An Analysis of North American Red-Light Camera Studies and Reports

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Prepared by StPeteCameras.org

info@stpetecameras.org

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Summary

This is a final report of an analysis of 20 primary source studies and reports done on the subject of Red-Light Cameras(RLCs) in North America since the year 2000. This analysis covers 264 red light camera intersections in 20 jurisdictions at the city and state(or province) level and derives the total crash change, injury crash change and other effects of the installation of red light cameras at intersections. The main reason for doing this analysis is because there have been no meta-studies done in the last few years on this subject, and several new primary-source studies and reports have been released on the subject in the last few years. The majority of these studies(by a margin of 3 to 1) show an increase in total crashes once red light cameras are installed at an intersection, and a simple majority of the studies that measured injury crashes also show an increase in injury crashes after red light cameras are installed at an intersection. The average total crashes per-intersection increased 27% after RLCs were installed, and the average number of injury crashes per-intersection, across the 15 studies that measured injury crashes, increased by 21%. There are some consistency issues with the collected data, with many of the included studies and reports using different collection methods and standards for reporting and counting crashes as well as very different before and after period lengths. Even with these issues, the large increase in crashes and the similar increase in injury crashes shows the very dangerous unintended consequences of using red light camera systems, especially since most municipalities install them in order to increase safety.

Introduction and Background

Red light camera systems are designed to take pictures of a car before and after they run through a signaled intersection that has turned red. There are many different methods of doing this, from using magnetic sensors embedded in the road, to using purely optical-based computer systems for violation detection. Some RLC systems will take only a picture(and/or video) of the vehicle, while some will also take a picture of the driver of the vehicle. The fines vary greatly depending on the municipality issuing the fine, from a low of $50 to a high of over $500 per offense, and some municipalities increase the fines after the first offense. Some states have a set amount for the fine statewide, some states allow the local municipality to set the fine amount, and in some states the use of RLCs is illegal by decision of the state legislature or state supreme court.

RLC systems have been in use in North America for almost 20 years, with an increased growth in installations in the last 10 years. There are currently over 400 municipalities in the United States alone that have installed RLC systems. The primary goal that is given for installing these systems is usually to increase safety, with a secondary goal in some cases of raising revenue to be used by municipalities for other purposes.

On the topic of citizen support for RLC systems, many surveys have been done on the subject over the last 10 years, but since surveys can be easily slanted to one side or the other rather easily through the way a survey is worded or the people that are chosen to take the survey, we chose to look instead at the 15 communities that have put RLCs up for public vote in the United States. In every case where RLCs

have been up for a public vote, the people have voted against them. The most recent examples being 5 communities voting against RLCs in the November 2010 general election: Houston TX, Baytown TX, Anaheim CA, Garfield Heights OH, Mukilteo WA.

As for the banning of photo enforcement systems at the state level, there are currently 15 states that ban these systems. These states have passed laws prohibiting their use: Arkansas, Maine, Mississippi, Montana, Nevada, New Hampshire, South Carolina, Utah, West Virginia and Wisconsin. These states have had court decisions or attorney general rulings that have banned their use: Alaska, Indiana, Michigan, Minnesota and Nebraska.

Further into this report are analysis of all of the 20 reports and studies which are used for this study along with 11 additional reports and studies that were not included in this analysis because they failed to meet the requirements for inclusion. The requirements for inclusion in this analysis are:

- Several months of before/after RLC installation crash data with no annualized estimate data
- The statistics for overall crashes at the RLC installed intersections must be available
- A primary statistical study or report, not a summary of several different studies or results
- Been released after the year 2000 with all study sites being within the USA or Canada
- Crash data must be based upon intersections, not monitored signaled approaches
- Consistent data sources and collection methods within the report or study

Due to the inconsistency of the data and other consistency issues from study to study, it is difficult to make definitive conclusions from this data. Although with the vast majority of results pointing to an increase in crashes, there is an increased level of comfort in concluding that RLC systems lead to a significant increase in total and injury crashes when they are installed at an intersection.

There were several lessons learned after analyzing all 31 reports and studies including how using selective data can greatly impact the results of these studies. The lessons learned are further detailed in the “Discussion and Conclusions” section at the end of this report.

All 31 reports and studies can be viewed from the STPETECAMERAS.ORG website, on the RLC Studies page.

Data Collection

The first point of data to be collected from the included studies and reports is the number of RLC intersections. The more intersections included in the study the better. It also adds to the validity of the study if a similar number of non-RLC intersections are used as a control, and the same analysis is then done on this data to compare to the results from the RLC intersections.

The second point of data to be collected are the before and after RLC installation time periods. For this data the longer the better, and less than one year(12 months) is not considered optimal to yield conclusive results. Some results have a gap between the before and after periods, and the longer the

gap, the less useful the results will be.

The third point of data to be collected are the before and after RLC installation crash totals. This data should be collected consistently during the entire study period and should not exclude any sub-segment of crashes.

The fourth point of data, related to the third point, is the distance from intersection crash inclusion zone, and it is not defined in most of the included studies, but it can be very important to understanding the crash data. Some municipalities have a fixed value for this, and some do not use one at all, instead relying entirely on the reporting police officer or citizen to determine whether an accident was "intersection-related" or not. Some municipalities use a very limited distance, like the City of Plano, TX which counts only crashes that happen within 30 feet of the intersection as being tied to that intersection(This is the same standard reportedly used by the Texas Department of Transportation although an official from the TxDOT denies that any fixed distance is mandated in that state), and as you can see from Figure 1-1 using such a limited distance removes any crashes that happen beyond two car-lengths from the intersection from these statistics. In light of the 2010 study by the University of Illinois at Chicago which compares the crash statistics from the Chicago Department of Transportation(CDOT), which uses 25-50 feet, and the Illinois Department of Transportation(IDOT) which uses 150 feet, we can see that using such a limited distance from intersection does skew the results and removes many rear-end crashes from being associated with the intersection that the crash occurred near.

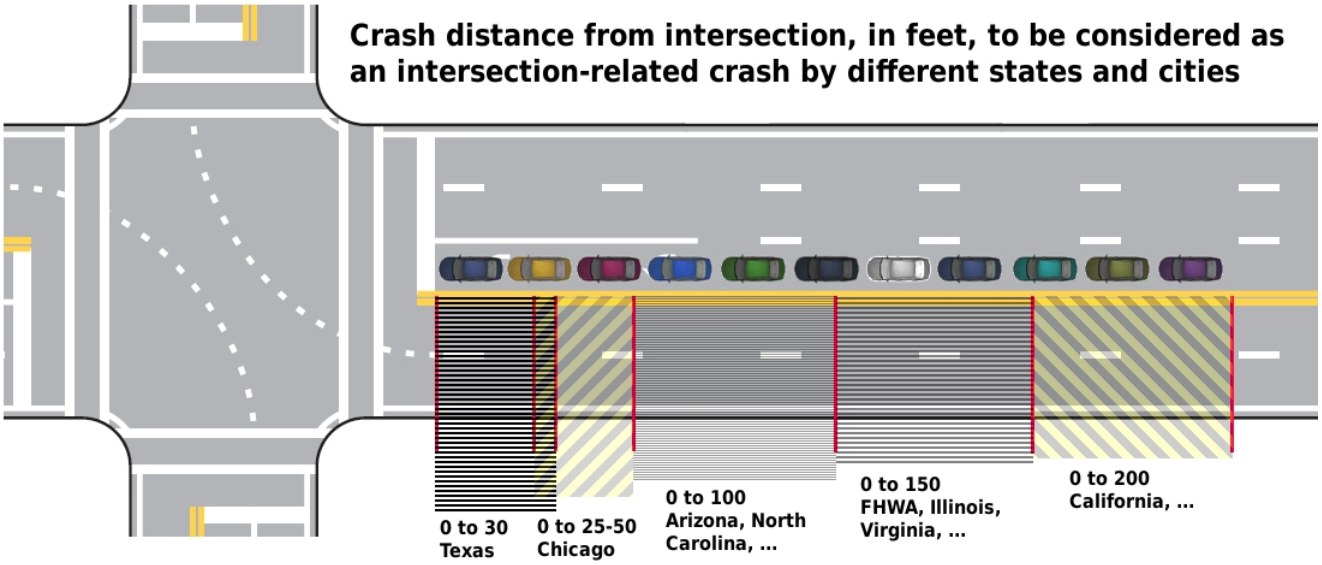

Figure 1-1 – Different crash distances by state and city

The standard Distance From Intersection used in many states as well as the Federal Highway Administration(FHWA) is 100 feet or higher.

Summaries of the Included Studies and Reports

Below are the summaries and comments for each of the primary-source studies and reports on the 20 municipalities that were included in this analysis. They are listed in alphabetical order by city, state(province), municipality or organization that conducted the study. There are 19 reports shown because the Phoenix and Scottsdale reports are included in a single study, although the data from the two cities is only reported separately throughout the report creating, in effect, 2 separate reports.

Albuquerque, NM, USA 2010 RLC Study

Official Title: City of Albuquerque Red Light Camera Study Final Report

Author: Paul Guerin Ph.D.

Summary:
This is a 2010 study by the Institute for Social Research at the University of New Mexico on the effects of red-light and speed cameras in the city of Albuquerque, New Mexico. This study compares the before and after crash statistics of 20 RLC intersections in that city. The study uses 57 to 87 months of pre-RLC crash data compared to 20 to 50 months of post-RLC data. The statistics used in this analysis are from the Albuquerque Police Department and additional citizen reports of automobile crashes and the study uses no defined Distance-From-Intersection inclusion zone for crashes. This study excludes all data on crashes having an estimated damage of less than $500. This study also excludes all alcohol-related crashes from its data. This study uses 38 non-RLC intersections as control intersections. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The results show that total crashes at RLC-equipped intersections have increased by 1% after RLCs were installed while crashes at non-RLC intersections have decreased over 9%. Injury crashes decreased at RLC intersections during the study period, but they decreased 11% more at non-RLC intersections than they did at RLC intersections. The study also does a cost analysis on the crashes at the RLC intersections, and concludes that : "The primary finding of a moderate net cost benefit supports the continued use of RLCs in Albuquerque."

Comments:
This is a detailed 74 page study, the data is not standardized as well as most other studies, due to the inclusion of citizen reported crashes and having no standardized way of reporting crashes(including no Distance-from-intersection crash inclusion zone). The exclusion of alcohol-related crashes is something that we cannot find any record of in any other study like this and somewhat diminishes the results. They give a reason for the exclusion, but provide no data to back up their assertion: "These crashes were removed because they would have occurred regardless of the existence of the RLC system". Also, the exclusion of all crashes costing less than $500 is not something that other studies do and that somewhat diminishes the results. Yet another diminishing factor is that these RLC cameras also issued speeding tickets during the course of study period, which is something that is very rare to include in these kind of studies. The selection of 20 RLC intersections is an above-average number of intersections for this kind of study. The before-RLC period is very long and the after-RLC period is above average for this kind of study. The conclusions ignore the 10% differential increase in crashes at RLC intersections as compared to non-RLC intersections, and while the conclusion of moderate

reduction in crash costs at RLC intersections is supported by the data, they made no attempt to calculate or show the change in crash costs for the non-RLC control intersections, which would have been the proper thing to do to validate their conclusions.

Chicago, IL, USA 2010 RLC Study

Official Title: Effectiveness of Red Light Cameras in Chicago: An Exploratory Analysis

Author: Rajiv C. Shah

Summary:
This is a 2010 analysis by the University of Illinois at Chicago that compares the crash rate at 39 of the Red-Light camera intersections in the city of Chicago compared to the non-RLC intersections in the city. The analysis uses 12 months of pre-RLC crash data compared to 12 months of post-RLC data. The statistics used in this analysis are from the Illinois Department of Transportation(IDOT), which use a different definition of an intersection-related crash(within 150-300 feet from the intersection) as compared to the Chicago Department of Transportation definition(25-50 feet from the intersection). There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This analysis does not go over injury crashes at all. The results show that while overall crashes in the city are down, the crashes at RLC-equipped intersections are up over 5%.

Comments:
This is a fairly brief analysis consisting of only 8 pages, but the data and statistical analysis are verifiable, the selection of 39 RLC intersection sites is quite large as these studies go, and the conclusions are supported by the data. The City of Chicago had claimed RLCs were responsible for a 24% decrease in crashes.

Costa Mesa, CA, USA, 2009 RLC Report

Official Title: NESTOR RED LIGHT CAMERA ENFORCEMENT PROGRAM REVIEW

Author: Sergeant Rob Sharpnack, Police Department

Summary:
This is a 2009 report on red-light cameras for the City Council of Costa Mesa, California that compares the before and after crash statistics of the two RLC intersections in that city. The analysis uses 30 months of pre-RLC crash data compared to 36 months of post-RLC data. The statistics used in this analysis are from the Costa Mesa Police Department which specifies their Distance-From-Intersection inclusion zone for crashes at 200 feet which is the standard for California. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This report does not cover injury crashes. The results show that crashes at RLC-equipped intersections have increased over 13%. The data also shows that injury crashes have decreased 15% at RLC intersections.

Comments:
This is a brief seven page report, but the data and statistical analysis are verifiable, the selection of 2 RLC intersections is quite small and the gap of over 2 years in the before and after periods greatly

weakens the analysis of the data. However, the conclusions are supported by the data.

Davenport and Council Bluffs, IA, USA 2007 RLC study

Official Title: The Effectiveness of Iowa's Automated Red Light Running Enforcement Programs

Authors: Eric J. Fitzsimmons, Shauna Hallmark, Thomas McDonald, Massiel Orellana, and David Matulac

Summary:
This is a 2007 study by the Center for Transportation Research and Education at Iowa State University on the effects of red-light cameras in the cities of Davenport and Council Bluffs, Iowa. This study compares the before and after crash statistics of nine RLC intersections in those cities. The study uses 36 months of pre-RLC crash data compared to 12-24 months of post-RLC data. The statistics used in this analysis are from the cities' Police Departments which use 25 meters(82 feet) as their Distance-From-Intersection inclusion zone for crashes. here are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This report does not cover injury crashes. The results show that crashes at RLC-equipped intersections have decreased about 20% by quarter over the study period, using Bayesian analysis.

Comments:
This is a detailed 139 page study, the data and statistical analysis appear valid. The selection of 9 RLC intersections is a below-average number of intersections for this kind of study. The use of 82 feet as the Distance-From-Intersection inclusion zone for crashes is below the average for most states and the Federal Highway Administration, and slightly diminishes the validity of the conclusions of this study by excluding some intersection-related crashes from their statistics. There is a comparison of control intersections, but no mention of the total intersection-related crashes city-wide as many other studies mention. For some unexplained reason the statistical analysis is done per-quarter(groupings of 3 months) instead of monthly or yearly, this is the only study we could find that was done in this way. Another question that is unanswered is why they chose to analyze only red light running(RLR) rear end crashes instead of total rear end crashes since many other studies have shown RLR rear end crashes make up a very small percentage of the total rear end crashes at an intersection. The majority of the after-RLC data is only for 12 months and only had a simple statistical analysis done on it. It is stated that a more thorough Bayesian analysis would be done when 2007 traffic data was made available, but 3 years later no report or analysis has been released. The conclusions of this study are supported by the data supplied.

Notes:
The RLCs installed in the City of Clive, IA are also mentioned in the study and take up many of the study's pages, but none of the statistics used are from Clive because of how new those installations were.

Garland, TX, USA 2006 RLC Report

Official Title: Report on the Effectiveness of Automated Red Light Enforcement

Author: <uncredited>

Summary:
This is a 2006 report by the city of Garland Transportation Department on the effects of red-light cameras in the city of Garland, Texas, USA. This study compares the before and after crash statistics of 4 RLC intersections in that city. The study uses 31 months of pre-RLC crash data compared to 31 months of post-RLC data. The statistics used in this analysis are from the Garland Police Department and the study does not define a fixed Distance-From-Intersection inclusion zone for crashes. This study uses crash data for 6 similar intersections in the city as control data. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The results show that total crashes at RLC-equipped intersections have decreased by almost 25% while total crashes at the control intersections also decreased by almost 10%. Injury crashes have also decreased at RLC intersections by almost 27%. The study concludes that : "Crashes have been significantly reduced in both severity and number as a result of the Safelight Garland Program".

Comments:
This is a brief 8 page study, the detail data per intersection per month is not included in this report, even though the violations data per month is included. Also, the selection of 4 RLC intersections is far below average for this kind of study and somewhat diminishes the usefulness of this report. The use of 31 months of pre and post-RLC data is above average for this kind of report and somewhat improves the validity of this report. The lack of a defined crash inclusion zone somewhat diminishes the usefulness of this report, especially due to the fact that several Texas cities use an extremely limited range of 30 feet as their Distance-from-intersection crash inclusion zone(as compared to 150 feet used by the Federal Highway Administration(FHWA)), which severely under-reports the number of rear-end crashes, as evidenced by the Chicago 2010 RLC report. We have asked the city of Garland what they used for a crash inclusion zone, but we have not received a reply. The conclusions are supported by the data that is supplied in this report.

Grande Prairie, AB, CAN 2009 RLC Report

Official Title: Review of Red Light Camera Program

Author: Garry Roth, Program Manager

Summary:
This is a 2009 report by the city of Grande Prairie, Alberta, Canada on the effects of red-light and speed cameras in the city of Grande Prairie. This study compares the before and after crash statistics of 3 RLC intersections in that city. The study uses 60 months of pre-RLC crash data compared to 12 months of post-RLC data. The statistics used in this analysis are from the Grande Prairie Police Department and the report does not defined a set Distance-From-Intersection inclusion zone for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The results show that total crashes at RLC-equipped intersections have increased by 43% and injury crashes have increased by 126% after RLCs were installed. The study concludes that: "There have not been significant reductions in collisions, while only a few of these collisions during this time fram, have actually resulted from a red light violation."

Comments:
This is a basic 4 page report, the data and statistical analysis appear valid. One slightly diminishing factor is that there is at least a two year gap between the pre and post RLC periods, which is something that diminishes the validity of the report, although the very long pre-RLC period somewhat adds to the validity of the report. The post RLC period is slightly below average for this kind of report. The selection of 7 RLC intersections is a below-average number of intersections for this kind of study and somewhat diminishes the usefulness of the report. The report uses no control intersections to help validate the data conclusions. The conclusions are supported by the supplied data.

Greensboro, NC, USA 2004 RLC Study

Official Title: A DETAILED INVESTIGATION OF CRASH RISK REDUCTION RESULTING FROM RED LIGHT CAMERAS IN SMALL URBAN AREAS

Authors: Mark Burkey, Ph.D. and Kofi Obeng, Ph.D.

Summary:
This is a 2004 study by the Urban Transit Institute at the North Carolina Agricultural & Technical State University on the effects of red-light cameras in the city of Greensboro, North Carolina. This study compares the before and after crash statistics of 18 RLC intersections in that city. The study uses 26 to 35 months of pre-RLC crash data compared to 31 to 22 months of post-RLC data. The statistics used in this analysis are from the North Carolina Department of Transportation which used 100 feet as their Distance-From-Intersection inclusion zone for crashes. There are no significant data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. Injury crashes were counted and did increase, but the study contains no raw data on injury crashes to back this up. The results show that crashes at RLC-equipped intersections have increased by 40% over the study period while crashes city-wide fell during the same time period. The study concludes that : "The results do not support the view that red light cameras reduce crashes. Instead, we find that RLCs are associated with higher levels of many types and severity categories of crashes."

Comments:
This is a detailed 60 page study, the data and statistical analysis appear valid. The selection of 18 RLC intersections is slightly above-average number of intersections for this kind of study. The use of 100 feet as the Distance-From-Intersection inclusion zone for crashes is close to the average for most states and below what the Federal Highway Administration uses. The before and after RLC date periods are sequential and more than adequate to provide a valid data set for comparison. There is a comparison of crashes at many control intersections in the same city which show a decline in total crashes over the study period. The conclusions of this study are mostly supported by the data supplied.

Notes:
This study has a thorough analysis of several other previously released studies on the issue of RLC safety issues, and concludes that: "several studies have shown that RLCs usually reduce the rate of violations, very little evidence exists that confirms that RLCs reduce accident rates". Specifically the Oxnard, CA study is criticized in several ways: "The overall implication is that the effect attributed to the red light cameras by Retting and Kyrychenko is only a comparison of the accident growth rate between signalized and non-signalized intersections in Oxnard, CA. The other data does not act as a

control, nor does it add any information to this model."

Lubbock, TX, USA 2008 RLC Report

Official Title: Public Works Update Safety Campaign Second Quarter Report

Author: <uncredited>

Summary:
This is a 2008 report on red-light cameras for the City of Lubbock, Texas that compares the before and after crash statistics of the 12 RLC intersections in that city. The analysis uses at least 24 months of pre-RLC crash data compared to 6 months of post-RLC data. The statistics used in this analysis are from the Lubbock, TX Police Department which does not specify their Distance-From-Intersection inclusion zone for crashes. The data shows that crashes at RLC-equipped intersections have increased over 52% while city-wide crashes have gone down 2.7%. The data also shows that injury crashes have decreased 10% at RLC intersections. Control intersection data is used in this report, and it shows a rise in crashes at non-RLC intersections similar to the rise in crashes as RLC intersections. The data also shows that the city has lost money on their RLC program. The recommendation of the report is an immediate review of the program instead of waiting for it's one year anniversary for a review.

Comments:
This is a brief 16 page report, but the data and statistical analysis appear valid, the selection of 12 RLC intersections is only slightly below average for this kind of report. There is significant pre-RLC data, but only 6 months of post-RLC data does somewhat decrease the weight of any conclusions that may be drawn from the report. The use of control intersections somewhat improves the validity of the data in this report. Since there are no conclusions in the actual report we must assume that they were negative since the City Council voted to remove RLCs from their city within one month of this report being released.

Modesto, CA, USA 2007 RLC Report

Official Title: Informational Update on Red Light Enforcement Program

Author: Roy W. Wasden, Chief of Police

Summary:
This is a 2007 report by the city of Modesto on the effects of red-light cameras in the city of Modesto, California. This study shows the crash statistics of 4 RLC intersections in that city before, during and after their installation. The study does not define a pre-RLC and post-RLC time period. The statistics used in this analysis are from the Modesto Police Department and the study does not define if they used a standard Distance-From-Intersection inclusion zone for crashes. This study does not use any control intersections. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The study concludes that: "The program’s success or failure cannot be judged by these stats alone because the red light camera at each intersection only monitors one approach", and "In comparing collisions with the collision injuries, the numbers indicate that in all four intersections the likelihood that someone was injured in a collision decreased."

Comments:
This is a brief 5 page report. The data is not detailed in a way to allow for any significant before and after statistical analysis since there are no results shown(or able to be calculated from the supplied data) that show an increase or decrease in crashes after RLCs were installed because they were installed mid-year in 2005 and only full year totals are given, resulting in a full one year gap in the gathered data, and only 12 months of before and after data. If the data had been broken down by month, then a much more authoritative analysis could have been done. The selection of 4 RLC intersections is very small for this kind of study and further diminishes the usefulness of any results from this report. Just taking the first year(pre-RLC) and comparing it to the last year(post-RLC) there was a 5% decrease in overall crashes at RLC intersections, but almost a 19% increase in injury crashes at RLC intersections. The conclusion of a reduced likelihood of injury in a collision is contradicted by the data supplied.

Ontario MOT, ON, CAN 2003 RLC Study

Official Title: EVALUATION OF THE RED LIGHT CAMERA ENFORCEMENT PILOT PROJECT

Authors: Synectics Transportation Consultants Inc.

Summary:
This is a 2003 study by Synectics Transportation Consultants Inc. for the Ontario Ministry of Transportation on the effects of red-light cameras and other red light treatments in the city of Toronto and a few surrounding communities in Ontario in Canada. This study compares the before and after crash statistics of 19 RLC intersections in that city. The study uses 60 months of pre-RLC crash data compared to 24 months of post-RLC data. The statistics used in this analysis are from the Ontario Ministry of Transportation which does not define their Distance-From-Intersection inclusion zone for crashes. The study does use 12 control intersections to help validate the study. There is no specific data in this report that suggests a reduction or increase in fatalities due to RLCs, although they do make the statement that red light treatments "reduced the number of severe collisions from occurring thereby saving lives", but when RLCs specifically are analyzed, they show a 2% increase in injury and fatal crashes. The results show that crashes as a whole at RLC-equipped intersections have increased by 16% over the study period. The study concludes that for all attempted red light treatments taken as a whole(not just RLCs): "the pilot project has been shown to be a valid safety program for the province of Ontario, having achieved the objective of reducing fatal and injury collisions."

Comments:
This is a very detailed 111 page study, the data and statistical analysis appear valid. The selection of 19 RLC intersections is slightly above-average number of intersections for this kind of study. Not defining the Distance-From-Intersection inclusion zone for crashes slightly diminishes the validity of the data. The before and after RLC date periods are sequential and adequate to provide a valid data set for comparison. There is a comparison of crashes at several control intersections in the same cities over the study period. Most of the conclusions of this study are supported by the data supplied, although the claim that RLCs specifically save lives is not supported at all by specific fatality-only data, and it is stated that injury and fatal crashes at RLC intersections actually went up 2%, and the control intersections during the same time period saw a 13% decrease in injury and fatal crashes.

Notes:
It is very important to note that RLCs are less than half of the "red light treatments" mentioned in this study. The majority of red light treatment intersections use only increased police presence with no RLCs involved. The RLC intersections show an increase in all types of crashes.

Phoenix and Scottsdale, AZ, USA 2005 RLC Study

Official Title: The Impact of Red Light Cameras (Automated Enforcement) on Safety in Arizona

Authors: Dr. Simon Washington and Mr. Kangwon Shin

Summary:
This is a 2005 study by the University of Arizona in the cities of Phoenix and Scottsdale, Arizona. This study compares the before and after crash statistics as well as anticipated economic cost differences at 11 RLC intersections in Phoenix and 14 RLC intersections in Scottsdale. The study reports the two cities' data separated without statistically combining them in the final analysis, so this is in effect two separate studies. the Phoenix analysis uses 36 to 39 months of pre-RLC crash data compared to 18 to 21 months of post-RLC data while the Scottsdale analysis uses 83 to 160 months of pre-RLC crash data compared to 79 to 8 months of post-RLC crash data. The statistics used in this analysis are from the cities of Phoenix and Scottsdale which used 100 feet as their Distance-From-Intersection inclusion zone for crashes. There are no significant data or conclusions in this report that specifically suggest a reduction or increase in fatalities due to RLCs. The results show that crashes at RLC-equipped intersections in Phoenix have increased by 5% over the study period while crashes at RLC intersections in Scottsdale decreased by 12%. The study concludes that: "When crash severities and costs are considered and intersections are analyzed..., the benefits of RLCs range small benefits (Phoenix) to relatively large (Scottsdale). For example, the crash costs (frequency and severity considered) of rear end crashes are slightly greater than the reduction in crash costs (benefits) for angle and left-turn crashes. In Scottsdale, in contrast, the cost savings from reducing the severity of angle and left-turn crashes is greater than additional costs of rear-end crashes, and as a result there is an expected cost savings from the RLCs.".

Comments:
This is a detailed 141 page study, the data and statistical analysis appear valid. The selection of 25 RLC intersections is a slightly above-average number of intersections for this kind of study. The use of 100 feet as the Distance-From-Intersection inclusion zone for crashes is close to the average for most states. The before and after RLC date periods are sequential and mostly adequate to provide a valid data set for comparison, although the vast difference in lengths of the Scottsdale data should have been restricted to yield a more uniform set of data to work with. The study mentions the use of non-RLC intersection crash data, but it only mentions a few pieces of this data instead of listing all of the raw statistics on this data, which somewhat degrades the validity of the conclusions. These control intersections also had very few to no crashes which make them unsuitable for use as control intersections further weakening the conclusions of this study. Using the crash-frequency calculations for before and after injury statistics(since there are no raw before/after statistics given for injury crashes) there was a 10% increase in injury crashes in Phoenix and a 21% decrease in injury crashes in Scottsdale during the study period. The final conclusion of the study is that more studies should be conducted with data from more RLC intersections to get a more comprehensive set of results "It should

be noted that these results are based on small sample sizes and observed trends in the means and therefore require further research to validate". The conclusions of this study are somewhat supported by the data supplied.

Raleigh, NC, USA 2004 RLC Study

Official Title: Evaluating the Use of Red Light Running Photographic Enforcement Using Collisions and Red Light Running Violations

Authors: Christopher M. Cunningham, MS, EI and Joseph S. Hummer, Ph.D., PE

Summary:
This is a 2004 study by the Institute for Transportation Research and Education North Carolina State University on the effects of red-light cameras in the city of Raleigh, North Carolina and the Town of Chapel Hill. This study compares the before and after crash statistics of 7 RLC intersections in those cities. The study uses 69 to 70 months of pre-RLC crash data compared to 4 to 5 months of post-RLC data. The statistics used in this analysis are from the North Carolina Department of Transportation and the study claims that 500 feet is used as their Distance-From-Intersection inclusion zone for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This study does not cover injury crashes. The results show that crashes at RLC-equipped intersections have decreased by 14% after RLCs were installed after the halo effect is taken into account. The study concludes that : "RLCs appear to have a positive affect... Based on the comparison group study, collisions were reduced in all four categories we examined by sizeable amounts."

Comments:
This is a very detailed 192 page study, the data and statistical analysis appear valid. The selection of 7 RLC intersections is a below-average number of intersections for this kind of study. The use of 500 feet as the Distance-From-Intersection inclusion zone for crashes far above average for most states. The before-RLC period is very long but the after-RLC period of 4 to 5 months is extremely short and makes the conclusions of this study much less useful. The conclusions of this study are supported by the data supplied.

Regina, SK, CAN 2006 RLC Study

Official Title: Collision Statistics for Red Light Cameras

Author: Stella Madsen and D. Calam

Summary:
This is a 2006 report by the city of Regina, Saskatchewan, Canada on the effects of red-light and speed cameras in the city of Regina. This study compares the before and after crash statistics of 3 RLC intersections in that city. The study uses 48 months of pre-RLC crash data compared to 48 months of post-RLC data. The statistics used in this analysis are from the Regina Police Department and the report does not defined a set Distance-From-Intersection inclusion zone for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The results show that total crashes at RLC-equipped intersections have increased by 12% and injury crashes have

increased almost 8% after RLCs were installed. The study concludes that: "Red Light Cameras can have a significant impact on traffic collisions.", and "At the Lewvan Drive and Dewdney Avenue intersection, rear-end collision increased significantly causing the overall total number of collisions to increase. The increase in traffic volumes(50%) and the higher speed limit on Lewvan Drive are likely the reason for this change."

Comments:
This is a basic 6 page report, the data and statistical analysis appear valid. One slightly diminishing factor is that there is a one month gap between the pre and post RLC periods, which is something that is rare in these kind of studies, although the very long pre and post RLC periods are far above average for a study like this and add to the validity of this report. The selection of 3 RLC intersections is a far below-average number of intersections for this kind of study and somewhat diminishes the validity of the report. The report uses no control intersections to help validate the data, or their assertion that the increase in crashes is caused by traffic increases. Some of the conclusions are supported by the supplied data.

Seattle, WA, USA, 2007 RLC Report

Official Title: City of Seattle Traffic Safety Camera Pilot Project Evaluation Report

Author: <uncredited>

Summary:
This is a 2007 report for the city of Seattle, Washington, USA on the effects of red-light cameras in the city of Seattle, Washington. This study compares the before and after crash statistics of 4 RLC intersections in that city. The study uses 40 months of pre-RLC crash data compared to 7 to 10 months of post-RLC data. The statistics used in this analysis are from the Seattle Police Department and the study does not define a fixed Distance-From-Intersection inclusion zone for crashes. This study uses crash data from 4 non-RLC intersections in the city as control data. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The results show that total crashes at RLC-equipped intersections have increased by 6% as well as a 30% decrease in injury crashes for the first 7 to 10 months after RLCs were installed at RLC intersections. The study concludes that : "There is little evidence that cameras have decreased the frequency of all auto crashes or of the more dangerous angle collisions; however, it does appear that cameras may have mitigated the severity of crashes".

Comments:
This is a brief 15 page report, there is no detail source data per intersection included in this report, and the pre-RC data used has several gaps of two months which somewhat reduces the validity of the report. Also, one of the four RLC intersections was only operational for 7 months at the time the report was written, but the difference in post-RLC data periods is not mentioned anywhere and that fact is not taken into account in the analysis of the report which also diminishes the validity of the report. The use of only 4 RLC intersections and 4 control intersections is far below the average for this kind of study and reduces the usefulness of the report. The before-RLC period is very long and the after-RLC period is well below average for this kind of study and somewhat reduces the validity of the conclusions. This report mentions that a final report will be issued later that year, but it is 3 years later and no report has

ever been filed that we can determine. The conclusions are supported by the very limited data that is supplied in this report.

Stockton, CA, USA 2007 RLC Report

Official Title: PERFORMANCE AUDIT: RED LIGHT CAMERA PROGRAM

Authors: F. MICHAEL TAYLOR, CITY AUDITOR and VANESSA D'SOUZA SENIOR DEPUTY CITY AUDITOR

Summary:
This is a 2007 report by the city auditor of the city of Stockton, California, USA on the effects of red-light cameras in the city of Stockton, California. This study compares the before and after crash statistics of 12 RLC intersections in that city. The study uses 12 months of pre-RLC crash data compared to 12 to 24 months of post-RLC data. The statistics used in this analysis are from the Stockton Police Department and the study does not define a fixed Distance-From-Intersection inclusion zone for crashes. This study uses crash data for all intersections in the city as control data. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The results show that total crashes at RLC-equipped intersections have increased by 10% as well as a 14% decrease in injury crashes for the first year after RLCs were installed at RLC intersections. The study concludes that: "Red light cameras have reduced the number of accidents and injuries as well as the seriousness of injuries.", and "City's Red Light Camera Program is generating revenue".

Comments:
This is a brief 28 page study, the detail data per intersection per month is not included in this report, and the use of undefined partial-year data for the second year post-RLC greatly invalidates all comparisons made to the second year post RLC. In fact they state "We had insufficient data to make a conclusion regarding the 2 year period after implementation", yet they went ahead and made conclusions based on that exact data. Also, the selection of only 6 of the 12 RLC intersections for the detailed injury statistics and analysis is never explained or justified, and it seems to disprove the conclusion that severity of injury crashes is going down. The before-RLC period is average and the after-RLC period is average for this kind of study. There are several mathematical errors in the calculations shown in this report for the data that is supplied. The conclusions assume partial-year data as total year data, which severely harms the validity of the analysis of pre-RLC data against the second year post-RLC data. The report explains the increase in crashes as being a function of increased population and traffic, but those increases over the 3-year data period are relatively very small compared to the increase in crashes. On the financial side, the conclusion that the program is "generating revenue" makes no mention of the true audited net profit from the system, and the numbers they use are only estimates and assume 100% payment of all fees, which is not confirmed in any way. Some of the conclusions are supported by the data that is supplied in this report.

Temple Terrace, FL, USA 2009 RLC Report

Official Title: (no official title)

Author: (no author given)

Summary:
This is a 2009 report on red-light cameras for the City of Temple Terrace, FL, USA that compares the before and after crash statistics of the two RLC intersections in that city. The analysis uses 5 months of pre-RLC crash data compared to 5 months of post-RLC data. The statistics used in this analysis are from the Temple Terrace Police Department which does not specify their Distance-From-Intersection inclusion zone for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This report does not cover injury crashes. The results show that crashes at RLC-equipped intersections have increased over 133%.

Comments:
This is a brief three page report, but the data and statistical analysis are verifiable, the selection of 2 RLC intersections is quite small and only using 5 months of before and after periods weakens the analysis of the data. The report you can download is really just a few sets of data with no analysis included. ABC Action News reviewed an additional 2 months of crash data at the intersections(for a total of 7 months) which showed an 18% increase in crashes since RLCs were installed.

Virginia DOT, VA, USA 2007 RLC Study

Official Title: The Impact of Red Light Cameras (Photo-Red Enforcement) on Crashes in Virginia

Authors: NICHOLAS J. GARBER, Ph.D., P.E., JOHN S. MILLER, Ph.D., P.E., R. ELIZABETH ABEL, SAEED ESLAMBOLCHI, SANTHOSH K. KORUKONDA

Summary:
This is a 2007 study by the Virginia Transportation Research Council on the effects of red-light cameras in several cities in the state of Virginia. This study compares the before and after crash statistics of 28 RLC intersections in that state. The study uses 4 to 36 months of pre-RLC crash data compared to 8 to 80 months of post-RLC data. The statistics used in this analysis are from various municipalities all with different reporting standards but the report does define that they used 150 feet as their Distance-From-Intersection inclusion zone for crashes. This study does use comparison control intersections to help validate the analysis of the data. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The study shows that there was an overall increase in total crashes of 23% and an injury crash increase of 17% after the installation of RLCs at intersections. The study concludes that: "the cameras are associated with a net increase in comprehensive crash costs", and "These results cannot be used to justify the widespread installation of cameras because they are not universally effective. These results also cannot be used to justify the abolition of cameras, as they have had a positive impact at some intersections and in some jurisdictions."

Comments:
This is a very detailed 149 page study, the data and statistical analysis are not standard or thoroughly explained. The selection of 28 RLC intersections is well above average for this kind of study. The defined Distance-From-Intersection inclusion zone for crashes of 150 feet is the same as recommended by the Federal Highway Administration and adds to the consistency and validity of the data. The before and after RLC date periods of as few as 4 months of before RLC data and as few as 8 months of after-

RLC data is less than optimal for this type of analysis and somewhat reduces the validity of this study. The validity of this study would have been improved if some of this short-time-period data had been excluded. This is a very well thought out and executed study with explanations of every element of how the data collection and analysis was conducted. The conclusions are supported by the data.

Washington DC, USA 2005 RLC Report

Official Title: D.C. Red-Light Cameras Fail to Reduce Accidents

Authors: Del Quentin Wilber and Derek Willis

Summary:
This is a 2005 report and article by the Washington Post on red-light cameras for the City of Washington DC, USA that compares the before and after crash statistics of 37 oldest RLC intersections in that city. The analysis uses more than 12 to 36 months of pre-RLC crash data compared to 36 to 60 months of post-RLC data. The statistics used in this analysis are from the Washington DC Police Department which does not specify their Distance-From-Intersection inclusion zone for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The results show that crashes at RLC-equipped intersections have increased 107% and "The increase is the same or worse than at traffic signals without the devices." Also, "The cameras do not appear to be making any difference in preventing injuries or collisions.", as evidenced by the 81% increase in injury accidents. The Washington DC Department of Transportation did not disagree with this analysis and offers no explanation for the trends shown.

Comments:
This is a brief three page article, but the data and statistical analysis are verifiable, the selection of 37 RLC intersections is very large for this kind of report. Using at least 12 months of before-RLC data is adequate and 36-60 months of after-RLC data is much more than most studies use, increasing the usefulness of this report. The report was reviewed by three separate independent experts who all agreed with conclusions. The conclusions are supported by the data supplied.

Notes:
There was also a 5-part series of articles by the Weekly Standard three years before that also comes to the same conclusions about Washington DC's RLC program.

Winnipeg, MB, CAN 2006 RLC Report

Official Title: Photo Enforcement Program Review

Author: Shannon Hunt, CGA, CFE City Auditor, Brian Whiteside, CA•CIA Deputy City Auditor, Bryan Mansky, MBA, CMA, CIA, Audit Manager, Jason Egert, CA•CIA, Senior Auditor

Summary:
This is a 2006 audit report by the Winnipeg Audit Department that compares the crash rate at 12 of the Red-Light camera intersections in the city of Winnipeg, Manitoba, Canada. The analysis has two

separate sets of data, using up to 12 months of pre-RLC crash data compared to up to 24 months of post-RLC data(with another 48 months of post-RLC data available in the MPI update). The statistics used in this analysis are from Manitoba Pubic Insurance(MPI) and the City of Winnipeg, neither of which define their Distance-from-intersection crash inclusion zone. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The MPI data in this report shows a 64% increase in injury crashes into the second year post-RLC as well as a 58% increase in total crashes. The report concludes that "Information gathered from two sources on the number of collisions at monitored intersections is not consistent and would lead to contradictory conclusions." The update confirms this conclusion again, and shows that the MPI(insurance data) shows increases in crashes while the city-supplied data shows decreases in crashes.

Comments:
This is a 65 page audit report and the MPI crash data and statistical analysis are verifiable, the selection of 12 RLC intersection sites is somewhat below average as these studies go. The use of less than 12 months of pre-RLC crash data is less than optimal, while the use of 24 months of post-RLC data is adequate. The conclusions are supported by the data.

Notes:
This report shows what a large discrepancy there can be between police-reported crashes and the real number of crashes at an intersection. There was also a 2010 analysis by the Tom Brodbeck of the Winnipeg Sun that also compares the crash rate at 12 Red-Light camera intersections in the city of Winnipeg. This analysis used upto 12 months of pre-RLC crash data compared to up to 72 months of post-RLC data. The statistics used in this analysis are from Manitoba Pubic Insurance(MPI), and the results show that crashes at RLC-equipped intersections have increased by 18%, and the crash rate was not trending down during the 6 years since RLCs were installed.

Summaries of the Excluded Studies and Reports

Below are the summaries and comments for each of the reports that were excluded from this analysis for one or more reasons, which are explained in the comments. They are listed in alphabetical order by city, state, municipality or organization that conducted the study.

California State Auditor, CA, USA 2002 RLC Report

Official Title: Red Light Camera Programs

Author: ELAINE M. HOWLE, State Auditor

Summary:
This is a 2002 report by the California State Auditor, Bureau of State Audits on the effects of red-light

cameras installed in 7 out of 20 communities in the state of California. This report compares the before and after crash statistics of 72 of the 138 RLC intersections in that state. The report uses 19 to 77 months of pre-RLC crash data compared to 4 to 62 months of post-RLC data. The statistics used in this analysis are from the Statewide Integrated Traffic Records System (SWITRS), produced by the California Highway Patrol (CHP) which defines that they use 200 feet as their Distance-From-Intersection inclusion zone for crashes, although inconsistency in reporting is mentioned as an issue for this data. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This report does not cover injury crashes. The results show that "Although They Have Contributed to a Reduction in Accidents, Operational Weaknesses Exist at the Local Level".

Comments:
This is a detailed 115 page report, the data is selectively chosen, only 7 communities out of the 20 communities that they have data for are used in the analysis(no reason is given for excluding 13 communities from the report), and the report only actually shows data from 6 of the 7 communities that it says are used to generate the results, because that one community apparently had no post-RLC data, which leads to the question of why it was selected for inclusion in this report in the first place. Out of those 6 communities where crash data is actually shown, not all of the RLC intersections data is used(no reason is given for these omissions). All of these selective omissions severely affect the validity of the analysis and the conclusions reached in this report. The selection of 72 RLC intersections is far above average for this kind of report, but the fact that these intersections are only a selective subset of the total data collected negatively impacts this report. The use of crash data at intersections with as few as 4 months of post-RLC data also diminishes the usefulness of this report. The conclusions of this report are somewhat supported by the limited selective data supplied. This report is excluded from our analysis because of the selective exclusion of some of the intersection data from being shown in this report even though it was used in the report.

Notes:
It is important to also mention that all of the data used in this report is over 9 years old, and many changes have taken place to the RLC programs in the state of California, including changing technology as well as the fees for violations being greatly increased. One very interesting fact shown in this report is that the vast majority of RLC violations occurred within 1 second of the light turning red, with all but one community showing more than 70% of violations occurring within 1 second, and 4 out of 7 showing greater than 80%.

Delaware DOT, DE, USA 2007 RLC Study

Official Title: Electronic Red Light Safety Program, After Analyses Summary

Authors: Carolann Wicks, Secretary

Summary:
This is a 2007 study by the Delaware Department of Transportation on the effects of red-light cameras in the state of Delaware. This study compares the before and after crash statistics of 20 RLC intersections in that state. The study uses 36 months of pre-RLC crash data compared to 9 to 12 months of post-RLC data. The statistics used in this analysis are from the Delaware Department of Transportation which does not define what they use as their Distance-From-Intersection inclusion zone

for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This report does not cover injury crashes. The results show that "total intersection crashes decreased, or improved, at 16 of the 20 intersections" over the study period, an overall percentage change is not given. The study concludes that: "The ERLSP(Electronic Red Light Safety Program) has largely been successful."

Comments:
This is a detailed 63 page study, the data and statistical analysis appear inconsistent and selectively chosen, and the raw true total crash data is not shown in the study except in bar-chart form. The selection of 20 RLC intersections is slightly above-average number of intersections for this kind of study. The lack of a defined Distance-From-Intersection inclusion zone for crashes somewhat lowers the value of the statistics. The before and after RLC date periods are not sequential and the post-RLC periods are mostly less than 12 months due to the exclusion of the first 3 months of RLC data "to allow drivers to be acclimated to the presence of red light enforcement equipment", (which is a reason that we have not seen before in other related studies with the exception of the 2002 Oxnard, CA study which only skipped 2 months). This removes up to 25% of the post-RLC data from some of these intersections, decreases the consistency of the data and decreases the validity of any statistical analysis done with this data. Another anomaly is the choice to calculate "Total crashes" as all crash types in some datasets and "angle and rear-end" type crashes only in other datasets, leading to inconsistent analysis and further degrading the results of the study. There are no control intersections used to validate the findings of this study, further degrading the results given. The costs and revenues of the program show that in the most recent year of operation the program(2006) lost money for the state. The conclusions of this study are somewhat supported by the limited selective data supplied. This report is excluded from our analysis because there were no total crash stats supplied.

Federal Highway Administration, USA 2005 RLC Study

Official Title: Safety Evaluation of Red-Light Cameras

Authors: Forrest M. Council, BMI-SG; Bhagwant Persaud, Ryerson University; Kimberly Eccles, BMI-SG; Craig Lyon, Ryerson University; and Michael S. Griffith, Federal Highway Administration.

Summary:
This is a 2005 study by the Federal Highway Administration(FHWA) on the effects of red-light cameras in 132 intersections across seven municipalities in the USA. This study compares the before and after crash statistics of those RLC intersections using the Bayesian statistical analysis method as well as calculating the estimated economic impact of the presence of RLCs at intersections. The crash statistics used in this study use various distances from 20 to 158 feet as their Distance-From-Intersection inclusion zone for crashes. The study uses from 48 to 108 months of pre-RLC crash data compared to 10 to 60 months of post-RLC data. The statistics used in this analysis are from various state, city and county authorities. The study focuses on the total cost of crashes, not the percent of change in crashes like most of the other studies on the subject do, and in fact no total crash percentage statistics are listed in the summary or conclusions anywhere. Pulling from their total rear-end and right-angle crash statistics, there was a 1% decrease in total crashes across this study at RLC-enabled intersections. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The final conclusion reached by the study is: "RLC systems do indeed provide a

modest aggregate crash-cost benefit... The indications of a spillover effect point to a need for a more definitive study of this issue".

Comments:
This is a detailed 98 page study, that uses data collected in differing ways using differing specifications by different jurisdictional entities at various state, county and city levels. There are several mentions of inconsistencies in the data collected, but this is really the largest and most comprehensive multi-state study on the subject that has been released in spite of it's flaws. All of the data used in this study at this point is at least 8 years old, including the economic impact figures that are based on 2001 numbers which have undoubtedly changed in the last 9 years. The lack of any meaningful crash data per jurisdiction being shown, as well as the fact that the municipalities were guaranteed anonymity in the limited reporting of crash data that is shown means that the data is not verifiable. The conclusions are supported by the limited and unverifiable data that is shown. This report is excluded from our analysis because there were no total crash stats supplied, only rear-end and right-angle crash numbers are given. Also, there are serious consistency issues with the way the data was collected across the seven jurisdictions and there are issues because of the anonymity of some of the limited data that is shown.

Notes:
This study has a thorough analysis of other previously released studies on the issue of RLC safety issues, and concludes that "most studies are tainted by methodological difficulties that raise questions about any conclusions from them". Specifically the Oxnard, CA study is criticized for its failure to "separate the specific effects at treatment sites from citywide effects".

Houston, TX, USA 2008 RLC Study

Official Title: Evaluation of the City of Houston Digital Automated Red Light Camera Program

Authors: Robert A. Dahnke, Benjamin C. Stevenson, Robert M. Stein, Timothy Lomax

Summary:
This is a 2008 study by the Rice University Center for Civic Engagement on the effects of red-light cameras in the city of Houston, Texas. This study compares the before and after crash statistics of 70 RLC approaches at 50 intersections in that city. The study uses 24 months of pre-RLC crash data compared to at least 12 months of post-RLC data. This study uses a comparison of monitored approaches, not intersections, for it's crash data and analysis. The statistics used in this analysis are not from a defined source and the report did not define what they used as their Distance-From-Intersection inclusion zone for crashes, although the supporting correspondence suggests that 100 feet was used. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This study does not cover injury crashes. The study concludes that: "The comparison of data between monitored and non-monitored approaches supports the conclusion that red light cameras are mitigating a general, more severe increase in collisions." Another conclusion is: "the absolute number of collisions at camera-monitored approaches is not decreasing".

Comments:
This is a brief 16 page report, the data and statistical analysis are not standard or thoroughly explained. The selection of 50 RLC intersections is large number of intersections for this kind of study. The use of

"monitored approaches" instead of intersections as the analysis metric is not the standard for this kind of study. In fact, only one other related study(San Diego, CA 2002) uses this method, and it is not explained why they chose this non-standard measurement method. The lack of a defined Distance-From-Intersection inclusion zone for crashes somewhat diminishes the conclusions. The before and after RLC date periods are sequential but only 12 months of after-RLC data is less than optimal for this type of analysis. There is also evidence to conclude that this report was possibly written with bias in mind due to influence from officials from the city of Houston, which was paying for the study. The crash data for this same time period in Houston used by this report is also used as a significant portion of the data in the 2008 TxDOT/Texas A&M study which directly contradicts a large sample of the referenced data. Also, data from the Houston Police Department shows that crashes city-wide were decreasing during the time of this study, while this study suggest that crashes have significantly increased. Not all of the conclusions of this study are supported by the data supplied. This report is excluded from our analysis because this study uses crash data per monitored approach instead of per intersection, and there are many inconsistencies in the data compared to external data that are not explained.

Notes:
A few days before the November 2, 2010 election in Houston, Bob Stein and the Rice University Center for Civic Engagement released the results of a poll showing 55% of likely voters in favor of keeping the city's RLCs and only 36% in favor of removing them(the poll had a stated 4.5% margin of error). When the votes were counted on the night of November 2nd, a very different set of results came out: 47% in favor of keeping RLCs and 53% in favor of removing them, a 17% difference on the RLC removal side, which seems to again call into question the methods of Robert Stein and the Center for Civic Engagement if they can be that far off. Because of this vote, the RLCs in Houston were deactivated.

Jefferson Parish, LA, USA 2010 RLC Study

Official Title: Red Light Cameras: Do They Change Driver Behavior and Reduce Accidents?

Authors: Georgia M. Wahl, MD, Tareq Islam, MD, MPH, Bridget Gardner, RN, Alan B. Marr, MD, John P. Hunt, MD, MPH, Norman E. McSwain, MD, Chistopher C. Baker, MD, and Juan Duchesne, MD, FACS, FCCP

Summary:
This is a 2010 study by medical staff from the Tulane University School of Medicine and the Louisiana State University School of Medicine on the effects of the red-light camera system installed at the most crash-prone intersection in the state of Louisiana. This study compares 10 months of before-RLC citation and crash statistics against 10 months of after-RLC citation and crash statistics. The study was done on only one intersection equipped with RLCs. The data used in the study was supplied by the Jefferson Parish Sheriff’s Office, Traffic Division. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The study concludes that: "In this study, use of RLC does not seem to prevent traffic collisions at this intersection."

Comments:
This is a detailed 4-page page study(very small print). The goal of this study was to evaluate the

effectiveness of the RLC system and how well it reduced crashes. The use of only 10 months of pre and post RLC installation is below the average and does compromise the conclusions somewhat. The use of data for only one RLC intersection and no control data further compromises the conclusions. One interesting aspect of this study is that it was conducted by members of the medical profession instead of by traffic planners, political specialists or insurance-backed organizations, which does somewhat add to its credibility. The conclusions are validated by the available data. This report was excluded from our analysis because the full report is not freely available.

Los Angeles, CA, USA 2010 RLC Audit

Official Title: Audit of the Photo Red Light Program

Author: Wendy Greuel, City Controller

Summary:
This is a 2010 audit by the Controller of the City of Los Angeles, California on the effects of red-light cameras in the city of Los Angeles, CA. This report does not compare specific before and after crash statistics, but is does analyze the effectiveness of the city's 32-intersection RLC program that was started 10 years before. There are no significant data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This report does not cover injury crashes. The audit concludes that: "We found that the program cannot conclusively demonstrate that it has reduced traffic collisions, thereby increasing public safety." Another conclusion is: "we noted that the PRLP does not currently generate revenue in excess of costs for the City".

Comments:
This is a detailed 77 page audit. The goal of this audit was to evaluate the program as a whole. The conclusions are validated by the available data. The city lost $1 million in 2009 on their RLC system, they also have no meaningful statistics available as to the effectiveness of the system, with the available data showing significant no increase in safety at the RLC-installed intersections while crashes in the city as a whole went down over the same time period. This report was excluded from our analysis because no verifiable crash data is included in the report.

Oxnard, CA, USA 2002 RLC Study

Official Title: Reductions in Injury Crashes Associated With Red Light Camera Enforcement in Oxnard, California

Authors: Richard A. Retting, MS, and Sergey Y. Kyrychenko, MS

Summary:
This is a 2002 study on red-light cameras in the City of Oxnard, California that compares the before and after crash statistics where there are 11 RLC intersections in that city. The analysis uses at least 29 months of pre-RLC crash data compared to 29 months of post-RLC data. The statistics used in this analysis are from the California Statewide Integrated Traffic Records System (SWITRS) and the Distance-From-Intersection inclusion zone for crashes is not specified. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The data shows that crashes

city-wide decreased 5.4% during the study period after RLCs were installed. Controls for this study are created by using whole-city crash data at three other California cities that are over 100 miles from Oxnard and are considered similar in size to Oxnard. The conclusion arrived upon is: "We estimated that red light camera enforcement would reduce the number of crashes at signalized intersections in Oxnard by 7%".

Comments:
This is a brief 4 page study summary, but the data appears to be valid, the selection of 11 RLC intersections is slightly below average for this kind of study. There is significant pre and post-RLC data, but removing the crash data from the first two months of RLCs being enabled decreases the consistency of the data and decreases the validity of any statistical analysis done with this data. There is no proof that these two months should be excluded, and no data is given on what crashes occurred during these two months to evaluate the validity of excluding this data. Only one other study that we have found on this subject purposely excludes the first months of RLC data like this(Delaware 2007). The use of control cities instead of control intersections in the same city(far removed from the RLC intersections) is also something that is not used in most other studies on this subject, and the failure to "separate the specific effects at treatment sites from citywide effects" in this study is criticized in the FHWA 2005 study on this subject. The lack of raw crash statistical data being cited does not allow for a more open analysis to confirm the conclusions of this study, but the conclusions are supported by the selective data that is provided. This report is excluded from our analysis because the crash statistics are not separated into RLC and non-RLC intersections.

Notes:
This study is also criticized by the 2004 Greensboro Study, the 2004 Raleigh Study and the 2008 USF Analysis(in addition to the FHWA study already mentioned in the Comments). The authors of this study work for the Insurance Institute for Highway Safety(IIHS), an organization sponsored by car insurance companies which make substantial amounts of money on RLC installations due to points being assessed on drivers licenses and higher crash rates, both of which lead to higher insurance premiums, as well as direct investment by some insurance companies in the companies that sell Red Light Camera systems themselves, so they have a very strong vested interest in presenting RLCs in a positive light and cannot be considered a neutral or impartial party on this subject.

Philadelphia, PA, USA 2007 RLC Study

Official Title: Reducing Red Light Running Through Longer Yellow Signal Timing and Red Light Camera Enforcement: Results of a Field Investigation

Authors: Richard A. Retting, Susan A. Ferguson and Charles M. Farmer

Summary:
This is a 2007 study by the Insurance Institute for Highway Safety(IIHS) on red-light cameras in the City of Philadelphia that compares the before and after red light violation statistics where there are 2 RLC intersections in that city. The study also alters the timing of Yellow Light signals during the pre-RLC period. The analysis uses 3 months of pre-RLC crash data compared to 16 months of post-RLC data. The statistics used in this analysis were collected by the IIHS and since there are no crash statistics gathered for this study there is no Distance-From-Intersection inclusion zone for crashes used.

There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. This study does not cover injury crashes. Controls intersections are used for this study by analyzing several periods of video recordings of similar intersections several miles away from the treatment intersections. The conclusions arrived upon are: "Results showed that yellow timing changes reduced red light violations by 36 percent. The addition of red light camera enforcement further reduced red light violations by 96 percent beyond levels achieved by the longer yellow timing".

Comments:
This is a brief 12 page study, and the data appears to be valid, but the selection of 2 RLC intersections is very small for this kind of study. There is very minimal pre-RLC data(only 3 months) that substantially reduces the significance of this study, but the post-RLC data(16 months) is much more adequate. The changing of yellow light timings during the already limited pre-RLC period further compromises the results. The lack of raw crash statistical data being cited significantly reduces the value of this study since stronger compliance with red lights is never proven to equate to safer intersections. The limited conclusions are mostly supported by the data that is provided. This report is excluded from our analysis because there are no crash statistics from the study city included in the report.

Notes:
Philadelphia Weekly researched the crash data for these two RLC intersections and published an article detailing that crashes have increased 12% since the RLCs were installed. The data came directly from the Philadelphia Police Department and was available at the time of this IIHS study, although the authors of this study give no reason why they did not analyze the crash statistics for these intersections. The authors of this study work for the Insurance Institute for Highway Safety(IIHS), an organization sponsored by car insurance companies which make substantial amounts of money on RLC installations due to points being assessed on drivers licenses and higher crash rates, both of which lead to higher insurance premiums, as well as direct investment by some insurance companies in the companies that sell Red Light Camera systems themselves, so they have a very strong vested interest in presenting RLCs in a positive light and cannot be considered a neutral or impartial party on this subject.

San Diego, CA, USA 2002 RLC Study

Official Title: IMPACTS OF THE SAN DIEGO PHOTO RED LIGHT ENFORCEMENT SYSTEM ON TRAFFIC SAFETY

Authors: Jacqueline M. Golob, Seongkil Cho, James P. Curry P.E., Thomas F. Golob

Summary:
This is a 2002 study by PB Farradyne and the Institute of Transportation Studies at the University of California on the effects of red-light cameras in the city of San Diego, California. This study compares the before and after crash statistics at 19 intersections in that city. The study uses at least 39 months of pre-RLC crash data compared to 12-34 months of post-RLC data. This study uses a comparison of monitored approaches, not intersections, for it's crash data and analysis. The statistics used in this analysis were supplied by the City of San Diego's Traffic Engineering Department and the report did not define what they used as their Distance-From-Intersection inclusion zone for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The

study concludes that: "crashes attributable to red light running decreased after implementation to approximately 60 percent of pre-enforcement rates, while rear end crashes increased to approximately 140 percent of pre-implementation levels"

Comments:
This is a brief 18 page report, the data and statistical analysis are not standard or thoroughly explained. The selection of 19 RLC intersections is an average number of intersections for this kind of study. The use of "monitored approaches" instead of intersections as the analysis metric is not the standard for this kind of study. In fact, only one other related study(Houston, TX 2002) uses this method, and it is not explained why they chose this non-standard measurement method. The lack of a defined Distance-From-Intersection inclusion zone for crashes somewhat diminishes the conclusions. The before and after RLC date periods are sequential but several intersections only having 12 months of after-RLC data is less than optimal for this type of analysis. The conclusions of this study are supported by the data supplied, but are less convincing than most of the other studies on the subject. This report is excluded from our analysis because this study uses crash data per monitored approach instead of per intersection.

Texas DOT, TX, USA 2008 RLC Study

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

Author: Troy D. Walden, Ph.D.

Summary:
This is a 2008 study by the Center for Transportation Safety at the Texas Transportation Institute of Texas A&M University on the effects of red-light cameras in the city of Houston, Texas and several other cities in the state of Texas. This study compares the before and after crash statistics of 56 RLC intersections in that state. The study uses 6 to 12 months of pre-RLC crash data compared to up to 12 months of post-RLC data. The statistics used in this analysis are from various municipalities all with different reporting standards and the report did not define what they used as their Distance-From-Intersection inclusion zone for crashes. There are no data or conclusions in this report that suggest a reduction or increase in fatalities due to RLCs. The study concludes that: "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", and "Due to the short time period of analysis, no conclusions may be inferred from the pre or post-analysis with any statistical confidence".

Comments:
This is a 65 page report, the data and statistical analysis are not standard or thoroughly explained. The selection of 56 RLC intersections is large number of intersections for this kind of study. The lack of a defined Distance-From-Intersection inclusion zone for crashes somewhat diminishes the conclusions and consistency of the data. Their method of "annualizing" crash data in effect creates fake data in order to "fill in" the gaps in the data where they have less than 12 months of real crash data. This is something that is not standard in these studies and it greatly compromises this study and its validity. The before and after RLC date periods of 12 or less months of before and after-RLC data is less than

optimal for this type of analysis. No raw crash data is available or referenced in this report. The crash data for this same time period in Houston used by this report for over half of its data set is also used as the crash data in the 2008 Houston Rice University RLC report which directly contradicts a large sample of the referenced data(external link). Not all of the conclusions of this study are supported by the data supplied. This report is excluded from our analysis because this study uses annualized crash data which is made up, not real. Also, the documented inconsistencies in the collection methods of the data and the documented inconsistencies in the data itself are further reasons for exclusion in our analysis.

Notes:
Something else that should be mentioned is the the RLC crash data from the city of Lubbock, TX was specifically omitted from this study even though it fit the stated requirements of this study and the data was available to the author. No reason was given for this omission, and Lubbock is not mentioned anywhere in this study.

USF, FL, USA 2008 RLC Study

Official Title: Red Light Running Cameras: Would Crashes, Injuries and Automobile Insurance Rates Increase If They Are Used in Florida?

Author: Barbara Langland-Orban, Ph.D., MSPH, Etienne E. Pracht, Ph.D., John T. Large, PhD.

Summary:
This is a 2008 study by the University of South Florida on the potential effects of red-light cameras in the state of Florida. This study analyzes several previous studies as well as offering some new possible results of implementing RLC systems in the state of Florida. Some of those estimated effects are increased insurance rates and increased traffic crashes. Also, the study gives reasons why RLC systems are not needed, citing a steady consistent decrease in the crash rate nationwide and the very small percentage of traffic fatalities that are actually caused by red light running. This report is not included in our analysis because no new crash data is included in it.

Comments:
This is a brief 7 page report. There is some new data related specifically to Florida and the unique effects that RLCs might have in that state. The conclusions are supported by the data supplied.

Results

The results of the analysis of the 20 reports and studies are summarized in Figure 1-2 below. The chart shows each study or report, its release date, the organization that performed the study or report, the length of the study or report in months, the distance from intersection crash inclusion zone(radius), the change in crash percentage, the change in injury percentage, the pre and post RLC installation time periods(in months) and the number of RLC intersections included in each study or report.

LOCATION	RELEASE DATE	ORGANIZATION	LENGTH (MONTHS)	RADIUS (FEET)	CRASH CHANGE	INJURY CHANGE	PRE-RLC MONTHS	POST-RLC MONTHS	INTERSE-CTIONS
ONTARIO, CAN	2003	Synetics Transportation Consultants	84	n/a	16%	2%	60	24	19
GREENSBORO, NC, USA	2004	Urban Transit Institute	57	100	40%	n/a	26-35	22-31	18
RALEIGH, NC, USA	2004	North Carolina State University	74	500	-14%	n/a	70-69	4-5	7
PHOENIX, AZ, USA	2005	University of Arizona	57	100	5%	10%	36-39	18-21	11
SCOTTSDALE, AZ, USA	2005	University of Arizona	168	100	-12%	-21%	83-160	8-79	14
WASHINGTON DC, USA	2005	Washington Post	72	n/a	107%	81%	12-36	36-60	37
GARLAND, TX, USA	2006	City of Garland	62	n/a	-25%	-27%	31	31	4
REGINA, SK, CAN	2006	City of Regina	97	n/a	12%	8%	48	48	3
WINNIPEG, MB, CAN	2006	City of Winnipeg	31	n/a	58%	64%	7	24	12
DAVENPORT, IA, USA	2007	Iowa State University	54	82	-20%	n/a	36	12-24	9
MODESTO, CA, USA	2007	City of Modesto	36	n/a	-5%	19%	12	12	4
SEATTLE, WA, USA	2007	City of Seattle	50	n/a	6%	-30%	40	7-10	4
STOCKTON, CA, USA	2007	City of Stockton	36	n/a	10%	-14%	12	12-24	12
VIRGINIA, USA	2007	Virginia Dept. Transportation	84	150	23%	17%	4-36	8-80	28
LUBBOCK, TX, USA	2008	City of Lubbock	36	n/a	52%	-10%	24-30	6	12
COSTA MESA, CA, USA	2009	City of Costa Mesa	66	200	13%	-15%	30	36	2
GRANDE PRAIRIE, AB, CAN	2009	City of Grande Prairie	72	n/a	43%	126%	60	12	7
TEMPLE TERRACE, FL, USA	2009	City of Temple Terrace	10	n/a	133%	n/a	5	5	2
ALBUQUERQUE, NM, USA	2010	University of New Mexico	107	n/a	1%	-26%	57-87	20-50	20
CHICAGO, IL, USA	2010	University of Illinois Chicago	24	150	5%	n/a	12	12	39

Figure 1-2 – Summary table of studies and their crash changes

The majority of the above studies and reports(by a margin of 3 to 1) show an increase in total crashes once red light cameras are installed at an intersection, and a simple majority of studies and reports that measured injury crashes also show an increase in injury crashes once red light cameras are installed at an intersection. The average of the increase in total crashes per-study across the studies is 22%, but when weighing the studies by the number of red-light-camera-installed intersections included, the average total crash increase per intersection is 27%. The average of the increase in injury crashes per-study, across the 15 studies that measured injury crashes, is 12%, but when weighing those injury crash numbers by the number of red-light-camera-installed intersections included, the average injury crash increase per intersection is 21%. There are consistency issues with the collected data, with many of the included studies and reports using different collection methods and standards for reporting and counting crashes as well as very different before and after lengths. Even with these issues, the large increase in crashes and the similar increase in injury crashes shows the very dangerous unintended consequences of using red light camera systems, especially since most municipalities install them in order to increase safety.

On the subject of injury crashes, a few of the studies break these down into different categories of severity and make attempts to put dollar amount costs on different types of injury crashes in an attempt to determine whether there is a monetary benefit to using RLCs. Since the majority of studies in this analysis did not do this, and those that did were not consistent on the categories used or the method of calculating the costs of these injuries, we have not attempted to divide injury crashes by severity in any way in our analysis.

Discussion and Conclusions

Red light running is a problem in some communities, although when compared to other causes of fatalities it is often not even in the top 5 causes of traffic fatalities. For instance, in Florida almost three times as many people die from crashes while riding in the back of a pickup truck compared to those who die because of a red-light runner.

Every study in this analysis that measures violation statistics shows that red light cameras are effective at reducing the number of red light running violations, but as this analysis has also shown, that decrease usually comes with very serious and dangerous side effects that make the overall safety problem worse at an intersection in spite of the reduction in red light running violations.

Another piece of information that should also be considered in this discussion: traffic fatalities have been decreasing at an increasing rate for the last 5 years according to the latest NHTSA statistics released in September 2010. These numbers show more than a 9% drop in fatalities for the last two and a half years, including the first half of 2010, and more modest decreases for the two years before 2008. Since 2005, traffic fatalities have decreased more than 22%. This proves that safety is already improving nationwide with the vast majority of communities not using RLCs.

In response to the conclusion that Red Light Cameras lead to more total crashes and more injury crashes, we have researched some of the less dangerous ways of reducing red light violations which are discussed below.

Alternatives to Using Red Light Cameras

The first alternative to using RLCs is increasing the yellow light signal time beyond the recommended ITE/MUTCD-formula-calculated minimum interval. Several studies(such as Retting 1999, Armey 2001, Howle 2002) show that 70-80% of red light running violations occur within the first second after the signal turning red, leading to the logical conclusion that lengthening the yellow timing should result in less red light violations.

A 2004 Texas Transportation Institute study found that after 1.0 second was added to the yellow signal timing at test intersections, accidents dropped by 35 to 40%.

A 2003 Texas Transportation Institute study found that increasing the yellow light interval by 0.5 to 1.5 seconds decreased red light running by 50%, and that while drivers adjust to the longer yellow light interval, the overall benefit was not undone by this.

A 2001 report by the US House of Representatives shows that intersections in 4 cities where yellow light timings were raised by about 30% saw a decrease in red light violations of at least 73%.

in 2008 the state of Georgia passed a law relating to RLCs that mandated at intersections where RLCs

were to be installed, the ITE/MUTCD formula should be used to determine the optimal yellow signal timing, then one additional second should be added. This law went into effect on January 1, 2009 and the effects were felt from it very quickly. Red light running violations dropped by an average of 72% the first 90 days after the law went into effect in the 8 jurisdictions that immediately complied with the law. These cases in Georgia actually proved that increasing the yellow interval timing was more effective at reducing red light running than the using the RLCs themselves.

In November of 2009, the city of Loma Linda, California(which had RLCs installed for over 4 years at that point) lengthened their yellow light time at their 5 RLC intersections by one additional second and saw a 92% drop in red light violations. In December 2010 the city let their contract with RLC vendor Redflex expire without renewing it as a result.

Aside from increasing the yellow timing, another set of engineering changes conducted by AAA and the City of Detroit were tried and deemed successful in Detroit, MI. Improvements such as enlarging traffic light lenses by 50 percent, re-striping left turn lanes with pavement markings, re-timing the traffic signals, and adding an all-red clearance interval (when you leave both sides red for a second or two while the signals are changing).During the first 27 months of the four demonstration projects, crashes decreased by 47 percent with a 50 percent reduction in injuries.

Issues with Data Analysis in RLC Studies

Throughout our analysis of RLC studies and reports we found many instances of data omitted, hidden or altered which resulted in sometimes significant changes in the results of the studies involved. Most of these issues are explained in the summaries of the studies already detailed in this analysis, but we wanted to highlight some of the issues here to help the people reading this analysis in the future as they read more studies on the subject.

The first issue that we have seen in a few reports are the exclusions of certain data from the crash results. The Albuquerque 2010 study removes all alcohol-related crashes from it's data, which no other study on the subject does, and even though it gives an explanation for why they did this(they would have happened anyway), they gave no data to back up this reason. Even if this number was the same from the before period to the after period, this data still would have reduced the percentage change, and the study would be better able to be compared to the other existing studies.

The 2002 California State Auditor report excludes crash results from some intersections within the cities that it was analyzing without giving any reasons at all, the intersections they detailed in the report are simply indicated as “selected” intersections.

The 2008 Texas DOT study omits an entire city from its study data. Lubbock, TX fits within the parameters for inclusion in the report and that city's crash data was available at the time of the report, but it was excluded without any reason being given. One reason for this may be the 52% increase in crashes after RLCs were installed in that city, which contradicts the conclusions that were reached in the Texas DOT report. Also, the city of Lubbock turned off their RLCs a few months before the Texas DOT report was published.

One example where all crash data was excluded from a study was the 2007 Philadelphia, PA study, which only measured the change in red light violations even though the crash data for those intersections was available before the study was released. No reason is given for not including crash data, and it is especially strange that in the study itself, other studies' crash data is mentioned more than once. Of course an easy explanation for this is that crashes increased 12% during the study period, which contradicts one of the conclusions reached in the study that RLCs can reduce crashes.

The second issue that we have seen is the use of "signaled approaches" as a measurement instead of the much more common red-light intersection method. Only the Houston and San Diego studies use this measurement method exclusively, although a few other studies list some statistics in this way as well. No reason is given for the choice to use this non-standard approach, but the results seen in the Houston study are quite different when using the Texas DOT report from that city from the same time and supposedly using the same data.

The third issue that we have seen is that several of these studies lack control intersections, which gives a perspective of local non-changing intersections to compare the RLC intersections to, and helps to show whether RLCs were effective at improving safety or not. While some studies simply do not have any control intersections, the Oxnard, CA study attempts to use entire cities for its control data, without giving any justification of why this should work, instead of the standard of using control intersections in the same city but removed somewhat geographically from the treatment intersections to minimize any spillover effect.

The fourth issue that we have seen is the use of annualized data, where a data-set may be as small as 6 months and that data will be estimated out to 12 months so that it can be fully compared to a full 12 months of data from another source. The Texas DOT study uses this method extensively, although no reason is given for why they did not just use the "month"(as several other studies have done) as their time unit of choice given that the time frame of their data was so small.

The fifth issue that we have seen is the use of very small time frames for the before or after RLC time periods. Six of the studies that we included in our analysis use at least some post-RLC data that is less than 12 months in length, and two of those use less than 6 months of post-RLC data. Using such a limited time frame greatly decreases the usefulness of the data. Another issue strongly related to this is the fact that several of these studies mention that an update will be released once more data is available, but to date none of those studies have released updates with extended data-sets.

The sixth issue that we have seen are the existence of contradicting sets of data, as has happened in the Chicago and Winnipeg reports included in this analysis, as well as being noted in other municipalities like Salem, Oregon. In all of these examples, a smaller and more limited set of data shows a decrease in crashes at red light camera intersections, but when a larger set of data is used, the results show an increase in crashes at RLC intersections, sometimes these datasets have very large variances in crash totals. The reason for these differences are usually because of a more restrictive crash inclusion zone, or exclusion of subsets of crash data. Related to this are the issues with the data inconsistencies between the Houston 2008 study and the Texas DOT 2008 study(which uses Houston data from the same time period as the majority of its data).

Suggestions for Future Studies

Here are a list of suggestions for gathering data and analyzing data that we would recommend for future RLC studies so that the analysis can be best compared to the existing base of research:

- Use a minimum of 12 months of before and after RLC installation crash data
- Do not put a gap between the before and after time periods, make them sequential
- Use “months” as an analysis time period instead of “years”
- Include all intersection-related crashes in the crash totals data, without excluding any subset of crashes
- Do not use “signaled approaches” as a measurement metric
- Set a Distance-From-Intersection crash inclusion zone, we recommend 150 feet, which is what the FHWA uses
- Gather data from the same number of similar, but geographically removed, control intersections during the same time period and in the same municipality if possible
- Count the injury crashes, and if possible use the KABCO scale for injury severity classification
- Include the actual per-intersection per-month crash data in the report if possible