DISTRICT OF COLUMBIA
RED LIGHT CAMERA PLANNING AND IMPLEMENTATION GUIDELINES

FINAL REPORT

District Department of Transportation

GOVERNMENT OF THE DISTRICT OF COLUMBIA
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1 EXECUTIVE SUMMARY

This document formalizes the RLC planning and implementation process for the District of Columbia. It provides guidelines for establishing an RLC program and for determining which intersections would be appropriate for an RLC system to yield the most possible safety benefits. These guidelines were based on many lessons learned that have been reported in the literature, obtained through interviews with other agencies operating RLC systems, and observed in the analysis of the TARAS crash data for the original 37 RLC intersections operated in the District of Columbia.

The guidelines include the following major components:

a. The establishment of an Intersection Safety Team to provide oversight, guidance and advice to the RLC planning process. This Team should include representatives from the Metropolitan Police Department (MPD), District Department of Transportation (DDOT) Traffic Services Administration (TSA), DDOT Planning, Executive Office of the Mayor, and the Advisory Neighborhood Commission (ANC). It is recommended that the MPD lead this Team and coordinates meetings twice per year, at a minimum, and more frequently if the needs arise. The ANC representative will serve as a liaison between the Team and the community.

b. A method to screen crash data to identify the intersections with the most promising safety benefits to be achieved by an RLC system. This method includes the development of an intersection safety index based on an analysis of various crash types, crash frequencies, and the number of personal injuries. The safety index is used to rank all signalized intersections under consideration and to identify those that are most likely candidates for an RLC system.

c. A detailed field guide to help capture the intersection data elements that are important in assessing the suitability of an RLC at the candidate intersections, and in determining the safety improvement needs at such locations. This field guide also includes rationale, standards, and technical references related to the intersection data elements to assist experienced engineers to determine what types of treatments are most likely to improve safety at a potential RLC location.

d. A procedure to evaluate the RLC system effectiveness on a regular basis. The Intersection Safety Team will review the evaluation results based on which decisions to improve, continue, or remove the RLC systems will be made.

This document is by no means an end in itself. As the guidelines are used, modifications and revisions are expected to occur. This will ensure that the District's RLC program serves the public the way it was intended.

2 INTRODUCTION

2.1 Background

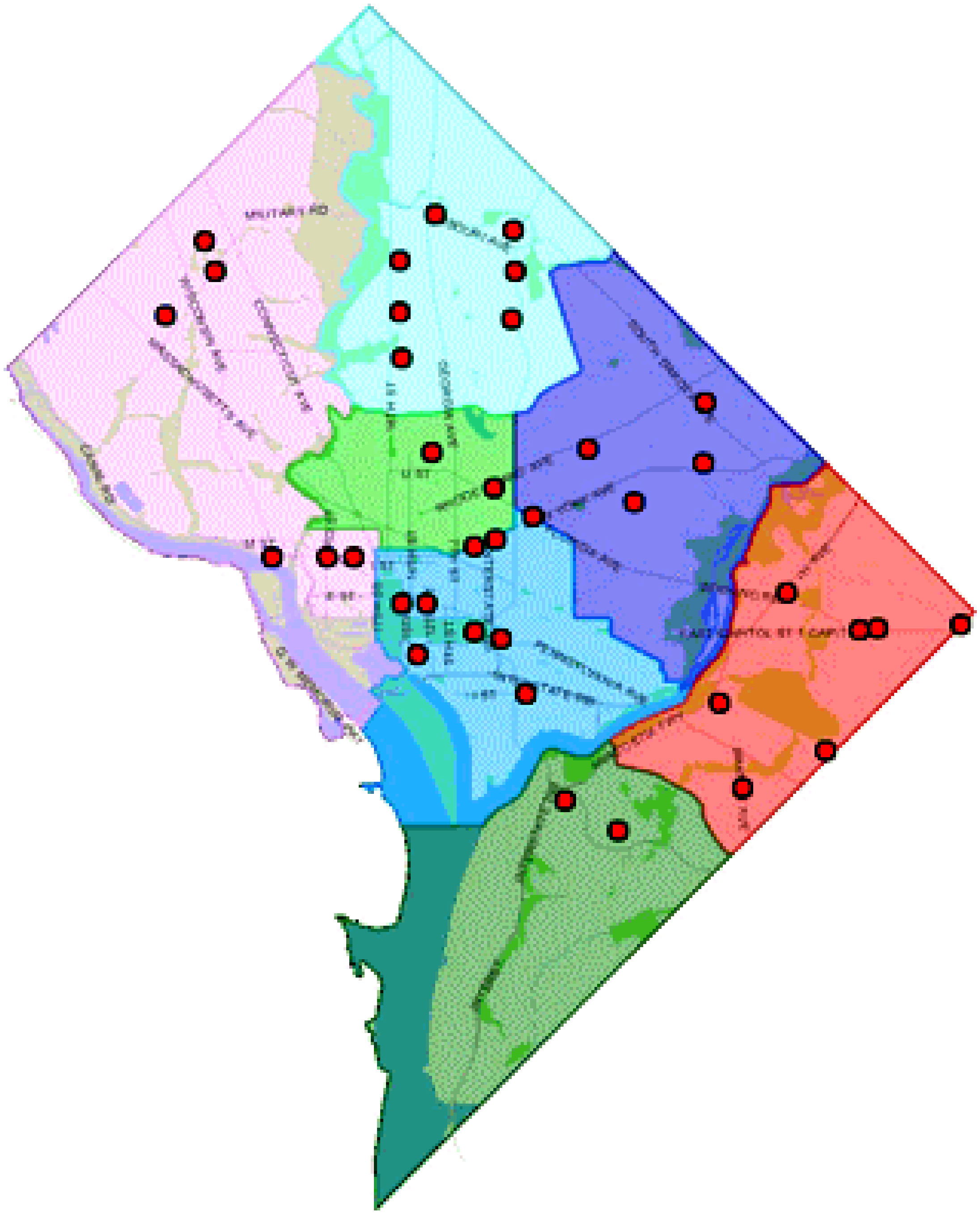
Red light camera (RLC) systems are used to reduce the frequency of red light running by detecting and issuing citations to violators. Reduced red-light running violations would lead to a reduction in the overall severity of traffic crashes at an intersection. The measures of crash severity may be the number of fatalities and injuries, and the cost of property damages. Once installed, the camera system continuously monitors vehicles on an intersection approach. It photographs the license plate of any vehicle entering the intersection after the signal has turned red. The registered owner of the vehicle will then receive a citation through the mail. Appendix 1 shows a more detailed description of the RLC system operation.

Red light camera systems have been used successfully in many jurisdictions in the country as part of a comprehensive traffic safety improvement program. The District of Columbia started the operation of its RLC program in August 1999, under the direction of the Metropolitan Police Department (MPD). Between 1999 and 2000, 39 cameras were installed at 37 intersections throughout the District (see Figure 2-1). Additional RLC installations have been planned since 2004.

In 2003, DDOT's TSA conducted a crash evaluation at intersections where red light cameras had been installed to determine the RLC system's safety effectiveness (1). The lessons learned from that evaluation and those from other RLC programs have led DDOT to developing the RLC planning process presented in this document. The process is intended for use by DDOT and other stakeholder agencies in determining the need for and the appropriate locations of future RLC installations.

2.2 Purpose

The purpose of this document is to provide the guidelines on where an RLC system could be placed to maximize its safety benefits. The target audience of this document includes DDOT engineers and planners, MPD staff, community leaders, and elected officials. DDOT engineers and planners may use the guidelines to assess the needs for an RLC system at an intersection and to determine the traffic engineering requirements associated with implementing such a system. Proper RLC site selection requires experienced engineering judgment. This document will help ensure that the engineers have all of the required data to make sound decisions. MPD staff may use the document to understand the framework for determining the appropriateness of an RLC system. This framework includes factors such as accident patterns, road characteristics, and possible traffic control measures that may remedy the intersection's safety concerns. This document can assist the MPD in their role as program implementers. Community leaders and elected officials may use this document to understand the planning process that is necessary for maximizing the benefits of RLC systems as a safety tool. An understanding of the RLC planning process will help these agencies to collaborate more effectively to reduce traffic crashes at intersections in the District of Columbia.



SOURCE: District of Columbia Government's Web Site

Figure 2-1 Original Red Light Running Camera Enforcement Locations in D.C.

2.3 Goal And Objective

The goal of this research is to provide a framework for planning, designing, implementing, and monitoring RLC systems as a traffic crash countermeasure. This framework is based on many important factors that can affect the efficacy of an RLC program, including:

a. The interagency collaboration for assembling the expertise of engineering, enforcement, traffic safety, and traffic operation professionals to effectively accomplish the planning, design, implementation, and operation of the RLC systems (2, 3, 4)

b. The ability to maintain proper oversight of the system operation and performance to ensure that the program's objectives are fulfilled. The lack of proper oversight can result in litigation and the stoppage of safety initiative involving the RLC systems (5).

c. Public education to convey the safety benefits of the RLC program to the citizens. Effective public education programs can help gain public acceptance of the RLC systems as a safety improvement tool (2).

In addition to guiding the development of an RLC program, the objective of this research is to help the District to rationally and effectively determine where RLC systems should be deployed to reduce red-light running violations and improve intersection safety.

2.4 Organization of the Guide

In accordance with the above goal and objective, this guide was organized into four major sections (including this Introduction as Section 1). Section 2 sets forth the overarching principles that form the basis for the development of the individual guidelines. These principles are a collection of lessons learned, ideas, and recommendations gathered during: (a) the review of the technical literature on RLC design and implementation, and (b) interviews with other agencies that currently use RLC systems (the results of the interviews are summarized in Appendix 2). Section 3 includes a description of the District's RLC planning and implementation process, which includes two parts. The first part contains the Program Planning guidelines, which define a framework for interagency coordination, program oversight, public education, and system monitoring. The second part includes Site Selection and Preparation guidelines. These guidelines provide a method for: (a) selecting candidate sites that may yield the most safety benefits from the RLC systems, and (b) determining what improvements to the existing intersection and traffic control devices are required to properly support the RLC system operation. The guidelines in Section 3 use many RLC-related technical terms that are defined in Appendix 3. Finally, Section 4 summarizes the document.

This document also includes seven appendices of supporting information, as shown below:

- Appendix 1: Overview of the RLC technology and concept of operation.

- Appendix 2: Lessons learned from selected agencies that have implemented an RLC program.

- Appendix 3: Definitions of terms related to RLC systems, traffic safety, and traffic engineering.
- Appendix 4: District of Columbia Legal Authority for RLC implementation.

- Appendix 5: Metropolitan Police Department PD-10 Traffic Accident Form.

- Appendix 6: Analysis of the safety indices of the existing 37 RLC locations in the District of Columbia.

- Appendix 7: Traffic Engineer's Resource Guide, which contains a description and explanation of certain items in the *Intersection Field Data Collection* Form. Technical references are also provided as appropriate.

- Appendix 8: Field Observations at nine locations in the District where crash severity had increased following the installation of the RLC system.

3 OVERARCHING PRINCIPLES

Five overarching principles, described below, were used as a basis to develop the guidelines for the District's RLC planning and implementation process. These principles reflect the lessons learned and collective ideas from other RLC programs.

a. A successful traffic-safety program requires continual and coordinated efforts in Engineering, Education, and Enforcement (or 3-E). A successful RLC program, which is a subset of a safety program, should encompass the same areas of focus (2, 3, 6). Engineering work is necessary to ascertain that other engineering measures cannot be effective against red-light running at the intersection, and that proper traffic control improvements are made to support the RLC operation. Education activities include public information and education, which helps the public understand the benefits of RLC enforcement and dispel the myths that the cameras are used for revenue generation (6). The benefit of public information and education is the public's acceptance of the RLC system. Finally, enforcement activities are to influence the drivers' behaviors to reduce red-light running and its associated crashes.

b. An effective RLC program requires the collaboration of many disciplines and organizations, including, for example, traffic and transportation engineering, law enforcement, public works, Executive Office of the Mayor, legal, the D.C. Department of Motor Vehicles (DCDMV), and community organizations (2, 3, 7). The interdisciplinary collaboration is necessary to address a wide spectrum of issues (such as engineering improvements, citizen complaints, legal challenges, privacy issues, etc.) and to effectively communicate the program's objectives and results to the community and elected officials.

c. RLC systems are one of many measures that may be used to improve traffic safety at intersections. They are not a panacea for all intersection problems (6, 8). Thus, other countermeasures must be considered and applied as appropriate (9). For example, in some cases, the causes of red-light violations may be the design deficiencies at intersections (e.g., limited line-of-sight to the signal heads, or short clearance intervals). In such cases, the use of a red-light camera system would not be appropriate.

d. Careful planning can reduce community concerns and empower the officials to make sound decisions based on actual data (2, 6, 7). Media reports have indicated that some members of the community are concerned that the RLC program exists to raise revenue. A structured, data driven, process to determine where RLC systems should be placed to maximize safety can be used to reduce these community concerns.

e. The safety benefits of the RLC system at each intersection must be continually evaluated (2, 6, 8) and used as a basis for modification, continued operation, or removal of an RLC system. System evaluation requires complete and accurate crash data. An RLC program must have provisions for data collection, validation, analysis, and evaluation as part of the post-installation monitoring efforts. The monitoring efforts are necessary to quantify the program's performance, and to provide results for decision-making and communication with community leaders and elected officials.

4 GUIDELINES

The District's RLC planning guidelines cover two aspects of RLC system implementation: (a) Program Planning and (b) Site Selection. The RLC Program Planning guidelines focus on developing a framework for interagency coordination, program oversight, and public education. The Site Selection guidelines provide a method for selecting promising candidate sites for RLC implementation, and determining the needed improvements to the existing traffic control devices. As shown in Figure 4-1, both sets of guidelines complement each other, but serve different audiences. The Program Planning guidelines are for addressing "strategic" issues while the Site Selection guidelines are for "tactical" issues. The details of each set of guidelines are described next.

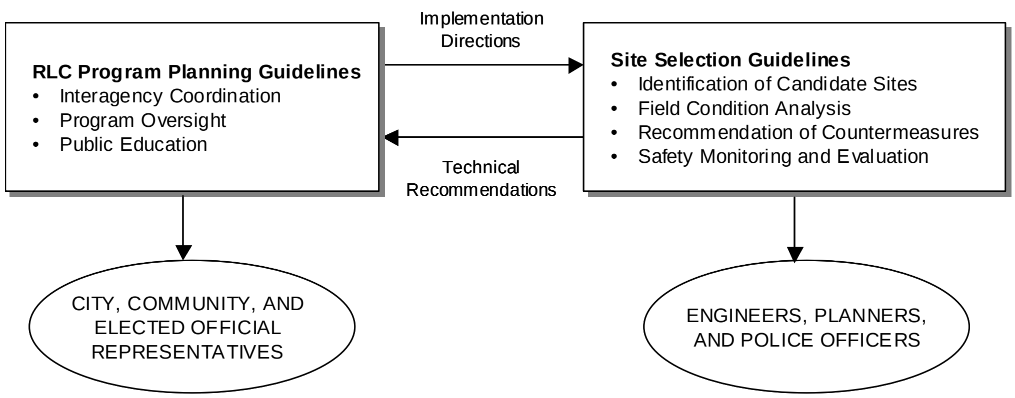


Figure 4-1 – The District's RLC Guidelines address both the programmatic and technical needs of the RLC Program

4.1 RED-LIGHT-CAMERA PROGRAM PLANNING PROCESS

Although RLC systems can provide significant safety benefits, they can evoke anxiety within the community if installations are perceived as being capricious. A documented process for developing and executing an RLC program could calm fears and elicit public support. This section of the Guidelines presents a framework for establishing a comprehensive process (refer to Figure 4-2), noting the following critical activities.

a. Form an Intersection Safety Team
b. Determine Violation-Processing Requirements
c. Provide input to the Procurement Process
d. Facilitate Public Awareness and Education Campaign
e. Review Candidate Sites at Program Level
f. Evaluate and Monitor Operations

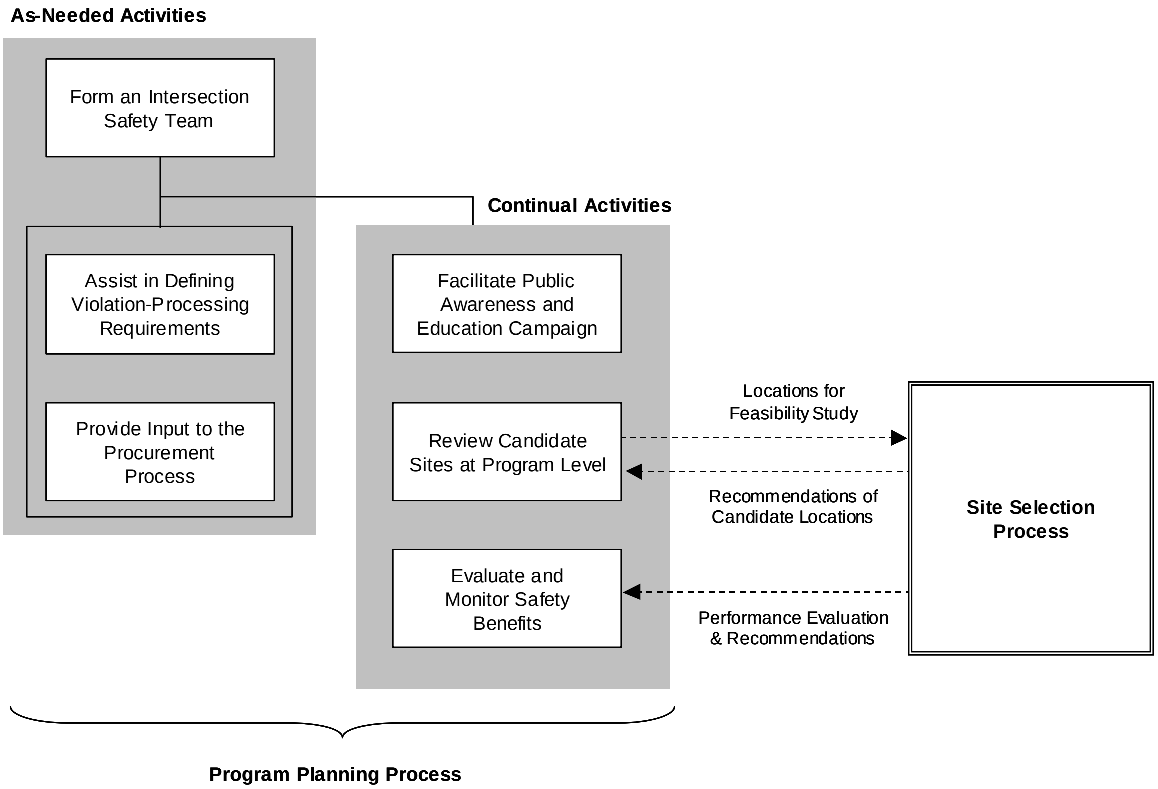


Figure 4-2 – Overview of the RLC Program Planning Process

Activities (a), (b), and (c) are one-time events, identify a standing program review team, formulate an agreed-upon process for determining violations, and contribute to elements of the procurement process for RLC systems. Discussions of the six activities are presented in Sections 4.1.1 through 4.1.6.

Figure 4-2 also shows the relationship of the Program Planning activities with the Site Selection process. The details of the Program Planning activities are described next.

4.1.1 Form an Intersection Safety Team

The recently published guidance by the U.S. Department of Transportation (USDOT) and many other sources recommend the establishment of an RLC steering committee of stakeholder groups (2, 7, 4). The steering committee for the District of Columbia is the Intersection Safety Team. The Team guides the establishment of the overall program objectives, facilitates program support activities, and monitors program results. The Team may recommend changes to the RLC system operation as appropriate – which may include the removal of the RLC system, subject to the criteria set by the Team. The Intersection Safety Team should include representatives from MPD, DDOT TSA, DDOT Planning, Executive Office of the Mayor, and the ANC. Since members of the Team are also engaged in normal duties at their various organizations, the establishment of a protocol for leadership, meetings, and communication among members is the first substantial activity. It is recommended that the MPD lead the effort in convening potential members for establishing the Team, since MPD will have a major role in the RLC implementation, operations, and enforcement. The Team should meet twice per year, at a minimum, and more frequently if the needs arise. The ANC representative will serve as a liaison between the Team and the community.

4.1.2 Provide Input to the Procurement Process

Since RLC is a relatively new technology used in law enforcement, the success of an RLC program depends on the experience and performance of contractors. This makes the selection of the contractor an important part of the RLC program. The Intersection Safety Team – with its members having various backgrounds, experience, and expertise – can assist in providing input to the RLC procurement process to ensure that qualified contractors are considered for bidding. The Intersection Safety Team should assist MPD in developing the required qualifications of the bidders. The qualifications should include such requirements as: financial stability, proof of past performance, demonstrated knowledge of RLC technologies, ability to understand and address the traffic safety and traffic engineering issues associated with intersections.

4.1.3 Assist in Defining Violation Processing Requirements

Violation processing eventually leads to decisions regarding whether the vehicle owners or the drivers should receive citations for running the red light. The processing responsibility rests with MPD, but portions of the processing may be assigned to the contractors or other agencies. Since the processing of violation information is an after-the-fact office activity, it is essential that the evidence leading to the citations is accurate. A high level of quality control and coordination of activities are required for the operation and maintenance of an RLC program.

Violation processing requirements should address issues regarding the maintenance of the integrity of evidence, possible legal actions that may arise from decisions based on evidence provided by the RLC system, and compliance with applicable laws (the District of Columbia Legal Authority for RLC is summarized in Appendix 4). The Intersection Safety Team should assist MPD in defining the violation processing requirements to ensure that all identified issues and coordination protocols are resolved and addressed in the request for proposal. As an example, FHWA (2) has published the following issues related to violation processing:

a. The "grace period" before red-light enforcement takes effect should be considered. A grace period of 0.1 seconds is used in RLC systems in neighboring jurisdictions in Maryland and Virginia. This grace period helps instill a sense of fairness. The District does not currently use a grace period beyond what is built into the RLC system.

b. The number of days allowed between the violation occurrence and the mailing of the citation should also be considered. If a person receives a citation too long after a violation, this person may lose the ability to defend against the citation in a hearing. The Maryland law requires that a citation be issued within 14 days of a violation.

The District of Columbia Official Code does not specify a time limit for issuing a citation.

c. The procedure for processing citations regarding violators who are driving commercial and rental vehicle should be reviewed. The District of Columbia Code, Section 50-2209.02 (a), allows a vehicle owner to complete a sworn affidavit identifying who had control of the vehicle at the time of the violation. The Team should consider if this been effective in reducing violations committed by commercial and rental vehicle drivers.

d. The minimum vehicle-speed threshold to trigger a RLC system should be considered. A minimum speed threshold is used to avoid taking photographs of vehicles that are stopping for a red signal but edge past the stop bar, or vehicles that turn right on a red signal. A typical minimum speed threshold is about 13 MPH. Lower speeds can result in taking more photographs of vehicles making right turns, for example. This threshold can vary from site to site.

e. The option to issue citations only during specified time periods or days of week should be discussed. Based on the available literature, it is recommended that RLC enforcement be consistent at all time.

f. The maximum number of days before a citation is re-issued to a newly identified violator, after the vehicle's registered owner disputed the initial citation, should be discussed. The District of Columbia Code, Section 50-2209.02 (a), allows a vehicle owner to complete a sworn affidavit identifying the person who had control of the vehicle at the time of the violation. If a citation is issued to that person, it should be done so in a timely manner that would allow an adequate defense to be prepared. It is recommended that this time frame be no longer than 14 days from the receipt of the affidavit identifying the driver. The Team should review the current MPD policy regarding citation re-issuing.

g. The photographic data requirements for issuing citations, including the red signal indication and the time elapsed since the onset of the red signal display, should be defined. Generally, the minimum data elements on the photographic or digital evidence should include: the date and time, a unique location identification number, time into red when the image was taken, the time the signal was amber before it went to red, and an incident number. The Team may want to consider the vehicle speed as a required data element. Some adjudicators like to have the vehicle speed information to determine if a fine should be raised or lowered. Appendix 1 contains a more detailed explanation of the photographic data elements.

4.1.4 Facilitate Public Awareness and Education Campaign

Public acceptance of the RLC enforcement is an important element for the success of an RLC program. Public acceptance may be increased with an awareness campaign to inform the community of the red-light running problem and actions being taken by MPD to improve safety, and to remind motorists of the presence of RLC enforcement in the District. Public awareness campaigns may be complemented by public education on the safety benefits of the RLC systems. These safety benefits may be quantified using the results of intersection safety analysis, conducted as part of an RLC program, or may be integrated into standing periodic programs that are aimed at aggressive behavior of the motorist such as the Smooth Operator Program that is launched every Spring and involves regional governments. The responsibility for the public awareness and education campaign rests with the MPD. However, the Intersection Safety Team should review and facilitate such efforts, including seeking support from elected officials. The means for publicity may include the press, radio, television, posters, billboards, the Internet, etc. Presentations at Council and community meetings may be helpful as well. Citizens' input may be solicited at these meetings and used in deciding where RLC systems should be installed first.

4.1.5 Review Candidate Sites at Program Level

Not all intersections can benefit from red-light cameras. Inappropriate applications of RLC systems would negatively impact traffic safety at an intersection. The sites for inclusion in the annual RLC program are to be drawn from those that are recommended by DDOT TSA, based on the selection process to be described in Section 4.2. This program level selection is concerned with the final set of intersections for RLC systems and takes into account primarily non-engineering considerations. Depending on the operating protocol of the Intersection Safety Team, either the MPD or DDOT TSA should present the candidate sites to the Intersection Safety Team for review. Among other factors, the review should consider funding distribution across various City Wards, critical intersections, technology, schedule, location of the new RLC system in relation with existing deployments, and sites where RLC systems should be removed because of evidence of ineffectiveness.

4.1.6 Monitoring And Evaluation

A continual evaluation process is required to ensure that the RLC program is achieving the desired positive safety effect (2, 4). The evaluation is essentially a traffic safety study whose conduct is best administered by DDOT TSA or its consultants. The RLC intersections should be monitored over a sufficient time period before and after the RLC installation to provide meaningful measures the program's performance. The evaluation should include the use of control sites (i.e., intersections with similar characteristics and accident history, but without red-light cameras) in order to differentiate the RLC effects from other influences. The evaluation results may be used to determine whether to continue or terminate the RLC operation at an intersection, and to report the program's outcome to the community and elected officials.

It is recommended that a two-tier evaluation approach be undertaken. Every two years, an evaluation should be completed at each RLC system location. If an individual site is not achieving a positive safety impact, decision makers can use this analysis to support their decision to remove the RLC and consider other safety options. Every fifth year, a citywide evaluation of all signalized intersections should be conducted. An overall goal of the RLC program is to achieve improved compliance with red light laws at all signalized intersections. This generalized effect can be evaluated and analyzed. If the overall effect is not as positive as expected, this analysis will help the Team to make informed decisions about other improvement options.

To conduct the RLC system effectiveness evaluation, a number of methods may be considered. An analysis of traffic crash data collected by the MPD via the PD-10 reports (a sample of the PD-10 Form is shown in Appendix 5) may provide insights into the safety benefits of the RLC system. The information on the PD-10 reports is entered into the Traffic Accident Reporting and Analysis System (TARAS) computer database, which can be used to generate various types of data reports for analysis. To ensure the validity of the evaluation, the accuracy and completeness of the crash data for the period of interest must be assessed.

Other methods for conducting the safety-benefit evaluation may include, for example, the Empirical Bayes (EB) procedure for observational before-after traffic studies (10), the estimated societal cost of crashes (11), and the crash frequencies analysis (12). The EB procedure shows the difference between the number of crashes (or societal cost of crashes) that would be expected in the after period and the number that actually occurred. The estimated societal cost of crashes allows for the determination of the aggregate economic effect per site per year for each RLC location. This method estimates the net safety impact of the RLC system, caused by a decrease in right-angle crashes, but an increase in rear-end crashes (11, 12, 13, 14, 15, 16).

To maintain an unbiased evaluation, DDOT TSA may engage an independent team or organization that is familiar with various RLC evaluation methods to conduct the evaluation. The evaluation is aimed at determining if the program’s safety objectives are met and at advancing specific recommendations for improving the effectiveness of the program. If the evaluation result for an intersection does not show acceptable safety benefits, traffic engineers should be consulted to diagnose the problems. The Intersection Safety Team will ultimately decide whether the RLC system at such a location should continue to operate or be removed. DDOT TSA, or its consultants, should present the results of the evaluation to the Intersection Safety Team for discussion and decision on future actions.

4.2 RLC SITE SELECTION PROCESS

This section describes a process that helps to determine where red-light cameras should be placed to yield the most possible safety benefits. The selection of the potential sites requires safety, operation, and engineering considerations, and should be performed by DDOT TSA or its designee. Safety analyses and engineering studies must be based on accurate and complete crash data, and field observations and measurements to derive appropriate courses of actions.

The Site Selection process begins by subjecting each intersection under consideration to a set of criteria, one at a time, from which “unqualified” intersections are eliminated from further consideration. The outcome of this process is a list of candidate sites – along with the rationale for site selection – and a set of design improvement requirements for making the intersection suitable for RLC applications. Design improvement requirements may include signal-timing adjustments, signing, marking, line-of-sight improvements, etc. Figure 4-3 shows an overview of the activities in the RLC Site Selection process. The details of these activities are described below.

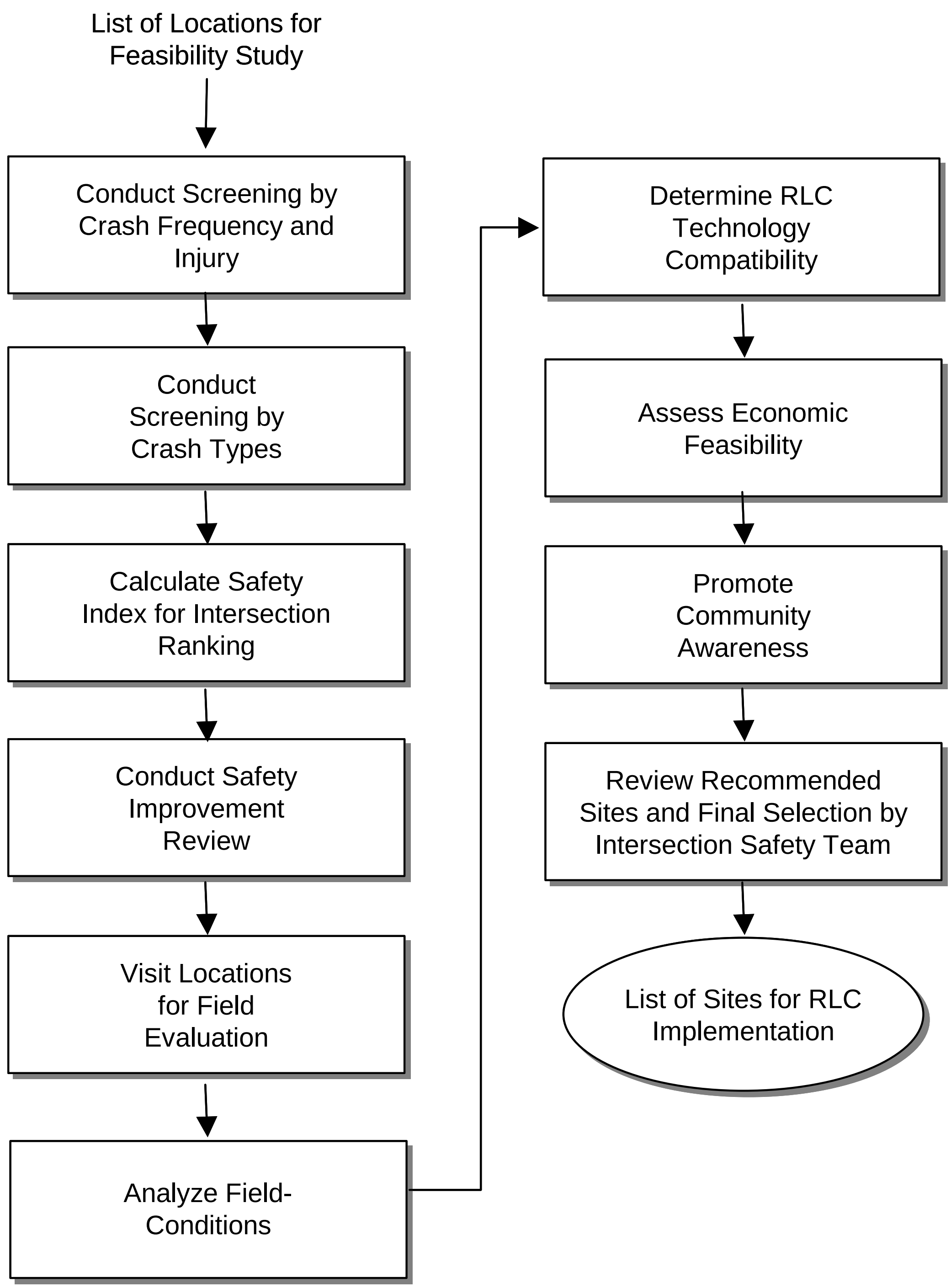


Figure 4-3 – Overview of the District's RLC Site Selection and Preparation Process

4.2.1 Screening by Crash Frequency and Injuries

The purpose of screening crash data is to identify potential locations for safety improvements and RLC applications. If the list of potential locations is not already available, screening should be performed, using the TARAS database, to identify all signalized intersections in the District with two or more vehicular angle crashes or one pedestrian crash per year over the prior three years. TARAS is a DDOT-maintained accident-record database created based on accident reports completed by MPD, using the PD-10 Form. Each PD-10 Form is filled out by the police officer investigating the crash. Only intersections that meet the crash experience criteria will be considered for additional evaluation. With a traffic signal system as large as that of the District of Columbia, the two-crash-per-year criterion may result in a large number of candidate locations. If there is a desire to have a smaller number of intersections in the initial screening, those that fit DDOT's high-accident location standard should become the candidates (17).

Current research findings (13-15) have shown that, at well-engineered intersections, an RLC system can reduce injury crashes, but could increase property-damage crashes. To target injury crashes, the next crash-data screening focus on the number of people injured (and/or dead) at intersections. Only intersections that experience at least two injured (and/or dead) people per year will be considered for further screening.

4.2.2 Screening by Crash Types

The best way to determine if an intersection is appropriate for RLC applications is through a field evaluation by an experienced engineer. However, this is not practical for a city as large as the District of Columbia. Thus, to reduce the number of potential intersections that have already passed the crash frequency and injury criteria of Section 4.2.1, additional criteria must be developed.

Because of the potential ambiguity and inaccuracy in the descriptions in the recorded crash causes in the TARAS database, the data on crash types may be used as a surrogate for identifying crashes that can reasonably be explained by red-light violations or by the impact of an RLC system. The reasons for using crash-type as screening criteria are:

- The crash-type data are readily available in the TARAS database
- Other research findings have indicated that the number of crashes by type change after the implementation of an RLC system, and that the most possible economic benefits by an RLC system occur at intersections with certain crash types
- Other crash data, while readily available, have not been proven to be useful in determining locations appropriate for RLC applications
- Currently, red-light violation data are not available for all intersections. Such data can only be obtained by having personnel and equipment in the field (a cost consideration). For example, traffic volume counting tubes may be installed in an intersection and connected to the signal controller to count vehicles entering the

intersection in violation of a red signal. Newer technologies have been demonstrated to be even more effective at violation counting.

- The presence of red-light violations does not necessarily mean that a specific location is appropriate for an RLC system. The number of violations could relate to an insufficient amber phase or insufficient sight distance, for example. However, violations may serve as a useful criterion for screening potential intersections for RLC applications.

The use of different crash types to screen intersections for possible RLC application is described below.

Many studies (11-16) have found that, following the installation of an RLC system, right angle (RA) crashes decrease, but rear end (RE) crashes increase. An analysis of crash data for the District of Columbia has shown that an increase in RE crashes was observed along with an increase in sideswipe (SS) crashes (1). A possible reason for the increase in these crash types is that as one vehicle stops for a red traffic signal, the vehicle immediately behind it may fail to stop quickly enough to avoid a rear end crash. It may also be possible that the vehicle immediately behind the stopped vehicle pulls out of the lane to avoid hitting the stopped vehicle, but it, instead, causes a sideswipe crash with another vehicle in the next lane. Based on these observations, two ratios of different crash types are recommended to further screen intersections for possible RLC applications.

The ratio of RA crashes to RE crashes has been found to be one of the indicators associated with the greatest economic benefits from RLC systems (11, 12). The ratio of the sum of RA, left-turn (LT), and right-turn (RT) crashes to the sum of RE and SS crashes is a new ratio, which has been observed to have a correlation with the use of the RLC system where SS crashes are observed (1).

To continue the screening process, the annual averages of RA, RE, LT, RT, and SS crashes are used to calculate the two ratios described above for each intersection. Intersections with ratios at 0.5 and above are more likely to have increased safety benefits after the RLC installation. Intersections with either ratio less than 0.5 will not be considered. The reason is that an RLC system, which is intended for decreasing RA crashes, but causes RE and SS crashes to increase, would not be appropriate at an intersection that is experiencing more than twice as many RE (and/or SS) crashes compared to RA (and/or LT and RT) crashes.

4.2.3 Calculation of Safety Index for Intersection Ranking

The frequency, severity, and type of crashes are among the major attributes of intersection safety improvement needs. These attributes vary significantly from one intersection to another, making a direct comparison of the attributes between intersections very difficult. Thus, there exists a need to have a common measure by which the safety improvement needs of one intersection may be compared with those of another. Measures based on economic costs have been developed for comparing crash severities among intersections or between the before-RLC and the after-RLC-installation conditions at the same intersection (11). Although such economic costs may be useful in ranking the safety improvement needs of intersections, their development is time consuming and requires various data types that are not yet readily available in TARAS.

DDOT has developed a new approach that uses a site safety index to rank candidate intersections. This index allows locations that are likely to yield high safety benefits to be among the first locations considered for possible RLC applications. The procedure to calculate the safety index for an intersection is as follows (see also Figure 4-4):

a. For every crash in the average annual crash statistics (taken over a period of three years) that occurred at the intersection, a point is added to the rating.

b. For each person injured in the average annual injury statistics (taken over a period of three years) at the intersection, a point is added to the rating.

c. For each crash-type ratio that is above 0.5, but no more than 1.0, five points are added to the rating.

d. For each ratio that is above 1.0, ten points are added to the rating.

e. The intersection safety index is the final rating value obtained from the above steps.

To illustrate the above procedure, consider the following example for the intersection at *12th Street and Constitution Ave. NW*. The accident records in the TARAS database for this intersection from 1993 to 1995 were extracted for calculating the safety index. The results are as follows:

- The average annual crashes = 20.0
- Average annual injured people = 6.7
- RA/RE Ratio = 0.929 (since the ratio is above 0.5, but not more than 1.0, 5 points will be added to the rating)
- (RA+LT+RT)/(RE+SS) Ratio = 0.769 (since the ratio is above 0.5, but not more than 1.0, 5 points will be added to the rating)
- The safety index for this intersection = 20+6.7+5+5 = 36.7

Once all ratings are calculated, the intersections are ranked in a descending order of the ratings. Intersections with higher ratings should be among the first locations to have further consideration for potential RLC applications.

The above procedure for calculating the intersection Safety Index was applied to the existing 37 RLC locations in the District of Columbia. The data used in the calculations were the 1993-1995 crash data in TARAS, which serves as “before” data because the three-year data immediately before the RLC implementation were not adequate. The ranking of these intersections was compared with the result of the RLC applicability assessment conducted in 2004 (1). A summary of this analysis is shown in Appendix 6.

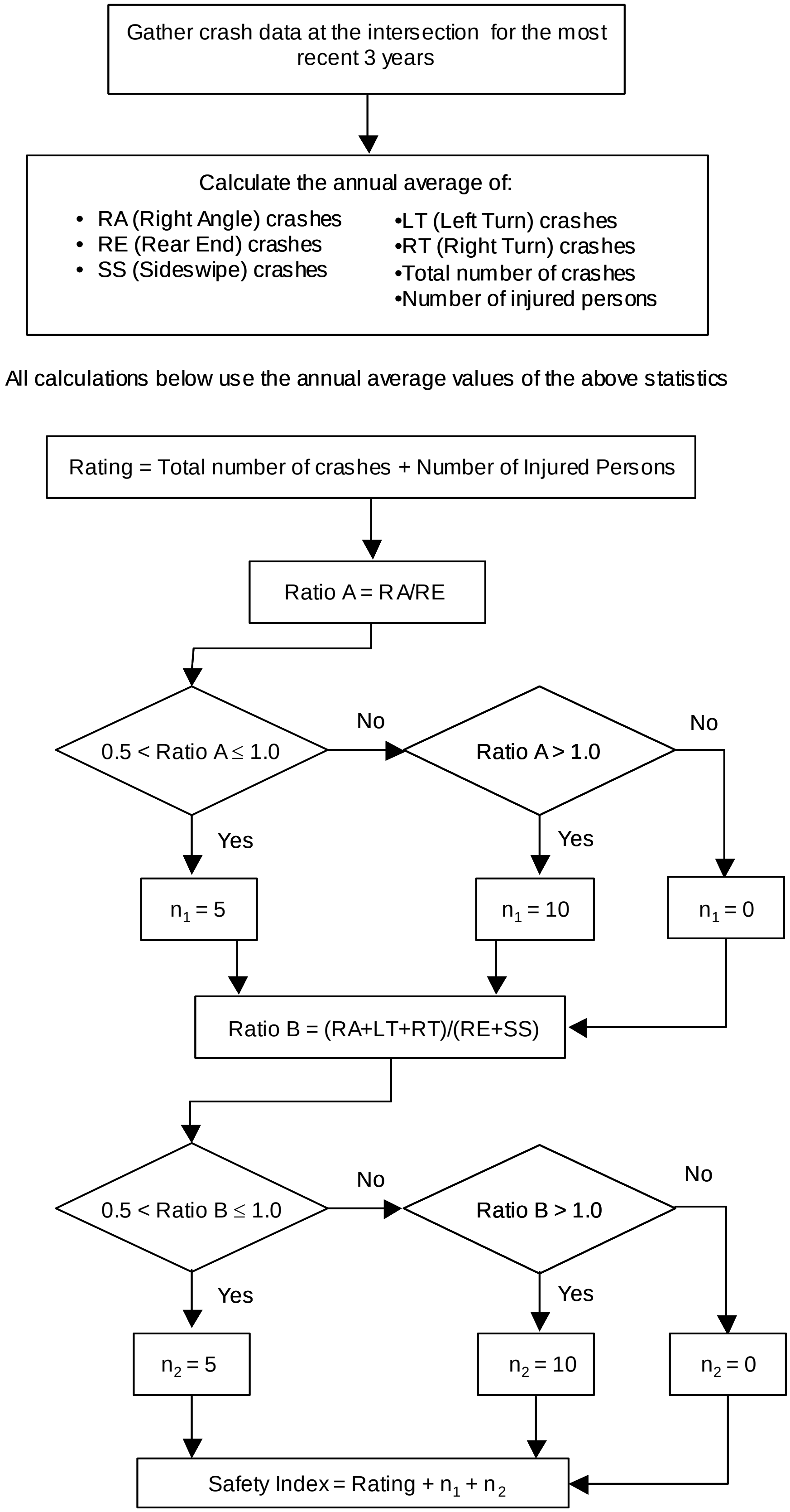


Figure 4-4 – Procedure for Calculating the Safety Index for an Intersection

Since this methodology for ranking intersection is new, feedback from the Intersection Safety Team is necessary to refine the methodology. If the methodology is accepted as a tool for intersection safety ranking, a computer program can be developed to access the TARAS database and to calculate the Safety Index for each signalized intersection. [A computer program was written to retrieve data from TARAS and to calculate various safety measures for use in the analysis of the 37 RLC locations in the District of Columbia (1).]

4.2.4 Conducting Safety Improvement Review

The use of an RLC system is one of many safety measures that can be deployed at an intersection. If a candidate intersection has been significantly modified by DDOT to improve safety within the prior year, the intersection should not be considered as a candidate site. The exception to this rule would be if significant data support the belief that the improvement did not correct the safety problem.

Pending capital and operational improvements must also be considered. If an intersection is already scheduled to receive major geometrical and traffic control improvements, in the next six months, for example, it would not make sense to pursue installing a red light camera system for that intersection.

DDOT will conduct the safety improvement review, considering all of the above factors, and eliminate any unwarranted intersections from the RLC candidate list as needed.

4.2.5 Performing Field Evaluation

Studies have shown that RLC systems can improve safety at well-engineered intersections. On the other hand, introducing an RLC system at a poorly engineered intersection could have negative effects. For example, inadequate sight distance or inadequate amber time could create a situation where drivers are not able to come to a controlled stop, or continue into the intersection before the signal turns red. Drivers using this intersection may have ignored the engineering flaw and regularly violated the red light signal in the past. If an RLC system is installed in such a situation, rear-end and sideswipe crashes may increase significantly. This is because drivers are now aware of the RLC system and would make abrupt stops or abrupt maneuvers to avoid other stopped vehicles.

While every effort is made to ensure that all intersections within the District are engineered properly, DDOT has recognized the need to conduct a careful field evaluation of a candidate intersection prior to an RLC system is proposed for installation. A complete field evaluation of the intersection is recommended before an RLC system is installed. This is consistent with current practices the practice of neighboring jurisdictions surrounding the District of Columbia (3, 18) and the current practice of DDOT for traffic signal installations

To facilitate proper field evaluation for RLC applications, intersection field evaluation data collection forms were developed as shown in Appendix 7. The contents of these forms were based on the Manual on Uniform Traffic Control Devices (19) and other sources (2, 3, 17). Many of the specific elements were drawn from the ITE/FHWA Toolbox of Countermeasures (9) and from a checklist developed by the Maryland State Highway

Administration. This field evaluation guide is also consistent with the guide developed by the Institute of Transportation Engineers (8), though it provides much more detail than the ITE's guide.

The Field Evaluation Guide allows field personnel to make specific observations about an intersection according to established standards. The completed guide provides an experienced traffic engineer with the data needed to make judgments about each element that can lead to red light running.

Following the Guide is a Traffic Engineer's Resource Guide. This resource guide provides standards and references for each data element captured on the Field Evaluation Guide.

4.2.6 Analyzing Field Data

The engineering staff of TSA shall be responsible for determining if a red light camera, or any other countermeasures, should be implemented at an intersection based on their investigation of each site. To assist in this review, a table, which describes the relevance of each field data item collected and applicable standards, is provided in Appendix 7. Each field investigation is aimed at gathering environmental, operational, geometrical, and additional safety information for use in determining whether or not an intersection is suitable for an RLC system installation. The field investigation is a part of a traffic safety study and should be thoroughly documented. Based on the results of the field investigation, DDOT TSA will select intersections for inclusion in the candidate list for the final review by the Intersection Safety Team.

4.2.7 Determining RLC Technology Compatibility

All current RLC technologies have limitations. Some limitations may prohibit the installation of an RLC system at a desired intersection. For example, the RLC technology currently implemented in the District uses inductive loops buried in the road to detect a vehicle that is about to commit a red-light violation. Inductive loops for actuating RLCs should not be used on left-turn lanes and side streets where existing inductive loops are used to detect the presence of vehicles waiting to enter the intersection. In other cases, the right of way may not exist to place an RLC system in the proper location to have an unobstructed view of a vehicle committing a violation. Still in other cases, some RLC systems use a gantry over the road to position lane-specific cameras, which may cause an obstruction to the driver's continuous view of the traffic signal.

To understand and avoid such technology incompatibility issues, MPD in collaboration with DDOT TSA may consult vendors during the development of the Request for Proposal (RFP). MPD should ensure that the RFP has provisions to hold the contractor responsible for modifying its system to work with the existing conditions of the intersections in the District without creating additional safety problems or compromising the integrity of the data used for identifying violators.

4.2.8 Assessing Economic Feasibility

The responsibility for the economic feasibility analysis belongs to MPD. The economic feasibility assessment for an RLC system is similar to that of other safety improvement projects. The benefit-to-cost analysis method may be used to assess the economic feasibility of an RLC system at an intersection. Unlike many safety improvement projects, an RLC system requires operating costs and generates revenue, both of which must be considered in the economic assessment. Various cost components may be estimated from the contractual arrangements if the District decides to use the RLC contractor or vendor. The cost items are relatively deterministic. The revenue component of the RLC system, however, should change over time because of the following reasons:

a. RLC systems at properly engineered intersections will reduce the number of drivers committing violations – a suggested value of a 30% reduction is based on documented reductions of 20 to 60% in published studies (15, 20)

b. Not all captured images would result in the issuance of a citation. On occasion the registration plate on the vehicle is not visible or the image may show a non-violation. The existing citation issuance rate should be used to estimate the percentage of captured images that will result in issued citations.

c. Not all citations are paid. The reasons for not paying the fines are not known. To accurately estimate the citation payment, the existing payment rate should be used.

With the above reduction, the revenue from red-light violation citations may be realistically estimated for the economic feasibility assessment. In time, the revenue collected from fines might not even be sufficient to cover the operating cost of the RLC system. The Intersection Safety Team must be aware of the estimated time when that situation will occur so that alternative funding sources may be sought to continue the RLC operation if needed.

Red light running violations may be estimated using one of several methods. Some jurisdictions have used traffic volume counting tubes installed inside the intersection and connected to the traffic controller. Once the traffic signal turns red, all vehicles entering the intersection are counted. Another method, which is more accurate, involves the use of a camera system to monitor violations on approaches of a sample of intersections. Once the red-light violations are estimated, the revenue component of the economic assessment can be estimated.

4.2.9 Promoting Community Awareness

Up to this point, the selection of a candidate RLC location is based exclusively on data and engineering assessments of the safety improvement needs of an intersection. To ensure the program's success, acceptance of the RLC systems by the affected community is important. To gain the community's acceptance, public outreach campaigns must be conducted to help citizens understand why the RLC systems are needed and how the systems can improve the safety of the intersections in their neighborhood. MPD should lead the outreach campaigns with support from DDOT and other agencies. Interaction with citizens must first aim at obtaining their views of the problem and at providing information on the state of red light violations in the District. Providing information on the RLR problem, actions being taken, and results being achieved is essential for maintaining the public confidence that the cameras are beneficial to the community. The Area Neighborhood Committee representative should serve as a conduit for information that is of value to the community.

4.2.10 Recommending Sites for Final Selection

The Intersection Safety Team will decide the final list of intersections for inclusion in the annual RLC systems program, including those identified for removal by DDOT TSA. The decision must be based on deliberation involving members of the Team and supported by the information gathered for that purpose. The MPD will utilize the approved list of candidates for selecting intersections for implementing RLC systems based on its budget authority, priorities and schedule.

4.2.11 RLC System Implementation

The implementation of the RLC system is the responsibility of MPD. This responsibility includes budgeting, programming, procurement and contract, review of design plans, inspection and acceptance of the system, etc. This responsibility also includes the site preparation to correct any traffic control system deficiencies identified in the field evaluation. The correction may include the reconditioning of the stop bar, installation of additional speed-limit signs and RLC enforcement warning signs, improving the line-of-sight distance to the signals, road surface repair, signal timing adjustments, etc. Since DDOT is responsible for the right-of-way and pertinent traffic control devices at the intersections, DDOT TSA should have the oversight function (e.g., review contractor's drawings and new field installations to ensure that design standards are met) over the contractor/vendor performing these improvements for MPD. DDOT must approve the RLC construction plan prior to the start of work. And once the construction is completed, a set of "as built" drawings will be submitted to DDOT by MPD as part of the records for future road and intersection safety improvements.

5 MONITORING AND EVALUATION

All RLC systems must be evaluated to determine whether or not the desired safety benefits are being accomplished and to identify where improvements or removals are necessary. DDOT TSA is the logical agency to be responsible for the evaluation. Although a reduction in red-light running crashes for individual intersections is desirable, a citywide reduction in such crashes is the best indicator of success. Thus, the evaluation of the program must include a comprehensive perspective.

DDOT TSA should make sure that a set of “before” crash data (preferably for a period of three years before the RLC system installation) is available for comparison with the “after” data. The before-and-after comparison should be performed every other year. In such a comparison, crash data of the first year after the commencement of the RLC system operation should not be used. Several studies (14-16) have identified the novelty effect immediately following the installation of an RLC system, which may result in an increase in crash experience as drivers react to the presence of the system. This type of effect has been observed with other safety treatments like a new traffic signal.

It is recommended that a two-tier evaluation approach be undertaken. Every two years an evaluation should be completed at each RLC system location. If an individual site is not achieving a positive safety impact, the Intersection Safety Team must consider ways to improve the RLC system operation (based on the two-year evaluation results) or to remove the RLS system at that location. Every fifth year a citywide evaluation of all signalized intersections should be conducted. This evaluation will aim at assessing the overall performance of the RLC program to improve compliance with red-light laws at all signalized intersections. If the overall effect is not as positive as expected, the Intersection Safety Team must consider other safety improvements based on the five-year evaluation results.

The Intersection Safety Team will review the result of the RLC effectiveness evaluations and the associated recommendations to decide if any adjustment should be made to the RLC program. The Team will use the evaluation result to communicate with community representatives and elected officials as described earlier in the Program Planning Guidelines.

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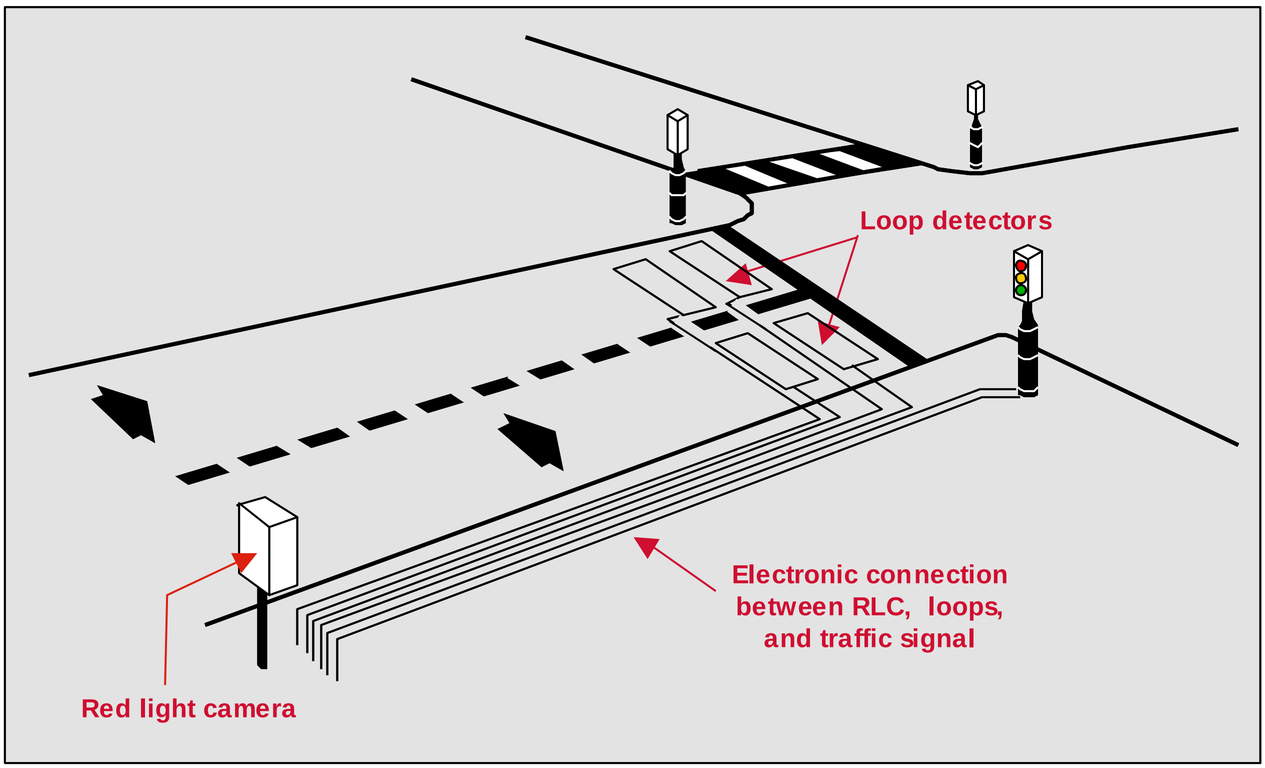
APPENDIX 1: OVERVIEW OF RLC TECHNOLOGY AND CONCEPT OF OPERATION

This appendix provides an overview of the operation a typical RLC system in the District of Columbia today. It focuses on the concept of operation, rather than the details of the technology.

An RLC system has a detection unit, a red-light camera, and communications cables. The violation detection unit includes two pairs of inductive loops, each is buried in the pavement of each travel lane, and located just upstream of the stop bar of the intersection approach being monitored. Communications cables (in conduit) connect the inductive loops with the traffic signal controller and the red light camera unit. A slave flash unit is often connected to the system.



The red-light camera unit consists of an inner housing and an outer housing. The outer housing is mounted on a pole at approximately 15 feet above the ground. It is bullet proof and tamper resistant, and secured by a key lock. The inner housing contains a microprocessor that tracks the speed of all vehicles about to enter the intersection. When the microprocessor receives a red-signal display message from the traffic signal controller, the microprocessor triggers the camera to take two photographs of each vehicle traveling above a

Camera Outer Housing Unit

threshold speed (which is typically about 13 MPH and can be adjusted). The microprocessor determines a vehicle's speed using the time-distance information provided by the pair of inductive loops in each lane.

The first picture of the vehicle must show the following:

- The front of the vehicle is not in the intersection when the traffic signal is red
- The pavement marking that defines the intersection (usually the stop bar or the crosswalk)
- The traffic signal displaying a red light

The second picture taken a short time later (0.5 to 1.5 seconds) must show the vehicle in the intersection. From the pictures taken, the license plate will be magnified for identification.

The camera system records relevant evidentiary data on the violation photograph, including the date and time of day, the time elapsed since the beginning of red signal, and the speed of the vehicle.

Following a pre-determined schedule, a contractor's employee retrieves the film from each RLC and loads new film. The contractor's employee then develops the film and takes it to the violation-processing center where the sets of two images are reviewed. This review provides a preliminary conclusion on whether or not the image set possibly shows a red light running violation. In many cases, the photographs do not show a red light running violation. For example, a police officer could be waving a driver through an intersection against a red traffic signal, causing the RLC to photograph the vehicle; or the RLC may have captured a picture of an ambulance on an emergency call for service.

If it appears that a red light running violation may have occurred, the registration records of the Department of Motor Vehicle are accessed to determine the registered owner of the vehicle. An officer from the Metropolitan Police Department then examines the photographs and a draft red light running citation. Based on the review of the photographic evidence, the officer decides if a citation should be issued.

If the officer approves a citation for issue, it is then mailed to the registered owner of the vehicle. Once the registered owner of the vehicle receives the citation, that owner can pay the fine or attend a hearing to contest the citation.

If a citation is not issued, the reason is documented in a database. The reason may be that the registration plate could not be read, or perhaps the vehicle had already entered the intersection by the time the first picture was taken. This data allows for future evaluation to determine how to improve the system's operation.

In the District of Columbia, and most U.S. cities where red light camera programs exist, the method to detect a potential red-light violation today is through the use of inductive loops. Since the inductive loops have many drawbacks, other types of detection technologies are tested and deployed, such as Radar Sensor, Laser Sensor, Piezo Sensor, and Video Loop Detector. New types of camera technologies are also available, including Wet Film, Digital, and Video.

APPENDIX 2: INTERVIEWS WITH AGENCIES CURRENTLY OPERATING RLC CAMERAS

	JURISDICTIONS INTERVIEWED		
	EL CAJON, CALIFORNIA	**TOLEDO, OHIO**	**PHOENIX, ARIZONA**
1. Contact name	(Available with permission of interviewee)	(Available with permission of interviewee)	(Available with permission of interviewee)
2. Telephone	(Available with permission of interviewee)	(Available with permission of interviewee)	(Available with permission of interviewee)
3. How long have you personally been involved?	Since inception, October 1996	System started operations in 2000, I have been involved since 2003	Since about 1999 or 2000, the cameras started operating in October of 2001
4. Who was involved before you?	N/A	A Police Lieutenant who is now retired	An individual from the Street Transportation Department who is still involved but to a much lesser extent
5. How many cameras are now in operation?	7 sites, but that is probably 2 more than needed	21	13 cameras at 12 intersections
6. Are you planning to add more red light camera systems?	Not at the present time	Yes	Not at this time
7. How many signalized intersections are in your jurisdiction?	110	Over 1300	948 traffic signals operated by the City. The Arizona Dept. of Transportation operates some signals in the City at some freeway interchanges
8. How were camera locations selected?	Locations with red light running accidents – more than 3 per year	High accident locations at red lights	It was a rather long process that involved several criteria, including the number of red light running crashes, the number of red-light running violations on an approach (as measured by the red-light camera vendor), and the need for having citywide coverage for the red-light cameras. We only use red-light cameras for straight through movements, not left-turning movements. Candidate locations received extra consideration if it were at or near a school, and lastly, the red-light camera vendor had to conduct a site inspection to verify that the camera would physically be workable at the location (including looking at driveway locations, bus stops, utility conflicts in the streets, etc.) The last two camera locations were the result of a published study indicating that two of the U.S. top-ten high crash locations were intersections in Phoenix. RLCs were installed at these locations in part because there was not much in the way of other improvements that could be done.

	JURISDICTIONS INTERVIEWED		
	EL CAJON, CALIFORNIA	**TOLEDO, OHIO**	**PHOENIX, ARIZONA**
a. Who made the selections?	The Police Dept. along with the traffic engineer assigned as the project administrator and other DPW members	Police Department	The locations were primarily selected by the Street Transportation Department with Police input and vendor input.
b. Did this person use input from other people? If yes, what are of expertise did the other people come from?	Police and traffic engineers	The red light camera equipment supplier	The selected locations were also reviewed by the City Council, who approved them. There was also a committee established to review the use of red-light camera enforcement in Phoenix (including photo speed enforcement) that was chaired by the Police Dept., and included representatives from Street Transportation Dept., City Courts, the Prosecutors Office, City Manager's Office, and the Law Dept. While the entire committee was not involved in selecting the locations, some of the representatives were involved (Street Transportation and Police to a lesser extent). The Committee was primarily involved in overseeing how a photo enforcement program would work in Phoenix, what additional staff & other resources would be needed, and what the system would cost. The committee also oversaw the bidding by the vendors, and the implementation and finalizing of the contract; reviewed the progress as the red light cameras were being installed; and reviewed the feedback from the public, politicians, and media.
c. Was there a threshold for the number of crashes required at an intersection before it would be considered for a camera?	At least 3 in a year	Not sure	No, but the vendor did require a threshold number of red-light running violations based on a 24-hour period of videotaping of the intersections. Most of our intersections rarely met their violations threshold.
9. Did you look for specific crash types before selecting camera locations? If yes, please explain what you were looking for.	Red light crashes, directional crashes, right angle crashes	Red light running crashes were examined	Yes – We looked at angle crashes at signal locations as well as any other crash at a traffic signal that involved a violation of "Disobey Traffic Signal." In addition to totaling the number of red-light running crashes by signalized intersection for the most recent three years, we also looked at red-light running crash by approach (direction traveled by the red-light running vehicle)
10. Did you examine other ways to reduce crashes before deciding to install a red light camera system?	Yes-longer hanging all red and longer amber times	Yes-Police officer enforcement was examined	Yes – including implementing a short all-red interval at all of our traffic signals, having special red-light enforcement zones at our traffic signals using motor officers, and having a publicity campaign relating to the need to "Brake on Yellow – Stop on Red"

	JURISDICTIONS INTERVIEWED		
	EL CAJON, CALIFORNIA	**TOLEDO, OHIO**	**PHOENIX, ARIZONA**
11. Did someone visit each potential camera site before a final decision was made to use a red light camera system? If yes, was a checklist used to record observations? If there is a checklist, may we get a copy?	Yes, someone visited. No checklist	Not sure	Yes – our red-light camera vendor conducted a field review at all of the locations (ACS). I have asked the vendor to provide a checklist or guidelines if they have any, and if so, I will forward them to you. [DCI received no checklist]
12. Is the amber time at red light camera locations set according to a standard? If so, what is the standard that you follow?	The amber time is 1 second longer than the national standard	The standard is 4 seconds city-wide	*Yes – We follow the ITE standard for the calculation of the amber time.* *Yellow = t + v/(2a + 64.4G)* *t = reaction time, 1.0 seconds* *v = posted peed limit* *a = deceleration rate, 10.0 feet per second per second* *G = grade, in percent* We also have a short all-red interval for each intersection of 1.8 to 2.0 seconds (depending on the conditions)
13. Are there documented site selection criteria and a sign off to put a camera in a specific location?	No	No	The vendor has to confirm that a red light camera (and the loops) will be workable at a location. The vendor has to prepare the plans for the camera, flash unit and pavement loops, and connection to the traffic signal controller. The locations are provided to the City Council for informational purposes and questions prior to approval as well. Because the red light camera program operates at a loss to the general fund, Council has to approve any new locations for financial purposes.
14. How would you rate traffic-engineering involvement in the program 1 to 10?	10	8	4 for the program overall (8 or 9 if you only are referring to site selection)
15. How would you rate police involvement in the program from 1 to 10?	10	10	*6 for the program overall (1 or 2 if you are referring to site selection)*
16. Who is involved from the police perspective? What is their phone number?	(Available with permission of interviewee)	Myself	(Available with permission of interviewee)

	JURISDICTIONS INTERVIEWED		
	EL CAJON, CALIFORNIA	**TOLEDO, OHIO**	**PHOENIX, ARIZONA**
17. Do police, traffic engineers, and other stakeholders meet on a regular basis to discuss the red light camera program?	Yes	No – the Transportation department allows the Police Department to manage the day-to-day operations	The Committee (referred to previously) did meet during the time the program was being planned and for about two years after it was established. When the vendor was identified and retained, a vendor representative was also part of the committee meeting as well.
18. If you were able to start red light camera operations all over again in your city what would you do differently?	Nothing	Nothing	Not much, except that I wish there were more vendors to select from (there are only two in the valley) and I wish everything occurred more rapidly. From my perspective, it was a rather slow process. It was good to have a very cooperative committee from the different City Departments to work together on this project.
19. What jurisdiction do you feel currently follows the "best practice" for selecting where red light cameras should be placed?	El Cajon	Toledo, Ohio	I personally am not familiar with the practices used in other jurisdictions. We did, however, wait until the other smaller cities in the metropolitan area implemented their photo-enforcement programs (Paradise Valley, Scottsdale, Mesa, etc.), so we could learn from their experiences. This resulted in a much smoother implementation process in Phoenix.
20. In the ideal world, how would you choose where red-light camera systems should be placed?	Where they could eliminate or at least greatly lower red light crashes	Exactly the way we place them	I would not change much from what we did. Part of the reason for having photo enforcement is for driver education purposes. If we only selected the high red-light running crash locations, many of the cameras would be bunched in a small, low-income part of a large city. There would be little driver education opportunity for the rest of the city. Location selection is not the only important part of a photo enforcement program, and most of the changes I would want to implement have to do with making the program pay for itself, and making it easier to give an offending driver a red-light running ticket. These require changes at the State level.
21. Questionnaire completed by	Tracey M. Poler (Daniel Consultants, Inc.)	Tracey M. Poler (Daniel Consultants, Inc.)	Tracey M. Poler (Daniel Consultants, Inc.)
22. Date	8/17/04	11/8/04	9/9/04

APPENDIX 3: DEFINITIONS

Approach – all lanes of traffic moving towards an intersection or a mid-block location from one direction, including any adjacent parking lane(s).

Back Plate – a thin strip of material that extends outward from and parallel to a signal face on all sides of a signal housing to provide a background for improved visibility of the signal indications.

Cycle Length – the time required for one complete sequence of signal indications.

Intersection – (a) the area embraced within the prolongation or connection of the lateral curb lines, or if none, the lateral boundary lines of the roadways of two highways that join one another at, or approximately at, right angles, or the area within which vehicles traveling on different highways that join at any other angle may come into conflict; (b) the junction of an alley or driveway with a roadway or highway shall not constitute an intersection.

Interval – the part of a signal cycle during which signal indications do not change.

Louver – a device that can be mounted inside a signal visor to restrict visibility of a signal indication from the side or to limit the visibility of the signal indication to a certain lane or lanes.

Red Clearance Interval – an optional interval that follows a yellow change interval and precedes the next conflicting green interval.

Red Light Violation Detector – an automated system that identifies a vehicle entering an intersection during a red signal interval. The system used by Washington DC consists of two sets of inductive loops buried in the road surface connected to the red light camera system.

Red Light Camera (RLC) System – an automated system designed to take a photograph, image or video of a vehicle once triggered by a red light violation detector. The system used in The District of Columbia consists of a camera mounted on a pole, upstream of the intersection being monitored. Wires connect the camera to a flash unit, the traffic signal control cabinet, and the violation detector. When a photograph is taken, the view captured is the rear of the vehicle.

Red Light Camera Violation Photographs – The red light camera currently used by The District of Columbia takes two photographs in sequence if a red light violation is detected. The first photograph is designed to show the vehicle upstream of the stop bar as well as the visible interval of the traffic signal. The second photograph, taken a brief time later, is designed to show if the vehicle continued into the intersection.

Signal Coordination – the establishment of timed relationships between adjacent traffic control signals.

Signal Phase – the right-of-way, yellow change, and red clearance intervals in a cycle that are assigned to an independent traffic movement or combination of movements.

Signal Timing – the amount of time allocated for the display of a signal indication.

Signal Visor – that part of a signal section that directs the signal indication specifically to approaching traffic and reduces the effect of direct external light entering the signal lens.

Signal Warrant – a threshold condition that, if found to be satisfied as part of an engineering study, shall result in analysis of other traffic conditions or factors to determine whether a traffic control signal or other improvement is justified.

Traffic Control Signal (Traffic Signal) – any highway traffic signal by which traffic is alternatively directed to stop and permitted to proceed.

Yellow Change Interval – the first interval following the green interval during which the yellow signal indication is displayed.

APPENDIX 4: DISTRICT OF COLUMBIA LEGAL AUTHORITY FOR RLC

DISTRICT OF COLUMBIA OFFICIAL CODE 2001 EDITION
DIVISION VIII. GENERAL LAWS.
TITLE 50. MOTOR AND NON-MOTOR VEHICLES AND TRAFFIC
SUBTITLE VII. TRAFFIC
CHAPTER 22. REGULATION OF TRAFFIC
SUBCHAPTER V. AUTOMATED TRAFFIC ENFORCEMENT

§ 50-2209.01. Authorized; violations as moving violations; evidence; definition.

(a) The Mayor is authorized to use an automated traffic enforcement system to detect moving infractions. Violations detected by an automated traffic enforcement system shall constitute moving violations. Proof of an infraction may be evidenced by information obtained through the use of an automated traffic enforcement system. For the purposes of this subchapter, the term "automated traffic enforcement system" means equipment that takes a film or digital camera-based photograph which is linked with a violation detection system that synchronizes the taking of a photograph with the occurrence of a traffic infraction.

(b) Recorded images taken by an automated traffic enforcement system are prima facie evidence of an infraction and may be submitted without authentication.

§ 50-2209.02. Liability for fines; notice of infraction; hearing.

(a) The owner of a vehicle issued a notice of infraction shall be liable for payment of the fine assessed for the infraction, unless the owner can furnish evidence that the vehicle was, at the time of the infraction, in the custody, care, or control of another person. In the event that the registered owner claims that the vehicle was in the custody, care, or control of another person, the registered owner of the vehicle shall provide evidence in a sworn affidavit, under penalty of perjury, setting forth the name and address of the person who leased, rented, or otherwise had care, custody, or control of the vehicle.

(b) When a violation is detected by an automated traffic enforcement system, the Mayor shall mail a summons and a notice of infraction to the name and address of the registered owner of the vehicle on file with the Bureau of Motor Vehicle Services or the appropriate state motor vehicle agency. The notice shall include the date, time, and location of the violation, the type of violation detected, the license plate number, and state of issuance of the vehicle detected, and a copy of the photo or digitized image of the violation.

(c) An owner or operator who receives a citation may request a hearing which shall be adjudicated pursuant to subchapter I of Chapter 23 of this title.

(d) The owner or operator of a vehicle shall not be presumed liable for violations in the vehicle recorded by an automated traffic enforcement system when yielding the right of way to an emergency vehicle, when the vehicle or tags have been reported stolen prior to the citation, when part of a funeral procession, or at the direction of a law enforcement officer.

§ 50-2209.03. Agreement with private entity to provide records and services.

The Mayor may enter an agreement with a private entity to obtain relevant records regarding registration information or to perform tasks associated with the use of an automated traffic enforcement system, including, but not limited to, the operation, maintenance, administration or mailing of notices of violations.

Section 2 of D.C. Law 14-226 added § 50-2209.04 to read as follows:

Sec. 904. Automated Traffic Enforcement Fund.

(a) There is established the Automated Traffic Enforcement Fund ('Fund') as a lapsing fund, to be administered by the Mayor as an agency fund as defined in D.C. Official Code § 47-373(2)(I), into which shall be deposited funds to be used exclusively for administration of the automated traffic enforcement system. Authorized expenditures include, but are not limited to, vendor payments pursuant to an agreement reached under section 903 of this title, overtime incurred by members of the Metropolitan Police Department in the administration of the system, adjudication costs resulting from use of the system, supplies and equipment purchases related to use of the system, and any other expense determined by the Mayor or his designee to be required for the administration of the system. The Fund shall be financed through fines and fees received from enforcement and regulation of the activities described in section 902 of this title and through other funds as may be appropriated to the Fund. Revenue deposited into the Fund and all interest earned thereon shall revert to the General Fund on September 30 of each fiscal year, but shall, during the fiscal year, be continually available for the uses and purposes set forth in this section, subject to authorization by Congress in an appropriations act.

(b) The Fund shall be accounted for under procedures established pursuant to D.C. Official Code §§ 47-371-47-377.

APPENDIX 5: METROPOLITAN POLICE DEPARTMENT PD-10 FORM

PD 10 Rev. 7/03 Prescribing Directive G.O. 401.3

Traffic Crash Report

Metropolitan Police Department , Washington,D.C.

1. Date of Crash	2. Time (Use Military)	3. Day Of Week	4. Date Of This Report	5. Type Of Crash (Check All That Apply, Except for Property Damage.)	6. Complaint Number
				01 ☐ Fatality 02 ☐ Injury 03 ☐ Prop. Damage only 04 ☐ Hit and Run 05 ☐ Pedestrian 06 ☐ D.C.Property 07 ☐ Non-collision	

7. Crash Occurred On (Street, Direction, Distance From Mile Post, Ramp)	8. District	9. PSA	10. No. Of Vehicles Involved	11. No. Of Injured Persons	12. No. Of Occupants (Including Driver)
					Veh. 1 ____ 2 ____ 3 ____ 4 ____

13. Enter The No. Of Feet In Whatever Direction, From The Nearest Inter. or Block, On Freeways Enter The No. Of Feet From The Nearest Mile-Post Or PEPCO Pole No., Indicate If Accident Occurred On Exit Ramp, Access Ramp Or Bridge. Circle The City Quadrant.	14. Is This A Construction Zone	15. On Street	16. Off Street	17. Report taken On Scene?	18. Photos Taken?
________ Feet N S E W ________________ NW NE SW SE	☐ Yes ☐ No	01 ☐ At Intersection 02 ☐ Within 100' Of Inter. 03 ☐ Private Property	01 ☐ Public Space 02 ☐ Private Property	☐ Yes ☐ No	☐ Yes ☐ No If Yes, Number.

Striking Object

1. Driver ☐ Pedestrian ☐ Fixed Object ☐

19. Name Of Driver/Pedestrian (Last, First, Middle) 19A.Type Of Prop.(Fixed Object) And Describe Damage In Narrative	20. Sex ☐ 01 M ☐ 02 F	21. Birthdate

22. Address (Street, Room, Apt. No., City and State if outside D.C.)

23. Home Phone	24. Permit Number and State	25. Bus. Phone

Owner

26. Model	27. Make	28. Year	29. Body	30. Color	31. Tag No., State/Year	32. Vehicle ID No. (VIN)

33. Name Of Owner (Veh./Prop.), (Last, First, Middle), If Driver Enter "Driver"	34. Phone No.
35. Address (Street, Room, Apt. No., City and State if outside D.C.)	36. Owner Notified ☐ Yes ☐ No

3. Driver ☐ Pedestrian ☐ Fixed Object ☐

19. Name Of Driver/Pedestrian (Last, First, Middle) 19A. Type Of Prop.(Fixed Object) And Describe Damage In Narrative.	20. Sex ☐ 01 M ☐ 02 F	21. Birthdate

22. Address (Street, Room, Apt. No., City and State if outside D.C.)

23. Home Phone	24. Permit Number and State	25. Bus. Phone

Owner

26. Model	27. Make	28. Year	29. Body	30. Color	31. Tag No., State/Year	32. Vehicle ID No. (VIN)

33. Name Of Owner (Veh./Prop.), (Last, First, MIddle), If Driver Enter "Driver"	34. Phone No.
35. Address (Street, Room, Apt. No. ,City and State if outside D.C.)	36. Owner Notified ☐ Yes ☐ No

2. Driver ☐ Pedestrian ☐ Fixed Object ☐

19. Name Of Driver/Pedestrian (Last, First, Middle) 19A.Type Of Prop.(Fixed Object) And Describe Damage In Narrative	20. Sex ☐ 01 M ☐ 02 F	21. Birthdate

22. Address (Street, Room, Apt. No., City and State if outside D.C.)

23. Home Phone	24. Permit Number and State	25. Bus. Phone

Owner

26. Model	27. Make	28. Year	29. Body	30. Color	31. Tag No., State/Year	32. Vehicle ID No. (VIN)

33. Name Of Owner (Veh./Prop.), (Last, First, Middle), If Driver Enter "Driver"	34. Phone No.
35. Address (Street, Room, Apt. No.,City and State if outside D.C.)	36. Owner Notified ☐ Yes ☐ No

4. Driver ☐ Pedestrian ☐ Fixed Object ☐

19. Name Of Driver/Pedestrian (Last, First, Middle) 19A. Type Of Prop.(Fixed Object) And Describe Damage In Narrative.	20. Sex ☐ 01 M ☐ 02 F	21. Birthdate

22. Address (Street, Room, Apt. No., City and State if outside D.C.)

23. Home Phone	24. Permit Number and State	25. Bus. Phone

Owner

26. Model	27. Make	28. Year	29. Body	30. Color	31. Tag No., State/Year	32. Vehicle ID No. (VIN)

33. Name Of Owner (Veh./Prop.), (Last, First, Middle), If Driver Enter "Driver"	34. Phone No.
35. Address (Street, Room, Apt. No.,City and State if outside D.C.)	36. Owner Notified ☐ Yes ☐ No

Non-Involved Witnesses

37.	Name	Address	Phone Number

Codes

38. Seat Location Code

01	02	03
04	05	06

07 Station Wagon Rear
08 Motor Cycle / Moped Pass.
09 Occupant - Bus
10 Pedestrian
11 Bicycle Rider
12 Other: SkateBoard, Tricycle, etc.

39. Injury Code
00 Unknown
01 Fatal
02 Disabling
03 Non-Disabling
04 None
05 Complaint of pain but no visible injury

40. Seat Belt /Bag Code
00 Use Unknown
01 Not Installed
02 Not Fastened
03 Fastened
04 Air Bag Install.
05 Belt/ Bag Failed
06 Air Bag Deployed
07 Child Restraint
08 Helmet

41. Ejection Code (Thrown From Veh.)
00 Unknown
01 NO
02 Partial
03 Total

PERSONS INVOLVED

42. Name/ Address/ Phone No. (Include all Operators, Passengers and Pedestrians involved even if not injured)	Age	Sex	Pass. in Veh. No.	Code 38.	Code 39.	Belt 40.	Bag 40.	Code 41.	Employed by D.C. Govt.?	Transported to Hospital?
									☐ Yes ☐ No	☐ Yes ☐ No
									☐ Yes ☐ No	☐ Yes ☐ No
									☐ Yes ☐ No	☐ Yes ☐ No
									☐ Yes ☐ No	☐ Yes ☐ No
									☐ Yes ☐ No	☐ Yes ☐ No
									☐ Yes ☐ No	☐ Yes ☐ No
									☐ Yes ☐ No	☐ Yes ☐ No

INJURED TO HOSPITAL

43. Name of Injured Person	Where Taken (Hospital)	By Whom	Status	Major Crash Notified (Name)	Teletype Notified (Name)	Relative Notified (Name)
			☐ Admitted ☐ Released			
			☐ Admitted ☐ Released			
			☐ Admitted ☐ Released			
			☐ Admitted ☐ Released			
			☐ Admitted ☐ Released			
			☐ Admitted ☐ Released			
			☐ Admitted ☐ Released			

Vehicle No. 1

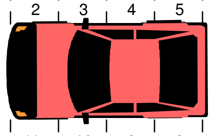
44. Direction Of Travel and Street (Must be same as in narrative diagram)

46. Vehicle was: 01 ☐ Left on scene 02 ☐ Towed by 03 ☐ Driven Away by

Name:

45. Circle All Numbers Where There is Damage.

1 2 3 4 5 6



12 11 10 9 8 7

13 Hood
14 Roof
15 Trunk
16 Undercarriage
17 Overturned
18 Other (Explain in Narrative)

47. Location Towed To

48. Skid Marks

To Impact ________ After Impact ________

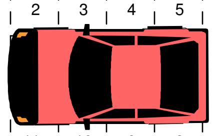
Vehicle No. 2

44. Direction Of Travel and Street (Must be same as in narrative diagram)

46. Vehicle was: 01 ☐ Left on scene 02 ☐ Towed by 03 ☐ Driven Away by

45. Circle All Numbers Where There is Damage.

1 2 3 4 5 6



12 11 10 9 8 7

13 Hood
14 Roof
15 Trunk
16 Undercarriage
17 Overturned
18 Other (Explain in Narrative)

47. Location Towed To

48. Skid Marks

To Impact ________ After Impact ________

Vehicle No. 3

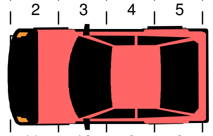
44. Direction Of Travel and Street (Must be same as in narrative diagram)

46. Vehicle was: 01 ☐ Left on scene 02 ☐ Towed by 03 ☐ Driven Away by

Name:

45. Circle All Numbers Where There is Damage.

1 2 3 4 5 6



12 11 10 9 8 7

13 Hood
14 Roof
15 Trunk
16 Undercarriage
17 Overturned
18 Other (Explain in Narrative)

47. Location Towed To

48. Skid Marks

To Impact ________ After Impact ________

Vehicle No. 4

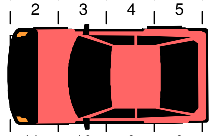
44. Direction Of Travel and Street (Must be same as in narrative diagram)

46. Vehicle was: 01 ☐ Left on scene 02 ☐ Towed by 03 ☐ Driven Away by

Name:

45. Circle All Numbers Where There is Damage.

1 2 3 4 5 6



12 11 10 9 8 7

13 Hood
14 Roof
15 Trunk
16 Undercarriage
17 Overturned
18 Other (Explain in Narrative)

47. Location Towed To

48. Skid Marks

To Impact ________ After Impact ________

49. Diagram: The predetermined north in the right hand corner of this section shall not be changed by the Reporting Officer. The diagram must correspond to Item No. 44, and the narrative. If the report is being taken by an officer, after the fact, the diagram shall be completed to show the general area in which the crash occurred. Freeway access ramps, exit ramps and bridges shall be indicated.

North

Pedestrian ○ Bike/ Motorcycle ○—○ Vehicle ⇨

— Indicate type of fixed object
— Indicate direction ⇨
— indicate posted speed
— indicate vehicles by No.

Note: This report is used for statistical analysis of vehicular crashes and the prevention thereof. The data given represents the opinion and conclusions of the reporting officer based on his or her judgement after considering all the facts disclosed through his/her investigation of this crash.

Complaint No.

Page _____ of _____ Pages

Complaint No. ____________________

Darken the appropriate block in each category.

Police Action	50. Dr./Ped	Arrest / NOI Number	Charge (Report must support charge.)	BTA/ Superior Court Hearing Date)	DPW 40-1 Issued?	What Traffic Signs Present?
	No.					
	No.					

51. Type of Crash

- 00 ☐ Unknown
- 01 ☐ Right Angle
- 02 ☐ Left Turn Hit Veh.
- 03 ☐ Right Turn Hit Veh.
- 04 ☐ Rear End
- 05 ☐ Side Swiped
- 06 ☐ Head On
- 07 ☐ Parked Vehicle
- 08 ☐ Fixed Object
- 09 ☐ Ran Off Roadway
- 10 ☐ Left Turn Hit PED.
- 11 ☐ Right Turn Hit PED.
- 12 ☐ Straight Hit Ped.
- 13 ☐ Backing Hit Moving Veh.
- 14 ☐ Backing Hit Parked Veh.
- 15 ☐ Backing Hit Parked Veh.
- 16 ☐ Backing Hit Pedestrian.
- 17 ☐ Non-Collision Accident
- 99 ☐ Other

52. Road Surface

- 01 ☐ Concrete
- 02 ☐ Asphalt
- 03 ☐ Brick
- 04 ☐ Gravel
- 05 ☐ Dirt
- 99 ☐ Other

53. Road Type

- 01 ☐ Straight
- 02 ☐ Curve
- 03 ☐ Level
- 04 ☐ Grade
- 05 ☐ Crest
- 06 ☐ UnderPass
- 07 ☐ Ramp
- 08 ☐ Bridge
- 99 ☐ Other

54. Pedestrian Action

- 00 ☐ Unknown
- 01 ☐ With Signal In Crosswalk
- 02 ☐ Against Signal In Crosswalk
- 03 ☐ In Crosswalk - No Signal
- 04 ☐ From Between parked Cars
- 05 ☐ Not in Crosswalk
- 06 ☐ In Unmarked Crosswalk
- 99 ☐ Other

55. Traffic controls

- 00 ☐ Unknown
- 01 ☐ Flashing
- 02 ☐ Yield
- 03 ☐ Stop Sign
- 04 ☐ Signal
- 05 ☐ None
- 06 ☐ Officer
- 07 ☐ Restricted Turn
- 99 ☐ Other

56. Road Condition

- 00 ☐ Unknown
- 01 ☐ Repairing
- 02 ☐ Dry
- 03 ☐ Wet
- 04 ☐ Ice/ Snow

57. Street Lighting

- 00 ☐ Unknown
- 01 ☐ Defective
- 02 ☐ None
- 03 ☐ Street Lights On
- 04 ☐ Street Lights Off

58. Light Condition

- 00 ☐ Unknown
- 01 ☐ Dawn/ Dusk
- 02 ☐ Dark
- 03 ☐ Daylight

59. Traffic Condition

- 00 ☐ Unknown
- 01 ☐ Heavy
- 02 ☐ Medium
- 03 ☐ Light
- 04 ☐ Other

60. Weather

- 00 ☐ Unknown
- 01 ☐ Fog/ Mist
- 02 ☐ Clear
- 03 ☐ Rain
- 04 ☐ Snow
- 05 ☐ Sleet

61. Pedestrian Clothing

- 01 ☐ Unknown
- 02 ☐ Wearing Dark Clothing
- 03 ☐ Wearing Light Clothing

62. Driver / Pedestrian Condition

	1	2	3	4	
00	☐	☐	☐	☐	Unknown
01	☐	☐	☐	☐	Fatigued
02	☐	☐	☐	☐	ILL
03	☐	☐	☐	☐	Physical Defect
04	☐	☐	☐	☐	Apparently Asleep
05	☐	☐	☐	☐	Apparently Normal
99	☐	☐	☐	☐	Other

63. Contributing Circumstances. Darken The Primary Factor For All Vehicles And "X" All Secondary Factors.

	1	2	3	4	
01	☐	☐	☐	☐	Speed
02	☐	☐	☐	☐	Defective Brakes
03	☐	☐	☐	☐	Following Too Close
04	☐	☐	☐	☐	Auto Right-Of-Way
05	☐	☐	☐	☐	Ped. Right-Of-Way
06	☐	☐	☐	☐	Red Light Running
07	☐	☐	☐	☐	Yield Sign
08	☐	☐	☐	☐	Stop / Go Light
09	☐	☐	☐	☐	Flashing Light
10	☐	☐	☐	☐	Directional Light
11	☐	☐	☐	☐	Stop Sign
12	☐	☐	☐	☐	Alcohol Influence
13	☐	☐	☐	☐	Improper Passing
14	☐	☐	☐	☐	Wrong Way-One Way St.
15	☐	☐	☐	☐	Wrong Side of Street
16	☐	☐	☐	☐	Cell Phone Use
17	☐	☐	☐	☐	Other Distraction. (Explain in Narrative)
18	☐	☐	☐	☐	Other Defects
19	☐	☐	☐	☐	Pedestrian violation
20	☐	☐	☐	☐	No violation
21	☐	☐	☐	☐	Driver Inattention
22	☐	☐	☐	☐	Changing Lanes Without Caut.
23	☐	☐	☐	☐	Fail To Set Parking Brake
24	☐	☐	☐	☐	Open Door To Traffic
25	☐	☐	☐	☐	Drug Influence
26	☐	☐	☐	☐	Improper Backing
27	☐	☐	☐	☐	Defective Lights
28	☐	☐	☐	☐	Pedestrian Drunk
29	☐	☐	☐	☐	Road Defects
30	☐	☐	☐	☐	Driver Vision Obstructed
31	☐	☐	☐	☐	Right Turn On Red
99	☐	☐	☐	☐	Other

64. Insurance

65. Sobriety

	1	2	3	4	
01	☐	☐	☐	☐	Had Not Been Drinking
02	☐	☐	☐	☐	Had Been Drinking and Obviously Drunk
03	☐	☐	☐	☐	Ability Impaired
04	☐	☐	☐	☐	Not Impaired
05	☐	☐	☐	☐	Impairment Unknown
06	☐	☐	☐	☐	Other

66. Vehicle Type: Private

	1	2	3	4	
00	☐	☐	☐	☐	Unknown
01	☐	☐	☐	☐	Passenger Auto
02	☐	☐	☐	☐	Motorcycle
03	☐	☐	☐	☐	Bicycle
04	☐	☐	☐	☐	SUV
05	☐	☐	☐	☐	Pick Up Truck
06	☐	☐	☐	☐	Moped
07	☐	☐	☐	☐	Recreational Vehicle
08	☐	☐	☐	☐	Minivan
09	☐	☐	☐	☐	Taxi Cab
99	☐	☐	☐	☐	Other (Explain In Narrative. Include SkateBoards,Tricycles, Play Vehicles, Etc.)

67. Vehicle Type: Commercial

	1	2	3	4	
00	☐	☐	☐	☐	Unknown
01	☐	☐	☐	☐	Tour Bus
02	☐	☐	☐	☐	Metro Bus
03	☐	☐	☐	☐	Passenger Van
04	☐	☐	☐	☐	Cargo Van
05	☐	☐	☐	☐	School Bus
06	☐	☐	☐	☐	Tow Truck
07	☐	☐	☐	☐	Truck / Tractor
	__	__	__	__	No. Of Trailers
	__	__	__	__	No. Of Wheels
99	☐	☐	☐	☐	Other (Explain In Narrative. Include SkateBoards,Tricycles, Play Vehicles, Etc.)

US DOT Number: ______________________________

68. Vehicle Type: Government

	1	2	3	4	
00	☐	☐	☐	☐	Unknown
01	☐	☐	☐	☐	Passenger Van
02	☐	☐	☐	☐	Cargo Van
03	☐	☐	☐	☐	Passenger Auto
04	☐	☐	☐	☐	Motorcycle
05	☐	☐	☐	☐	Bicycle
06	☐	☐	☐	☐	Tow Truck
07	☐	☐	☐	☐	SUV
08	☐	☐	☐	☐	Police Vehicle
09	☐	☐	☐	☐	Bus
10	☐	☐	☐	☐	Ambulance
11	☐	☐	☐	☐	Fire Truck
99	☐	☐	☐	☐	Other (Explain In Narrative. Include SkateBoards,Tricycles, Play Vehicles, Etc.)

69. Blood Alcohol Content

DR./Ped. 1 __________ DR./Ped. 1 __________

DR./Ped. 1 __________ DR./Ped. 1 __________

70. Driver Actions

	1	2	3	4	
00	☐	☐	☐	☐	Unknown
01	☐	☐	☐	☐	Backing
02	☐	☐	☐	☐	Turning Right
03	☐	☐	☐	☐	Turning Left
04	☐	☐	☐	☐	Stopped / Standing-Traffic Lane
05	☐	☐	☐	☐	Parked
06	☐	☐	☐	☐	Entering / Leaving Parked Position
07	☐	☐	☐	☐	Making "U" Turn
08	☐	☐	☐	☐	Merging
09	☐	☐	☐	☐	Ran Off Road
10	☐	☐	☐	☐	Changing Lanes
11	☐	☐	☐	☐	Going Straight
12	☐	☐	☐	☐	OverTaking
13	☐	☐	☐	☐	Slowing/Stopping
14	☐	☐	☐	☐	Avoiding
99	☐	☐	☐	☐	Other

Item No.	71. NARRATIVE: Give a concise statement , in your own words, of the facts that are not covered in this report, or to clarify any items that are not satisfactorily explained. If statements are taken , use PD 118 Def./Suspect Statement), or PD119 (Compl./ Witness Statement). If crash occurred in a construction zone, describe type of construction. *(List item number of section continued with required Information.)* Complaint No.

72. Signature Of Officer	Badge No.	Unit	73. Signature Of Reviewing Official	Badge No.	Unit	74. Reviewer	75. Distribution

APPENDIX 6: ANALYSIS OF THE SAFETY INDICES OF THE EXISTING 37 RLC LOCATIONS

The safety index is not designed to reveal the most appropriate RLC locations, but to determine where the maximum safety benefits can be obtained with an RLC installation. The index captures crash and crash severity data. Locations that have higher safety indices are those that require greater attention from traffic engineers. High crash locations are typically the first place where engineers should look to apply safety improvement measures. These measures could include an RLC system or any other engineering applications to improve intersection safety.

The table on the next page shows the safety index applied to the existing 37 RLC locations in the District of Columbia. Also shown are the conclusions from a safety evaluation to determine if the application of the RLC system at the location was appropriate, not appropriate, or may be appropriate with modifications. This safety evaluation was based on a before-and-after (RLC installation) comparison of crash data, results of the Highway Safety Improvement Program, and results of the field survey conducted by the consultant conducting the initial study for the 37 RLC locations.

The safety indices, in conjunction with the safety evaluation results, show that intersections with a safety index above 31 require careful field evaluations and crash data analyses to further assess the applicability of the RLC system. None of the 15 intersections with a safety index of 31 or below were determined to be appropriate for RLC applications.

The ranking of the intersection according to the safety indices seems to be consistent with the safety evaluation results. If all intersections with high safety indices had received a field evaluation and an analysis of the crash data before the RLC implementation, other additional measures might have been implemented to enhance the RLC program’s performance.

Location	Safety Index	Prior Assessment	Reasons for Prior Assessment Result
New York Ave. & Bladensburg Rd	90	Not Appropriate	Low RA, but high RE & LT crashes, and other safety issues
Pennsylvania Ave. & Minnesota Ave.	89	Appropriate	Reduced crashes and injuries
New York Ave. & New Jersey Ave.	86	Not Appropriate	High RA, long queues, turning violations
South Capitol & I Street	69	Appropriate w/ Mod	High RE, limited line-of-sight
Suitland Parkway & Firth Sterling Ave.	66	Appropriate w/ Mod	LT crashes and long queues should be addressed first
Suitland Parkway & Stanton Rd	63	Not Appropriate	Low RA, high RE
Branch Ave. & Alabama Ave.	60	Appropriate w/ Mod	"Other" crashes are high
South Dakota & Bladensburg Rd	55	Appropriate w/ Mod	Need signal timing adjustment & pavement resurfacing
Mt. Olivet Rd & West Virginia Ave.	53	Appropriate w/ Mod	High "other" crashes
East Capitol St. & Benning Rd	53	Appropriate w/ Mod	High RE, long queues
New York Ave. & Florida Ave.	51	Not Appropriate	Low RA, but high RE (mostly at night)
New York Ave. & 4th Street	48	Not Appropriate	Most problems associated with LT flow onto I-395
North Capitol St. & Harewood Rd	47	Appropriate	Other safety improvements needed
North Capitol St. & Missouri Ave.	45	Appropriate w/ Mod	Longer amber time may help
16th Street & Irving Street	43	Appropriate w/ Mod	Longer amber time to reduce RE & SS
Connecticut Ave. & Nebraska Ave.	42	Not Appropriate	Low RA, high LT crashes
14th Street & U Street	39	Not Appropriate	Low RA, but high RE, SS, LT, parked vehicle crashes
12th Street & Constitution Ave.	38	Not Appropriate	Other geometric and operational solutions needed
Pennsylvania Ave. & Southern Ave.	37	Appropriate w/ Mod	Issues: amber time, signal visibility, parked vehicle crashes
Benning Rd & Minnesota Ave.	36	Not Appropriate	Very low RA, high RE
Georgia Ave. & Missouri Ave.	35	Not Appropriate	Low RA, high RE
East Capitol St. & Southern Ave.	34	Appropriate w/ Mod	Longer amber time, focus on LT & parked veh crash reduction
Constitution Ave. & 15th Street	31	Not Appropriate	Low RA crashes, no safety benefits shown
Connecticut Ave. & Military Rd	30	Not Appropriate	Very low crash experience; detailed crash data needed
16th Street & Oak Street	30	Not Appropriate	Very low crash experience; signal visibility may be a concern
Independence Ave. & 3rd Street	27	Not Appropriate	SS and parked vehicle crashes
Rhode Island Ave. & 1st Street	26	Not Appropriate	Low crash experience; RT crashes may be a concern
14th Street & C Street	14	Not Appropriate	Very low crash experience; low RA, increased RE and SS
East Capitol St. & Texas Ave.	11	Not Appropriate	Low RA. RE, HO and fixed-object crashes may be a problem
K Street & 27th Street	11	Not Appropriate	Very low crash experience, detailed crash data needed
North Capitol St. & Gallatin St.	11	Not Appropriate	Low crash experience; RE crashes may be a concern
Wisconsin Ave. & Brandywine St.	11	Not Appropriate	Low crash experience; no reduction in injuries
K Street & 25th Street	7	Not Appropriate	Very low RA; Re and parked vehicle crashes may be issues
16th Street & Colorado Ave.	7	Not Appropriate	Low crash experience; RE may be a concern
Whitehurst Freeway & Canal	6	Not Appropriate	Very low crash experience
Rhode Island Ave. & Reed	5	Not Appropriate	Very low crash experience
Independence Ave. & Washington Ave.	4	Not Appropriate	No RA; very low crash experience

APPENDIX 7: TRAFFIC ENGINEER'S DATA COLLECTION FORM AND RESOURCE GUIDE FOR INTERSECTION FIELD EVALUATION

While every effort is made to ensure that all intersections within the District are engineered properly, DDOT has recognized the need to conduct a careful field evaluation of a candidate intersection prior to an RLC system is proposed for installation. A complete field evaluation of the intersection is recommended before an RLC system is installed. This is consistent with the practice of jurisdictions surrounding the District of Columbia (3,18) and the current practice of DDOT for traffic signal installations.

To facilitate proper field evaluation for RLC applications, intersection field evaluation data collection forms were developed and included in this appendix. The contents of these forms were based on the Manual on Uniform Traffic Control Devices (19) and other sources (2, 3, 17). Many of the specific elements were drawn from the ITE/FHWA Toolbox of Countermeasures (9) and from a checklist developed by the Maryland State Highway Administration. This field evaluation guide is also consistent with the guide developed by the Institute of Transportation Engineers (8), though it provides much more detail than the ITE's guide.

The Field Evaluation Guide allows field personnel to make specific observations about an intersection according to established standards. The completed guide provides an experienced traffic engineer with the data needed to make judgments about each element that can lead to red light running. If the DDOT engineer decides that any identified potential treatment will never be considered, the items can be crossed off the list of data to collect/consider. Back plates to improve signal conspicuity, for example, may be eliminated from this list because DDOT does not use them.

This Field Guide is intended to be as comprehensive as possible to include all elements that an experienced engineer can use to make judgments about the cause of crashes at a particular site and what the appropriate treatments would be. Following the Field Guide is a Traffic Engineer's Resource Guide, which provides standards and references for each data element captured on the Field Evaluation Guide.

DDOT Red Light Camera Intersection Field Evaluation Data Collection Form

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Location Information

Route: ____

At Intersection: ____

Approach: ____

Visibility and Conspicuity Features

1. Sight distance to signals: __________________________________

2. Does distance exceed recommended minimum (provide chart on Part 3)? (Yes or No)

3. Are there any obstructions to full, continuous visibility to the signals? (Yes or No)

   If yes, explain and take photograph(s) ________________________________

   ____

4. Is there a bus stop on the approach to this intersection? (Yes or No). If yes, what is the distance from the stop bar to the closest part of the bus stop? _____________

5. Is parking allowed on the side of the road approaching this intersection? (Yes or No)

   If yes, what is the distance from the stop bar to the edge of parking? __________

6. Is at least one signal greater than 40 ft, but less than 150 ft, from the stop line and within a 40-degree cone of vision centered on the approach lanes? (Yes or No)

7. The number of signal heads ___________

8. Are signal heads 8 in. or 12 in.? __________________

DDOT Red Light Camera Intersection Field Evaluation Data Collection Form

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9. Position of signals (sketch a diagram on Part 4 of the form, and circle the appropriate description of each of the three signal position attributes):

Signal # from left to right	1	2	3	4	5	6
Near or far	N F	N F	N F	N F	N F	N F
Median (M), Left (L), Right (R), or Over lane (O)	M L R O	M L R O	M L R O	M L R O	M L R O	M L R O

10. Note any problems with line of sight that may restrict the visibility to the signals:

____

____

11. Are signals positioned where a driver would reasonably expect them? (Yes or No)

If not, describe ____

____

12. Does the brightness of signals appear to be adequate? (Yes or No)

13. Does the signal use an incandescent bulb or an LED? ______________________

14. Are back plates utilized (indicate “yes” of “no” for each signal number)?

____

15. Are visors utilized (indicate “yes” of “no” for each signal number)?

____

16. Are louvers utilized (indicate “yes” of “no” for each signal number)?

DDOT Red Light Camera Intersection Field Evaluation Data Collection Form

Page 3 of 6

Location: ____

17. If any signal is not visible, explain why: _________________________________
    ____

18. What is the compass direction of the approach? ___________________________

19. Could glare affect the ability to see the signal? ___________________________

Signal Control Parameters *(Information on Items 19 to 23 may be available in the traffic signal control system. Obtain this information for verification against field measurements)*

20. Does this signal operate in coordination with other signals? ___________

21. If the distance to the downstream traffic signal appears to be less than 500 ft, measure the distance ____

22. If it is an isolated signal, what is the cycle length? ________________________

23. What is the duration of the yellow change interval? _______________________

24. Is an all-red clearance interval used? If so, what is its duration? _____________

Geometric Features

25. What is the apparent grade of the approach (up, down, negligible)? ___________

26. If grade appears to be significant, determine actual grade: __________________

27. What is the road surface material? (Asphalt or Concrete)

28. What is the pavement condition? (Good, Somewhat Rough, Repair Needed)

DDOT Red Light Camera Intersection Field Evaluation Data Collection Form

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29. The number of through approach lanes (also sketch a diagram in Part 4 of the form to show the lanes): ____

30. The number of left turn only lanes (show on the diagram): __________________

31. The number of exclusive right turn lanes (show on the diagram): ______________

32. The number of lanes in the cross street (show on the diagram): _______________

33. What is the width of the cross street (show on the diagram)? ________________

34. Can the signal faces on other approaches be seen? (Yes or No)

    If yes, indicate which approach (or approaches) __________________________

    ____

35. Is there any visual clutter that could distract from the signal during the day?

    (Yes or No)   At night? (Yes or No)

<u>Traffic Operations Features</u>

36. Vehicle approach speed (if measured): _______________________________

37. What is the posted speed limit: _____________________________________

38. Is the speed limit sign posted within 1000 ft of this approach? (Yes or No)

39. Is right turn on red prohibited? ___________________________________

DDOT Red Light Camera Intersection Field Evaluation Data Collection Form

Location: ____

40. What is the condition of the stop bar? (Good, Poor, Very Poor)

    Take a photo if the condition is very poor

41. Is there a marked pedestrian crossing on this approach? ____________________

42. What is the condition of the crosswalk? (Good, Poor, Very Poor)

    Take a photo if the condition is very poor

43. *What is the percentage of truck traffic, if measured*?* ______________________

44. Are positive guidance principles utilized? (Yes or No)

    Note and photograph any potentially confusing direction _____________________

    ____

45. *What is the ADT and when was it measured*?* ____________________________

<u>Traffic Signal Warrant</u>

46. Does a traffic signal appear to be warranted at this location? (<u>Yes</u> or <u>study is needed</u>)

47. Is this a four-leg intersection? (Yes or No). If not, please describe ____________

    ____

<u>Additional Notes</u> (refer to the Item Number if applicable)

* Answers to this question will be added to field data based on existing data available elsewhere

DDOT Red Light Camera Intersection Field Evaluation Data Collection Form

Page 6 of 6

Location: ____

Instructions: Sketch a diagram of the intersection layout, including lane widths, median widths, obstructions, any conditions of concern, and signal positions. Next to each signal note v=visor present, b=back plate present, d=double red indicator, 8=8in. lamp, 12=12 in. lamp, LED or bulb. Photograph each visited approach and any areas of concern. Show on the diagram the approximate position of the photographer for each image. Use additional copies of this form as needed

Intersection Diagram, Notes, and Photograph List

Field data collected by: ____

____

____

Date: _______________________________

INTERSECTION FIELD EVALUATION RESOURCE GUIDE			
Item Number	**Topic**	**Reference**	**Comments**
1	Sight Distance	MUTCD Table at 4D-1 and text at 4D-23	The driver needs an adequate sight distance to allow for enough time to react
2	Does Sight Distance Exceed The MUTCD Minimum Distance?		85th Percentile UUSpeed (MPH) / Minimum Sight Distance (Feet) 20 175 25 215 30 270 35 325 40 390 45 460 50 540 55 625 60 715
3	Obstructions to continuous visibility?	MUTCD 4D-27	
4	Bus Stop		A stopped bus can block the driver's ability to see a signal
5	Parking allowed?	USDOT (P.3)	Consider restricting up to 200' prior
6	Cone of vision	MUTCD 4D-24 to 4D- 27	
7	Number of signal heads	MUTCD 4D-23, MUTCD 4D-31	Minimum of 2 required; encourage 1 per lane; and consider redundancy
8	Size of signal heads	MUTCD 4D-22 to 23, BMI pg. 23	Recommend 12 inches
9	Signal positions	MUTCD 4D-24 to 27, BMI pg. 23	
10	Visibility restricted signal heads		Signal face should be visible to the approaching drivers, but not drivers in other lanes
11	Are signals where driver would expect them?	FHWA/ITE pg. 23	
12	Brightness	FHWA/ITE pg. 45	View during different ambient conditions
13	LED or Incandescent	MUTCD 4D-34, FHWA/ITE pg. 25 and 26	
14	Back plates	MUTCD 4D-32 to 33, FHWA/ITE pg. 26 and 27	Enhances contrast between signal and surroundings
15	Visors	MUTCD 4D-32 to 33, MUTCD 4D-30, FHWA/ITE pg. 24	Direct light to drivers without reducing light output such as signal louvers
16	Louvers		Directs light to drivers, but reduces light output
17	Signal not Conspicuous?		
18, 19	Compass direction? Is glare visible on signal face?	USDOT pg. 8	Can help determine if sun glare could cause reduced signal visibility

INTERSECTION FIELD EVALUATION RESOURCE GUIDE			
Item Number	**Topic**	**Reference**	**Comments**
20, 21	Signal coordinated with others?	MUTCD 4D-21	MUTCD states that signals within 0.5 miles of one another on a major corridor should be coordinated, preferably with interconnected controller units. In D.C., signals within 500 feet should be closely examined to determine if signal phases should change simultaneously.
22	Isolated signal	MD Principles, FHWA/ITE pg. 46	For isolated signals, consider a mid cycle time in the 90 to 180 second range
23	Yellow change interval	MUTCD 4D-15, USDOT pg. 9, FHWA/ITE pg. 33 to 35 and 46, NC pg. 2, ITE Briefing	MUTCD indicates 3 to 6 seconds required. Adherence to ITE formula is highly recommended, but consider agency's practice. Yellow time should be predetermined. Lengthening the yellow time within appropriate guidelines has been shown to significantly reduce inadvertent red light running
24	All red clearance	MUTCD 4D-15	All red clearance can provide additional time before conflicted movement is released, all red time should be predetermined
25	Grade	ITE History pg. 46	Grade of approach is required data to calculate the proper yellow time using the ITE formula
26	Road material		
27	Condition of pavement	MD principles, FHWA/ITE pg. 31 and 49	A road surface in need of repair may reduce a driver's ability to stop safely
28	Number of through approach lanes		
29	Number of left turn only lanes		
30	Number of exclusive right turn lanes		
31	Number of lanes crossed		
32	Distance crossed	ITE History	Cross street width is a required data element for the ITE formula to calculate the change period
33	Can the driver see signal faces intended for other approaches?		
34	Visual clutter	ITE Briefing	Clutter could distract the driver from the signal
35	Vehicle approach speed	ITE History, FHWA/ITE pg. 47	The current ITE formula to determine the appropriate yellow time is based on the 85th percentile speed of traffic
36	Speed limit		
37	Is limit posted?		
38	Is right turn on red allowed?		
39	Stop bar condition		Poor stop bar visibility to lead to increased red light running and hurt public acceptance of the RLC program
40	Pedestrian crossing condition		
42	Crosswalk condition		
43	Percentage of truck traffic	FHWA/ITE, MD Principles	
44	Positive guidance	MD Principles	

INTERSECTION FIELD EVALUATION RESOURCE GUIDE			
Item Number	**Topic**	**Reference**	**Comments**
45	AADT	Council, *et al.*	Study found that higher entering AADT resulted in greater economic benefit from RLC
46	Is signal warranted?	MUTCD 4-C1 to C14, MD principles	If signal does not appear to be warranted a study should be conducted to verify that the signal is still required
47	Four leg intersection	NC pg. 7 –4h to pg. 8 4i	

The ITE formula for calculating yellow time follows:

$$y = t + UU\frac{V}{2a + 64.4g} + \frac{W + L}{V}$$

where,

y = yellow interval, sec
a = deceleration rate, ft/sec^2
g = grade of approach, expressed as a decimal
L = length of the vehicle, ft.
t = perception-reaction (P-R) time, sec
W = width of the intersection, ft.
V = approach velocity, ft/sec

ITE notes that for intervals longer than 5 seconds, an all red is typically used. Some use value of third term as all red. *According to ITE, the 85th percentile speed is currently to be used for calculation of the recommended yellow time.*

UNotations To Cited References In The Table

MUTCD = Manual on Uniform Traffic Control Devices Millennium Edition, U.S. Department of Transportation, December 2000.

USDOT = U.S. Department of Transportation, Federal Highway Administration and the National Highway Traffic Safety Administration, *Red Light Camera Systems Operational Guidelines*, January 2005.

Council = Council, F. M. *et al.*, “Economic Analysis of the Safety Effects of Red Light Camera Programs and the Identification of factors Associated with the Greatest Benefits,” Transportation Research Board 2005 Annual Meeting.

FHWA/ITE = Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running, Institute of Transportation Engineers and the Federal Highway Administration, 2003.

NC = Milazzo, J.S., A Recommended Policy for Automated Electronic Traffic Enforcement of Red Light Running Violations in North Carolina, June 2001.

ITE Briefing = Engineering Countermeasures to Reduce Red Light Running, ITE Briefing Sheet, April 2004.

ITE History = History of Yellow and All Red Intervals for Signals, Institute of Transportation Engineers

MD Principles = Lipps, R., “Draft Principles for the Use of Red Light Camera Systems”, presented at the Maryland Symposium on Intersection Safety, Linthicum, Maryland, November 2001.

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1. Presentation by Ling Li of the Virginia Department of Transportation at the Traffic Signal Operations Forum, Columbia, Maryland, December 8, 2004.

APPENDIX 8: FIELD OBSERVATIONS

On November 24, 2004, field observations were conducted at nine locations where crash severity had increased following the installation of the RLC system.[1] The purpose of the field observations was:

a. Measure the actual durations of the yellow and all-red signal phases for comparison with those of the signal timing plan

b. Identify any other field conditions that must be accounted for in the Field Evaluation Data Collection Forms

The nine locations visited were:

1. 12th Street and Constitution Avenue, NW
2. 14th Street and C Street, SW
3. Benning Road and Minnesota Avenue, NE
4. New York Avenue and Bladensburg Road, NE (3 approaches)
5. New York Avenue and New Jersey Avenue, NW
6. Rhode Island Avenue and First Street, NW
7. South Capitol and I (Eye) Street, SW
8. Suitland Parkway and Firth Sterling Avenue, SE
9. Suitland Parkway and Stanton Road, SE

Below is a summary of the findings of the field visit.

Finding: Observed Versus Timing Plan's Yellow Times

During the field visit, a video camera with a digital clock was used to record the durations of the signal phases. The recorded field data confirmed that the yellow times and all-red times in the Timing Plan Schedule were consistent with those observed at all nine intersections. A summary of the yellow times is shown in Table A8-1.

[1] "Safety Evaluation of Red Light Running Camera Locations in Washington, D.C.," Final Report prepared by Daniel Consultants, Inc., for the District of Columbia Department of Transportation, Traffic Services Administration, July 2004

Table A 8-1 – Comparison of Observed Yellow Times with Those in the Timing Plan and those Recommended by ITE

Location No.	Street 1	Street 2	Quad	Camera Appr	Inter. Width (ft)	Posted Speed (mph)	ITE Yellow Time* (Sec) – Posted Speed	ITE Yellow Time* (Sec) – Design Speed	Timing Plan Yellow Time (Sec)	Observed Yellow Time (sec)	Meet ITE?	Timing Plan All Red	Observed All Red	Existing Yellow +All Red	Comments
1	12th Street	Constitution Ave	NW	NB	80	25	5.6	5.5	4.0	4.0	No	2.0	2.0	6.0	
2	14th Street	C Street	SW	NB	56	40	5.2	5.7	4.0	4.0	No	0.0	0.0	4.0	NB through movement does not get any all-red clearance time because it's a lag phase. LT movement from the WB leg follows NB Yellow (Phase 7 follows Phase 2).
8	Benning Rd	Minnesota Ave	NE	NWB	68	30	5.2	5.4	4.0	4.0	No	2.0	2.0	6.0	2% down grade on RLC approach
22 (1)	New York Ave	Bladensburg Rd	NE	WB	69	40	5.5	5.9	4.0	4.0	No	2.0	2.0	6.0	WB approach
22 (2)	New York Ave	Bladensburg Rd	NE	EB	69	40	5.5	5.9	4.0	4.0	No	2.0	2.0	6.0	EB approach
22 (3)	Bladensburg Rd	New York Ave	NE	NEB	106	25	6.3	6.0	4.0	4.0	No	3.0	3.0	7.0	NB approach
24	New York Ave	New Jersey Ave	NW	SWB	29	30	4.3	4.8	4.0	4.0	No	1.0	1.0	5.0	Drivers on New York Ave can see the traffic signals at both New Jersey Ave and Third Street intersections simultaneously, potentially causing confusion. The signal at New Jersey Ave turns red about 9 seconds before that at the Third Street intersection.
30	Rhode Island Ave	1st Street	NW	SWB	34	30	4.4	4.9	4.0	4.0	No	0.0	0.0	4.0	
32	South Capitol	I Street	SW	SB	34	45	5.1	5.7	4.0	4.0	No	0.0	0.0	4.0	The camera monitors the signal at the end of the ramp prior to reaching the intersection. As drivers approach this location, the signal intended for South Capitol traffic is clearly visible and may cause confusion.
34	Suitland Parkway	Firth Sterling Ave	SE	SEB	52	45	5.4	5.9	4.0	4.0	No	1.0	1.0	5.0	A green interval of 23 seconds was observed on Suitland Parkway with no traffic waiting on Firth Sterling Ave. The speed-limit sign posted after the intersection. Slight up grade exists at the intersection
35	Suitland Parkway	Stanton Rd	SE	SWB	46	45	5.3	5.9	4.0	4.0	No	2.0	2.0	6.0	Left-turn traffic from Stanton Road onto Suitland Parkway gets only one second of red clearance time.

* See the ITE equation on the next page

The recommended yellow times for the RLR camera sites were calculated based on the ITE formula as follows:

$$y = t + \frac{V}{2a + 64.4g} + \frac{W+L}{V}$$

where

y	=	yellow interval, sec
a	=	deceleration rate, ft/sec²
g	=	grade of approach, expressed as a decimal
L	=	average length of the vehicle, ft
t	=	perception-reaction (P-R) time, sec
W	=	width of the intersection, ft
V	=	approach vehicle speed, ft/sec

The ITE notes that for yellow intervals longer than 5 seconds, an all-red interval is typically used. Some agencies use the value of the third term in the above equation as an all-red interval.

The 85th percentile speed should be used for calculating the ITE recommended yellow time. For this study, the 85th percentile speed was not available. Initially, the posted speed limit was used instead of the 85th percentile speed in the equation. The calculation was completed a second time using the “design speed,” which is assumed to be equal to 10 MPH over the posted speed limit.

Finding: Potentially Confusing Signal and Sign Layouts

There are two locations, among those visited, where the traffic signal layouts may cause confusion to the drivers on the RLC approach. These locations are the intersection at New York Avenue and New Jersey Avenue, NW; and that at South Capitol Street and I (Eye) Street, SW. More details of each situation are provided below.

<u>New York Avenue and New Jersey Avenue, NW</u>

The drivers on the RLC-monitored approach of New York Avenue at New Jersey Avenue can see simultaneously the traffic signals at this intersection and those at the next intersection (i.e., New York Avenue and Third Street). The distance from the stop bar at the intersection with New Jersey Avenue to the far side of Third Street is only about 160 feet (see Figure A8-1). With both traffic signals so close together, serious consideration should be given to having both signals operate simultaneously.

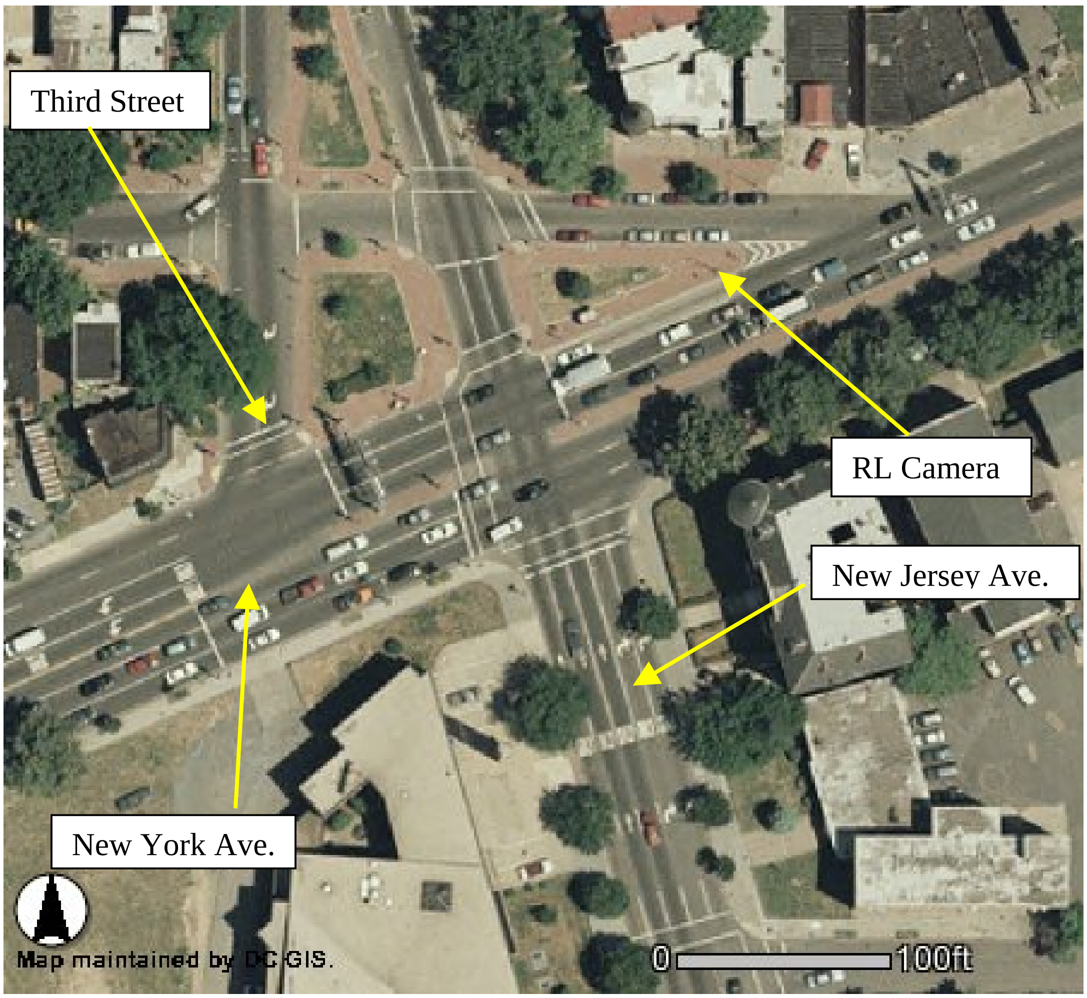

Figure A8-1 – Layout of New York Ave and New Jersey Ave, NW, Intersection

Because of the short distance between the signals and the traffic signal at New Jersey Avenue turns red nine seconds before that at Third Street signal (as observed during the field visit), a driver looking at the traffic signal at Third Street could inadvertently run the red signal at New Jersey Avenue (refer to the two photos in Figure A8-2).

Figure A8-2 –Signal Layout along New York Ave at New Jersey Ave and Third Street may cause confusion, leading to red light running violations

In addition, other potential driver distractions at this location include a number overhead direction signs as shown earlier in Figure A8-2. These distractions could add to the inadvertent red light violation. In fact, three red light running violations were observed in the 10-to-15-minute field visit at this location.

South Capitol Street and I (Eye) Street, SW

As drivers approach the RLC at the end of the ramp from I-395 NB to South Capitol Street, the first traffic signal faces that they see are not the ones intended for them. As a driver goes down the ramp, the traffic signals for South Capitol Street traffic are clearly visible. When the driver proceeds farther down the ramp, the traffic signal faces for the ramp traffic become visible (refer to Figure A8-3). This arrangement could confuse the drivers and result in inadvertent red-light running violations.

Figure A8-3 – At South Capitol and I (Eye) Street Intersection, the driver can see the signal faces on the left prior to those on the right, which the driver should obey

Finding: Need for Signal Timing Adjustments

During the PM rush period, on several occasions, traffic on Suitland Parkway received a red signal with no cross traffic waiting on Firth Sterling Avenue. The observed green phase for Suitland Parkway traffic of 23 seconds was not adequate to clear the mainline traffic on Suitland Parkway. This situation could lead to driver frustration and possibly the intentional running of the red light.

Finding: Consideration of Downgrade in Yellow Time Setting

The RLC-monitored approach on Benning Road at Minnesota Avenue has a downgrade of about 2%. The ITE formula uses the approach grade to determine the appropriate yellow time for a traffic signal. The downgrade would result in a longer recommended yellow time. Inadequate yellow time has been found to be among the factors affecting red-light running frequency.

Summary

Based on the findings of the site visit, the Field Evaluation Data Collection Forms were refined accordingly. As described in the above findings, field observations are important input to determining the appropriateness of an RLC system. The developed Field Evaluation Data Collection Forms will help improve the utility of the field observation data.