Analysis of the Red Light Camera Program in Garden Grove, CA

By Jay Beeber, Executive Director, Safer Streets L.A., Member ITE

The following report is a detailed discussion of the Red Light Camera (RLC) Program in Garden Grove, California. This report provides independently collected data as well as offering commentary on the Staff Report dated August 25, 2015.

Background

Safer Streets L.A. is a grassroots organization dedicated to furthering the interests of the motoring public through the adoption of scientifically sound and sensible transportation and traffic laws. We believe that accurate information and critical thinking are crucial to implementing sound public policy. Towards that end, we strive to provide the public and elected representatives with well researched and verifiable data. Our goal is to counter misconceptions and misinformation with solid facts in order to promote scientifically based solutions to motorist and pedestrian safety issues. Safer Streets L.A. provides this information on a voluntary basis and is not paid to interact with elected officials.

Our goal in forwarding you the following information is to provide you with additional data on the use of photo enforcement in Garden Grove, California. We hope that this information proves useful in your deliberations as to whether or not to continue the red light camera program.

About the Author

Jay Beeber is the Executive Director of Safer Streets L.A. and a research fellow with the Reason Foundation concentrating on traffic safety and enforcement. He also serves on the City of Los Angeles' Pedestrian Advisory Committee and has written numerous scientific studies on traffic related safety issues. Most recently, he served on the subcommittee of the California Traffic Control Devices Committee (CTCDC) which recommended changes to State standards and guidance for yellow light timing. These recommendations have since been incorporated into the latest version of the California MUTCD released in November 2014.

Introduction

Included in this report is an analysis of Red Light Related (RLR) collisions in the City of Garden Grove. Accident statistics were compiled from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) database. The SWITRS database serves as a means to collect and process data gathered from collision scenes by multiple police agencies throughout the state. Cities are required to provide this information for all injury and fatality collisions occurring within their jurisdictions. In addition, most cities provide information for property damage only (PDO) collisions as well.

A review of the collision data supplied by the City of Garden Grove shows the inclusion of PDO collisions along with injury and fatality collisions. It is therefore reasonable to assume that the SWITRS database provides the best and most comprehensive data on traffic collisions occurring in the city.

Collision Analysis

Safer Streets L.A. conducted an analysis of Red Light Related (RLR) collisions and rear end collisions occurring at the eight intersections with red light camera enforcement in Garden Grove. Accident statistics were compiled beginning in 2001 (the earliest date available) from the SWITRS database through 2014, the most recent complete year for which data is available. The fourteen years of available data is sufficient to draw valid conclusions as to whether or not red light cameras improved safety at those locations.

Methodology

The most important measure of the effectiveness of a RLC program is whether or not there has been a statistically significant reduction in red light running collisions at intersections where the cameras were installed. Therefore, any analysis of the potential benefit from photo enforcement must focus solely on collisions *caused by* red light running rather than on a particular *type* of collision (e.g. head on, sideswipe, broadside (T-bone), etc.) or on "collisions" in general.

Our analysis of the intersections in Garden Grove, therefore, considers only actual red light running collisions, i.e collisions where the cause of the accident was a red light violation. In the SWITRS database, these are crashes in which the primary collision factor is listed as a violation of CVC 21453.

Additionally, statistical analysis was performed on the before and after collision history to determine if any differences in the number of collisions between the before and after time periods were statistically significant (i.e. possibly due to the presence of red light cameras) or were instead due to random fluctuations or regression to the mean (not significant). Both a 2-tailed T-Test and Analysis of Variance (ANOVA) calculation was performed on the data.

For our analysis of rear end collisions, we performed a before and after study of rear end collisions concurring within 50 feet of the intersection as these are the collision most likely to be caused by drivers "panic braking" as an over-reaction to the presence of red light cameras.

Statistical Significance

Determining whether changes in collision rates are statistically significant is a crucial step in any analysis of collision data, especially where the actual number of collisions is relatively low, which is the case at Garden Grove intersections. This is because small changes will be magnified giving the appearance of a large percentage change when, in fact, the actual change in the number of collisions is small and due only to random fluctuations or regression to the mean. For example, consider a situation where there are two collisions in year one, and one collision in year two. This might be reported as a 50% reduction in collisions when there has only been a difference in one collision from year to year. This would typically not be a statistically significant change and would likely be due simply to a random fluctuation in collisions from one year to the next.

Statistical significance is reported in p-values. A small p-value (typically ≤ 0.05) indicates that the difference between data sets may be statistically significant and not due to random fluctuation. Conversely, a large p-value (> 0.05) indicates that the difference is likely due to random change and not statistically significant.

Statistical Analysis

In order to determine whether there was a statistically significant change in the number of red light related collisions, we first tabulated the number of collisions that were caused by an at-fault driver running a red light at each red light camera location before and after the cameras were installed. Complete collision data from the SWITRS database is available from 2001 through 2014. Red light cameras were first installed at the intersection of Brookhurst & Westminster in mid-1999. Photo enforcement began at the other seven intersections at various times between late 2003 and mid-2005. Due to the lack of uniformity in start times, it was necessary to analyze each intersection independently. For each, we chose January 2001 through the approximate date of installation as the "before period" and the approximate date of installation through December 2014 as the "after period".

In order to compare the two unequal time periods, we then calculated the average number of red light related collisions per year for each time period and calculated the percentage change in the average. Finally, we conducted a 2-tailed T-Test and ANOVA test on the raw collision numbers from both time periods to determine if any change in the number of collisions was statistically significant or due to the random fluctuation in collisions which is expected to naturally occur from year to year.

Because collision data prior to January 2001 is not available from the SWITRS database, we were unable to conduct a before and after study at the intersection of Brookhurst & Westminster, however we do provide an analysis of collision trends starting in 2001 for this location.

Collision Severity

Often, when rear end collisions increase in the presence of red light cameras, enforcement supporters claim that this is a reasonable trade-off for a reduction in broadside collisions which are often thought to be more severe. This concept is alluded to on page 2 of the staff report.

In order to determine whether the total severity of injuries increased or decreased in the presence of the cameras where red light running collisions decreased and rear end collisions increased, at the intersections where this occurred, we calculated a "collision severity index" for each collision using the collision severity listed in the SWITRS database. While the SWITRS database assigns higher numbers to less severe collisions and lower numbers to more severe collisions (with the exception of PDO collisions which are assigned a number of 0) it was necessary for us to assign higher numbers to more severe injuries and lower numbers to less severe injuries in order to get the proper weighting. We therefore assigned PDO collisions an index of 1, minor injuries (Complaint of Pain) an index of 2, and so forth up to an index of 5 for fatal collisions.

We then multiplied the number of collisions of each type by its severity index to achieve a separate severity amount for the total red light related and total rear end collisions occurring each year. Finally, we compared the average severity of collisions per year for both types (RLR or Rear end) for the before and after periods and calculated the percent change in the severity of collisions. Comparing the reduction or increase in the severity of injuries caused by red light running vs rear end collisions is one way to account for the possible differences in severity between these two types of collisions.

Broadside Collisions

As noted previously, analizing broadside collisions does not provide accurate information as to the effect of red light camera enforcement. However, since the staff report relies heavily on this type of analysis, we have include data on broadside collisions at each intersection for comparison purposes.

Results

Brookhurst & Orangewood

Photo enforcement began at this location in July 2005. The before period was designated as January 2001 through June 2005. The after period was designated as July 2005 through December 2014.

The Table below shows the results for the analysis of various collision types occurring at this intersection.

Brookhurst & Orangewood - Enforcement start date July 2005			
Year	RLR Collisions	Rear End 50'	Broadside
2001	1	0	1
2002	1	0	1
2003	1	2	0
2004	0	0	1
Jan – June 2005	0	1	1
July – Dec. 2005	0	1	1
2006	1	2	3
2007	1	1	1
2008	1	1	1
2009	1	1	1
2010	1	1	1
2011	3	0	3
2012	0	0	1
2013	0	2	0
2014	3	2	3
Ave before period	0.67	0.67	0.75
Ave after period	1.16	1.16	1.56
% Change	**73.68%**	**73.68%**	107.41%
P-value T-test	**0.361**	**0.268**	
P-value ANOVA	**0.371**	**0.278**	

The average number of red light related collisions and rear end collisions both **increased** at this location by over **73%**. Statistical analysis showed p-values of 0.36 and 0.27 respectively. Neither change was statistically significant at $p < 0.05$.

Further, this location was not experiencing a high level of red light related collisions prior to the installation of red light cameras and was therefore not a good candidate for photo enforcement.

Photo enforcement did not improve safety at this intersection and may have decreased safety due to an increase in rear end collisions.

Valley View & Chapman

Photo enforcement began at this location in April 2005. The before period was designated as January 2001 through March 2005. The after period was designated as April 2005 through December 2014.

The Table below shows the results for the analysis of various collision types occurring at this intersection.

Valley View & Chapman - Enforcement start date April 2005			
Year	RLR Collisions	Rear End 50'	Broadside
2001	1	0	2
2002	0	1	2
2003	0	0	3
2004	0	0	1
Jan –March 2005	0	0	1
April – Dec. 2005	1	4	4
2006	0	3	1
2007	2	4	3
2008	1	0	2
2009	0	1	1
2010	0	1	1
2011	0	1	1
2012	0	1	3
2013	0	3	2
2014	0	2	2
Ave before period	0.24	0.24	2.00
Ave after period	0.41	2.05	1.91
% Change	**74.36%**	**771.79%**	-4.55%
P-value T-test	**0.574**	**0.036**	
P-value ANOVA	**0.669**	**0.031**	

The average number of red light related collisions increased **increased** at this location by over **74%** In addition, the average number of rear end collisions **increased** at this location by over **771%.**

Statistical analysis showed a p-value of 0.574 for the RLR collision increase which was not statistically significant. However, the 771% increase in rear end collisions was a statistically significant change.

Further, this location had only one red light related collision in 2001 prior to the installation of cameras and was therefore not a good candidate for photo enforcement.

Photo enforcement did not improve safety at this intersection and may have decreased safety due to a substantial increase in rear end collisions.

Brookhurst & Chapman

Photo enforcement began at this location in January 2014. The before period was designated as January 2001 through December 2003. The after period was designated as January 2004 through December 2014.

The Table below shows the results for the analysis of various collision types occurring at this intersection.

Brookhurst & Chapman - Enforcement start date Jan 2004					
Year	RLR Collisions	Rear End 50'	Broadside	RLR Collisions Severity Index	Rear End Severity Index
2001	1	2	2	3	3
2002	4	3	5	6	4
2003	3	4	4	7	5
2004	5	9	6	6	17
2005	3	8	5	4	14
2006	5	8	3	8	10
2007	0	7	0	0	11
2008	1	2	3	2	2
2009	0	5	3	0	5
2010	2	3	3	6	5
2011	2	2	5	3	3
2012	2	5	7	8	5
2013	1	1	1	1	2
2014	0	2	4	0	4
Ave before period	2.67	3.00	3.67	5.33	4.00
Ave after period	1.91	4.73	3.64	3.45	7.09
% Change	**-28.41%**	**57.58%**	-0.83%	**-35.23%**	**77.27%**
P-value T-test	**0.523**	**0.342**			
P-value ANOVA	**0.522**	**0.320**			

There was a non-statistically significant decrease in the average number of red light related collisions and a **57% increase in rear end collisions**. In a comparison of the trade-off of red light related collisions for increased rear end collisions, the data shows that **overall, injuries increased** at this location.

Photo enforcement did not improve safety at this intersection and may have decreased safety due to an increase in rear end collisions and injury severity.

Trask & Magnolia

Photo enforcement began at this location in January 2014. The before period was designated as January 2001 through December 2003. The after period was designated as January 2004 through December 2014.

The Table below shows the results for the analysis of various collision types occurring at this intersection.

Trask & Magnolia - Enforcement start date Jan 2004					
Year	RLR Collisions	Rear End 50'	Broadside	RLR Collisions Severity Index	Rear End Severity Index
2001	2	0	2	4	0
2002	4	0	6	6	0
2003	3	3	4	5	4
2004	4	8	4	8	10
2005	0	0	2	0	0
2006	1	1	2	2	1
2007	0	7	0	0	8
2008	2	2	2	2	3
2009	0	3	2	0	3
2010	1	3	2	2	3
2011	2	2	3	2	2
2012	3	1	2	6	3
2013	0	3	1	0	3
2014	2	2	0	2	2
Ave before period	3.00	1.00	4.00	5.00	1.33
Ave after period	1.36	2.91	1.82	2.18	3.45
% Change	**-54.55%**	**190.91%**	-54.55%	-56.36%	159.09%
P-value T-test	**0.079**	**0.238**			
P-value ANOVA	**0.079**	**0.238**			

There was a non-statistically significant decrease in the average number of red light related collisions and a **191% increase in rear end collisions**. In a comparison of the trade-off of red light related collisions for increased rear end collisions, the data shows that **overall, injuries increased** at this location.

Photo enforcement did not improve safety at this intersection and may have decreased safety due to an increase in rear end collisions and injury severity.

Valley View & Lampson

Photo enforcement began at this location in October 2014. The before period was designated as January 2001 through September 2004. The after period was designated as October 2004 through December 2014.

The Table below shows the results for the analysis of various collision types occurring at this intersection.

Valley View & Lampson - Enforcement start date Oct 2004					
Year	RLR Collisions	Rear End 50'	Broadside	RLR Collisions Severity Index	Rear End Severity Index
2001	1	0	14	3	0
2002	0	2	4	0	3
2003	1	2	3	1	2
Jan – Sept 2004	1	1	2	3	1
Oct. - Dec. 2004	0	0	0	0	0
2005	0	0	0	0	0
2006	0	2	2	0	4
2007	0	4	3	0	7
2008	1	1	4	3	2
2009	2	1	4	3	1
2010	1	1	2	1	2
2011	0	1	3	0	1
2012	0	1	5	0	2
2013	0	2	3	0	4
2014	1	3	4	2	4
Ave before period	0.80	1.33	6.13	1.87	1.60
Ave after period	0.57	1.83	3.43	1.03	3.09
% Change	**-28.57%**	**37.14%**	-44.10%	-44.90%	92.86%
P-value T-test	**0.450**	**0.767**			
P-value ANOVA	**0.568**	**0.466**			

There was a non-statistically significant decrease in the average number of red light related collisions and a **31% increase in rear end collisions**. In a comparison of the trade-off of red light related collisions for increased rear end collisions, the data shows that **overall, injuries increased** at this location.

Further, this location was not experiencing a high level of red light related collisions prior to the installation of red light cameras and was therefore not a good candidate for photo enforcement.

Photo enforcement did not improve safety at this intersection and may have decreased safety due to an increase in rear end collisions and injury severity.

Brookhurst & Trask

Photo enforcement began at this location in January 2014. The before period was designated as January 2001 through December 2003. The after period was designated as January 2004 through December 2014.

The Table below shows the results for the analysis of various collision types occurring at this intersection.

Brookhurst & Trask - Enforcement start date Jan 2004					
Year	RLR Collisions	Rear End 50'	Broadside	RLR Collisions Severity Index	Rear End Severity Index
2001	1	2	2	3	2
2002	4	0	6	7	0
2003	1	3	2	1	5
2004	1	3	2	1	3
2005	4	7	2	8	9
2006	3	8	5	4	11
2007	0	8	4	0	10
2008	1	8	1	2	11
2009	0	5	1	0	5
2010	0	4	1	0	5
2011	2	1	1	4	1
2012	1	4	2	2	5
2013	1	2	3	2	3
2014	2	2	4	3	2
Ave before period	2.00	1.67	3.33	3.67	2.33
Ave after period	1.36	4.73	2.36	2.36	5.91
% Change	**-31.82%**	**183.64%**	-29.09%	**-35.54%**	**153.25%**
P-value T-test	**0.490**	**0.084**			
P-value ANOVA	**0.487**	**0.084**			

There was a non-statistically significant decrease in the average number of red light related collisions and a **184% increase in rear end collisions**. In a comparison of the trade-off of red light related collisions for increased rear end collisions, the data shows that **overall, injuries increased** at this location.

Photo enforcement did not improve safety at this intersection and may have decreased safety due to an increase in rear end collisions and injury severity.

Harbor & Trask

Photo enforcement began at this location in Februray 2014. The before period was designated as January 2001 through January 2004. The after period was designated as February 2004 through December 2014.

The Table below shows the results for the analysis of various collision types occurring at this intersection.

Harbor & Trask - Enforcement start date Feb 2004			
Year	RLR Collisions	Rear End 50'	Broadside
2001	3	2	4
2002	3	4	6
2003	2	11	1
2004	1	9	4
2005	0	4	4
2006	0	3	1
2007	0	4	0
2008	0	4	0
2009	0	4	0
2010	0	5	3
2011	3	9	4
2012	1	2	6
2013	1	2	3
2014	2	3	3
Ave before period	2.67	5.67	3.67
Ave after period	0.73	4.45	2.55
% Change	**-72.73%**	**-21.39%**	-30.58%
P-value T-test	**0.009**	**0.537**	
P-value ANOVA	**0.009**	**0.535**	

The average number of red light related collisions decreased at this location. The change was deemed to be statistically significant at $p < 0.05$. Note that this does not mean that the change was *caused* by the presence of red light cameras as numerous factors can affect the number of collisions including changes in signal timing, implementation of other engineering countermeasures, changes in traffic patterns, etc. As this was the only location where a statistically significant change in red light running collisions occurred, official may wish to investigate further as to the reasons for the decrease rather than simply making the assumption that it was due to the implementation of photo enforcement.

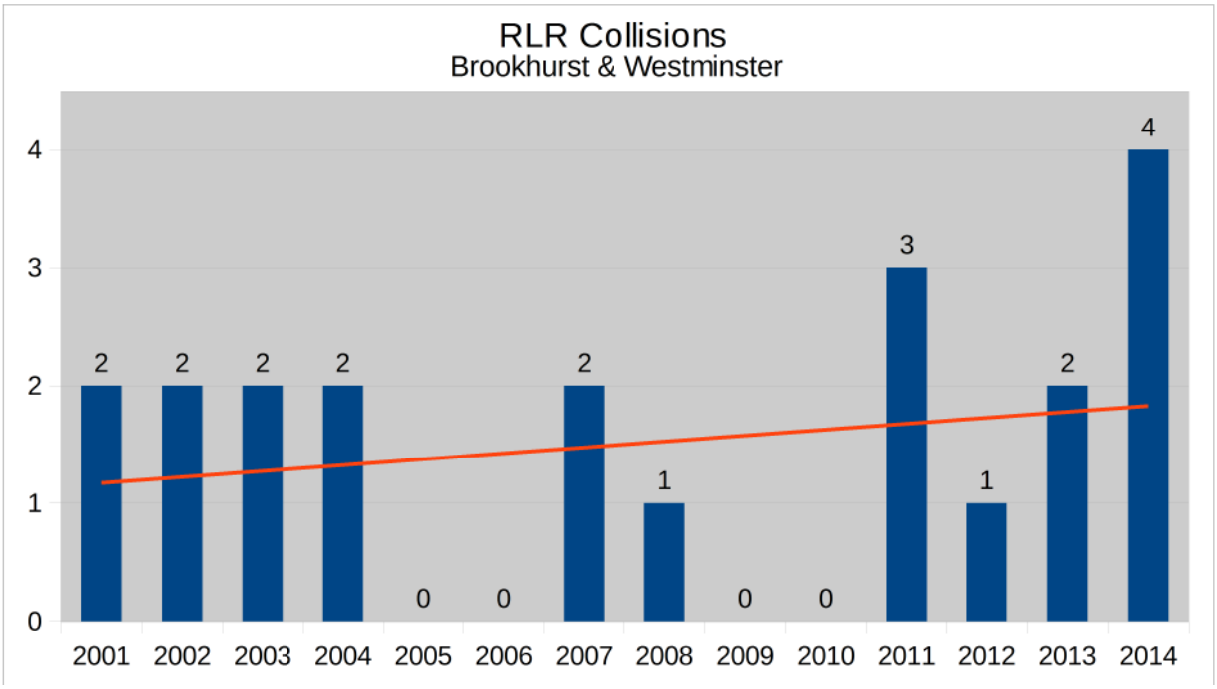
Brookhurst & Westminster

Red light cameras were first installed at this location in July 1999. According to city staff, the cameras were continually present at this intersection since that time but may not have been issuing tickets during the first years of the program. Since it was not possible to determine a start date for enforcement at this intersection and since the SWITRS database does not provide data prior to January 2001, we were unable to perform a before and after collision analysis at this location.

However, for comparison purposes we compiled the data for collisions starting in 2001. The Table below shows the raw numbers of collisions occurring at this location for the full 14 year period.

Brookhurst & Westminster - Installation date July 1999			
Year	RLR Collisions	Rear End 50'	Broadside
2001	2	11	11
2002	2	17	8
2003	2	5	10
2004	2	8	12
2005	0	6	3
2006	0	6	7
2007	2	4	9
2008	1	5	0
2009	0	6	6
2010	0	5	4
2011	3	2	7
2012	1	2	7
2013	2	6	8
2014	4	4	4

In addition, we graphed the trends in the number of red light related collisions for the full 14 year period.



As can be seen from the above chart, red light related collisions are trending upwards at this location. It is therefore unlikely that the cameras are improving safety or changing driver behavior after more than two decades of use.

Summary of Results

Rear end collisions increased at almost every red light camera enforced intersection in the city of Garden Grove after photo enforcement was implemented. The following increases in rear end collisions were found: 37.14%, 57.58%, 73.68%, 183.64%, 190.91%, and 771.79%. Further, the increase in rear end collisions represented an actual increase in injuries, even when compared to decreases in red light running collisions.

For red light running collisions, with one exception, collisions at photo enforced intersections either increased or the decrease was not statistically significant.

The results of this study show that with regards to determining the impact of red light cameras on safety, it is critical that the analysis look at collisions caused by red light running rather than the more general category of "broadside collisions" which may have no relationship to actual red light violations.

Further, our analysis shows that a trade-off between an increase rear end collision and a decrease in red light related collision is likely not good public policy as collision severity may increase overall. The following table shows that in Garden Grove there was a non-statistically significant 37% decrease in red light related collisions and a 61% increase in rear end collisions. This likely represents an overall decrease in safety on the city's roadways.

All RLC Intersections		
	RLR Collisions	Rear End 50'
Total Ave before period	12.04	13.57
Total Ave after period	7.50	21.86
% Change	**-37.66%**	**61.08%**

Violation and Citation Issuance

The staff report states: "In January of this year, the yellow light signal phase was adjusted upward and each RCLP intersection had an increase of 0.5 seconds." According to citation data available at http://highwayrobbery.net/redlightcamsdocsGardenGroveMain.html, this increase in the yellow interval resulted in an immediate 61% decrease in red light running violations. Some locations saw as much as a 90%+ decrease.

Month	Violations
Jun14	1744
Jul14	1802
Aug14	2106
Sep14	2094
Oct14	2044
Nov14	1883
Dec14	1314
Jan15	644
Feb15	625
Mar15	724
Apr15	694
May15	762
Jul15	865
Ave June '14 – Dec '14	1,855.29
Ave Jan '15 – Jul '15	719
% Change	-61.25%

This decrease in violations is significantly greater than anything achieved during the 10+ years of ticketing at red light camera locations and mirrors the kinds of reductions we have seen in other cities when they have increased their yellow signal timing.

Unfortunately, Garden Grove is still issuing large numbers of tickets at the intersection of Trask and Harbor, mostly for right turn on red and left turn violations. Throughout the life of the program, Garden Grove has issued the majority of tickets at this location. Due to the heavy reliance on right turn tickets at this intersection, the city ranks 11th in the entire state of California for the number of tickets issued for slow rolling right turns.

While some may argue that these violations pose a hazard to other roadway users, especially pedestrians and bicyclists, the data does not bear this out. Our study of right turn on red collisions in the City of Los Angeles showed that the chance that a rolling right turn might result in a collision was 1 in 345,000. Further, in the rare case when such a collision did occur, it was mostly minor, resulted in property damage only, and did not involve pedestrians or bicyclists.

The collision data in Garden Grove provides similar statistics. Although the city has issued upwards of 10,000 tickets at the one intersection approach of Trask eastbound at Harbor, no collision has resulted from a rolling right turn on red at this location either before or after the cameras were installed. This is strong evidence that despite the fact that drivers make this maneuver frequently, it generally does not result in danger to other roadway users.

Comments on Videos to be Shown During the Council Presentation

From the staff report, it appears that staff will show three videos captured by the red light cameras in Garden Grove.

Video 1: The camera captured a northbound vehicle running the red light, causing a collision.

Comment: This actually shows that the cameras do not prevent these collisions from occurring. Red light violations that result in the most serious collisions are due to the motorist being unaware of the red light due to impairment, distraction, fatigue, etc., not a driver trying to beat the light. If a driver is unaware that the light is red and enters the intersection late into the red interval (usually 2 seconds or more), then the presence of enforcement cameras will have no effect on preventing this from occurring. The fact that the red light camera was able to capture this incident, proves the ineffectiveness of this type of enforcement.

Video 3: The camera captured an 80,000 pound tanker truck running a red light.

Comment: The likely reason this tanker truck ran the red light is that heavy vehicles of this type are not accounted for in the yellow signal timing protocols of most jurisdictions. Heavy vehicles need more yellow warning time due to their greater momentum, but many cities set their yellow intervals at the absolute minimums which barely allows enough warning time for passenger vehicles, let alone heavy vehicles such as tanker trucks. Once again, the red light cameras are unable to prevent these vehicles from running the red light as the problem is in the engineering of the signal timing, which does not account for heavier vehicles on our roadways.

Recommendations

There is no urgency in renewing the contract with Redflex at this time and we urge the City Council to either vote to end the program or defer this decision to a later date.

1. If the Council wishes to consider its options, it is likely that Redflex will be amenable to extending the contract for 2 – 3 months to allow for more study of the program.

2. Council should not enter into any longer term agreement until the full effect of required longer yellow intervals has been measured.

3. Council should fully explore the reasons other cities have chosen to end their relationship with Redflex to learn from their example.

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