implementation of corrective measures. The city council typically approves an annual budget of approximately \$30,000 to complete various minor traffic safety projects, such as small scale signing and striping modifications. For large scale projects, the council approves funding on a project-by-project basis, either during the presentation of the Safety Report or as part of the following year's Capital Improvement Program. Following the preparation of the report, city staff begins the design and implementation of the mitigation measures, and the public works and police departments then develop and carryout strategic enforcement campaigns focusing on the high collision rate locations identified in the report.

With over a 30 percent reduction in collisions over a six-year period, the program has proven to have a tremendous positive impact on the community.

The program has been successful because of how it optimizes staff efforts by guiding the public works department as to where and how to implement traffic safety improvements. In addition, the program provides guidance to the police regarding where to focus collision prevention enforcement activities. The program has provided other benefits as well. Additional benefits include the following:

- Improving the justification and award of transportation grants
- Correcting inaccurate public opinion regarding traffic safety issues
- Optimizing expenditures on traffic safety projects and programs

The program has also proven to be a valuable asset by helping to provide protection against litigation. Since the program was initiated, the city has been the target of two significant lawsuits involving traffic-related fatalities and several claims regarding various minor injury related collisions. However, ongoing application of the Traffic Safety Program has demonstrated due diligence on the behalf of the city and contributed to judgments in the city's favor.

San Luis Obispo's annual traffic safety program is an effective tool that the city has been able to use to identify safety issues and prioritize how funding is spent to mitigate these issues. As a result of the program, traffic collisions in the city have decreased significantly. The program has resulted in direct savings to the city, by providing the documentation necessary to defend the city against unwarranted claims. The program also has resulted in savings to drivers in reduced costs associated with collisions. Over the life of the program, city staff have adapted it into a successful method of conducting city business, with a significant positive impact to the community and numerous benefits to the agency itself.

Chapter VIII: Conclusion and Recommendations

Based on state collision data, it is clear that annual collision rates are increasing among local agencies. Approximately one-third of all California cities are experiencing increases in overall collisions rates, particularly among smaller California cities. Collision, demographic, and agency administrative data collected as part of this research indicate that there is a correlation between the operational and resource strategies of local agencies and their annual collision rate trends. This analysis has revealed a statistically significant difference between cities that are and are not experiencing increasing collision rates in terms of the level of staff resources, resource allocation, and analysis/mitigation methodologies. Generally, agencies that rely more on enforcement activities and have lower staff to population ratios for their traffic safety responsibilities are likely to experience increasing collision rates.

Based on the findings of this study, agencies that maintain a staff to population ratio and engineering resource allocation for traffic safety as identified in Table VIII-1, below, are more likely to maintain and/or reduce collision rates.

Table VIII-1: Average Per Capita Resource Allocation for Declining Collision Rate Cities.

	Staff : Pop. Ratio	Engr. Resource Allocation
Class V 0 - 25,000 Pop.	1.3 : 10,000	40%
Class IV 25,000 – 50,000 Pop.	0.92 : 10,000	50%
Class III 50,000 – 100,000 Pop.	0.42 : 10,000	50%
Class II 100,000 – 250,000 Pop.	0.35 : 10,000	42%
Class I 250,000 + Pop.	0.20 : 10,000	45%

It is important to understand that the threshold identified in Table VIII-1 are based on overall averages of hundreds of cities. While these thresholds do represent the best ratio and resources allocation collectively; jurisdictions can expect the results of implementing these values to vary. For example as demonstrated in the data some agencies are effective at reducing collision rates with lower staff

ratios and engineering resource allocations, however the numbers of those agencies are very few.

In addition to administrative strategies, this research has also identified the predominant factors that lead to the various collision types or collision patterns, and has identified standard practices for correcting those factors. Based on the agency survey and collision trend data collected accumulated as part of this research, it is evident that cities that employ routine system wide safety audits are more likely to be effective at reducing collision rates, as opposed to those agencies that rely on public opinion or political influence. In July of 2010, the AASHTO (American Association of State Highway and Transportation Officials) released the *Highway Safety Manual*²⁵, which provides an effective model program for routine systemwide safety audits. The HSM includes specific direction ranking and prioritizing critical locations based on crash modification and reduction factors. This manual however does not serve as a best practices guide for the administrative and organizational structure aspects of public agencies. This research is a step in the direction of establishing best practices in City organizational structure necessary to build the capacity for implementing such a safety program as defined in the *Highway Safety Manual*.

Based on the findings of this study it is clear that there is a correlation between the engineering practices of cities and the collision trends that they experience. Therefore, ultimately this area of research should lead towards a complete and unified standard practice for public agencies in terms of staff levels, resource allocation, engineering priorities, and safety program. In order to accomplish this, further in-depth study is needed for identifying benchmarks and

²⁵“Highway Safety Manual” AASHTO, 2010

measures of effectiveness for organizational strategies, personnel and staffing, institutional cooperation and coordination, and budgeting methodologies of cities.

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Appendices

APPENDIX A: CALIFORNIA S.W.I.T.R.S DATA

CALIFORNIA S.W.I.T.R.S DATA																													
Agency	Ave Rate Δ	2002						2003						2004						2005						COLLISION RATE CHANGE			
		Fatal	Injury	Property	Total	Population	Rate	Fatal	Injury	Property	Total	Population	Rate	Fatal	Injury	Property	Total	Population	Rate	Fatal	Injury	Property	Total	Population	Rate	2002-2003	2003-2004	2004-2005	AVE
Adelanto	0.01	1	31	80	32	18,847	1.7	4	37	121	41	20,033	2.0	4	50	130	54	21,612	2.5	2	40	139	42	24,360	1.7	0.3	0.5	(0.8)	0.01
Agoura Hills	0.71	-	60	166	60	21,617	2.8	1	97	230	98	21,774	4.5	0	110	216	110	22,801	4.8	2	110	234	112	22,765	4.9	1.7	0.3	0.1	0.71
Alameda	(0.31)	2	248	957	250	72,513	3.4	1	217	829	218	71,690	3.0	3	210	785	213	70,981	3.0	3	174	785	177	70,576	2.5	(0.4)	(0.0)	(0.5)	(0.31)
Albany	(0.21)	-	90	300	90	16,533	5.4	1	72	267	73	16,374	4.5	0	71	284	71	16,180	4.4	0	77	278	77	15,994	4.8	(1.0)	(0.1)	0.4	(0.21)
Alhambra	0.02	5	402	903	407	87,354	4.7	3	400	927	403	87,812	4.6	4	461	964	465	87,826	5.3	4	408	893	412	87,410	4.7	(0.1)	0.7	(0.6)	0.02
Aliso Viejo	0.06	-	54	125	54	40,786	1.3	2	76	115	78	40,856	1.9	1	70	107	71	41,387	1.7	0	63	113	63	41,541	1.5	0.6	(0.2)	(0.2)	0.06
Alturas	0.11	-	3	2	3	2,866	1.0	0	6	3	6	2,897	2.1	0	3	4	3	2,925	1.0	0	4	3	4	2,902	1.4	1.0	(1.0)	0.4	0.11
American Canyon	(0.28)	-	48	129	48	12,089	4.0	1	38	131	39	13,104	3.0	0	63	146	63	13,889	4.5	1	47	137	48	15,331	3.1	(1.0)	1.6	(1.4)	(0.28)
Anaheim	0.28	22	2,192	3,158	2214	331,158	6.7	26	2,430	2,971	2,456	332,271	7.4	27	2,426	3,261	2,453	333,150	7.4	32	2,468	3,459	2,500	331,804	7.5	0.7	(0.0)	0.2	0.28
Anderson	(0.42)	1	63	97	64	9,450	6.8	0	87	96	87	9,915	8.8	1	65	87	66	10,375	6.4	1	57	92	58	10,528	5.5	2.0	(2.4)	(0.9)	(0.42)
Angels Camp	0.76	-	14	44	14	3,410	4.1	0	15	44	15	3,571	4.2	0	20	44	20	3,681	5.4	1	23	56	24	3,761	6.4	0.1	1.2	0.9	0.76
Antioch	0.09	5	280	392	285	99,489	2.9	8	289	346	297	100,909	2.9	5	263	351	268	100,386	2.7	6	308	389	314	100,631	3.1	0.1	(0.3)	0.5	0.09
Apple Valley	(0.14)	4	121	409	125	57,823	2.2	13	141	417	154	60,066	2.6	12	156	490	168	62,544	2.7	10	103	574	113	65,156	1.7	0.4	0.1	(1.0)	(0.14)
Arcadia	(0.07)	3	301	610	304	54,559	5.6	4	332	615	336	55,215	6.1	3	312	661	315	55,875	5.6	1	300	589	301	56,153	5.4	0.5	(0.4)	(0.3)	(0.07)
Arcata	(0.27)	1	56	157	57	16,689	3.4	1	55	166	56	16,864	3.3	0	41	162	41	16,900	2.4	0	44	169	44	16,914	2.6	(0.1)	(0.9)	0.2	(0.27)
Arroyo Grande	(0.44)	-	103	195	103	16,196	6.4	1	81	148	82	16,360	5.0	1	104	179	105	16,177	6.5	2	80	157	82	16,315	5.0	(1.3)	1.5	(1.5)	(0.44)
Artesia	(0.20)	-	123	269	123	16,646	7.4	2	129	350	131	16,736	7.8	0	123	402	123	16,748	7.3	0	113	399	113	16,672	6.8	0.4	(0.5)	(0.6)	(0.20)
Arvin	0.07	-	21	89	21	13,611	1.5	0	22	89	22	13,997	1.6	0	29	84	29	14,353	2.0	0	26	90	26	14,724	1.8	0.0	0.4	(0.3)	0.07
Atascadero	(0.46)	1	116	327	117	26,812	4.4	3	113	375	116	27,023	4.3	8	116	345	124	27,144	4.6	1	80	232	81	27,130	3.0	(0.1)	0.3	(1.6)	(0.46)
Atherton	(0.35)	-	40	77	40	7,083	5.6	0	47	88	47	7,090	6.6	0	31	77	31	7,116	4.4	0	33	61	33	7,177	4.6	1.0	(2.3)	0.2	(0.35)
Atwater	(0.54)	2	111	275	113	24,708	4.6	1	74	280	75	26,529	2.8	1	93	388	94	26,397	3.6	2	78	283	80	27,107	3.0	(1.7)	0.7	(0.6)	(0.54)
Auburn	(0.34)	3	65	252	68	12,542	5.4	1	52	200	53	12,522	4.2	2	48	202	50	12,713	3.9	0	57	201	57	12,912	4.4	(1.2)	(0.3)	0.5	(0.34)
Avalon	(0.00)	-	6	5	6	3,333	1.8	0	2	4	2	3,355	0.6	0	7	9	7	3,353	2.1	0	6	12	6	3,334	1.8	(1.2)	1.5	(0.3)	(0.00)
Avenal	0.00	-	-	11	0	14,903	0.0	2	0	7	2	15,822	0.1	0	3	13	3	16,660	0.2	0	0	12	0	16,631	0.0	0.1	0.1	(0.2)	0.00
Azusa	0.21	2	243	537	245	46,017	5.3	2	265	548	267	46,741	5.7	4	257	524	261	47,292	5.5	5	275	526	280	47,120	5.9	0.4	(0.2)	0.4	0.21
Bakersfield	0.12	23	983	833	1006	260,443	3.9	25	1,019	792	1,044	271,143	3.9	22	1,144	994	1,166	283,010	4.1	31	1,216	1,070	1,247	295,536	4.2	(0.0)	0.3	0.1	0.12
Baldwin Park	(0.55)	5	499	1,085	504	77,323	6.5	6	418	1,012	424	78,402	5.4	7	422	953	429	78,722	5.4	6	377	961	383	78,861	4.9	(1.1)	0.0	(0.6)	(0.55)
Banning	0.44	3	66	116	69	25,535	2.7	5	97	146	102	27,269	3.7	6	98	179	104	28,681	3.6	4	114	201	118	29,308	4.0	1.0	(0.1)	0.4	0.44
Barstow	(0.12)	6	105	259	111	22,831	4.9	8	102	235	110	23,401	4.7	8	94	196	102	23,555	4.3	8	99	169	107	23,737	4.5	(0.2)	(0.4)	0.2	(0.12)
Beaumont	(0.59)	1	87	232	88	13,360	6.6	5	96	237	101	15,695	6.4	7	99	262	106	18,355	5.8	1	98	281	99	20,530	4.8	(0.2)	(0.7)	(1.0)	(0.59)
Bell	(0.21)	4	172	601	176	37,168	4.7	1	152	522	153	37,603	4.1	2	180	474	182	37,701	4.8	4	150	466	154	37,521	4.1	(0.7)	0.8	(0.7)	(0.21)
Bell Gardens	0.18	-	106	132	106	44,945	2.4	1	117	149	118	45,246	2.6	0	122	153	122	45,277	2.7	0	131	132	131	45,135	2.9	0.2	0.1	0.2	0.18
Bellflower	0.15	8	3																										

Chula Vista	(0.15)	17	960	947	977	192,689	5.1	10	995	849	1,005	197,975	5.1	9	1,058	896	1,067	204,499	5.2	10	962	850	972	210,497	4.6	0.0	0.1	(0.6)	(0.15)		
CALIFORNIA S.W.I.T.R.S DATA																															
2002							2003							2004							2005							COLLISION RATE CHANGE			
Citrus Heights	(0.33)	9	615	964	624	88,153	7.1	8	556	829	564	88,216	6.4	7	559	763	566	87,319	6.5	4	521	719	525	86,272	6.1	(0.7)	0.1	(0.4)	(0.33)		
Claremont	(0.03)	4	160	305	164	34,696	4.7	3	160	238	163	34,918	4.7	3	144	263	147	35,034	4.2	3	160	286	163	35,182	4.6	(0.1)	(0.5)	0.4	(0.03)		
Clayton	0.29	-	10	31	10	10,971	0.9	1	10	47	11	10,995	1.0	1	15	47	16	11,039	1.4	0	20	50	20	11,142	1.8	0.1	0.4	0.3	0.29		
Clearlake	(0.06)	2	44	112	46	13,963	3.3	2	37	118	39	14,156	2.8	2	43	97	45	14,477	3.1	2	44	90	46	14,728	3.1	(0.5)	0.4	0.0	(0.06)		
Cloverdale	(0.24)	-	17	27	17	7,237	2.3	0	16	19	16	7,487	2.1	0	10	22	10	7,835	1.3	0	13	42	13	8,016	1.6	(0.2)	(0.9)	0.3	(0.24)		
Clovis	(0.31)	2	346	669	348	74,408	4.7	4	332	639	336	78,678	4.3	2	322	587	324	82,357	3.9	4	319	634	323	86,527	3.7	(0.4)	(0.3)	(0.2)	(0.31)		
Coachella	(0.38)	9	85	222	94	26,013	3.6	6	74	213	80	28,132	2.8	5	54	186	59	30,138	2.0	6	74	247	80	32,432	2.5	(0.8)	(0.9)	0.5	(0.38)		
Coalinga	(0.29)	-	16	35	16	16,418	1.0	1	0	5	1	16,510	0.1	0	9	14	9	17,086	0.5	0	2	7	2	17,350	0.1	(0.9)	0.5	(0.4)	(0.29)		
Colfax	0.33	-	7	10	7	1,649	4.2	0	5	2	5	1,673	3.0	1	7	16	8	1,706	4.7	0	9	14	9	1,720	5.2	(1.3)	1.7	0.5	0.33		
Colma	(3.94)	-	29	49	29	1,173	24.7	1	13	29	14	1,216	11.5	0	23	24	23	1,392	16.5	1	17	16	18	1,394	12.9	(13.2)	5.0	(3.6)	(3.94)		
Colton	0.63	7	312	813	319	49,757	6.4	4	386	833	390	50,616	7.7	3	361	798	364	51,305	7.1	9	417	797	426	51,350	8.3	1.3	(0.6)	1.2	0.63		
Colusa	(0.07)	-	22	34	22	5,539	4.0	0	21	36	21	5,615	3.7	0	22	43	22	5,698	3.9	0	22	42	22	5,826	3.8	(0.2)	0.1	(0.1)	(0.07)		
Commerce	0.49	4	224	901	228	13,034	17.5	6	228	853	234	13,236	17.7	2	288	852	290	13,377	21.7	3	252	855	255	13,455	19.0	0.2	4.0	(2.7)	0.49		
Compton	(0.11)	8	427	890	435	95,263	4.6	6	470	766	476	95,882	5.0	7	467	784	474	96,033	4.9	9	397	689	406	95,659	4.2	0.4	(0.0)	(0.7)	(0.11)		
Concord	0.20	6	615	699	621	124,634	5.0	3	647	763	650	124,407	5.2	4	616	784	620	123,674	5.0	7	681	814	688	123,252	5.6	0.2	(0.2)	0.6	0.20		
Corcoran	0.00	1	19	90	20	21,436	0.9	1	2	84	3	21,592	0.1	0	12	68	12	22,445	0.5	0	21	77	21	22,456	0.9	(0.8)	0.4	0.4	0.00		
Corning	(0.80)	-	29	18	29	6,851	4.2	0	16	23	16	6,969	2.3	0	15	23	15	7,067	2.1	0	13	13	13	7,140	1.8	(1.9)	(0.2)	(0.3)	(0.80)		
Corona	0.26	7	650	1,470	657	140,766	4.7	10	741	1,413	751	145,216	5.2	5	836	1,441	841	148,001	5.7	16	796	1,459	812	149,387	5.4	0.5	0.5	(0.2)	0.26		
Coronado	(0.10)	1	83	127	84	25,282	3.3	0	100	119	100	25,261	4.0	2	88	124	90	26,639	3.4	0	80	114	80	26,424	3.0	0.6	(0.6)	(0.4)	(0.10)		
Corte Madera	(0.81)	-	92	95	92	9,310	9.9	0	59	104	59	9,246	6.4	0	60	77	60	9,173	6.5	2	66	77	68	9,120	7.5	(3.5)	0.2	0.9	(0.81)		
Costa Mesa	2.36	10	91	1,237	101	110,408	0.9	6	1,010	1,227	1,016	110,320	9.2	13	1,004	1,202	1,017	110,392	9.2	5	874	1,135	879	109,830	8.0	8.3	0.0	(1.2)	2.36		
Cotati	(0.80)	-	43	69	43	6,661	6.5	1	42	52	43	6,724	6.4	0	49	66	49	7,081	6.9	0	29	57	29	7,138	4.1	(0.1)	0.5	(2.9)	(0.80)		
Covina	(0.40)	3	239	499	242	47,736	5.1	0	190	505	190	47,987	4.0	1	266	531	267	47,991	5.6	2	183	422	185	47,850	3.9	(1.1)	1.6	(1.7)	(0.40)		
Crescent City	(0.23)	-	25	41	25	7,434	3.4	0	17	44	17	7,530	2.3	0	22	39	22	7,613	2.9	0	21	45	21	7,825	2.7	(1.1)	0.6	(0.2)	(0.23)		
Cudahy	(0.15)	-	46	85	46	25,008	1.8	0	39	77	39	25,135	1.6	0	43	70	43	25,138	1.7	2	33	67	35	25,004	1.4	(0.3)	0.2	(0.3)	(0.15)		
Culver City	0.02	2	307	309	309	39,576	7.8	4	311	298	315	39,808	7.9	1	275	311	276	39,813	6.9	4	307	293	311	39,603	7.9	0.1	(1.0)	0.9	0.02		
Cupertino	(0.38)	-	228	641	228	51,589	4.4	2	220	583	222	52,186	4.3	0	194	561	194	51,892	3.7	0	171	536	171	52,171	3.3	(0.2)	(0.5)	(0.5)	(0.38)		
Cypress	0.12	-	152	194	152	47,102	3.2	1	161	180	162	47,267	3.4	2	157	179	159	47,581	3.3	0	170	183	170	47,383	3.6	0.2	(0.1)	0.2	0.12		
Daly City	(0.15)	6	321	866	327	101,573	3.2	5	312	936	317	100,957	3.1	2	307	768	309	100,470	3.1	3	275	745	278	100,339	2.8	(0.1)	(0.1)	(0.3)	(0.15)		
Dana Point	(0.13)	-	112	256	112	35,694	3.1	3	105	309	108	35,805	3.0	4	139	304	143	35,952	4.0	1	98	295	99	35,867	2.8	(0.1)	1.0	(1.2)	(0.13)		
Danville	0.20	-	130	344	130	42,390	3.1	2	148	357	150	42,439	3.5	2	118	323	120	41,973	2.9	0	153	360	153	41,852	3.7	0.5	(0.7)	0.8	0.20		
Davis	(0.25)	-	261	416	261	62,126	4.2	3	256	393	259	62,342	4.2	0	239	355	239	62,051	3.9	3	207	344	210	60,709	3.5	(0					

Fremont	(0.19)	13	1,165	1,702	1178	205,494	5.7	10	1,032	1,622	1,042	203,917	5.1	8	1,089	1,429	1,097	201,932	5.4	10	1,025	1,233	1,035	200,468	5.2	(0.6)	0.3	(0.3)	(0.19)	
Fresno	(0.29)	55	2,261	2,617	2316	444,022	5.2	52	2,097	2,474	2,149	451,840	4.8	41	1,970	2,468	2,011	457,160	4.4	47	1,963	2,388	2,010	461,116	4.4	(0.5)	(0.4)	(0.0)	(0.29)	
CALIFORNIA S.W.I.T.R.S DATA																														
		2002						2003						2004						2005						COLLISION RATE CHANGE				
Fullerton	(0.27)	8	904	1,482	912	128,621	7.1	6	951	1,435	957	131,589	7.3	5	929	1,407	934	133,476	7.0	10	822	1,285	832	132,787	6.3	0.2	(0.3)	(0.7)	(0.27)	
Galt	(0.25)	-	67	120	67	22,272	3.0	1	57	140	58	22,579	2.6	1	55	128	56	22,957	2.4	2	50	115	52	23,173	2.2	(0.4)	(0.1)	(0.2)	(0.25)	
Garden Grove	0.08	11	869	1,536	880	166,630	5.3	11	877	1,365	888	166,881	5.3	13	915	1,709	928	167,038	5.6	7	911	1,673	918	166,075	5.5	0.0	0.2	(0.0)	0.08	
Gardena	(0.23)	4	369	174	373	59,473	6.3	2	398	173	400	59,847	6.7	5	352	187	357	59,876	6.0	2	332	197	334	59,891	5.6	0.4	(0.7)	(0.4)	(0.23)	
Gilroy	0.08	2	120	233	122	42,960	2.8	7	145	204	152	43,806	3.5	5	144	245	149	44,281	3.4	3	138	317	141	45,718	3.1	0.6	(0.1)	(0.3)	0.08	
Glendale	(0.05)	5	795	2,661	800	198,816	4.0	14	750	2,675	764	200,598	3.8	5	756	2,359	761	200,908	3.8	8	767	2,610	775	200,065	3.9	(0.2)	(0.0)	0.1	(0.05)	
Glendora	0.06	2	217	613	219	50,249	4.4	3	238	641	241	50,650	4.8	1	257	606	258	50,762	5.1	0	229	632	229	50,540	4.5	0.4	0.3	(0.6)	0.06	
Goleta	(0.01)	1	153	31	154	29,799	5.2	1	135	273	136	30,123	4.5	2	117	277	119	29,761	4.0	4	147	274	151	29,367	5.1	(0.7)	(0.5)	1.1	(0.01)	
Gonzales	(0.13)	1	9	39	10	8,317	1.2	0	13	36	13	8,494	1.5	0	3	43	3	8,481	0.4	0	7	30	7	8,498	0.8	0.3	(1.2)	0.5	(0.13)	
Grand Terrace	0.04	1	25	88	26	12,035	2.2	0	31	83	31	12,188	2.5	0	36	80	36	12,331	2.9	1	27	48	28	12,342	2.3	0.4	0.4	(0.7)	0.04	
Grass Valley	0.11	-	68	149	68	11,914	5.7	2	61	133	63	12,088	5.2	0	59	148	59	12,408	4.8	2	73	156	75	12,449	6.0	(0.5)	(0.5)	1.3	0.11	
Greenfield	0.27	-	3	2	3	13,107	0.2	0	0	4	0	13,104	0.0	0	4	68	4	13,070	0.3	0	14	82	14	13,330	1.1	(0.2)	0.3	0.7	0.27	
Gridley	(0.21)	-	27	47	27	5,683	4.8	0	23	56	23	5,686	4.0	0	18	61	18	5,640	3.2	0	23	48	23	5,588	4.1	(0.7)	(0.9)	0.9	(0.21)	
Grover Beach	(0.54)	1	39	20	40	12,980	3.1	1	37	21	38	12,991	2.9	2	34	27	36	13,029	2.8	0	19	107	19	12,887	1.5	(0.2)	(0.2)	(1.3)	(0.54)	
Guadalupe	(0.32)	-	10	17	10	5,739	1.7	0	3	22	3	5,838	0.5	0	6	22	6	5,945	1.0	0	5	17	5	6,346	0.8	(1.2)	0.5	(0.2)	(0.32)	
Gustine	0.04	-	15	30	15	5,223	2.9	0	12	32	12	5,343	2.2	1	5	13	6	5,337	1.1	1	15	22	16	5,324	3.0	(0.6)	(1.1)	1.9	0.04	
Half Moon Bay	(0.19)	2	46	141	48	11,938	4.0	1	54	118	55	12,147	4.5	2	42	118	44	12,191	3.6	0	42	146	42	12,203	3.4	0.5	(0.9)	(0.2)	(0.19)	
Hanford	0.02	3	201	191	204	44,230	4.6	1	229	238	230	45,496	5.1	0	219	192	219	46,735	4.7	6	216	248	222	47,485	4.7	0.4	(0.4)	(0.0)	0.02	
Hawaiian Gardens	(0.42)	1	66	93	67	15,127	4.4	1	55	92	56	15,270	3.7	0	72	116	72	15,373	4.7	0	49	113	49	15,398	3.2	(0.8)	1.0	(1.5)	(0.42)	
Hawthorne	(0.07)	3	392	433	395	85,517	4.6	4	373	466	377	85,996	4.4	6	386	372	392	86,099	4.6	1	376	440	377	85,697	4.4	(0.2)	0.2	(0.2)	(0.07)	
Hayward	(0.72)	5	1,168	1,908	1173	141,585	8.3	7	983	1,655	990	140,632	7.0	10	930	1,499	940	140,490	6.7	7	852	1,352	859	140,293	6.1	(1.2)	(0.3)	(0.6)	(0.72)	
Healdsburg	(0.07)	1	43	144	44	11,238	3.9	2	35	164	37	11,210	3.3	0	50	131	50	11,117	4.5	1	40	128	41	11,051	3.7	(0.6)	1.2	(0.8)	(0.07)	
Hemet	0.01	9	381	555	390	63,150	6.2	3	354	369	357	64,844	5.5	7	428	509	435	66,639	6.5	5	418	485	423	68,063	6.2	(0.7)	1.0	(0.3)	0.01	
Hercules	0.10	1	33	142	34	20,171	1.7	0	39	167	39	21,581	1.8	0	38	178	38	23,300	1.6	0	48	136	48	24,109	2.0	0.1	(0.2)	0.4	0.10	
Hermosa Beach	(0.43)	-	73	103	73	19,197	3.8	0	77	95	77	19,404	4.0	0	63	123	63	19,496	3.2	0	49	100	49	19,500	2.5	0.2	(0.7)	(0.7)	(0.43)	
Hesperia	(0.08)	16	215	831	231	67,030	3.4	14	157	907	171	69,294	2.5	14	213	981	227	73,384	3.1	11	238	1,041	249	77,984	3.2	(1.0)	0.6	0.1	(0.08)	
Hidden Hills	0.00	-	-	3	0	1,949	0.0	0	1	2	1	1,982	0.5	0	1	6	1	1,989	0.5	0	0	1	0	1,994	0.0	0.5	(0.0)	(0.5)	0.00	
Highland	0.09	4	103	291	107	47,004	2.3	3	110	273	113	48,486	2.3	3	91	275	94	50,160	1.9	4	125	290	129	50,892	2.5	0.1	(0.5)	0.7	0.09	
Hillsborough	0.35	-	12	63	12	10,674	1.1	2	21	51	23	10,602	2.2	0	19	58	19	10,584	1.8	0	23	54	23	10,615	2.2	1.0	(0.4)	0.4	0.35	
Hollister	(0.09)	-	117	342	117	36,270	3.2	1	94	321	95	36,420	2.6	0	112	267	112	36,164	3.1	1	105	320	106	35,941	2.9	(0.6)	0.5	(0.1)	(0.09)	
Holtville	(0.24)	-	6	20	6	5,537	1.1	0	4	23	4	5,532	0.7	0	6	21	6	5,503	1.1	0	2	27	2	5,470	0.4	(0.4)	0.4	(0.7)	(0.24)	
Hughson	(0.41)	-	9	22	9	4,639	1.9	0	3	20	3	5,146	0.6	0	6	33	6	5,621	1.1	0	4	22	4	5,7						

Lawndale	0.04	2	154	371	156	32,182	4.8	1	139	371	140	32,354	4.3	2	116	274	118	32,368	3.6	0	160	344	160	32,193	5.0	(0.5)	(0.7)	1.3	0.04	
Lemon Grove	(0.48)	3	141	266	144	24,865	5.8	1	119	206	120	24,765	4.8	1	110	226	111	24,492	4.5	2	103	217	105	24,124	4.4	(0.9)	(0.3)	(0.2)	(0.48)	
Lemoore	(0.20)	-	78	165	78	20,981	3.7	0	78	209	78	21,597	3.6	0	58	158	58	22,181	2.6	0	71	140	71	22,699	3.1	(0.1)	(1.0)	0.5	(0.20)	
CALIFORNIA S.W.I.T.R.S DATA																														
		2002						2003						2004						2005						COLLISION RATE CHANGE				
Lincoln	(0.26)	-	60	171	60	19,919	3.0	1	78	205	79	23,913	3.3	1	73	259	74	28,866	2.6	0	73	217	73	32,804	2.2	0.3	(0.7)	(0.3)	(0.26)	
Lindsay	(0.14)	1	21	65	22	10,492	2.1	1	29	55	30	10,604	2.8	0	32	59	32	10,695	3.0	0	18	47	18	10,767	1.7	0.7	0.2	(1.3)	(0.14)	
Live Oak	0.08	-	29	5	29	6,383	4.5	0	24	51	24	6,503	3.7	0	21	52	21	6,546	3.2	1	33	42	34	7,128	4.8	(0.9)	(0.5)	1.6	0.08	
Livermore	(0.02)	5	458	868	463	76,134	6.1	2	404	821	406	77,517	5.2	6	453	762	459	77,812	5.9	1	471	893	472	78,409	6.0	(0.8)	0.7	0.1	(0.02)	
Livingston	0.04	-	12	83	12	11,220	1.1	0	20	70	20	11,478	1.7	0	17	42	17	12,086	1.4	0	15	91	15	12,585	1.2	0.7	(0.3)	(0.2)	0.04	
Lodi	(0.47)	2	375	946	377	60,529	6.2	3	363	900	366	61,452	6.0	5	298	859	303	61,948	4.9	3	297	847	300	62,133	4.8	(0.3)	(1.1)	(0.1)	(0.47)	
Loma Linda	0.06	3	85	229	88	19,783	4.4	2	82	278	84	20,076	4.2	1	86	234	87	20,302	4.3	2	95	159	97	20,901	4.6	(0.3)	0.1	0.4	0.06	
Lomita	(0.16)	1	106	210	107	20,376	5.3	2	103	186	105	20,495	5.1	1	110	172	111	20,505	5.4	0	98	204	98	20,515	4.8	(0.1)	0.3	(0.6)	(0.16)	
Lompoc	(0.33)	3	161	395	164	41,104	4.0	0	113	250	113	40,960	2.8	1	159	386	160	40,637	3.9	2	118	374	120	39,985	3.0	(1.2)	1.2	(0.9)	(0.33)	
Long Beach	(0.16)	22	2,422	5,545	2444	470,561	5.2	35	2,529	5,475	2,564	475,288	5.4	32	2,464	5,335	2,496	475,753	5.2	30	2,210	5,146	2,240	474,014	4.7	0.2	(0.1)	(0.5)	(0.16)	
Loomis	(0.88)	-	31	65	31	6,305	4.9	0	26	43	26	6,301	4.1	1	19	52	20	6,344	3.2	0	15	41	15	6,577	2.3	(0.8)	(1.0)	(0.9)	(0.88)	
Los Alamitos	0.85	3	92	177	95	11,607	8.2	0	108	209	108	11,641	9.3	0	109	240	109	11,704	9.3	2	123	198	125	11,657	10.7	1.1	0.0	1.4	0.85	
Los Altos	(0.29)	-	119	240	119	27,129	4.4	1	115	207	116	27,071	4.3	0	109	208	109	26,941	4.0	1	94	189	95	27,096	3.5	(0.1)	(0.2)	(0.5)	(0.29)	
Los Altos Hills	0.06	-	38	68	38	8,075	4.7	2	43	104	45	8,079	5.6	0	32	73	32	8,107	3.9	0	40	87	40	8,164	4.9	0.9	(1.6)	1.0	0.06	
Los Angeles	(0.13)	260	28,860	29,565	29120	3,785,821	7.7	278	28,947	29,912	29,225	3,818,212	7.7	268	28,003	28,812	28,271	3,837,399	7.4	265	27,818	29,228	28,083	3,844,829	7.3	(0.0)	(0.3)	(0.1)	(0.13)	
Los Banos	(0.10)	-	120	253	120	29,518	4.1	0	108	263	108	30,606	3.5	2	118	270	120	31,830	3.8	3	123	226	126	33,506	3.8	(0.5)	0.2	(0.0)	(0.10)	
Los Gatos	0.24	1	100	288	101	28,130	3.6	0	99	252	99	28,009	3.5	2	105	244	107	27,889	3.8	3	118	251	121	28,029	4.3	(0.1)	0.3	0.5	0.24	
Lynwood	(0.16)	5	368	876	373	71,018	5.3	5	304	846	309	71,431	4.3	5	309	807	314	71,485	4.4	7	333	836	340	71,208	4.8	(0.9)	0.1	0.4	(0.16)	
Madera	(0.69)	4	262	712	266	45,980	5.8	4	215	648	219	48,038	4.6	6	184	698	190	50,021	3.8	2	192	680	194	52,147	3.7	(1.2)	(0.8)	(0.1)	(0.69)	
Malibu	(0.18)	2	121	209	123	12,985	9.5	4	139	232	143	13,156	10.9	2	133	286	135	13,242	10.2	5	113	261	118	13,208	8.9	1.4	(0.7)	(1.3)	(0.18)	
Mammoth Lakes	0.21	-	23	54	23	7,337	3.1	1	32	49	33	7,235	4.6	0	32	64	32	7,215	4.4	0	27	50	27	7,156	3.8	1.4	(0.1)	(0.7)	0.21	
Manhattan Beach	(0.18)	1	121	185	122	35,284	3.5	0	101	225	101	35,870	2.8	0	90	184	90	36,245	2.5	0	106	190	106	36,481	2.9	(0.6)	(0.3)	0.4	(0.18)	
Manteca	(0.15)	3	244	242	247	56,717	4.4	3	233	279	236	59,345	4.0	2	257	287	259	61,353	4.2	5	239	242	244	62,651	3.9	(0.4)	0.2	(0.3)	(0.15)	
Marina	0.05	-	57	212	57	19,589	2.9	1	52	201	53	19,516	2.7	2	72	221	74	19,320	3.8	1	57	229	58	19,006	3.1	(0.2)	1.1	(0.8)	0.05	
Martinez	(0.07)	-	92	336	92	36,570	2.5	0	89	351	89	36,528	2.4	3	88	273	91	36,119	2.5	2	81	313	83	35,916	2.3	(0.1)	0.1	(0.2)	(0.07)	
Marysville	(2.77)	3	174	76	177	12,558	14.1	0	109	51	109	12,599	8.7	0	77	21	77	12,491	6.2	0	70	13	70	12,131	5.8	(5.4)	(2.5)	(0.4)	(2.77)	
McFarland	0.08	-	9	40	9	10,384	0.9	0	16	37	16	11,090	1.4	0	11	15	11	11,710	0.9	0	13	34	13	11,875	1.1	0.6	(0.5)	0.2	0.08	
Mendota	(0.29)	-	9	19	9	8,227	1.1	1	8	33	9	8,457	1.1	1	1	4	2	8,846	0.2	0	2	0	2	8,942	0.2	(0.0)	(0.8)	(0.0)	(0.29)	
Menlo Park	(0.04)	2	204	511	206	30,165	6.8	2	229	428	231	29,850	7.7	1	210	434	211	29,715	7.1	5	194	417	199	29,661	6.7	0.9	(0.6)	(0.4)	(0.04)	
Merced	(1.55)	5	594	1,128	599	68,294	8.8	9	566	1,057	575	69,710	8.2	5	382	583	3													

Oroville	(0.28)	2	136	263	138	13,070	10.6	2	132	364	134	13,146	10.2	3	123	375	126	13,163	9.6	3	128	332	131	13,468	9.7	(0.4)	(0.6)	0.2	(0.28)		
Oxnard	(0.21)	9	1,338	1,960	1347	177,503	7.6	9	1,305	1,887	1,314	180,853	7.3	9	1,237	1,671	1,246	183,529	6.8	9	1,270	1,629	1,279	183,628	7.0	(0.3)	(0.5)	0.2	(0.21)		
Pacific Grove	(0.04)	-	38	152	38	15,599	2.4	0	40	146	40	15,462	2.6	1	23	144	24	15,277	1.6	2	33	141	35	15,091	2.3	0.2	(1.0)	0.7	(0.04)		
Pacifica	0.16	-	106	119	106	37,633	2.8	1	104	126	105	37,320	2.8	0	105	115	105	37,126	2.8	2	120	116	122	37,092	3.3	(0.0)	0.0	0.5	0.16		
CALIFORNIA S.W.I.T.R.S DATA																															
2002							2003							2004							2005							COLLISION RATE CHANGE			
Palm Desert	(0.09)	4	257	491	261	44,484	5.9	5	224	434	229	45,970	5.0	6	239	496	245	46,610	5.3	2	261	514	263	47,058	5.6	(0.9)	0.3	0.3	(0.09)		
Palm Springs	0.08	5	378	547	383	44,548	8.6	12	406	596	418	45,397	9.2	12	454	601	466	46,374	10.0	14	402	430	416	47,082	8.8	0.6	0.8	(1.2)	0.08		
Palmdale	0.41	12	623	778	635	123,892	5.1	16	635	940	651	127,718	5.1	14	721	940	735	130,876	5.6	18	839	1,072	857	134,570	6.4	(0.0)	0.5	0.8	0.41		
Palo Alto	0.00	1	457	1,060	458	57,336	8.0	2	446	1,015	448	56,986	7.9	0	420	965	420	56,723	7.4	3	453	812	456	56,982	8.0	(0.1)	(0.5)	0.6	0.00		
Palos Verdes Estates	(0.25)	-	23	42	23	13,665	1.7	0	14	41	14	13,772	1.0	0	9	52	9	13,839	0.7	0	13	57	13	13,812	0.9	(0.7)	(0.4)	0.3	(0.25)		
Paradise	(0.06)	4	136	83	140	26,629	5.3	0	127	80	127	26,750	4.7	0	143	67	143	26,637	5.4	2	133	69	135	26,517	5.1	(0.5)	0.6	(0.3)	(0.06)		
Paramount	0.11	2	183	521	185	56,334	3.3	6	188	553	194	56,710	3.4	1	220	519	221	56,780	3.9	2	203	656	205	56,540	3.6	0.1	0.5	(0.3)	0.11		
Parlier	(0.10)	-	29	77	29	12,284	2.4	0	20	84	20	12,401	1.6	0	19	103	19	12,963	1.5	0	27	70	27	13,025	2.1	(0.7)	(0.1)	0.6	(0.10)		
Pasadena	0.19	7	916	2,696	923	139,464	6.6	4	1,013	2,750	1,017	141,405	7.2	12	1,094	2,369	1,106	143,845	7.7	10	1,025	2,373	1,035	143,731	7.2	0.6	0.5	(0.5)	0.19		
Paso Robles	0.51	1	63	377	64	26,166	2.4	2	105	430	107	26,477	4.0	1	159	458	160	26,909	5.9	1	108	506	109	27,477	4.0	1.6	1.9	(2.0)	0.51		
Patterson	0.05	-	26	89	26	13,490	1.9	0	33	59	33	14,226	2.3	0	22	63	22	14,811	1.5	0	32	103	32	15,500	2.1	0.4	(0.8)	0.6	0.05		
Perris	(0.04)	6	151	230	157	38,599	4.1	4	128	254	132	41,121	3.2	4	172	240	176	44,349	4.0	13	167	269	180	45,671	3.9	(0.9)	0.8	(0.0)	(0.04)		
Petaluma	0.03	1	308	613	309	55,082	5.6	2	310	619	312	55,366	5.6	2	302	619	304	55,385	5.5	2	310	577	312	54,846	5.7	0.0	(0.1)	0.2	0.03		
Pico Rivera	0.02	5	151	504	156	64,432	2.4	1	164	555	165	65,022	2.5	3	194	559	197	65,061	3.0	4	157	557	161	64,679	2.5	0.1	0.5	(0.5)	0.02		
Piedmont	0.05	-	13	64	13	10,973	1.2	0	7	40	7	10,829	0.6	0	13	54	13	10,690	1.2	0	14	63	14	10,559	1.3	(0.5)	0.6	0.1	0.05		
Pinole	0.51	3	81	172	84	19,344	4.3	2	104	166	106	19,362	5.5	2	131	235	133	19,171	6.9	1	111	221	112	19,061	5.9	1.1	1.5	(1.1)	0.51		
Pismo Beach	0.45	1	62	189	63	8,599	7.3	0	56	168	56	8,560	6.5	0	69	185	69	8,468	8.1	1	72	192	73	8,419	8.7	(0.8)	1.6	0.5	0.45		
Pittsburg	(0.11)	2	248	954	250	60,179	4.2	1	188	717	189	60,706	3.1	5	183	809	188	62,270	3.0	6	234	1,008	240	62,547	3.8	(1.0)	(0.1)	0.8	(0.11)		
Placentia	0.09	1	199	394	200	47,680	4.2	2	188	402	190	48,307	3.9	2	244	411	246	49,856	4.9	1	221	367	222	49,795	4.5	(0.3)	1.0	(0.5)	0.09		
Placerville	(1.00)	-	74	191	74	10,103	7.3	2	61	161	63	10,113	6.2	1	51	155	52	10,142	5.1	0	44	130	44	10,184	4.3	(1.1)	(1.1)	(0.8)	(1.00)		
Pleasant Hill	0.04	2	224	323	226	33,372	6.8	3	191	361	194	33,733	5.8	1	201	363	202	33,353	6.1	5	223	370	228	33,153	6.9	(1.0)	0.3	0.8	0.04		
Pleasanton	(0.22)	2	466	771	468	65,756	7.1	5	416	707	421	65,839	6.4	5	477	677	482	65,778	7.3	3	422	670	425	65,950	6.4	(0.7)	0.9	(0.9)	(0.22)		
Plymouth	0.26	-	3	1	3	1,021	2.9	0	1	1	1	1,048	1.0	0	2	4	2	1,080	1.9	0	4	2	4	1,072	3.7	(2.0)	0.9	1.9	0.26		
Pomona	(0.45)	14	1,149	2,37	1163	151,262	7.7	23	962	1,966	985	152,298	6.5	22	915	1,899	937	153,565	6.1	18	957	1,868	975	153,787	6.3	(1.2)	(0.4)	0.2	(0.45)		
Port Hueneme	1.00	-	9	138	9	22,020	0.4	1	58	126	59	21,836	2.7	3	86	125	89	22,003	4.0	1	74	178	75	22,032	3.4	2.3	1.3	(0.6)	1.00		
Porterville	(0.68)	2	275	421	277	41,360	6.7	3	226	466	229	42,604	5.4	2	250	427	252	43,892	5.7	4	205	306	209	44,959	4.6	(1.3)	0.4	(1.1)	(0.68)		
Portola	(0.00)	-	2	13	2	2,208	0.9	0	2	13	2	2,228	0.9	0	1	7	1	2,238	0.4	0	2	16	2	2,242	0.9	(0.0)	(0.5)	0.4	(0.00)		
Portola Valley	(0.45)	1	6	5	7	4,408	1.6	0	3	7	3	4,421	0.7	0	0	2	0	4,411	0.0	0	1	2	1	4,417	0.2	(0.9)	(0.7)	0.2	(0.45)		
Poway	(0.12)	3	153	305	156	48,804	3.2	2	109	336	111	48,963	2.3	0	120																

San Gabriel	0.51	1	147	235	148	40,632	3.6	2	166	217	168	40,964	4.1	2	186	229	188	41,174	4.6	4	208	244	212	41,056	5.2	0.5	0.5	0.6	0.51		
San Jacinto	(0.14)	3	129	227	132	25,588	5.2	3	16	20	19	26,849	0.7	6	64	117	70	28,035	2.5	6	137	220	143	30,253	4.7	(4.5)	1.8	2.2	(0.14)		
San Jose	(0.24)	53	4,776	4,158	4829	896,095	5.4	37	4,537	3,535	4,574	897,123	5.1	41	4,245	3,415	4,286	902,760	4.7	44	4,216	3,819	4,260	912,332	4.7	(0.3)	(0.4)	(0.1)	(0.24)		
San Juan Bautista	(0.24)	1	2	2	3	1,565	1.9	0	1	4	1	1,668	0.6	0	2	3	2	1,664	1.2	0	2	4	2	1,652	1.2	(1.3)	0.6	0.0	(0.24)		
San Juan Capistrano	0.30	3	121	363	124	34,461	3.6	1	161	400	162	34,752	4.7	0	165	397	165	34,818	4.7	4	152	336	156	34,673	4.5	1.1	0.1	(0.2)	0.30		
CALIFORNIA S.W.I.T.R.S DATA																															
2002							2003							2004							2005							COLLISION RATE CHANGE			
San Leandro	(0.25)	3	470	1,302	473	80,014	5.9	7	481	1,169	488	79,808	6.1	5	444	899	449	79,011	5.7	1	402	721	403	78,178	5.2	0.2	(0.4)	(0.5)	(0.25)		
San Luis Obispo	(0.15)	1	332	979	333	44,022	7.6	1	338	829	339	44,187	7.7	5	336	914	341	44,009	7.7	3	306	823	309	43,509	7.1	0.1	0.1	(0.6)	(0.15)		
San Marcos	(0.12)	3	239	574	242	61,624	3.9	7	280	566	287	63,767	4.5	2	255	592	257	68,220	3.8	6	257	568	263	73,487	3.6	0.6	(0.7)	(0.2)	(0.12)		
San Marino	0.63	-	43	111	43	13,176	3.3	0	71	136	71	13,237	5.4	0	57	127	57	13,244	4.3	0	68	118	68	13,165	5.2	2.1	(1.1)	0.9	0.63		
San Mateo	(0.38)	4	516	751	520	91,688	5.7	0	524	902	524	91,351	5.7	1	491	867	492	91,138	5.4	5	408	802	413	91,081	4.5	0.1	(0.3)	(0.9)	(0.38)		
San Pablo	0.14	2	103	278	105	30,802	3.4	3	119	308	122	30,814	4.0	1	123	244	124	30,878	4.0	1	118	190	119	31,004	3.8	0.6	0.1	(0.2)	0.14		
San Rafael	(0.43)	1	385	1,152	386	56,239	6.9	3	393	1,022	396	55,892	7.1	1	345	875	346	55,535	6.2	2	308	782	310	55,716	5.6	0.2	(0.9)	(0.7)	(0.43)		
San Ramon	0.09	-	105	190	105	46,780	2.2	1	108	192	109	47,583	2.3	2	104	228	106	49,148	2.2	3	123	195	126	49,999	2.5	0.0	(0.1)	0.4	0.09		
Sand City	2.88	-	6	21	6	285	21.1	0	3	24	3	303	9.9	0	12	24	12	307	39.1	0	9	21	9	303	29.7	(11.2)	29.2	(9.4)	2.88		
Sanger	(0.46)	-	67	95	67	19,759	3.4	0	41	88	41	20,112	2.0	0	35	86	35	21,018	1.7	1	43	114	44	22,041	2.0	(1.4)	(0.4)	0.3	(0.46)		
Santa Ana	0.09	23	1,708	2,194	1731	341,393	5.1	24	1,928	2,110	1,952	341,669	5.7	16	1,803	2,283	1,819	342,084	5.3	26	1,791	2,021	1,817	340,368	5.3	0.6	(0.4)	0.0	0.09		
Santa Barbara	(0.16)	6	674	1,038	680	88,771	7.7	4	630	974	634	87,781	7.2	2	673	1,001	675	86,753	7.8	9	607	1,134	616	85,899	7.2	(0.4)	0.6	(0.6)	(0.16)		
Santa Clara	(0.31)	6	489	1,248	495	101,337	4.9	6	394	1,135	400	101,935	3.9	4	378	1,030	382	103,807	3.7	6	412	1,047	418	105,402	4.0	(1.0)	(0.2)	0.3	(0.31)		
Santa Clarita	(0.14)	14	667	1,317	681	158,845	4.3	6	648	1,189	654	162,598	4.0	10	615	1,315	625	164,455	3.8	4	648	1,354	652	168,253	3.9	(0.3)	(0.2)	0.1	(0.14)		
Santa Cruz	(0.09)	3	315	708	318	55,252	5.8	3	313	646	316	55,610	5.7	1	303	667	304	55,517	5.5	2	299	640	301	54,760	5.5	(0.1)	(0.2)	0.0	(0.09)		
Santa Fe Springs	(0.46)	5	397	924	402	16,795	23.9	7	385	977	392	16,945	23.1	5	395	969	400	17,025	23.5	4	381	931	385	17,058	22.6	(0.8)	0.4	(0.9)	(0.46)		
Santa Maria	(0.33)	2	501	994	503	79,375	6.3	1	434	1,048	435	81,374	5.3	5	463	965	468	83,188	5.6	11	440	1,097	451	84,346	5.3	(1.0)	0.3	(0.3)	(0.33)		
Santa Monica	0.01	5	641	1,100	646	86,537	7.5	1	582	1,091	583	87,206	6.7	2	594	1,055	596	87,643	6.8	2	655	1,020	657	87,800	7.5	(0.8)	0.1	0.7	0.01		
Santa Paula	(0.14)	-	101	115	101	28,701	3.5	0	102	116	102	28,817	3.5	1	72	123	73	28,680	2.5	0	88	125	88	28,478	3.1	0.0	(1.0)	0.5	(0.14)		
Santa Rosa	(0.40)	11	1,180	1,616	1191	152,816	7.8	11	1,045	1,543	1,056	153,639	6.9	11	1,079	1,480	1,090	153,674	7.1	13	995	1,296	1,008	153,158	6.6	(0.9)	0.2	(0.5)	(0.40)		
Santee	(0.09)	-	176	371	176	52,787	3.3	1	171	345	172	52,563	3.3	2	148	337	150	52,481	2.9	3	158	329	161	52,306	3.1	(0.1)	(0.4)	0.2	(0.09)		
Saratoga	(0.43)	-	104	230	104	29,335	3.5	1	104	237	105	29,243	3.6	1	76	194	77	29,576	2.6	1	66	256	67	29,663	2.3	0.0	(1.0)	(0.3)	(0.43)		
Sausalito	(0.16)	1	37	49	38	7,297	5.2	2	27	30	29	7,248	4.0	0	22	36	22	7,224	3.0	0	34	34	34	7,184	4.7	(1.2)	(1.0)	1.7	(0.16)		
Scotts Valley	(0.01)	1	41	83	42	11,379	3.7	0	42	88	42	11,247	3.7	0	38	96	38	11,215	3.4	0	41	90	41	11,154	3.7	0.0	(0.3)	0.3	(0.01)		
Seal Beach	0.44	5	166	368	171	24,460	7.0	4	184	390	188	24,455	7.7	5	199	421	204	24,414	8.4	6	196	526	202	24,295	8.3	0.7	0.7	(0.0)	0.44		
Seaside	(0.24)	-	123	455	123	33,986	3.6	1	107	471	108	33,933	3.2	0	104	451	104	34,124	3.0	1	98	453	99	34,214	2.9	(0.4)	(0.1)	(0.2)	(0.24)		
Sebastopol	(0.17)	-	57	104	57	7,757	7.3	0	70	78	70	7,754	9.0	0	54	60	54	7,681	7.0	0	52	59	52	7,598	6.8	1.7	(2.0)	(0.2)	(0.17)		
Selma	(0.72)	1	90	2282																											

Vacaville	(0.15)	-	279	431	279	93,227	3.0	4	244	388	248	93,896	2.6	6	231	400	237	94,078	2.5	3	233	398	236	92,985	2.5	(0.4)	(0.1)	0.0	(0.15)		
Vallejo	(0.30)	9	636	1,305	645	119,299	5.4	10	604	1,332	614	119,429	5.1	9	587	1,255	596	118,090	5.0	7	524	1,232	531	117,483	4.5	(0.3)	(0.1)	(0.5)	(0.30)		
Ventura	(0.30)	10	756	1,352	766	103,207	7.4	7	776	1,394	783	103,999	7.5	4	735	1,382	739	103,882	7.1	10	667	1,147	677	104,017	6.5	0.1	(0.4)	(0.6)	(0.30)		
Vernon	50.72	1	110	254	111	92	1206.5	1	152	271	153	93	1645.2	3	136	259	139	93	1494.6	4	121	267	125	92	1358.7	438.6	(150.5)	(135.9)	50.72		
Victorville	(0.06)	5	231	1,294	236	70,996	3.3	12	253	1,397	265	75,023	3.5	15	278	1,552	293	82,668	3.5	16	272	1,282	288	91,264	3.2	0.2	0.0	(0.4)	(0.06)		
Villa Park	(0.05)	-	7	22	7	6,041	1.2	0	4	12	4	6,048	0.7	0	5	16	5	6,058	0.8	0	6	8	6	6,026	1.0	(0.5)	0.2	0.2	(0.05)		
CALIFORNIA S.W.I.T.R.S DATA																															
2002							2003							2004							2005							COLLISION RATE CHANGE			
Visalia	(0.38)	9	703	1,369	712	97,048	7.3	6	678	1,368	684	100,627	6.8	8	639	1,326	647	104,479	6.2	11	662	1,445	673	108,669	6.2	(0.5)	(0.6)	0.0	(0.38)		
Vista	0.03	7	402	685	409	90,962	4.5	7	390	628	397	91,328	4.3	8	402	633	410	91,418	4.5	8	407	729	415	90,402	4.6	(0.1)	0.1	0.1	0.03		
Walnut	(0.21)	1	78	151	79	30,670	2.6	1	66	140	67	31,094	2.2	1	60	149	61	31,540	1.9	0	61	171	61	31,424	1.9	(0.4)	(0.2)	0.0	(0.21)		
Walnut Creek	0.01	2	371	474	373	65,266	5.7	4	340	434	344	65,160	5.3	3	296	458	299	64,482	4.6	4	364	554	368	64,196	5.7	(0.4)	(0.6)	1.1	0.01		
Wasco	(0.26)	-	49	101	49	21,739	2.3	0	32	93	32	22,459	1.4	0	37	104	37	23,179	1.6	1	34	149	35	23,874	1.5	(0.8)	0.2	(0.1)	(0.26)		
Waterford	(0.13)	-	14	39	14	7,515	1.9	1	6	19	7	8,036	0.9	1	8	25	9	8,129	1.1	0	12	51	12	8,161	1.5	(1.0)	0.2	0.4	(0.13)		
Watsonville	(0.07)	3	168	611	171	46,457	3.7	4	179	532	183	46,117	4.0	3	179	493	182	47,192	3.9	1	166	545	167	47,927	3.5	0.3	(0.1)	(0.4)	(0.07)		
Weed	0.07	-	8	9	8	2,975	2.7	0	3	15	3	2,986	1.0	0	11	11	11	3,078	3.6	0	9	22	9	3,114	2.9	(1.7)	2.6	(0.7)	0.07		
West Covina	(0.28)	5	676	1,095	681	107,106	6.4	5	624	945	629	107,935	5.8	4	673	1,056	677	108,440	6.2	12	586	1,254	598	108,185	5.5	(0.5)	0.4	(0.7)	(0.28)		
West Hollywood	(0.32)	3	239	813	242	36,524	6.6	1	255	789	256	36,703	7.0	1	200	807	201	36,855	5.5	1	207	809	208	36,732	5.7	0.3	(1.5)	0.2	(0.32)		
West Sacramento	0.01	3	173	578	176	36,212	4.9	6	174	653	180	37,564	4.8	5	153	609	158	39,301	4.0	1	203	647	204	41,744	4.9	(0.1)	(0.8)	0.9	0.01		
Westlake Village	0.03	-	26	53	26	8,508	3.1	0	41	57	41	8,556	4.8	0	31	61	31	8,566	3.6	1	26	53	27	8,585	3.1	1.7	(1.2)	(0.5)	0.03		
Westminister	2.05	4	47	1,291	51	88,941	0.6	6	558	1,319	564	89,220	6.3	9	595	1,224	604	89,689	6.7	4	599	1,183	603	89,523	6.7	5.7	0.4	0.0	2.05		
Wheatland	0.51	-	1	2	1	2,505	0.4	0	9	15	9	2,895	3.1	0	3	8	3	3,330	0.9	0	7	28	7	3,638	1.9	2.7	(2.2)	1.0	0.51		
Whittier	(0.22)	3	448	946	451	85,030	5.3	2	514	951	516	85,411	6.0	11	439	961	450	85,334	5.3	2	390	906	392	84,473	4.6	0.7	(0.8)	(0.6)	(0.22)		
Williams	0.62	1	8 27		1	3,928	0.3	0	9	22	9	4,134	2.2	2	14	36	16	4,576	3.5	0	10	36	10	4,755	2.1	1.9	1.3	(1.4)	0.62		
Willits	(0.71)	-	23	84	23	5,115	4.5	0	19	67	19	5,145	3.7	0	12	34	12	5,090	2.4	0	12	34	12	5,066	2.4	(0.8)	(1.3)	0.0	(0.71)		
Willows	0.16	-	14	49	14	6,265	2.2	2	18	44	20	6,325	3.2	0	21	51	21	6,290	3.3	1	16	28	17	6,296	2.7	0.9	0.2	(0.6)	0.16		
Windsor	0.16	1	27	148	28	24,053	1.2	1	34	121	35	24,441	1.4	3	32	104	35	24,723	1.4	1	40	116	41	24,968	1.6	0.3	(0.0)	0.2	0.16		
Winters	(0.48)	-	17	53	17	6,503	2.6	0	5	49	5	6,618	0.8	0	12	39	12	6,830	1.8	0	8	42	8	6,764	1.2	(1.9)	1.0	(0.6)	(0.48)		
Woodlake	(0.40)	-	12	13	12	6,812	1.8	0	7	8	7	6,933	1.0	0	8	8	8	7,073	1.1	0	4	10	4	7,215	0.6	(0.8)	0.1	(0.6)	(0.40)		
Woodland	(0.28)	-	189	270	189	50,910	3.7	2	166	271	168	51,105	3.3	0	171	278	171	51,634	3.3	2	145	248	147	51,020	2.9	(0.4)	0.0	(0.4)	(0.28)		
Woodside	(0.50)	1	35	53	36	5,440	6.6	0	18	37	18	5,422	3.3	2	19	34	21	5,425	3.9	3	25	29	28	5,463	5.1	(3.3)	0.6	1.3	(0.50)		
Yorba Linda	(0.28)	1	265	625	266	60,905	4.4	5	274	512	279	62,502	4.5	2	245	454	247	63,541	3.9	3	224	435	227	64,476	3.5	0.1	(0.6)	(0.4)	(0.28)		
Yountville	0.01	-	7	12	7	3,343	2.1	0	6	21	6	3,337	1.8	0	4	14	4	3,328	1.2	1	6	13	7	3,307	2.1	(0.3)	(0.6)	0.9	0.01		
Yreka	(0.43)	2	28	42	30	7,183	4.2	0	20	27	20	7,204	2.8	1	26	62	27	7,168	3.8	1	20	41	21	7,295	2.9	(1.4)	1.0	(0.9)	(0.43)		
Yuba City	(0.37)	2	299	243	301	52,833	5.7	1	347	281	348	54,853	6.3	2	325	254	327	56,811	5.8	2	267	316	269	58,628	4.6	0.6	(0.6)	(1.2)	(0.37)		
Yucaipa	0.88	3	15	376	18	43,585	0.4	1	163	406	164	45,922	3.6	3	174	410	177	47,792	3.7	5	145	440	150	49,100	3.1	3.2	0.1	(0.6)	0.88		
Yucca Valley	(0.18)	6	78	174	84	17712	4.7	4	62	145	66	18,275	3.6	2	56	170	58	19,003	3.1	7	76	187	83	19,696	4.2	(1.1)	(0.6)	1.2	(0.18)		

**APPENDIX B: CALIFORNIA CITY
ADMINISTRATIVE SURVEY DATA**

City of Belvedere

AACR Δ : +.16

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:2,072 Pop.

Contract Staff Budget: Not Stated

Program & Project Budget:

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: Yes
Primary Objective: Overall Traffic Safety
Analysis Methodology: App./Enforcement of Policy
Prioritization Methodology: Agency Expert Opinion

Fort Bragg

AACR Δ : -.67

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 0

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: No
Primary Objective: N/A
Analysis Methodology: N/A
Prioritization Methodology: N/A

Truckee

AACR Δ : -.41

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 0

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: No
Primary Objective: N/A
Analysis Methodology: N/A
Prioritization Methodology: N/A

Atherton

AACR Δ : -.35

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 0

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: No
Primary Objective: N/A
Analysis Methodology: N/A
Prioritization Methodology: N/A

Capitola

AACR Δ : -.34

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 0

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: No
Primary Objective: N/A
Analysis Methodology: N/A
Prioritization Methodology: N/A

Dixon

AACR Δ : -.01

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:5,777 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: No
Primary Objective: N/A
Analysis Methodology: N/A
Prioritization Methodology: N/A

Arcadia

AACR Δ : -.07

Population Group: 50,000 - 100,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:8,457 Pop.
Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: No
Primary Objective: N/A
Analysis Methodology: N/A
Prioritization Methodology: N/A

Moraga

AACR Δ : -.01

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:8,435 Pop.
Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Routine Traffic Safety Program: No
Primary Objective: N/A
Analysis Methodology: N/A
Prioritization Methodology: N/A

Sunnyvale

AACR Δ : +.05

Population Group: 100,000 - 250,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:3,620 Pop.
Contract Staff Budget: Not Stated

Methodologies

Routine Traffic Safety Program: Yes
Primary Objective: Speed Reduction
Analysis Methodology: Location Collision Patterns
Prioritization Methodology: Cost-Benefit

El Cerrito

AACR Δ : +.39

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:22,868 Pop.
Contract Staff Budget: Not Stated

Methodologies

Pinole

AACR Δ : +.51

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 0

Contract Staff Budget: \$15,000

Methodologies

Windsor

AACR Δ : +.16

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:24,968 Pop.

Contract Staff Budget: Not Stated

Methodologies

Solvang

AACR Δ : +.67

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 0

Contract Staff Budget: Not Stated

Methodologies

Hillsborough

AACR Δ : +.35

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:5,308 Pop.

Contract Staff Budget: \$100,000

Methodologies

Weed

AACR Δ : +.07

Population Group: 0 - 25,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 0

Contract Staff Budget: Not Stated

Methodologies

Saratoga

AACR Δ : -.43

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:9,888 Pop.

Contract Staff Budget: Not Stated

Methodologies

San Dimas

AACR Δ : -.43

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:5,121 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Calexico

AACR Δ : -.13

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:36,005Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Ceres

AACR Δ : -.30

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:13,524 Pop.

Contract Staff Budget: Not Stated

Methodologies

Temple City

AACR Δ : -.10

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:37,363 Pop.

Contract Staff Budget: Not Stated

Methodologies

Monterey

AACR Δ : -.10

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Priority

In-House Staff Rate: 1:7,304 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

San Luis Obispo

AACR Δ : -.15

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:8,702 Pop.

Contract Staff Budget: \$20,000

Methodologies

ASSESSMENT METHODOLOGY

Santa Paula

AACR Δ : -.14

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

In-House Staff Rate: 1:9,493 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Coronado

AACR Δ : -.10

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:13,212 Pop.

Contract Staff Budget: \$100,000

Methodologies

ASSESSMENT METHODOLOGY

Palm Desert

AACR Δ : -.09

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:11,675 Pop.
Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Menlo Park

AACR Δ : -.04

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:14,831 Pop.
Contract Staff Budget: \$50,000

Methodologies

ASSESSMENT METHODOLOGY

Moorpark

AACR Δ : -.06

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:11,948 Pop.

Contract Staff Budget: Not Stated

Methodologies

Campbell

AACR Δ : -.02

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:18,524 Pop.

Contract Staff Budget: \$100,000

Methodologies

Palm Springs

AACR Δ : +.08

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:23,541 Pop.
Contract Staff Budget: \$0

Methodologies

Rocklin

AACR Δ : +.03

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:16,542 Pop.
Contract Staff Budget: Not Stated

Methodologies

San Pablo

AACR Δ : +.14

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:7,751 Pop.
Contract Staff Budget: Not Stated

Methodologies

Aliso Viejo

AACR Δ : +.06

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:20,771 Pop.
Contract Staff Budget: \$60,000

Methodologies

Danville

AACR Δ : +.20

Population Group: 25,000 – 50,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:20,929 Pop.
Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Chico

AACR Δ : -.86

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:17,857 Pop.
Contract Staff Budget: \$200,000

Methodologies

ASSESSMENT METHODOLOGY

Madera

AACR Δ : -.69

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Priority

Traffic Engr. Staff Rate: 1:5,471 Pop.
Contract Staff Budget: \$0

Methodologies

Alameda

AACR Δ : -.31

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:14,115 Pop.
Contract Staff Budget: Not Stated

Methodologies

Camarillo

AACR Δ : -.44

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:30,788 Pop.
Contract Staff Budget: Not Stated

Methodologies

San Mateo

AACR Δ : -.38

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:30,360 Pop.
Contract Staff Budget: Not Stated

Methodologies

Davis

AACR Δ : -.25

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:15,177 Pop.
Contract Staff Budget: Not Stated

Methodologies

Mission Viejo

AACR Δ : -.24

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:31,661 Pop.
Contract Staff Budget: Not Stated

Methodologies

South San Francisco

AACR Δ : -.28

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:15,184 Pop.
Contract Staff Budget: \$1,000,000

Methodologies

Vacaville

AACR Δ : -.15

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:18,597 Pop.
Contract Staff Budget: Not Stated

Methodologies

Chino

AACR Δ : -.27

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:19,395 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Turlock

AACR Δ : -.19

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:22,556 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Encinitas

AACR Δ : -.16

Population Group: 50,000 – 100,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:14,881 Pop.

Contract Staff Budget: Not Stated

Methodologies

Whittier

AACR Δ : -.22

Population Group: 50,000 – 100,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:14,079 Pop.

Contract Staff Budget: \$100,000

Methodologies

La Mesa

AACR Δ : -.15

Population Group: 50,000 – 100,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:26,541 Pop.
Contract Staff Budget: Not Stated

Methodologies

Hawthorne

AACR Δ : -.07

Population Group: 50,000 – 100,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:42,849 Pop.
Contract Staff Budget: Not Stated

Methodologies

Pittsburg

AACR Δ : -.11

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:20,849 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Rialto

AACR Δ : -.05

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:33,171 Pop.

Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Buena Park

AACR Δ : -.06

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:79,174 Pop.
Contract Staff Budget: Not Stated

Methodologies

Redondo Beach

AACR Δ : -.02

Population Group: 50,000 – 100,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:33,412 Pop.
Contract Staff Budget: \$0

Methodologies

Murrieta

AACR Δ : +.21

Population Group: 50,000 – 100,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:41,389 Pop.
Contract Staff Budget: Not Stated

Methodologies

Rancho Cordova

AACR Δ : +1.17

Population Group: 50,000 – 100,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:19,055 Pop.
Contract Staff Budget: \$0

Methodologies

Santa Clara

AACR Δ : -.31

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:17,567 Pop.
Contract Staff Budget: Not Stated

Methodologies

Modesto

AACR Δ : -.46

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:34,502 Pop.
Contract Staff Budget: Not Stated

Methodologies

Vallejo

AACR Δ : -.30

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:11,748 Pop.
Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

Fairfield

AACR Δ : -.40

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:26,119 Pop.
Contract Staff Budget: Not Stated

Methodologies

ASSESSMENT METHODOLOGY

West Covina

AACR Δ : -.28

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:54,093 Pop.
Contract Staff Budget: Not Stated

Methodologies

Daly City

AACR Δ : -.15

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:100,339 Pop.
Contract Staff Budget: Not Stated

Methodologies

Burbank

AACR Δ : -.27

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:20,882 Pop.
Contract Staff Budget: Not Stated

Methodologies

Fontana

AACR Δ : -.17

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:32,772 Pop.
Contract Staff Budget: Not Stated

Methodologies

Rancho Cucamonga

AACR Δ : -.14

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:56,451 Pop.

Contract Staff Budget: \$0

Methodologies

Norwalk

AACR Δ : -.14

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:105,834 Pop.

Contract Staff Budget: Not Stated

Methodologies

Irvine

AACR Δ : -.03

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:20,761 Pop.
Contract Staff Budget: Not Stated

Methodologies

Elk Grove

AACR Δ : -.01

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:22,468 Pop.
Contract Staff Budget: Not Stated

Methodologies

Garden Grove

AACR Δ : +.08

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:55,358 Pop.
Contract Staff Budget: Not Stated

Methodologies

Orange

AACR Δ : +.14

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:134,950 Pop.
Contract Staff Budget: \$0

Methodologies

Huntington Beach

AACR Δ : +.12

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:68,819 Pop.
Contract Staff Budget: Not Stated

Methodologies

Moreno Valley

AACR Δ : +.12

Population Group: 100,000 – 250,000

Staffing & Resources

Resource Allocation

Traffic Engr. Staff Rate: 1:22,296 Pop.
Contract Staff Budget: Not Stated

Methodologies

Palmdale

AACR Δ : +.41

Population Group: 100,000 – 250,000

Staffing & Resources

Traffic Engr. Staff Rate: 1:33,364 Pop.
Contract Staff Budget: \$300,000

Methodologies

Long Beach

AACR Δ : -.61

Population Group: 250,000 +

Staffing & Resources

Traffic Engr. Staff Rate: 1:118,504 Pop.
Contract Staff Budget: \$0

Methodologies

San Diego

AACR Δ: -.08

Population Group: 250,000 +

Staffing & Resources

Traffic Engr. Staff Rate: 1:39,326 Pop.
Contract Staff Budget: \$0

Methodologies

**APPENDIX C: CALIFORNIA CITIES
COLLISION DATA SUMMARY**

Data Sample Total		
	Total	Correctable
BroadSides	8085	1522
HeadOn	1762	53
HitObject	3156	351
Other	763	6
OverTurned	326	6
RearEnd	9263	2165
Sideswipe	6221	676
Ped	1091	6
NA	418	4
Total	31085	4789

Collision Type Severity					
	PDO	COMPLAINT	VIS. INJURY	SEV INJ	FATAL
BroadSides	4706	2242	956	145	36
HeadOn	1059	436	211	43	13
HitObject	2338	359	359	73	27
Other	540	102	99	19	3
OverTurned	153	70	86	14	3
RearEnd	6514	2219	467	50	15
Sideswipe	5264	624	284	37	12
Ped	94	472	369	120	35
NA	282	90	36	8	1

Collision Type Causal Factor														
	DUI	IMPEED TRAFFIC	SPEED	TOO CLOSE	WRONG LANE	PASSING	LANE CHANGE	TURNING	AUTO ROW	PED ROW	TRAFFIC SIGNAL	PARKING	OTHER EQUIP	N/A
BroadSides	155	3	259	9	197	66	115	826	3396	23	1704	10	382	941
HeadOn	131	1	173	10	171	4	59	296	492	10	102	2	94	217
HitObject	336	0	728	4	45	7	155	1099	22	0	8	5	441	301
Other	9	0	48	0	31	0	34	60	50	7	20	1	244	259
OverTurned	33	0	117	0	0	0	19	98	5	0	9	0	29	16
RearEnd	377	19	5929	719	14	16	401	445	59	1	28	12	600	645
Sideswipe	260	5	401	13	154	162	1734	1632	351	4	119	3	407	977
Ped	10	0	35	0	13	5	5	21	377	286	48	0	81	211
NA	14	0	44	5	10	1	27	61	72	6	27	0	51	100

Collision Type Secondary Factor									
	DEFFECTIVE EQUIP	INATTENTION	NONE	OTHER	CONGESTION	OTHER VEHICLE	VIOLATION	SIGHT DIST.	NA
BroadSides	46	959	4334	158	77	21	764	260	1465
HeadOn	24	226	702	70	12	9	312	37	372
HitObject	63	230	1719	137	64	41	533	23	346
Other	10	70	341	64	7	9	76	12	174
OverTurned	1	21	178	20	14	5	56	1	30
RearEnd	65	1311	5040	187	401	44	996	55	1165
Sideswipe	36	623	3257	191	93	40	781	61	1138
Ped	6	158	512	28	6	7	90	51	232
NA	4	64	174	7	6	4	49	7	103

Collision Type Movement Preceding																	
	Backing	Change Lanes	Ent. Traffic	Left	Right	U-Turn	Other	Other Turn	Parked	Parking	Passing	Off Road	Straight	Slow/Stop	Stoped	Wrong Way	NA
BroadSides	281	141	440	2238	419	189	133	66	17	17	32	30	3833	39	95	63	83
HeadOn	21	28	13	562	107	27	33	40	5	5	5	41	681	4	22	74	24
HitObject	139	165	32	202	222	28	523	90	11	19	5	316	1305	26	17	19	50
Other	156	29	8	56	35	8	87	7	29	12	1	14	264	15	6	1	37
OverTurned	0	20	4	17	20	2	47	8	0	0	0	32	166	4	1	2	3
RearEnd	390	398	56	216	154	22	169	83	27	65	31	32	6806	570	184	31	51
Sideswipe	138	1268	194	544	489	69	336	187	104	67	151	42	2328	41	63	72	129
Ped	41	10	81	117	147	4	109	7	3	6	4	5	471	10	18	6	50
NA	27	15	15	57	29	7	11	6	9	2	4	7	181	3	9	3	36