ANALYSIS ON THE EFFECTIVENESS OF PHOTOGRAPHIC TRAFFIC SIGNAL ENFORCEMENT SYSTEMS IN TEXAS

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Executive Summary

The 80th Texas Legislature enacted House Bill 1052 and Senate Bill 1119 giving local communities the authority to install red light camera enforcement systems. The Texas Transportation Code requires the Texas Department of Transportation to annually publish the reported collisions that occur at local community intersections that are monitored by red light camera enforcement systems. This report intentionally explored the potential impact that camera systems have on crash frequency at reported Texas intersections. Second, the report focuses on crashes that occur when drivers disregard traffic signals causing right angle and rear end crashes. Finally, the report is intended to fulfill the Texas Transportation Code legislative reporting requirements for the Texas Department of Transportation.

This evaluation considered 56 separate intersections in the data set. Each community reported pre and post-installation crash data that was annualized for a 12 month period of time. Based on the pre and post-installation crash data, there were 586 annualized collisions across all intersections. In contrast, 413 annualized crashes were reported during the same time period following installation which resulted in an average decrease of 30%.

In regards to red light violation crashes, there were 265 annualized right angle collisions prior to the installation of the camera system. By way of comparison, an annualized total of 151 post-installation collisions occurred for a crash reduction change of 114 events. This 114 difference represents a 43% annualized decrease in right angle collisions at the treatment intersection locations.

There were 106 annualized rear end crashes that occurred at intersections prior to the installation of the camera systems. Post-installation, there were 111 annualized rear end collisions that occurred. Although the number of overall rear end crashes increased slightly by 5% or approximately 5 crashes, 66% of the intersections decreased or maintained the same frequency of rear end crash events.

While these results cannot conclusively determine that red light cameras are responsible for the overall reduction in crashes, it does appears that the presence of the treatment provided some effect on the frequency of crashes at the selected intersections for the limited time period of this analysis. Table 1 provides a simple crash summary of the annualized collision events that were reported by local authorities over the reported period.

Table 1: Crash Summary

	Pre-Installation Crashes	Post-Installation Crashes	Change in Number of Crashes	Change in Annualized Crashes
Right Angle Collisions	265	151	-114	-43%
Rear End Collisions	106	111	+5	+5%
Other Collisions	215	151	-64	-30%
Annualized Crash Total	586	413	-173	-30%

Disclaimer

The opinions and conclusions expressed in this document are those of the staff of the Center for Transportation Safety of the Texas Transportation Institute and do not represent those of the State of Texas, the Texas Department of Transportation or any political subdivision of the State or Federal government.

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Introduction

Background

The Federal Highway Administration (FHWA) recognizes red-light running as a national safety problem resulting in as many as 176,000 injuries and 950 fatalities annually. Conservatively, the economic loss associated with red light running collisions is estimated to be $14 billion dollars annually (FHWA, 2001). Intersection crashes constitute 35% of the nation's traffic-related fatalities with 22% of all urban crashes being a direct result of drivers disobeying red signals (NHTSA, 2005). Injuries occur at 45% of all red light running crashes as compared to 30% with others (Retting, Williams, Farmer, &Feldman, 1995).

Retting, Williams, Preusser, & Weinstein (2005) determined that 56% of collisions that occur take place in intersections with a majority of those intersection collisions being right angle or rear end events. While 99% of surveyed drivers acknowledged the dangers of red light running, they perceived a low likelihood of receiving a citation for the violation (ITE, 2003). Even with injury events being significant, 56% of Americans who drive admit to running steady red signals at intersections (FHWA, 2001). Boyle, Dienstfrey, and Sothoron (1998) observed that 83% of the respondents they interviewed considered running a red traffic signal as being dangerous. Porter and Berry (1999) reported that 28% of respondents they interviewed indicated that they would speed up to beat a red traffic signal with the most common reasons given being that the driver was in a rush (35%), saving time (34%), being frustrated with having to stop (12%), and enjoying the thrill of beating the light cycle (3%).

Doerzaph, Neale, Bowman & Wiegand said:

> *"Relative to other roadway segments, intersections occupy an underrepresentation of the overall infrastructure; however, they represent the location for a significant percentage of the annual automotive crashes in the*

United States. Thus, intersections are inherently dangerous and are prime locations for vehicle conflict" (p. 2).

The Texas Strategic Highway Safety Plan (SHSP) recognizes that driver behavior involving disregard of intersection signal authority is a significant and recognized traffic safety problem demanding attention. The plan calls for reducing the fatal and serious injury crash rate by 10% over the next 5 years and provides the use of red light cameras by municipalities as a potential countermeasure (Texas Department of Transportation SHSP, 2007).

So why is it that so many drivers choose to risk losing their life or chance sustaining serious injury by running red signals? The choice may be due to a belief that a collision will not happen to them or if encountered it can be avoided. The choice may be based upon the driver's failure to observe cross traffic, misjudge speed, perceive distance or direction of approaching traffic incorrectly, or have a faulty assumption that other vehicles will yield to their vehicle. Whatever the causes are for crash events, the disproportional number of red light running crashes at signal-controlled intersections must be addressed.

Causation

The subject of what constitutes a crash variable is a complex question to answer. In many ways, the classification of a crash variable is arbitrary leading the investigator to draw a subjective conclusion based upon one possible explanation for the event. There are many different layers and interactions among differing crash variables that complicate the effort to define any one aspect of the crash as the single definitive cause (Quiroga, Kraus, Schalkwyk, and Bonneson, 2003). In order for the results of a crash study to be rigorous, one must consider which factor(s) significantly contribute to the collision event. Unfortunately, the chain of events and circumstances that lead up to the collision are not always known. The presence and or absence of crash variables that potentially contributed to the event may also be unknown. These unknowns make it difficult at best to determine the harmful events that make up the crash.

Collision variables that must be considered and accounted for in any signal controlled intersection crash analysis are traffic flow rates, frequency of signal cycles, vehicle speed, travel distance to the stop line, type of signal control(s), duration of yellow interval, approach grade and visibility. Each variable, in and of itself or in combination with others, can directly influence the potential for red light running and the crash event. Unfortunately, limitations in research design of traditional crash investigations make it complicated, if not impossible, to deduce causality particularly in instances where traffic safety countermeasures are installed as treatments and are evaluated for crash reduction effectiveness. This is especially true when a wide variety of crash variables exist which play significant roles in the occurrence of crash events at intersections.

Nonetheless, a comprehensive investigation of crash variables should strive to consider issues involving human factors, traffic engineering, vehicle design, roadway design, enforcement, environment, and annual daily traffic (Quiroga et al, 2003). Enhancing the quality of crash data by eliminating unrelated variables contributes to the robustness of the safety countermeasure analysis. This ultimately leads to defendable conclusions about the use of the traffic safety treatment at the intersection. By accounting for the crash variables that contribute to running the red signal, the investigative findings can provide a more reasonable conclusion regarding the effectiveness of red light cameras as traffic safety countermeasures. Identifying countermeasures that contribute positively to intersection safety ultimately save lives and reduces injuries and property damage.

Scope

Beginning in 2003 local authorities in Texas contracted with vendors to install the first photographic traffic enforcement camera systems at signal controlled intersections that had a high frequency of crashes specific to red signal violations. Over the past five years, The State of Texas has averaged approximately 3,700 traffic fatalities and over 100,000 serious injury crashes annually (Texas Department of Transportation, 2008). In 2006, The State of Texas recorded more than 48,000 injury and 400 fatal crashes that were intersection related. Over 60% of those intersection crash fatalities, involved right angle collisions.

The Texas Department of Transportation is responsible for publishing the legislative report on crash information provided by local authorities with red light camera systems. The fundamental purpose of this research was to determine the effectiveness of the red light camera systems and their impact on the frequency and severity of crashes at reported monitored intersections.

Red Light Violation

Red light running is a violation of the law and is considered an illegal act. According to the Texas Transportation Code Section 544.007 (d) “Traffic Control Signals in General”,

> *“An operator of a vehicle facing only a steady red signal shall stop at a clearly marked stop line. In the absence of a stop line, the operator shall stop before entering the crosswalk on the near side of the intersection. A vehicle that is not turning shall remain standing until an indication to proceed is shown. After stopping, standing until the intersection may be entered safely, and yielding right of way to pedestrians lawfully in an adjacent crosswalk and other traffic lawfully using the intersection, the operator may: turn right; or turn left, if the intersecting streets are both one way streets and a left turn is permissible”.*

A driver who decides to stop before entering an intersection may do so as long as they maintain a minimum distance from the intersection and control for factors such as approach speed, timing of the yellow signal interval, and regulating perception and reaction. A red signal violation occurs when a driver cannot stop because of failing to control for one or more of these factors. Once the light changes to red, if the vehicle enters the intersection and continues to cross, the driver is considered to have run the red signal (Quiroga et. al, 2003, Texas Transportation Code Section 544.007).

Typically, a law enforcement officer must observe the red light violation which in most cases, requires them to directly view the same traffic signal that the violator runs. Upon viewing the infraction, the officer must pursue the violator into the intersection several seconds after the signal has turned steady red. Gaining compliance is often difficult because the dynamics associated with traditional enforcement requires police officers to pursue violators through red intersections and into harm's way in order to make the traffic stop. The dangerous action of pursuing vehicles in areas of high vehicle density can endanger motorists, pedestrians, and the officers. Because of this risk, conventional traffic enforcement in some communities is being supplemented with red light camera technology (Retting et al. 1998, Freedman and Paek, 1992).

While increased enforcement may moderately reduce the incidence of red light running, it is not a permanent solution to this ongoing problem. Cooper (1975) evaluated the effects of increased enforcement and the impact it has on red light violations at signal controlled intersections. Observations of the intersections took place for two weeks in which base line data was gathered. After the two-week observation period ended, enforcement was increased to determine the effects the treatment had on red light running. Increased enforcement continued for four weeks and at the end of this time period, enforcement was reduced back to normal levels. Two weeks after the decreased enforcement effort, the intersections were again observed for red light running violations and data was collected to be compared against the base line information that was previously recorded. While there was a dramatic decrease in the

number of red light running violations during the enhanced enforcement period, the number of violations increased after the enforcement stopped suggesting that drivers fell back into pre-enforcement driving behavior.

Cooper's discovery suggests that enforcement has a significant relationship regarding the frequency of red light running events that occur at intersections. The evidence also suggests that without a continuous deterrent presence in place that causes compliance, violations of the law are more prone to occur. Clearly, there is a need for some form of continual enforcement to be present at intersections in order to maintain driver compliance. Photographic traffic enforcement of red light violations at intersections is one method to enhance existing law enforcement strategies that are already in place.

Automated Enforcement Systems as a Traffic Safety Countermeasure

Porter and England (2000) suggest that the greatest challenge concerning intersection collisions is not whether the issue of traffic safety is important but rather how traffic safety countermeasures can be developed that truly change risky driving behavior. Countermeasure is simply defined as an action taken that counters or offsets other opposing acts. In the case of red light camera systems, the adverse action of a driver running a red signal is countered by the opposing reaction which is usually in the form of a citation. This causes the original action to diminish or cease altogether. In theory, the driver's fear of receiving a citation is not worth the risk of violating the law.

Automated enforcement systems act as a persistent reminder to drivers that there is a system in place holding them accountable for risky driving behavior. In the case of red light running, automated enforcement systems provide a 24-hour a day 7 day a week monitor of driving behavior which in theory, holds the motorists accountable for their actions while encouraging them to comply with the law. While it is true that red light camera systems cannot stop the driver from violating the law, it does provide a general deterrence effect and a punishment for drivers who make poor driving choices.

The aim of the traffic safety countermeasure is to ensure that the implemented treatment action taken is appropriate for reducing the violation risk. The function is to modify dangerous driver behavior by utilizing general deterrence and threat of punishment as a means for getting drivers to comply with the law. Ultimately, the goal of the countermeasure is to eliminate crashes and significantly reduce the number of injury, serious injury, and fatal crashes from occurring.

Automated Red Light Running Enforcement

Red light camera systems cover a broad range of electronic devices and systems that are used to detect and photograph vehicles engaged in traffic violations. The Texas Transportation Code defines a “photographic traffic signal enforcement system” under Section 707.001.

> *“Photographic traffic signal enforcement system means a system that: consists of a camera system and vehicle sensor installed to exclusively work in conjunction with an electrically operated traffic-control signal; and is capable of producing at least two recorded images that depict the license plate attached to the front or the rear of a motor vehicle that is not operated in compliance with the instructions of the traffic-control signal”.*

The technology can include radar or laser detection devices, electromagnetic loops embedded in the road, pole-mounted or portable cameras, microprocessors, and networking devices. Older systems usually capture the red light violation on 35mm film while newer models utilize digital photography. The 35mm film must be routinely extracted from the older units, while the newer systems employ digital and video cameras which send the captured information to the enforcement authority over data networks.

Detection of the violation is usually made by sensors (electromagnetic loops) that are buried in the pavement and tied into the timing system of a traffic signal and a pole-mounted camera. Because the camera's position is fixed, only one direction of traffic flow is monitored at the intersection unless other additional cameras are installed. Once the signal changes from yellow to red, the system activates with a small red light enforcement tolerance of between 0.1 to 0.3 seconds. After the system activates, any vehicle crossing the loops will trigger the camera unit to take two photographs (Burkey & Obeng, 2004).

The first photograph is taken of the vehicle as it enters into the intersection. The second photograph is taken when the vehicle is within the intersection. The captured image includes the license plate, the traffic control signal and the vehicle as it is in the intersection. Upon review of photographic evidence usually by a qualified law enforcement agent, a civil citation is issued to the registered owner of the vehicle. Those charged with traffic offenses have the opportunity for judicial review (USDOT/FHWA, 2006, Texas Transportation Code Section 707.011, Texas Transportation Code Section 707.001).

Infrastructure

The Texas Transportation Code Section 707.003 indicates that a county, municipality, or other local entity authorized to enact traffic laws under the laws of this state (local authority) that wishes to install a red light camera system(s) must take preliminary steps before the system can be installed for use. First, a traffic engineering study of the approach to the intersection must be made to determine whether in addition to or as an alternative to the system, a design change to the approach or a change in signalization may reduce the number of red light violations. Selection of the intersection must be based on traffic volume, collision history at the approach, the frequency of red light violations at the intersection, traffic engineering and other safety criteria.

The Texas Department of Transportation does provide an “engineering analysis template” that may be used as a basis for the traffic engineering study referenced in the statutory language under the Texas Transportation Code Section 707.003. The Texas Department of Transportation engineering analysis template is specific and details intersection and signal data, signal timing and traffic data, crash and enforcement data, and other supporting information that is considered in a traffic engineering study. The engineering analysis template is included as Attachment A.

After the engineering analysis of the intersection is complete, the local authority must report the findings to a “citizen advisory committee” consisting of one citizen appointed by each member of the governing body (city council, etc.). Unless this procedure is conducted the local authority may not impose a civil penalty for violation of the system (Texas Transportation Code Section 707.003).

The local authority must also ensure that the yellow change interval meets the minimum standards for steady yellow in accordance with the Texas Manual Uniform Traffic Control Devices (TMUTCD) (Texas Transportation Code Section 707.005). The MUTCD provides guidance that a yellow-change interval should have a duration of approximately 3 to 6 seconds, with the longer intervals reserved for use on approaches with higher speeds. The TMUTCD also reference the Manual of Traffic Signal Design published by ITE. Attachment D provides an example of the TMUTCD that addresses yellow signal change interval recommendations.

The local authority must also have an ordinance in place that provides recourse in the form of a hearing to persons who are charged with the running the red signal (Texas Transportation Code Section 707.009). The ordinance must also provide a time period in which the hearing must be held, provide for the appointment of a hearing officer and designate the department, agency or office of the local authority that is responsible for enforcement/administration of the ordinance (Texas Transportation Code Section 707.009). The ordinance must also regulate the fine for the violation (civil infraction) which can be no greater than $75 with a late payment fee that cannot exceed

$25 (Texas Transportation Code Section 707.007). Attachment C provides an example of a red light camera system ordinance.

Finally, the local authority must erect signs along each roadway that leads to a photographically enforced intersection. The signs are required to warn motorists that the approaching signalized intersection is being photographically enforced. Each warning sign must be easily readable and be no less than 100 feet from the intersection (Texas Transportation Code Section 707.003 and Section 544.001).

The local authority must also have on file with the Texas Department of Transportation an “amendment to the municipal maintenance agreement” (MMA) when requesting a red light camera system placed on state highway right of way. Attachment B is a copy of the Texas Department of Transportation MMA. Without an MMA in place, the Texas Department of Transportation will not allow any camera system to be operated on State right of way. The Texas Department of Transportation reviews the installation plans and inspects the installation of the cameras even though a city or a contractor may be performing the work.

Objective

In 2007, the 80th Texas Legislature enacted House Bill 1052 and Senate Bill 1119 giving local authorities the authorization to install red light camera enforcement systems at qualified intersections. The local authorities who installed red light camera enforcement systems were required to report pre and post-installation crash data to the Texas Department of Transportation. Local authorities with red light camera enforcement systems were required to record the number of crash events and the types of collisions that occurred within each separate camera monitored intersection. This collected data was intended to define the nature of the crash problem in order to determine whether red light camera enforcement systems positively or negatively influence crash frequency and severity levels.

As a condition of an Interagency Cooperation Contract, the Texas Transportation Institute was granted the opportunity to assist the Texas Department of Transportation in compiling, analyzing, and evaluating community intersection crash data that was submitted from around the State of Texas. The research objective was to investigate and determine the impact that red light camera enforcement systems had on right angle crashes, rear end crashes and total crashes. This objective was addressed by analyzing the crashes of all reporting local authorities where data was available.

Reporting Requirements

Pre-Installation Crash Reporting

The reporting period covers the time in which the camera first becomes active in an enforcement capacity. The pre-installation reporting requirements are specific to camera-controlled intersections that became active January 1, 2008 and forward.

The Texas Transportation Code Section 707.004 requires that the local authority submit a written report to the Texas Department of Transportation detailing the frequency and injury severity of crashes that occurred at the intersection 18 months prior to the installation of the enforcement camera system. The report must be submitted to the Texas Department of Transportation no later than 6 months after the camera becomes active for enforcement purposes. However, if the camera became active on or before December 31, 2007, there is no requirement for the local authority to provide a report to the Texas Department of Transportation concerning the 18 months of pre-installation crash data even if the system remains active in 2008. However, the Texas Department of Transportation asked the local authorities to submit the data.

This presents a problem in reporting since some local authorities reported pre-installation crash data while others did not. This made the process of analyzing the effectiveness of the red light camera system difficult to perform since no base line data was present for some local authorities. In short, there was no metric to determine the rise, fall or static percent difference in crash rates at some of the reported treatment intersections.

Post-Installation Crash Reporting

The Texas Transportation Code Section 707.004 requires local authorities to monitor and file an annual report to the Texas Department of Transportation that lists the number and type of traffic crashes at the red light camera monitored intersection in

order to determine if the system results in reducing the frequency of crashes and their severity. This post-installation report is due to the Texas Department of Transportation no later than August 31 annually.

The post-installation report is required to include data collected from crashes that occurred in the photo-enforced intersections from July 1, 2007 to June 30, 2008. This report is mandatory regardless of whether the photo enforcement system had been installed on, before, or after December 31, 2007.

Since this is the first year that the law requires a post-installation report to be generated, some local authorities will provide more crash data than others depending on when their camera(s) went active. For instance, if College Station activated their cameras on January 1, 2008, then they would not have 12 months worth of post-installation crash data on record for the photo enforced intersection. Instead, College Station would only be able to report post-installation crash data up to June 30, 2008 (according to the Texas Department of Transportation report instructions) which is only 6 months. Another example would be if Grapevine activated a camera on March 1, 2007, they would only be required to report post-installation crash data from July 1, 2007 to June 30, 2008 (required Texas Department of Transportation time frame) and none of the data dating back to the day the camera was activated.

The requirements for reporting are directly affected by when the photographic enforcement system went active. The magic date for reporting pre-installation crash data is December 31, 2007. Any pre-installation crash data on or before this date, is not required to be reported to the Texas Department of Transportation for the report. Systems that went active January 1, 2008 forward do require the pre-installation crash data report detailing the past 18 months of pre-installation crash data.

All local authorities must provide a post-installation report for each camera controlled intersection according to when the system went active. Reporting applies to all photographic enforcement systems to varying degrees. Camera’s that were active

December 31, 2007 or earlier have no required pre-installation crash data requirements while those that were activated January 1, 2008 forward require the pre-installation crash data. Regardless of the pre-installation crash data requirements, all local authorities must report post-installation crash data annually to the Texas Department of Transportation (due no later than August 31, 2008).

Data Analysis

The Texas Transportation Code Section 707.004 requires local authorities with red light camera systems to report to the Texas Department of Transportation the frequency and severity of pre and post-crash events that occurred at camera monitored intersections. The Texas Department of Transportation made local authorities aware through a notice in the Texas Register, that each community with a red light camera system was required to report pre and post-installation crash data no later than August 31, 2008. The Texas Department of Transportation required the data be submitted electronically through a collection site located on the Departments website.

The data used in this analysis was the collection of self-reported information submitted by local authorities prior to the August 31, 2008 deadline. Intersection crash data that was submitted after the August 31, 2008 deadline was not considered in this analysis.

There were 26 local authorities reporting red light camera enforcement activity to the Texas Department of Transportation. In addition to the 26 cities that had red light cameras in place, 58 other local authorities were considering or were in the process of installing systems at the time of this report.

There were 12 local authorities that provided pre-installation intersection crash data. Of the 12 local authorities that provided pre-installation crash data, all but 2 provided post-installation intersection crash data. Table 2 represents the local authorities and the number of intersections that reported pre-installation intersection crash data to the Texas Department of Transportation.

Table 2: Local Authorities Reporting Pre-Installation Data

Local Authority	Number of Intersections Pre-Installation
Arlington	1
Baytown	8
Bedford	3
Fort Worth	5
College Station	4
Frisco	2
Grand Prairie	4
Houston	51
Irving	6
Jersey Village	8
Rowlett	3
Terrell	2

Twenty four (24) local authorities reported post-installation intersection crash data to the Texas Department of Transportation. Of the 24 cities that provided post-installation intersection crash data, 14 failed to provide pre-installation crash data. Table 3 represents the local authorities and the number of intersections that reported post-installation intersection crash data to the Texas Department of Transportation.

Table 3: Local Authorities Reporting Post-Installation Data

Local Authority	Number of Intersections Post-Installation
Amarillo	11
Arlington	8
Baytown	1
Cedar Hill	5
Bedford	3
Dallas	52
Garland	8
Mesquite	3
College Station	6
Coppell	2
Corpus Christi	10
Dallworthington	1
Duncanville	5
Farmers Branch	7
Frisco	3
Grand Prairie	12
Houston	66
Irving	7
North Richland Hills	7
Plano	19
Richardson	3
Richland Hills	5
Rowlett	5
Terrell	2

Ultimately, there were 10 local authorities that provided pre and post-installation intersection crash data. The information provided represented 56 different intersections within these 10 reporting communities. Table 4 represents the local authorities that provided pre and post-installation crash data to the Texas Department of Transportation.

Table 4: Local Authorities Reporting Pre and Post-Installation Data

Local Authority	Number of Intersections Pre Post-Installation
Arlington	1
Baytown	1
Bedford	3
College Station	4
Frisco	2
Grand Prairie	4
Houston	31
Irving	6
Rowlett	2
Terrell	2
Total Intersections	56

This report provides an analysis of data from 56 intersections that installed red light cameras in an effort to reduce the frequency and severity level of crashes in their communities. Table 5 represents all reported intersection crashes by frequency and community. Due to the short time period of analysis, no conclusions may be inferred from the pre or post-analysis with any statistical confidence.

Table 5: Intersection Frequency by City

City	Number of Intersections Pre-Installation	Number of Intersections Post-Installation	Number of Matched Intersections
Amarillo	0	5	0
Arlington	1	8	1
Baytown	8	1	1
Coppell	0	2	0
Cedar Hill	0	5	0
City of Bedford	3	3	3
City of Plano	0	14	0
College Station	4	4	4
Corpus Christi	0	9	0
Dallas	0	49	0
Dalworthington	0	1	0
Duncanville	0	4	0
Farmers Branch	0	7	0
Fort Worth*	5	6	4
Frisco	2	2	2
Garland	0	8	0
Grand Prairie	4	11	4
Houston*	51	65	32
Irving	6	6	6
Jersey Village	8	0	0
Mesquite	0	2	0
North Richland	0	7	0
Richardson	0	3	0
Richland Hills	0	1	0
Rowlett*	3	5	3
Terrell	2	2	2
Totals	**97**	**230**	**62**

Note (*): Several local authorities were not included in the detailed analysis since the data provided was not complete.

Results

The results section is divided into three areas to provide the reader with a better understanding of how red light cameras influenced the crash rates in the intersections where data was reported for the period of July 1, 2007 through June 30, 2008. The first area addresses the impact of the installation on the overall frequency of crashes at the identified intersections. The second area speaks to the results according to crash type and the third area explored how different types of intersections, based on crash frequencies, were affected by the installation of the red light cameras.

Since some red light cameras were installed at different times after the reporting period had began, there was a significant difference in the number of months where crash information was provided. In some cases local authorities reported 12 months of post-installation crash data while others reported less. In addition, some local authorities were required to provide pre-installation crash data for 18 months prior to the installation of the red light camera system while other local authorities were not required to report pre-installation crash data at all.

In order to make the data sets comparable, the crash rates included in this study were annualized. This was performed so that each intersection that was investigated possessed the same number of months in which the crash rates could be compared. By calculating the frequency of crash events at intersections by months and then projecting the cash rate over a 12 month period, the method allowed for a uniformed approach at comparing crash rates across the year. Since the crash data for the intersections were annualized there were some crash rate percentages that possessed decimal fractions while others did not. These decimal fractions represent the percentage of crashes that were accounted for as a result of annualizing the data sets. The decimal fractions were rounded to the next highest or lowest interval in order to make the report more practical for the reader.

For the purposes of this analysis, only those intersections where the local authority reported both pre and post-installation crash data were included in the data set. The data reported by intersection and an overall summary analysis has been included in this section of the report.

Impact of Camera Installation on the Overall Frequency of Crashes

Based on the pre and post-installation crash data submitted to the Texas Department of Transportation, there were 586 annualized crashes at the intersections identified in the data set. After the red light cameras were installed, local authorities reported 413 crashes for a 30% decrease in the number of annualized crashes.

Additionally, there were 265 annualized pre-installation right angle crashes that occurred prior to the installation of the cameras. By way of comparison, 151 annualized post installation right angle crashes occurred after the cameras were installed. This represented a 43% decrease in right angle collisions.

Finally, 106 annualized pre-installation rear end crashes occurred at intersections prior to installation of the cameras. A total of 111 annualized post-installation rear end crashes occurred after installation which represented an average increase of 5% for those events. Pre and post-installation collision data for total annualized crashes are summarized in Table 6.

Table 6: Annualized Crashes According to Intersection: Pre and Post-Installation

			Annualized Crashes		
City	Approach 1	Approach 2	Pre-Installation	Post-Installation	Change in Annualized Crashes
Arlington	E Pioneer Pkwy	S. Collins	10.67	4	-62.5%
Baytown	Garth Rd	W. Baker	27.33	10	-63.4%
City of Bedford	Central Dr.	L. Don Dodson	2	0	-100.0%
City of Bedford	Central Dr.	SH 183 S FR	1.33	0	-100.0%
City of Bedford	SH 183 N FR	Central Dr.	1.33	0	-100.0%
College Station	BS-6R (Tx Ave)	Walton	4.5	0	-100.0%
College Station	FM 2154	FM 2347	9	7.5	-16.7%
College Station	SH 30	Bush	4	2.5	-37.5%
College Station	SH 30	Munson	3.5	5	42.9%
Frisco	Dallas Parkway	Gaylord	22	15	-31.8%
Frisco	Dallas Parkway	Main	35.33	56	58.5%
Grand Prairie	Belt Line Rd	Tarrant Rd	6.5	12	84.6%
Grand Prairie	Carrier Pkwy	IH-20 EBFR	3.5	0	-100.0%
Grand Prairie	Carrier Pkwy	Pioneer Pkwy (Spur 303)	11.43	7.5	-34.4%
Grand Prairie	Jefferson St	Carrier Pkwy	8.82	15	70.1%
Houston	Antoine	Northwest Freeway West Service R	7.33	2	-72.7%
Houston	Bellaire	Wilcrest	5.33	7	31.3%
Houston	Brazos	Elgin	2	4	100.0%
Houston	Chartres	St. Joseph Parkway	16	5	-68.8%
Houston	East Freeway North Service Rd	Normandy	13.33	10	-25.0%
Houston	East Freeway North Service Rd	Uvalde	11.33	3	-73.5%
Houston	El Dorado Blvd	Gulf Freeway East Service Rd	20	8	-60.0%
Houston	FM 1960 West	Tomball Parkway East Service	28.67	16	-44.2%

			Annualized Crashes		
City	Approach 1	Approach 2	Pre-Installation	Post-Installation	Change in Annualized Crashes
Houston	Fairbanks-North Houston	Northwest Freeway West Service R	29.33	5	-83.0%
Houston	Greens Rd	North Freeway East Service Rd	28.67	5	-82.6%
Houston	Harwin	Hillcroft	0.67	4	497.0%
Houston	Hollister	Northwest Freeway West Service Rd	12.67	5	-60.5%
Houston	John F Kennedy	Greens Rd	8.67	14	61.5%
Houston	Main St.	South Loop West South Service Rd	20.67	37	79.0%
Houston	Milam	Elgin	3.33	3	-9.9%
Houston	Monroe	Gulf Freeway East Service Rd	12	7	-41.7%
Houston	North Freeway West Service Rd	West Rankin Rd	19.33	13	-32.7%
Houston	North Shepherd Drive	North Loop West South Service Rd	20	4	-80.0%
Houston	Northwest Freeway East Service Rd	Mangum	6	2	-66.7%
Houston	Pease	La Branch	12.67	3	-76.3%
Houston	Post Oak Blvd.	West Loop South West Service Rd	9.33	4	-57.1%
Houston	Richmond	Dunvale	10	10	0.0%
Houston	Richmond	Hillcroft	3.33	2	-39.9%
Houston	Scott St.	South Loop East North Service Rd	5.33	8	50.1%
Houston	South Gessner	Beechnut	6	12	100.0%
Houston	South Sam Houston Pkwy East N	Telephone Rd	8.67	7	-19.3%
Houston	Travis	Webster	4	2	-50.0%
Houston	West Bellfort	Southwest Freeway East Service Rd	14	5	-64.3%
Houston	Westheimer	West Loop South	6	6	0.0%

			Annualized Crashes		
City	Approach 1	Approach 2	Pre-Installation	Post-Installation	Change in Annualized Crashes
Houston	Westpark Dr	Southwest Freeway West Service Rd	20.67	1	-95.2%
Houston	Woodridge	Gulf Freeway East Service Rd	14.67	6	-59.1%
Irving	Highway 356	South Walton Walker Boulevard	4	3	-25.0%
Irving	Lane Street	North O'Connor Road	2.67	2	-25.1%
Irving	North Belt Line Road	West Pioneer Drive	10	5	-50.0%
Irving	State Highway 161 Service Rd	Gateway Drive	4.67	3	-35.8%
Irving	West Airport Freeway	North Belt Line Road	13.33	14	5.0%
Irving	West John Carpenter Freeway	State Highway 161 Service Road	9.33	6	-35.7%
Rowlett	Rowlett, Beech	Beech, Rowlett	0.5	7	1300.0%
Rowlett	Rowlett, Chaha	Chaha, Rowlett	0.67	1	49.3%
Terrell	IH-20	SH34	3.33	5	50.2%
Terrell	US Hwy 80	State Hwy 205	6	12.5	108.3%
		Totals	**585.74**	**413**	**-29.5**

Crash Types

In addition to reducing the number of crashes at intersections, local authorities pay special attention to the number of right angle and rear end crashes that occur prior to and after the installation of red light cameras. A crash is classified as a right angle collision when a driver enters the intersection after the light turn's steady red and collides into another vehicle that has the right of way. In contrast, a rear end crash occurs when the traffic signal is red or yellow and the first vehicle is slowing or was stopped and the second vehicle strikes the first from behind.

The results according to crash type are summarized in Table 7. Additional data related to individual intersections regarding crash type are further detailed in Table 8.

Table 7: Summary of Results: Comparison of Annualized Pre and Post-Crash Data

Total Intersections Analyzed		56
Pre-Installation	Annualized Crashes at Monitored Intersections	586
	Annualized Crashes at Monitored Intersections Attributed to Right Angle Violations	265
	Annualized Total Crashes at Monitored Intersections Attributed to Rear End Collisions	106
Post-Installation	Annualized Crashes at Monitored Intersections	413
	Annualized Crashes at Monitored Intersections Attributed to Right Angle Violations	151
	Annualized Crashes at Monitored Intersections Attributed to Rear End Collisions	111
% Change in Annualized Crashes at Monitored Intersections		- 29.5%
% Change in Annualized Crashes at Monitored Intersections Attributed to Right Angle Collisions		- 43%
% Change in Annualized Crashes at Monitored Intersections Attributed to Rear End Collisions		+ 5%

Table 8: Summary of Annualized Crash Data: Pre and Post-Installation of Red Light Cameras

			Pre-Installation					Post-Installation						
CITY	Approach 1	Approach 2	Annualized Crashes Pre- Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	Rear End Crashes	Rear End Crashes as a % of Total	Total Crashes Post-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	% Change in Right Angle Violation Crashes	Rear End Crashes	Rear End Crashes as a % of Total	% Change in Rear End Crashes
Arlington	E Pioneer Pkwy	S. Collins	10.67	7.33	68.7%	3.33	31.2%	4	1	25.0%	-86.4%	3	75.0%	-9.9%
Baytown	Garth Rd	W. Baker	27.33	4	14.6%	14.67	53.7%	10	3.33	33.3%	-16.8%	6.67	66.7%	-54.5%
City of Bedford	Central Dr.	L. Don Dodson	2	2	100%	0	0.0%	0	0	N/A	-100%	0	N/A	N/A
City of Bedford	Central Dr.	SH 183 S FR	1.33	1.33	100%	0	0.0%	0	0	N/A	-100%	0	N/A	N/A
City of Bedford	SH 183 N FR	Central Dr.	1.33	1.33	100%	0	0.0%	0	0	N/A	-100%	0	N/A	N/A
College Station	BS-6R (Tx Ave)	Walton	4.5	2	44.4%	2	44.4%	0	0	N/A	-100%	0	N/A	-100%
College Station	FM 2154	FM 2347	9	0.5	5.6%	3.5	38.9%	7.5	0	0.0%	-100%	5	66.7%	42.9%
College Station	SH 30	Bush	4	1.5	37.5%	0	0.0%	2.5	0	0.0%	-100%	0	0.0%	N/A
College Station	SH 30	Munson	3.5	2	57.1%	0.5	14.3%	5	2.5	50.0%	25.0%	2.5	50.0%	400%
Frisco	Dallas Parkway	Gaylord	22	5.33	24.2%	16.67	75.8%	15	8	53.3%	50.1%	7	46.7%	-58.0%
Frisco	Dallas Parkway	Main	35.33	13.33	37.7%	16	45.3%	56	24	42.9%	80.0%	16	28.6%	0.0%
Grand Prairie	Belt Line Rd	Tarrant Rd	6.5	1.5	23.1%	2.5	38.5%	12	2	16.7%	33.3%	6	50.0%	140%

			Pre-Installation					Post-Installation						
CITY	Approach 1	Approach 2	Total Crashes Pre-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	Rear End Crashes	Rear End Crashes as a % of Total	Total Crashes Post-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	% Change in Right Angle Violation Crashes	Rear End Crashes	Rear End Crashes as a % of Total	% Change in Rear End Crashes
Grand Prairie	Carrier Pkwy	IH-20 EBFR	3.5	1.5	42.9%	0.5	14.3%	0	0	N/A	-100%	0	N/A	-100%
Grand Prairie	Carrier Pkwy	Pioneer Pkwy (Spur 303)	11.43	3.33	29.1%	4.29	37.5%	7.5	2.5	33.3%	-24.9%	2.5	33.3%	-41.7%
Grand Prairie	Jefferson St	Carrier Pkwy	8.82	2.94	33.3%	2.35	26.6%	15	1	6.7%	-66.0%	8	53.3%	240%
Houston	Antoine	Northwest Freeway West Service R	7.33	2	27.3%	0.67	9.1%	2	1	50.0%	-50.0%	1	50.0%	49.3%
Houston	Bellaire	Wilcrest	5.33	3.33	62.5%	2	37.5%	7	2	28.6%	-39.9%	5	71.4%	150%
Houston	Brazos	Elgin	2	1.33	66.5%	0.67	33.5%	4	1	25.0%	-24.8%	0	0.0%	-100%
Houston	Chartres	St. Joseph Parkway	16	14.67	91.7%	0	0.0%	5	1	20.0%	-93.2%	0	0.0%	N/A
Houston	East Freeway North Service Rd	Normandy	13.33	3.33	25.0%	0	0.0%	10	0	0.0%	-100%	3	30.0%	N/A
Houston	East Freeway North Service Rd	Uvalde	11.33	0.67	5.9%	3.33	29.4%	3	0	0.0%	-100%	2	66.7%	-39.9%
Houston	El Dorado Blvd	Gulf Freeway East Service Rd	20	3.33	16.7%	0.67	3.4%	8	1	12.5%	-70.0%	4	50.0%	497%
Houston	FM 1960 West	Tomball Parkway East Service Rd	28.67	17.33	60.4%	4	14.0%	16	10	62.5%	-42.3%	2	12.5%	-50.0%

			Pre-Installation					Post-Installation						
CITY	Approach 1	Approach 2	Total Crashes Pre-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	Rear End Crashes	Rear End Crashes as a % of Total	Total Crashes Post-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	% Change in Right Angle Violation Crashes	Rear End Crashes	Rear End Crashes as a % of Total	% Change in Rear End Crashes
Houston	Fairbanks-North Houston	Northwest Freeway West Service R	29.33	12.67	43.2%	1.33	4.5%	5	1	20.0%	-92.1%	1	20.0%	-24.8%
Houston	Greens Rd	North Freeway East Service Rd	28.67	19.33	67.4%	0	0.0%	5	2	40.0%	-89.7%	0	0.0%	
Houston	Harwin	Hillcroft	0.67	0.67	100%	0	0.0%	4	3	75.0%	348%	0	0.0%	N/A
Houston	Hollister	Northwest Freeway West Service R	12.67	4	31.6%	0	0.0%	5	4	80.0%	0.0%	1	20.0%	N/A
Houston	Milam	Elgin	3.33	2	60.1%	0	0.0%	3	3	100.0%	50.0%	0	0.0%	N/A
Houston	Monroe	Gulf Freeway East Service Rd	12	8	66.7%	0.67	5.6%	7	2	28.6%	-75.0%	1	14.3%	N/A
Houston	North Freeway West Service Rd	West Rankin Rd	19.33	10	51.7%	3.33	17.2%	13	5	38.5%	-50.0%	4	30.8%	20.1%
Houston	North Shepherd Drive	North Loop West South Service Rd	20	10	50.0%	0	0.0%	4	2	50.0%	-80.0%	0	0.0%	N/A
Houston	Northwest Freeway East Service R	Mangum	6	1.33	22.2%	0	0.0%	2	0	0.0%	-100%	0	0.0%	N/A
Houston	Pease	La Branch	12.67	10	78.9%	0	0.0%	3	2	66.7%	-80.0%	1	33.3%	N/A

			Pre-Installation					Post-Installation						
CITY	Approach 1	Approach 2	Total Crashes Pre-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	Rear End Crashes	Rear End Crashes as a % of Total	Total Crashes Post-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	% Change in Right Angle Violation Crashes	Rear End Crashes	Rear End Crashes as a % of Total	% Change in Rear End Crashes
Houston	Post Oak Blvd.	West Loop South West Service Rd	9.33	7.33	78.6%	0	0.0%	4	1	25.0%	-86.4%	0	0.0%	N/A
Houston	Richmond	Dunvale	10	4	40.0%	0.67	6.7%	10	5	50.0%	25.0%	0	0.0%	-100%
Houston	Richmond	Hillcroft	3.33	3.33	100%	0	0.0%	2	0	0.0%	-100%	2	100.0%	N/A
Houston	Scott St.	South Loop East North Service Rd	5.33	3.33	62.5%	0.67	12.6%	8	5	62.5%	50.2%	1	12.5%	49.3%
Houston	South Gessner	Beechnut	6	3.33	55.5%	0.67	11.2%	12	8	66.7%	140%	1	8.3%	49.3%
Houston	South Sam Houston Pkwy East North	Telephone Rd	8.67	1.33	15.3%	1.33	15.3%	7	1	14.3%	-24.8%	1	14.3%	-24.8%
Houston	Travis	Webster	4	3.33	83.3%	0	0.0%	2	1	50.0%	-70.0%	0	0.0%	N/A
Houston	West Bellfort	Southwest Freeway East Service R	14	9.33	66.6%	0	0.0%	5	2	40.0%	-78.6%	1	20.0%	N/A
Houston	Westheimer	West Loop South	6	0	0.0%	0.67	11.2%	6	3	50.0%	N/A	0	0.0%	-100%
Houston	Westpark Dr	Southwest Freeway West Service R	20.67	12.67	61.3%	2	9.7%	1	0	0.0%	-100%	1	100.0%	-50.0%
Houston	Woodridge	Gulf Freeway East Service Rd	14.67	5.33	36.3%	1.33	9.1%	6	1	16.7%	-81.2%	0	0.0%	-100%

			Pre-Installation					Post-Installation						
CITY	Approach 1	Approach 2	Total Crashes Pre-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	Rear End Crashes	Rear End Crashes as a % of Total	Total Crashes Post-Installation	Right Angle Violation Crashes	Right Angle Violation Crashes as a % of Total	% Change in Right Angle Violation Crashes	Rear End Crashes	Rear End Crashes as a % of Total	% Change in Rear End Crashes
Irving	Highway 356	South Walton Walker Boulevard	4	1.33	33.3%	0.67	16.8%	3	0	0.0%	-100%	0	0.0%	-100%
Irving	Lane Street	North O'Connor Road	2.67	2	74.9%	0	0.0%	2	0	0.0%	-100%	2	100.0%	N/A
Irving	North Belt Line Road	West Pioneer Drive	10	2	20.0%	8	80.0%	5	1	20.0%	-50.0%	1	20.0%	-87.5%
Irving	State Highway 161 Service Road	Gateway Drive	4.67	3.33	71.3%	0.67	14.3%	3	3	100.0%	-9.9%	0	0.0%	-100%
Irving	West Airport Freeway	North Belt Line Road	13.33	2.67	20.0%	2	15.0%	14	1	7.1%	-62.5%	1	7.1%	-50.0%
Irving	West John Carpenter Freeway	State Highway 161 Service Road	9.33	8.67	92.9%	0.67	7.2%	6	4	66.7%	-53.9%	0	0.0%	-100%
Rowlett	Rowlett, Beech	Beech, Rowlett	0.5	0.5	100%	0	0.0%	7	0	0.0%	-100%	0	0.0%	N/A
Rowlett	Rowlett, Chaha	Chaha, Rowlett	0.67	0	0.0%	0	0.0%	1	0	0.0%	N/A	0	0.0%	N/A
Terrell	IH-20	SH34	3.33	0.67	20.1%	0	0.0%	5	2.5	50.0%	273%	0	0.0%	N/A
Terrell	US Hwy 80	State Hwy 205	6	0.67	11.2%	2	33.3%	12.5	0	0.0%	-100%	12.5	100%	525%

Note: The following intersections were not included in this table due to the lack of data prior to installation and/or after installation of the red light cameras: Fort Worth: Beach St & Western Center Blvd., Bryant Irving Rd & W. Vickery Rd, Lancaster Ave. & Riverside, McCart & Westcreek; Rowlett: Hickox, Rowlett & Rowlett, Hickox; Houston: Bay Area Blvd. & El Camino Real. Cities that installed their equipment prior to December 31, 2007 were not required to submit pre-installation data as part of this reporting period.

It is important to note that the annualized number of crashes decreased by an average of 30% and the number of right angle related crashes decreased from 265.06 to 151 or 43%. Additionally, the number of crashes attributed to other causes decreased from 214 to 151, an average of 30%. These figures appear to support the assertion that red light cameras can be an effective means of preventing crashes at selected intersections within the statistical limitations of the analysis period.

Crash Frequency and Type

The next two figures illustrate the change in crash frequency according to crash type. As previously noted, the annualized number of crashes decreased across those intersections that were included in this data set. The proportions of those crashes classified as right angle, rear end, and other based on the annualized number of crashes are depicted in Figure 1.

The overall results indicate that the installation of red light cameras may have an effect on the number of crashes in an intersection. Additionally, there are some interesting elements that local authorities may want to be aware of when considering red light cameras as a deterrence method.

One of the concerns that is usually raised when red light cameras are installed is the possible increase of rear end crashes since drivers may stop abruptly at a monitored intersection to avoid red light running citations. Based on the selected intersection analyzed as part of this study, rear end crashes did increase slightly by an average of 5%, which was equivalent to 5 crashes based on annualized data. Interestingly, at intersections where there were more the 10 crashes per year, the number of rear end crashes actually decreased while there was a slight increase of rear end crashes at those intersections with less than 10 annualized crashes per year.

Figure 2 provides a visual summary of the frequency of crashes according to type relative to the annualized number of crashes that occurred at that intersection prior to the camera installation.

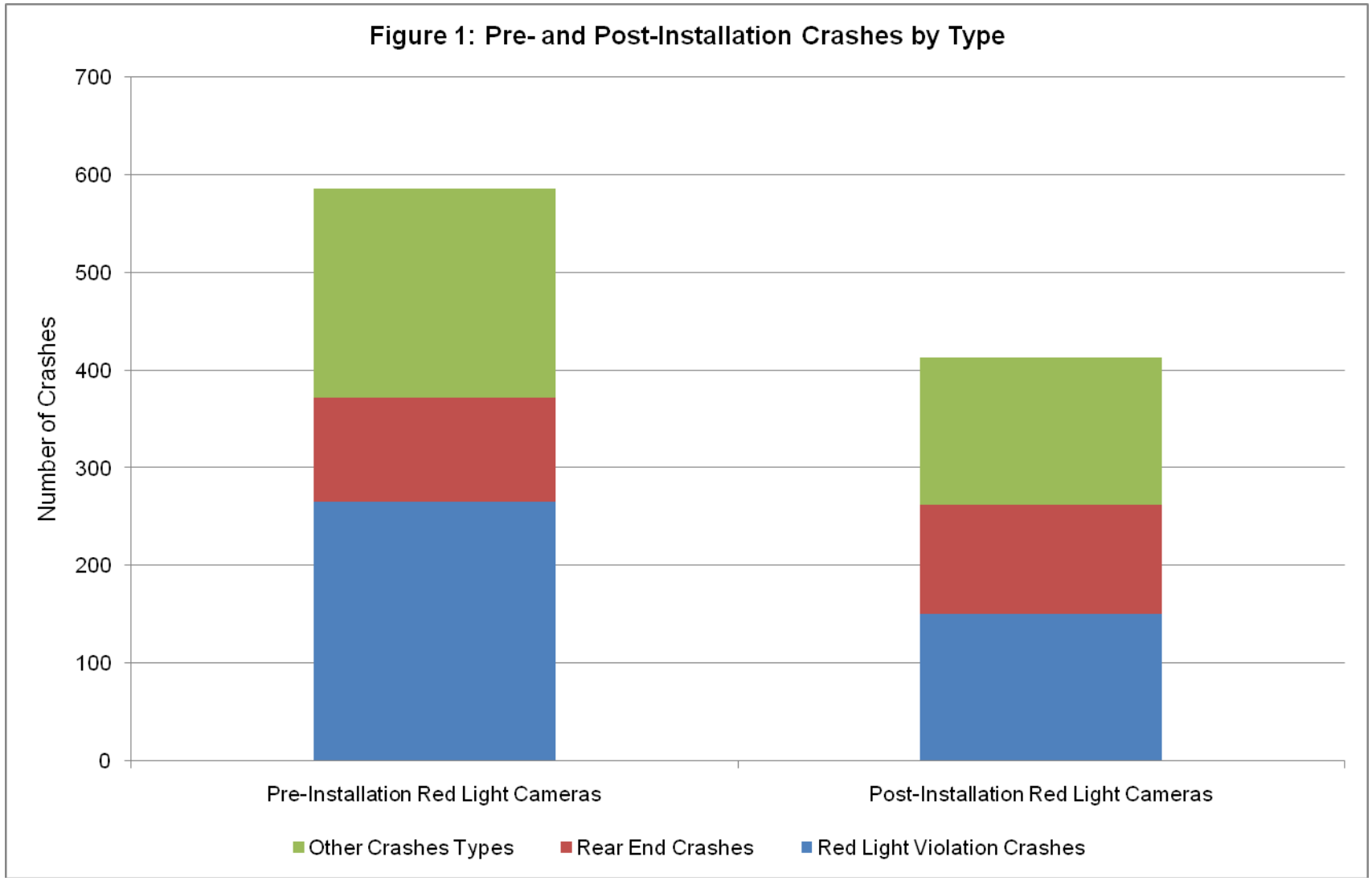
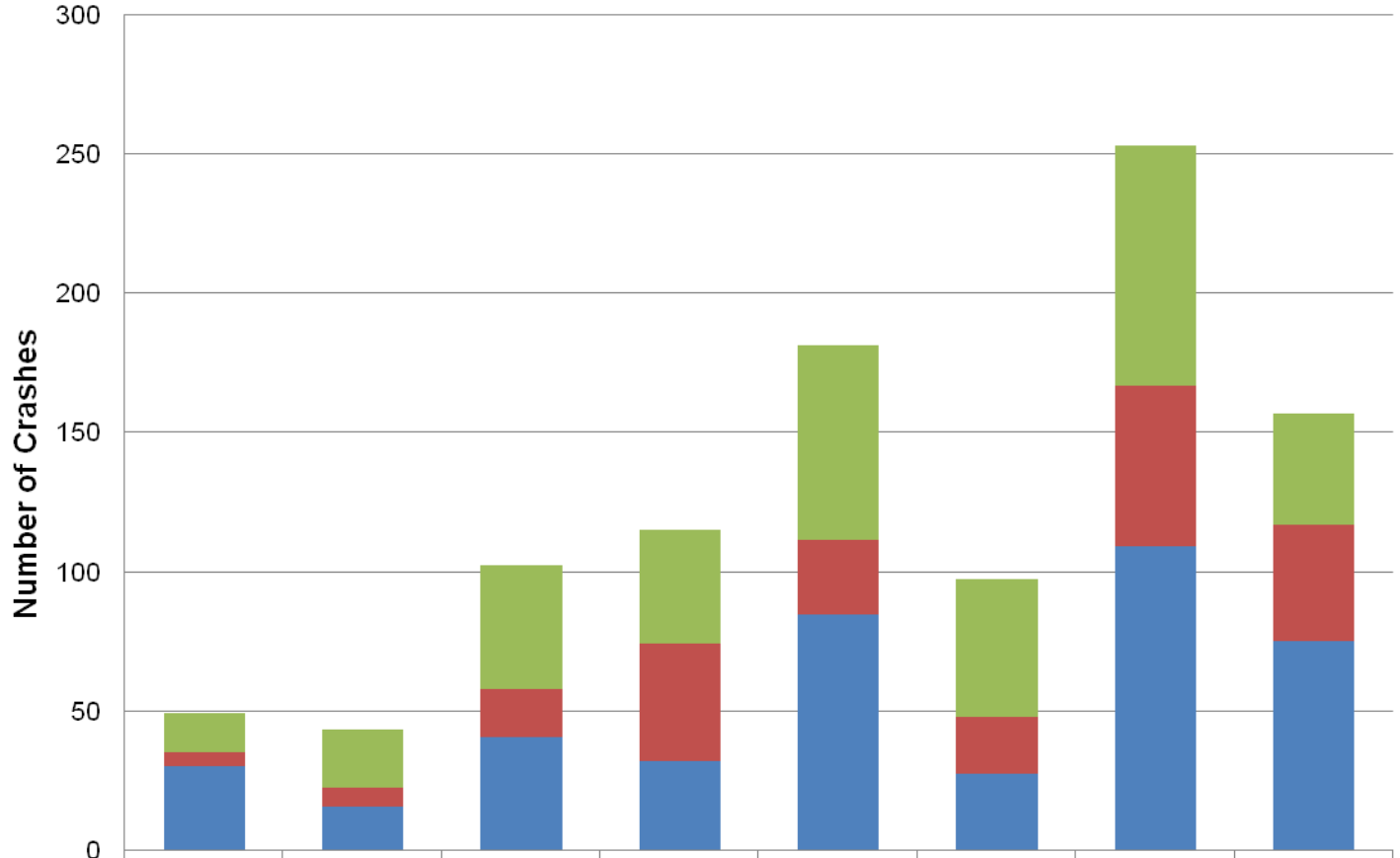


Figure 1: Pre- and Post-Installation Crashes by Type
700
600
500
400
300
200
100
0
Number of Crashes
Pre-Installation Red Light Cameras
Post-Installation Red Light Cameras
Other Crashes Types
Rear End Crashes
Red Light Violation Crashes

Figure 2: Crash Type According to Total Pre-Installation Crash Frequency



Based on number of crashes prior to installation	Between 0 and 5 Crashes		Between 5 and 10 Crashes		Between 10 and 20 Crashes		With More Than 20 Crashes	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Other Crashes Types	14.17	21	44.35	40.5	69.82	49.5	86.01	40
Rear End Crashes	5.01	6.5	17.03	42.5	26.95	20.5	57.34	41.67
Red Light Violation Crashes	30.15	16	40.93	32	84.66	27.5	109.32	75.33

Although this report only considered intersection crashes according to frequency, right angle, and rear end events, it is reasonable to assume that the number of crashes was positively impacted by the installation of red light cameras in these monitored intersections. The crash frequency according to intersections can be described as the crashes increased, deceased, or remained the same. Interestingly, the proportion of crashes classified as rear end collisions remained at 63% prior to and after the installation of red light cameras. Table 9 offers a general overview of the performance data according to these criteria.

Table 9: Overall Change in Crash Frequency

	Number of Intersections Where					
	Crashes Increased		Crashes Decreased		Crashes Remained Unchanged	
Annualized Crashes	17	30%	37	66%	2	4%
Right Angle Violation Crashes	13	23%	42	75%	1	2%
Rear End Crashes*	20	36%	20	36%	16	29%

N= 56 Total Intersections

Note (*): Of the 16 intersections where the number of Rear End Crashes remained the same, only one of those intersections had any Rear End Crashes prior to the installation of the cameras. Fifteen of the intersections had zero Rear End Crashes prior to the installation and that frequency remained the same after the cameras were installed.

Conclusions

Based on the crash data analyzed as part of this evaluation, the installation of red light cameras had a positive influence on the number of crashes in the intersection where they were operational during the most recent performance period. Across the 56 intersections reporting pre and post-installation crash data, there was a 30% decrease in annualized crashes and a 43% reduction in right angle violation type crashes. There was a slight increase, 5% or approximately 5 additional crashes attributed to rear end collisions.

Approximately 66% of the intersections saw a decrease in annualized crashes and 75% of the intersections realized a reduction in right angle violation crashes. Although rear end crashes increased at some of the selected intersections, the frequency of rear end crashes remained the same or decreased at 64% of the locations where red light cameras were installed during the July 1, 2007 to June 30, 2008 reporting period. In addition to the impact red light cameras had on right angle and rear end crash types, the number of collisions attributed to other causes decreased from 214 to 151 across all selected intersections.

While these figures suggest that red light camera systems are effective traffic safety countermeasures, the investigator was not able to account for other influential crash variables due to lack of reported information concerning driver risk exposure to the intersections. Limitations such as average daily traffic rates, roadway engineering, human factors, environmental conditions, enforcement and vehicle design all play a significant role in the occurrence of crash events at intersections

Since there was no accounting for these types of variables at the intersections, the investigation was focused on crash events that occurred prior to the installation of the red light camera system against those events that occurred after the red light camera systems were activated. This made it difficult to determine the impact that red light cameras had as a safety countermeasure because other crash variables could have produced a biasing effect on the number of red light running collisions that

occurred. As such this analysis provided only a limited descriptive investigation of the self-reported local authority red light camera data that was provided to the Texas Department of Transportation.

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Attachment A

Evaluation of the Need for Red Light Running Cameras Engineering Analysis Template

City:_____

County:_____

Intersection:_____

_____

A. Intersection and Signal Data

1. Signal Visibility

a. Minimum Sight Distance to Signal

Approach	Grade	Speed Limit (mph)	Measured (ft)	Required (ft)*

* See TMUTCD Table 4D-1 for minimum sight distance requirements.

b. Are "SIGNAL AHEAD" warning signs present? ☐ Yes ☐ No

Are "SIGNAL AHEAD" warning signs needed? ☐ Yes ☐ No

Are other warning signs present in the vicinity of the intersection? ☐ Yes ☐ No

Explain:_____

_____

_____

_____

c. Information on Signal Heads

Approach	Lens Size	Lens Type (LED or Bulb)	Back Plates (Y or N)	Retroreflective Border (Y or N)

2. Pavement and Markings Data

a. Are stop bars in "good" condition? ☐ Yes ☐ No

Explain:_____

b. Are lane lines “clearly” visible? ☐ Yes ☐ No
Explain:_____

c. Are crosswalks “clearly” marked? ☐ Yes ☐ No
Explain:_____

d. What is the pavement condition (ruts, potholes, cracking, etc.)?

☐ Good Explain:_____

☐ Fair Explain:_____

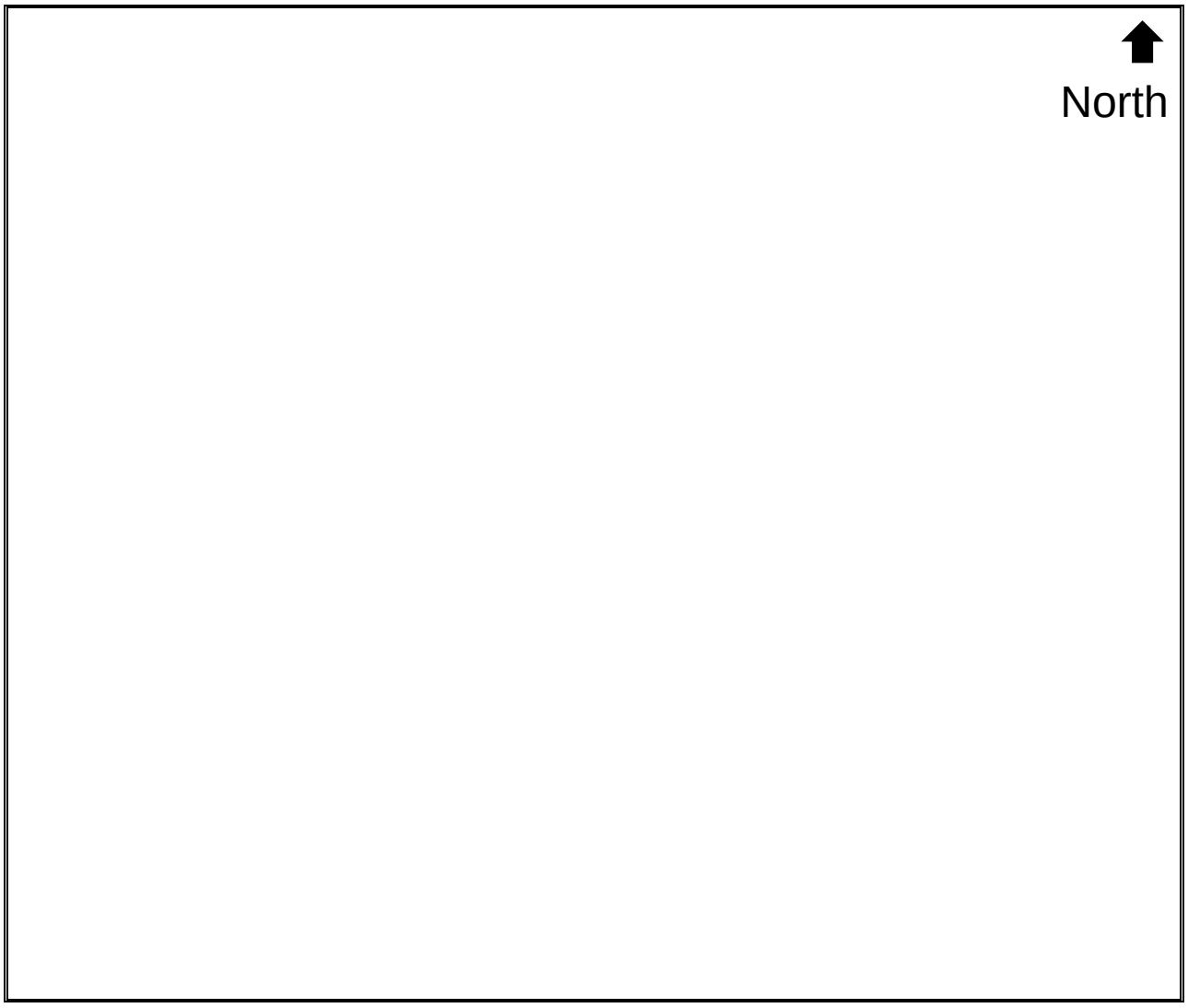
☐ Poor Explain:_____

e. Do pavement surface treatments exist (rumble strips, texturing, pavers, etc.)?

☐ Yes Explain:_____

☐ No

3. Provide diagram of intersection including: pavement markings, width of lanes and medians, location of signal heads and signs, locations of loops/detectors, and grades.



B. Signal Timing and Traffic Data

1. Clearance Intervals

Approach	Posted Speed Limit	Grade	Width of Intersection	Yellow Interval		All Red Interval	
				Existing	Calculated*	Existing	Calculated*

* Reference ITE for calculation of clearance intervals.

2. Include existing controller settings for each phase and each time-of-day. Information should include applicable settings such as minimum green, max 1 & 2, passage, minimum gap/ext, protected-permissive, lead-lag, yellow and all red, walk and ped clearance time, recall settings, offsets, cycle length, etc. Include

analysis of peak hour conditions and a determination of whether signal timings are contributing to red-light running problems.

a. Does signal timing or phasing factor in as a possible contributor to red light running at this intersection?

☐ Yes Explain:_____

☐ No

b. List comments or recommendations on potential signal timing or phasing changes:_____

3. Vehicle Detection Data

Approach	Detection Type (loop, video, etc.)	Detector Location (measured from stop bar)

4. Traffic Volume Data

Approach	Daily Volumes		Peak Hour Volumes	
	Total	Heavy Vehicles	Total	Heavy Vehicles

C. Crash and Enforcement Data

1. 18 Months of "Before" Crash Data

Approach	Collision Type	Total	Number of Injury Crashes	Number of Fatal Crashes	Crashes Associated with Red Light Running
	Rear End				
	Angle				
	Head-On				
	Pedestrian				
	Pedalcyclist				
	Other				
	Total				

	Rear End				
	Angle				
	Head-On				
	Pedestrian				
	Pedalcyclist				
	Other				
	Total				
	Rear End				
	Angle				
	Head-On				
	Pedestrian				
	Pedalcyclist				
	Other				
	Total				
	Rear End				
	Angle				
	Head-On				
	Pedestrian				
	Pedalcyclist				
	Other				
	Total				

2. Violation Rate
    a. Number of red light running citations per year issued by law enforcement
    Number:_____ Year:_____

    b. Observed Violations:
    Date:_____ Time Period:_____

Approach	Traffic Volume	Number of Violations

3. Enforcement and Operational Issues
    a. Describe the difficulty experienced by law enforcement officers in patrol cars or on foot in apprehending violators._____
    _____
    _____
    _____
    _____
    _____

    b. Describe the ability of law enforcement officers to apprehend violators safely within a reasonable distance from the violation._____

c. Are pedestrians at risk due to violations?

☐ Yes ☐ No

Explain:

Number of pedestrians per hour:

Pedestrian crosswalk provided?

☐ Yes ☐ No

d. Have there been any changes to the operations of the intersection (signal timing, restriping, increased enforcement, etc.) with the past three years?

☐ Yes ☐ No

D. Other Supporting Information:

Attachment B

Texas Department of Transportation
Municipal Maintenance Agreement

THE STATE OF TEXAS §

THE COUNTY OF TRAVIS §

AMENDMENT TO MUNICIPAL MAINTENANCE AGREEMENT FOR THE FURNISHING, INSTALLING, OPERATION AND MAINTENANCE OF CAMERAS ON STATE HIGHWAY RIGHTS-OF-WAY TO MONITOR COMPLIANCE WITH TRAFFIC-CONTROL SIGNALS

THIS AMENDMENT is made by and between the State of Texas, acting through the Texas Department of Transportation, hereinafter called the "State", and the City of _____, hereinafter called the "City", acting by and through its duly authorized officers.

W I T N E S S E T H

WHEREAS, the State owns and maintains a system of highways and roadways in the City of _____ pursuant to Transportation Code, Section 201.103; and

WHEREAS, the State and the City executed a Municipal Maintenance Agreement on _____; and

WHEREAS, the City has requested permission to install cameras on state highway rights-of-way to monitor compliance with traffic-control signals, hereinafter referred to as "camera monitoring equipment", at the locations listed on Exhibit A attached hereto and made a part of hereof; and

WHEREAS, the State has determined that when the City's installation of camera monitoring equipment will not damage the highway facility, impair safety, impede maintenance, or in any way restrict the operation of the highway, the proposed camera monitoring equipment may be installed by the City or its contractor;

NOW, THEREFORE, in consideration of the premises and of the mutual covenants and agreements of the parties hereto to be by them respectively kept and performed as hereinafter set forth, it is agreed as follows:

A M E N D M E N T

ARTICLE 1. CONTRACT PERIOD
This amendment becomes effective on final execution by the State and shall remain in effect as long as said camera monitoring equipment is in operation at the described locations.

ARTICLE 2. TERMINATION
This amendment may be terminated by one of the following conditions:

1) By mutual agreement of both parties;
2) By the State giving written notice to the City as consequence of failure by the City or its contractor to satisfactorily perform the services and obligations set forth in this amendment, with proper allowances being made for circumstances beyond the control of the City or its contractor. The State's written notice to the City shall describe the default and the proposed termination date. If the City cures the default before the proposed termination date, the proposed termination is ineffective; or

3) By either party upon thirty (30) days written notice to the other.

Termination of this amendment shall not serve to terminate the underlying Municipal Maintenance Agreement between the State and the City.

ARTICLE 3. COMPENSATION
No compensation shall be paid for this amendment.

ARTICLE 4. PERSONNEL, EQUIPMENT, AND MATERIAL

A. The City will use labor and supervisory personnel employed directly by the City or its contractor, and use City owned or contractor owned machinery, equipment, and vehicles necessary for the work. In the event that the City or its contractor does not have the machinery, equipment, and vehicles necessary to perform the work, the machinery, equipment, and vehicles may be rented or leased as necessary.

B. No reimbursement shall be paid for any materials supplied by the City or its contractor.

C. Any adjustment, replacement, or reinstallation of the camera monitoring equipment due to reconstruction or alteration of the intersection shall be performed by the City at the City's expense. The State will work with the City to provide adequate notice of any planned work to allow for the necessary modification or removal.

D. All installation or maintenance work performed by the City or its contractor requiring traffic control shall be performed in accordance with the *Texas Manual on Uniform Traffic Control Devices*.

ARTICLE 5. INSPECTION OF WORK

A. The City or its contractor will furnish the State a complete set of design drawings and installation plans for review. The installation plans shall include all electrical, electronics, signing, civil and mechanical work pertaining to the camera monitoring equipment.

B. The State reserves the right to inspect and request modification of any camera monitoring equipment under this agreement both prior to and after installation. No installation may occur until the State has approved the proposed installation.

C. The State reserves the right to inspect and approve the completed installation.

D. The State will promptly notify the City or its contractor of any failure of materials, equipment, or installation methods, and the City or its contractor will take such measures necessary to obtain acceptable systems components and installation procedures without delay.

ARTICLE 6. RESPONSIBILITIES OF THE PARTIES
The parties agree that neither party is an agent, servant, or employee of the other party and each party agrees it is responsible for its individual acts and deeds as well as the acts and deeds of its contractors, employees, representatives, and agents. The State shall <u>not</u> be held responsible for the operation (or non-operation) of the camera monitoring equipment or for any effect it may have.

The City is responsible for any damage that may occur to state equipment during the installation, maintenance or operation of the camera monitoring equipment. The City is responsible for maintaining the camera monitoring equipment and related signing in good working order and keeping such equipment free from graffiti.

ARTICLE 7. DE-ACTIVATION OF CAMERA MONITORING EQUIPMENT
The State reserves the right to disconnect and remove camera monitoring equipment from the traffic signals should any problem arise affecting the State. The State will notify the appropriate

City office of the de-activation of the camera monitoring equipment. Upon correction of the problem, the City may reconnect the camera monitoring equipment.

ARTICLE 8. INSTALLATION REQUIREMENTS
The City or its contractor shall furnish and install all equipment related to the camera monitoring equipment installation. This includes, but is not limited to, camera equipment, camera housing and supporting structure, intersection lighting, vehicle detection system, communications equipment, electrical service and connections, roadway signing, and any interconnection with the signal. The City or its contractor will be responsible for all power costs associated with the operation of the camera monitoring equipment.

Electrical connections made to the State's signal equipment shall be optically or otherwise isolated as approved by the State and shall not affect the operation of any component of the traffic signal system including both the signal controller and the conflict monitor/malfunction management unit.

ARTICLE 9. REPORTS
Upon written request, the City will be required to supply the State with data related to the operation of the camera monitoring equipment.

ARTICLE 10. REMEDIES
Violation or breach of contract terms by the City shall be grounds for termination of the amendment, and any increased cost arising from the City default, breach of contract, or violation of terms shall be paid for by the City. This amendment shall not be considered as specifying the exclusive remedy for default, but all remedies existing at law and in equity may be availed of by either party and shall be cumulative.

ARTICLE 11. INSURANCE
Before beginning work, the entity performing the work shall provide the State with a fully executed copy of the State's Form 1560 Certificate of Insurance verifying the existence of coverage in the amounts and types specified on the Certificate of Insurance for all persons and entities working on State right of way. This coverage shall be maintained until all work on the State right of way is complete. If coverage is not maintained, all work on State right of way shall cease immediately.

ARTICLE 12. SUCCESSORS AND ASSIGNS
The City shall not assign or otherwise transfer its rights or obligations under this amendment except with the prior written consent of the State.

ARTICLE 13. LEGAL CONSTRUCTION
In case any one or more of the provisions contained in this agreement shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other provision thereof and this amendment shall be construed as if such invalid, illegal, or unenforceable provision had never been contained herein.

ARTICLE 14. NOTICES
All notices to either party by the other required under this amendment shall be delivered personally or sent by certified or U.S. mail, postage prepaid, addressed to such party at the following respective addresses:

City:	State:
_____	_____
_____	_____
_____	_____
_____	_____

All notices shall be deemed given on the date so delivered or so deposited in the mail, unless otherwise provided herein. Either party hereto may change the above address by sending written notice of such change to the other in the manner provided herein.

ARTICLE 15. GOVERNING LAWS AND VENUE
This amendment shall be construed under and in accordance with the laws of the State of Texas. Any legal actions regarding the parties' obligations under this agreement must be filed in Travis County, Texas.

ARTICLE 16. PRIOR AGREEMENTS SUPERSEDED
This amendment constitutes the sole and only agreement of the parties hereto and supersedes any prior understandings or written or oral agreements between the parties respecting the within subject matter.

ARTICLE 17. REVISIONS TO EXHIBIT A
Revision to the locations listed in Exhibit A may be made if submitted in writing by the City and initialed by both parties.

IN WITNESS WHEREOF, the State and the City have signed duplicate counterparts of this agreement.

THE CITY OF _____
Executed on behalf of the City by:

By_____ Date_____

Typed or Printed Name and Title _____

_____

THE STATE OF TEXAS
Executed for the Executive Director and approved for the Texas Transportation Commission for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved and authorized by the Texas Transportation Commission.

By_____ Date_____
District Engineer

Attachment C

City of Richardson Red Light Camera Ordinance

ORDINANCE NO. 3483

AN ORDINANCE OF THE CITY OF RICHARDSON, TEXAS, AMENDING THE CODE OF ORDINANCES OF THE CITY OF RICHARDSON, BY AMENDING CHAPTER 22, TO ADD ARTICLE VII. AUTOMATED TRAFFIC SIGNAL ENFORCEMENT; PROVIDING A REPEALING CLAUSE; PROVIDING A SEVERABILITY CLAUSE; PROVIDING FOR THE IMPOSITION OF CIVIL PENALTIES AND PROVIDING AN EFFECTIVE DATE.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF RICHARDSON, TEXAS:
SECTION 1. That the Code of Ordinances of the City of Richardson, Texas be and the same is hereby amended by amending Chapter 22, to add Article VII. Automated Traffic Signal Enforcement, to read as follows:

"**ARTICLE VII. AUTOMATED TRAFFIC SIGNAL ENFORCEMENT**

Sec. 22-185. Definitions.

In this article:

(1) *Department* shall mean the Police Department of the City of Richardson, Texas.

(2) *Intersection* shall mean the place or area where two or more streets intersect.

(3) *Owner* shall mean the owner of a motor vehicle as shown on the motor vehicle registration records of the Texas Department of Transportation or the analogous department or agency of another state or country..

(4) *Photographic Traffic Signal Enforcement System* shall mean a system that:

(a) consists of a camera system installed to work in conjunction with an electrically operated traffic-control signal; and

(b) is capable of producing at least two recorded images that depicts the license plate attached to the rear of a motor vehicle that is not operated in compliance with the instructions of the traffic-control signal.

(5) *Recorded Image* means an image recorded by a photographic traffic monitoring system that depicts the rear of a motor vehicle and is automatically recorded on a photograph or digital image.

(6) *System Location* means the approach to an intersection toward which a photographic traffic monitoring system is directed and in operation.

(7) *Traffic Control Signal* shall mean a traffic control device that displays alternating red, amber and green lights that directs traffic when to stop at or proceed through an intersection.

Sec. 22-186. Imposition of Civil Penalty for Violations.

(a) The City Council finds and determines that a vehicle that proceeds into an intersection when the traffic control signal for that vehicle's direction of travel is emitting a steady red signal damages the public by endangering motor vehicle operators and pedestrians alike, by decreasing the efficiency of traffic control and traffic flow efforts, and by increasing the number of serious accidents to which public safety agencies must respond at the expense of the taxpayers.

(b) Except as provided in (c) and (d) below, the owner of a motor vehicle is liable for a civil penalty of seventy-five dollars ($75) if the motor vehicle proceeds into an intersection at a system location when the traffic control signal for that motor vehicle's direction of travel is emitting a steady red signal.

(c) For a third or subsequent violation committed by the owner of the same motor vehicle during any 12-month period, the amount of the civil penalty shall be one hundred fifty dollars ($150).

(d) A owner who fails to timely pay the civil penalty shall be subject to a late payment penalty of twenty-five dollars ($25).

Sec. 22-187. Enforcement; procedures.

(a) The Department is responsible for the enforcement and administration of this article.

(b) In order to impose a civil penalty under this article, the Department shall mail a notice of violation to the owner of the motor vehicle liable for the civil penalty not later than the 30th day after the date the violation is alleged to have occurred to:

(1) the owner's address as shown on the registration records of the Texas Department of Transportation; or

(2) if the vehicle is registered in another state or country, the owner's address as shown on the motor vehicle registration records of the department or Page 2 40571 Ordinance No. 3483 agency of the other state or country analogous to the Texas Department of Transportation.

(c) A notice of violation issued under this article shall contain the following:

(1) a description of the violation alleged;

(2) the date, time, and location of the violation;

(3) a copy of a recorded image of the vehicle involved in the violation

(4) the amount of the civil penalty to be imposed for the violation;

(5) the date by which the civil penalty must be paid;

(6) a statement that the person named in the notice of violation may pay the civil penalty in lieu of appearing at an administrative adjudication hearing;

(7) information that informs the person named in the notice of violation:

(A) of the right to contest the imposition of the civil penalty in an administrative adjudication;

(B) of the manner and time in which to contest the imposition of the civil penalty; and

(C) that failure to pay the civil penalty or to contest liability is an admission of liability; and

(8) a statement that a recorded image is evidence in a proceeding for the imposition of a civil penalty;

(9) a statement that failure to pay the civil penalty within the time allowed shall result in the imposition of a late penalty of $25.00

(10) any other information deemed necessary by the department.

(d) A notice of violation under this article is presumed to have been received on the 10th day after the date the notice of violation is mailed.

(e) In lieu of issuing a notice of violation, the Department may mail a warning notice to the owner.

Sec. 22-188. Administrative adjudication hearing.

(a) A person who receives a notice of violation may contest the imposition of the civil penalty by request in writing an administrative adjudication of the civil penalty

within fifteen (15) days after receipt of the notice of violation. Upon receipt of a timely request, the Department shall notify the person of the date and time of the hearing on the administrative adjudication. The administrative adjudication hearing shall be held before a hearing officer appointed by the City Manager.

(b) Failure to pay a civil penalty or to contest liability in a timely manner is an admission of liability in the full amount of the civil penalty assessed in the notice of violation, and is a waiver of the right to appeal under section 22-188(i).

(c) The civil penalty shall not be assessed if after a hearing, the hearing officer enters a finding of no liability.

(d) In an administrative adjudication hearing, the issues must be proved at the hearing by a preponderance of the evidence. The reliability of the photographic traffic signal enforcement system used to produce the recorded image of the violation may be attested to in an administrative adjudication hearing by affidavit of an officer or employee of the City or the entity with which the City contracts to install or operate the system and who is responsible for inspecting and maintaining the system. An affidavit of an officer or employee of the City that alleges a violation based on an inspection of the pertinent recorded image, is admissible in a proceeding under this article and is evidence of the facts contained in the affidavit.

(e) A person who is found liable after an administrative adjudication hearing or who requests an administrative adjudication hearing and thereafter fails to appear at the time and place of the hearing is liable for administrative hearing costs in the amount of $25.00 in addition to the amount of the civil penalty assessed for the violation. A person who is found liable for a civil penalty after an administrative adjudication hearing shall pay the civil penalty and costs within 10 days of the hearing.

(f) It shall be an affirmative defense to the imposition of civil liability under this article, to be proven by a preponderance of the evidence, that:

(1) the traffic-control signal was not in proper position and sufficiently legible to an ordinarily observant person;

(2) the operator of the motor vehicle was acting in compliance with the lawful order or direction of a police officer;

(3) the operator of the motor vehicle violated the instructions of the traffic-control signal so as to yield the right-of-way to an immediately approaching authorized emergency vehicle;

(4) the motor vehicle was being operated as an authorized emergency vehicle under Chapter 546 of the Texas Transportation Code and that the operator was acting in compliance with that Chapter;

(5) the motor vehicle was a stolen vehicle and being operated by a person other than the owner of the vehicle without the effective consent of the owner;

(6) the license plate depicted in the recorded image of the violation was a stolen plate and being displayed on a motor vehicle other than the motor vehicle for which the plate had been issued; or

(7) the presence of ice, snow, unusual amounts of rain or other unusually hazardous road conditions existed that would make compliance with this article more dangerous under the circumstances than non-compliance.

(8) the person who received the notice of violation was not the owner of the motor-vehicle at the time of the violation.

(g) To demonstrate that at the time of the violation the motor vehicle was a stolen vehicle or the license plate displayed on the motor vehicle was a stolen plate, the owner must submit proof acceptable to the hearing officer that the theft of the vehicle or license plate had been timely reported to the appropriate law enforcement agency.

(h) Notwithstanding anything in this article to the contrary, a person who fails to pay the amount of a civil penalty or to contest liability in a timely manner is entitled to an administrative adjudication hearing on the violation if:

(1) the person files an affidavit with the hearing officer stating the date on which the person received the notice of violation that was mailed to the person; and

(2) within the same period required by Sec. 22-187(c)(7)(B) for a hearing to be timely requested but measured from the date the mailed notice was received as stated in the affidavit filed under Subdivision (1), the person requests an administrative adjudication hearing.

(i) A person who is found liable after an administrative adjudication hearing may appeal that finding of civil liability to the Municipal Court by filing a notice of appeal with the clerk of the Municipal Court. The notice of appeal must be filed not later than the 31st day after the date on which the administrative adjudication hearing officer entered the finding of civil liability. Unless the person, on or before the filing of the notice of appeal, posts a bond in the amount of the civil penalty and any late fees, an appeal does not stay the enforcement of the civil penalty. An appeal shall be determined by the Municipal Court by trial de novo. The affidavits submitted under Section 22-188(d) shall be admitted by the municipal judge in the trial de novo, and the issues must be proved by a preponderance of the evidence. A person found liable by the Municipal Court shall pay an appellate filing fee of $50.00 in addition to the civil penalty and any other fees due the City.

Sec. 22-189. Order.

(a) The hearing officer at any administrative adjudication hearing under this article shall issue an order stating:

(1) whether the person charged with the violation is liable for the violation; and

(2) the amount of any civil penalty, late penalty, and administrative adjudication cost assessed against the person.

(b) The orders issued under subsection (a) may be filed with the office of the hearing examiner. The hearing examiner shall keep the orders in a separate index and file. The orders may be recorded using microfilm, microfiche, or data processing techniques.

Sec. 22-190. Effect of liability; exclusion of civil remedy.

(a) The imposition of a civil penalty under this article is not a criminal conviction for any purpose.

(b) A civil penalty may not be imposed under this article on the owner of a motor vehicle if the operator of the vehicle was arrested or was issued a citation and notice to appear by a peace officer for the same violation of Section 544.007(d) of the Texas Transportation Code recorded by the photographic traffic signal enforcement system.

(c) An owner who fails to pay the civil penalty or to timely contest liability for the penalty is considered to admit liability for the full amount of the civil penalty stated in the notice of violation mailed to the person.

(d) The City Attorney is authorized to file suit to enforce collection of a civil penalty imposed under this article.

Sec. 22-191. Traffic Safety Fund.

The penalties and fees collected from the imposition of civil liability under this article shall be deposited in the Traffic Safety Fund account established by the City Council. Funds from the Traffic Safety Fund may be expended only for the costs of automated signal enforcement under this article, public traffic or pedestrian safety programs, traffic enforcement and intersection improvements."

SECTION 2. That all provisions of the ordinances of the City of Richardson in conflict with the provisions of this ordinance be, and the same are hereby, repealed, and all other

provisions of the ordinances of the City of Richardson not in conflict with the provisions of this ordinance shall remain in full force and effect.

SECTION 3. That should any sentence, paragraph, subdivision, clause, phrase or section of this ordinance be adjudged or held to be unconstitutional, illegal or invalid, the same shall not affect the validity of this ordinance as a whole, or any part or provision thereof other than the part so decided to be invalid, illegal or unconstitutional, and shall not affect the validity of the Code of Ordinances as a whole.

SECTION 4. This Ordinance shall take effect immediately from and after its passage, and the publication of the caption, as the law and charter in such cases provide.

DULY PASSED by the City Council of the City of Richardson, Texas, on the 13th day of September 2004.

APPROVED:

_____
MAYOR

CORRECTLY ENROLLED:

_____
CITY SECRETARY

APPROVED AS TO FORM:

_____
CITY ATTORNEY
(PGS/ 01/27/06 40571)

ORDINANCE NO. _____

AN ORDINANCE OF THE CITY OF RICHARDSON, TEXAS, AMENDING THE CODE OF ORDINANCES OF THE CITY OF RICHARDSON, BY AMENDING CHAPTER 22, TO ADD ARTICLE VII. AUTOMATED TRAFFIC SIGNAL ENFORCEMENT; PROVIDING A REPEALING CLAUSE; PROVIDING A SEVERABILITY CLAUSE; PROVIDING FOR THE IMPOSITION OF CIVIL PENALTIES AND PROVIDING AN EFFECTIVE DATE.

DULY PASSED by the City Council of the City of Richardson, Texas, on the _____ day of _____, 2004.

APPROVED:

_____
MAYOR

CORRECTLY ENROLLED:

_____
CITY SECRETARY

Attachment D

Texas Manual Uniform Traffic Control Devices (2006)

Section 4D.10 Yellow Change and Red Clearance Intervals

Standard:

A yellow signal indication shall be displayed following every CIRCULAR GREEN or GREEN ARROW signal indication. The exclusive function of the yellow change interval shall be to warn traffic of an impending change in the right-of-way assignment.

Option:

The yellow change interval may be followed by a red clearance interval to provide additional time before conflicting traffic movements, including pedestrians, are released.

Standard:

The duration of each yellow change interval shall be determined using engineering practices. When used, the duration of each red clearance interval shall be determined using engineering practices.

Support:

Engineering practices for determining the duration of yellow change and red clearance intervals are found in ITE's "Traffic Control Devices Handbook" and in ITE's "Manual of Traffic Signal Design" (see Section 1A.11).

Standard:

The duration of yellow change intervals and red clearance intervals shall be consistent with the determined values within the technical capabilities of the controller unit. The duration of a yellow change interval shall not vary on a cycle-by-cycle basis within the same signal timing plan.

Option:

When an actuated signal sequence includes a signal phase for permissible/protected (lagging) left-turn movements in both directions, the red clearance interval may be shown during those cycles when the lagging left turn signal phase is shown. The duration of a yellow change interval may be different in different signal timing plans for the same controller unit.
The duration of a red clearance interval may be different in different signal timing plans for the same controller unit. 2006 Edition Page 4D-9

Guidance:

A yellow change interval should have a duration in the range of 3 to 6 seconds. The longer intervals should be reserved for use on approaches with higher speeds. Except when clearing a one-lane, two-way facility (see Section 4G-02), a red clearance interval should have a duration not exceeding 6 seconds.