Final Report

Evaluation of Traffic Engineering Aspects of Photo Monitoring Programs in Virginia

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EVALUATION OF PHOTO MONITORING PROGRAMS IN VIRGINIA

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EVALUATION OF PHOTO MONITORING PROGRAMS IN VIRGINIA

Executive Summary

The purpose of this report is to document the evaluation of photo monitoring of red light running programs in Virginia. Photo monitoring of red light running is the use of cameras to automatically detect and capture vehicles that fail to stop for a red light. In 1995, the Virginia General Assembly authorized the use of photo-red light monitoring to enforce red lights as a demonstration program in ten jurisdictions in the Commonwealth. Currently, six Virginia jurisdictions administer photo-monitoring programs. The specific objectives of the study are to document the current practices of these programs within the Commonwealth, to identify the concerns and related issues surrounding these programs that relate to traffic engineering, to record lessons learned, and to suggest guidelines where appropriate.

The scope of this report is limited to implementation process, signal operations, related safety impacts, and evaluation efforts. Legal, privacy, enforcement, and financial issues are important aspects of photo enforcement, but are beyond the scope of this study and the area of expertise of transportation engineers.

A collaborative study process was initiated by the State Traffic Engineer, based on a recognition that photo-enforcement programs are implemented by the jurisdictions in an isolated fashion and that much could be gained by learning together and from each other. An advisory committee was formed to guide the work of this study. The committee consisted of representatives from all of the ten jurisdictions within the Commonwealth that are authorized to employ photo monitoring, the Federal Highway Administration (FHWA), various divisions and districts within the Virginia Department of Transportation (VDOT) and the Virginia Transportation Research Council (VTRC). The various aspects of the camera enforcement programs that are examined are the implementation, equipment, public awareness and evaluation.

Implementation

The evaluation of implementation strategies indicated that the key to effective implementation of a photo-monitoring program is to follow a well-defined, clear, inclusive, proper process. This process should include representation from transportation and enforcement agencies as well as elected officials and citizens from the jurisdiction. Specific goals need to be defined early in the process. Goals can range from a focus on increasing pedestrian safety to a focus on reducing vehicle crashes. Defining and endorsing a common goal is important to effective implementation. The most critical aspect of the process is the evaluation and selection of sites.

A proper and thorough selection process will increase the effectiveness of the program, will help ensure that the best possible sites are selected and will help in building and maintaining public support. A good process will help eliminate from the selection pool those sites where other countermeasures may be effective in reducing red light running. If sites are selected where other problems prevail, a reduction in red light violations or crashes is not likely to be realized. Automated enforcement of the red light will only work if the intersection is engineered appropriately to encourage good driver behavior first. There are two main criteria typically used to identify an intersection as a candidate for automated photo enforcement: a high violation rate of the red light and a high crash frequency that is linked to violations of the red light.
Additionally, other criteria that can be used for selection and prioritization include the difficulty of enforcement, unsafe conditions of enforcement and concern for pedestrian safety.

Each municipality must determine its own proper process for the selection and evaluation of potential photo red sites that will reflect its own objectives and philosophies. Each jurisdiction’s process should be inclusive, thorough, and consistent and the process should include a comprehensive engineering review of the intersection before photo monitoring is implemented. A general approach is suggested in this report.

As part of this suggested approach, special attention is paid to the timing of the yellow phase because of its critical role in promoting appropriate driver behavior. Traffic engineers must set signal timing appropriate for the local environment, type of signal system and site conditions. Yellow timing should have a clear, consistent approach in each jurisdiction. Based on the ITE recommended practice DOT developed the Traffic Engineering Division Memorandum 306, Calculation of Clearance Intervals, which governs clearance timings for signals operated by VDOT.

*Equipment*

The equipment section of the report describes the basic mechanisms that photo-enforcement systems use to capture red-light running violations, describes the components of the system and the main camera technologies, and summarizes the systems offered by some manufacturers. Each jurisdiction should choose a system based on their objectives, priorities and resources.

*Public Awareness*

A public information campaign is an important aspect of a photo-monitoring program as it builds public support and can be an instrument in reducing violations because it raises awareness to the safety problems associated with red light running. Possible components of a public awareness campaign include media releases, roadway signs—placed at the entrances to the locality and/or at the individual intersections being monitored, web site information, mailings to residents and warning periods during which violators are issued warnings instead of citations during an initial period of time. The purpose and objectives of any automatic enforcement program should also be publicized. By pulling citizens into the problem and the tools for addressing the problem, we invite them to be part of the solution.

*Evaluation*

The goal of the evaluation section of the report is to present a practical approach that jurisdictions can follow in order to evaluate the effectiveness of their photo enforcement programs. The evaluation approach presented highlights good practices, common pitfalls to avoid, and suggestions that jurisdictions may wish to consider when evaluating their photo enforcement programs. An evaluation method should emphasize consistency, objectivity and practicality.

At the first meeting of this statewide advisory committee, it was suggested that the use of automatic enforcement for citing red light violators in Virginia was too new for best practices to be defined. This proved true in the case of technical details of program operation, but not for the process. The suggested process for implementation represents a compilation of lessons learned and is the best practice currently available in Virginia. The overriding belief of the committee
was that each jurisdiction must tailor the implementation and evaluation aspects of a program to their own needs, objectives and the available resources while keeping public safety as the most important goal. This report serves as an informational source and provides some general guidelines needed to achieve that end.

**Introduction**

The use of automated enforcement (AE), using technology to enforce laws, has been increasing in the United States over the past decade. This rise is largely due to advances in technology, the desire to improve safety and the efficiency gained through the use of technology above that of enforcement officers. In the transportation field, AE has applications in enforcing speed limits, toll collections and red light violations. This report focuses only on the use of technology to enforce the law requiring vehicles to stop for a red light and not on any other AE applications.

In 1995, the General Assembly authorized the use of photo-red light monitoring to enforce red lights as a demonstration program in several jurisdictions in the Commonwealth. The full text of the Highway Laws of Virginia § 46.2-833.01 is included in Appendix A. This automated enforcement can detect and cite motorists who enter a signalized intersection during the red phase. Through increased compliance, this photo-enforcement program has the potential to reduce accidents not only at the intersections being monitored, but also because of a “carry-over” effect, at all intersections throughout the jurisdictions using this approach.

Photo enforcement has received a great deal of attention from elected officials, media, the public and proponents and opponents alike. Those agencies involved with photo enforcement have by extension, received much notice. In Virginia, those agencies include local governments where such cameras have been permitted by acts of the General Assembly, their agencies, the affiliated private sector companies who provide equipment, software, or services for photo enforcement and VDOT. Advocates argue that these cameras can improve safety at signalized intersections by reducing the number of motorists who will violate a red light. Critics argue that the main intention of these programs is to increase revenue for agencies (who operate the signals) and firms (who provide the camera equipment), that the programs are not effective in improving safety, and that this is a violation of personal privacy rights.

VDOT resolved to study photo-monitoring programs in Virginia in order to document current practices and issues and to provide the information needed to improve practices. A statewide advisory committee was formed to guide the work of this study. This collaborative process was initiated by the State Traffic Engineer, based on a recognition that photo enforcement programs are implemented by the jurisdictions in an isolated fashion and that much could be gained by learning together and from each other. While some elements of red light photo enforcement do not fall under VDOT ownership (for example, enforcement), others do, such as signal timing and intersection safety. Therefore VDOT is committed to study and address those issues that are appropriate.

This report documents the work and the recommendations reached by the Photo Enforcement Advisory Committee. The body of this report is divided into four sections (implementation, equipment, public awareness and evaluation) that each describes the tasks undertaken by the
committee: (1) the documentation of existing programs in Virginia, (2) the identification of
issues, and (3) the suggested approach to that section.

Purpose and Scope

The purpose of this study is to evaluate photo enforcement of red light running programs in the
Commonwealth of Virginia. The specific objectives of the study are to document the current
practices of these programs in Virginia, to identify the concerns and related issues surrounding
these programs, to record lessons learned and to recommend guidelines where appropriate. The
various aspects of the camera enforcement programs that will be examined are the
implementation, equipment, public awareness and evaluation.

The scope of this report is limited to implementation process, signal operations and related safety
impacts and evaluation efforts. Legal, privacy, enforcement, and financial issues are important
aspects of photo enforcement but beyond the scope of this document.

The program implementation section includes a description of the process that each jurisdiction
used to implement photo red light monitoring, which includes the decision process and the
intersection selection process. The issues that arose during this time are documented with some
lessons learned. Guidelines are suggested on how to implement a program while avoiding some
identified difficulties.

In the equipment section, the most common types of equipment are described. The study looks at
the various systems that are currently being used in Virginia and documents the features of each
type of system as described in available literature and as reported from those who operate and
administer the programs in Virginia.

The various methods used to inform the public about the red light cameras will be described in
an overview of public awareness campaigns. Lessons learned from the jurisdictions will be
recorded and some recommendations given.

The purpose of the evaluation section is to develop a practical approach that jurisdictions can
follow in order to evaluate the effectiveness of their photo enforcement programs based on their
defined objectives. This section highlights good practices, common pitfalls to avoid, and
suggestions that jurisdictions might wish to consider when evaluating their photo enforcement
programs.

Background

Running red lights is a significant problem leading to many injuries and fatalities in the United
States. Nationwide, fatal crashes at traffic signals increased 18 percent during 1992-1998, an
increase of more than three times the rate for all other fatal crashes during the same time period.\(^1\)
Each year more than 800 people die and an estimated 200,000 are injured in crashes that involve
red light running. Total deaths in red light running crashes were almost 6,000 between 1992-
1998. More than half of these fatalities were pedestrians or occupants in vehicles other than that
of the red light violator. During the same period (1992-1998), approximately 1,500,000 people
were injured in such crashes in the U.S.\(^2\)
Each year, more than 1,800,000 intersection crashes occur. In 1998, there were 89,000 crashes attributed to red light running, and in 1999, this number rose to 92,000. Occupant injuries occurred in 45 percent of red light running crashes, compared to 30 percent for other urban crash types. In one study of four urban areas conducted by the Insurance Institute for Highway Safety (IIHS), it was estimated that drivers violating a traffic control device caused 22 percent of crashes.

The IIHS conducted a study to determine the characteristics of drivers who run red lights. The study reported that the red light violators as a group were younger, less likely to wear seat belts, had poorer driving records, and drove smaller and older vehicles than drivers who did not run red lights.

As of the time of writing this report, the following six Virginia jurisdictions have implemented red light monitoring programs: Cities of Alexandria, Fairfax and Falls Church, Town of Vienna, and the Counties of Arlington and Fairfax. These jurisdictions have chosen different approaches in the implementation of photo enforcement. There are differences in the type of equipment used for collecting the data, the mobility of the systems, when and how many pictures are taken, signal timing issues, placement or warning signs and special features. Another variance lies in the variety of criteria that are applied for selecting intersections to be monitored. Selection is made using some combination of the following: violation rates, accident reports, police and citizen input, intersection configuration, difficulty of enforcement. The jurisdictions made various, in most cases, extensive efforts to inform and involve the public and raise awareness to the problem of red light running and the enforcement program being implemented.

Within the Commonwealth, many cities and two counties own and operate their own traffic signals; the remainder are owned and operated by VDOT. In those localities that own the signals, all aspects of photo-enforcement are handled from within the jurisdiction. For those localities where VDOT owns the signals, a state permit is required. The local jurisdiction is responsible for all aspects of the program; however, VDOT sets the signal timings. This necessitates additional coordination and communication.

Why photo enforcement?

Most photo enforcement programs cite their main objective as an increase in safety at signalized intersections. When a driver runs a red light, the violator risks the life, health and property of him/herself, other drivers and occupants of cars, and pedestrians in or near the intersection. Photo monitoring is a cost effective method compared with traditional law enforcement, provides continuous monitoring of violations in the intersection, and does not put law enforcement officers at risk to follow a violator through a red light to write a citation.

The process of identifying a driver running a red light and enforcing the violation is time consuming using traditional police methods. Enforcement is challenging because the officer must have a direct view of the traffic signal to be able to decide if the signal was red before the vehicle entered the intersection. In Florida, courts require an officer to view the same face of the traffic signal as the violator. Photo monitoring offers an objective method of observing the intersection, signals and vehicles with the ability to overlay time of day, date and time into red signal phase.
Photo monitoring is also available at all hours of the day and night and may cause a “carry-over” effect to other intersections because drivers are aware of the monitoring.

Interest in (but not necessarily agreement with) photo enforcement exists in the U.S. and abroad, and extends to other areas beyond red lights; for example, a Federal Railroad Administration proposed rule suggested photo enforcement as one of several techniques to reduce violations at at-grade rail crossings. A quick literature review based on electronically searchable abstracts suggests three findings:

- **First**, studies agree that a myriad of institutional issues (e.g., privacy concerns) are associated with red light cameras.
- **Second**, studies suggest red light cameras reduce violations, although it is not yet clear if all of these studies controlled for other factors that could affect the number of violations, such as a change in volumes.
- **Third**, studies suggest that red light cameras reduce the number of crashes, although there is not agreement as to the extent of crashes eliminated by red light running.

Two of the most noted opposing positions are that cameras are an invasion of personal privacy and that the programs are implemented not to improve safety, but to make money for the jurisdiction and the contractor. However, as earlier noted, these types of issues are outside of the scope of this study.

**International programs**

Photo-monitoring programs have been in use since 1968 in Europe and are currently installed in over 45 countries throughout Europe and in Australia, Canada, Hong Kong, Malaysia, Singapore and South Africa.

In Canada, the City of Winnipeg has a pilot program using one intersection. The installation is too recent for useful data. Recently introduced legislation would allow the full implementation of 12 installations monitoring both red light running and speed violations in early 2002.

A 1995 FHWA scanning tour reports that in Australia, which has implemented red light cameras since 1979, total reported intersection crashes have been reduced by 6.7 percent, with higher reductions for specific crash types (e.g., rear end accidents reduced by 30.8 percent). The same report quotes a 1994 Monash University Accident Research Centre literature review indicating red light cameras could reduce crashes by 35 to 60 percent. Australia’s experience with red light cameras is further suggested in a 1988 report indicating cameras reduced right angle accidents and accident casualties.
**Domestic programs**

In the United States, the first photo-monitoring program began in New York City in 1985. Programs in Howard County (Maryland) and Polk County (Florida) suggested decreases in the number of crashes (8 percent and 26 percent, respectively) but the authors caution that these results are preliminary and that additional data are needed to evaluate the programs. The Polk County program has since been discontinued because it was a demonstration project and no legislation has yet been enacted to enable citations to be sent to violators. The IIHS reports that Oxnard, California saw crashes reduced by 7 percent (and injury crashes reduced by 29 percent) after the installation of red light cameras.

Photo-monitoring cameras are now in use in Arizona, California, Colorado, Delaware, District of Columbia, Hawaii, Maryland, New York (City only), North Carolina, Ohio, Oregon, South Carolina, Tennessee and Washington. The following briefly describes photo-monitoring implementations in these jurisdictions. Photo monitoring in the Commonwealth of Virginia is summarized separately.

**Arizona**

Six cities in Arizona (Mesa, Tempe, Phoenix, Chandler, Scottsdale and Paradise Valley) currently have photo-monitoring systems. All systems are administered by local police departments and were installed by photo-monitoring vendors. No federal funds were used to install the cameras. Three jurisdictions use digital cameras and three use wet film cameras.

Scottsdale and Paradise Valley compared accident statistics before and after implementation. In Scottsdale, an initial decrease was followed by an increase due to diverted highway traffic through monitored intersections. Paradise Valley reported significant reduced severity and number of violations issued, with an increase in rear-end collisions. An independent study was done in 1999 for the City of Mesa that reported “there was a clear decline in the crash rate for the study intersections in the two years following the implementation of photo radar speed and red light camera technologies. Further, there has also been a reduction in injury accidents and fatalities.”

**California**

California has the greatest number and variety of photo monitoring programs. Jurisdictions using photo monitoring include Cupertino, Fresno, Long Beach, Los Angeles City and County, Sacramento City and County, and San Francisco for a total of 23 local programs in the state. All jurisdictions implemented the program with a 30-day warning period before issuing citations. California also has the highest fine for running a red light with a statewide fee of $271 and 1 demerit point for the driver. The state law requires a clear photograph of the driver for a citation to be issued. The two most studied implementations are Oxnard and San Diego with a pilot study in San Francisco.

In Oxnard, where the photo-monitoring program has been active since 1996, the red light violation rate was reduced approximately 42 percent several months after the program began. Increases in driver compliance with red lights was not limited to the monitored intersections but applied to non-monitored intersections as
well. In a later study on the program’s effect on crashes, over a period of 29 months, crashes at signalized intersections were reduced by seven percent and injury crashes were reduced by 29 percent as a result of red light camera enforcement. Specifically, right-angle collisions were reduced by 32 percent and right-angle crashes involving injuries were reduced 68 percent. There was no significant effect on rear-end crashes.

San Diego’s program was suspended in mid 2001 due to a pending court case. The judge ruled in September 2001 that the evidence of the cameras was suspect because the private company that installed the system was paid on a per-violation basis. The City refunded almost 300 citations. The case was related to several implementation factors: time of yellow phase, placement of loops and selection of intersections for photo monitoring. Although San Diego police reviewed the violation before the private company issued a citation, the judge ruled that the private company was actually in charge of the program.

The results of the two-year pilot study in the City and County of San Francisco indicated a 42 percent reduction in red light violations at photo-monitored intersections. Throughout the City, collisions caused by red light running have decreased significantly. San Francisco’s experience differs from other jurisdictions in the collaborative approach between City/County agencies and the extensive public awareness campaign developed by the SF Department of Public Safety and sponsored by the FHWA.

**Colorado**

Photo enforcement programs are in place in Boulder, Denver and Fort Collins. The City of Boulder began using photo enforcement in July 1998 with four intersections and in September 2001 expanded the photo red light program to include speed limit enforcement using the same equipment. The City will also add two more intersections to the program. During a 32-month period, red light violations decreased from a daily average of 69 in 1998 to 44 in 2001, a 36 percent reduction. The number of accidents for the monitored intersections was an annual average of 11.3 in 1998 reduced to 4.9 in 2001, a 57 percent reduction. Public information activities include City entrance and intersection signage, City web site, and releases to TV and other media.

**Delaware**

Wilmington is the first jurisdiction in Delaware to use cameras to enforce red light running violations. The system became operational in July 2001 with 10 digital cameras. The City maintained the yellow phase time of three to four seconds on those signals. The goal of the program is to reduce red light violations and enforce safety. The City Council raised the fine for running a red light from $50 to $75 in August 2001. The program is too recent for meaningful data. Additional programs are being considered in Seaford and Newark.

**District of Columbia**

The District’s photo enforcement program began in August 1999 with cameras at two intersections. The program has grown to include 39 cameras at high-risk intersections within the District. The intersections were selected by the Metropolitan Police Department and the program was implemented with no
taxpayer money. No warning signs were posted initially. The public became aware of the program through the media. Signs have now been posted throughout the District by the vendor. The number of motorists running red lights dropped by 61 percent—the equivalent of 15,285 fewer violations each month. The police have recently expanded the program to include speed violations triggered by a radar beam and captured by cameras in police cruisers. An initial month long grace period ended in August 2001 and speeders are now issued citations.

**Hawaii**

Red light photo enforcement began in December 2001 in ten intersections in Oahu in a three-year demonstration project. In the past five years, 73 people died at Hawaii intersections when a driver ran a red light; 266 people were killed and more than 12,500 injured in speeding crashes since 1991. The program includes vendor installation of cameras at intersections selected due to high violation and crash data. The implementation includes a two-week warning period before violators are required to pay the $77 fine. Signs will identify the camera-equipped intersections. No federal funds will be used to support the demonstration project. If the program is judged successful at reducing violations and crashes, the program will expand to the Neighbor Islands. The State is also using photo laser technology in unmarked police vans to cite speeders, again only on Oahu.

**Maryland**

The State of Maryland has a large photo enforcement program in 6 counties and 13 cities. Each program is controlled by its locality. The first program started in February 1998 in Howard County and this implementation has been the most studied. Local jurisdictions conducted engineering studies and improved traffic engineering at intersections prior to installing the cameras. Results of the photo enforcement program show significant reduction in violations and collisions at monitored intersections—including a 56 percent collision reduction at one intersection.

The Howard County program began with a pilot in 1996 and 1997 using FHWA funding for camera leasing and public awareness. Selecting the sites for photo monitoring involved many details. Selection began with review of accident data with an emphasis on angle accidents. Those selected intersection plans were reviewed, followed by field review and a special traffic counter for vehicles crossing during the red phase only. The traffic counter incorporated the .3-second delay and vehicle entering speed of greater than 20 mph that the camera system used. Intersections with 30 or more violations per day were chosen for photo monitoring. The partnership between Howard County police and traffic engineering in implementing the program is a model for other jurisdictions. The County used an extensive public relations campaign to make drivers aware of the danger of running red lights and the photo monitoring system. Signs are posted at main entrances to the County warning of photo monitoring at intersections. No signs are posted at approaches to the monitored intersections.

In 1998, Howard County was the first installation in the U.S. to use digital cameras. Some cameras still used 35 mm wet film because the digital cameras were in a test period. Digital cameras proved accurate and required less
maintenance because the film did not need to be retrieved. During calendar year 1998, violation rates at the monitored signals were reduced an average of 48 percent and 13,711 citations were issued. Collisions were reduced at these signals by an average rate of 23 percent.26

**New York**

New York City (NYC) is the only jurisdiction using photo monitoring in the State. The City began investigating photo monitoring for red light running in 1983 and invited three vendors to install demonstration cameras. By March 1989, the City DOT was able to issue a Request for Information (RFI) and received detailed technical information from ten vendors. Using that information, NYC issued an RFP in July 1989 and received six proposals. Due to the fiscal constraints on the City, no contract was awarded although each respondent received an acknowledgement and announcement of which company would have won the contract.

The vendor responded with an offer to install the system at no cost to the City and receive a portion of the citations as payment. After months of negotiations, a contract for 20 cameras was agreed upon with the vendor. In 1991, the traffic engineers began testing of hardware and site selection. After testing, traffic engineers developed a standard installation of two loops with the loop location within three inches of the crosswalk or stop bar. Site selection was determined by accident data for right angle collisions and police recommendation. The cameras were also proportionally distributed by population density over the five boroughs. NYC DOT also increased yellow timing on some subject intersections and the violations were reduced. No cameras were installed at those intersections.27

To avoid a privacy issue, NYC DOT decided on rear view photos and citation of the registered owner of the vehicle. Once the cameras were installed in 1993, the DOT began fine tuning the process. Problems included glare in license photos, a distance of sometimes four lanes between camera and violator, and double-parked vehicles blocking camera views. DOT changed the camera installation to a mast arm 16 feet in the air and 8 feet out from the curb.28 Slave flash units are used to reduce glare in photos but this is still a problem during rain at night.

Today, the demonstration program has been extended to 2005 and an additional 30 cameras have been installed throughout the City bringing the total to 50. The DOT is currently seeking action from the State Legislature to make the program permanent and increase the number of cameras to 100. The fine for running a red light is currently $50. Local studies at the monitored intersections show that violations have been reduced by 40 percent.29 A comparison of the size of the NYC program compared to other major cities shows that New York has far fewer red light cameras than other cities with programs with the exception of Los Angeles whose program is relatively recent.30

**North Carolina**

In 1998, Charlotte was the first city to install red light monitoring cameras and had 28 wet film technology cameras operational as of early 2001. Thirteen jurisdictions have legislative approval to install photo-monitoring systems; in
early 2001, six communities—Charlotte, Wilmington, Fayetteville, Greensboro, High Point and Matthews—have their systems operational. The statewide program is called SafeLight. Three of the implementations use wet film technology and three use digital film technology. The remaining jurisdictions have uncertain timetables for implementation pending issues with vendors and proposals.31

Intersections were selected for monitoring in different ways. Charlotte used crash and violation data and police recommendations. Wilmington selected intersections with high overall crashes and angle accidents and tapped into the experience of traffic engineers and police. Fayetteville made selections based on police expertise and high crash and violation statistics. The North Carolina Department of Transportation (NCDOT) added to the list of possible intersections and the vendor filmed each candidate intersection for eight hours. Only intersections with greater than 25 violations per day were selected.32 Greensboro supplied the vendor with a pool of 80 intersections and associated accident data, traffic volumes and progression data. The vendor conducted a field investigation and made recommendations. High Point chose intersections based on accident locations, an earlier police study, a vendor study and review by traffic engineers. The vendor was asked to select 10 intersections from 30 possible intersections identified by the City.

The SafeLight implementation in Charlotte has been the most thoroughly studied. Data as from August 1998 to December 1999 are: (1) citywide increase in crash totals of 5.69 percent, (2) crashes in SafeLight intersections decreased 9.14 percent, (3) crashes on camera approaches in SafeLight intersections decreased 27.11 percent, (4) red light running crashes at SafeLight intersections decreased 19.3 percent, (5) crash severity per crash decreased 27.14 percent at SafeLight intersections, and (6) at eight studied SafeLight intersections, red light running violations decreased 93 percent.33

Ohio
Use of photo enforcement is prohibited in Ohio, but incorporated municipalities can pass local traffic laws. The City of Toledo enacted an ordinance that permits police to use photo enforcement cameras and a $75 fine for a violation. Prior to installation of the system, four or five police officers teamed up on problem intersections with one officer to observe violations and the other officers waiting down the street to stop and cite violators.34 The program is installed at 10 intersections, one of which is the second most dangerous in the state according to a State Farm Insurance press release.35 The City of Toledo Police Department selected the intersections to be monitored based on high numbers of crashes. No engineering studies were done prior to implementation. The program began in January 2001 and included a 30-day warning period before citations were issued. The vendor installed the camera systems and collects a percentage of the fines.36

Oregon
Beaverton is one of two jurisdictions in Oregon to use photo enforcement for red light running violations. Oregon first authorized red light running citations based on photo enforcement in 1999 for six cities.37 The program began on January 13,
2001 with active cameras at one intersection. The program includes a 10-day warning period during which violators receive a warning letter. Four additional intersections have been added since then. The intersections chosen were identified by the City as having substantial problems with red light violations.

Portland’s program is beginning with three cameras installed in September 2001 and two scheduled for January 2002. The first three cameras went live on November 1\textsuperscript{st} after a two-week warning period. The City did traffic engineering studies on all potential intersections and implemented traffic solutions prior to installing cameras. The vendor filmed intersections for 18 hours for police to review the violations and traffic flow.\textsuperscript{38} The monitored intersections were chosen by collision rates, fatalities and degree of difficulty to enforce a violation.\textsuperscript{39}

Oregon state traffic law requires a motorist to stop on yellow if safe to do so. The first photo is taken prior to the stop bar at the edge of the crosswalk; the second photo is taken 20-30 feet into the intersection. The yellow times of all signals are adequate with no decrease in yellow phase in the last 15 years. The implementation also includes a one second all red phase. The police informed TV, radio, newspapers and neighborhood associations about the new program. The City posted signs on all main entries into Portland and on all approaches to monitored intersections warning that “speed and red lights photo enforced.” Early results show a dramatic reduction of as much as 75 percent in violations at monitored approaches.\textsuperscript{40}

**South Carolina**

The City of Charleston installed cameras at three intersections during 1996 to 1998. The units were digital cameras using telecommunications lines to transfer images to the City. During the demonstration period, the City became uncomfortable with using the cameras for enforcement following research and community response. The images have never been used for enforcement and records of the images are not kept. The systems are still functional but there is no legislation in South Carolina allowing cameras to be used for enforcement.\textsuperscript{41}

**Tennessee**

The City of Germantown, a suburb of Memphis, is the first jurisdiction in Tennessee to plan to install photo enforcement for red light running. The City plans to install a video-based system with electronic transmission to the police department at four approaches in two intersections.\textsuperscript{42} Germantown has been researching red light photo enforcement technology and law for over a year and will install the system in early 2002.\textsuperscript{43}
Washington  

The City of Lakewood was selected by the Washington Traffic Safety Commission to perform two pilot projects on photo enforcement. In May 2001, the City began photo enforcement of speed limits in school zones throughout the community. On July 1, 2001, photo enforcement of red light running began at two Lakewood intersections. The vehicle is photographed from the rear and the citation is mailed to the registered owner of the vehicle.44

The citation is issued only for drivers who enter the intersection after the signal turns red. At one of the intersections, the yellow phase is 4 seconds and 3.5 seconds at the other. No changes have been made to the yellow phase prior to installing the system. The yellow light duration is based on State and County standards. “Because the equipment is speed sensitive, vehicles that stop on a red signal and then make a right turn will not receive a citation.” 45 The two intersections that were chosen for photo enforcement “have some of the highest numbers of red signal violations in Lakewood.” 46

The fine for running a red light is $86, of which a portion goes to the state, a flat fee of $30 to the vendor, and a portion to administrative costs and the City for Court costs. The program, partially funded by a grant from the Federal Hazard Elimination System Program and fines from citations,47 is expected to break even according to the Public Works Director.48 The program was implemented with a one-week warning period during which warning tickets were issued. In the first week, Lakewood sent out 454 warning tickets.49

The pilot project was to run through September 2001 but has been extended until January 200350 by state lawmakers and additional jurisdictions (Seattle, Spokane and Vancouver) have been added to the pilot. Seattle plans to begin photo monitoring in spring 2002 using leased cameras that the City will operate and maintain.51

Commonwealth of Virginia programs

Pilot programs were authorized in the following ten cities and counties:

- Cities of Virginia Beach, Richmond, Alexandria, Fairfax City, Falls Church and Herndon, and the Town of Vienna
- Counties of Fairfax, Loudoun and Arlington

The jurisdictions that have implemented photo-enforcement have gone about it in a number of ways. There are differences in the type of equipment used for collecting the data, the mobility of the systems, when and how many pictures are taken, signal timing issues, placement or warning signs and special features. Another inconsistency lies in the variety of criteria that are applied for selecting intersections to be monitored. Selection is made using some combination of the following: Accident reports, police and citizen input, intersection configuration, difficulty of enforcement.
STUDY ADVISORY COMMITTEE

As this issue has statewide implications, it was important to include representatives from throughout the Commonwealth and to involve all the jurisdictions that are authorized under state law to implement photo monitoring. A wide variety of participation was needed to assure a comprehensive evaluation and to gain valuable input so that the best possible product would be provided. Ilona Kastenhofer, State Traffic Engineer, chairs the committee and the study manager is Mena Lockwood, Traffic Engineering Division. Diane Bowden Beverly, Traffic Engineering Division, and Mark Hagan, Northern Virginia District, have also made significant written contributions to the report. The following is a complete list of the committee members and the agencies they represent:

**Photo-Monitoring Evaluation Advisory Committee**

<table>
<thead>
<tr>
<th>Name</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark Canoyer</td>
<td>Alexandria Police Department</td>
</tr>
<tr>
<td>Terry Bellamy</td>
<td>Arlington County – Traffic Engineering</td>
</tr>
<tr>
<td>Vanloan Nguyen</td>
<td>City Richmond – Traffic</td>
</tr>
<tr>
<td>Kevin Bowser</td>
<td>Fairfax City Police Department</td>
</tr>
<tr>
<td>Bruce Taylor</td>
<td>Fairfax County Department of Transportation</td>
</tr>
<tr>
<td>Young Ho Chang</td>
<td>Fairfax County Department of Transportation</td>
</tr>
<tr>
<td>Chief Robert Murray</td>
<td>Falls Church Police Department</td>
</tr>
<tr>
<td>Becky Crowe</td>
<td>Federal Highway Administration</td>
</tr>
<tr>
<td>Terrie Laycock</td>
<td>Loudoun County Administration</td>
</tr>
<tr>
<td>John Patton, Mjr.</td>
<td>Loudoun County Sheriff’s Office</td>
</tr>
<tr>
<td>Lt. Robert A. Gray</td>
<td>Richmond Police Department</td>
</tr>
<tr>
<td>Ramin Sabet</td>
<td>Town of Herndon-Engineering</td>
</tr>
<tr>
<td>Chief Bob Carlisle</td>
<td>Town of Vienna Police</td>
</tr>
<tr>
<td>John Cheyne</td>
<td>Town of Vienna Police</td>
</tr>
<tr>
<td>K. Todd Morrison</td>
<td>VDOT – Hampton Roads</td>
</tr>
<tr>
<td>Loren Epton</td>
<td>VDOT – NOVA District</td>
</tr>
<tr>
<td>Mark Hagan</td>
<td>VDOT – NOVA District</td>
</tr>
<tr>
<td>Frank Dorman</td>
<td>VDOT – Public Relations, Central Office</td>
</tr>
<tr>
<td>M. D. Cassidy</td>
<td>VDOT – Richmond District</td>
</tr>
<tr>
<td>Travis Bridewell</td>
<td>VDOT – Richmond District</td>
</tr>
<tr>
<td>Robert Perdue</td>
<td>VDOT – Salem District</td>
</tr>
<tr>
<td>Ilona Kastenhofer</td>
<td>VDOT – Traffic Engineering, Central Office</td>
</tr>
<tr>
<td>Mena Lockwood</td>
<td>VDOT – Traffic Engineering, Central Office</td>
</tr>
<tr>
<td>Steve Brich</td>
<td>VDOT – Traffic Engineering, Central Office</td>
</tr>
<tr>
<td>Cheryl Reints</td>
<td>VDOT, Hampton Roads District</td>
</tr>
<tr>
<td>Scott Roughton</td>
<td>Virginia Beach Police Department</td>
</tr>
<tr>
<td>Sgt. S. D. Kurrle</td>
<td>Virginia Beach Police Department</td>
</tr>
<tr>
<td>John Miller</td>
<td>Virginia Transportation Research Council</td>
</tr>
<tr>
<td>Bill Knost</td>
<td>Fairfax County Police Department</td>
</tr>
</tbody>
</table>
Subcommittee members

At the first committee meeting, these members were asked to participate in the development of the report by working on a subcommittee. The three subcommittees formed were: Implementation and Public Awareness, Equipment, and the Evaluation. These subcommittees were asked to document the current practices within the state within their area through means of a survey, to identify some of the issues and concerns that had arisen for the agencies involved and to use the lessons learned to develop some general guidelines and suggested approaches. The sub-committee chairs provided the substance of the material for the report. However, the final report was edited by the study manager based on discussions at committee meetings, and written and verbal comments received from committee members. The report reflects the majority opinions of the committee.

The subcommittees were comprised as follows:

**Implementation and Public Awareness Subcommittee:**
Mena Lockwood, Chair
Travis Bridewell
Mark Canoyer
Bob Carlisle / John Cheyne
Ho Chang
Becky Crowe
Frank Dorman
Loren Epton
Vanloan Nguyen
John Patton
Cheryl Reints
Ramin Sabet
Bruce Taylor

**Equipment Subcommittee:**
Mark Hagan, Chair
Terry Bellamy
MD (Spike) Cassidy
Mena Lockwood
Todd Morrison
Robert Perdue
Bruce Taylor

**Evaluation Subcommittee:**
John Miller, Chair
Terry Bellamy
Ho Chang
Terrie Laycock
Mena Lockwood
Vanloan Nyguen
Bruce Taylor
IMPLEMENTATION

Existing Programs

There are currently six jurisdictions within Virginia that have a photo red light running program. There are many similarities in the way that these systems were implemented. In all of the six jurisdictions, the governing body was required to approve the system. Both transportation and law enforcement officials were involved in the evaluation of options and decision to use photo-enforcement. The basic objective of all six programs was to improve intersection safety through increased compliance with traffic laws. The site selection process varied among the jurisdictions, but the evaluation of possible locations included a review of many of the same items, such as accident data, the number of red light violations, and input from citizens, police personnel, and other agencies. Localities also included a field review to ensure that the intersection was a suitable location for camera enforcement.

Alexandria

The program was initiated in November 1997 using three sites and one camera. The City Council was largely responsible for having the photo-monitoring system implemented. After the light turns red, photos are taken of the rear of the vehicle before it enters the intersection and after it is in the intersection. There is a 0.3 second delay after the light turns red before the first photo is taken. Signal timing did not receive a great deal of attention in the context of the photo red monitoring program before the program was implemented. However, at two of the three intersections, factors related to the signal timings appear to have had a significant impact on the violation rate. Current policy is for a 4 second yellow phase at a 35 mph intersection and 3 seconds at a 25 mph intersection.

The objective of the program is to reduce red light violations at the three subject intersections. The sites were selected with input from the Police Department, the City Department of Transportation, and City management. The sites were approved by the City Council. No formal evaluation of the program has been done.

Arlington County

The program was implemented in 1999 with a pilot project in one intersection. The background begins in 1989 when the Board of Directors of the Metropolitan Washington Council of Governments passed a resolution in favor of photo enforcement. In 1990, the Arlington County Police Department sent an endorsement to the County Manager to recommend using the technology in the County. In 1991, legislation was introduced in the Virginia General Assembly to permit the use of photo enforcement in Arlington County. In 1992, the Virginia Transportation Research Council conducted a photo enforcement pilot project on the Capital Beltway. The legislation to permit photo monitoring passed and the County Board of Supervisors authorized the program in Arlington.

The current program includes four 35mm, wet-film cameras and seven signals with housings for cameras. The implementation uses one camera and a flash facing the signal and positioned to capture the rear license plate in the intersection. Two pictures are taken: (1) the rear of the
vehicle before it enters the intersection with the signal showing the red light, and (2) the rear of
the vehicle after it is in the intersection with the red signal. The metallic loop detectors are placed
prior to the solid white stop lines. There is a 0.2 second lag time from the time the signal turns
red to when a photograph is taken.

Sites were selected using accident and violation data, and suggestions from citizens, civic
associations and police. The data used to select intersections included address, traffic volume,
pedestrian numbers, accident history, sight distances, crossing distances, and roadway lighting.
Sites were videotaped to validate the violation problem prior to installation.

The objective of the program is to address citizens’ concerns about vehicles speeding through
intersections with high pedestrian usage. This program is designed to reduce red light violations
in signalized intersections that have high pedestrian traffic.

**Fairfax (City)**

The first full month of use was August 1997. One camera rotated between three intersections. In
May 1998, a second camera and five more intersections added. In October 1999, the third camera
was added. Fairfax is presently rotating two cameras between six intersections, one camera
works full time at one intersection and cameras at another intersection have been retired. The
Fairfax City Council and Mayor wanted the photo red light program. The implementation team
consisted of Director of Public Works, Clerk of Court and Police Captain.

The program objective is to reduce red light violations, reduce intersection accidents, and change
driver behavior. Accident and violation data are gathered. Police department suggests locations.
The photo-monitoring vendor advises as to whether locations are feasible in terms of
construction and layout.

**Fairfax (County)**

The Fairfax County Board of Supervisors authorized the program in October 1999. The first
camera was operational in October 2000. Nine more were installed by October 2001. The Fairfax
County Department of Transportation was named the lead agency in the program management.
The process consisted of submitting a request to issue an RFP to the Board. A vendor was
selected and the Board was asked to approve the expenditure and the vendor. The Board also
held public hearings to amend the Code of the County of Fairfax to permit the use of Photo Red
Light monitoring.

Intersection safety is the objective of the program. This is done by making the program highly
visible and targeting locations where violations are most prevalent. The Fairfax County
Department of Transportation selects the locations where cameras will be located. Factors
considered are: (1) red light running accidents; (2) red light running citations issued by police
officers; (3) citizen recommendations; (4) other agency recommendations; and (5) field review of
violations. Data is obtained from the police department and field technicians. Fairfax County is a
unique situation as the signals are owned and operated by VDOT and not by the jurisdiction, as
is the case in all other jurisdictions that have photo enforcement programs. The County and
VDOT have developed a process so that candidate intersections are reviewed by VDOT before
implementation of photo enforcement to ensure signal timings are proper and no other factors would preclude the use of a camera.

**Falls Church**

Three intersections will have the system and, unlike the photo systems, the cameras do not move between intersections. Traffic is monitored in eight directions for a total of 16 video cameras. The contract was signed in December 1999 and became active at one location on October 8, 2001. The final two intersections should be active in November 2001. The City Manager, Director of Public Works and Chief of Police obtained information on the programs across the country and presented the proposal to the City Council. The Council approved the project and the City released an RFP. After a review of the proposals, the staff and the City Attorney recommended to Council that the contract go to Nestor, Inc.

The goal of the program is reducing both the number of vehicles running red lights and accidents. The intersections were selected through a police department review of the accident reports and surveys at intersections to determine the number of vehicles running red lights.

**Vienna**

The Vienna program was implemented in 1999 with three cameras currently in use. The Mayor, Town Council, Town Manager and the Chief of Police approved the system.

The objective of the system is to reduce injuries and property damage due to intersection crashes. The intersections were selected by the number of crashes and observed red light violations occurring at each. All signals are given at least a 4.5 second yellow phase and intersections have a speed limit of 30 or 35 mph.
### Implementation comparison/overview

The following table gives a brief comparison of the implementation of these programs.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Camera type</th>
<th>Number of cameras in use</th>
<th>Number of signals with camera housings</th>
<th>Date implemented</th>
<th>Lag time (after red) before photo</th>
<th>Public process</th>
<th>Program objectives</th>
<th>Intersection selection process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandria</td>
<td>still (wet film)</td>
<td>1</td>
<td>3</td>
<td>Nov-97</td>
<td>0.3 seconds</td>
<td>City Council</td>
<td>Reduce violations</td>
<td>Police, City DOT and City management</td>
</tr>
<tr>
<td>Arlington (County)</td>
<td>still (wet film)</td>
<td>4</td>
<td>7</td>
<td>1999</td>
<td>0.2 seconds</td>
<td>County Board of Supervisors approved after Commonwealth legislation and pilot project</td>
<td>Pedestrian safety in signalized intersections</td>
<td>Accident &amp; violation data, police &amp; citizen recommendation, video validation</td>
</tr>
<tr>
<td>Fairfax (City)</td>
<td>still (wet film)</td>
<td>3</td>
<td>8</td>
<td>Aug-97</td>
<td>0.4 seconds</td>
<td>City Council</td>
<td>Reduce violations &amp; accidents; change driver behavior</td>
<td>Police data &amp; suggestions</td>
</tr>
<tr>
<td>Fairfax (County)</td>
<td>still (wet film)</td>
<td>10</td>
<td>10</td>
<td>Oct-00</td>
<td>0.2 seconds plus time due to loop setback</td>
<td>Board of Supervisors and public hearings</td>
<td>Intersection safety</td>
<td>County DOT field review and police data</td>
</tr>
<tr>
<td>Falls Church</td>
<td>video</td>
<td>16</td>
<td>3</td>
<td>Oct-01</td>
<td>None</td>
<td>City Council</td>
<td>Reduce violations &amp; accidents</td>
<td>Police data</td>
</tr>
<tr>
<td>Vienna</td>
<td>video</td>
<td>3</td>
<td>3</td>
<td>1999</td>
<td>None</td>
<td>Town Council</td>
<td>Reduce injuries and property damage due to crashes</td>
<td>Police data and field observation</td>
</tr>
</tbody>
</table>

Figure 1. Comparison of how Virginia jurisdictions implemented photo monitoring

### Identification of Issues

Many issues need to be considered in deciding to implement and in determining the parameters of a photo red light monitoring program. In working with the advisory committee, a list of issues relating to this aspect of the project was developed.

The first issue concerns the decision of who to involve in the decision-making process—what is the appropriate representation within the jurisdiction and are representatives needed from the community? This is both an enforcement issue and a safety issue, and a public policy issue necessitating broad involvement. Determining program objectives is another issue that is part of the initial process. Once the problem has been identified for which automatic enforcement is being considered, specific objectives need to be defined. In this manner, a common
understanding is achieved among the participants; the program can be tailored to reach these objectives and the data and evaluation needs can be more clearly identified. The final issue that arises during this phase is appropriate expectations. The expected benefits of photo enforcement programs vary considerably depending on the source of information. There is a need to gather information from a variety of sources and to base the expectations on site-specific characteristics.

Once a decision is made to use automated enforcement as a safety tool within a jurisdiction, the next step is to determine the most appropriate equipment that fits the objectives and resources of the jurisdiction. As this area is covered in some detail later in this report, the next step for consideration is the selection of intersections. Issues that arise are the criteria that guide the selection and the evaluation of potential locations. This is a very critical area, as a thorough selection process will increase the effectiveness of the program and will establish parameters for a fair and equitable program. Both effectiveness and fairness are important in building and maintaining public support. In order to ensure that a photo red light running program is effective in addressing safety, the selection criteria needs to be clear and consistently applied.

It was the goal of the implementation and public awareness subcommittee to consider all of these identified issues, to build upon the lessons learned and create a recommended approach to implementation that is comprehensive, reasonable and fair.

**Suggested Approach**

Based on the experience of members of the advisory committee, it was suggested that the key to effective implementation of a photo-monitoring program is to follow a well-defined, clear, inclusive, proper process. This process should include the following: appropriate representation from the jurisdiction, identification of program objectives, provision of needs to achieve objectives and proper evaluation and selection of sites.

**Appropriate Representation:** One of the first steps of implementation is to identify those that need to be involved in the decision to initiate a program. Photo red light monitoring is an enforcement and traffic-engineering tool; however, the decision to use cameras to enforce traffic laws is a public policy issue. Therefore, inclusive involvement and comprehensive coordination is needed. In each locality, coordination needs to occur between those responsible for traffic operations and the enforcement agency. Elected officials need to be informed of all the options and play a key role in the final decision to implement a program and to appropriate the necessary funds. Input is helpful from any locally appointed traffic-related citizen committees. By obtaining citizen input, a different perspective can be added to the development process and concerns can be addressed early.

It was the opinion of this sub-committee that after the decision has been made to implement a photo-enforcement program, the implementation and operation should be removed from the political realm. It was stressed that photo enforcement is a public safety tool. The program must be implemented with clear objectives and operated through a clear, impartial process that is not subject to interpretation or interference from outside the enforcement or administering agency.

**Identification of Objectives:** Once the traffic engineering personnel and the enforcement personnel are working together, the objectives need to be clearly defined and understood. Within
the context of “improving safety” or “reducing crash risk”, there are many possible objectives for a photo enforcement program. Possible objectives include the following:

- **Reduce the number of violations at the intersection.** These violations may include during the red interval, for example, the number of straight through entries, the number of left turn entries, or both. A violation is defined herein as an observed failure to obey a traffic law.

- **Reduce the number of citations at the intersection.** Similar to the above objective, one may reduce the total number of citations; a citation is simply a violation where a ticket is issued based on a particular license plate.

- **Reduce the number of convictions at the intersection.** Similar to the above objective, one may reduce the total number of convictions; a conviction is a citation where either the person pays the fine immediately or the person contests the citation in court and is found guilty.

- **Reduce the number of violations at nearby intersections.** The objective of a program may be to achieve carry-over effects, where motorists change their behavior throughout a community in response to a photo enforcement program at a particular intersection. (As above, one could also seek to reduce the number of citations or convictions).

- **Reduce the number of crashes at the intersection attributable to red light running.** These crashes might include, for example, some angle crashes (where two vehicles were in the intersection at the same time) as well as select rear end crashes (where the lead vehicle was stopping yet the following vehicle did not intend to stop). Experiences in Australia and at a few limited locations in the U.S. indicate that photo enforcement, while reducing overall crashes, did not reduce all crash types by the same amount.

- **Reduce the number of crashes at other intersections attributable to red light running.** One objective might be for the effects of a photo enforcement program at one intersection to carry over to other intersections, where motorists would change their behavior.

Each of these objectives has strengths and weaknesses. For example, many persons would probably argue that the last objective—reduce the number of red light crashes throughout a community—is the most important objective of any photo enforcement program. That objective measures safety (or crash risk) more directly than violation rates, and it assesses whether a program has a broader impact beyond the individual intersection where cameras are installed. Unfortunately, data are difficult to obtain. Not only are crashes themselves relatively rare events, but isolating the causes of individual crashes can also be time consuming—for example, one would want to know whether the reduction in angle crashes at a particular intersection was the result of a nearby photo-enforcement camera or the result of increased law enforcement visibility.

By contrast, obtaining data for violation rates is relatively easy, provided the equipment is functioning correctly. The weakness of using violation rates alone, however, is that they are a less precise indicator of safety: clearly the person who can say “we reduced crash rates by 50
percent” is going to have a stronger position than the person who says “we reduced violation rates by 50 percent.”

Next, convictions and citations carry some strengths and weaknesses relative to violations. Their downside is that they can exclude violations for reasons other than safety. For example, suppose a violation does not become a citation because the license plate is not visible. From a safety perspective, that violating vehicle is just as relevant as a violating vehicle where the license plate was visible: the exclusion of the former confounds the analysis of citations. The strength of citations and convictions may be that they enable red light running to be directly compared with other types of traffic offenses, independent of the technology used. Compare red light running to speeding, in which the former violation rate is recorded by camera and traffic engineers record the latter violation rate with a radar detector. It may be the case that because of automation, equipment, or visibility to the public, the violation rates of one (or both of these methods) are imperfect. However, since citation and conviction information expose the person to the judicial process, it may be the case that citations and convictions allow one to compare these rates more directly.

Finally, communities may develop other objectives (such as reduce citizen complaints). In this approach, we do use violation rates as our objective, with the acknowledgment that these readily available data give an imperfect estimation of safety impacts.

**Site Selection and Site Evaluation:** The importance of a proper process for selecting photo red light monitoring sites cannot be understated. A comprehensive, consistently applied process will not only help ensure that the best possible sites are selected (NC report), but is also critical to the effectiveness of an automated enforcement program.

Such a process will help pinpoint those locations where red light running contributes to the safety concerns at an intersection and where automated enforcement of the red light has the greatest potential to reduce crashes. In addition, a good, proper process in the selection of sites will help eliminate from the selection pool those sites where other countermeasures may be effective in reducing red light running. Automated enforcement of the red light will only work if the intersection is engineered appropriately to encourage good driver behavior. If sites are selected where other problems prevail, a reduction in red light violations or crashes is not likely to be realized. The program will be deemed ineffective because it was not implemented appropriately—it was the not the right tool for the problem.

**Initial Identification of Sites** - There are two main criterion used to identify an intersection as a candidate for automated photo enforcement: a high violation rate of the red light or a high occurrence of crashes linked to violations of the red light. Jurisdictions often choose to look at violation rates because they have a much more frequent occurrence than crashes so trends can be observed over shorter durations of time. Also, crash data can be time consuming to analyze, especially when it is necessary to review individual accident reports. The weakness in only using violation rates as the criteria for selecting intersections is that an opportunity is missed to realize the maximum benefit of the program since those intersections with the highest violation rates are not necessarily those with the highest crash rates. By also selecting intersections that have a high accident rate due to red light running, a direct effect can be achieved at that particular intersection as well as modifying driver behavior at other intersections.
Because violation rates can be quickly and easily collected, it is most practical for violation rates to be used as the first indicator of a problem. The history of crashes at those intersections identified should then be reviewed to determine if red light cameras are an appropriate tool for the intersection. Typically, only crashes that are linked to red light running are used for this evaluation, as those are the types of crashes most likely to be affected by this enforcement tool. As it is sometimes difficult to know the reason for each crash because false connections between crashes and causes can be made at the time of reporting, violation rates can represent a good surrogate. It is reasonable to assume a correlation between a high violation rate and the potential for a crash. When evaluating the crash history at an intersection, some jurisdictions choose to categorize accidents into fatality, injury, and property damage and pedestrian/bicycle involvement. This level of detailed information would enable them to better target those sites of the greatest concern and to better quantify the impacts after implementation.

Some additional criteria that can be used for the selection and prioritization of intersections for automatic enforcement include the difficulty of enforcement at an intersection, unsafe conditions of enforcement, and a high volume of pedestrian traffic. Pedestrians are at a great risk from red light runners, and a substantial violation rate may create such an unsafe perception to discourage pedestrians from a preferred route.

Each municipality must determine its own proper process for selection and evaluation of potential photo red sites that should be tailored to its own objectives and philosophies. However, it is strongly recommended that each jurisdiction have an inclusive, thorough, consistent process. A general approach is suggested here.

**Suggested Process to Select and Evaluate Sites for Photo Red Light Monitoring:**

I. Identify and validate the existence of a problem through the examination of violation rates and any other locally determined criteria.

II. At those locations identified, review the history of crashes associated with red light violations. A study of specific accident patterns and turning movements can help determine if a particular countermeasure is needed and if the intersection is an appropriate candidate for photo monitoring.

III. Conduct a thorough engineering review of the intersection to look for possible causes of the identified problem(s). The object of this review is to create a distinction between the deliberate violators of red lights and those that run the red lights because of some unhelpful intersection conditions, which could possibly be improved.

It is expected that there will be a reduction in the violation and accident rate due to the implementation of a photo-enforcement program. However, it was indicated by the committee that these reductions would only be seen if the intersection was engineered appropriately to serve and encourage good driver behavior. For example, if the signal is behind a sharp curve and sight distance is very limited, this may result in red light running. Providing early information of upcoming signal indication could solve the problem. All steps should be taken to provide possible improvements before photo
enforcement to encourage appropriate driver behavior. At a minimum, an engineering review of the intersection should include a field visit by both the enforcement and transportation officials and the following:

1) A determination that the signal is visible from a sufficient distance away to ensure that drivers can react and stop within a minimum stopping distance; violations can occur because drivers do not have enough warning of an upcoming signal. A determination needs to be made that enough distance exists between the point that a motorist views the signal head and the stop bar for a motorist to stop using an average perception reaction time and a comfortable level of deceleration.

2) A determination that the yellow time is sufficient for drivers to stop or pass the stop bar before the red phase.

There are several different ways that the yellow time can be determined. Traffic engineers must select values that match the local environment, the particular type of signal system and specific site conditions. It is important, however, that each jurisdiction have a clear, consistent approach to setting yellow timing. This becomes even more important when the red light is automatically enforced so that no distinctions are made among different intersections. That is not to say that the yellow times need to be the same among all intersections in a jurisdiction, but that the approach used to set the times should be consistent and serve safety.

VDOT has dealt with this issue a great deal over the last year and has recently issued a traffic engineering policy that defines a specific approach to be utilized for the determination of the clearance interval at all state-operated traffic signals. The details of the development process and the actual approach are summarized here to serve as a possible approach for others and to identify the issues that must be addressed in determining the yellow time.

A statewide collaborative effort to develop a policy for setting the clearance interval was initiated in order to create greater consistency among the nine VDOT districts and to insure that the latest research developments and recommendations in this area were being used throughout the state.

In documenting the manner in which the clearance interval was previously determined, distinct variety in approaches among the districts became apparent. Some strictly applied the Institute of Transportation Engineers (ITE) recommended formula, while others relied more on less formal methods and rules of thumb based on previously recommended methods. Since meeting driver expectancy by maintaining consistent conditions typically results in safer roads, it was presumed that a consistent approach to setting yellow times would be beneficial. However, further discussion revealed that although a consistent approach was warranted, a certain degree of flexibility in how the approach was carried out among districts and individual locations was critical.

The policy adopted by the traffic engineering division is based on the recommendations of the ITE; the text of the policy is shown in Figure 2. This method was adopted because
it is a nationally accepted sound approach, considers appropriate site conditions and
generates reasonable values consistent with field experience. Flexibility is allowed in
applying the formula. First, the perception reaction time is taken to be 1.0 second unless
the situation warrants an increase. An isolated signal where expectation is low might
warrant an increase to 1.5 seconds. The deceleration is another area where engineering
judgment plays a role. For the past several years, the deceleration has been recommended
to be 10 feet/second². However, in the recently published AASHTO Geometric Design of
Highways and Streets, the recommended deceleration is 11.2 feet/second². Heavy truck
traffic might warrant a decrease in deceleration rate, whereas an increase to a faster
deceleration may be warranted in urban conditions where drivers decelerate and
accelerate faster.

In development of this policy, the greatest discussion was elicited by the appropriate
speed to use in the formula. A part of the engineering community supported use of the
actual or 85 percent speed, as that would always provide ample yellow for the majority of
drivers to stop during the yellow phase. However, district traffic engineers who operate
VDOT signals voiced serious concerns. They did not feel that it should be the policy of
the state to set traffic controls for violators of traffic laws, and that it was not a helpful
approach. Also, the approach speed varies considerably at some locations based on the
time of day and the level of congestion. Since the technology is currently not in place to
continuously monitor the approach speeds and modify the yellow times in response to the
changing speeds, there is no simple way to implement this approach. It was also pointed
out that drivers expect consistent yellow times at an individual intersection, therefore
using the posted speed is more reasonable alternative from this perspective also. The final
decision of the State Traffic Engineer was to adopt the usage of the posted speed for the
above reasons. Other measures can and should be taken into consideration to provide for
the safest possible intersections and for addressing any speeding problems.

The VDOT traffic engineering community recognizes that despite the best approaches
and formulas that are used for calculating clearance intervals, field conditions may
warrant modifications. For example, engineers can account for situations where the
prevailing speed is consistently above the posted speed by increasing the yellow time.
The policy encourages individual assessment and allows for modification through the
final statement of the TED memorandum: “In all cases of developing signal timings,
engineering judgment governs final decisions.” Of course, the engineering judgment
should be based on a thorough analysis.

One way that individual timings can be field-tested is by observing the behavior of the
drivers who run the red light. The distribution of times when drivers ran the red light can
give some indication as to whether the change plus clearance interval has been set
correctly. For example, if a large number of vehicles run the red during the first half
second of the red phase, an increase in the yellow phase may be warranted.

IV. Implement any countermeasures that result from engineering review. If the engineering
review reveals that there are steps that can be taken to encourage better driver behavior
and possibly reduce the violation rate or to make the intersection safer, these measures
should be implemented before the automatic enforcement is considered.
V. Determine if problems of high violation rates and accident rates still exist. After identified countermeasures have been implemented, the intersections need to be reevaluated after a reasonable length of time to determine if the countermeasures have been effective.

VI. The physical characteristics of the intersection should then be evaluated to determine if it is an appropriate candidate for camera enforcement based on the characteristics of the equipment selected.

VII. Implement photo red light cameras. Once it has been determined that the intersection is designed to encourage compliance with the traffic laws, and the violation rate is still unacceptable, photo enforcement can be considered as a viable option. Part of this implementation should include a public awareness campaign, which is discussed in a following section.

The final determination of where and when to install photo enforcement should be the sole responsibility of the administering agency after diligently evaluating the suitability of potential sites.
In an effort to establish consistency throughout the Commonwealth, this memorandum will govern the method in which the timing of the yellow change intervals and all red intervals is established.

The formula recommended by the Institute of Transportation Engineers will be employed in the following manner:

\[
\text{yellow change interval} = t + \frac{V}{(2a \pm 64.4g)}
\]

where:
- \( t \) = the perception reaction time expressed in seconds. This is 1 second unless the engineer responsible determines that the situation warrants increasing it to 1.5 seconds.
- \( V \) = the posted speed expressed in feet/second.
- \( a \) = the deceleration rate expressed in feet/second\(^2\). This should be 10 ft/sec\(^2\) under typical conditions. Engineers may decrease this to 8 or 9 feet/second\(^2\) if conditions warrant such as heavy truck traffic or increase to 11 or 12 feet/second\(^2\) if warranted.
- \( g \) = the grade of approach (percent/100); use + for a positive grade and – for a negative grade.
- minimum yellow time should be 3 seconds and the maximum should be 6 seconds.

\[
\text{all red interval} = \frac{(w+l)}{V}
\]

where:
- \( w \) = width of intersection, curb to curb expressed in feet.
- \( l \) = vehicle length, taken as 20 feet.
- \( V \) = posted speed in feet/second.
- minimum all red interval should be 1 second and the maximum should be 3 seconds. Longer all reds can be used at the engineer’s discretion where extreme conditions warrant.

General
- all timings will be calculated to the nearest tenth of a second
- if rounding to the nearest half second is desired, it should be done in the following manner:
  - .0 to .1 – rounded down to whole number
  - .2, .3, .4 – rounded up to next half second
  - .6 – rounded down to half second
  - .7, .8, .9 rounded up to next whole number

In all cases of developing signal timings, engineering judgment governs final decisions.

Figure 2. Traffic Engineering Division Memorandum 306, Calculation of Clearance Intervals
EQUIPMENT

Photo-enforcement cameras are fully automated systems designed to detect and photograph, under any weather or light condition, vehicles in violation of a red traffic signal. The primary purpose of the photo-monitoring camera is to provide objective evidence of red-light running offenses. Benefits of photo enforcement can include increased safety, deterrence and revenue.

This section reviews the basic mechanism that photo-enforcement systems use to capture red-light running violations, describes the components of the system and the main camera technologies, and summarizes the systems offered by some manufacturers.

How it works

Photo-enforcement camera systems capture images of red light violations. Images are captured digitally or on 35mm film. The system is activated when a vehicle crosses a trigger during the red phase of a signal. The trigger is usually an inductance loop, but can be piezo strips, laser, radar, or digital detection. Jurisdictions may choose to add speed thresholds and activation delays. Speed thresholds of 5–15 miles per hour are added to eliminate vehicles that creep into the detection zone, but do not go through the intersection. Activation delays, usually not more than 3/10 second, are added to give the driver a grace period. The cameras can be placed to photograph the front, rear, or both ends of the vehicle. Most wet film and digital systems take at least two pictures – one of the vehicles prior to the intersection and one of the vehicles in the intersection.

Camera placement is determined by the requirements of the law. In states such as Virginia, where the owner, lessor or renter of the vehicle is held responsible, the camera is required to photograph only the rear license plate. In states such as California, where the driver is issued a moving violation, front and rear cameras are necessary to record the image of the driver and the rear license plate. Most jurisdictions require the red signal to be visible in the image. The camera records the date, time of day, time elapsed since the beginning of the red signal, and the speed of the vehicle. Tickets typically are sent by mail to owners of violating vehicles, based on a review of photographic evidence.

Implementations in Virginia

Within the Commonwealth, four jurisdictions (Arlington and Fairfax Counties, and the Cities of Fairfax and Alexandria) use 35mm wet film technology in photo enforcement. Two jurisdictions (Falls Church and Vienna) use video camera technology. In the City of Fairfax one camera was installed in August 1997 and two more in 1998; cameras currently rotate between six intersections. In November 1997, Alexandria installed one camera and rotated it between three intersections. Vienna began photo enforcement in 1999 with three cameras and has not increased that number. Fairfax County’s first camera system was installed in October 2000 and nine more systems have been added to the program. The three systems in Falls Church all became active in late 2001.
Photo-enforcement System Components

Several companies provide photo-monitoring camera systems in the United States and internationally. Each provides the same basic functionality, but implements different features and uses different technology. Photo-enforcement camera systems are composed of three main subsystems:

- Camera technologies
- Control mechanism
- Violation detection

Camera technologies

Camera technologies are described in more detail on the following page. In general, photo-monitoring cameras can capture images of red-light violations on 35mm photographic film in black and white or in color. They are similar to standard 35mm cameras, but are manufactured to more rigorous standards and are able to withstand years of continuous operation in a variety of conditions. Film must be collected from the camera site at regularly scheduled intervals.

Some systems use digital or video cameras to record the violation. These systems may be connected to a central dispatch facility to eliminate the need to pick up the images from the camera site. They can also provide an optional real-time video system to monitor traffic and record collisions on video.

Control mechanism

Standard photo-monitoring cameras include computers that record the date, time, seconds into red phase, and location code. These data are superimposed onto each photograph in a data block. Lane number, vehicle speed, and seconds of yellow phase may also be recorded. The computer also handles the triggering function. The computer requires an interface to the traffic signal controller and is only active during the red phase. An image is captured when a violation is detected.

Photo-monitoring systems are typically housed in their own enclosures, which are mounted to existing traffic signal poles or on a separate foundation. The camera equipment interfaces with the signal equipment through the 110-volt outputs.

Violation detection

In order to photograph a violation, a mechanism must be in place to accurately determine when and if a violation has occurred. The trigger mechanism can be a variety of devices, including air tubes, loops, piezo strips, radar, laser or video detection.

While all photo-monitoring system manufacturers offer violation-processing services, some are willing to provide the processing software to the jurisdiction or agency. This local control allows the agency to process, review and issue citations without third party involvement.
Photographic Technologies

Photo-enforcement systems use one of three basic photographic technologies: 35mm wet film, and digital photography or video. Following is a brief description of how these systems work and how they differ from each other.

**Wet film**
When a violation is detected, a traditional film camera takes two pictures. The first picture is of the signal indication and the car at the stop bar, the other is of the signal indication and the car in the intersection. Detection is usually by a pair of loop detectors. The film cartridge is retrieved and shipped to the processing center, where it is developed and scanned into a computer. The negatives are stored for use as evidence if needed. The citation is processed from the scanned digital images. The primary user of this technology is Affiliated Computer Services (ACS), formerly Lockheed Martin IMS.

**Digital**
When a violation occurs, one or more digital cameras take between two and four pictures of the vehicle and signal indications. One is of the car at the stop bar; the second is of the car in the intersection. Some brands take an additional picture with a special high-resolution camera for a close up of the license plate. Others will take one of the previous photos and zoom in on the license plate. Some brands also support the use of a second camera to photograph the front of the vehicle for states that require it such as California, which charges the driver with a moving violation. The data is uploaded from the camera over a communication link and fed directly into the citation processing system. Most brands offer the option of encrypting the communication for security. Detection is usually by a pair of loop detectors, though some brands prefer the use of piezoelectric detectors. Radar, laser or other detection types have also been used.

The various manufacturers have different ways of handling the evidence to ensure its integrity. Most support the use of a digital watermark to ensure the picture has not been altered. They also store the data in an encrypted format to prevent unauthorized access. Two brands (Peek & Poltech) write the data to a secure WORM (Write Once Read Many) drive for permanent archiving. Others are developing support for CD-R drives. These disks can be produced as evidence in court if needed. Many brands also store the retrieved data in databases at the processing center, where it can be accessed later. Companies using this technology include Peek, Transcore, Redflex, Precision Traffic Systems, and Poltech.

**Video**
A video-based, photo-enforcement system uses two cameras per approach, a “tracking” camera and a “signal view” camera. Both tracking and signal view cameras are dome style with pan, tilt, and zoom capabilities. Tracking cameras provide the front view of a violation event as well as a rear view. The signal view camera (simultaneously with the tracking camera) records front views of a violation, as well as a wide-angle view of the traffic signal, showing the violating vehicle before and after it crosses the stop bar. The tracking camera can also be
used to record a context view of a violation to determine if a violating vehicle was justified in proceeding through the red light in order to avoid an emergency vehicle.

**Manufacturer Overview**

A brief description and comparison of some features of photo-monitoring systems (by manufacturer) follows. This overview was prepared with readily available information and is not meant to be an exhaustive survey of all manufacturers in the photo-enforcement sector.

**Affiliated Computer Services (ACS)**

ACS systems use a pair of loop detectors to monitor for infractions. When a violation is detected, the camera takes two pictures. The film is collected from the cameras daily, and sent for processing. As all the equipment is mounted in a single box, the camera can be easily rotated between locations.

- Wet film technology
- Products include Red Light Camera system and CITEWARE™ Ticket Processing System software
- Two frames per infraction
- Many installations (Arizona, California, District of Columbia, Hawaii, Maryland, North Carolina, and Alberta, Canada) including four jurisdictions in Virginia
- Developed in U.S.
- One camera per approach
- Triggered by loop detectors
- All equipment stored in one box

**Nestor Traffic Systems**

Nestor uses video detection technology to predict and capture violations. The system does not require loops or sensors in the roadway. The video captures the entire context of the violation. The violations can be captured in the field, and then sent to the local police station for processing, or the video is sent in real time to the police station for detection and processing of a violation.

- Video technology
- Products include CrossingGuard®
- 5 second video clip of infraction
- Video clips stored at police department in a database
- Developed in U.S.
- Installed in California, Iowa, Kansas, Tennessee and in two jurisdictions in Virginia
- Two cameras per approach
- Requires environmental cabinet for processing unit
- Processing unit can handle two approaches
- Requires fast communication link to transmit video
Peek

Peek systems use a pair of loop detectors per lane to monitor for infractions, but can use other technologies. When a violation is detected, the camera takes three pictures. Encrypted images are sent to the citation-processing center daily over a communication link and stored on a WORM drive.

- Digital technology
- Products include Guardian® outstation and central Offence Viewing and Decision System (OVDS)
- Three frames per infraction:
  1. Color wide angle of car at stop bar with signal heads in background
  2. Color wide angle of car in intersection with signal heads in background
  3. Black and white close up of license plate
- Photos stored permanently on WORM drive in encrypted format
- Infraction data can be retrieved over communications link
- Processing unit requires separate cabinet
- Processing unit can handle two approaches
- Triggered by loop detectors, can use other technologies
- Developed in Europe
- Installed in North Carolina and Europe

Poltech

Poltech uses a pair of loop detectors per lane or piezoelectric detectors to monitor for infractions. When a violation is detected, the camera takes at least three pictures. Images of violations can be sent to the citation-processing center over a communication link. Encrypted images are stored on a WORM drive.

- Digital technology
- Products include Centaur camera system and Minotaur adjudication software
- Four or five frames per infraction:
  1. Color wide angle of car at stop bar with signal heads in background
  2. Color wide angle of car in intersection with signal heads in background
  3. Color close up of vehicle
  4. Optional color of front of vehicle (with second camera)
- Photos stored permanently on WORM drive in encrypted format
- Infraction data can be retrieved over communications link
- Triggered by piezoelectric detectors
- One camera per approach
- Developed in Australia
- Installed in California, Maryland, Hawaii, Oregon, Australia, Europe and Asia
Precision Traffic Systems (PTS)

This system utilizes digital cameras. They use a pair of loop detectors per lane to monitor for infractions. When a violation is detected, the camera takes two pictures. All violation data is available in real time over a secure Internet connection.

- Digital technology
- Products include PTS Street and Office systems
- Two frames per infraction:
  1. Color wide angle of car at stop bar with signal heads in background
  2. Color wide angle of car in intersection with signal heads in background
- Infraction data can be retrieved over comm. link
- Images stored in database
- Triggered by loop detectors
- Developed in U.S.
- One camera per approach
- Separate processing unit at intersection

Redflex

Redflex uses a pair of loop detectors per lane or radar detectors to monitor for infractions. When a violation is detected, the camera takes at least two pictures. Images of violations can be sent to the citation-processing center over a communications link. Images are stored in an Oracle database.

- Digital technology
- Products include SMARTCAM™ cameras and REDFLEXred enforcement systems
- Two or three frames per infraction:
  1. Color wide angle of car at stop bar with signal heads in background
  2. Color wide angle of car in intersection with signal heads in background
  3. Close up of license plate (zoom in on one of the two images)
  4. Optional color of front of vehicle (with second camera)
- Infraction data can be retrieved over communications link
- Images stored in Oracle database
- Triggered by loop or radar detectors
- Developed in Australia
- Installed in California, Arizona, Colorado, Ohio, Australia and Canada
- One camera per approach
- All equipment stored in one box
TransCore

The TransCore system uses a pair of loop detectors per lane, piezoelectric detectors or radar detectors to monitor for infractions. When a violation is detected, the camera takes at least two pictures. Images of violations can be sent to the citation-processing center over a communication link. This system can do integrated video monitoring and recording.

- Digital technology
- Products include AutoPatrol® camera systems, and Attlas™ and TraffiCourt® software
- Two or three frames per infraction:
  1. Color wide angle of car at stop bar with signal heads in background
  2. Color wide angle of car in intersection with signal heads in background
  3. Optional color of front of vehicle (with second camera)
- Infraction data can be retrieved over communications link
- Triggered by piezoelectric detectors, can use loop or radar detectors
- Developed in U.S.
- Installed in New York, Canada and New Zealand
- One camera per approach
- All equipment stored in one box

Features of photo-enforcement systems are compared in the following figure.
<table>
<thead>
<tr>
<th>Manufacturer and URL</th>
<th>Camera technology</th>
<th>Products</th>
<th>Frames per violation</th>
<th>Comm link</th>
<th>Database</th>
<th>Encryption</th>
<th>Trigger</th>
<th>Camera(s) per approach</th>
<th>Where developed</th>
<th>Where installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS</td>
<td>35mm wet film</td>
<td>Red Light Camera System &amp; CITEWARE</td>
<td>2</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Loops</td>
<td>1</td>
<td>U.S.</td>
<td>Widespread in U.S. and Canada incl. Alexandria, Arlington &amp; Fairfax (City &amp; County)</td>
</tr>
<tr>
<td>Nestor</td>
<td>Digital video</td>
<td>Crossing-Guard</td>
<td>5 sec. video clip</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Predicts violation</td>
<td>2 -- processing unit can handle 2 approaches</td>
<td>U.S.</td>
<td>California, Iowa, Kansas, Tennessee, Falls Church &amp; Vienna</td>
</tr>
<tr>
<td>Peek</td>
<td>Digital still photos</td>
<td>Guardian and OVDS</td>
<td>3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Loops or other</td>
<td>1</td>
<td>Europe</td>
<td>Europe and North Carolina</td>
</tr>
<tr>
<td>Poltech</td>
<td>Digital still photos</td>
<td>Centaur and Minotaur</td>
<td>4 or 5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Loops or piezo</td>
<td>1</td>
<td>Australia</td>
<td>Australia, Asia, Europe, California, Hawaii, Maryland &amp; Oregon</td>
</tr>
<tr>
<td>PTS</td>
<td>Digital still photos</td>
<td>PTS Street and Office</td>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Loops</td>
<td>1</td>
<td>U.S.</td>
<td>Texas pilot project</td>
</tr>
<tr>
<td>Redflex</td>
<td>Digital still photos</td>
<td>SMARTCAM and REDFLEXed</td>
<td>3 (4 with 2nd camera)</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Loops or radar</td>
<td>1 (2nd camera required for color front of vehicle)</td>
<td>Australia</td>
<td>Australia, Canada, Arizona, California, Colorado &amp; Ohio</td>
</tr>
<tr>
<td>TransCore</td>
<td>Digital still photos</td>
<td>AutoPatrol, Attlax and TraffiCourt</td>
<td>2 (3 with 2nd camera)</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Loops, piezo or radar</td>
<td>1 (2nd camera required for color front of vehicle)</td>
<td>U.S.</td>
<td>New York City, Canada &amp; New Zealand</td>
</tr>
</tbody>
</table>

Figure 3. Photo-enforcement systems—comparison of features
PUBLIC AWARENESS

A public information campaign is an important aspect of a photo-enforcement program as it builds public support. Also, by alerting the driving public to the safety problem of red light running, it can aid in reducing the violation rates at signals throughout the area. A North Carolina State University Study states that, “Effective publicity for a well-conceived program can achieve tremendous gains due to voluntary compliance alone.”

Existing Programs

All of the jurisdictions within Virginia that responded to our questionnaire began implementation of their red light running program with a public information campaign. Roadside signs placed at the entrance to the locality or at the intersections monitored by the cameras were part of each jurisdiction’s public awareness program. All localities also used radio and printed media to get the news out, several used TV and electronic media. Fairfax City supplemented their media accounts with a mailing to all of the city residents and began their program with a thirty-day warning period in which the cameras were activated and tickets were issued, but no fines were remitted.

The following Virginia jurisdictions made the public aware of the photo-monitoring program as follows.

Alexandria

An extensive public awareness program began in September 1997 before the system was implemented. An informational post card was mailed to all City residences and businesses. Signs were posted at every major entrance to the City. Press releases were sent to print and electronic media.

Photos were taken for several weeks before the systems went live but no warnings or citations were sent. Television and newspaper coverage seemed to generate the most reaction. Feedback has been informal and generally positive, even from many who received citations.

Arlington County

The County posted signs about the program and contacted civic associations to get the word out. Road signs are posted at a variety of entrances to the County and at other locations. Many of the residents are familiar with the program from other jurisdictions in the area that use AE. Citizens have identified other problem intersections and requested that the photo-monitoring program expand to those locations. Arlington County is not seeing a high number of appeals of the citations.

Fairfax (City)

Postcards were mailed to all City residents a month before implementation. Press releases were given to local media. During a thirty-day warning period, cameras were functional but no tickets
were issued. Signs advising motorists of photo enforcement were posted on major highways at numerous locations entering the City.

Media and mailings seemed most effective at getting the word out. The City of Fairfax has not done a study, but the Insurance Institute for Highway Safety produced a report in October 1998 called *Evaluation of Red Light Camera Enforcement in Fairfax, VA*. As part of the Institute’s study, they conducted a random sample telephone survey of city residents about their awareness and opinions of red light camera enforcement approximately 1 month before and 1 year after the enforcement program began. Among total respondents, 75 percent favored the use of cameras to enforce red light running in Fairfax one month before implementation and 84 percent favored one year after. Most feedback has been positive from violators and non-violators alike.

**Fairfax (County)**

To make the public aware of the program, the County held news conferences, on-site TV interviews, a local government TV session on the whole program, news releases, and radio interviews. The County established a web site for photo red light monitoring, distributed brochures on the program, conducted a pre-implementation survey and installed warning signs prior to each monitored intersection.

**Falls Church**

The City released Public Service Announcements (PSAs) to the local papers and television stations. They used the city newsletter to advise residents of the program, worked with the Chamber of Commerce, City web page, and held public hearing before the City Council. The public has been informed from the beginning of the program, but 30 days before the start of monitoring at a new intersection, the information was placed again in the local print and electronic media.

The roadway signs have been the most effective public awareness medium because the resident community is just over 10,000 people and the majority of Falls Church vehicular traffic is non-resident. The response from the public on the program has been positive, but the City has just begun to issue tickets. Because photo monitoring has become more common in the Northern Virginia area, the public now assumes all jurisdictions in the region have a system.

**Vienna**

Six months prior to the start of the program, the Town began a public awareness program to include TV, radio and printed press. TV interviews and newspapers appeared to be the most effective way to let people know about the program. No formal surveys have been undertaken. Public feedback has been very positive for two reasons: (1) the program uses videos which people like better than still pictures, and (2) violators are invited in to see the video prior to payment or court. The conclusiveness of the video system has helping gain public support of the program.
Public awareness comparison

The following chart gives a brief comparison of how these jurisdictions made the public aware of the photo monitoring programs.

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandria</td>
<td>Postcards, press releases and road signs</td>
<td>Two months before implementation</td>
<td>None</td>
<td>TV and newspapers</td>
<td>No</td>
<td>Positive</td>
</tr>
<tr>
<td>Arlington (County)</td>
<td>Road signs throughout county, TV, radio, public service announcements and printed media</td>
<td>Six months before implementation</td>
<td>30-day warning period</td>
<td>Road signs</td>
<td>No</td>
<td>Citizen requests to expand the program; few requests to appeal violations</td>
</tr>
<tr>
<td>Fairfax (City)</td>
<td>Postcards, press releases and road signs</td>
<td>One month before implementation</td>
<td>30-day warning period</td>
<td>Media and mailings</td>
<td>IIHS</td>
<td>Positive</td>
</tr>
<tr>
<td>Fairfax (County)</td>
<td>TV/radio news conferences and interviews</td>
<td>One to two months before implementation</td>
<td>None</td>
<td>TV and web site</td>
<td>Yes</td>
<td>Overwhelmingly positive</td>
</tr>
<tr>
<td>Falls Church</td>
<td>TV and newspaper public service announcements, web site, city newsletter and public hearings</td>
<td>30-days before implementation</td>
<td>30-day warning period</td>
<td>Road signs</td>
<td>No</td>
<td>Positive</td>
</tr>
<tr>
<td>Vienna</td>
<td>TV, radio and print media, road signs</td>
<td>6 months before implementation</td>
<td>N/A</td>
<td>TV and newspaper interviews</td>
<td>No</td>
<td>Very positive</td>
</tr>
</tbody>
</table>

Figure 4. Comparison of public awareness of photo monitoring in Virginia jurisdictions

Identification of Issues

Some of the issues identified by the committee include which methods of communicating with the public are most effective, can public perception be altered based on communication and whether or not to identify individual locations where photo red light cameras are in use.

The most effective methods of communicating messages to the public differed among the jurisdictions. Both the Town of Vienna and the City of Alexandria indicated that the media disseminated the most widespread information; TV interviews and newspapers appeared to get
the message out to the greatest numbers as they generated the greatest response. Unfortunately, there was little control over the accuracy.

The City of Falls Church indicated that the roadway signs were most effective because the majority of the vehicular traffic within their city is non-residents. Fairfax City found that both the media and mailings were effective in informing the public of the upcoming program.

It was generally agreed that public awareness campaigns helped raise awareness, but what effect did they have on the public perception of the program? Although we could not objectively link the public awareness campaign to the public perception of the program, all four jurisdictions that believed they had high public support of their photo-monitoring program among their citizens had extensive public awareness campaigns. Officer John Cheyne, from the Town of Vienna, offered some specific insight into why support of their program was so high:

High public support comes from both the violators and non-violators. One reason the violators end up supporting the system is that they are invited to see the video of their vehicle traversing the intersection prior to payment or appearance in court. Once they view the infraction, they find little reason to object. The conclusiveness of the video has helped gain public support of the program [paraphrased].

Any opposition that was cited against the photo red light monitoring was typically on the grounds of a variety of constitutional and personal privacy reasons. Additional opposition has come from individuals that believe the objectives of the automated enforcement are not on safety, but are on monetary gains for the jurisdictions and the contractors that they employ. Although it is challenging to address and influence an individual’s philosophical issues, it is possible to address concerns about the objectives of an automated enforcement program. Advertising the objectives of the program and the clear and consistent process for selecting and evaluating sites does this best.

Another issue that needs to be addressed is whether or not to advertise the location of the individual cameras. Authors of the North Carolina State University report identified the following four types of public notification:

1. No publicity of the program at all; install the cameras and commence automated enforcement.
2. Widespread publicizing of the program’s existence through the media, but no public release of particular camera locations.
3. Widespread publicizing of both the existence of the program as well as specific camera locations.
4. Widespread publicizing of both the existence of the program as well specific camera locations through the media, and advance warning signs at actual intersections.

Little value was given to the first option of no publicity as exemplified by all of the jurisdictions in Virginia who have implemented automated enforcement programs with a public awareness campaign. The remaining options have all been implemented in Virginia. The decision of how
and what to publicize should be tailored to the needs and beliefs of the individual jurisdiction. For example, one philosophy is that if you reveal the location of the cameras, you will only have compliance at those locations being monitored; if individuals know only that automated enforcement is used within the jurisdiction, they will be compliant at all of the intersections. As the cameras and their housings are rather obvious, it does not seem possible to conceal the locations.

**Recommendations**

Once a jurisdiction decides to implement a photo red light running program, a public awareness campaign should precede the issuance of citations. In this manner, the greatest effectiveness of the program can be achieved. Possible components of a public awareness campaigns include:

- Media releases
- Roadway signs—placed at the entrances to the locality and/or at the individual intersections being monitored
- Web site information
- Mailings
- Warning periods

Several of these components should be combined to form an effective public awareness campaign. It is recommended that information be released to the media as this has proven an effective form of getting information out to a large number of people. Additional components of a campaign developed by a municipality should be tailored to its specific characteristics and resources. For example, small jurisdictions may consider mailing notices to all of its residents. However, if much of the traffic is generated from outside of the jurisdiction, roadway signs should be used. Websites provide an inexpensive way to provide information to a large number of people and allows the jurisdiction control over the type and presentation of data.

Once the forms of communication have been identified, the type of information to be released must be decided. It is important to let the public know the extent of the red light running problem—the crashes that it causes and the costs to all of us. Such information will not only help gain support of the program, but will raise awareness and may increase voluntary compliance. The purpose and objectives of any automatic enforcement program should also be publicized. By pulling the citizens into the problem and your tools for addressing the problem, you invite them to be part of the solution.

It is also recommended that communication with the public be an on-going effort. Available statistics regarding the number of violations could be published in various public information sources, such as the jurisdiction’s website or displays at community events. This can further raise awareness of the extent of the problem, encourage voluntary compliance as well as keep the public informed of effects of the program on violations and other evaluation measures.
EVALUATION

Existing Programs

VDOT's Traffic Engineering Division surveyed those jurisdictions that under state law have the authority to have a photo-monitoring program. The survey asked representatives of each jurisdiction whether they had conducted an evaluation of the effectiveness of photo enforcement.

Of the six jurisdictions that currently have a photo-monitoring program, two jurisdictions (Falls Church and Fairfax County) had only recently initiated their programs and for that reason indicated that they had not yet conducted an evaluation. They noted, however, that to determine "before" data at the sites they had reviewed crash and citation information before the photo enforcement system was established. Arlington County indicated that they had studied crash data, violation data, and input from "citizens, civic associations, and police officers" in order to make decisions regarding where to initially install the cameras. Vienna indicated "the considerable reduction of violations over the span of the project indicates the program's effectiveness"; Vienna noted that it also monitored the number of crashes. Finally, the City of Fairfax indicated that the IIHS has conducted an evaluation in their city. That report, written by Retting, Williams, Farmer and Feldman in October 1998 looked at changes in violation rates over time, both at photo enforcement sites and at control sites.

Issues and Objectives of Evaluation Approach

The goal of the evaluation subcommittee, whose members are listed previously, is to develop a practical approach that jurisdictions can follow in order to evaluate the effectiveness of their photo enforcement programs. The approach should highlight good practices, common pitfalls to avoid, and suggestions that jurisdictions might wish to consider when evaluating their photo enforcement programs. The methods should emphasize consistency, objectivity, and practicality.

The scope is limited to signal operations and related safety impacts. This approach does not constitute a specification, requirement, standard, or mandate, and certainly does not guarantee that a particular photo enforcement program will be shown to be effective. Legal issues, such as incentives for private and public entities to issue citations, are important aspects of photo enforcement but beyond the scope of this document.

This section has three specific objectives:

1. To provide an evaluation approach that uses existing data or data that are feasible to acquire in the future
2. To holistically outline issues associated with evaluating a signal’s effectiveness
3. To recommend additional data that should be collected
Suggested Approach for Evaluating Photo Enforcement Effectiveness

Five iterative steps may be used for evaluating photo enforcement effectiveness:

1. Define the objectives of the photo-enforcement program.
2. Determine the data necessary to conduct the evaluation.
3. Ensure that the signal is functioning correctly, including a sufficient change plus clearance interval.
4. Analyze the data that have been collected.
5. Draw conclusions from the analysis and state the limitations of these conclusions.

Step 1. Define the objectives of the photo-enforcement program

Within the context of “improving safety” or “reducing crash risk,” there are many possible objectives for a photo enforcement program. A list of these objectives with a discussion of their strengths and weaknesses is included in the implementation section. The need to define objectives is included as one of the steps in implementing a photo-monitoring program, and is repeated in this evaluation approach to stress its importance and its necessity to the evaluation process. Evaluation cannot commence unless objectives are clearly defined.

As an example of Step 1, we can state the following:

The objective of our photo enforcement program is to reduce the number of violations at the intersection by a statistically significant amount.
Step 2. Determine the data necessary to conduct the evaluation

The next step is to identify the data necessary for the objective selected previously; in other words, we want to link each objective to an evaluation technique. Data may be categorized in a number of ways, and Figure 5 shows one set of data elements from Fairfax County. For the purposes of determining violation rates, however, one can categorize these data elements into two categories:

- Events that are not a violation (right on red, no violation, emergency vehicle, or “other”)
- Events that are a violation (even if the offending vehicle cannot be identified)

<table>
<thead>
<tr>
<th>Fairfax County Data Elements</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events</td>
<td>1,214</td>
<td>100%</td>
</tr>
<tr>
<td>Non Cites</td>
<td>304</td>
<td>25%</td>
</tr>
<tr>
<td>Right on Red</td>
<td>9</td>
<td>3%</td>
</tr>
<tr>
<td>No Violation</td>
<td>292</td>
<td>96%</td>
</tr>
<tr>
<td>Emergency Vehicle</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Possible Violations</td>
<td>910</td>
<td>75%</td>
</tr>
<tr>
<td>Initial Rejects</td>
<td>413</td>
<td>45%</td>
</tr>
<tr>
<td>Clarity of Plate</td>
<td>170</td>
<td>41%</td>
</tr>
<tr>
<td>Dark Environment</td>
<td>149</td>
<td>36%</td>
</tr>
<tr>
<td>Plate Obstructed</td>
<td>21</td>
<td>5%</td>
</tr>
<tr>
<td>Framing of Car</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>No Plate</td>
<td>13</td>
<td>3%</td>
</tr>
<tr>
<td>V-dash</td>
<td>54</td>
<td>13%</td>
</tr>
<tr>
<td>Databox Error</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Exposed</td>
<td>5</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>No Hits</td>
<td>180</td>
<td>36%</td>
</tr>
<tr>
<td>Total Verify Rejects</td>
<td>66</td>
<td>7%</td>
</tr>
<tr>
<td>Client Rejects</td>
<td>66</td>
<td>7%</td>
</tr>
<tr>
<td>Number Mailed</td>
<td>251</td>
<td>28%</td>
</tr>
<tr>
<td>Number Paid</td>
<td>36</td>
<td>14%</td>
</tr>
<tr>
<td>Affidavit Filed</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Dismissed/Suspended/Other</td>
<td>12</td>
<td>5%</td>
</tr>
<tr>
<td>Open Tickets</td>
<td>203</td>
<td>81%</td>
</tr>
</tbody>
</table>

Figure 5. Data available from Fairfax County (intersection of Route 50 and Rugby), February 2001 (data provided courtesy of the Fairfax County Department of Transportation)
In Figure 5, there were 304 events in the first category (not a violation) and 910 events from the second category (possible violation). It is this second number—the 910 violations—that is of interest. In addition, one also needs some exposure data that can give some obvious reasons for data variation, such as the number of vehicles entering the intersection. For example, the data from Fairfax County by month (actual violations and hypothesized entering vehicles) are shown in Figure 6. In practice, the 24-hour entering vehicles into the intersection (from the major and minor approaches) are needed.

<table>
<thead>
<tr>
<th></th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td>Violations (actual)</td>
<td>910</td>
<td>1,175</td>
<td>472</td>
<td>482</td>
<td>482</td>
</tr>
<tr>
<td>24 Hour Entering Vehicles (made up)</td>
<td>10,000</td>
<td>12,000</td>
<td>13,000</td>
<td>14,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Violation Rate (per vehicle)</td>
<td>0.091</td>
<td>0.0979</td>
<td>0.0363</td>
<td>0.0344</td>
<td>0.0321</td>
</tr>
<tr>
<td>Violation Rate (per 10,000 vehicles)</td>
<td>910</td>
<td>979</td>
<td>363</td>
<td>344</td>
<td>321</td>
</tr>
</tbody>
</table>

Figure 6. Hypothetical violation rates for the Fairfax County intersection of Route 50 and Rugby

Next, the question arises as to how long one needs to collect these data. Ideally, one would like to collect these violation data at intersections for some “before” period when the camera was not in use, as well as for some “after” period when the camera was in use. Often, before/after crash studies are done with a three year time period, where the goal is to have a large sample yet not have conditions change substantially within the before period or within the after period. Given that violations, unlike crashes, are relatively numerous, one can have a much smaller time frame and still obtain a large number of violations. However, one must ensure that the time frame is long enough such that one knows if the before and after period have stabilized. For example, from Figure 6 above, it is clear that picking just one month of data could give spurious results—for no apparent reason at all, February and March could give different crash rates than the average. The length of time will vary by location, but it should be such that one does not expect a subsequent month to be substantially different. Given that the average violation rate in Figure 6 is 583 with steady decreasing in rates from February to June, the data shown in Figure 6 are not stable, thus one needs to collect additional data from July, August, and so on to see what is the long term trend at that intersection.

It may also be the case that changes in violation rates are due to factors other than the installation of the photo enforcement program. One tactic is to capture data from a “control site” that ideally would have all of the characteristics of the photo enforcement site except the camera itself. Choosing the control site is clearly a challenge, for if one believes that photo enforcement does have carry-over effects, then nearby sites would be affected. Thus the selection of the control site should be guided by the publicity and expectations associated with this program. For example, given that Fairfax County has advertised to the public that the cameras are placed “at locations where chronic red light violations create safety concerns” (e.g., throughout the County)—it seems appropriate to have control sites in a different jurisdiction where the public knows cameras have not been implemented. If one can assume that motorist behavior in Prince William County is unaffected (and this assumption would need to be checked), then sites from Prince William County could serve as a control. If this assumption is not accurate, then one
could choose control sites in another part of the state, such as Richmond or Hampton Roads, where one has intersections similar to Fairfax County yet presumably no carry-over effect from its red light cameras.

Thus assuming six months of before and after violation rate data, the data elements necessary for this evaluation might include the items shown in Figure 7. Conceivably one would have multiple Fairfax County intersections and multiple control site intersections.

<table>
<thead>
<tr>
<th>Intersection (Fairfax County)</th>
<th>Control Site 1 (Pr. William)</th>
<th>Control Site 2 (Pr. William)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of violations during the before period</td>
<td>Number of entering vehicles during the before period</td>
<td>Number of violations during the after period</td>
</tr>
<tr>
<td>Number of entering vehicles during the before period</td>
<td>Number of entering vehicles during the after period</td>
<td></td>
</tr>
</tbody>
</table>

Figure 7. Required data elements

**Step 3. Ensure that the signal is functioning correctly**

In collecting the data for both the before and after period, one should ensure that the signal is operating as expected and that the data do not have any abnormalities hidden in them. As a checklist, one can check that the following italicized statements are true:

- *The phasing of the signal has been constant.* Not only should the change plus clearance interval (the yellow time plus the associated red time) be constant, but also the type of phasing and cycle length should be similar for the before and after periods. For example, for actuated signals, the extension limit would be the same; otherwise, different motorist patience levels might be responsible for changes in violation rates (rather than the presence of a camera).

- *The camera was working for the entire before and after period OR steps have been taken to account for errors.* If there are periods when the camera is not functioning, then one needs to adjust the before and after volumes accordingly. For example, one should not assume that missing three hours of PM peak hour volumes is the same as missing three hours of weekend volumes.

- *Periods of abnormal behavior have been eliminated or analyzed separately.* Factors that could cause driver characteristics to deviate from the norm, such as reconstruction, occasions of unusually high levels of tourist traffic, or special events should be recognized. If doing a year long average, for example, then one might eliminate the highest month and lowest month of violations if these are very different from the remaining 10 months (and if
they are not part of a long term trend, such as that shown in Figure 6). Ideally, these periods could be anticipated before the evaluation begins.

- **The change plus clearance interval has been set correctly.** It has been argued that the yellow time is the most critical element for ensuring that signal operations are “safe.” Determination of an appropriate clearance interval should be made during the implementation stage. It is listed here to emphasize its potential impact on the evaluation.

The data generated from camera enforcement can be very helpful in observing the behavior of drivers who run the red light. The distribution of times when drivers ran the red light can give some indication as to whether the change plus clearance interval has been set correctly. For example, suppose that during the “before” period, one observes 1,400 possible violations at a signal with a change plus clearance interval of 4.5 seconds. Figure 8 suggests that this change plus clearance interval should probably be closer to 5.0 seconds as a large percentage of the violations are occurring between 4.5 and 5.0 seconds.

John Miller raised a concern about the VDOT Traffic Engineering Memorandum 306, Calculation of Clearance Intervals, which is included in this report on page 27 as a guideline for the determination of the yellow and all red signal phases. John believes that in the computation of the time for the traffic signal’s “change plus clearance interval,” one should use the prevailing speed rather than the speed limit if the prevailing speed is higher. In such an instance, use of the prevailing speed will yield a longer amber time (or a longer all red time if it is not acceptable to increase the amber time) than would be the case using the speed limit, and consequently, the system will begin recording violations later than would be the case if a shorter amber time (or all red-time) had been used. In his opinion, this practice can (1) enable better data collection to evaluate the effectiveness of photo enforcement programs, and (2) help convey that the focus of the photo red enforcement programs is to increase safety rather than revenue.

In response to John’s concerns, the Traffic Engineering Division does acknowledge the validity of using the prevailing speed in the calculation of the clearance interval. However, in the development of the TE-306 memorandum, as discussed on pages 24 and 25, the nine district traffic engineers and the central office staff agreed that mandating the use of the prevailing speed is not only an impractical alternative for field engineers, but it is unnecessary as well. Use of the prevailing speed is impractical, as the large daily and seasonal temporal variances would require that extensive data be collected to determine the prevailing speed at each signalized intersection. It is unnecessary as the regional signal engineers study each signal site before determining the optimum timing. They account for extenuating circumstances, such as an actual speed that consistently exceeds the posted speed, which would require additional yellow time. In addition, after implementing a new time, engineers monitor the intersection to assess performance. By reviewing the percentage of violations of the red light at a signalized intersection, an engineer can ascertain if the yellow duration needs to be increased. When knowledge of the corridor and engineering judgment are applied, use of the posted speed in the initial calculation of the yellow phase will result in timings that are most appropriate for the site and are not significantly different from those obtained using the prevailing speed.
In reference to the concern that photo monitoring systems will begin collecting violation prematurely, it should be noted that a five mph difference in the speed results in a difference of less than half a second in the calculation of the yellow time. Some of this variation is accounted for by the practice of rounding up to the nearest half second as dictated in the Traffic Engineering Policy. Additional variance is accounted for in the lag or grace period, the time between when the signal turns red and the camera begins taking pictures, which is typically set from between 0.2 and 0.4 seconds.

![Graph](image)

**Figure 8. When do vehicles clear the intersection?**

- **Violations are defined correctly.** In this paper, a “violation” is being defined from Figure 5 as a vehicle that entered after the signal had turned red, exclusive of emergency vehicles, right turn on red, and vehicles falling in the “no violation” category. If, instead, other data elements are used—such as crashes or citations, then it is important to define these consistently between the before and after periods.

Finally, note that in most cases, there is probably a difference between the change plus clearance interval and the time when the camera starts to take the picture. Figure 9 shows that for this example, the change plus clearance interval is 4.88 seconds, thus things would be simplest if somehow a camera started taking pictures of vehicles crossing the “right” stop bar after this time. However, cameras are usually focused on the “left” stop bar. In theory, therefore, a camera would be catching red light runners if it took pictures at the left stop bar at the time \( t + \frac{V}{2a} \) or 3.62 seconds after initiation of the yellow phase.
In practice, however, one would not want to be citing for a violation a vehicle that crossed the left stop bar when the signal indication was still yellow. One quick way around this problem is to follow the ITE practice of making the yellow (change) interval equivalent to or greater than $t + \frac{V}{2a}$ and making the red (clearance) interval equivalent to $\frac{W + L}{V}$. In such a case, common sense still suggests that one should not start taking pictures until some increment of time after the yellow (change) interval has elapsed. This time increment should depend on the precision of the equipment and possibly other factors.

**Step 4. Analyze the data that have been collected**

There is no perfect technique for comparing the data; each technique has its strengths and weaknesses.

- *A simple comparison of “before” and “after” data,* is appealing because the results are readily understood: if sites across the board show a reduction in violation rates, then one might surmise that something at these sites has improved safety. That is, one could compare the average violation rate at intersections in year 2001 (when red light cameras were not present) to the average violation rate at the same intersections in year 2002 (when red light cameras are present).
The disadvantage is that a difference in rates is not necessarily due to the effects of a camera: the cause could be increased enforcement, changes in motorist behavior induced by a public education campaign, random variation, or other factors. Graphically, one would simply need two data elements as shown in Figure 10.

| mean crash rate for 2001 (sites without cameras) |
| mean crash rate for 2002 (sites with cameras) |

Figure 10. Data elements for a simple before/after test

- A Chi-square test with before and after data and control sites (unaffected by red light cameras) can be helpful if one can find good control sites. Using the above example, one would also identify sites with similar characteristics where no cameras were present in 2001 or 2002, to tell if the change from 2001 to 2002 was due to the cameras or due to some long-term trend common to all signalized intersections. Graphically, one would need two more data elements shaded in Figure 11.

| mean crash rate for 2001 (sites without cameras) |
| mean crash rate for 2002 (same sites with cameras) |
| mean crash rate for 2001 (control sites without cameras) |
| mean crash rate for 2002 (control sites without cameras) |

Figure 11. Data elements with a control site
- **An Analysis of Variance (ANOVA) test** can be useful if one wants to make use many individual values rather than only a mean value. For example, rather than simply comparing the mean violation rate of three intersection groups (with cameras, without cameras, and a control group), an ANOVA table makes use of the individual violation rates within each group. The ANOVA approach compares the variability within each group to the variability between groups. In other words, is the variation in violation rates within individual intersections that have a camera as large as the variability among all intersections (those with and without cameras)? Graphically, one would need additional data elements shaded in Figure 12, the crash rates at the individual intersections.

<table>
<thead>
<tr>
<th>Data Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001 rate at site 1, rate at site 2, rate at site 3…</td>
<td>mean crash rate for 2001 (sites without cameras) ⇒</td>
</tr>
<tr>
<td>2002 rate at site 1, rate at site 2, rate at site 3…</td>
<td>mean crash rate for 2002 (sites with cameras) ⇒</td>
</tr>
<tr>
<td>2001 rate at control site A, control site B….</td>
<td>mean crash rate for 2001 (control sites without cameras) ⇒</td>
</tr>
<tr>
<td>2002 rate at control site A, control site B….</td>
<td>mean crash rate for 2002 (control sites without cameras) ⇒</td>
</tr>
</tbody>
</table>

**Figure 12. Data elements for an ANOVA table**

There are a variety of other techniques besides these three just listed. One can choose the analysis technique that fits the question at hand and the data available. For example, in this instance we can decide how to compare the before/after sites in Fairfax County to before/after control sites in Prince William, where the latter county does not have cameras installed. Thus, our data table will look like Figure 13, where violations have been divided by the number of entering vehicles to obtain violation rates. In this example, there are four sites selected from Fairfax County and three sites selected from Prince William County.

<table>
<thead>
<tr>
<th>Site Selection</th>
<th>Average Annual Violation Rate in 2001</th>
<th>Average Annual Violation Rate in 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Sites in Fairfax County (Cameras in 2002 but not in 2001)</td>
<td>400, 410, 420, 300</td>
<td>410, 350, 370, 200</td>
</tr>
<tr>
<td>3 Sites in Prince William County (Cameras never present)</td>
<td>500, 550, 525</td>
<td>510, 560, 490</td>
</tr>
</tbody>
</table>

**Figure 13. Hypothetical Fairfax/Prince William data being used**

Three judgment calls have been made in choosing the data for Figure 13. **First**, average annual rates rather than individual months were analyzed because we would eliminate high and low months from each year using the practices outlined in Step 3 above. **Second**, Prince William County intersections were selected as control sites because they are urbanized (as is Fairfax County) but not subject to red light running. It is always possible that with real data, either or both of these assumptions could be incorrect. **Third**, there is some dependence between the rates...
in 2001 and 2002 (since these are before/after data at the same sites); however, other tests, such as the paired t-test, can be conducted to see if there is a difference from the ANOVA results.

Visual inspection of Figure 13 suggests that the violation rates, on average have decreased somewhat in Fairfax County from 2001 to 2002. On the other hand, violation rates have decreased in Prince William County at one intersection and increased at two other sections over the same period. Yet are these changes significant, or are they due to the inherent variability in violation rates? A two-way analysis of variance (ANOVA) can answer three specific questions:

1. Is there a significant difference between all Fairfax County sites and Prince William County sites?
2. Is there a significant difference between all violation rates in 2001 and violation rates in 2002?
3. Are the differences between Fairfax County and Prince William County spread out evenly between 2001 and 2002?61

There are a number of computer programs (Microsoft Excel, SPSS, NCSS, Minitab, and so forth) that can conduct a two-way analysis of variance (ANOVA). An ANOVA table from the data shown in Figure 13 is given in Figure 14. The larger the column to the right (the computed F value), the more likely that there is a significant difference. In fact, the farthest column to the right—the Significance—indicates the probability that the particular factor has no significant effect on violation rates. Standard practice is that if the value in the significance column is below 0.05, then the particular factor does have a significant effect.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Computed F Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>3</td>
<td>008.540</td>
<td>0.004</td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>691.429</td>
<td>0.000</td>
</tr>
<tr>
<td>COUNTY</td>
<td>1</td>
<td>024.308</td>
<td>0.001</td>
</tr>
<tr>
<td>YEAR</td>
<td>1</td>
<td>000.675</td>
<td>0.430</td>
</tr>
<tr>
<td>COUNTY * YEAR</td>
<td>1</td>
<td>000.452</td>
<td>0.517</td>
</tr>
<tr>
<td>Error</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 14. ANOVA results for the hypothetical data

The three shaded cells in Figure 14 answer questions 1, 2, and 3 respectively.

1. The county (Prince William versus Fairfax) does affect violation rates. With a significance value of 0.001, there is a significant difference between these two counties’ violation rates (with Fairfax County being lower).
2. The year (2001 versus 2002) does not significantly affect violation rates, since 0.430 is relatively large.
3. The interaction of county and year—shown as 0.517—is not significant. In other words, with this data set, the presence of cameras in 2002 does not reflect a significant change in violation rates.62

Step 5. Draw conclusions from the analysis and state the limitations of these conclusions

Findings

The results in Figure 14 indicate that red light cameras did not have a significant effect on violation rates, for the hypothetical data set from Figure 13.

Limitations

There are at least four limitations of this approach:

1. Long-term changes in driver behavior are not addressed with this two-year study.

2. Suppose the results had been different, with all violation rates dropping substantially in 2002. If there is an underlying, confounding reason for a change in violation rates that is common to both the camera sites (Fairfax County) and the control sites (Prince William county), the analysis in Figure 14 will not pinpoint that reason.

3. The broader issues beyond signal operations, such as privacy or compensation for private sector partners and/or municipalities that does not present a conflict of interest with their responsibility of applying traffic laws fairly, have not been addressed.

4. Crashes are (fortunately) rare events. A change in violation rate does not guarantee a change in crash rate; thus, the best analysis will be a long-term comparison of crash rates.

Recommendations of Additional Data That Should Be Collected

This sample approach used two data elements that are not currently available but necessary to conduct an effective evaluation.

- A histogram indicating when potential violators crossed the stop bar, comparable to Figure 8, is needed. Knowing when most vehicles have entered the intersection can help one determine if the yellow time (and follow up all red time) is sufficient. A large number of vehicles crossing the stop bar shortly after the yellow time has elapsed suggests that the yellow time is insufficient. These data may also help answer the long term question as to whether motorist behavior remains constant when the yellow interval increases or whether motorists will take advantage of longer yellow times by treating the initial seconds of the yellow interval as an extended green interval.

- Exposure data, in the form of the total number of vehicles entering an intersection, are needed. If the cameras themselves cannot yet provide these data, then as an interim measure it may be possible to use vehicle counts on major and minor approaches depending on how
often these volumes are sampled. Although some studies in the literature simply tabulated raw numbers of crashes or violations (rather than crashes or violations divided by vehicle volumes), it is appropriate to make the comparison with crash or violation rates as volumes can fluctuate at these intersections.
FINDINGS

The purpose of this report is to document the evaluation of photo monitoring of red light running programs in Virginia. The study was conducted because of the recognition that in Virginia, photo-enforcement programs are implemented by the jurisdictions in an isolated fashion and that much could be gained by learning together and from each other. The advisory committee, formed to guide the work of this study, consisted of representatives from all of the ten jurisdictions within the Commonwealth that are authorized to employ photo monitoring, the FHWA, various divisions and districts within the VDOT and the VTRC. In summary, here are the findings and suggestions of this report.

Implementation

Of the 10 jurisdictions that have authority to implement photo-monitoring programs in Virginia, six jurisdictions have implemented programs. Transportation and law enforcement officials evaluated the options and contributed to the decision to use photo-enforcement in each jurisdiction. The underlying objective of all six programs is to improve intersection safety for drivers and pedestrians through increased compliance with traffic laws, thus reducing violations.

Based on the experience of members of the advisory committee, the key to effective implementation of a photo-monitoring program is to follow a well-defined, clear, inclusive process. This process should include the following: appropriate representation from the jurisdiction, identification of program objectives, adequate provision to achieve objectives and proper evaluation and selection of sites.

A proper process for selecting photo red light monitoring sites is a critical component of an effective program. Automated enforcement of the red light will be most effective if the intersection is engineered appropriately to encourage good driver behavior. The Suggested process to Select and Evaluate Sites described in this report includes a thorough engineering review of the intersection to look for possible causes of the violation or accident problems. At a minimum, the review should include a determination that the sight distance of the signal is adequate and that the duration of the yellow phase is sufficient for drivers to stop or pass the stop bar before the red phase begins.

Equipment

Technological choices vary—four of the jurisdictions use 35mm, wet film cameras, and two use digital video. Each implementation is tailored by the jurisdiction to the unique traffic circumstances in the locality and the intersection. Basic camera technologies are 35mm wet film, digital still cameras and digital video. The variety of photo-monitoring system vendors offer the same basic functionality: cameras at the intersection recording traffic violations with a back office processing system to review violations, compile statistics and issue citations.
Public Awareness

All six jurisdictions created public awareness of the photo-monitoring program before implementing it. Each jurisdiction chose appropriate media for their implementation including signs, mailings, media releases, brochures and web site information. Public response has been uniformly positive to photo-monitoring programs.

A public awareness campaign should precede the issuance of citations and may combine media releases, roadway signs, web site information, mailings, and warning periods. It is important to let the public know the purpose, objectives and extent of the red light running problem—the crashes that it causes and the costs to all of us. Such information will help gain support and raise awareness that may increase voluntary compliance. By including citizens into the problem and the tools for addressing the problem, we invite them to be part of the solution. Communication with the public should be an on-going effort.

Evaluation

Virginia jurisdictions have used violation statistics to assess the effectiveness of the cameras. The City of Fairfax has had a more detailed evaluation of the effectiveness of its photo-monitoring program performed by the IIHS.

This report identifies five iterative steps that may be used for evaluating photo enforcement effectiveness:

1. Define the objectives of the photo-enforcement program.
2. Determine the data necessary to conduct the evaluation.
3. Ensure that the signal is functioning correctly, including a sufficient change plus clearance interval.
4. Analyze the data that have been collected.
5. Draw conclusions from the analysis and state the limitations of these conclusions.

Gathering two additional types of data is also recommended for a thorough evaluation: (1) a histogram indicating when potential violators crossed the stop bar can help one determine if the yellow time (and follow up all red time) is sufficient, and (2) exposure data, in the form of the total number of vehicles entering an intersection, since traffic volume can fluctuate at these intersections.

The consensus of the advisory committee is that each jurisdiction must tailor the implementation and evaluation aspects of a photo-monitoring program to their own needs, objectives, and available resources while keeping public safety as the most important goal.
Appendix A—Highway Laws of Virginia

§ 46.2-833.01. (Effective until July 1, 2005.) Use of photo-monitoring systems to enforce traffic light signals; penalty.

A. The governing body of any city having a population of more than 390,000, any city having a population of at least 200,000 but less than 225,000, any county having the urban county executive form of government, any county adjacent to such county, and any city or town adjacent to or surrounded by such county except any county having the county executive form of government and the cities surrounded by such county may provide by ordinance for the establishment of a demonstration program imposing monetary liability on the operator of a motor vehicle for failure to comply with traffic light signals in such locality in accordance with the provisions of this section. Each such locality may install and operate traffic light signal photo-monitoring systems at no more than twenty-five intersections within each locality at any one time.

B. The operator of a vehicle shall be liable for a monetary penalty imposed pursuant to this section if such vehicle is found, as evidenced by information obtained from a traffic light signal violation monitoring system, to have failed to comply with a traffic light signal within such locality.

C. Proof of a violation of this section shall be evidenced by information obtained from a traffic light signal violation monitoring system authorized pursuant to this section. A certificate, sworn to or affirmed by a technician employed by a locality authorized to impose penalties pursuant to this section, or a facsimile thereof, based upon inspection of photographs, microphotographs, videotape, or other recorded images produced by a traffic light signal violation monitoring system, shall be prima facie evidence of the facts contained therein. Any photographs, microphotographs, videotape, or other recorded images evidencing such a violation shall be available for inspection in any proceeding to adjudicate the liability for such violation pursuant to an ordinance adopted pursuant to this section.

D. In the prosecution of an offense established under this section, prima facie evidence that the vehicle described in the summons issued pursuant to this section was operated in violation of this section, together with proof that the defendant was at the time of such violation the owner, lessee, or renter of the vehicle, shall constitute in evidence a rebuttable presumption that such owner, lessee, or renter of the vehicle was the person who committed the violation. Such presumption shall be rebutted if the owner, lessee, or renter of the vehicle (i) files an affidavit by regular mail with the clerk of the general district court that he or she was not the operator of the vehicle at the time of the alleged violation or (ii) testifies in open court under oath that he or she was not the operator of the vehicle at the time of the alleged violation. Such presumption shall also be rebutted if a certified copy of a police report, showing that the vehicle had been reported to the police as stolen prior to the time of the alleged violation of this section, is presented, prior to the return date established on the summons issued pursuant to this section, to the court adjudicating the alleged violation.

E. For purposes of this section "owner" means the registered owner of such vehicle on record with the Department of Motor Vehicles. For purposes of this section, "traffic light signal violation-monitoring system" means a vehicle sensor installed to work in conjunction with a traffic light that automatically produces two or more photographs, two or more microphotographs, a videotape, or other recorded images of each vehicle at the time it is used or operated in violation of §§ 46.2-833, 46.2-835, or § 46.2-836. For each such vehicle, at
least one recorded image shall be of the vehicle before it has illegally entered the intersection, and at least one recorded image shall be of the same vehicle after it has illegally entered that intersection.

F. Imposition of a penalty pursuant to this section shall not be deemed a conviction as an operator and shall not be made part of the operating record of the person upon whom such liability is imposed nor shall it be used for insurance purposes in the provision of motor vehicle insurance coverage. No monetary penalty imposed under this section shall exceed fifty dollars nor shall it include court costs.

G. A summons for a violation of this section may be executed pursuant to § 19.2-76.2. Notwithstanding the provisions of § 19.2-76, a summons for a violation of this section may be executed by mailing by first-class mail a copy thereof to the address of the owner, lessee, or renter of the vehicle as shown, in the case of vehicle owners, in the records of the Department of Motor Vehicles or, in the case of vehicle lessees or renters, in the records of the lessor or rentor. Every such mailing shall include, in addition to the summons, a notice of (i) the summoned person's ability to rebut the presumption that he was the operator of the vehicle at the time of the alleged violation through the filing of an affidavit as provided in subsection D of this section and (ii) instructions for filing such affidavit, including the address to which the affidavit is to be sent. If the summoned person fails to appear on the date of return set out in the summons mailed pursuant to this section, the summons shall be executed in the manner set out in § 19.2-76.3. No proceedings for contempt or arrest of a person summoned by mailing shall be instituted for failure to appear on the return date of the summons.

H. In any action at law brought by any person or entity as the result of personal injury or death or damage to property, such evidence derived from a photo-monitoring system shall be admissible in the same method prescribed as required in the prosecution of an offense established under this section without the requirements of authentication as otherwise required by law.

I. On behalf of a locality, a private entity may not obtain records regarding the registered owners of vehicles which fail to comply with traffic light signals. A private entity may enter into an agreement with a locality to be compensated for providing the traffic light signal violation-monitoring system or equipment, and all related support services, to include consulting, operations and administration. However, only an employee of the locality may swear to or affirm the certificate required by subsection C.


Editor's note. - Acts 1998, cc. 663 and 685, cl. 2 provides: "That the second enactment [which provided for the expiration of this section on July 1, 2000] of Chapter 492 of the Acts of Assembly of 1995, as amended, is repealed."

The 1998 amendments. - The 1998 amendments by cc. 663 and 685 are identical, and added subsection J.
The 1999 amendment, substituted "owner, lessee, or renter" for "registered owner" throughout the section, in subsection E, deleted the former second sentence, which read: "For purposes of this section 'owner' does not mean a vehicle rental or vehicle leasing company," and substituted "'lessee, or renter of the vehicle' as shown, in the case of vehicle owners, in the records of the Department of Motor Vehicles or, in the case of vehicle lessees or renters, in the records of the lessor or rentor. Every such mailing shall include, in addition to the summons, a notice of (i) the summoned person's ability to rebut the presumption that he was the operator of the vehicle at the time of the alleged violation through the filing of an affidavit as provided in subsection D of this section and (ii) instructions for filing such affidavit, including the address to which the affidavit is to be sent" for "of the vehicle as shown on the records of the Department of Motor Vehicles" in subsection G.

The 2000 amendments. - The 2000 amendment by c. 575, in subsection E, substituted "§§ 46.2-833, 46.2-835, or § 46.2-836" for "this section" at the end of the second sentence and added the third sentence.
Introduction and Problem Statement
In 1995, the General Assembly authorized the use of photo-red light monitoring to enforce red lights in several jurisdictions in the Commonwealth. This automated enforcement can detect and cite motorists who enter a signalized intersection during the red phase. Through increased compliance, this photo-enforcement program has the potential to reduce accidents not only at the intersections being monitored, but also at all intersections throughout the jurisdictions using this approach. Objectives cited by localities having implemented the program include increasing safety for motorists and for pedestrians and bicyclists as well.

According to the Federal Highway Administration (FHWA), approximately 800,000 motor vehicle collisions occurred at signalized intersections resulting in over one-half million injuries and several thousand fatalities in 1997 and the number of collisions has been increasing over the last five years. (1) In one study of four urban areas conducted by the Insurance Institute for Highway Safety, it was estimated that 22 percent of crashes were caused by the driver violating a traffic control device. (1,2)

Two significant measures identified by the FHWA to combat red light running are to provide proper signal timing and enforcement. Many states, like Virginia, have authorized the use of photo-enforcement to combat red light running. A pilot program has been authorized in the following cities and counties:

Cities of Virginia Beach, Richmond, Alexandria, Fairfax City, Falls Church, Vienna and Herndon

Counties of Fairfax, Loudoun, and Arlington

The jurisdictions that have implemented photo-enforcement have gone about it in a number of ways. There are differences in the type of equipment used for collecting the data, the mobility of the systems, when and how many pictures are taken, signal timing issues, placement or warning signs and special features. Another inconsistency lies in the variety of criteria that are applied for selecting intersections to be monitored. Selection is made using some combination of the following: Accident reports, police and citizen input, intersection configuration, difficulty of enforcement.

The issues mentioned all relate to traffic operations, but there are other significant issues that need to be addressed, such as public process and public acceptance. Two of the most noted
opposing positions are that cameras are an invasion of personal privacy and that the programs are implemented not to improve safety, but to make money for the jurisdiction and the contractor. The latter view has given rise to great scrutiny of amber timings. If the yellow time is insufficient, drivers are unable to stop before the red phase begins and may be ticketed unjustly. This suggests a need for good selection and evaluation criteria as part of every effective implementation.

While some elements of red light photo-enforcement do not fall under VDOT ownership (for example, enforcement), others do, such as signal timing. Therefore VDOT is committed to study and address issues that are appropriate for VDOT to deal with. This is essential for effective and fair implementation, which can be achieved through consistent, reasonable guidelines and implementation strategies.

The advisory committee recognizes that this is a new program for the state of Virginia, and relatively new for the country. As such there are currently no best practices. There are lessons to be learned and improvements that can be made to existing and future programs.

Within the Commonwealth, there are many cities and two counties that own and operate their own traffic signals; the remainder are owned and operated by VDOT. In those localities that own the signals, all aspects of photo-enforcement are handled from within the jurisdiction. For those localities where VDOT owns the signals, a state permit is required. The locality is responsible for all aspects of the program, however, VDOT sets the signal timings. This necessitates additional coordination and communication.

**Purpose**
The purpose of this study is to document the current practices relating to the equipment, implementation and the evaluation of the photo-red light running program in Virginia, to identify related concerns and to identify possible solutions. The study will be limited to only those issues that are of a technical nature and fall within the focus of the traffic-engineering field.

It is also a purpose of this study to develop minimum guidelines of coordination for those jurisdictions where VDOT operates the traffic signals.

**Study Tasks**
The first set of objectives relates to current practices of the program. The specific tasks are:

1.1 Document the photo-enforcement programs currently underway in Virginia. This will include an overview of the type of equipment in use, intersection selection criteria, signal timing evaluations, public awareness programs, and evaluation techniques.
1.2 Identify critical issues and concerns faced by the jurisdictions in the implementation and on-going operation of their programs.
The second set of tasks relates to improving future implementation and operation of the program. Specifically,

2.1 Identify possible solutions to critical issues that were identified.
2.2 Develop recommended practices of implementation and operation.
2.3 Develop guidelines to enhance coordination and improve overall implementation in those jurisdictions whose signals are owned by the state.

The final set of tasks relates to evaluation of the photo enforcement program. Tasks associated with this are:

3.1 Develop guidelines for appropriate and consistent program evaluation, including how best to assess the program’s effectiveness in light of stated objectives.
3.2 Develop a vehicle for ongoing sharing of evaluations and experiences between study committee and method of disseminating information to other interested parties.

Study Advisory Committee
As this issue has statewide implications, a wide variety of participation is needed to assure comprehensive evaluation and also to help insure that any policies or recommendations made by the committee are implemented. We recommend that representation be included from the following divisions or organizations:

Traffic Engineering Division Central Office
Traffic Engineering Section Districts
Virginia Transportation Research Council
Participating Local Jurisdictions
Enforcement Agencies
Public Affairs Division Central Office

Schedule
The work of this committee will begin immediately with invitations being sent out to potential committee representatives by mid-August and the initial meeting to be held shortly after. Work will continue throughout the fall with our goal of having a draft report complete by early December.

References
Appendix C—Sample Study Invitation Letter

MEMORANDUM

August 14, 2001

TO: Travis Bridewell
Loren Epton
Wayne Ferguson
Ray Khoury
Linda South
Joyce Curtis, Assistant Division Administrator FHWA

From: Ilona O. Kastenhofer

Subject: Evaluation of Photo Enforcement, Study Committee

We are beginning a study of the red light photo enforcement programs in the Commonwealth and invite your participation.

The purpose of the study is to evaluate the current practices and programs being implemented in Virginia and make recommendations regarding the implementation and operation of the program as well as its on-going evaluation. While some elements of red light photo-enforcement do not fall under VDOT ownership (for example, enforcement), others do, such as signal timing. We are committed to studying and addressing issues in a collaborative effort. The attached Study Work Plan details our objectives and study scope. The planned content of the first meeting includes: discussion of study objectives and scope, overview of current practices and issues, discussion of study process. A thorough evaluation of this demonstration program is essential for effective and fair implementation, which can be achieved through consistent and reasonable implementation guidelines and strategies.

The first meeting of the advisory committee will be held on Thursday August 30, 2001 at 10:00 here at the Central Office in the Monroe Building, conference Room D. This is an opportunity to learn more about current practices, exchange ideas, and to improve implementation of photo-monitoring systems. Please contact Mena Lockwood at 804-371-0849 with the name of your representative. Additional meeting details will be provided at that time.

Thank you for your cooperation.

Attachment (See Appendix B)
Appendix D—Sample Study Invitation Letter (Implemented Jurisdictions)

August 21, 2001

Dear (See Appendix E):

In 1995, the General Assembly authorized the use of photo-monitoring systems, as a demonstration program, to enforce red lights in several jurisdictions in the Commonwealth. We are beginning a study of the programs in the Commonwealth and invite your participation.

The purpose of our study is to evaluate the current practices and programs being implemented in Virginia and make recommendations regarding the implementation and operation of the program as well as its on-going evaluation. While some elements of red light photo-enforcement do not fall under the Virginia Department of Transportation (VDOT) ownership (for example, enforcement), others do, such as signal timing. We are committed to studying and addressing issues in a collaborative effort. The attached Study Work Plan details our objectives and study scope. The planned content of the first meeting includes: discussion of study objectives and scope, overview of current practices and issues, and discussion of study process. A thorough evaluation of this demonstration program is essential for effective and fair implementation, which can be achieved through consistent, reasonable implementation guidelines and strategies. I will facilitate the study process and the project manager will be Ms. Mena Lockwood, Senior Traffic Engineer.

Your jurisdiction has implemented this enforcement tool and we would like your participation in a Study Advisory Committee. We see this as an opportunity to learn more about current practices, exchange ideas with each other, and to improve implementation of photo-monitoring systems.

The first meeting of the advisory committee will be held on Thursday, August 30, 2001 at 10:00 A.M. in the Monroe Building Conference Room D, 101 North 14 Street, Richmond, Virginia 23219. If you would like to participate, please contact Ms. Lockwood of our Traffic Engineering Division at 804-371-0849 with the name of your representative.

I know that you share my interest in increasing the safety of our intersections and hope that you will join us in the evaluation of this demonstration program. Thank you for your time and consideration.

Sincerely,

Ilona O. Kastenhofer

Cc: Mr. Andrew V. Bailey, II
    Ms. Mena Lockwood
Appendix E—Addressees for Letter to Implemented Jurisdictions

Jurisdictions that have implemented programs.
Letter sent to following persons:

Mr. Young Ho Chang, P.E., Director
Fairfax County Department of Transportation
12055 Government Center Parkway
Suite 1034
Fairfax, Virginia  22035-5511

Mr. John Veneziano, Director
Department of Public Works
City of Fairfax
10455 Armstrong Street
Room 204
Fairfax, Virginia  22030

Mr. Robert Murray, Chief
City of Falls Church
300 Park Avenue
Falls Church, Virginia  22046

Mr. Terry Bellamy, Chief
Traffic Engineering Division
County of Arlington
2100 Clarendon Boulevard
Suite 706
Arlington, Virginia  22201
Dear (See Appendix G):

In 1995, the General Assembly authorized the use of photo-monitoring systems, as a demonstration program, to enforce red lights in several jurisdictions in the Commonwealth. We are beginning a study of the programs in the Commonwealth and invite your participation.

The purpose of our study is to evaluate the current practices and programs being implemented in Virginia and make recommendations regarding the implementation and operation of the program as well as its on-going evaluation. While some elements of red light photo-enforcement do not fall under the Virginia Department of Transportation (VDOT) ownership (for example, enforcement), others do, such as signal timing. We are committed to studying and addressing issues in a collaborative effort. The attached Study Work Plan details our objectives and study scope. The planned content of the first meeting includes: discussion of study objectives and scope, overview of current practices and issues, and discussion of study process. A thorough evaluation of this demonstration program is essential for effective and fair implementation, which can be achieved through consistent, reasonable implementation guidelines and strategies. I will facilitate the study process and the project manager will be Ms. Mena Lockwood, Senior Traffic Engineer.

As your jurisdiction is authorized to implement this enforcement tool, you are invited to participate in the Study Advisory Committee along with those jurisdictions who have already implemented a photo-enforcement program. We see this as an opportunity to learn more about current practices, exchange ideas with each other, and to improve implementation of photo-monitoring systems.

The first meeting of the advisory committee will be held on Thursday, August 30, 2001 at 10:00 A.M. in the Monroe Building Conference Room D, 101 North 14 Street, Richmond, Virginia 23219. If you would like to participate, please contact Ms. Lockwood of our Traffic Engineering Division at 804-371-0849 with the name of your representative.

I know that you share my interest in increasing the safety of our intersections and hope that you will join us in the evaluation of this demonstration program. Thank you for your time and consideration.

Sincerely,

Ilona O. Kastenhofer

Attachment (See Appendix B)

Cc: Mr. Andrew V. Bailey, II
   Ms. Mena Lockwood
Appendix G—Addressees for Letter to Authorized Jurisdictions

Jurisdictions that are authorized to but have not implemented programs.
Letter sent to the following persons:

Mr. James Spore  
City Manager  
City of Virginia Beach  
Municipal Center  
2401 Courthouse Drive  
Virginia Beach, Virginia  23456-9031

Ms. Vanloan Nguyen, P.E.  
City Traffic Engineer  
City of Richmond  
City Hall, Room 707  
900 East Broad Street  
Richmond, Virginia  23219

Mr. John E. Moore, Jr.  
Town Manager  
Town of Herndon  
777 Lynn Street  
Suite 105  
Herndon, Virginia  20172

Ms. Terry Laycock, Acting Director  
Office of Transportation  
County of Loudoun  
P.O. Box 7000  
Leesburg, Virginia  20177
Appendix H—Committee Agenda (08/30/01)

EVALUATION OF PHOTO ENFORCEMENT IN VIRGINIA
VIRGINIA DEPARTMENT OF TRANSPORTATION
ADVISORY COMMITTEE MEETING
August 30, 2001

Proposed Sub Committees with co-chairs

- Equipment – Mark Hagan
- Implementation and Public Awareness Campaigns – Mena Lockwood
- Evaluation – John Miller

Action Items:

- Make changes to the work plan based on group discussion and disseminate to committee for further comment.
- Document current practices (updating and expanding existing table) this will be done through a questionnaire that the co-chairs will help develop, which we will be sent out to all the jurisdictions.
- Send out TE-306 to committee.

Next Steps:

- Document Current practices:  *(Work on-going in Sept.)*
- Identify Concerns:  *(Work on-going in October)*
  Committees work to identify issues

- Develop Guidelines and Recommended Practices:
  *(Work on-going in November)* Committees work to identify best practices in related issues.

- Second Meeting of Advisory Meeting is held to present findings and discuss  *(last week of November)*

- Final Report Issued  *(tentative date – early December):*

- Vehicle is set up for On-going Communication and Exchange of Information
### Appendix I—First Meeting Attendees

**Photo-Monitoring Evaluation Advisory Committee**  
August 30, 2001

<table>
<thead>
<tr>
<th>Name</th>
<th>Agency</th>
<th>Phone Number</th>
<th>E-Mail Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travis Bridewell</td>
<td>VDOT</td>
<td>804-524-6119</td>
<td><a href="mailto:bridewell_tc@vdot.state.va.us">bridewell_tc@vdot.state.va.us</a></td>
</tr>
<tr>
<td>M. D. Cassidy</td>
<td>VDOT</td>
<td>804-524-6111</td>
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</tr>
<tr>
<td>Sgt. S. D. Kurrle</td>
<td>VBPD</td>
<td>757-427-8957</td>
<td><a href="mailto:skurrle@vbegov.com">skurrle@vbegov.com</a></td>
</tr>
<tr>
<td>Ramin Sabet</td>
<td>Town of Herndon-Engr.</td>
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</tr>
<tr>
<td>Chief Bob Carlisle</td>
<td>Town of Vienna Police</td>
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<td><a href="mailto:chief@vienna.va.us">chief@vienna.va.us</a></td>
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<td>Lt. Robert A. Gray</td>
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<td>Fairfax Co. Dept. of Trans.</td>
<td>703-324-1185</td>
<td><a href="mailto:bruce.taylor1@co.fairfax.va.us">bruce.taylor1@co.fairfax.va.us</a></td>
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<td>Fairfax Co. DOT</td>
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<tr>
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<td>434-293-1999</td>
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<td>Vanloan Nguyen</td>
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<td><a href="mailto:hagan-md@vdot.state.va.us">hagan-md@vdot.state.va.us</a></td>
</tr>
<tr>
<td>K. Todd Morrison</td>
<td>VDOT – Hampton Roads</td>
<td>757-925-2566</td>
<td><a href="mailto:morrison_kt@vdot.state.va.us">morrison_kt@vdot.state.va.us</a></td>
</tr>
<tr>
<td>Steve Brich</td>
<td>VDOT – Asst. Traffic Engr.</td>
<td>804-786-7941</td>
<td><a href="mailto:brich_sc@vdot.state.va.us">brich_sc@vdot.state.va.us</a></td>
</tr>
<tr>
<td>Terrie Laycock</td>
<td>County Admn. Loudoun</td>
<td>703-777-0553</td>
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</tr>
<tr>
<td>John Patton, Mjr.</td>
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<td>703-777-0625</td>
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<td>Cheryl Reints</td>
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</tr>
</tbody>
</table>

**Additional Representatives:**  
Kevin Bowser  
Fairfax City Police Dept  
703-293-7102  
kbowser@ci.fairfax.va.us  
Mark Canoyer  
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Chief Robert Murray  
Falls Church Police dept
Appendix J—Sample Questionnaire on Current Practices

Evaluation of Photo-Enforcement in Virginia
Advisory Committee
Current Practices Questionnaire
September 2001

Jurisdiction:

Contact:

Equipment and Daily Operations of Photo-Enforcement Program:

1. Are you currently using red light photo-enforcement equipment at this time? (yes, no) Have you ever used such equipment?

(if your jurisdiction currently does not employ photo red light monitoring equipment, please provide any information you deem appropriate about your exploration of the issues, or steps toward defining objectives, etc.)

2. Please describe the type of red light photo-enforcement equipment you are using? Include the brand of equipment and the contractor.

3. If you are using a camera system, what pictures are taken? Where is the camera located? Where is the car located when the picture is taken? Are the pictures taken from the front or the rear of the vehicle? Describe either in relation to the intersection or in relation to time.

4. What is the lag between initiation of red phase and first photo?

5. Are loops utilized? If so, describe placement.

6. What, if any, warning or information signs are used? Where are they placed?

7. Are there any special features or safety designs of the program?

Implementation

1. How many cameras are you currently using in your jurisdiction?

2. How many signals have housings for cameras?

3. What is the total number of signals that you have in your jurisdiction?

4. When was the program implemented? Please give details as to the number of cameras that were first used and how many more have been added since then.
5. What was the process for gaining approval for the implementation of the red light running program. Please include the position of those people involved in the decision making process.

6. What are the specific objectives of the use of photo-red light running cameras in your jurisdiction?

7. What criteria do you use to select intersections? Who is involved in the process? What type of data is collected?

8. Is the timing of the lights considered or evaluated before installing a camera at a particular intersection? How?

Public Awareness

1. Please describe the public information program used to launch or to gain approval for the photo-enforcement program and any on-going communication. How far in advance of implementation was the public information program begun?

2. Which methods of communication do you find to be most effective in reaching and informing the greatest numbers of people?

3. Have you done any surveys of public acceptance? What are the results?

4. What type of feedback have you received from the public? From what groups? I.e. those who have received tickets, those who are citizens in the jurisdiction, those who are visitors to the jurisdiction.

Evaluation

1. Have you conducted an evaluation of the effectiveness of the system?

2. What criteria did you use?

3. What data do you collect at the intersections with cameras and with what frequency? Please include a copy of a regular report if available.

4. What type of data was collected before implementation of the program to develop a picture of the “before” situation?

Please include any other information pertinent to the purpose of this study.
Appendix K—Alexandria Response

Evaluation of Photo-Enforcement in Virginia
Advisory Committee
Current Practices Questionnaire
September 2001

Jurisdiction:
Contact:
Equipment and Daily Operations of Photo-Enforcement Program:

1. Are you currently using red light photo-enforcement equipment at this time? (yes, no) Have you ever used such equipment?
   Yes
   (if your jurisdiction currently does not employ photo red light monitoring equipment, please provide any information you deem appropriate about your exploration of the issues, or steps toward defining objectives, etc.)

2. Please describe the type of red light photo-enforcement equipment you are using? Include the brand of equipment and the contractor.

   Gatso Red Light Camera Type 36 MS-MC

3. If you are using a camera system, what pictures are taken? Where is the camera located? Where is the car located when the picture is taken? Are the pictures taken from the front or the rear of the vehicle? Describe either in relation to the intersection or in relation to time.

   Photos are taken prior to vehicle entry into the intersection (after red activation) and while in the intersection. All Photos are taken from the rear.

4. What is the lag between initiation of red phase and first photo?
   .3 Seconds

5. Are loops utilized? If so, describe placement.

   Yes – they are positioned so that the vehicle breaks the magnetic field and activates the camera .3 seconds after the red phase has initiated but prior to the vehicle entering the intersection

6. What, if any, warning or information signs are used? Where are they placed?

   Signs are located at every major entrance to the City including each of our three red light camera locations
7. Are there any special features or safety designs of the program?

There are no special safety features of our Red light Camera technology.

Implementation

1. How many cameras are you currently using in your jurisdiction? One

2. How many signals have housings for cameras? Three

3. What is the total number of signals that you have in your jurisdiction?

I don’t know – I have inquired with our Transportation Department and will supply this information when it is available.

4. When was the program implemented? Please give details as to the number of cameras that were first used and how many more have been added since then.

November 12, 1997– Our program was initiated with three sites and a single camera – no changes has been made to date.

5. What was the process for gaining approval for the implementation of the red light running program. Please include the position of those people involved in the decision making process.

Our program was largely initiated by our City Council.

6. What are the specific objectives of the use of photo-red light running cameras in your jurisdiction?

Primarily to reduce the incidence of red light violations at the subject intersections.

7. What criteria do you use to select intersections? Who is involved in the process? What type of data is collected?

Sites were selected with input from the Police Department, the City Department of Transportation, and City management and were approved by City Council.

8. Is the timing of the lights considered or evaluated before installing a camera at a particular intersection? How?

Not in our initial application of the program.
Public Awareness

1. Please describe the public information program used to launch or to gain approval for the photo-enforcement program and any on-going communication. How far in advance of implementation was the public information program begun?

An extensive pre-implementation program began in September 1999. This involved the mailing of an information post card to all City residences and businesses, the erection of signs at every major entrance to the City, and multiple exposures in the print and electronic media.

2. Which methods of communication do you find to be most effective in reaching and informing the greatest numbers of people?

Hard to tell – however local newspaper and television coverage seemed to generate the most reaction.

3. Have you done any surveys of public acceptance? What are the results? No

4. What type of feedback have you received from the public? From what groups? I.e. those who have received tickets, those who are citizens in the jurisdiction, those who are visitors to the jurisdiction.

Feedback has been generally positive even from many who have received citations. Some feedback has come from persons opposed to the program for a variety of constitutional and personal privacy reasons and a few of those who have received citations object on the grounds that, although the program is good, the camera’s must have malfunctioned in their particular instance.

Evaluation

1. Have you conducted an evaluation of the effectiveness of the system? Informally

2. What criteria did you use?

We looked at the trend in violations per pass at the three intersections

3. What data do you collect at the intersections with cameras and with what frequency? Please include a copy of a regular report if available.

Substantial data is collected by the camera/computer at each intersection which can be provided.

4. What type of data was collected before implementation of the program to develop a picture of the “before” situation?
Motor vehicle accident data in the vicinity of the intersections had been gathered prior to program implementation.

Please include any other information pertinent to the purpose of this study.

[By email] I have answered the questionnaire and attached some charts of our violations-per-pass experience which illustrate the importance of "other" considerations on the rate at which red lights are violated. At both Patrick/Gibbon and Seminary/Nottingham (charts 2 and 3) other factors significantly contributed to steep drops in our rate of red light running. In the case of Patrick and Gibbon the cause was a retiming of the lights immediately preceding this intersection which had a profound impact. Similarly, the retiming of the yellow phase at Seminary and Nottingham had a dramatic effect.

No such changes occurred at the Duke and Walker intersection. While the violations-per-pass were low to begin with there has been a noticeable reduction since the program began. Feel free to give me a call with questions or comments.

Mark Canoyer, Tech. Services Div. Chief
Alexandria Police Department
Appendix L—Arlington Response

Evaluation of Photo-Enforcement in Virginia
Advisory Committee
Current Practices Questionnaire
September 2001

Jurisdiction: Arlington County
Contact: Terry Bellamy, Division Chief-Traffic Engineering

Equipment and Daily Operations of Photo-Enforcement Program

1. Yes.
2. ACS Camera System
3. Uses 1 camera and flash facing signal positioned to capture the license plate in the intersection. Two pictures are taken, one of the rear of the vehicle before it enters the intersection with the traffic signal showing the red light. The second picture is of the vehicle in the intersection with the red traffic signal.
4. There is a lag time of .2 second from the time the light turns red to when a photograph is taken.
5. Yes, metallic detection. Prior to the solid white stop lines.
6. Warning signs are posted a various entrances and other locations throughout the County.
7. Site Selection has included studying accident data, red light running data, receiving suggestion input from citizens, civic associations and police officers. Sites are video validated before the final decision

Implementation:

1. 4 cameras.
2. 7 signals with housings for cameras.
3. 250 signalized intersections.
4. 1999--started with one intersection pilot.
5. 1989, The Board of Directors of the Metropolitan Washington Council of Governments passed a favorable resolution. 1990, the Arlington County Police Department transmitted to the County Manager, a favorable recommendation endorsing the use of the technology. 1991, State Senator Edward M. Holland proposed to have legislation enacted permitting the use of the technology in Arlington County. 1992, Virginia Transportation Research Council conducted a pilot project for the use of the Technology on the Capital Beltway. Virginia passed a statute to allow the implementation in Arlington. The Final authorization in this process in Arlington County was the County Board.
6. The major objective was to address citizen concerns over speeding autos through intersections in high pedestrian areas. The intent was to address the pedestrian safety aspect to traffic signal enforcement.
7. The criteria used include: address, volumes, pedestrian, automobile, accident history, site distances, crossing distances and roadway lightings. The vendor Lockheed Martin performs a before analysis to see if a camera can work at particular intersection. Due to
phases, possible location for placement of the cameras and the history of accidents and red-light running.

8. Yes. Information when requested from the county is provided to the vendor.

Public Awareness

1. Signage and neighborhood outreach with civic associations. Since this technology is being used in Fairfax County, Alexandria City and the District of Columbia, many of the motorists are aware of the program and the signage.

2. Signage.

3. No.

4. We are receiving feedback for additional locations. However, photo red light is merely another tool to reduce speeding through red-lights. At times the lack of contact with a police officer affect the violator's, however, we are not seeing the high numbers of appeals.

Evaluation

DPW--Traffic Engineering continued to monitor accident data and to see if there are reductions. I have contacted the Police Department for additional information.
Appendix M—Fairfax (City) Response

Evaluation of Photo-Enforcement in Virginia
Advisory Committee
Current Practices Questionnaire
September 2001

Jurisdiction: Fairfax City

Contact: Kevin Bowser

Equipment and Daily Operations of Photo-Enforcement Program:

1. Are you currently using red light photo-enforcement equipment at this time? Yes
   Have you ever used such equipment? Yes

(if your jurisdiction currently does not employ photo red light monitoring equipment, please provide any information you deem appropriate about your exploration of the issues, or steps toward defining objectives, etc.)

2. Please describe the type of red light photo-enforcement equipment you are using? Include the brand of equipment and the contractor.
   35mm cameras with presence loops, ACS contractor, Cameras are Gatso.

3. If you are using a camera system, what pictures are taken? Where is the camera located? Where is the car located when the picture is taken? Are the pictures taken from the front or the rear of the vehicle? Describe either in relation to the intersection or in relation to time.
   Two rear view pictures are taken first when car is just prior to stop bar, second when car is in middle of intersection. Camera is facing the red light it monitors on right side of the intersection near sidewalk.

4. What is the lag between initiation of red phase and first photo?
   System begins taking photos at .4 seconds.

5. Are loops utilized? If so, describe placement.
   Two loops placed just prior to stop bar. If traffic flows to the right it looks like this:

6. What, if any, warning or information signs are used? Where are they placed?
   Signs say red lights are photo enforced. Placed at all major entrances to the city

7. Are there any special features or safety designs of the program?
   No special features.
Implementation

1. How many cameras are you currently using in your jurisdiction?
   3 cameras

2. How many signals have housings for cameras?
   8 locations camera ready.

3. What is the total number of signals that you have in your jurisdiction?
   58

4. When was the program implemented? Please give details as to the number of cameras that were first used and how many more have been added since then. August 1997 was first full month. One camera rotated between three intersections. May 1998 second camera and five more intersections added. October third camera added. Presently rotating two cameras between six intersections, one camera full time at one intersection and one intersection has been retired.

5. What was the process for gaining approval for the implementation of the red light running program. Please include the position of those people involved in the decision making process. City council and mayor wanted photo red light. Implementation team consisted of Director of Public Works, Clerk of Court and Police Captain.

6. What are the specific objectives of the use of photo-red light running cameras in your jurisdiction? To reduce red light violations, reduce intersection accidents, change driver behavior.

7. What criteria do you use to select intersections? Who is involved in the process? What type of data is collected? Accident and violation data are gathered. Police department suggests locations. Vender advises as to whether locations are feasible in terms of construction and layout.

8. Is the timing of the lights considered or evaluated before installing a camera at a particular intersection? How? All lights in Fairfax City are 3.5 second or greater. Max speed is 35.

Public Awareness

1. Please describe the public information program used to launch or to gain approval for the photo-enforcement program and any on-going communication. How far in advance of implementation was the public information program begun? Notices were mailed to all City residents a month before implementation. Press releases were given to local media. A warning period of thirty days was used, cameras were functional but did no tickets were issued.

2. Which methods of communication do you find to be most effective in reaching and informing the greatest numbers of people? Media and mailings.
3. Have you done any surveys of public acceptance? What are the results? The City of Fairfax has not but the Insurance Institute for Highway Safety has.

4. What type of feedback have you received from the public? From what groups? I.e. those who have received tickets, those who are citizens in the jurisdiction, those who are visitors to the jurisdiction. Most feedback has been positive from violators and non-violators alike. Most people support the use of cameras.

Evaluation

1. Have you conducted an evaluation of the effectiveness of the system? The city has not officially but IIHS has. IIHS report attached.

2. What criteria did you use? The city looks at the violation rate per hour at each site to determine if the cameras are effective. But, this relies on the vendors data.

3. What data do you collect at the intersections with cameras and with what frequency? Please include a copy of a regular report if available. Monthly report attached.

4. What type of data was collected before implementation of the program to develop a picture of the “before” situation? Accident and violation data.

Please include any other information pertinent to the purpose of this study.
Appendix N—Fairfax (County) Response

Evaluation of Photo-Enforcement in Virginia
Advisory Committee
Current Practices Questionnaire
September 2001

Jurisdiction: Fairfax County
Contact: Bruce Taylor 703-324-1185

Equipment and Daily Operations of Photo-Enforcement Program:

1. Are you currently using red light photo-enforcement equipment at this time? (yes, no) Have you ever used such equipment? YES

2. Please describe the type of red light photo-enforcement equipment you are using? Include the brand of equipment and the contractor. We-film photographic equipment. Contractor is Affiliated Computer Systems (ACS) (formerly a division of Lockheed-Martin recently sold to ACS)

3. If you are using a camera system, what pictures are taken? Where is the camera located? Where is the car located when the picture is taken? Are the pictures taken from the front or the rear of the vehicle? Describe either in relation to the intersection or in relation to time.

   Two photographs are taken. The first as the vehicle enters the intersection and the second about half to three fourths of the way into the intersection. The photos are of the rear of the vehicle.

4. What is the lag between initiation of red phase and first photo? .2 seconds plus the time due to the loop set back.

5. Are loops utilized? If so, describe placement. Magnetic loops are used and they are set back 5 feet from the stop bar.

6. What, if any, warning or information signs are used? Where are they placed? Warning signs are placed prior to intersections monitored by cameras. The signs are placed approximately 200 feet prior to the intersections.

7. Are there any special features or safety designs of the program? Speed measurements are taken.
Implementation

1. How many cameras are you currently using in your jurisdiction? 10

2. How many signals have housings for cameras? 10

3. What is the total number of signals that you have in your jurisdiction? Approx 800

4. When was the program implemented? Please give details as to the number of cameras that were first used and how many more have been added since then.

The Board of Supervisors authorized the program in Oct, 1999. The first camera was operational in Oct 2000. Nine more were installed by Aug, 2001.

5. What was the process for gaining approval for the implementation of the red light running program. Please include the position of those people involved in the decision making process.

The Fairfax County Board of Supervisors authorized the cameras. The Fairfax County Department of Transportation was named the lead agency in the program management. The process consisted of submitting a request to issue a Request For Proposal (RFP) to the Board. A vendor was selected and the Board was asked to approve the expenditure and the vendor. The Board also held public hearings to amend the Code of the County of Fairfax to permit the use of Photo Red Light monitoring.

6. What are the specific objectives of the use of photo-red light running cameras in your jurisdiction?

Intersection safety is the objective of the program. This is done by making the program highly visible and targeting locations where violations are most prevalent.

7. What criteria do you use to select intersections? Who is involved in the process? What type of data is collected?

The Fairfax County Department of Transportation selects the locations where cameras will be located. Factors considered are: 1) red light running accidents; 2) red light running citations issued by police officers; 3) citizen recommendations; 4) other agency recommendations; and 5) field review of violations. Data is obtained from the police department and field technicians. Also, VDOT has recently agreed to review candidate intersections to ensure signal timings are proper and no other factors would preclude the use of a camera.

8. Is the timing of the lights considered or evaluated before installing a camera at a particular intersection? How?

See above.
Public Awareness

1. Please describe the public information program used to launch or to gain approval for the photo-enforcement program and any on-going communication. How far in advance of implementation was the public information program begun?

2. Which methods of communication do you find to be most effective in reaching and informing the greatest numbers of people?

3. Have you done any surveys of public acceptance? What are the results?

4. What type of feedback have you received from the public? From what groups? I.e. those who have received tickets, those who are citizens in the jurisdiction, those who are visitors to the jurisdiction.

Evaluation

1. Have you conducted an evaluation of the effectiveness of the system?

Not at this time. The first camera has been in operation for one year. It is felt that at least one year is needed to adequately evaluate data.

2. What criteria did you use? N/A

3. What data do you collect at the intersections with cameras and with what frequency? Please include a copy of a regular report if available.

A monthly report is generated by the vendor that relates the number of recorded violations and the disposition of those violations. A copy of the latest report is included.

4. What type of data was collected before implementation of the program to develop a picture of the “before” situation?

Red Light violation related accident and violation data was recorded as well as a field study by technicians and later by a mounted video camera. It was found that the best before data was the first month’s worth of violation data. After that violation notices where sent out and behavior was probably modified.

Please include any other information pertinent to the purpose of this study. Responses to follow up questions:
Public awareness program--We held news conferences, on-site interviews on TV, local government TV session on the whole program, news releases, and radio interviews.

Did you issue tickets in the first month of operation? During the first month we gave out tickets but we did not receive revenues. There is a month's delay.
Appendix O—Falls Church Response

Evaluation of Photo-Enforcement in Virginia
Advisory Committee
Current Practices Questionnaire
September 2001

Jurisdiction: City of Falls Church

Contact: Lt. Dan Ellis/ 703-248-5285/ dellis@ci.falls-church.va.us
Chief Robert Murray/ 703-248-5055/ rmurray@ci.falls-church.va.us

Equipment and Daily Operations of Photo-Enforcement Program:

1. Are you currently using red light photo-enforcement equipment at this time? (yes) Have you ever used such equipment?

(if your jurisdiction currently does not employ photo red light monitoring equipment, please provide any information you deem appropriate about your exploration of the issues, or steps toward defining objectives, etc.)

2. Please describe the type of red light photo-enforcement equipment you are using? Include the brand of equipment and the contractor. The city uses a Digital Video product “CrossingGuard” by Nestor Traffic Systems, Inc. One Richmond Square Providence, R.I. 02906.

3. If you are using a camera system, what pictures are taken? Where is the camera located? Where is the car located when the picture is taken? Are the pictures taken from the front or the rear of the vehicle? Describe either in relation to the intersection or in relation to time. The system makes a video of the violation and from the video pictures of the violation are produced. The cameras are located before and after the intersection to allow pictures of both the front and rear of the vehicles. The video shows the vehicle approaching the intersection and continues to video the violation as the vehicle enters the intersection.

4. What is the lag between initiation of red phase and first photo? There is no lag time with system.

5. Are loops utilized? If so, describe placement. No

6. What, if any, warning or information signs are used? Where are they placed? The city has placed signs on the major roadways as motorists enter the city advising of the Video Red Light Enforcement.
7. Are there any special features or safety designs of the program? **The system has a collision avoidance component that delays the green light for traffic on the intersecting roadway that should reduce accidents.**

Implementation

1. How many cameras are you currently using in your jurisdiction? **We have three (3) intersections that will have the system and unlike the “Photo Systems” the cameras do not move between intersections. We monitor traffic in a total of eight directions for a total of sixteen (16) video cameras.**

2. How many signals have housings for cameras? **N/A**

3. What is the total number of signals that you have in your jurisdiction? **Twenty-three (23)**

4. When was the program implemented? Please give details as to the number of cameras that were first used and how many more have been added since then. **The contract was signed in December 1999 and just went active at one location October 8, 2001. The final two intersections should be “active” in the next thirty (30) days.**

5. What was the process for gaining approval for the implementation of the red light running program. Please include the position of those people involved in the decision making process. **The City Manager, Director of Public Works and Chief of Police obtained information on the programs across the country and presented the proposal to the City Council. The Council approved the project and the City released a Request for Proposal (RFP). After a review of the proposals the staff and the City Attorney recommended to Council that the contract go to Nestor, Inc.**

6. What are the specific objectives of the use of photo-red light running cameras in your jurisdiction? **The reduction both in the number of vehicles running red lights and accidents.**

7. What criteria do you use to select intersections? Who is involved in the process? What type of data is collected? **The police department reviewed the reports of accidents and conducted surveys at intersections to determine the number of vehicles running red lights.**

8. Is the timing of the lights considered or evaluated before installing a camera at a particular intersection? **No** **How?**
Public Awareness

1. Please describe the public information program used to launch or to gain approval for the photo-enforcement program and any on-going communication. How far in advance of implementation was the public information program begun? **We have done Public Service Announcements (PSAs) in the local papers and television stations. We used the city News Letter to advise residents of the program, worked with the Chamber of Commerce, City Web Page, and held public hearing before the City Council. The public has been informed form the beginning of the program but thirty (30) days before the start we again placed the information in the local print and electronic media.**

2. Which methods of communication do you find to be most effective in reaching and informing the greatest numbers of people? **The roadway signs have been the most effective because our resident community is just over 10,000 people and the majority of our vehicular traffic is non-residents.**

3. Have you done any surveys of public acceptance? **No** What are the results? **N/A**

4. What type of feedback have you received from the public? From what groups? I.e. those who have received tickets, those who are citizens in the jurisdiction, those who are visitors to the jurisdiction. **The response form the public on the program has been positive but we have just begun to issue tickets. We are the last jurisdiction in this region of the Commonwealth to have a system so the public how assumes all jurisdictions have a system.**

Evaluation

1. Have you conducted an evaluation of the effectiveness of the system? **Not as of this time because it has just gone operational.**

2. What criteria did you use? **N/A**

3. What data do you collect at the intersections with cameras and with what frequency? **Data is collected on a continuous basis and available for review at any time.** Please include a copy of a regular report if available.

4. What type of data was collected before implementation of the program to develop a picture of the “before” situation? **We reviewed accident data, tickets issued and surveyed intersections for the number of red light violations. The surveys were conducted on two days at three different times of the day to be able to compare rush hours to non rush hours and daytime to night.**

Please include any other information pertinent to the purpose of this study.
Appendix P—Herndon Response

From: Sabet, Ramin [ramin.sabet@town.herndon.va.us]
Sent: Wednesday, September 26, 2001 2:54 PM
To: 'Lockwood, Philomena B.'
Cc: Colan, Ron
Subject: RE: Questionnaire to Document Current Practices - Photo-Red

Mena:

Town of Herndon does not use red light cameras. We studied 7 intersections in the town to
determine the level of red light running problems. At each intersection we videotaped the
intersection for 3 weekdays and 3 weekend days, each day fro 8 hours staggered throughout the
day (total of 48 hours of monitoring per intersection). These tapes were viewed and each
violation was recorded. The violation rates per hour were determined for each intersection. This
study identified 2 intersections as having the highest number of violations per hour. The Town is
exploring the possibility of installing cameras at these two intersections. However, before
installing cameras, we want to know if there are other ways of reducing red light running
problems. We are evaluating the yellow and all-red interval timings at each intersection based on
the newly released VDOT guidelines. We will consider increasing yellow timing if other
conditions warrant. Several jurisdictions have reported a sharp drop in red light running after
yellow interval was increased. We are also installing LED signal heads at these 2 intersections to
improve visibility.

I hope this information is of help to you. Please let me know if you need additional information.

Ramin Sabet
Senior Civil Engineer
Town of Herndon, VA
(703) 435-6856
Appendix Q—Loudoun County Response

Response from Loudoun County to Photo Red Questionnaire

Questionnaire to Document Current Practices - Photo-Red

Mena, this is John Patton with the Loudoun County Sheriff's Office. We do not currently use any type of Red Light Photo monitoring equipment, but are authorized to do so. We have looked into this system in the past and the reason for doing so was to reduce the number of accidents occurring at intersections. The data we had looked at (California and Arlington) suggested that implementation at selected intersections reduced the number of 1) red light runners and that led to 2) a reduction in the number of accidents.

Our then Board of Supervisors decided that they did not want us (Loudoun County) to look any further at this technology because they felt it was "too much of Big Brother watching". Our current Board of Supervisors is interested in this technology, but may not be too interested in the price. At this point, that is as far as we have gotten. I was not able to answer most of the question in your questionnaire, but I hope this helps. If you have any questions, please give me a call. Patton.
Appendix R—Richmond Response

Evaluation of Photo-Enforcement in Virginia
Advisory Committee
Current Practices Questionnaire
September 2001

Jurisdiction: City of Richmond

Contact: Police Lt. Robert Gray

Equipment and Daily Operations of Photo-Enforcement Program:

1. Are you currently using red light photo-enforcement equipment at this time? No
   Have you ever used such equipment? No

We were asked to conduct an examination of the technology and the current practices of other jurisdictions. I did so and returned it through channels to the City Manager. The Chief of Police added his opinion that the decision to implement the use of such equipment was political in nature and not within the authority of the Chief of Police.

(if your jurisdiction currently does not employ photo red light monitoring equipment, please provide any information you deem appropriate about your exploration of the issues, or steps toward defining objectives, etc.)

2. Please describe the type of red light photo-enforcement equipment you are using? Include the brand of equipment and the contractor.

3. If you are using a camera system, what pictures are taken? Where is the camera located? Where is the car located when the picture is taken? Are the pictures taken from the front or the rear of the vehicle? Describe either in relation to the intersection or in relation to time.

4. What is the lag between initiation of red phase and first photo?

5. Are loops utilized? If so, describe placement.

6. What, if any, warning or information signs are used? Where are they placed?

7. Are there any special features or safety designs of the program?

Implementation

1. How many cameras are you currently using in your jurisdiction?

2. How many signals have housings for cameras?

3. What is the total number of signals that you have in your jurisdiction?
4. When was the program implemented? Please give details as to the number of cameras that were first used and how many more have been added since then.

5. What was the process for gaining approval for the implementation of the red light running program. Please include the position of those people involved in the decision making process.

6. What are the specific objectives of the use of photo-red light running cameras in your jurisdiction?

7. What criteria do you use to select intersections? Who is involved in the process? What type of data is collected?

8. Is the timing of the lights considered or evaluated before installing a camera at a particular intersection? How?

Public Awareness

1. Please describe the public information program used to launch or to gain approval for the photo-enforcement program and any on-going communication. How far in advance of implementation was the public information program begun?

2. Which methods of communication do you find to be most effective in reaching and informing the greatest numbers of people?

3. Have you done any surveys of public acceptance? What are the results?

4. What type of feedback have you received from the public? From what groups? I.e. those who have received tickets, those who are citizens in the jurisdiction, those who are visitors to the jurisdiction.

Evaluation

1. Have you conducted an evaluation of the effectiveness of the system?

2. What criteria did you use?

3. What data do you collect at the intersections with cameras and with what frequency? Please include a copy of a regular report if available.

4. What type of data was collected before implementation of the program to develop a picture of the “before” situation?

Please include any other information pertinent to the purpose of this study.
Appendix S—Vienna Response

OCT 12 2001 12:S2 FR VIENNA POLICE T09-18042254978--9 P.02/05

I. EQUIPMENT AND DAILY OPERATIONS

1. Yes, Vienna has a VIDEO red light enforcement system in place.

2. Suspected violations are video recorded to the hard drive of a computer located at this department’s H.Q. Nestor Traffic System of Providence, RI provides the equipment.

3. The entire suspected violation is captured. Both front and rear views along with the capability to view both side by side are saved to the hard drive. Selected stills are reproduced on the Violation Notice that is mailed out by Nestor Traffic Systems. ONLY a police officer can view and select the actual violations and only these are saved. Any event not a violation is purged from the system on a twice-weekly basis.

4. There is no lag time as such. The suspected violation is recorded from yellow light cycle and reviewed by a police officer to decide if a violation occurred or not. No time limit can be used, as the speed of the vehicles will vary.

5. Loops are NOT used. The entire system is Video Camera/computer controlled.

6. Notification is by signs at the entrances to the town.

7. There is a device called "Crossing Guard" in the system that adds an additional 2 seconds to the all red phase of the lights cycle if the equipment "predicts" a violation is going to occur, Only the green time of the cross traffic is modified by the "Crossing Guard" feature.

II. IMPLEMENTATION

1. Three cameras are in use at this time.

2. Three lights have housings.

3. There are twelve signals in our jurisdiction.

4. The program was implemented in 1999 with three cameras.

5. The system was approved by the Mayor, Town Council, Town Manager and the Chief of Police.

6. The system was implemented to reduce injuries and property damage due to intersection crashes.

7. The intersections were selected by the number of crashes and observed red light violations occurring at each.

8. All lights are given at least a 4.5 second yellow phase. Speed limit is 30 or 35 miles per hour.
III. PUBLIC AWARENESS

1. Six months prior to the start of the program we began a public awareness program to include TV, radio and printed press.

2. TV interviews and newspapers appeared to be the most effective.

3. No formal surveys have been undertaken.

4. Our public feedback has been very positive for 2 reasons. We use video, which people like better than still pictures and we invite violators in to see the video prior to payment or court.

IV. EVALUATION

1. The considerable reduction of violations over the span of the project indication the program's effectiveness. We also track the number of accidents (rear-end and angle).

2. Computer generated reports supplied by the system software for the violation numbers. Accident information is taken from the department’s CAD system.

3. See attached report.

Scott Roughton [pd5s7@vbgov.com]
Sent: Thursday, October 18, 2001 8:49 PM
To: lockwood_pb@vdot.state.va.us
Subject: Re: FW: Questionnaire to Document Current Practices - Photo-Red

Hello there. Steve Kurrle has forwarded me the information that you requested. I have been slightly involved in discussions about the use of cameras, but as you are aware, we are not currently using them. There originally two main reasons for not going forward with the program, the first being the initial cost, the second being the distrust that some members of the community had with the program. However, I believe the attitude is changing. We have had a few high profile crashes that have brought the dangers of running red lights to the forefront. We have work a grant from DMV the last two years that has targeted the 10 highest crash location in the City--at intersections. We were somewhat successful in working these intersections in teams. Between May and October of this year, over 600 summonses were issued around these intersections. I do not have any results if we have altered the crash rate at those intersections, it will not be available till the end of the year.

I would like to see a program up and running in the near future targeting these 10 intersections. I believe that would be extremely useful with the number of crashes that have occurred. I have witnessed the results from other Departments programs to know that it does work. Right now, I know it is on the very back burner in the topic of discussions. I haven't been made aware of any upcoming work within the Department to address this issue. With all of the other distractions that are being thrust upon us at this time, I do not see it jumping to the front.

Let me know if I can be of any help. My desk number is 427-8294.
Welcome and Meeting Objectives – Ilona Kastenhofer

Presentation and Discussion of Draft Report

Implementation – Mena Lockwood

Equipment – Mark Hagan

Public Awareness – Mena Lockwood

Evaluation – John Miller

Next Actions

Adjourn
### Appendix V—Second Meeting Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Agency</th>
<th>Phone Number</th>
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<tr>
<td>Diane Beverly</td>
<td>VDOT – TED Central Office</td>
<td>804-371-4763</td>
</tr>
<tr>
<td>Ramin Sabet</td>
<td>Town of Herndon – Engineering</td>
<td>703-435-6856</td>
</tr>
<tr>
<td>M. D. Cassidy</td>
<td>VDOT – Richmond District</td>
<td>804-524-6111</td>
</tr>
<tr>
<td>John Cheyne</td>
<td>Vienna Police Dept</td>
<td>703-255-6392</td>
</tr>
<tr>
<td>Daniel Ellis</td>
<td>Falls Church Police Dept.</td>
<td>703-248-5285</td>
</tr>
<tr>
<td>Bob Murray</td>
<td>Falls Church Police Dept.</td>
<td>703-248-5055</td>
</tr>
<tr>
<td>John Patton</td>
<td>Loudon County Sheriff’s Office</td>
<td>703-777-0625</td>
</tr>
<tr>
<td>Terrie Laycock</td>
<td>Loudoun County Admin.</td>
<td>704-777-0553</td>
</tr>
<tr>
<td>Ilona Kastenhofer</td>
<td>VDOT – Traffic Engineer</td>
<td>804-786-2965</td>
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<tr>
<td>Loren Epton</td>
<td>VDOT – NOVA</td>
<td>703-383-2404</td>
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<tr>
<td>Mark Hagan</td>
<td>VDOT – NOVA</td>
<td>703-383-2872</td>
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<tr>
<td>Bill Knost</td>
<td>Fairfax County Police</td>
<td>703-280-0558</td>
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<tr>
<td>Young Ho Chang</td>
<td>Fairfax County DOT</td>
<td>703-324-1165</td>
</tr>
<tr>
<td>Bruce Taylor</td>
<td>Fairfax County DOT</td>
<td>703-324-1185</td>
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<tr>
<td>Vanloan Nguyen</td>
<td>City Richmond – Traffic Engineering</td>
<td>804-646-3435</td>
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<tr>
<td>Robert A. Gray</td>
<td>Richmond Police Dept.</td>
<td>804-646-1350</td>
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<tr>
<td>Kevin Bowser</td>
<td>Fairfax City Police Dept.</td>
<td>703-293-7102</td>
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<tr>
<td>John Miller</td>
<td>VTRC</td>
<td>434-293-1999</td>
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<tr>
<td>Mena Lockwood</td>
<td>VDOT – TED Central Office</td>
<td>804-371-0849</td>
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</tbody>
</table>
Notes


2. Ibid.


27. Ibid.

28. Ibid.


30. Ibid.


32. Ibid.


39. Ibid.

40. Ibid.


43. Ibid.


45. Ibid.

46. Ibid.

47. Ibid.


49. Ibid.


56. If one does not want to “eyeball” the data to determine if the rates are stabilizing in a before period, one can use a mathematical technique known as the c-chart. Using the data from Figure 6, the average violation rate is 583 violations per 10,000 vehicles. A rule of thumb is that the process is stable if future violation rates are between \( \lambda - 3\sqrt{\lambda} \) and \( \lambda + 3\sqrt{\lambda} \), where \( \lambda = 583 \) in this case. Thus, if the violation rate in July was between \( 583 - 3\sqrt{583} \) and \( 583 + 3\sqrt{583} \), or between 558 and 608, then the violation rate is stable.


59. In Figure 13 *Hypothetical Fairfax/Prince William data being used*, it can be argued that a blocking factorial design is more appropriate, since there are only seven intersections reflected in the data set. That is, the Prince William 2001 intersection with a violation rate of 500 is the same physical intersection as the Prince William 2002 intersection with a violation rate of 510. An alternative to the ANOVA table presented in Figure 14 called *ANOVA results for the hypothetical data* conducts the analysis with the “blocks” being the individual intersections. Using those data, the interaction between the county and year is still not significant. However, the blocking design is appropriate for instances when crash rates differ substantially from one intersection to the next and one wants to use multiple intersections within the ANOVA table.

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<th>Source of Variation</th>
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<td>Corrected Total</td>
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60. One certainly can analyze these data with individual months. At least two options are possible: (1) one could simply replace the annual rates in Figure 13 with the individual monthly rates (and have that many cells) or, (2) one could use a pairing statistical test (such as the paired t-test) to study these data. In this case, the paired t-test did not show significant differences between 2001 and 2002, whether one looked only at the Fairfax County data or the Fairfax and Prince William data together.

61. This third question refers to the two-way interactions between the two variables (year and county).

62. Compared to before/after data, the ANOVA table is helpful in that it makes use of the control site data. For example, imagine for a moment that in Figure 13, the Prince William violation rates for 2002 were changed from 510, 560, 490 to 700, 800, and 900. The shaded cell 0.517 would change to 0.002—in other words, the interaction of the county and the year is significant—meaning cameras had a significant impact. The intuitive explanation would be that while Fairfax County violation rates had dropped only slightly, at least they did not go up as was happening in Prince William County. The logic of this argument hinges on whether the control sites reflect the norm, which is why their selection is so important.