REPORT TO MAYOR AND COUNCIL

NO: 11-101

Council Meeting: May 24, 2011

SUBJECT: Red Light Camera Intersection Monitoring Systems in the City of Sunnyvale (Study Issue Update)

BACKGROUND

In September of 2010, Public Safety staff presented to Council a comprehensive Study Issue report (RTC 10-236/Attachment A) on the feasibility of a Red Light Camera (RLC) enforcement program in the City of Sunnyvale. In that report, staff provided Council with national, regional and local statistical data related to red light running, and an analysis of existing programs and issues.

Although Department of Public Safety (DPS) staff determined that intersection safety could be improved through the use of RLC systems, there were significant legal challenges as well as pending legislation that, if passed, would have impacted the feasibility of most RLC systems. Council directed staff to monitor these issues and report back no later than September of 2011. This report provides an update on legal challenges, legislative actions, and recent RLC enforcement studies for Council consideration.

EXISTING POLICY

Police Services Sub-Element

Goal 4.1A.5a: Provide traffic enforcement to deter traffic violations.

Goal 4.1A.5h: Participate in prevention and enforcement activities directed at minimizing personal injury in traffic collisions.

DISCUSSION

By a 7-0 vote, Council directed DPS staff to continue to monitor legal challenges and legislative actions potentially affecting the viability of RLC systems around the state. At the time of the original staff report, there were three significant legal issues in process;

- State of California vs. KHALED (case no. 30-2009-304893)
- Senate Bill 1362 (SB 1362), Senator Joe Simitian (D-Palo Alto)
- Assembly Bill 909 (AB 909), Assemblymember Jerry Hill (D-San Mateo]

As Council will recall, the Appellate Court in Orange County entered a ruling on May 21, 2010, in the matter of the **State of California vs. KHALED (case no. 30-2009-304893)**. The court held that the evidence presented by the prosecution, digital image(s) of an alleged red light violation, was mistakenly allowed into evidence by the lower court. The Appellate Court considered the images to be hearsay evidence and thus inadmissible. The Appellate Court reversed the conviction of KHALED and directed the charge be dismissed. This case is binding on courts in Orange County, but not in other county courts throughout the state. However, the decision can be cited as "persuasive authority" if a court outside of Orange County is asked to rule on a hearsay issue in an RLC case.

> NOTE: In a case from the Appellate Division of the Superior Court of State of California for the County of Los Angeles, People vs. Carmen Goldsmith (February 14, 2011), the court rejected the KHALED decision and held that the photographs should be handled no differently than all other photographic or video image evidence.

DPS staff has contacted Fremont Police Department and interviewed their staff regarding this issue because of their lengthy history and on-going experiences with RLC systems. The Fremont Police Department worked with the vendor of their system and determined that additional training of Fremont PD staff, along with additional assistance from the vendor, would satisfy hearsay issues raised at trial. To date, Fremont PD has experienced no issues in the prosecution of RLC citations.

Senate Bill 1362 (SB 1362) sponsored by Senator Joe Simitian (D-Palo Alto) would have required that cities using red light cameras establish policies and procedures to better ensure that citations are properly and appropriately issued, and that motorists can effectively challenge incorrectly administered tickets. But the bill would have placed unreasonable administrative burdens on the issuing agency.

As previously reported, this bill passed the Senate on June 2, 2010 and was to be sent to the Assembly. However, SB 1362 failed when, on Aug. 13, the Assembly Committee on Appropriations blocked it and kept it from reaching the Assembly floor for a vote by the annual deadline. The bill was not modified and it died.

Assembly Bill 909 (AB 909), sponsored by Assemblymember Jerry Hill (D-San Mateo), would have decreased the fine amount for a violation of 21453(b) CVC (right turn on red) from the current $100 to $35. It was unclear as to the impact this bill would have had on RLC systems, however, cities that utilize systems with the capability to capture "right turn on red" violations do issue a significant number of citations for this violation.

The bill was sent to the Governor in September of 2010. On September 29th AB 909 was vetoed by Governor Schwarzenegger.

RECENT RLC EFFECTIVENESS STUDIES

Studies and reports analyzing the benefits and potential negative outcomes of RLC systems previously cited in the original study issue report remain, for the most part, unchanged (see Attachment A). However, a study released by the Insurance Institute for Highway Safety in February of 2011 (Attachment B) further studied the issue of the potential benefits of RLC systems. Looking at the 99 US cities with populations over 200,000, the researchers compared those with red light camera programs to those without.

The researchers found that in the 14 cities that had cameras during 2004-08, the combined per capita rate of fatal red light running crashes fell 35 percent, compared with 1992-96. The rate also fell in the 48 cities without camera programs in either period, but only by 14 percent.

According to the Insurance Institute, "Researchers concluded that the rate of fatal red light running crashes in cities with cameras in 2004-08 was 24 percent lower than it would have been without cameras. That adds up to 74 fewer fatal red light running crashes or, given the average number of fatalities per red light running crash, approximately 83 lives saved."

It should be noted that two cities in this study, Raleigh, NC, and Bakersfield, CA, experienced an increase in intersection collisions. Researchers are not exactly clear on the cause of this; however, a contributing factor to this increase may be that each city expanded geographically over the last two decades, according to Insurance Institute information.

As council may recall, this finding of a potential increase in collisions is consistent with a study conducted by the Federal Highway Administration (FHWA) in April of 2005 and outlined in the original study issue report (see Attachment A). Additionally, a study conducted by the Virginia Transportation Research Council (a cooperative organization sponsored jointly by the Virginia Department of Transportation and the University of Virginia) in January 2005 came to a similar conclusion.

In the Virginia report, researchers studied RLC programs in seven Virginia communities (Alexandria, Arlington, Fairfax City, Fairfax County, Falls Church, Vienna, and Virginia Beach). The results of the study again showed the variable nature of the results of most studies. "The data from four jurisdictions (Fairfax City, Fairfax County, Falls Church, and Vienna) suggested that photo-red enforcement reduced the number of crashes *directly attributable to red light running.* Further analysis indicated that the cameras are contributing to a definite increase in rear-end crashes, a possible decrease in angle crashes, a net decrease in injury crashes attributable to red light running, and an increase in total injury crashes."

Staff has been able to find studies that support the theory of collision reduction through the use of RLC systems, as well as other studies that show an apparent increase in collisions after the implementation of RLC programs. Attempting to discern *definitive* results with regards to the collision reduction capabilities of RLCs from any of the reports obtained for this analysis has proven to be difficult.

FISCAL IMPACT

Fiscal impact remains unchanged from the original staff report (See Attachment A).

PUBLIC CONTACT

Public contact was made by posting the Council agenda on the City's official-notice bulletin board outside City Hall, in the Council Chambers lobby, in the Office of the City Clerk, at the Library, Senior Center, Community Center, and Department of Public Safety; posting the agenda and report on the City's Web site; and making the report available at the Library and the Office of the City Clerk.

ALTERNATIVES

1. Support RLC monitoring and enforcement in the City of Sunnyvale and direct City staff to execute a Request for Proposals for RLC systems at a specified number of intersections.
2. Do not support RLC monitoring and enforcement in the City of Sunnyvale.

RECOMMENDATION

RLC enforcement has been studied by a variety of entities, both public and private. The findings of the studies have been as varied as public opinion on the topic, with no definitive answers or consistent outcomes provided. Likewise staff opinions are varied, as the issue is not so much one of science, but one of emotion and personal experience. Staff believes that the technical studies and traffic statistics available today can be used to support either of the alternatives presented above, and that neither alternative is more defensible than the other from a professional perspective.

Reviewed by:

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Don Johnson, Director, Public Safety
Prepared by: Doug Moretto, Captain

_____
Marvin Rose, Director, Public Works

Approved by:

_____
Gary M. Luebbers
City Manager

Attachments

A. RTC #10-236
B. Insurance Institute for Highway Safety RLC Report

ATTACHMENT A

Council Meeting: September 14, 2010

SUBJECT: Red Light Camera Intersection Monitoring Systems in the City of Sunnyvale (Study Issue)

REPORT IN BRIEF

The purpose of this report is to review and evaluate the feasibility of implementing a Red Light Camera (RLC) enforcement program for selected intersections within the City of Sunnyvale. This report provides information on the technical, operational and fiscal feasibility of RLC systems, as well as information on the most recent court decisions governing the use of RLC systems.

Staff recommends that Council direct staff to monitor ongoing legal challenges and legislative actions and report back upon resolution, or in any case, no later than September of 2011.

BACKGROUND

Red-light running is a serious intersection safety issue across the nation. According to the National Highway Traffic Safety Administration's (NHTSA) analysis of 2008 statistics, there were more than 2.3 million reported intersection-related collisions, resulting in more than 7,770 fatalities and approximately 733,000 injury crashes. Red light running related collisions alone resulted in 883 deaths and approximately 165,000 injuries nationwide.

An analysis of collisions in the City of Sunnyvale between January 1, 2005 and February 4, 2010 showed that DPS documented 5227 collisions; 547, or approximately 10%, of these collisions were the result of a light violation at an intersection. Of the 547 accidents, 43% (236) were injury collisions resulting in two fatalities and 327 reported injuries.

In response to Council and community concern, Councilmembers Whittum and Chu requested DPS staff study the feasibility of an RLC enforcement program in the City of Sunnyvale (Attachment A, Study Issue Paper DPS 10-01). Staff has prepared a detailed report designed to provide Council with information relative to:

- Issue Analysis and Legislative Requirements
- Technical Feasibility

- Operational Feasibility
- Fiscal Feasibility

EXISTING POLICY

Police Services Sub-Element

Goal 4.1A.5a: Provide traffic enforcement to deter traffic violations.

Goal 4.1A.5h: Participate in prevention and enforcement activities directed at minimizing personal injury in traffic collisions.

DISCUSSION

According to California Vehicle Code Section 21452(a), a red light violation occurs when a vehicle crosses the established limit line at an intersection after the traffic signal turns red. RLC enforcement has proven to be a strong deterrent to these types of violations. The Federal Highway Administration (FHWA) and NHTSA have provided position guidance on RLC systems. In part, both agencies support a comprehensive approach to intersection safety that incorporates engineering, education, and enforcement countermeasures to prevent red-light running and improve intersection safety. Red-light camera systems can be a very effective countermeasure to prevent red-light running.

In California, photo enforcement by RLC systems have been authorized since 1996. California Vehicle Code Sections 21455.5, 21455.6, 21455.7 and 40520 outline the following requirements for RLC systems:

1. Identification of system with signs visible to traffic approaching from all directions or posting of signs at all major entrances to the City.

2. Ensure system location meets the specific criteria outlined in the Traffic Manual of the Department of Transportation for minimum yellow light change intervals.

3. Issuance of warning notices to violators and public service announcements for a period of thirty (30) days in advance of the utilization of an automated enforcement system(s).

4. Only a government agency, in cooperation with a law enforcement agency, may operate an automated enforcement system.

5. Holding of a public hearing on the proposed use of an automated enforcement system prior to a jurisdiction entering into a contract for the use of such a system.

Staff has contacted the Superior Court of Santa Clara County and asked for a judicial opinion on the use of RLC systems. The court does not have a position at this time. However, there is nothing at this time that would prevent a violation of

21453(a) CVC captured by an RLC system from being prosecuted in the courts of Santa Clara County. City staff would need to coordinate closely with the Traffic Court of Santa Clara County to ensure the proper court process is put into place prior to the implementation of any RLC system.

Technical Specification and Operational Consideration Discussion
Staff has spent a considerable amount of time researching the technical and operational aspects of RLC systems. This research has involved site visits to agencies utilizing RLC systems, presentations from a vendor of RLC systems, attending a user group meeting involving agencies from all over California and internet research.

All of the RLC systems in use today are designed to supplement conventional law enforcement traffic safety operations by accurately identifying violations without the presence of a police officer at the intersection being monitored. DPS currently uses a combination of Public Safety Officers assigned to the Traffic Safety Unit and Patrol Operations to monitor red light violations in intersections throughout the City. Although DPS attempts to provide a significant presence at high collision rate intersections, emergency calls for service and higher priority traffic safety operations, such as speed enforcement campaigns, often draw resources away from intersections. It should be noted that DPS often deploys available resources to high collision areas to focus on the leading causes of intersection collisions in the City of Sunnyvale; unsafe speed, improper turning and light violations respectively. DPS believes the ability to monitor selected intersections via the use of RLC systems could significantly enhance the efficiency of DPS' traffic safety enforcement and education operations throughout the City.

Technical specifications of the RLC system are specific to each manufacturer and/or vendor. However, all of the systems operate using the same basic technology. A series of sensors and digital cameras are placed around the intersection, often times utilizing existing infrastructure including signal poles and power supplies. The sensors become active upon the initiation of the red signal phase. If a vehicle crosses the limit line during the red phase of the signals, a series of cameras activate to capture the violation. The more robust systems can capture four or more lanes of travel. In addition to the through traffic, these systems can be designed to capture drivers failing to come to a complete stop prior to making a right turn on a red signal. These violations are particularly dangerous to pedestrians at intersections.

The RLC system will produce a series of high resolution digital photographs that are designed to capture the violation, the license plate of the violating vehicle and the driver's facial image. Some systems also produce full motion video of the violation. In addition to the photographs and videos, the system records the date, time, speed of the vehicle and the elapsed time of both the yellow and red signal phases.

After a violation is captured by the RLC system, the images are uploaded to a vendor maintained server through a secure internet connection. At this point it is the responsibility of the law enforcement agency to view the violation and begin the necessary processing. DPS staff made a site visit to the City of Fremont and conducted a fact finding exercise to learn more about the responsibilities of the law enforcement agency and the administrative process needed to maintain a successful RLC program. Fremont's operational model is also common to other agencies utilizing RLC systems. It should be noted that there are currently no operational RLC systems in Santa Clara County, thus no benchmarking was conducted in Santa Clara County.

The City of Fremont has maintained an RLC program since August of 2000. The program is managed through the Police Department. There are currently 10 intersections monitored by RLC. The City of Fremont is under contract with Redflex Traffic Systems as the provider of the RLC systems. Since 2000, the systems in Fremont have captured approximately 121,000 red light incidents. In 2009, the 10 Fremont systems captured over 19,500 red light incidents resulting in 10,516 citations (the reason for the difference between violations captured and citations issued will be discussed in the following paragraphs). During staff's site visit to Fremont, DPS staff was very interested in determining the process used to administer a program generating this volume.

As previously mentioned, once a violation is captured it is the responsibility of law enforcement to process the event. The Fremont Police Department has dedicated staff within their Community Engagement Unit, similar to the Community Safety Services Bureau within DPS, to administer the program. 50% of a civilian manager's allocated hours are used to oversee the entire program. Prior to a citation being issued to a violator, a police officer, or other qualified law enforcement employee, must review the evidence collected by the RLC system (digital photograph) and determine the validity of the evidence. This review is conducted by accessing the photo storage system through a secure internet connection. If the photo evidence supports the violation, the incident is referred forward for court processing by the Community Services Officer position at Fremont P.D. Incidents that do not have the requisite supporting evidence are rejected. Two part-time positions are utilized to accomplish this task. Currently the Fremont Police Department contracts with several retired police officers to review the RLC evidence. In 2009, Fremont P.D. rejected approximately 8,900 captured incidents for lack of evidence (difference between 19,500 captured incidents and 10,516 issued citations).

When a captured event is deemed to be prosecutable, all evidence is sent to the law enforcement agency. At Fremont P.D., a full-time Community Service Officer position is utilized to prepare all citations for court. This position must:

- Prepare all court documents and file the citation with the Traffic Court in Alameda County

- Testify in court, as needed, if citation is appealed
- Hold office hours to meet with citizens that request a meeting
- Address information requests as needed

This staffing model is utilized to process approximately 10,500 citations annually. 50% of the civilian manager position, 80% of the Community Service Officer position and 100% of the part-time positions are funded through the distribution of fines collected after the adjudication of a red light violation. Total program administrative costs for FY 09/10 in the City of Fremont were approximately $442,000. Staff believes that this staffing model has viability at DPS.

It is difficult at this time to predict the volume of citations that would be generated by a system implemented in the City of Sunnyvale, and the staff time that would be needed to administer the program. However, utilizing the Fremont annual totals as a baseline, each RLC location may produce approximately 87 citations per month. DPS believes that with minimal reorganization, administrative duties could be assigned to existing staff if the program were limited to one or two monitored intersections. RLC monitoring at additional locations would most likely require the addition of staff to DPS' Budgeted Position Allocation.

Other Discussion

The primary goals of any RLC system in the City of Sunnyvale would be to reduce collisions associated with light violations at intersections, enhance overall driver safety awareness and improve the efficiency of law enforcement traffic safety operations. Various studies seem to indicate that RLC systems can improve safety by reducing intersection related collisions. The following analysis points have been compiled from the "National Campaign to Stop Red Light Running" database:

- In New Orleans, LA, red light cameras led to an 85% drop in red light running (2009).
- In Council Bluffs, IA, red light cameras led to a 90% reduction in red light running crashes. Cameras led to a 40% reduction in red light running crashes in Davenport (2007).
- A Texas A&M Texas Transportation Institute study found traffic crashes at red light camera locations across Texas decreased by approximately 30%. Right angle crashes, which usually produce the most deaths and injuries, dropped by 43% (2008).
- An Insurance Institute for Highway Safety study of the Philadelphia, PA red light camera program tracked signal violation rates at intersections before and after extending the yellow light sequence, and again after RLC

enforcement had been in effect for about a year. Lengthening the yellow light reduced signal violations by 36%. The cameras reduced the remaining violations by 96% (2007).

- A review of 10 U.S. and international red light camera research studies, conducted by the respected Cochrane Collaboration, found "red-light cameras are effective in reducing total casualty crashes. In the best conducted of these studies, the reduction was nearly 30%" (2005).

- A multi-year study of the red light camera program in Virginia Beach found red light running violations more than tripled after the law permitting the city to use red light cameras was allowed to expire in 2005. Results showed that red light cameras provided a strong deterrent against red light running and that once the cameras were turned off, aggressive drivers returned to their old habits (2007).

- Columbus, OH, saw violations at its first two red light camera intersections drop from 1,684 in March 2006 to 477 in August 2006, a 71% decrease. There was only one crash at the two intersections, which each recorded between five and 14 crashes per year before the cameras were installed (2006).

- An Orange County, CA, government report found that one year after red light camera installation, crashes at monitored intersections dropped by 46.7% in Garden Grove, 28.2% in Costa Mesa, 16.2% in Santa Ana, 12.1% in San Juan Capistrano and 5.7% in Fullerton (Orange County Grand Jury, 2004-2005).

Locally, a report by a San Mateo County Civil Grand Jury on the use of RLC systems in San Mateo County was released on June 7, 2010. In this report, the Grand Jury found that the camera technology provides an effective method for enforcing a vehicle code violation that has a high probability of causing an accident and that the use of RLC is cost-effective and financially viable when compared to utilizing police officers to perform equivalent enforcement.

However, the Grand Jury found several areas of concern with regards to RLC program methodology, protocols and court consideration. In short, the Grand Jury concluded that there are no protocols established in San Mateo County for evaluating possible infractions captured by the RLC systems and determining which events will be issued citations, thus making court decisions difficult and undermining the public trust in the systems. Additionally, the Grand Jury found that although cities have claimed the goal of the RLC is to reduce intersection collisions, there fails to be a consistent and standardized reporting and evaluation process to determine if the RLC at any particular intersection, is in fact, reducing the accident rate. While at the same time, each RLC program seems to represent a significant source of funding for cities.

This Grand Jury report does not specifically point out recent RLC issues involving cities in San Mateo County. Staff is aware of errors made in the administration of the system in South San Francisco that has resulted in the dismissal of all citations issued via RLC between August 15, 2009 and January 27, 2010. South San Francisco, along with the State of California and the County of San Mateo, may refund in excess of $3.1 million to alleged violators. In the City of Burlingame, the single RLC has been deactivated due to the program being unable to pay for itself.

Although the data collected in various studies seems to point to the benefits of RLC systems, some of the studies, and the very use of RLC enforcement itself, are not without controversy.

Some studies have concluded that collisions have actually increased at some RLC monitored intersections. A study funded by the FHWA of seven U.S. cities utilizing RLC systems found that although broadside intersection collisions were reduced by 25%; rear-end collisions increased by 15%. This is most likely due to drivers that are approaching an RLC monitored intersection slamming on their breaks prior to the red phase activation and then being rear-ended by the vehicle following behind. This study is careful to point out that not all jurisdictions have experienced this increase and that although rear-end collisions increased, overall injuries decreased.

Since the authorization of RLC enforcement in California in 1996, RLC systems have come under frequent legal challenge from accused violators, and in some cases, their legal counsel. In 2001, a group of 400+ citizens banded together to challenge the City of San Diego's RLC system. This challenge showed potentially significant administrative and technical issues with the system, and pointed out that the systems seemed to be in place for the sole purpose of generating revenue and not improving traffic safety. As a result of this effort, the San Diego system, as well as several others, were taken off-line for evaluation and/or modification, or abandoned altogether. Locally, officials in Cupertino stopped their camera program in January 2004 after three years of use. Although they initially planned on using seven cameras, four were installed in that period and only two were fully operational, with the other two plagued by technical glitches. Cupertino ended up spending about $200,000 more each year to operate the program than the revenues it generated.

In 2004, Assembly Bill 1022 (AB 1022) made significant changes to the vehicle code regulating RLC systems. These changes are currently codified in the California Vehicle Code sections discussed on page two of this report. Armed with this clear direction from the Legislature of California, and multiple studies pointing to the safety benefits of RLC systems, cities throughout California have chosen to utilize RLC systems. There are approximately 70 communities in California utilizing RLC monitoring.

However, legal challenges to the programs have persisted. Some of these challenges may be significant to the on-going viability of RLC monitoring and enforcement. Additionally, pending legislation could impact RLC usage.

A recent challenge to RLC systems, and potentially one of the most significant, is a decision from Orange County, CA. The Appellate Court in Orange County entered a ruling on May 21, 2010, in the matter of the State of California vs. KHALED (case no. 30-2009-304893). The court held that the evidence presented by the prosecution, digital image(s) of an alleged red light violation, was mistakenly allowed into evidence by the lower court. The Appellate Court considered the images to be hearsay evidence and thus inadmissible. The Appellate Court reversed the conviction of KHALED and directed the charge be dismissed. This case is binding on courts in Orange County, but not in other county courts throughout the state. However, the KHALED case can be used in other counties as guidance in determining a ruling for similar cases.

It is unclear at this time the extent of the impact this will have on systems currently in operation. However, the City of Santa Ana, the city that issued the original citation to KHALED, is in the process of expanding its RLC program. Santa Ana has developed a protocol to provide expert testimony at trial to support the introduction of digital images captured by RLC. DPS, in conjunction with the Office of the City Attorney (OCA), will continue to monitor this situation.

The California Legislature is currently working with two bills related to RLC systems and enforcement. Senate Bill 1362 (SB 1362) sponsored by Senator Joe Simitian (D-Palo Alto) would require that cities using red light cameras establish policies and procedures to better ensure that citations are properly and appropriately issued, and that motorists can effectively challenge incorrectly administered tickets. Specifically, the legislation would:

- Require cities to document how installing cameras will reduce accidents, and make the justifications they use accessible to the public
- Invalidate tickets not reviewed by a sworn police officer
- Set stricter standards for how drivers accused of violations are notified of the citations
- End use of so-called "snitch tickets" that ask drivers to identify the person photographed by the cameras
- Require signs at all intersections where red-light cameras are in use

This bill passed the Senate on June 2, 2010 and will be sent to the Assembly.

Assembly Bill 909 (AB 909), sponsored by Assemblymember Jerry Hill (D-San Mateo), would decrease the fine amount for a violation of 21453(b) CVC (right

turn on red) from the current $100 to $35. It is unclear as to what impact this bill will have on RLC systems; however, cities that utilize systems with the capability to capture "right turn on red" violations do issue a significant number of citations for this violation. As of July 15, 2010, this bill has been modified twice and has now been ordered to a third reading. DPS, in conjunction with OCA, will continue to monitor these bills.

FISCAL IMPACT

There are two primary costs associated with RLC enforcement:

1. System hardware and infrastructure

2. Program administration.

The costs of the RLC system infrastructure vary between cities. However, the majority of cities researched by DPS staff seem to utilize similar vendor contract methodology and pricing. In most cases, cities incur no upfront costs for the analysis of selected intersections, engineering of the selected systems, requisite permits, and hardware installation. Rather, cities pay a fixed fee each month for each monitored intersection. These fees range from $4,800 to $8,600 per month, per intersection. This fee represents a payment of $288,000 to $516,000 to a selected vendor over the life of the typical five year contract.

Although California law expressly prohibits a city from entering into any agreement by which payment to a vendor is based on the number of citations issued by a RLC system, cities can utilize fines and fees collected from traffic citations in general to pay a fixed monthly fee for an RLC system. All of the cities researched for this report appear to have structured contractual agreements that identify fines and fees collected as a result of citations issued by the RLC system as the revenue source for the fixed monthly fee charged by the vendor. Additionally, some of the contracts attempt to build in cost neutrality that allows a city to seek relief from the contractual obligations if fines and fees from traffic citations fall below a level that will support the fixed monthly fee.

As mentioned previously in this report, staff will be needed to administer any RLC system. Program administration consists of, but is not limited to:

1. Management oversight

2. Image review processes

3. Citation issuance

4. Court testimony and follow-up

The City of Fremont in FY 09/10 allocated $202,420 in personnel costs and program wide allocations to their RLC program. An additional $240,000 was

allocated to the monthly vendor fee. Total FY 09/10 RLC system expenditures were projected to be $442,541. Total revenue projection from fines and fees collected through the issuance of citations was projected to be at $1.2 million. The fine in Santa Clara County associated with a citation issued by DPS for a violation of 21453(a) CVC is $466. The City of Sunnyvale currently receives 28% of this amount, or $131.

Currently there is no identified revenue source in the FY 10/11 or FY 11/12 DPS operating budget that will support a RLC program. The ability of the City of Sunnyvale to sustain a RLC system will need to involve the analysis of potential additional traffic fine revenue as a funding source for the payment of costs associated with any proposed system. Using an average system cost of $6,000 per month, per intersection approach, each system would need to capture approximately 45 prosecutable violations each month, with additional citations needed to cover for the approximately 30% (+/-) of citations that go unpaid by violators. Based on all of the research data collected by DPS, on average, each approach would need to produce 2 adjudicated (violator convicted/fee collected) citations per day to be cost neutral.

Should Council choose to select the recommended Alternative 2, DPS and other City staff will work together to further identify potential revenue sources, potential costs and any potential vendor contract structure that would explore the cost neutrality of any system.

PUBLIC CONTACT

Public contact was made by posting the Council agenda on the City's official-notice bulletin board outside City Hall, in the Council Chambers lobby, in the Office of the City Clerk, at the Library, Senior Center, Community Center, and Department of Public Safety; posting the agenda and report on the City's Web site; and making the report available at the Library and the Office of the City Clerk.

ALTERNATIVES

1. Direct staff to further study the issue and report back to Council. During this period, staff will monitor the on-going legal challenges and legislative actions and report back upon resolution, or in any case no later than September of 2011.

2. Direct City staff to execute a Request for Proposals for RLC and DPS staff to begin the implementation planning process for up to five (5) RLC enforced intersections.

3. Do not support RLC monitoring and enforcement in the City of Sunnyvale.

RECOMMENDATION

Staff recommends Alternative #1; Direct DPS staff to further study the issue and report back to Council in FY 11/12. Although DPS is confident that intersection safety could be improved through the use of RLC systems, there currently are significant legal challenges and political hurdles to overcome. By continuing to monitor the systems currently in operation, and the challenges facing the municipalities using them, staff believes that DPS can provide more clarity to the policy decision required by Council.

Reviewed by:

Don Johnson, Director, Public Safety
Prepared by: Doug Moretto, Captain

Reviewed by:

Marvin A. Rose, Director, Public Works

Reviewed by:

David A. Kahn, City Attorney

Approved by:

Gary M. Luebbers
City Manager

Attachments

A. Study Issue Paper 2009, DPS 10-01

Proposed 2010 Council Study Issue

DPS10-01 Photo Red Light Enforcement

Lead Department Public Safety

Element or Sub-element Public safety Law Enforcement Sub-Element

New or Previous New

Status Pending **History** **1 year ago** None **2 years ago** None

1. **What are the key elements of the issue? What precipitated it?**

   Photo red light enforcement has become a widely accepted traffic enforcement tool utilized by many cities and counties across the country to reduce accidents at intersections. Photo red light enforcement is a technique in which a camera photographs a vehicle that enters an intersection after the traffic light has turned red; a human reviewer validates the potential violation; and if appropriate, the reviewer sends a citation for red light running to the vehicle's registered owner.

   The study will evaluate three critical areas related to photo red light enforcement programs in other jurisdictions that have implemented programs. Technical feasibility (confirm the program meets legal standards and is accepted by Santa Clara County Courts), fiscal feasibility (whether program revenues and costs are in balance), and operational feasibility (whether the program is likely to improve safety).

2. **How does this relate to the General Plan or existing City Policy?**

   Public Safet law Enforcement Sub-Element 4.1A.5a: Provide traffic enforcement to deter traffic violatons
   4.1A.5h: Participate in prevention and enforcement activities directed at minimizing personal injury in traffic collisions.

3. **Origin of issue**

   Council Member(s) Whittum, Chu
   General Plan
   City Staff
   Public
   Board or Commission none

4. **Multiple Year Project?** No **Planned Completion Year** 2010

5. **Expected participation involved in the study issue process?**

   Does Council need to approve a work plan? No

Does this issue require review by a Board/Commission? No

If so, which?

Is a Council Study Session anticipated? No

What is the public participation process?
A public hearing conducted by Council. Public contact will be made by posting the Council agenda on the City's official-notice bulletin board outside City Hall, in the Council Chambers lobby, in the Office of the City Clerk, at the Library, Senior Center, Community Center, and Department of Public Safety; posting the agenda and report on the City's Web site; and making the report available at the Library and the Office of the City Clerk.

6. **Cost of Study**

Operating Budget Program covering costs
Project Budget covering costs
Budget modification $ amount needed for study
Explain below what the additional funding will be used for

7. **Potential fiscal impact to implement recommendations in the Study approved by Council**

Capital expenditure range None
Operating expenditure range None
New revenues/savings range None
Explain impact briefly

8. **Staff Recommendation**

Staff Recommendation For Study

If 'For Study' or 'Against Study', explain
Staff believes its important to evaluate this option as an additional enforcement tool. This option adds the ability to monitor intersections without adding personnel and to potentially reduce the number of accidents directly related to red light running and speed.

9. **Estimated consultant hours for completion of the study issue**

Managers

Role	Manager				Hours
Lead	Fitzgerald, Kelly	Mgr CY1:	60	Mgr CY2:	0
		Staff CY1:	0	Staff CY2:	0
Support	Moretto, Douglas	Mgr CY1:	40	Mgr CY2:	0
		Staff CY1:	0	Staff CY2:	0
Interdep	Witthaus, Jack	Mgr CY1:	10	Mgr CY2:	0

Staff CY1: 0 Staff CY2: 0

Total Hours CY1: 110
Total Hours CY2: 0

**Note: If staff's recommendation is 'For Study' or 'Against Study', the Director should
note the relative importance of this Study to other major projects that the Department
is currently working on or that are soon to begin, and the impact on existing services/priorities.**

Reviewed by

Department Director — **Date** 11/10/09

Approved by

City Manager — **Date** 11/11/09

Addendum

A. Board / Commission Recommendation

☐ **Issue Created Too Late for B/C Ranking**

Board or Commission	Rank	Rank 1 year ago	Rank 2 years ago
Arts Commission			
Bicycle and Pedestrian Advisory Committee			
Board of Building Code Appeals			
Board of Library Trustees			
Child Care Advisory Board			
Heritage Preservation Commission			
Housing and Human Services Commission			
Parks and Recreation Commission			
Personnel Board			
Planning Commission			

Board or Commission ranking comments

B. Council

Council Rank	(no rank yet)
Start Date	(blank)
Work Plan Review Date	(blank)
Study Session Date	(blank)
RTC Date	12/31/2010
Actual Complete Date	(blank)
Staff Contact	

ATTACHMENT B

Insurance Institute for Highway Safety RLC Report

Effects of Red Light Camera Enforcement on Fatal Crashes in Large US Cities

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February 2011

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Abstract

Objective: To estimate the effects of red light camera enforcement on per capita fatal crash rates at intersections with signal lights.

Methods: From the 99 large US cities with more than 200,000 residents in 2008, 14 cities were identified with red light camera enforcement programs during 2004-08 but not during 1992-96, and 48 cities were identified without camera programs during either period. Analyses compared the citywide per capita rate of fatal red light running crashes and the citywide per capita rate of all fatal crashes at signalized intersections during the two study periods, and rate changes then were compared for cities with and without cameras programs. Poisson regression was used to model crash rates as a function of red light camera enforcement, land area, and population density.

Results: The average annual rate of fatal red light running crashes declined for both study groups, but the decline was larger for cities with red light camera enforcement programs than for cities without camera programs (35 vs. 14 percent). The average annual rate of all fatal crashes at signalized intersections decreased by 14 percent for cities with camera programs and increased slightly (2 percent) for cities without cameras. After controlling for population density and land area, the rate of fatal red light running crashes during 2004-08 for cities with camera programs was an estimated 24 percent lower than what would have been expected without cameras. The rate of all fatal crashes at signalized intersections during 2004-08 for cities with camera programs was an estimated 17 percent lower than what would have been expected without cameras.

Conclusions: Red light camera enforcement programs reduce the citywide rate of fatal red light running crashes and, to a lesser but still significant extent, the rate of all fatal crashes at signalized intersections. Cities wishing to reduce fatal crashes at signalized intersections should consider red light camera enforcement.

1. Introduction

More than 2.2 million police-reported motor vehicle crashes in the United States in 2009 occurred at intersections or were intersection related, accounting for about 41 percent of all police-reported crashes. These crashes resulted in 81,112 serious nonfatal injuries and 7,358 deaths. About one-third of the deaths occurred at intersections with signal lights (Insurance Institute for Highway Safety, 2010a).

Running a red light is a common traffic violation. A study of traffic at 19 intersections in 4 states reported an average of 3.2 red light running events per hour per intersection (Hill and Lindly, 2003). In a national telephone survey conducted in 2010, 93 percent of drivers said it is unacceptable to go through a red light if it is possible to stop safely, but one-third reported doing so in the past 30 days (AAA Foundation for Traffic Safety, 2010).

The safety consequences of running red lights are considerable. A study of urban crashes reported that running red lights and other traffic controls was the most common type of crash (22 percent). Injuries occurred in 39 percent of crashes in which motorists ran traffic controls (Retting et al., 1995). In 2009, 676 people were killed and 113,000 were injured in crashes in which police were able to establish that drivers ran red lights. Sixty-four percent of these deaths were people other than the red light runners, including passengers in the red light running vehicles, occupants of the other vehicles, pedestrians, and bicyclists. Compared with the drivers involved in these crashes who did not violate the signal, red light runners were more likely to be male, to be younger than 30, and to have prior crashes, alcohol-impaired driving convictions, or citations for speeding or other moving violations. Violators also were much more likely to have been speeding or alcohol impaired at the time of the crash, and less likely to have had a valid driver's license (Insurance Institute for Highway Safety, 2010b).

A high likelihood of apprehension helps convince motorists to comply with traffic laws, but many enforcement agencies have insufficient personnel to mount effective enforcement programs using traditional police patrols. Red light cameras can supplement traditional methods of enforcement at intersections, especially at times of the day and on roads where traditional enforcement can be difficult or hazardous. Studies have reported reductions in red light violations of 40-96 percent after the introduction

of red light cameras (Retting et al., 1999a, 1999b; Retting et al., 2008), and reductions occurred not only at camera-equipped sites but also at signalized intersections without cameras. A study of the impact of red light camera enforcement on crashes in Oxnard, California, one of the first US communities to employ such cameras, reported significant citywide reductions in crashes at intersections with traffic signals, with injury crashes reduced by 29 percent (Retting and Kyrychenko, 2002). Right-angle collisions, the crash type most closely associated with red light running, at these intersections declined by 32 percent, and right-angle crashes involving injuries fell by 68 percent.

Some studies have reported that even though red light cameras reduce front-into-side collisions and overall injury crashes, they can increase rear-end crashes. A study evaluating red light camera programs in 7 communities reported a 25 percent reduction in right-angle crashes, whereas rear-end crashes increased by 15 percent. Because the types of crashes prevented by red light cameras tend to be more severe and more costly than the additional rear-end crashes that can occur, the study estimated a positive social benefit of more than $18.5 million in the 7 communities (Council et al., 2005). Not all studies have reported increases in rear-end crashes. A review of 10 controlled before-after studies of red light camera effectiveness that adjusted for regression to the mean, spillover effects, or both, reported an estimated 13-29 percent reduction in all types of injury crashes, a 24 percent reduction in right-angle injury crashes, and a nonsignificant 18 percent reduction in rear-end injury crashes (Aeron-Thomas and Hess, 2005).

Red light cameras have proven to be controversial in some US communities, but the number of communities that implemented camera programs during 1992-2010 has increased dramatically, from no communities in 1992 to 25 communities in 2000 and 501 communities in 2010 (Figure 1).

Numerous studies have examined the effects of red light camera enforcement on all crashes or crashes involving injury, but few if any studies have examined the effects on fatal crashes. The present study evaluated the effect of camera enforcement on per capita fatal crash rates for large US cities. Changes in per capita rates of fatal red light running crashes were compared for cities with and without camera programs. Because prior research reported citywide effects of red light cameras on all crashes at

signalized intersections, the present study also examined changes in the rates of all fatal crashes at signalized intersections in these cities.

2. Method

Large US cities were defined in this study as those with more than 200,000 residents; there were 99 such cities in 2008 (US Census Bureau, 2009). Information on red light camera programs in these 99 cities was obtained from news reports and calls to city police departments or public works departments. For cities with camera enforcement, program start and end dates were obtained. Other historical information was sought but was not available for all cities, including the number of cameras and number of signalized intersections over time.

Calendar years 2004-08, the latest 5 years for which fatal crash data were available, represented the "after" study period. Calendar years 1992-96 represented the "before" study period; very few US communities had camera programs during this time (Figure 1). The 14 cities with camera programs during 2004-08 but not during 1992-96 comprised the camera group. The 48 cities without camera programs during either time period comprised the comparison group. Of the remaining cities, 4 cities implemented camera programs prior to 1997, and 33 cities had camera programs for some but not all of the 2004-08 period. These 37 cities were excluded from analyses.

Data on fatal crashes at intersections with signal lights were extracted for 1992-96 and 2004-08 from the Fatality Analysis Reporting System (FARS), which contains detailed information on all fatal motor vehicle crashes occurring on US public roads (National Highway Traffic Safety Administration, 1992-96, 2004-08). Fatal red light running crashes were defined as the subset of these crashes that involved a driver traveling straight who was assigned the driver level contributing factor of "failure to obey traffic control devices." This definition was developed jointly by the Insurance Institute for Highway Safety and Federal Highway Administration so that consistent estimates of red light running crash losses would be produced (Retting, 2006).

Annual population estimates were obtained for each city from the US Census Bureau (1997, 2009). For each city in each study period and for each crash measure, the average annual per capita fatal crash rate (crashes per million population) was calculated by summing fatal crashes across the 5-year period and then dividing by the sum of the annual population counts. This resulted in two observations (one each for the before and after periods) per city for the rate of fatal red light running crashes and for the rate of all fatal crashes at signalized intersections. To study the citywide effect of camera enforcement on fatal crash rates, the per capita crash rates were computed for each study group for the 2004-08 period, aggregating crashes and population across the cities in each group, and these rates were compared with those for the 1992-96 period.

Using the city-specific data, Poisson regression models were used to more rigorously examine the relationship of camera enforcement and other variables with fatal crash rates. The Poisson models accounted for the covariance structure due to repeated measures because each independent unit of analysis (city) had two observations (before and after periods). Separate models were developed for the rate of fatal red light running crashes and the rate of all fatal crashes at signalized intersections. Independent variables in the model were population density (in thousands of people per square mile for each study period), land area (in square miles for each study period), study period (after vs. before), and city group (cities with camera programs during the after period vs. cities without cameras). Land area was included because large area changes potentially could confound the relationship between camera enforcement and fatal crash rates. Census information on cities' land areas is available only from the decennial reports (US Census Bureau, 1990, 2000). Therefore, the 1990 land area data were used for the before period and the 2000 data were used for the after period. The population density during the before period was calculated as the average annual population during 1992-96 divided by the 1990 land area, and the population density during the after period was calculated as the average annual population during 2004-08 divided by the 2000 land area. An interaction variable for study period and city group tested whether crash trends were different for cities with and without camera programs. The difference in modeled crash trend between cities with camera program and those without was taken as the primary

measure of effectiveness. It was interpreted as the change in fatal crash rate for cities with camera programs beyond what would have been expected absent the programs. Variables with p-values less than 0.05 were taken as statistically significant.

3. Results

The 62 large US cities studied accounted for 10 percent of the US population, 14 percent of all fatal red light running crashes, and 15 percent of all fatal crashes at signalized intersections in 2008.

Figures 2 and 3 show the percentage changes in average annual per capita fatal crash rates for cities with and without red light camera enforcement programs, respectively. Detailed population and crash data for each city are listed in Appendix A. All but two of the 14 cities with camera programs experienced reductions in the rate of fatal red light running crashes, and all but three experienced reductions in the rate of all fatal crashes at signalized intersections (Figure 2). Among the cities with camera programs that experienced reductions in both fatal crash rates, all but one city had percentage reductions for fatal red light running crashes that were larger than those for all fatal crashes at signalized intersections. Among the 48 cities without camera programs, the pattern of changes in crash rates was much more variable. About half of the cities experienced reductions in the rate of fatal red light running crashes, and about half experienced increases. More than one-third of the cities experienced reductions in the rate of all fatal crashes at signalized intersections (Figure 3).

Table 1 lists combined results for the camera and comparison groups. The average annual rate of fatal red light running crashes declined for both study groups, but the decline was larger for cities with camera programs than for cities without cameras (35 vs. 14 percent). The average annual rate of all fatal crashes at signalized intersections decreased by 14 percent for cities with camera programs and increased slightly (2 percent) for cities without cameras. For cities with camera programs, the percentage decline in the annual average rate of fatal red light running crashes was much higher than the decline in the rate of all fatal crashes at signalized intersections (35 vs. 14 percent).

Table 2 lists results of the Poisson regression model that estimated the effects of red light camera enforcement and other predictors on the per capita rate of fatal red light running crashes. No significant effect was associated with land area. After accounting for the effects of other predictors, an increase in population density (in thousands of people per square mile) reduced the rate of fatal red light running crashes by an estimated 4 percent ([exp(-0.0371)-1]×100), a marginally significant difference. After accounting for the interaction of study period and city group, the fatal crash rate during the before period was an estimated 65 percent higher ([exp(0.4998)-1]×100) for cities that later implemented camera programs compared with cities that did not. The rate of fatal red light running crashes between 1992-96 and 2004-08 was reduced by an estimated 16 percent ([exp(-0.1709)-1]×100) for cities without camera programs and by an estimated 36 percent ([exp(-0.1709-0.2809)-1]×100) for cities with cameras. The estimated effect of camera enforcement on the rate of fatal red light running crashes was obtained by interpreting the interaction term for study period and camera use directly. Based on this parameter, the rate of fatal red light running crashes during 2004-08 for cities with cameras programs was 24 percent lower ([exp(-0.2809)-1]×100) than what would have been expected without cameras.

Table 3 lists results of the Poisson regression model that estimated the effects of red light camera enforcement and other predictors on the per capita rate of all fatal crashes at signalized intersections. After accounting for the effects of other predictors, neither land area nor population density was significantly associated with the crash rate. After accounting for the interaction of study period and city group, the per capita rate of all fatal crashes at signalized intersections during the before period was an estimated 32 percent higher ([exp(0.2812)-1]×100) for cities that later implemented camera programs compared with cities that did not. The rate of all fatal crashes at signalized intersections between 1992-96 and 2004-08 changed only minimally for cities without camera programs and was reduced by an estimated 16 percent for cities with cameras ([exp(0.0112-0.1822)-1]×100). Based on the interaction term for study period and camera use, the actual per capita rate of all fatal crashes at signalized intersections during 2004-08 for cities with camera programs was 17 percent lower ([exp(-0.1822)-1]×100) than what would have been expected without cameras.

Land areas for 19 of the 62 study cities (4 camera cities and 15 comparison cities) increased by more than 10 percent between 1990 and 2000. Additional Poisson regression models were conducted that excluded these cities, and results changed little.

4. Discussion

Red light running is a frequent traffic violation, and the safety consequences have been established. Enforcing red light laws is important, but many communities do not have the resources for police to patrol intersections as often as would be needed to ticket most motorists who run red lights. Traditional police enforcement also poses special difficulties for police, who in most cases must follow a violating vehicle through a red light to stop it. This can endanger motorists and pedestrians as well as officers.

Before-after studies in communities that have implemented red light camera enforcement programs have reported reductions in red light running, not only at camera-equipped intersections but also at other signalized intersections without cameras (Retting et al., 1999a, 1999b), as well as citywide crash reductions at signalized intersections (Retting and Kyrychenko, 2002). The current study extends this research by examining the effects of camera enforcement on fatal crashes in large US cities. Based on Poisson regression models, camera programs were associated with statistically significant citywide reductions of 24 percent in the rate of fatal red light running crashes and 17 percent in the rate of all fatal crashes at signalized intersections, when compared with rates that would have been expected without cameras. The larger effect of camera enforcement on the rate of fatal red light running crashes would be expected because these are the crashes targeted by cameras. The significant reduction in the rate of all types of fatal crashes at signalized intersections indicates that cameras have a generalized effect on driver behavior at intersections that extends beyond running red lights.

Other factors also were found to influence fatal crash rates. Higher population densities were associated with lower fatal crash rates. A possible explanation is that denser populations generally lead to lower travel speeds and thus fewer fatal crashes (Cerrelli, 1997). Rates of fatal crashes during the

baseline period were higher for cities that subsequently implemented red light camera programs than for cities that did not implement camera programs. It is to be expected that cities with larger red light running problems should have been more likely to implement camera enforcement programs.

Several limitations of the study are worth noting. The definition of red light running crashes excluded some crashes such as those involving a driver making an illegal turn on red. Other factors not considered may have influenced fatal crash rates for the camera cities but could not be examined due to limitations in the data. Attempts were made to obtain historical information on the number of red light cameras in the study cities, but information on the scope of red light programs could not be obtained for many of the cities. Historical information also was sought on the number of signalized intersections but was unavailable in many cities.

Red light cameras are not the only countermeasure for reducing crashes at signalized intersections. Converting traditional intersections to roundabouts eliminates the need for traffic signals as well as cameras. It has been reported that conversion of traditional intersections to roundabouts reduces fatal crashes by 81-90 percent, injury crashes by 25-87 percent, and overall crashes by 37-61 percent (Federal Highway Administration, 2000; Persaud et al., 2001; Schoon and van Minnen, 1994; Troutbeck, 1993). However, it is not feasible to replace every traffic light with a roundabout, and not every intersection is appropriate for a roundabout. Better enforcement of traffic signals using cameras is a solution that can be implemented quickly on a large scale.

In tallying the costs and benefits of camera enforcement, communities should factor in the considerable social and economic benefits of successfully reducing crashes. Besides foregone medical costs, vehicle repair bills, travel delays, and lost income, citizens in communities with camera enforcement experience direct savings in terms of reduced police time to investigate and report crashes, lessened need for emergency response service, and lower roadway cleanup costs.

National surveys of drivers and surveys conducted in cities with and without red light camera programs have found that a large majority support camera enforcement (Garber et al., 2005; National Highway Traffic Safety Administration, 2004; Retting and Williams, 2000). Despite the widespread

support and the safety benefits of red light camera enforcement, cameras remain controversial in some communities where opponents raise concerns about "big brother" government tactics and claim that violators are victims of revenue-generating government schemes. In the current study, the cities that implemented red light camera programs had higher baseline crash rates, suggesting that government officials were motivated by safety concerns. Although automated traffic enforcement is not a panacea, the current study adds to the large body of evidence that red light cameras can prevent the most serious crashes. This evidence should be considered by communities seeking to reduce crashes at intersections.

Acknowledgements

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Table 1
Average annual per capita rates of fatal red light running crashes and all fatal crashes at signalized intersections for cities with and without red light camera enforcement programs, 1992-96 and 2004-08

	14 cities with camera programs			48 cities without camera programs		
	1992-96	2004-08	Percent change	1992-96	2004-08	Percent change
Average annual population (million)	9.02	10.08	11.7	17.07	19.08	11.7
Number of fatal red light running crashes	323	235	-27.2	409	391	-4.4
Number of all fatal crashes at signalized intersections	739	707	-4.3	1112	1266	13.8
Average annual rate of fatal red light running crashes per million population	7.16	4.66	-34.9	4.79	4.10	-14.4
Average annual rate of all fatal crashes at signalized intersections per million population	16.38	14.02	-14.4	13.02	13.27	1.9

Table 2
Poisson model of the effects of red light camera enforcement on average annual per capita rate of fatal red light running crashes

Parameter	Estimate	Standard error	p value
Intercept	1.7050	0.1547	<0.0001
Land area in square miles	0.0001	0.0003	0.6391
Population density (thousands of persons per square mile)	-0.0371	0.0191	0.0527
After period (2004-08) vs. before period (1992-96)	-0.1709	0.0678	0.0117
Cities that implemented red light cameras vs. cities that did not	0.4998	0.1436	0.0005
Interaction of study period and city group	-0.2809	0.1079	0.0092

Table 3
Poisson model of the effects of red light camera enforcement on average annual per capita rates of all fatal crashes at signalized intersections

Parameter	Estimate	Standard error	p value
Intercept	2.5994	0.1314	<0.0001
Land area in square miles	0.0002	0.0002	0.3805
Population density (thousands of persons per square mile)	-0.0187	0.0160	0.2428
After period (2004-08) vs. before period (1992-96)	0.0112	0.0564	0.8426
Cities that implemented red light cameras vs. cities that did not	0.2812	0.1284	0.0285
Interaction of study period and city group	-0.1822	0.0914	0.0462

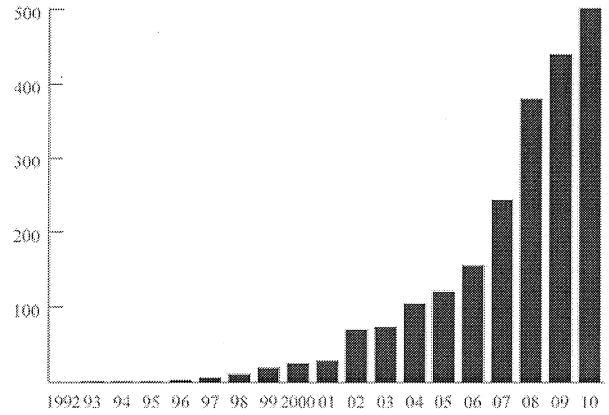

Fig. 1. US communities with red light camera enforcement programs, 1992-2010

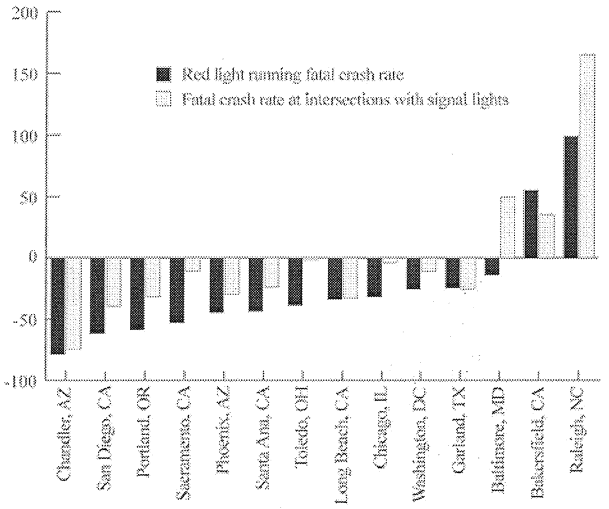

Fig. 2. Percent change in average annual per capita fatal crash rates for 14 large US cities with red light camera enforcement programs, 2004-08 vs. 1992-96

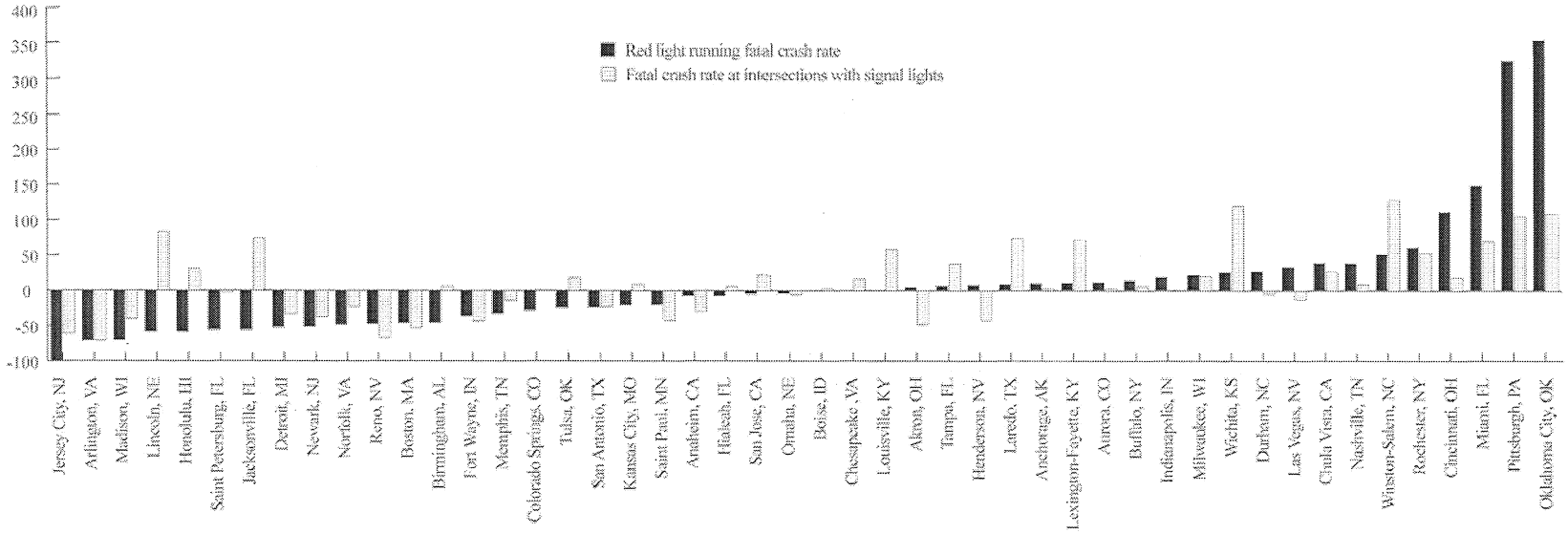

Fig. 3: Percent change in average annual per capita fatal crash rates for 48 large US cities without red light camera enforcement programs, 2004-08 vs. 1992-96

Appendix A

Population, crash counts, per capita crash rates, and changes in per capita crash rates for each study city for fatal red light running crashes and all fatal crashes at signalized intersections, 2004-2008 vs. 1992-1996

	Average annual population		Fatal red light running crashes: 5-year total crash counts		Fatal red light running crashes: Annual crash rate per 100,000 population		Percent change in crash rate	All fatal crashes at signalized intersections: 5-year total crash counts		All fatal crashes at signalized intersections: Annual crash rate per 100,000 population		Percent change in crash rate
	1992-96	2004-08	1992-96	2004-08	1992-96	2004-08		1992-96	2004-08	1992-96	2004-08	
Cities with red light camera programs												
Bakersfield, CA	203,797	301,102	7	16	0.69	1.06	55	14	28	1.37	1.86	35
Baltimore, MD	699,943	640,054	14	11	0.40	0.34	-14	32	44	0.91	1.37	50
Chandler, AZ	119,198	241,729	7	3	1.17	0.25	-79	16	8	2.68	0.66	-75
Chicago, IL	2,799,671	2,824,206	69	47	0.49	0.33	-32	175	170	1.25	1.20	-4
Garland, TX	187,241	215,403	7	6	0.75	0.56	-25	13	11	1.39	1.02	-26
Long Beach, CA	430,595	464,451	14	10	0.65	0.43	-34	32	23	1.49	0.99	-33
Phoenix, AZ	1,098,702	1,509,114	100	76	1.82	1.01	-45	197	190	3.59	2.52	-30
Portland, OR	497,777	541,682	18	8	0.72	0.30	-59	42	31	1.69	1.14	-32
Raleigh, NC	241,617	364,026	3	9	0.25	0.49	99	6	24	0.50	1.32	165
Sacramento, CA	400,480	452,320	15	8	0.75	0.35	-53	24	24	1.20	1.06	-11
San Diego, CA	1,161,107	1,291,335	26	11	0.45	0.17	-62	76	51	1.31	0.79	-40
Santa Ana, CA	298,297	336,783	11	7	0.74	0.42	-44	21	18	1.41	1.07	-24
Toledo, OH	322,241	316,835	10	6	0.62	0.38	-39	25	24	1.55	1.51	-2
Washington, DC	563,014	584,461	22	17	0.78	0.58	-26	66	61	2.34	2.09	-11
Cities without red light camera programs												
Akron, OH	218,976	209,668	2	2	0.18	0.19	4	8	4	0.73	0.38	-48
Anaheim, CA	282,074	330,345	12	13	0.85	0.79	-7	24	20	1.70	1.21	-29
Anchorage, AK	249,365	278,125	9	11	0.72	0.79	10	20	23	1.60	1.65	3
Arlington, VA	173,359	202,500	3	1	0.35	0.10	-71	9	3	1.04	0.30	-71
Aurora, CO	242,283	303,791	5	7	0.41	0.46	12	17	22	1.40	1.45	3
Birmingham, AL	256,388	231,578	14	7	1.09	0.60	-45	25	24	1.95	2.07	6
Boise, ID	154,806	201,372	0	1	0.00	0.10	N/A	3	4	0.39	0.40	3
Boston, MA	553,977	617,749	5	3	0.18	0.10	-46	21	11	0.76	0.36	-53
Buffalo, NY	316,662	275,641	4	4	0.25	0.29	15	26	24	1.64	1.74	6
Chesapeake, VA	179,792	217,583	0	2	0.00	0.18	N/A	5	7	0.56	0.64	16
Chula Vista, CA	146,629	211,660	2	4	0.27	0.38	39	6	11	0.82	1.04	27
Cincinnati, OH	352,050	332,341	2	4	0.11	0.24	112	8	9	0.45	0.54	19
Colorado Springs, CO	315,112	395,544	11	10	0.70	0.51	-28	27	34	1.71	1.72	0
Detroit, MI	1,007,094	918,776	46	20	0.91	0.44	-52	111	68	2.20	1.48	-33
Durham, NC	160,985	211,713	3	5	0.37	0.47	27	8	10	0.99	0.94	-5
Fort Wayne, IN	200,085	251,663	5	4	0.50	0.32	-36	14	10	1.40	0.79	-43

	Average annual population		Fatal red light running crashes: 5-year total crash counts		Fatal red light running crashes: Annual crash rate per 100,000 population		Percent change in crash rate	All fatal crashes at signalized intersections: 5-year total crash counts		All fatal crashes at signalized intersections: Annual crash rate per 100,000 population		Percent change in crash rate
	1992-96	2004-08	1992-96	2004-08	1992-96	2004-08		1992-96	2004-08	1992-96	2004-08	
Henderson, NV	86,311	239,939	1	3	0.23	0.25	8	5	8	1.16	0.67	-42
Hialeah, FL	204,090	220,141	3	3	0.29	0.27	-7	21	24	2.06	2.18	6
Honolulu, HI	390,745	374,348	5	2	0.26	0.11	-58	27	34	1.38	1.82	31
Indianapolis, IN	745,367	793,282	18	23	0.48	0.58	20	48	51	1.29	1.29	0
Jacksonville, FL	664,626	795,745	13	7	0.39	0.18	-55	38	79	1.14	1.99	74
Jersey City, NJ	229,201	237,973	4	0	0.35	0.00	-100	15	6	1.31	0.50	-61
Kansas City, MO	434,600	469,728	15	13	0.69	0.55	-20	33	39	1.52	1.66	9
Laredo, TX	152,870	210,741	2	3	0.26	0.28	9	5	12	0.65	1.14	74
Las Vegas, NV	334,750	550,914	10	22	0.60	0.80	34	33	47	1.97	1.71	-13
Lexington, Fayette, KY	236,005	283,144	6	8	0.51	0.57	11	13	27	1.10	1.91	73
Lincoln, NE	204,472	244,961	4	2	0.39	0.16	-58	5	11	0.49	0.90	84
Louisville, KY	670,350	706,926	17	18	0.51	0.51	0	28	47	0.84	1.33	59
Madison, WI	204,138	226,575	3	1	0.29	0.09	-70	9	6	0.88	0.53	-40
Memphis, TN	619,267	680,035	36	27	1.16	0.79	-32	73	69	2.36	2.03	-14
Miami, FL	362,845	407,606	5	14	0.28	0.69	149	35	67	1.93	3.29	70
Milwaukee, WI	606,704	602,397	14	17	0.46	0.56	22	37	44	1.22	1.46	20
Nashville, TN	502,398	585,422	8	13	0.32	0.44	39	34	43	1.35	1.47	9
Newark, NJ	271,809	276,721	12	6	0.88	0.43	-51	39	25	2.87	1.81	-37
Norfolk, VA	246,229	237,800	4	2	0.32	0.17	-48	8	6	0.65	0.50	-22
Oklahoma City, OK	459,474	539,146	1	5	0.04	0.19	326	12	29	0.52	1.08	106
Omaha, NE	371,308	437,344	15	17	0.81	0.78	-4	29	32	1.56	1.46	-6
Pittsburgh, PA	358,173	314,869	1	4	0.06	0.25	355	12	22	0.67	1.40	109
Reno, NV	148,367	209,923	4	3	0.54	0.29	-47	19	9	2.56	0.86	-67
Rochester, NY	225,908	209,022	2	3	0.18	0.29	62	12	17	1.06	1.63	53
Saint Paul, MN	262,938	277,799	7	6	0.53	0.43	-19	13	8	0.99	0.58	-42
Saint Petersburg, FL	237,878	246,461	13	6	1.09	0.49	-55	28	28	2.35	2.27	-3
San Antonio, TX	1,068,009	1,292,560	27	25	0.51	0.39	-23	68	64	1.27	0.99	-22
San Jose, CA	813,785	921,760	13	14	0.32	0.30	-5	29	40	0.71	0.87	22
Tampa, FL	283,464	330,769	8	10	0.56	0.60	7	26	42	1.83	2.54	38
Tulsa, OK	376,458	383,293	9	7	0.48	0.37	-24	15	18	0.80	0.94	18
Wichita, KS	322,887	358,229	5	7	0.31	0.39	26	9	22	0.56	1.23	120
Winston, Salem, NC	167,987	220,383	1	2	0.12	0.18	52	2	6	0.24	0.54	129